Children's wellbeing in Woonerf residential streets
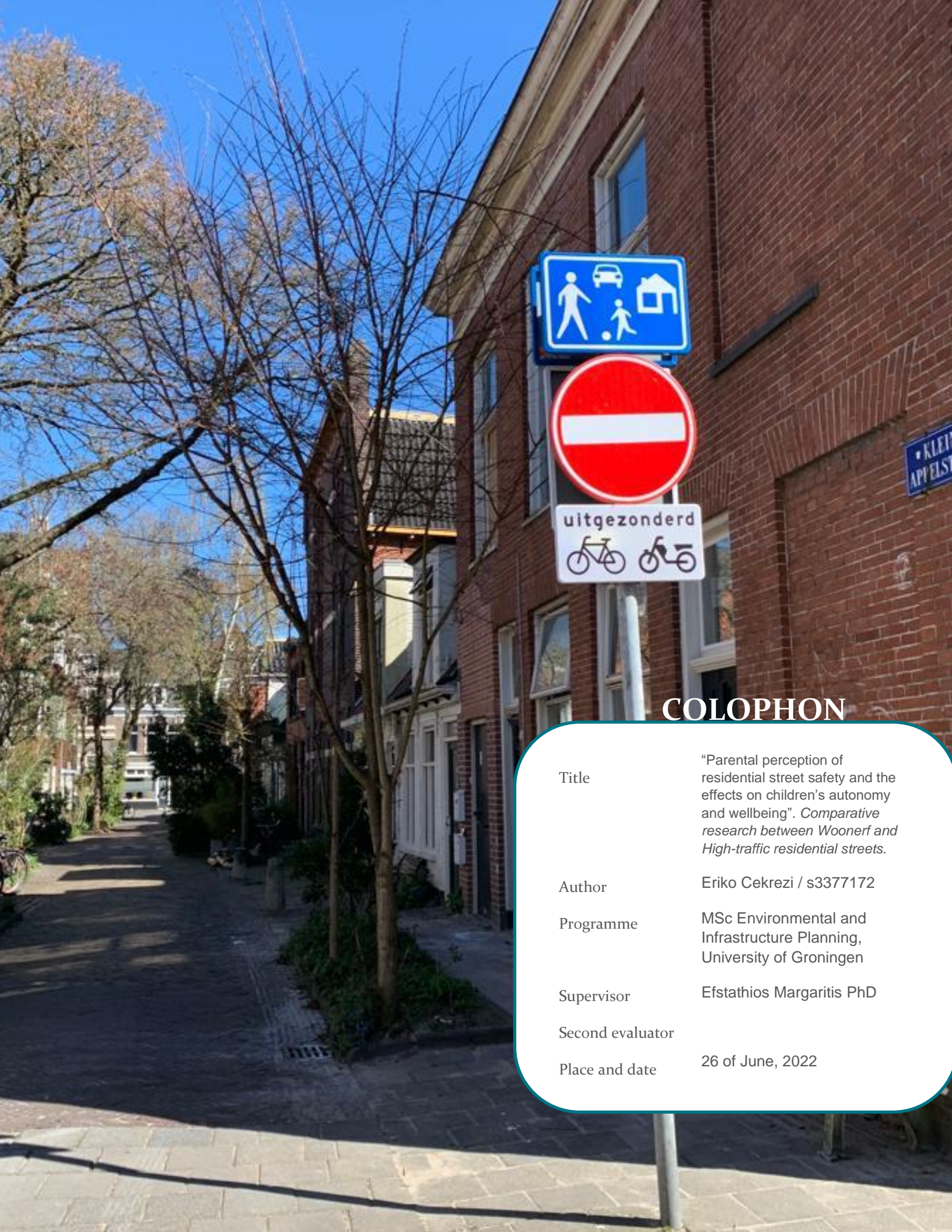
" A comparative research between Woonerf and High-traffic residential streets"

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Abstract

Woonerf is a Dutch spatial concept utilized to decrease the car traffic levels in residential streets by establishing spatial interventions. However, the effects of the spatial interventions on the residents and especially children remain unexplored. By conducting a Questionnaire this research explores the variation in the levels of parental perception of safety, children's autonomy, and wellbeing between a Woonerf and a High-traffic residential area. Results indicate that parents living in Woonerf streets perceive their residential streets as significantly safer which has an effect on the increase of children's autonomy and wellbeing levels by promoting outdoor physical and social activities. Children's wellbeing levels based on their physical and social outdoor activities living in Woonerf residential areas are significantly higher than children's wellbeing living in High-traffic residential areas. The explored benefits could be utilized for further implementation of the Woonerf concept in the Dutch Planning system.

Keywords: Woonerf residential streets, High-Traffic residential streets, parental perception of safety, children's autonomy, physical and social outdoor activities, children's wellbeing

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Chapter 1 Introduction

1.1 BACKGROUND

Across a broad range of developed and developing countries, the occurrence of declining physical activity, social interaction, and unsupervised mobility among children has been vastly noticed (Salmon & Timperio, 2007). The current children's wellbeing state is almost halved in comparison to children's wellbeing from the 1950s, with fewer performed physical activities and social interactions being the contributing reason (Pitchforth et al., 2019). The phenomenon is caused by a combination of enhanced parental concerns about children's unsupervised freedom (such as 'social danger 'and traffic safety concerns), decreased variety of outdoor spaces where they can safely perform outdoor activities, and increased usage of cars (Galaviz et al., 2016). These appear to be the main contributing factors to the decline of children's physical activity and social interaction levels.

In a car-dominated area, where parents have increased concerns about the dangers that car traffic poses to children, a pattern that underlines the growth in the preference for indoor activities (e.g. digital games, Television) has been recognized (Christie et al., 2007). This has decreased the children's engagement with the outdoors and has consequently reduced the levels of physical activity and outdoor social participation among children. A combination of factors stands behind intergenerational studies which substantiate that an ongoing increase in the age of the children that are allowed to be outdoor unsupervised is occurring (Pitchforth et al., 2019). Children nowadays are being granted less autonomy while parental supervision rates are constantly increasing (Archard, 2015). According to Prezza et al. (2005), car traffic-related dangers are rapidly restricting children's outdoor time and decreasing their autonomy levels. Before that, children would spend more time outdoors than indoors and would become autonomous at a younger age (Archard, 2015).

In the Netherlands, these preceding trends are noticeable. The time children spend engaged in outdoor physical and social activities has decreased to almost 60% over the past four decades (Runhaar et al., 2010). The children are spending less and less time performing outdoor activities and socializing with friends leading to a decreased level of wellbeing with more than 70% of the Dutch children not performing the minimal amount of

physical activity to sustain a healthy life (Runhaar et al., 2010). In addition, parents living in the Netherlands have become more concerned about the surrounding environment and its safety. According to a Dutch study conducted on parents with children aged from 10 to 15 years old, over 80% of parents are extremely worried when their child is performing outdoor activities near their residential area (Karsten & Van Vliet, 2006). In another study conducted on children living in the Netherlands, it was found that a vast majority of 75% of the children aged from 8 to 16 years old spend most of their free time indoors (Vandewater, 2006). These concerning numbers are only rising and raising alarming concerns about children's wellbeing, now and in the future if there is no reaction to the issue.

Several different approaches have delineated the urban system throughout the years so that these alarming rates are changed and wellbeing is promoted. Such spatial plans include the introduction of urban green spaces, designated playgrounds, and impervious open spaces which are found to positively affect the quality of people's lives and create a safer environment for children to perform unsupervised outdoor and social activities. However, the success of these interventions is too dependent on the context and cultural/demographical background. The Netherlands has been a heavy advocate of continuous urban development with aim of increasing the quality of life and the overall wellbeing of its citizens (de Hollander et al., 2003). As Barton (2005) states, planners and their products can benefit humans in a lot of aspects. The political and social structure that characterizes the Netherlands has historically emphasized the relationship between the urban built environment and the general quality of life (de Hollander et al., 2003). However, it is not the "wellbeing promoting" urban developments that are reportedly promoting an increase in outdoor physical and social activities. It is the "car-restricting" spatial interventions that are inviting children to participate more in outdoor physical and social activities.

In the early 1990s, the city of Delft introduced a new urban concept that shaped the current urban built environment in residential streets, called Woonerf. The intervention was not planned by experts in the field but it started as local responsiveness to the risk of cut-through traffic speeding inside a neighborhood in Delft (Ben-Joseph, 1995). The residents annoyed by the car high-speeding in their neighborhood took the initiative to replace the straight brick streets with winding serpentine paths (Ben-Joseph, 1995). This intervention

not only limited the vehicular speed and the amounts of cars passing through, but also promoted greater use of the public space. The concept was considered a massive success in the Netherlands and it has been professionally implemented in different countries across Europe as well. Based on the success of this intervention, research regarding Woonerfs has been mostly focused on the traffic constraining features that it enables and on the creation of a communal space of living. The possible relationship between Woonerf areas and well-being factors is surprisingly neglected.

Interventions of this nature in residential streets that take space from the car and give it back to the locals suggest that a lot of liveability aspects might be affected (Dudek, 2019). The most important factor that limits the children's autonomy in an outdoor environment and therefore their physical activity and general wellbeing is the parental perception of safety. The parental perception of safety is mostly influenced by social and traffic danger. Fear of traffic dangers and minimized autonomy are responsible for limited habits of outdoor movements and physical activities (Prezza, 2005). Considering that car traffic and car traffic dangers according to Prezza (2005) are the main causes that influence the parental perception of safety, children may experience more unsupervised outdoor time in Woonerf residential streets.

On the contrary, children that live in areas with high traffic congestion experience their local environment as more dangerous than children living in areas with no traffic. This has a direct effect on the children's unsupervised outdoor time. Children living in high-traffic areas are more anxious, experience more distress in terms of the traffic risks and have limited freedom of mobility (Bjorklid, 1994). Traffic danger in such areas highly depends on the improper habits of the drivers such as parking on sidewalks or not respecting the traffic lights. It also depends on the intensity and the type of road that the cars drive at (fast roads, dangerous crossroads). Therefore, it is noticed that the urban build environment can influence the traffic dangers to a large degree.

A pre-introductory hypothesis according to the existing research around the parental perception of safety, car traffic, children's autonomy, and wellbeing indicates that parents who live in a Woonerf residential street perceive their street as safer due to the lack of

traffic. This affects the amount of autonomy granted for unsupervised outdoor activities to their child/ren, which then has an efaffectsnt on physical and social activities performed.

Despite the high attention Woonerf areas received in the academic world for the car-related restrictive nature, there is almost no attention to the societal positive attributes that Woonerf interventions can have in relation to the parental perception of safety and children's wellbeing. Woonerf interventions are already widely used for their car-restricting capabilities, though if the hypothesis appears to be true, the wellbeing benefits of the Woonerf concepts could be the enhancing tool for further implementation in residential streets all around the Netherlands and Europe.

1.2 ACADEMIC RELEVANCE

The initial aim of this research is to achieve a better understanding of how Woonerf areas can contribute to increasing children's wellbeing by positively affecting the parental perception of safety and increasing the children's autonomy. While the alarming decreased levels of children's wellbeing and physical activity levels are widely and rightfully demonstrated, little research has been conducted to empirically find social attributes of spatial interventions, such as the Woonerf concept. Also, research regarding Woonerf areas needs to start including the topics of parental perception of safety, children's autonomy, and wellbeing, as they are currently solely focused on the restricting traffic benefits (Vasileiadis & Nalmpantis, 2018). Knowledge and research regarding the effects of the urban build characteristics on wellbeing and wellbeing itself have grown considerably in the last decade (Klent & Thompson, 2014). Research on a residential street scale, where the wellbeing of children could be potentially affected by the implementation of the Woonerf concept in residential streets, remains still limited.

The knowledge gap in Woonerf's effects on social systems and behaviors is quite profound. The research elaborates on Colarte's (2012) statement: "*The benefits of a Woonerf concept are far from decreasing traffic, unexplored benefits can be detrimental for the future of this concept*" for more research on the unexplored effects of residential streets which have adopted the Woonerf concept regarding their social liveability convenience. The target of this thesis is to re-focus on case-level research and empirically test the concealed benefits of the Woonerf concept. Increasing the understanding of those

benefits could stimulate the faster implementation of Woonerf as a concept, which unfortunately is currently slow (Collarte, 2012). The focus on small-scale residential streets can be considered significant because actual innovation and transformation happen at this scale (Katz & Wagner, 2014). Although those residential streets have been studied for their performance in terms of lowering traffic on a transportation and safety level, little research has been done on the social benefits they might pose. This research connects different theoretical debates about the parental perception of safety, children's autonomy, and wellbeing to practical outcomes on a case-study level so that a better understanding of the relation between the variables is achieved.

1.3 SOCIETAL RELEVANCE

The next purpose of this research, concerning the societal relevance of this thesis is to underline the unexplored benefits of Woonerf-related interventions regarding wellbeing and the quality of life. These benefits could be used as a stimulate for the Woonerf concept to be adapted in multiple Dutch residential streets. Discovering the societal benefits of wellbeing and improved quality of life can be beneficial for municipalities to come up with clear guidelines on how to transform residential streets into Woonerfs. The point of departure is inspired by several national and international cities that are posing societal concerns such as a generally decreased wellbeing and quality of life due to the high-traffic levels in residential streets. Numerous urban initiatives are actively being tried around the world, but the issue is not quite solved. The results of this comparative study could be valuable for city officials to perceive and strengthen the unrevealed benefits of the Woonerf residential streets.

Furthermore, as an academic researcher, I have a great interest in the effect that the planners and their planned environment have on the social sphere of people. Planning is not all about efficiency, transportation, and accessibility. By practicing good planning methods, we could also greatly affect the well-being and liveability levels of people. Thinking back to my hometown and how the built environment adds to the stress and decreased wellbeing of people, I believe that the Woonerf concept can fundamentally improve the quality of life and the implementation can be beneficial in a lot of aspects (traffic, quality of life, safety, wellbeing).

1.4 RESEARCH STATEMENT

Summarizing the sections above, this research aims to emphasize and explore the benefits that Woonerf areas and lack of traffic bring to the children's wellbeing by looking into the parental perception of safety and children's autonomy. This thesis uses a comparative case study to investigate the difference in wellbeing between children living in Woonerf residential streets and high-traffic residential streets, located in the city of Groningen, Netherlands. The context of this study provides knowledge on the relation between traffic, parental perception of safety, children's autonomy, spatial interventions, and children's wellbeing. Consequently, it provides insights for cities and municipalities on why implementing Woonerf streets could be beneficial from a societal aspect. The findings of this research are valuable for Dutch and international cities as well.

This all leads to the main research question:

How does the presence of car traffic in Woonerf and High-traffic areas affect the parental perception of safety and children's wellbeing?

To answer this question the following sub-questions are presented:

1. How does the car traffic vary between Woonerf and High-traffic areas?
2. What are the main causes and variations of parental perception of safety in Woonerf and high traffic areas?
3. To what degree is the children's autonomy affected by the parental perception of safety in both Woonerf and High-traffic residential streets?
4. To what degree are the children's autonomy and wellbeing affected by the characteristics of the residential streets they live in?
5. How does the children's well-being vary between Woonerf residential streets and high-traffic residential streets?

The structure of this research follows these steps. Firstly, the research starts with Chapter 1 which includes the introduction, the research statement, and the main research question. Secondly, the theoretical framework and the conceptual model are presented in Chapter 2. In Chapter 3 the methods used for this research are discussed in an extensive manner. After that, source Chapter 4 the results are presented through meaningful analytical

representation. Finally, the discussion, conclusion, and future recommendations for this research are presented in Chapter 5.

Chapter 2 Theoretical framework

This chapter presents the main concepts that are discussed in this research, namely children's wellbeing (2.1), children's autonomy (2.2), parental perception of safety (2.3), and traffic in residential streets (2.4). Furthermore, the Woonerf residential streets (2.5) and high-traffic residential streets (2.6) are discussed. To start with, the concepts are analysed separately by presenting the definition of the concepts, the relevance to this study, and the discussion of their most recent peer-reviewed literature. After that, the association and interconnection between the main concepts is presented in 2.7 and is briefly visualized in the graph below. Lastly, the chapter ends with extended visualization of the relations and interconnections of the key concepts (2.8). Each concept is explored in detail by presenting its full definition, the patterns, and relevant research around it, and the relation to the theme researched.

The articles were collected using different search engines provided by the University of Groningen, such as SmartCat and RUG Scholar. Furthermore, the snowball method, using the bibliography list of a paper or the citations to the paper to identify additional related papers, has been used in order to distinguish related literature (Wohlin, 2014).

2.1 CHILDREN'S WELLBEING
2.1.1 Simplifying the complex definition of children's wellbeing

The concept of wellbeing is widely discussed and acknowledged as a valuable approach in the context of improving the quality of life. Childhood wellbeing can be interpreted from different perspectives but at its bosom and for this research, it is a threshold that is achieved when children fulfill their psychosocial and physical necessities (Crivello et al., 2009). Children's wellbeing has often been placed at the core of qualitative research as it offers a wide focus of multidisciplinary inquiries centered on children's (and their parent's) experiences, perspectives, and expectations. The diversity of childhood across the globe is notable and already marked, but it is found that children's lives and their well-being share some common features. Notably, children share a largely marginalized structural

position in relation to adults, especially to their parents, but it could be argued that this generalized statement breaks down at an individual level and context plays a fundamental role in it (Crivello et al., 2009). Their wellbeing is affected a lot by this structural position about their parents, due to thebecausemostly are affected by adverse circumstances because of their relative immaturity and their lack of social adverse (Casas et al., 2008). This has also affected the quality of research on children's wellbeing as they have frequently labelled as the least visible groups in social research (Albanese, 2009).

Wellbeing consists of different variables that when all added together determine what the level of wellbeing is for one individual (Crivello et al., 2009). Determining wellbeing for children could be visualized as this extremely long and complex mathematical formula which consists of all the variables that determine wellbeing and their importance levels. Overall this formula determines the wellbeing levels of a child, configuring the variables that increase the wellbeing levels the most and those that do not pose any significant influence. According to Lou, Anthony, Stone, Vu, & Austin (2008), studies have shown that the three variables that influence in a detrimental way the complex well-being formula among children are: physical activity, psychosocial factors, and safety. These variables affecting wellbeing are consequently the main wellbeing measurements of this research. Physical activity entitles the amount of physical activity performed by children to sustain a healthy and active life (Sirar & Pate, 2001). Furthermore, the psychosocial factors consist of the mental and social health of the children, which are important aspects and have to be satisfied so that the child is entitled to a mentally healthy lifestyle (Welk & Schaben, 2004). Finally, safety concerns the process of limiting the occurrence of dangerous exposure and reducing children's risk of harm (Zeedyk et al., 2001). These variables are discussed further in the next sector and in the context of children's wellbeing.

The formula of variables that influences children's wellbeing is complex and implies numerous variables. Considering the context of this research, regarding the Woonerf residential streets and based on the fact that some variables contain a more important role in children's wellbeing, these wellbeing variables are selected to be assessed and considered in this research: physical activity, psychosocial factors, and safety.

2.1.2 Recent patterns and research highlight

According to the Global Department of Education and Wellbeing (2021), children's wellbeing has increased in 2021, following the small decrease posed in 2020. Nonetheless, the zoomed-out overall pattern of children's wellbeing has been decreasing since 2004 (Knuth & Hallal, 2009). Throughout the years it has reached an alarming level, which has drawn the immediate attention of research and organizations around the world. The report from the global department of education and wellbeing suggests that although there is a slight increase in wellbeing levels as of 2021, it is the physical activity levels and the psychosocial factors that have seen a larger decrease throughout the years and are still decreasing (Collishaw, 2015).

Even though the overall quality of life has increased and the poverty levels have vastly decreased throughout the years, it is quite surprising that the wellbeing curve for children is declining. Research on the examination of children's wellbeing showcases that their sense of wellbeing can reveal a great deal about their lives (Fattore et al., 2009). Over the years it is explored that low wellbeing can be an indication of poorer performance in various life context fields (Patalay & Fitzsimons, 2016). According to The Children's Society annual report, apart from the overall wellbeing levels decreasing, worrying gender patterns have emerged in these trends over time (Levy et al., 2020). The gap between male and female wellbeing was always substantial, but in recent years the gap has increased.

2.1.3 Variables that determine children's wellbeing

Physical activity

The promotion of physical activity from a young age is considered important to establish healthy lifestyles, which most of the time is maintained into adulthood as well (Byrne & Hills, 2007). Although physical activity is a self-explanatory concept, it is quite important to give a clear definition to it. According to WHO (2020), physical activity is explicated as any movement produced by the musculature structure that requires energy expenditure. Popular ways to perform physical activity, especially for children include walking, cycling, sports, active recreations, and outdoor play.

Studies explore that physically active children have higher probabilities to become physically active adults (Byrne & Hills, 2007). In children, the benefits of active physical activity are shown in a lot of different indexes, such as improved bone density, higher aerobic endurance, muscular strength, and reduced risk factors for cardiovascular diseases such as body mass index (Jannsen & LeBlanc, 2010). It is found that these indexes are higher when children perform at least 1 hour of physical activity each day (Jannsen & LeBlanc, 2010). It is recommended by the WHO organization that children aged between 5-17 years old should do a minimum of 60 minutes per day of physical activity across the week (WHO, 2022). Furthermore, it is recommended to incorporate vigorous-intensity activities at least 3 days a week, so that the muscles and bones are accordingly strengthened (Jannsen & LeBlanc, 2010). Recent research also shows that daily practice of physical activity in children improves the overall cognitive functions and academic performance at school (Ploughman, 2008). It is fundamental to ensure that children are engaging in insufficient levels of physical activity to ensure a current and future healthy lifestyle.

Although the clear benefits that physical activity poses to the children's wellbeing, according to Figure 1 one out of six children in the Netherlands do not meet the recommended levels of physical activity. Data from the TNO show a declining trend for the period between 2006 and 2020 in physical activity among children (Der Horst, 2007). The number of children who are meeting the recommended daily physical activity per day has decreased by approximately 20% during this period (Der Horst, 2017). These numbers suggest a growing inactivity crisis among Dutch youth.

%	ADOLESCENTS (12–17 YEARS)	
MALES	NNGB	31.6
	FITNORM	1.8
	COMBINED	32.3
FEMALES	NNGB	23.0
	FITNORM	2.2
	COMBINED	23.8
BOTH SEXES	NNGB	27.4
	FITNORM	2.0
	COMBINED	28.2

Figure 1: Physical inactiveness among Dutch youth

Psychosocial health among children

The term psychosocial health refers to the mental and social health of the children. On its own the definition of psychosocial health based on WHO reports is a circumstance of wellbeing in which a person achieves his/her full capabilities, can handle ordinary stresses of life an , is able to make contributions to the social community (Strauss et al., 2001). Psychosocial health is an important aspect of the individual and collective cognitive ability as humans to think, emote, enjoy life, and interact with each other (Walsh, 2011). Based on fundamental importance, the promotion, restoration, and protection of mental health have to be regarded as a vital concern of societies throughout the world (Walsh, 2011). On the other hand, social health can be explained as the potential to interact and create relevant relationships with others (Eime et al., 2013). Furthermore, the concept relates to the relative comfortability in adapting to social unexpected situations. Studies conclude that healthy social relationships have positive short and long-term effects on our health (Eime et al., 2013).

A lot of ongoing research in recent years has explored that mental and social health is also declining among children. It is found that mental health problems affect around one

in five children, appearing to be a more common issue than lack of physical activity (Slomski, 2012). According to Figure 2, low mental and social health in children can be configured in the form of severe depression, anxiety and behavioral problems also called conduct disorder (Donovan & Spence, 2000). In an international survey, as many as 13% of children reported that they 'feel low' more than once per week (Gray, 2011). According to Figure 3, responding to the low levels of psychosocial health is an alarming phenomenon, over 40% of parents report that their children's mental health is worsening.

Percent of Children with Anxiety, Depression, and ADD/ADHD, 2018 and 2019

■ All Children (Ages 3-17)   ■ Adolescents (Ages 12-17)

	Currently Have Depression	Currently Have Anxiety	Currently Have ADD/ADHD
All Children (Ages 3-17)	4%	8%	9%
Adolescents (Ages 12-17)	7%	13%	11%
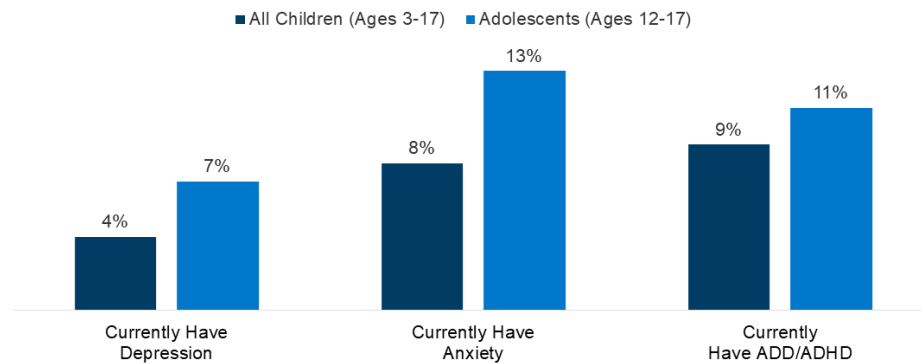
NOTES: ADD/ADHD refers to Attention Deficit Disorder or Attention Deficit/Hyperactivity Disorder.
SOURCE: KFF analysis of National Survey of Children's Health, 2018 and 2019.

KFF

Figure 2: Most common mental & social issues among children (Donovan & Spence, 2000)

Share of Parents Reporting Worsening Mental Health
For Their Children Ages 5-12, October - November 2020
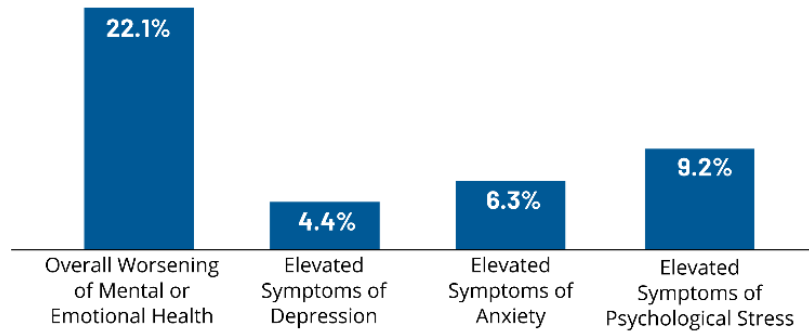
Figure 3: Amount of parents reporting decreased mental health of their children (Bennett et al., 2012)

Children's mental and social health configures as important as their physical health to their general wellbeing. Satisfactory levels of mental health and an active social life aid in developing the resilience to cope with different events life can appear and grow into well-rounded, healthy adults (Winston et al., 2016). Children who socialize on a large scale with other children at a young age are found to develop better teamwork and interpersonal qualities (Winston et al., 2016). It is found that for children to achieve a successful mental state, they have to practice physical activity, have time and freedom to play indoors and outdoors, and take part in local activities (Tennant et al., 2007).

In addition, for children to have an active and healthy social life they should have the ability and opportunity to form strong relationships with others, express and manage emotions, make friends, and explore the world around them (Tennant et al., 2007). Children who do not attain these skills are found to do worse at school and have difficulty learning while possessing the risk of showing behavioral problems (Tennant et al., 2007). The costs and consequences attained by the psychosocial factors are also transparent on a larger scale. It is estimated that the overall costs of social and mental issues (recovering process) are around 3.5% of a country's GDP (McDaid et al., 2017).

Children's safety as a wellbeing factor

Safety is the condition of being protected from danger, risk, and injury. Children's safety is the main concern of their parents and it has a lot of consequences for other aspects of life. For example, if a communal place where the child can perform physical activities and socialize with friends becomes unsafe for the child, then the consequences of not visiting that place anymore decrease the opportunities for physical activity and decrease the psychosocial health, which can influence the overall wellbeing. Safety is a quite complex issue itself, for this research it is mostly discussed in relation to the car traffic in residential streets.

This research is focused on the spatial and traffic limiting interventions of the Woonerf concept, thus the safety variable regarding children's wellbeing is discussed in the context of traffic. Car traffic in residential streets presents a serious threat to the children's safety and wellbeing. Yearly, the number of accidents caused by cars to children on a residential scale has been rising (Sing & Aggarwal, 2010). It is found that injuries sustained from car-related accidents are the most usual cause of death among children (Sing & Aggarwal, 2010). The WHO research – "Youth and road safety" investigates and concludes that road accidents are the most common cause of death in people younger than 18 years old (World Health Organization, 2007). Currently, worldwide statistics show that death caused by car-related accidents occur on average every 50 seconds (World Health Organization, 2007). According to Figure 4, the same patterns are also noticed in the Netherlands, where children score the highest fatality rates with regard to car accidents.
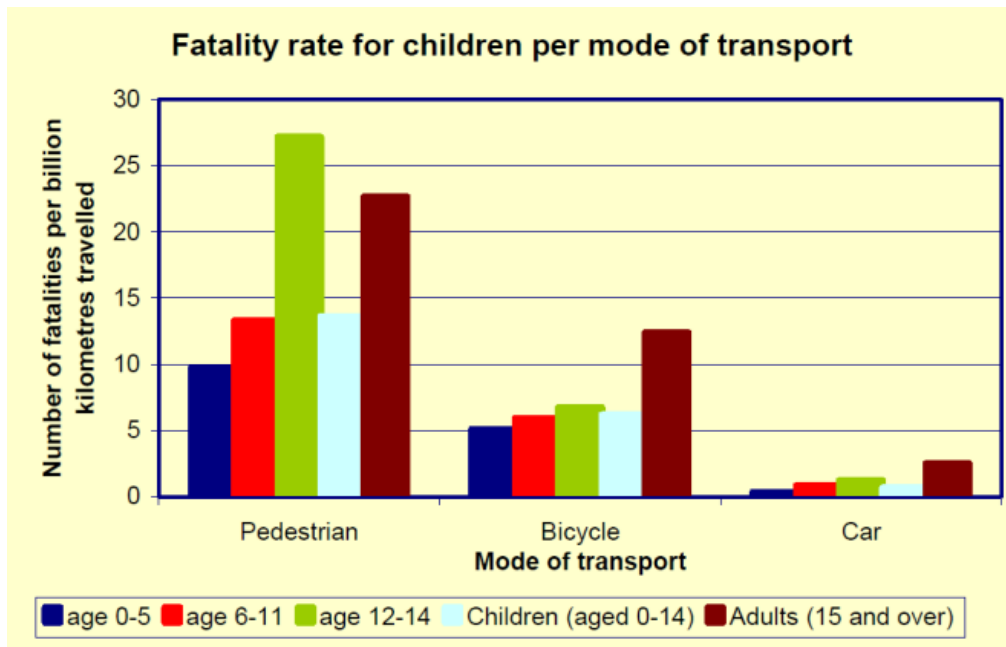
Figure 4: Car accident fatality rates in the Netherlands (Feleke et al., 2018)

Furthermore, the nature and cognitive levels of children cause them to get easily distracted and not always pay attention to the road. The capacity to perceive and circumvent emerging objects is a fundamental basic skill but it is found that children slowly master the skill of rapidly calculating the size, distance, and velocity of an upcoming vehicle (Meyer et al., 2014). New research showcased that children's perceptual abilities are slow to develop, making children more likely to sustain fatal injuries caused by vehicles (Meyer et al., 2014).

The pattern of physical activity and social interaction in an outdoor environment among children is being decreased throughout the years, due to the concerns of safety when performing those activities (Sandseter et al., 2017). Both parents and children are concerned about the possible risks that performing this outdoor activity on the roads poses. A study in the US explored that 78% of the parents would feel safer if their child was not performing outdoor activities in high-traffic areas (Christie et al., 2007). Furthermore, it was found that parents prefer to commute several extra kilometers daily to drive their child to a sports facility where he/she can perform outdoor activities without having safety concerns (Christie et al., 2007). To conclude, in another study conducted in the UK, parents mentioned that performing outdoor activities and unsupervised

movements in their residential streets back in their youth times was far safer than now (Carver & Timpersion, 2008). This was due to the urban characteristics of the residential areas and the inexistence of car traffic at that time (Carver & Timpersion, 2008).

2.2 PARENTAL PERCEPTION OF SAFETY

Perceived safety represents one important, yet less researched, influence on young children's behavior and wellbeing. Because young children's outdoor activity and autonomy are largely regulated by their parents, the parental perception of safety is likely to have a direct effect on the extent of children's outdoor activity time (Galaviz et al., 2016). The parental perception of safety is influenced by a variety of reasons, including crime rates in the residential streets, socioeconomic conditions, social incivilities, car traffic, and social dangers (Weir et al., 2006).

Recent research explores that children nowadays are less likely to go out in their residential areas and perform physical activities because of parents' concerns about their children's safety, with the key concern being car-traffic safety and harm from dangers (Weir et al., 2006). However, researchers and statistics do not fully support the second concern that affects the parental perception of safety. It is found that young children have a higher chance to be harassed by a member of the family than a stranger (Hardesty, 2002). On the other hand, the parent's concerns about road safety are substantiated by statistics. As mentioned in the safety sector, car-related accidents are the main cause of heavy sustained injury among children. The majority of the children involved in fatal road accidents were pedestrians performing unsupervised movements in local streets, usually within 500 meters of their homes (Von Kriest et al., 1998). Therefore, the parent's concerns around car traffic and their children's safety are largely supported by research.

2.3 CHILDREN'S OUTDOOR AUTONOMY

Autonomy about the children and the outdoor environment means the measure of letting children know that they have control over themselves and the choices that they make in the outdoor environment. It could be defined as the ability of a child to act of their own free will, without parental or caretaker guardianship (Prezza et al., 2005). Outdoor autonomy is a variable that influences all the three upper mentioned wellbeing variables. It is when

children are autonomous that they become more independent, they explore their surroundings on their own and discover how to create social connections and express themselves more (Bou- Habib, 2015). It is important to encourage outdoor autonomy in the early stages of life so that the children have the opportunity to develop a sense of themselves and their surroundings. The benefits of granting the children outdoor autonomy can be seen in the promotion of physical activity, increased mental health, and the opportunity for improving social health. It is when they are autonomous that children feel more in control of their lives which boosts their self-esteem and cognitive growth (Bou-Habib, 2015). Furthermore, it is when the children are autonomous that they have the possibilities and opportunities to perform physical activity and socialize with peers in the outdoor environment (Bou- Habib, 2015).

One of the most recognizable factors that impact outdoor autonomy at a young age, is the parental perception of safety. In recent years, a worrying change in the daily habits of children has been noticed. They have been increasingly less occupied in outdoor activities and less present in social public areas while being restricted to the house and engaged in indoor activities under their parent's surveillance (Knecht, 2008).

Because a sedentary life often leads to an increase in obesity, some authors hold that children who are less autonomous outdoors are more prone to weight problems (Prezza et al., 2005). The outdoor autonomy of children is granted by their parents and is affected by demographical, cultural, urban, and safety perception motives. Outdoor unsupervised time unfolds an opportunity for children to participate in health-promoting physical activity. The higher the outdoor autonomy of a child, the more he is eager to participate in outdoor activities and socialize, increasing his wellbeing (Aziz & Said, 2012). On the contrary, the lower the outdoor autonomy granted by the parents, the less a child is able to participate in outdoor activities and socialize, decreasing their wellbeing.

Despite these clear benefits, compared with the previous generations, outdoor autonomy has appeared to have decreased in children over the years (Prezza et al., 2005). According to Prezza et al. (2005), noticing children playing outdoors in the streets and open spaces without any strict adult supervision has become a rare sight in Western Europe. In the 1970s, 80% of the children in England used to commute alone to school,

now that number has decreased to only 10% (Kerr et al., 2006). This underlines that children are having less autonomy in recent years.

2.4 TRAFFIC IN RESIDENTIAL STREETS

Streets within a city are a living system and are responsible for their functionality of it. Often they are discussed as the arteries and capillaries of cities, connecting people and resources where it is demanded, efficiently (Hand, 2007). Although, the true potential of streets especially in residential areas is often overlooked; functionality and efficiency do not have to be the main considerations and they should not be just a short route between points A and B. In residential areas, the street is an area of public space that slices through areas of residence. Over the years the functionality and efficiency context of the residential streets has decreased and emphasis has been given to the social-wellbeing aspect of the streets.

The famous pedestrian-motorist conflict has been the starting point for urban planners and designers to research and creates innovative traffic calming and social-wellbeing enhancing solutions. The key to these innovative designs has been the concept of giving the street back to the people and limiting the vehicle activities and rights in these residential streets. Local success in the Netherlands and a great concept of transforming the streets into a liveability hub has been the inspiring concept of the Woonerf (Hand, 2007). The integration of car traffic with pedestrian activity is seen as the main positive aspect of the design of the Woonerfs. The result of the intervention was a streetscape that valued and gave back to the residents by providing a rich environment that promoted social interaction in addition to calming the traffic. Although the clear benefits of this approach, it is still not widely implemented in cities. The majority of the streets hold back to their main goal of efficiently connecting point A with point B, leading to high traffic rates and non-consideration of the street as a living commuting space.

2.5 WOONERF CONCEPT RESIDENTIAL STREETS

The conceptual roots of this concept date before its actual implementation and introduction moment in the city of Delft in the 1960s. The conceptual and philosophical roots of the woonerf were introduced by a British urban designer, Colin Buchanan (Hand, 2007). In a report that he sent over to the Ministry of Transportation, he

underlined the focus on providing an efficient transportation network is degrading the residential streetscape (Hand, 2007). He then introduces several concepts that promote the liveability of the residential streetscape, while limiting the car traffic that goes through the residential streets (Hand, 2007). Woonerf was one of the introduced concepts.

This concept of the British urban designer was made a reality by the Dutch in the early 1960s. The British concept was used as inspiration by Niek De Boer, which according to the concept he designed streets that would feel like driving through a garden (Ben-Joseph, 1995). The main focus of these designs was to slow down car traffic, force drivers to have their full attention, and give priority to the residents and other pedestrians. Due to the excessive-high traffic and safety concerns, the residents of numerous residential streets in Delft with the cooperation of the city officials implemented the first Woonerf interventions. The first woonerf design combined sidewalks and roadways into one surface, creating the impression of an open living environment (Nio, 2010). The interventions were perceived as a success for the residential streets, the traffic lowered and calmed significantly while the liveability levels in the surrounding areas increased (Hand, 2007). The Dutch government soon realized the first set of design standards and guidelines for the implementation of Woonerf, in 1976 (Hand, 2007).

It is important to understand that the interventions posed by the Woonerf concept are not universal-made and can have different effects on different residential streets. The Woonerf interventions to that degree are context depended and goal-driven. The goal of the Woonerf is to lower and calm car traffic while transforming the streets into a liveability hub. The interventions that take place to achieve that goal vary between residential streets, cities, and countries due to contextual differences, culture differences, geographical differences, and different political regimes. Therefore, it is important to underline that the interventions that worked in a specific residential street do not necessarily work in another one.

Structural characteristics of Woonerf

The Woonerf concept is a unit of interventions that work towards limiting the volume and speed of traffic. Simultaneously these interventions create a more liveable and socializing

resident street by creating spots for children to play, rest and gather. Although this concept is mostly goal-driven and contextualized which leads to different interventions in different locations, five main components are found in all of the Woonerfs. The first component that is key to every woonerf is to create distinct gateways from both sides of the street that makes it known to the driver that they are passing through a Woonerf street. At the same time, these gateways celebrate and enhance the residential streets by creating their own identity (Hand, 2007). Secondly, curving the current roads so that the driver's sightline is limited and is forced to break, is massively used as an intervention in Woonerf streets across the world. The third component is to add features that have a dual purpose of calming and slowing down the traffic while providing amenities for residents to enjoy a more pedestrian-friendly residential street. Examples of such interventions would be the implementation of benches, chairs, bollards, play equipment for children, trees, and plants. This creates a situation where drivers find it challenging to drive on the residential street and makes them extremely cautious about the pedestrians and their surroundings (Collarte, 2012). The main Woonerf principles are presented in Figure 5.

Research has shown that for the drivers to not speed on a residential street, that street should eliminate the continuous curbs (Collarte, 2012). This intervention is highly adapted as well by the Woonerf streets across Europe. Finally, the final intervention concerns the parking of cars in that street, it is indeed crucial to provide parking to the residents living in that street but it is important to organize this with intermittent spacing so that the street does not feel like a parking lot (Hand, 2007). All in all, these interventions aim to raise the sense of comfort and safety among the residents in hope that the street space is used for socializing and keeping the residents active.

Figure 5: Main Woonerf Principles

The significance of the Woonerf results regarding the calming and reduction of traffic are vastly noticed. The Woonerf is a proven, viable and exciting solution to some of the main problems caused by the car traffic in residential streets such as the requirement of space, traffic, smog, noise pollution, and safety. The concept is an innovative and unique way for cars and pedestrians to co-exist without intervening with each other. Secondly and equally important is the benefit of woonerfs in the creation of socializing spaces that could be utilized by the community, for children and adults to develop their social networking and participate in outdoor movement more.

The social and traffic benefits of the Woonerf concepts raise questions on why these interventions are not widely and densely spread within cities. Well, the woonerf poses several negative aspects as well. The biggest concern with the implementation of the woonerf concept is the large costs that go into transforming a residential street into a woonerf (Collarte, 2012). Extra funds for transforming residential streets are often not easily granted by the municipalities. Furthermore, woonerf interventions need constant maintenance of the amenities which increases the costs progressively. Finally, it is

important to understand that if a car is uninvited to pass through a woonerf street, the traffic does not disappear but it is simply re-directed to another street. This can have a lot of negative impact on the car traffic on the other street, as the choice of transportation routes would be limited.

2.6 HIGH-TRAFFIC RESIDENTIAL STREETS

Traffic in residential streets negatively influences the quality of life of the residents living there in a lot of different ways. Traffic grants access to functions and the rest of the city, but this positive aspect is largely taken for granted in many parts of the world. As the name suggests, the amount of traffic that occurs in these residential streets is significantly higher than the average traffic of the streets across the city. It is found that drivers passing through high-traffic residential streets are not much aware of their surroundings and they perceive that the road is focused on their car transportation (Young & Lenne, 2010). This leads to drivers becoming more reckless and driving faster in such areas (Warner et al., 2011).

Research by Donald Appleyard (1980) found that the volume of traffic on a residential street affects the quality of life for residents in profound ways. It was found that the amount of social interaction people had with their neighbours in high-traffic streets was curtailed in comparison with people living on low-traffic streets(Mohammadi et al., 2021). In high-traffic areas the street mostly serves as an accessibility and transportation route, taking away the opportunity of using the street for social interactions and outdoor activities.

2.7 THE RELATIONS BETWEEN THE VARIABLES

The previous sections introduced the main contributing concepts to this research, namely children's wellbeing, parental perception of safety, and outdoor autonomy in the context of car traffic in residential streets. The Woonerf concept and High-traffic residential streets were presented as well. In this section, the key concepts are going to be discussed as a whole system of interconnections and logical drives. At the end of this chapter, the conceptual model is discussed.

Parental perception of safety in Woonerf and High-Traffic residential streets

It is quite evident that the levels of traffic in residential streets largely influence the parental perception of safety. When considering the parental perception of street safety, car traffic and car-related accidents are big concerns for parents regarding their children's safety (Rothman et al., 2015). The differences in parental perception of street safety are not noticed solely in the availability or not of car traffic. It is also largely dependent on the volume of the car traffic, the car traffic speeds in the residential streets, and the driver's caution and awareness while driving (Rothman et al., 2015). The aforementioned interventions that the Woonerf concept introduced to the residential streets are found to lower the volume of traffic and significantly lower the traffic speeds. The spatial interventions such as the twisted roads and car bumpers are found to increase the driver's caution and awareness while driving through the streets. Furthermore, it was found that when a residential street adopts Woonerf concept interventions it becomes a sort of unpreferred driving route among drivers (Hand, 2007). This leads to drivers preferring other paths for their daily commuting, thus decreasing the number of cars commuting through the Woonerf streets.

Considering the fact that the Woonerf concepts aim in reducing the car traffic volumes and speeds in the streets, the car traffic risks in those residential streets are vastly decreasing as well (Hand, 2007). By lowering the risks of car traffic the parental perception of safety is also influenced. Less car traffic in the residential streets suggests that the parental traffic concerns regarding their children's safety are decreased as well (Prezza et al., 2005). Therefore, it is suggested that parents who live in Woonerf areas perceive their residential streets as safer than parents who live in streets that experience high car traffic (Prezza et al., 2005 & Rothman et al., 2015). The spatial interventions of the Woonerf adopted residential streets, decrease the phenomenon of car traffic and transform the area into a perceived safer environment.

Parental perception of safety and children's autonomy

One of the main reasons that influence the children's autonomy at a young age is the parental perception of residential street safety. How the parents perceive the safety levels in their residential streets has a direct effect on the amount of time and sequence of granting their children outdoor autonomy (Alparone, 2005). The more dangerous a street

is perceived the less autonomy the children have to perform unsupervised outdoor activities (Alparone. 2005). Assuming that the parental perception of safety differs between a Woonerf street and High-traffic streets it could be suggested that children living in the Woonerf streets get granted more autonomy than children living in high-traffic streets.

If the parents perceive their residential street as safe, they are less concerned about their child/ren performing unsupervised outdoor activities in the nearby area (Prezza et al., 2005). By having fewer concerns for their child/ren safety they are likely to allow them more autonomy and independence by a younger age. However, if the parents perceive their residential street as unsafe they are less likely to grant their child/ren autonomy and give them unsupervised time (Prezza et al., 2005). A study conducted in the UK showed that children which live in rural areas where car traffic is insubstantial, enjoy more autonomy and perform more unsupervised movements than children who live in urban dense traffic areas (Galaviz et al., 2016). Again, car traffic levels appear from a lot of researchers to be the main cause that affects a child's autonomy levels.

Children's autonomy and the effects on their physical and social activities

Research has found that the opportunity for the children to perform unsupervised movements is strongly linked to their levels of physical activity and psychosocial health (Sprint et al., 2016). It is when they feel more autonomous that they partake in outdoor activities to a larger degree and they perform physical activities without any limitations. The promotion of physical activity from a young age is considered important to establish healthy lifestyles, which most of the time are maintained into adulthood too. The more frequently children perform physical activities the more likely are to live a healthy and happy life. Furthermore, children that are more autonomous and independent from a young age are found to have increased psychosocial health (Moeijes et al., 2018). It is when they perform unsupervised activities that they have the opportunity to meet and interact with friends, increasing their social skills and overall mental health.

Children who experience less autonomy and less unsupervised outdoor time have fewer opportunities to perform physical activities and socialize with friends (Ensrud-Skraastad & Haga, 2020). In their research Yap et al., (2014) mention that children who experience

less autonomy at a young age show mental wellbeing issues such as depression and anxiety. Furthermore, children with less autonomy are less likely to accomplish the recommended weekly physical activity hours to live and perform a healthy lifestyle (Yap et al., 2014).

Urban built environment characteristics of Woonerf and High-traffic streets

In addition to the focus on the effects of the car-traffic levels, focus on the urban characteristics and attributes of the Woonerf and High-traffic areas are displaced too. Generally, the Woonerf concept introduces multiple socially driven spatial developments on the streets. These developments are place-oriented and vary between different streets, cities, and countries. As mentioned by Hand (2007) the majority of these interventions aim in reducing the speed of car traffic and aim in increasing the street liveability. Local-friendly streets are associated with higher children's well-being levels and higher physical activity indexes (Witten et al., 2015). According to Hand (2007), this is explained by two main reasons. First, spatial interventions of Woonerf residential streets can create new spaces and opportunities for local children to practice outdoor activities safely. For example, a great case of this is seen in Grote Rozenstraat in Groningen where after the transformation into a Woonerf street, part of the street that was used for car parking has now turned into a playground (Figure 6).

Figure 6: Playground in Rozenstraat

On the other hand, the main purpose of the streets in high-traffic areas is to serve the vehicles. Wide vehicle streets and soft speed measurements cause the drivers to drive more recklessly and at higher speeds than allowed (Dommes & Cavallo, 2011). Researches show that drivers tend to drive more carefully and slower when physical speed limit interventions are in place (Hand, 2007). When physical interventions are not found, drivers tend to exceed the speed limit by a considerable amount (Dommes & Cavallo, 2011). In figure 7, two streets with a 20km/h speed limit are put next to each

other, which assists in the visualization of the influence the different street designs and spatial interventions can have on drivers and car traffic patterns. This has direct effects and increases the concern levels that parents have for leaving their children unsupervised in such streets. With that said, street design and interventions can both enable or disable car traffic patterns.

Figure 7: Woonerf street in the Netherlands

Figure 7: Residential street in the US

2.8 CONCEPTUAL MODEL

The previous up mentioned sections describe the key main concepts that are central in this research, namely Woonerf residential streets, High-traffic residential streets, car traffic, parental perception of safety, children's autonomy, children's physical activity, children's psychosocial activity, children's wellbeing and how they are connected with each other. Within this research, the main concepts are connected to investigate to what degree car traffic affects the parental perception of safety and whether this has an effect on their children's autonomy and wellbeing by looking into their physical and psychosocial activity levels. This outcome in a conceptual model which connects the key concepts of this research (see Figure 8)**.** This conceptual model serves as the pillar aiming to guide and assist throughout this research process.
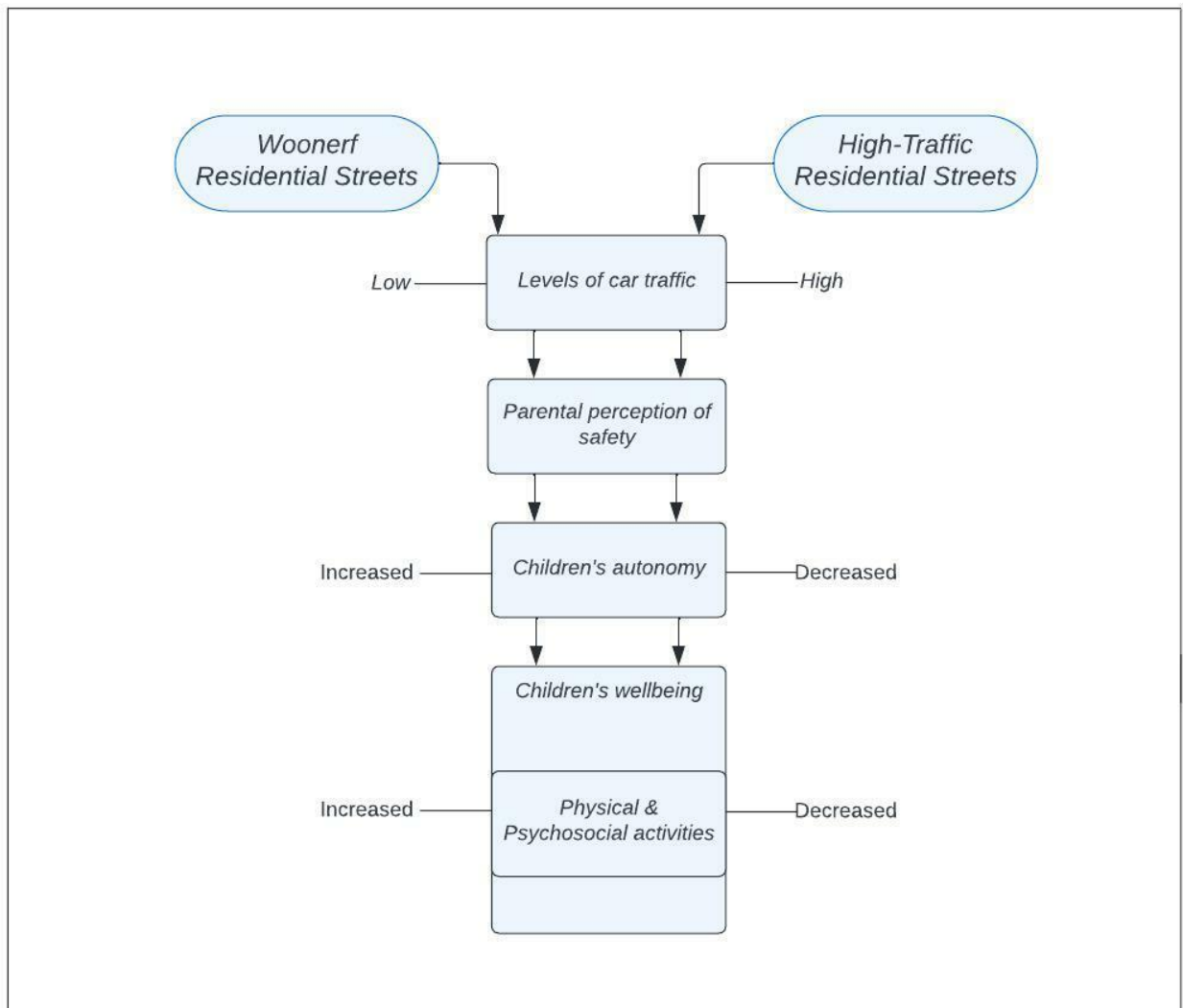
Figure 8: Conceptual model

3

Chapter 3 Methodology

This chapter discusses and elaborates on the research methods and design for data collection and analysis. To start with, section 3.1 discusses the research design chosen for this research, delineating the reason of choice for a mixed-method research approach and mentioning the main reasons behind the selected case studies. Then section 3.2 discusses the case selection and scope of this research. Following the topic selection and research scope, section 3.3 particularly presents the data collection process. To conclude, the ethical considerations of this research are considered and mentioned in section 3.4. A summary of the methodological approach in line with the research question and sub-questions can be found in Table 3.

3.1 RESEARCH DESIGN

The research design is a detrimental component and it dictates the success of the research as it is the starting point of connecting the hypothesis and research questions to the data (Punch, 2013). A combination of quantitative and qualitative data is used to answer the sub-questions and make use of triangulation in the process. Triangulation refers to the use of various methods and sources so that an extensive understanding of the phenomena occurred (Denzin, 2007). Triangulation is also used as a research strategy to test the validity of a phenomenon. However, it is often the case that too much data leads to confusion and loss of the main vision. Therefore, it is important for the researcher and the reader of the final report to understand which steps were made to arrive at a certain conclusion, what was selected and why was it relevant for this research. The next section substantiates the choice of conducting a comparative research study and the usage of mixed data and triangulation.

This thesis uses two case studies research to understand the degree of difference in children's wellbeing, autonomy, and parental perception of safety between two different urban areas (Woonerf & High-traffic)**.** Case studies are chosen as a research method for a variety of reasons that are discussed in the section below. The benefits of choosing case studies as methods incorporate depth, high conceptual validity, understanding of context and understanding of what causes a certain occurrence (Gable, 1994).

3.1.1 Case studies

Given the aim of this research, case studies are detrimental to the robustness and legitimacy of this research. The aim of this research is to conduct a comparative case study between a Woonerf area and a High-traffic area. Even though case studies have been traditionally considered and viewed as lacking generalization and objectivity, they are commonly used because they offer insights that might not be achieved with other approaches (Gomm, 2000). Conducting a case study research an element is studied more extensively as it puts a great emphasis on the investigation of a phenomenon in its natural setting. Yin(1994) mentions that case study research is useful when *why* and *how* questions regarding a phenomenon are asked.

The main goal of this research is to analyze and investigate several phenomena in Woonerf areas and High Traffic areas accordingly, compare the insights with each other and then conclude whether there is a difference in patterns. To achieve the main goals of this research it is necessary to understand the strength of case studies research in its ability to undertake an investigation into a phenomenon in its context (Simons, 2014). Case studies are a valuable and effective way of looking at and analyzing the world around us. In this research, the case study research is based on both quantitative and qualitative data approaches.

This research focuses on the socio-spatial nature of urban areas and its main goal is to see whether spatial planning interventions and the urban build environment affect the wellbeing and conceptual nature of its inhabitants. For this reason, case studies achieve a concrete, context-dependent knowledge geographically embedded knowledge that correlates with the goal of this study. For this study to be successful it has to embrace and recognize the differences in concrete context-dependent knowledge between two spatially different areas. According to Flyvbjerg (2004), this knowledge is more valuable than the vain search for predictive theories and assumptions. When discussing case-study research questions upon the generalization attribute it is rightfully posed. However, one can often generalize on the basis of case studies and the aforementioned may be central to future scientific development (Flyvbjerg, 2004). Formal generalization especially in the socio-spatial realm is overvalued and impossible to achieve due to the difference in cultural, social, economic, and build environment areas pose with each other. Using case

studies the research is set to have comprehensive results that are embedded in the context and embrace the difference between areas. After discussing the benefits of conducting a case study and the reason why this research needs to conduct a case-studies, the next section discusses why the comparison between case studies arrives at the main task of this research.

3.1.2 Comparative-case study

On their own, comparative case studies imply the analysis and conceptualization of the similarities, differences, and patterns across two case areas in the city of Groningen (Flyvbjerg, 2004). Comparative-case studies are ideal to analyze whether particular interventions or policies work or fail to work. In this study, the particular intervention mentioned aforehand is the Woonerf Spatial intervention. The comparative-case study explores similarities, differences, and patterns that are created between a Woonerf area and a High-traffic area to explore whether the Woonerf interventions bring social and health benefits to the inhabitants of the area that which they are applied.

To have a successful comparative case study, the specific features of each case should be described in-depth and discussed before the comparison part. The comparative case study in this research incorporates both quantitative and qualitative data. Given the context and the availability of data, methods such as fieldwork visits, Questionnaires, GIS, and secondary data are used. Comparative case studies are ideal for this type of research because they are useful for understanding and explaining how context influences the success of an intervention, in this case, the Woonerf concept (Flyvbjerg, 2004).

3.2 CASE SELECTION

This research is a comparative case study on the differences in parental perception of safety and children's wellbeing caused by the implementation of the Woonerf concept. For this comparative study, two cases are selected within the city of Groningen. For the goal of this research, one area should be spatially developed as part of a Woonerf area and the other must be an area that experiences high car traffic levels. The criteria for locating the cases within the city of Groningen and resulting in a successful comparative are the following:

1. The selected cases are part of a Woonerf area and a High-traffic area accordingly providing a geographical spread across Groningen.
   The primary criteria limits the study area within the city of Groningen. This decision increases the quality of the research and its relevance as the cases are within the same context and under the same geographical scope.

2. The selected cases have similar demographics. For the comparison to underline and stress the difference in parental perception of safety, children's autonomy, and wellbeing caused by car traffic levels between a Woonerf area and a High Traffic area, other variables that have an effect on the parental perception of safety, children's autonomy and wellbeing in must be on the same level.
   Variables that have to be similar between the two areas so that the difference between the key selected variables is not affected by them are accordingly: similar opportunities for physical activity, similar criminality rate, similar vandalism, violence, and sexual abuse rate. According to Weir et al. (2006), the aforementioned variables in addition to the car traffic levels are the most important variables that affect the parental perception of safety and the effects on the autonomy authorization of the children.

3. The demographics of the selected cases have to include a considerate percentage of families with children.
   This research focuses on parents with children living in a specific area. This criterion is set for the success of the data collection process. The higher number of parents and children in the researched area the higher the chance to collect a considerable amount of data.

The criteria are used to locate two very similar areas within the city of Groningen, with the main difference being that one area must be part of a Woonerf Concept and the other one has to be a high-traffic area. This allows the research to focus on the traffic levels towards the parental perception of safety, children's autonomy, and children's wellbeing. The two areas that fulfil these criteria and create an ideal comparative environment are the Hortusbuurt area and the Tuinwijk area. In the Hortusbuurt area, these residential streets that are chosen for this research and have adopted the Woonerf concept are: Kleine and

Grote Rozenstraat, Kleine and Grote Appelstraat, Kleine and Grote Leliestraat. In the Tuinwijk area, these residential streets chosen for this research are Moestraat, Mutua Fidesstraat, and Kastanjelaan.

3.2.1 Hortusbuurt area

Hortusbuurt is a residential area located north of the inner city and south of the Noordeplatsoen park. The area was part of the expansion of the inner city of Groningen and dates back to the 17th century, it was one of the Groningen's first city expansions outside its initial city walls. The residential area consists of a series of streets from which three residential streets are officially recognized as Woonerf streets since 2005 (Woud, 2005). The woonerf streets in the Hortusbuurt area are the 'Klein and Grote Rozenstraat', 'Klein and Grote Leliestraat' and 'Kleine and Grote Appelstraat'. These streets are highlighted with green in Figure 9. To check whether the streets are indeed a Woonerf concept, the researcher undertook a short observational walk. The streets had established all of the Woonerf characteristics and in both entries of the road, the 'Entering into a Woonerf Street' sign could be distinguished (see Figure 10).
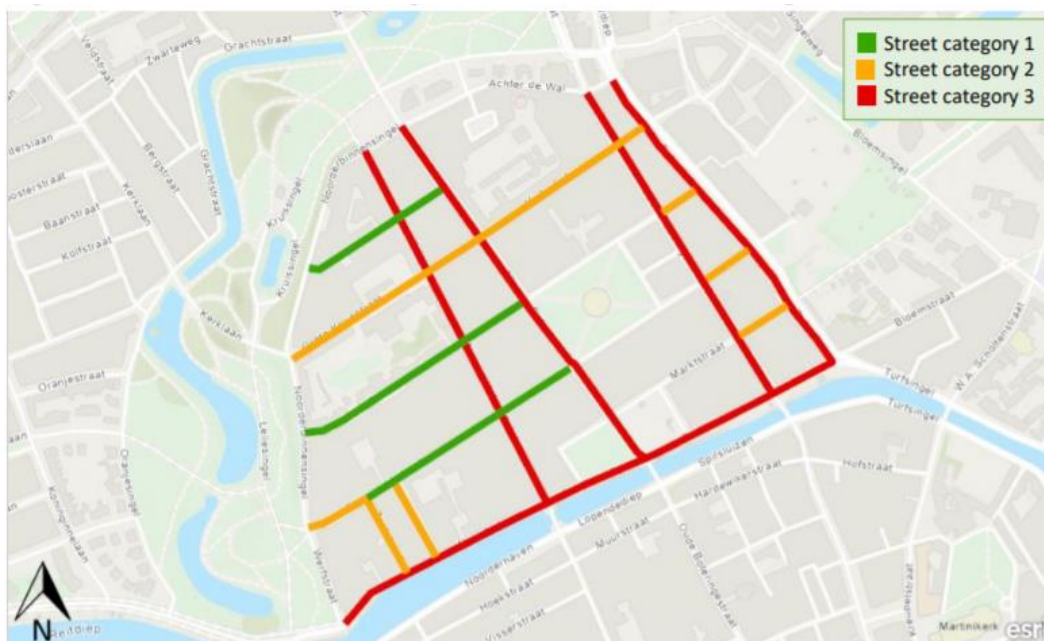
Figure 9: Selected Woonerf residential streets

Figure 10: Road sign when entering a Woonerf

After verifying that the streets are indeed part of the Woonerf concept, small desk research was conducted to check whether the rest of the criteria (as mentioned in 3.2) are fulfilled. Gronometer (2022) and CBS (2022) are used to explore the demographics of the Woonerf streets. The streets are home to nearly 330 families as of 2020 and over 260 children aged from 0 to 15 live there. Over 78% of the houses in the Woonerf streets are occupied by families with multiple members, making it an ideal case for this research (see Figure 11). Furthermore, the inhabitants living in these streets have one of the lowest cars per household number in the whole city of Groningen, the registered number of owned vehicles in the Woonerf streets is 124 per 876 households (Gronometer, 2022). According to Gronometer (2022), the crime rates in those streets are below the average in Groningen, there have been 4 crimes per 1000 inhabitants as of 2018. Data provided by Geodienst showed that as of 2020, the Woonerf streets were among the least visited roads by car (see Appendix D), which is explained due to the Woonerf spatial interventions and the numerous limitation for vehicles these streets have. In addition, an open geodata map which contains the exact spot of car accidents from 2008 to 2017 (see Figure 12), shows the small number of accidents that have occurred in the chosen Woonerf residential streets (PDOK.nl).
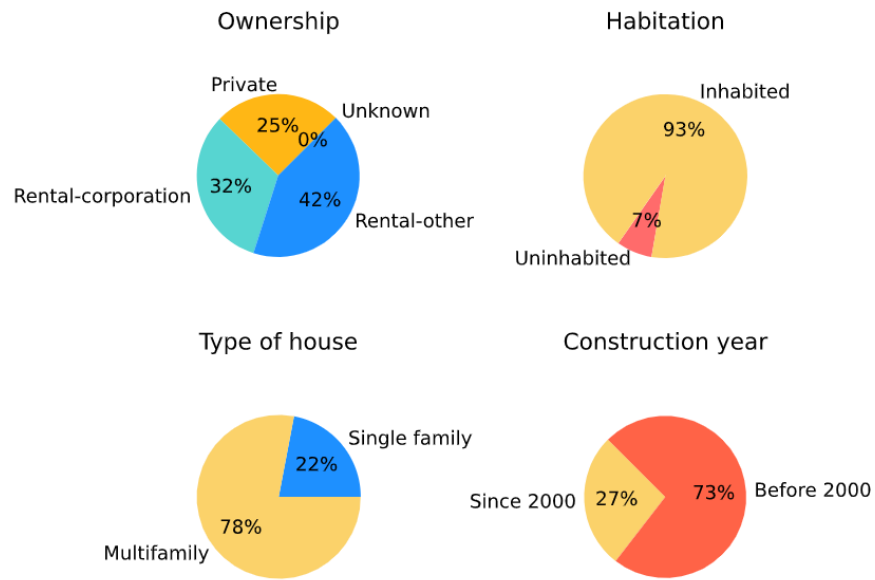
Figure 11: Demographic data of Woonerf streets

Figure 12: Car traffic accidents in Woonerf (green) streets

3.2.2 Tuinwijk residential area

Tuinwijk area is located north of the historical center of Groningen and is positioned between Paddepoel, Selwerd, and the Noordeplastoenbuurt. The residential area was established in the 18s, making it significantly newer than Hortusbuurt. The area consists of streets that appear to have very high-traffic congestion. Therefore, to scope down the focus of the research, these specific streets are selected as high-traffic streets in the Tuinwijk area: Moesstraat, Kastanjelaan, and Mutua Fidesstraat. The Geodienst from the University of Groningen provided information on the traffic numbers in the Tuinwijk residential area and in specific traffic data for the aforementioned streets. The whole area has one of the highest car-traffic levels In the region (see Appendix C). In addition, as a form of triangulation and verification GIS data showing car traffic accidents verified that Tuinwijk has significantly more car traffic accidents than other areas in Groningen (see Figure 14). Furthermore, Tuinwijk residents hold one of the highest numbers of cars per household in Groningen. As of 2018, in Tuinwijk there are 425 cars per 995 households (Gronometer, 2022).

Similar to the Woonerf streets, the researcher conducted a desk-research in order to validate whether the other criteria are fulfilled. Gronometer and CBS were used to explore the demographics of the high-traffic streets. The streets are home to nearly 315 families as of 2020 and over 190 children aged from 0 to 15 live there (CBS.nl). Over 86% of the houses in the high-traffic streets are occupied by families with multiple members, making it an ideal case for this research (see Figure 13). The crime rates in those streets are below the average in Groningen, there have been 6 crimes per 1000 inhabitants as of 2018, showing similar patterns to the Woonerf streets from that perspective (Gronometer, 2022).
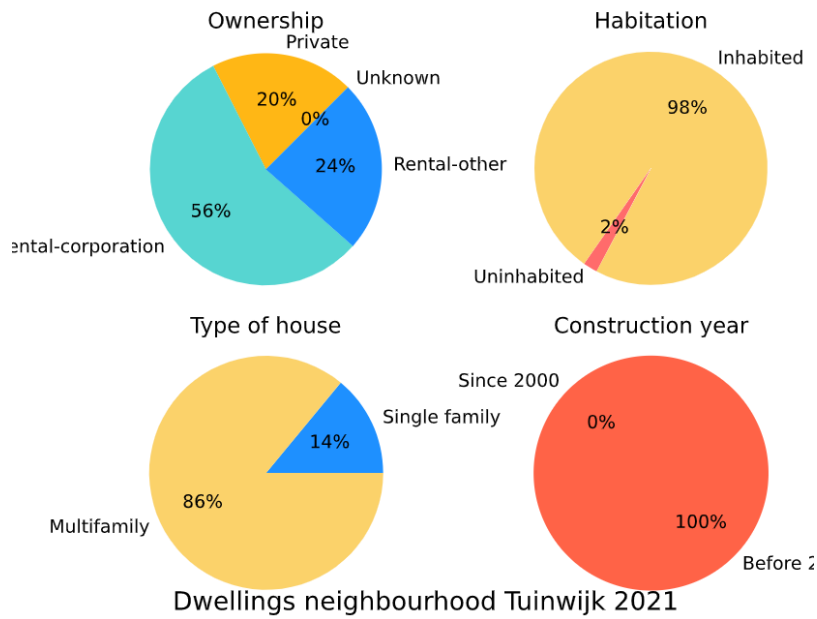
Figure 13: Demographic data of High-traffic streets
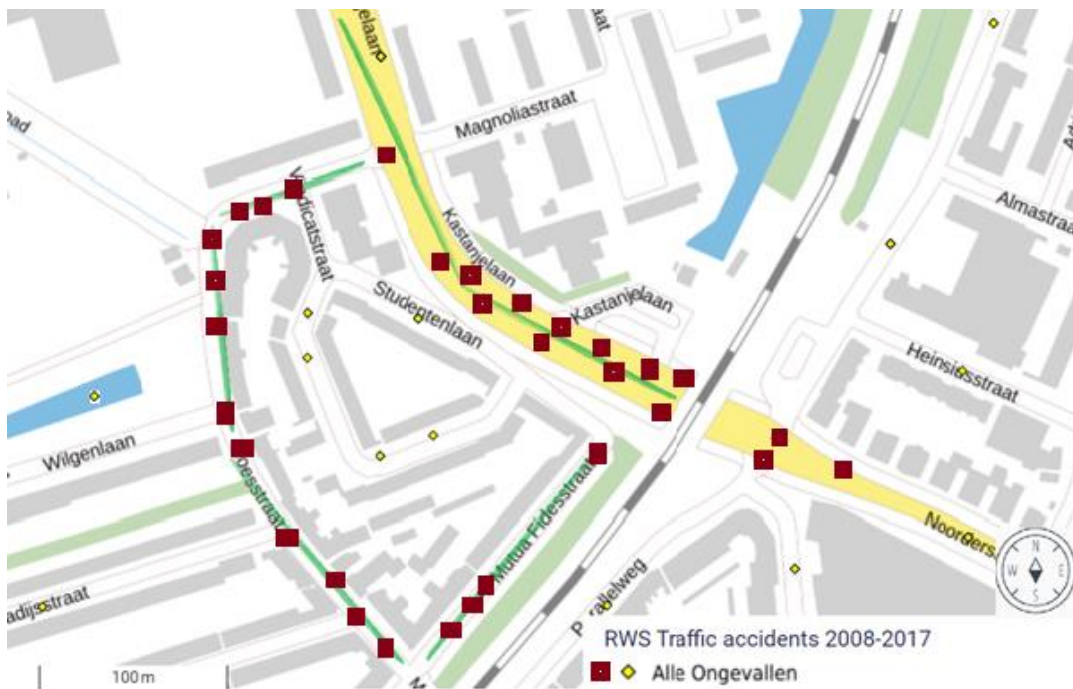
Figure 14: Car traffic accidents in High-traffic (green) streets

The cases fulfil the aforementioned criteria and are very similar regarding variables that affect the parental perception of safety, children's autonomy, and wellbeing, creating an ideal environment for case-study comparison. The similarity between the two cases is expected to highlight the effects of the only difference that they pose, car traffic levels. This way the research assures that car traffic is the only variable that affects the aforementioned variables and the results are pretentious to the car traffic. Table 1 summarizes the main findings and the main indicators that are used as a basis for this comparative study research.

Residential areas	Families	Ages 0-15	Crime vandalism	Crime total theft	Crime violence and sexual abuse	Amount of car accidents 2007-2018	The average amount of cars commuting per week
Tuinwijk (high-traffic area)	315	205	3	7	6	<10	55324 (Geodienst)
Hortsbuurt (woonerf),	330	260	4	4	6	>30	4780 (Geodienst)

Table 1: Summary of background data

3.3 DATA COLLECTION METHODS

In this section, the data collection methods used for this research are discussed.

Questionnaire

In this research, the majority of the data is collected by means of a Questionnaire. The structure of the Questionnaire gives the researcher the possibility of collecting both quantitative and qualitative. Furthermore, Questionnaires are a research method tool that allows to contact individuals and collect a large amount of data rapidly. Contrasted with different methodologies, the capacity to give obscurity an internet-based questionnaire is a major advantage, especially when discussing sensitive themes such as children's wellbeing and their autonomy (Bartram, 2019). In addition, the Questionnaire holds practical advantages over other forms of data collection such as the adaptability for respondents over where and when to finish their questionnaire.

The qualitative data derived from the Questionnaire give a more detailed insight into the problem by exposing the underlying reasons which are invisible from the quantitative

research methods. The qualitative questions posed in the Questionnaire allow the researcher to get to know the point of view from different angles, leading to comprehensive and detailed data which increases the overall quality of this research. The qualitative questions of the Questionnaire create a sense of openness by motivating people to expand their responses and can open new topic areas and interrelations that are not initially considered (Tetnowski & Damico, 2001).

On the other hand, quantitative data in this research are equally important considering the comparative nature of this research. The objective and accurate nature of the quantitative data allows for statistical analysis and means of comparison between the data of the two areas. Quantitative data are essential for the comparison of similarities, differences, and patterns between the Woonerf and the High-traffic areas. Using a combination of qualitative and quantitative data improves the quality of the research and ensures that the limitations of the one are balanced by the strengths of the other (Fearon & Laitin, 2008).

During this research two Questionnaires were constructed, one for the Woonerf residential streets and one for the High-traffic residential streets. Apart from the first three introductory questions, the questions between the two questionnaires are similar, both the Questionnaires can be accessed in Appendix B. The Questionnaire was distributed to all households on the streets mentioned in sections 3.2.1 and 3.2.2 so that the opportunity of achieving a higher number of replies was higher. The deliverable was a letter consisting of a small introduction, the purpose of the study, and the QR code/link of the digital Questionnaire (see Appendix A). Upon scanning the QR, the respondents were directed to the digital Questionnaire in the Qualtrics environment. In the Woonerf streets, 210 letters were distributed among households, and after a careful selection process based on the answers to the Introductory Questions, 63 respondents were assessed. For the High-traffic streets, 205 letters were distributed among households, and after a careful selection process which was based on the answers to the Introductory questions, 61 respondents were assessed. This process occurred in March 2022.

The introductory questions consisted of: "Do you live on this street (Woonerf/High-traffic)?" "Do you have (a) child/ren aged from 10-15?". Only the respondents who responded with a 'yes' to both these questions were considered. To narrow the scope of the research and improve the quality of the research an age range is decided for the children. According to

Parsapoor et al.(2014), children get more confident in their own decision-making skills, and they get granted more autonomy from their parents around the age of 15 to 18. For this reason, children who are older than 15 years old, do not serve well the aim of the research, as their autonomy is influenced by their state of mind and their age (Adams, 2009).

Therefore, this research is aimed at children whose autonomy is highly related to their parents but is progressively granted when the concerns of the parents regarding their child's safety for example is decreased due to urban build environment changes (in this research case) (Hauser Kunz & Grych, 2013). According to this criterion, selecting children which are aged from 10 to 15 years old is found to be the most beneficial for the context of this research. This is the reason why every respondent that did not have a child aged from 10 to 15 years old was not included in the research. The questions used in the Questionnaire for answering the research sub-questions are presented in Table 2.

Sub-questions	Quantitative questions in the Questionnaire used to answer the Sub-questions	Open-ended questions in the Questionnaire used to answer the Sub-questions
How does the car traffic vary between Woonerf and High-traffic areas?	1. Rate the car traffic in your residential street on a typical week based on the scale below (0-100)	N/A
What are the main causes and variations of parental perception of safety in Woonerf and high traffic areas?	1. How safe would you consider your residential street based on the scale below (0-100) 2. How does the level of traffic in your residential street influence your parental perception of safety? (MC) 3. Please re-order the main causes that you think influence your parental perception of safety from the most to the least significant (ranking)	1. Mention other causes if applicable
To what degree is the children's autonomy affected by the parental perception of safety in both Woonerf and High-traffic residential streets?	1. How safe would you consider your residential street based on the scale (0-100) 2. How important are the levels of car traffic in your residential street when considering	N/A

	granting your child/ren more autonomy? (0-100) 3. On a weekly basis, how often is your child in an outdoor environment without your supervision? (MC)	
To what degree are the children's autonomy and wellbeing affected by the characteristics of the residential streets they live in?	1. To what degree do you believe that the urban characteristics affect your child's autonomy and wellbeing?	1. How do you think that the urban characteristics can affect your child's autonomy and wellbeing?
How does the children's well-being vary between a Woonerf residential street and high-traffic residential streets?	1. On a weekly basis, how often is your child in an outdoor environment around your residential street without your supervision? 2. How often does your child interact with fellow children within a week? 3. How often does your child perform physical activities around your residential area?	N/A

Table 2: Which Questionnaire questions served to answer the research sub-questions

Summary of used methods

The data analysis for this research has been mainly divided into two parts and is done in a logical order. Data analysis is divided into quantitative and qualitative. For the quantitative data analysis, the Qualtrics data was extracted and transformed into an SPSS dataset, where multiple statistical analyses occurred. On the other hand, the qualitative answers from the Questionnaire are used to find patterns and insights that complement the quantitative data. For the qualitative data, ATLAS.ti a qualitative data analysis software program is used.

	Which information	Moment of retrieval	Method of retrieval (source)	Documentation method	Method of analysis
Main Research Question	Variation in parental perception of safety and children's wellbeing based on traffic levels.	January-April 2022.	Comparative case study	Data from the sub-questions.	Data analysis is based on combining the answers from each of the sub-questions.
Sub-RQ1	Variation in car traffic levels.	February-March 2022.	Geodienst & Questionnaires completed by residents.	Exporting to SPSS.	Statistical comparative analysis T-tests.
Sub-RQ2	Main causes affecting parental perception of safety and the variation of parental perception of safety between the two areas.	February- March 2022.	Questionnaires completed by residents and literature research	Exporting to SPSS & theoretical framework.	Descriptive statistics and statistical comparative analysis T-tests.
Sub-RQ3	Correlation between the parental perception of safety levels and their children's autonomy.	February-March 2022.	Questionnaires completed by residents.	Exporting to SPSS.	Correlational statistics (Pearson's test).
Sub-RQ4	Correlation between children's autonomy and urban characteristics.	February-March 2022.	Literature research and Questionnaires completed by residents (qualitative).	Exporting to SPSS, theoretical framework & Atlas. ti	Descriptive statistics and keywords as codes for Atlas.ti.
Sub-RQ5	Variance in children's wellbeing levels.	February-March 2022.	Questionnaires completed by residents.	Exporting to SPSS.	Statistical comparative T-tests to explore variance and significance.

Table 3: Brief data analysis (for the extensive version see Appendix E)

Quantitative data retrieving plan

Statistical analysis is the initial step to analyzing quantitative data and exploring correlations between the results while obtaining general descriptive statistics that are used for the comparison between Woonerf streets and High-Traffic streets. As mentioned before, two Questionnaires are introduced in this research, one for the Woonerf Streets and one for High-Traffic streets. The two different datasets were firstly statistically analyzed one by one. Then for several statistical data comparisons, the two datasets were merged.

To ensure an effortless and efficient statistical operation, for each dataset only the respondents that replied to all the questions are considered. After removing respondents who did not fulfill the criteria of fully completing the Questionnaire, a descriptive statistical analysis for every quantitative variable (Yes/No Questions, Ranking Questions, Scale Questions) occurred. The main goal of descriptive statistics is to summarize the given

variables and help to describe and understand the features of each of the variables by giving short summaries of the sample (Fisher & Marshall, 2009). Descriptive statistics are very vital in the early phases of the statistical analysis because it helps in creating a representation of the data that is easily visualized and compared (Fisher & Marshall, 2009). For providing basic information about variables in the datasets, the mean, median, mode, and standard deviation were mostly used. These helped in constructing an initial overview of the data collected by the respondents and creating an overall idea of where to look next. Visualizing the data is of high importance as it simplifies and suggests certain outcomes. For this, frequency histograms with a normality curve for the Scale Questions and frequency bar charts for the Ranking Questions were used. The descriptive statistics for both datasets are in Appendix F & G.

Apart from the basic information about variables in a dataset, the descriptive analysis highlighted the potential relationships between the variables. The second phase of the statistical analysis is focused on finding correlations between two or more variables within each dataset. This way, the literature theory assumptions and significance of the correlation between the variables are tested to explore whether they have a strong/weak relationship. Correlation tests investigate whether the variables are associated without assuming a cause and effect relationship (Curtis et al., 2016). For this, the Pearson Correlation test was used for different combinations of variables.

For the comparison of summarized data between the two Questionnaires some basic statistical significance difference tests occurred. In detail, a simple t-test occurred between the variables of the Woonerf Questionnaire and the variables of the High-Traffic Questionnaire. The objective is to explore whether there is a significant difference in the responses and if so how significant they are. This is crucial for answering the main research question.

Qualitative data retrieving plan

The analysis of the qualitative data, which consists of 3 open questions which were responded to by the respondents of the Questionnaire, has been done with coding as well. After the collection of the Questionnaires, the qualitative answers were transcribed using otranscribe.com. After transcribing all of the qualitative data were coded by using "Atlas.ti".

All the qualitative data were coded into 2 main categories based on the topic and the sub-questions of this research by following a deductive type of coding. The full coding scheme can be seen in Table 4. The coding scheme is focused on the qualitative data acquired to answer sub-question 4.

Theme	Sub-theme	Keywords
Children's autonomy	*Unsupervised outdoor activities* *Safety* *Urban characteristics of residential streets*	*Autonomous, safe environment, concern, safety, promote, restrict, independent, unsupervised*
Children's wellbeing	*Physical activities* *Psychosocial activities*	*Outdoor activities, play, meeting with friends, walking, riding the bike, socializing*

Table 4: Coding scheme

3.4 ETHICAL CONSIDERATIONS

It is very important to consider ethical considerations during research. The participants of research should be protected and efforts should be made to provide the safest environment for them. The wish for anonymity of participants, if requested, should be respected (Clifford et al., 2010). Although this research does not have high ethical risks, there are ethical considerations in any study. Firstly, respondents must have full background knowledge on what they are consenting to. This is underlined in the introduction and instructions of the Questionnaires, as it is important for the respondents they know that everything is confidential and anonymous Additionally, respondents and researcher should suffer no harm or disadvantage from participating in this research. Considering the goal and main concepts of this research, it is not expected that the respondents and researcher are to be harmed in any way.

Qualtrics does not give information about the respondents other than the time when the Questionnaire was ended. The respondents had the opportunity to stop answering the Questionnaire at any time without explanation.

Chapter 4 Results

This chapter discusses the quantitative and qualitative data collected from the Questionnaire in both the Woonerf and High Traffic areas. The results are presented per sub-question which complements the logical order of the variables and the conceptual model.

In combination with the theoretical framework this results sections provides more detailed and in-depth information that contributes to answering the main research question: *"How does the presence of car traffic in Woonerf and High-traffic areas affect the parental perception of safety and children's wellbeing?"* The results are structured according to the five sub-questions mentioned in chapter 3 and discussed following the order of the sub-questions.

4.1 CAR-TRAFFIC VARIANCE BETWEEN THE SELECTED WOONERF AND HIGH-TRAFFIC AREAS

This section explores the results aiming to find the car traffic difference between the two residential areas and answer sub-question 1. Although an overall moderate level of car traffic in residential areas, the volumes on a local level are unequally distributed. The average car traffic levels of Groningen are well under the average of other Western Dutch cities, but the unequal distribution of traffic levels in residential streets in the city of Groningen is significant. The difference is especially noticed between the Woonerf residential streets and the residential streets located near the exits/entrances of Groningen's ring road highways (High-traffic areas).

The car traffic levels of the selected residential streets for this research are discussed below. Then the variance in car traffic levels between the two selected areas is discussed as well. In addition to the car traffic levels in the selected residential streets, data showcasing the car traffic-related accidents between 2007-2018 are discussed and compared between the two areas. Data from the PDOK Viewer (geospatial dataset map), Geodienst, and the Questionnaire are combined to ensure that the measurement of car traffic and car traffic-related accidents are valid and trustworthy. Firstly the car traffic data are discussed per research area and then they are compared with each other.

4.1.1 Woonerf residential areas

The traffic restrictions and the specially designed urban build environment make the Woonerf streets unpreferred from the drivers, leading to extremely low levels of traffic. This pattern is not different for Grote & Kleine Appelstraat, Grote & Kleine Rozenstraat and Grote & Kleine Leliestraat. The aforementioned Woonerf residential streets are one of the least visited streets by car vehicle in Groningen. The average amount of cars in those eight years commuting through the three streets was around 4780 cars per month (see Table 5). Furthermore, using the open-access dataset map from PDOK Viewer with the *RWS Traffic Accidents 2008-2018* dataset, car-related accidents were discovered (see Figure 12). In the time span of 10 years, only 6 car-related accidents were registered in the three researched Woonerf streets.

Data from the Questionnaire illustrated the resident's perception of car traffic in their residential street. On a normal distributed variable environment, residents of the aforementioned Woonerf streets rated the car traffic levels in their residential streets as relatively low (M = 26) (see Figure 15). By looking at the graph, it is noticed that the responses are clustered around the mean which means that the responses are reliable and significant (Synek, 2008). The low standard deviation (SD = 18.2) confirms that the values are close to the mean, implying that the data is not subject to change if the research is repeated.

Woonerf residential street	The average number of cars commuting per month from 2010 to 2018 (according to Geodienst dataset)	Total
Grote & Kleine Appelstraat	1178 cars per month	
Grote & Kleine Rozenstraat	1298 cars per month	
Grote & Kleine Leliestraat	2300 cars per month	
		4780 cars per month

Table 5: Car accidents in Woonerf residential streets
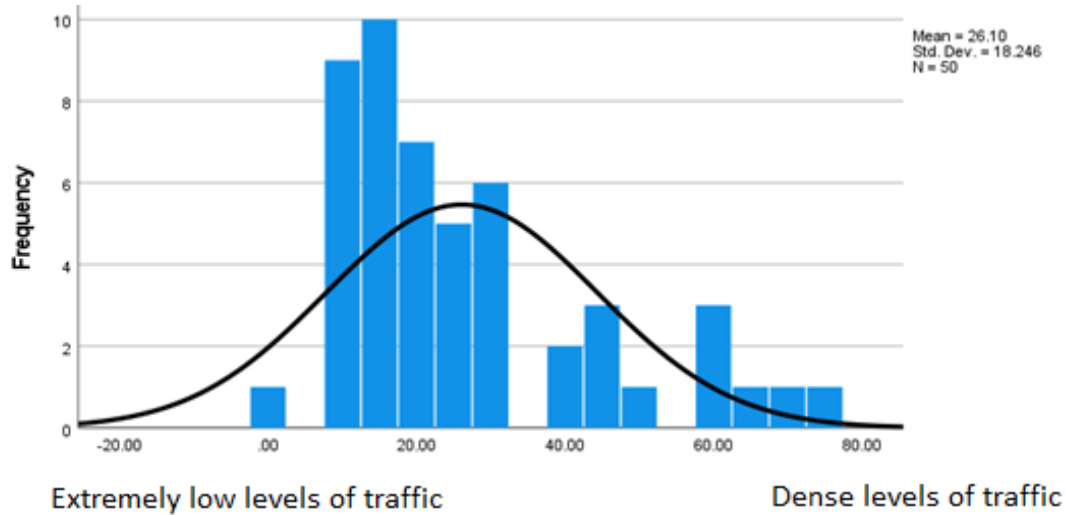
Figure 15: Perceived car traffic from Woonerf residents

4.1.2 High-traffic residential area

The selected high-traffic streets in the city of Groningen are located and part of the Kastanjelaan ring road entrance in the North-East of Groningen. Considering that Groningen attracts a lot of commuters from the outskirts and smaller Northern Region cities, due to its positioning the area experiences a very high level of traffic. The residential streets chosen for this research are: Kastanjelaan, Moesstraat, and Mutua Fidesstraat. The aforementioned residential streets register high car traffic levels when compared to the average car traffic in Groningen. Geondiest provided data for the number of cars that have commuted through the selected High-traffic streets per month from 2010 to 2018. The average amount of cars in eight years commuting through the three streets was around 55324 cars per month (see Table 6). Furthermore as for the Woonerf streets, using the open-access dataset map from PDOK Viewer with the *RWS Traffic Accidents 2008-2018* dataset, car-related accidents were discovered (see Figure 14). In the time span of 10 years, more than 30 car-related accidents were registered in the three researched high-traffic streets.

Data from the Questionnaire illustrated the resident's perception of car traffic in their residential street. In a normally distributed variable environment, residents of the

aforementioned High-traffic streets rated the car traffic levels in their residential streets as considerably high (M = 71) (see figure 16).

Woonerf residential street	The average number of cars commuting per month from 2010 to 2018 (according to Geodienst dataset)	Total
Kastanjelaan	34215 cars per month	
Moesstraat	12435 cars per month	
Mutua Fidestraat	8674 cars per month	
		55324 cars per month

Table 6: Car accidents in High-traffic residential streets
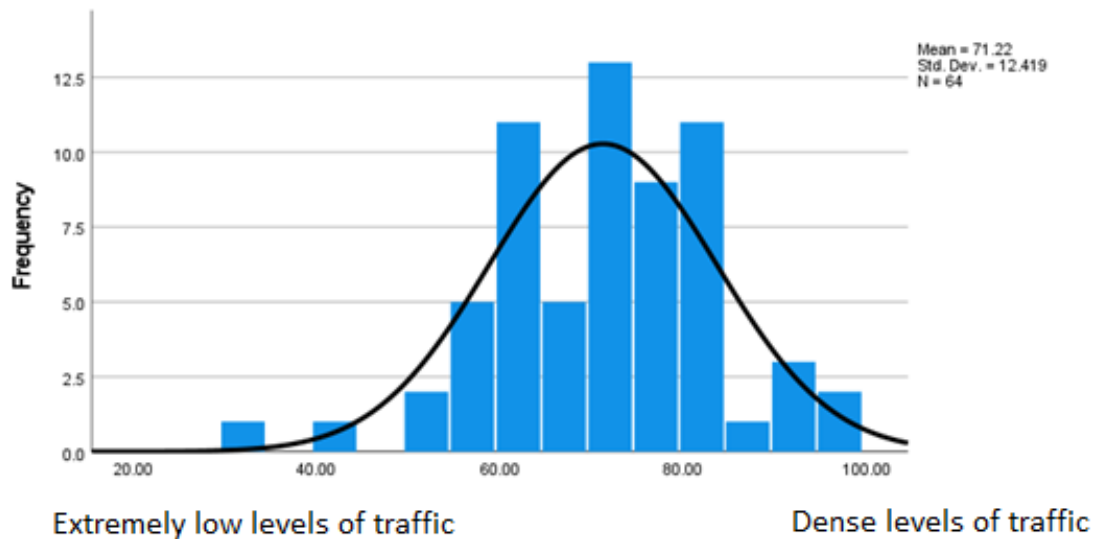
Figure 16: Perceived car traffic from High-traffic residents

4.1.3 Differences and variations between the two residential areas

Comparing the data acquired by Geodienst is quite straightforward. The average car traffic in the High-traffic residential streets is nearly eleven times higher than car traffic in the Woonerf residential streets. Apart from the noticeable difference in car traffic in those streets, the patterns from both the datasets for car traffic in those streets from 2007 to 2018 are quite similar (see Appendix C). Since 2007 the car traffic in both types of residential streets has been increasing progressively throughout the years, which is in line with the overall car usage increase throughout the Netherlands (Meurs et al., 2013). The

monthly car commuting data from the Geodienst show clearly that the researched Woonerf residential streets are less commuted than the research High-traffic residential streets.

The perception of car traffic from residents of Woonerf and High-traffic areas is quite similar to the aforementioned Geodienst data. A statistical comparison between the mean answer of the residents living in Woonerf streets and the mean answer of the residents living in High-traffic streets explored that the difference between them is significant considering a 0.05% coefficient. The high statistical significance (0.02) is a result that Is not attributed to chance. To summarize, both the monthly car commuting desk data and the perception of residents of the car traffic in their residential streets measured by the Questionnaire underline the difference in car traffic levels between the two types of residential streets. Statistically, the car traffic in High-traffic residential streets is eleven times higher than car traffic in Woonerf streets, and the residents perceive it as such.

4.2 MAIN CAUSES OF PARENTAL PERCEPTION OF SAFETY AND VARIATION BETWEEN THE SELECTED CASES

Here the results aiming to answer sub-question 2 regarding the main causes that affect parental perception of safety and the parental perception of safety levels in the two case-studies are discussed. Patterns and characteristics of the residential streets shape the overall parental perception of safety. According to Galaviz et al. (2016), there are several reasons and variables that affect the parental perception of safety, with the most common ones being the levels of car traffic, levels of crime, and the presence of social dangers in the residential streets. In order to focus on the car traffic availability, the two cases were selected so that they have similar levels of crime and the presence of social dangers.

Quite interestingly the residents between the two types of residential streets have different insights on what they consider more important when discussing their parental perception of safety. According to the statistical analysis (see Table 7) the residents living in Woonerf streets consider social dangers as the main concern that affects their parental perception of safety, followed by car traffic and then the levels of crime. On the other hand, (see Table 8) shows that car traffic is the main cause that affects parental perception of safety for residents living in high-traffic residential streets. The causes are discussed separately in

the following sections and then the variation between parental perception of safety in the two types of residential streets is presented.

4.2.1 Parental perception of safety in the Woonerf residential area

Both the causes and measurement of the parental perception of safety in Woonerf residential streets were measured by the Questionnaire. Based on the literature review, the main causes that affect the parental perception of safety in residential streets were distinguished. According to data gathered from the Questionnaire, the main cause that affects the parental perception of the safety of residents in the Woonerf residential streets is *social danger.* Out of 60 respondents that live in a Woonerf residential street, 42 of them consider *Social Dangers* as the main cause that influences their parental perception of safety. Surprisingly, out of 60 respondents, only 5 consider car traffic to be the most important cause that affects their parental perception of safety. This entails that due to the lack of traffic, car traffic is not considered the main cause that affects parental perception of safety.

Please re-order the main causes that you think they influence the safety in your residential streets from the most to least significant - Social dangers

Please re-order the main causes that you think they influence the safety in your residential streets from the most to least significant - Car traffic
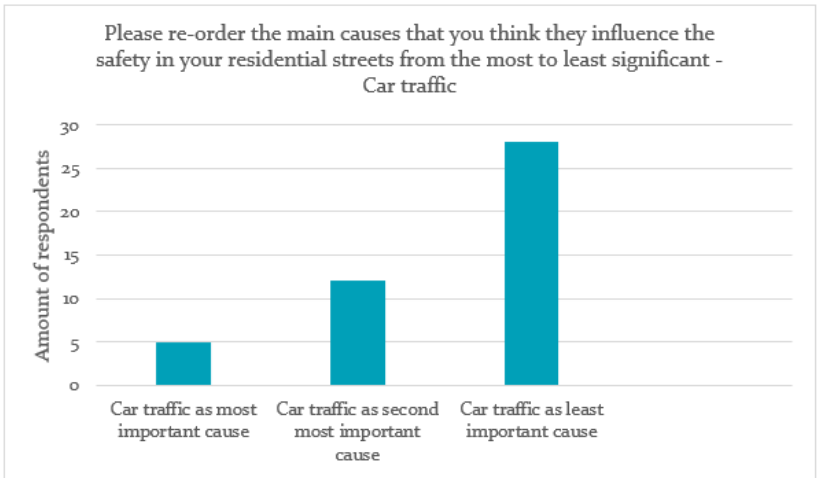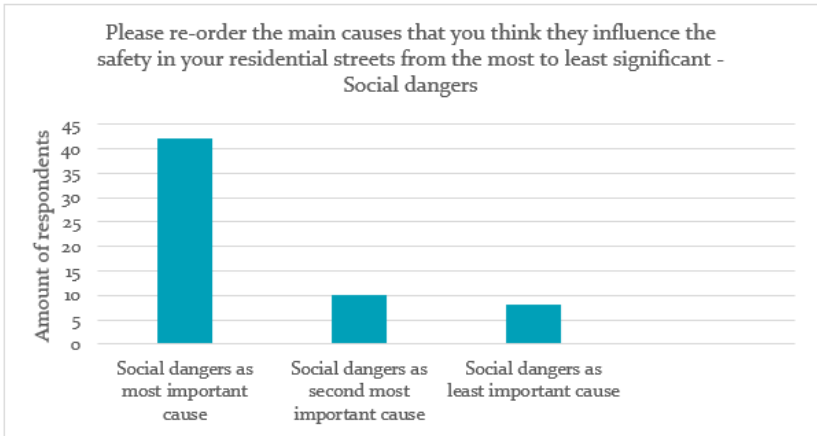
Figure 17: Ranking of causes affecting the parental perception of safety in Woonerf areas

According to the data gathered from the Questionnaire, residents that live in Woonerf residential streets consider the area somewhat safe. In a normally distributed environment, the Woonerf residents consider their residential area as safe (M = 68) (see Figure 18). The results are clustered (SD = 17) meaning that they are highly reliable.
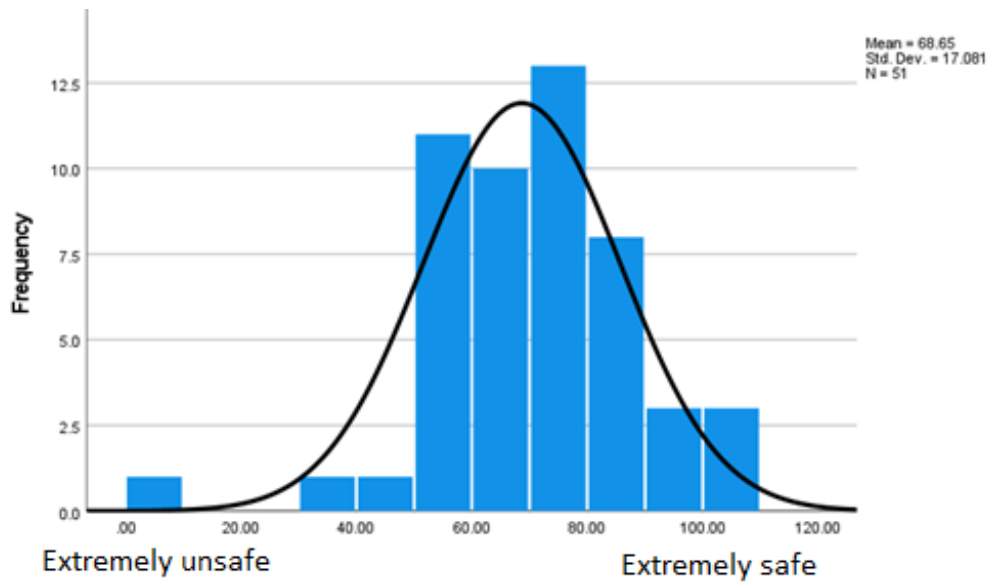
Figure 18: Parental perception of safety Woonerf area

4.2.2 Parental perception of safety in the High-traffic residential area

A different pattern regarding the main causes that affect the parental perception of safety is noticed in High-traffic residential streets. Out of 64 respondents, 57 ranked car traffic as their most important cause that affects the parental perception of safety (Figure 19).
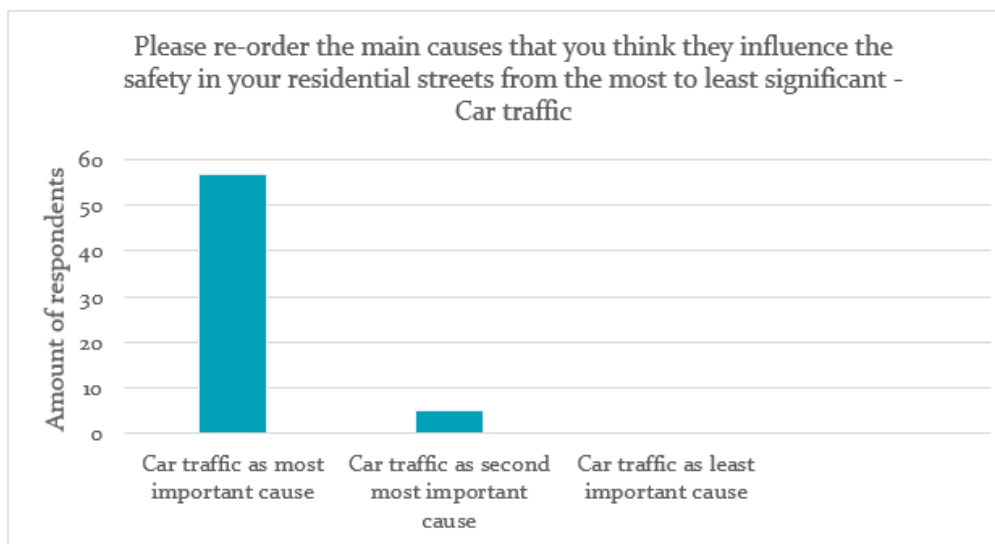
Figure 19: Ranking of causes affecting the parental perception of safety in High-traffic areas

Residents living in a High traffic residential area consider their streets as relatively unsafe (M = 47) (see Figure 20). The data is somewhat dispersed and not so concentrated around the mean, which decreases the credibility of the data.
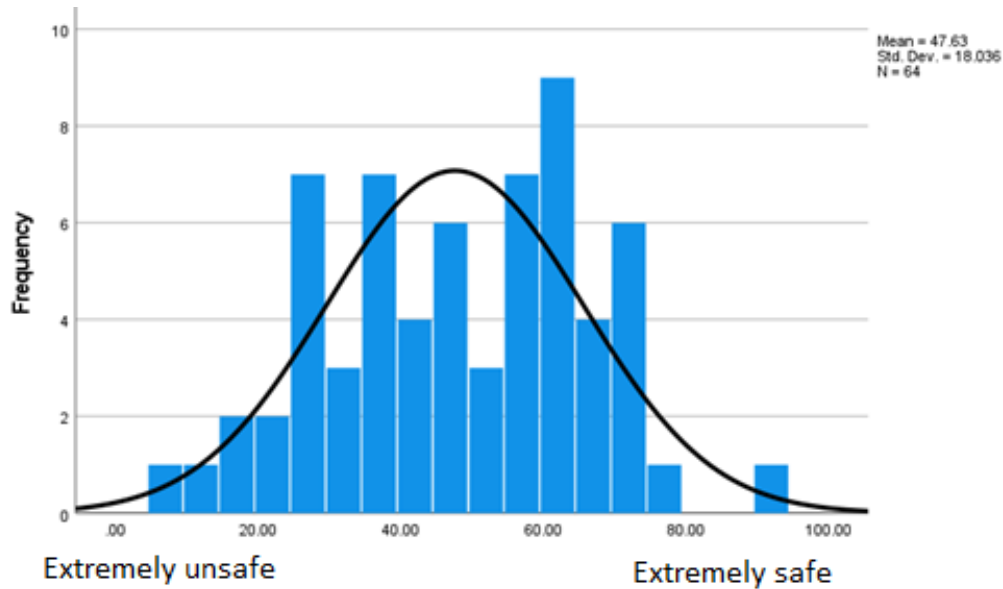
Figure 20: Parental perception of safety Woonerf area

4.2.3 Differences and variations between the two residential areas

The data explored that the difference in the main causes that affect the parental perception of safety between Woonerf residential streets and High-traffic residential streets is quite significant. 57 respondents living in a high-traffic area positioned car traffic as the main cause that affects their parental perception of safety compared to 5 respondents living in Woonerf residential streets. Furthermore, the Questionnaire measured the parental perception of safety levels in both the researched areas. After running a statistical mean comparison analysis for the means of parental perception of safety, it was found that the difference in parental perception of safety is significant (p = 0.04) but it could be subject to change if a bigger number of respondents is researched.

To explore whether this considerable difference is correlated with the amount of car traffic in each of the researched areas, the next sector dives into the correlation between the car traffic levels variable and the parental perception of safety variable. According to the results of the correlation between them, the assumption of whether the parental perception

of safety is affected by high/low levels of car traffic occurs. Even though the ranking of the causes affecting the parental perception of safety shows a pattern between car traffic and parental perception of safety in High-traffic residential streets, the correlational statistics are ought to establish a relationship between the two variables (car traffic and parental perception of safety). The correlation is investigated in both Woonerf and High-traffic residential areas.

4.2.4 Correlation between parental perception of safety and car-traffic levels

For both the case studies, a statistical analysis conducting Pearson's correlation test between the parental perception of safety and car traffic showed quite some interesting results. The correlation between parental perception of safety and car traffic in Woonerf residential areas is significant and positive (r = 0.64, p = 0.03). Furthermore, the relationship is quite strong meaning that the variables of car traffic levels and parental perception of safety move in the same direction. Assuming that car traffic levels are decreased in a Woonerf area, the parental perception of safety levels is decreased as well, meaning that the street is perceived as safer.

In addition, the correlation between parental perception of safety and car traffic in High-traffic residential areas is significant and positive as well (r = 0.817, p = 0.01). The Pearson correlation between the variables is stronger than in Woonerf areas, meaning that the two variables move in the same direction. Whether the car traffic levels are increased the parental perception of safety is to be increased as well, meaning that the street is perceived as more unsafe.

The correlational tests distinguished a clear relationship between car traffic and parental perception of safety. The variables are positively correlated and they move in the same direction. This is in line with the theoretical framework and the current research around those two variables. A small difference in correlational strength is noticed between the two types of residential areas.

4.3 CORRELATION: PARENTAL PERCEPTION OF SAFETY AND CHILDREN'S AUTONOMY

This section provides the results aiming to answer Sub-question 3 regarding the correlation between the parental perception of safety and children's autonomy. By

measuring both the parental perception of safety variables and the autonomy levels variable it was possible to examine whether the two variables are correlated in both Woonerf and High-traffic residential streets. The analyzed parental perception of safety variable is already introduced in the previous sector. The measured children's autonomy and the correlation with parental perception of safety for each of the researched case studies are discussed below.

Parental perception of safety and children's autonomy in the Woonerf residential area

The correlation between parental perception of safety and children's autonomy is assessed in both direct and indirect ways by making use of the Questionnaire. The direct assessment of the correlation between the two variables was analyzed by asking this quantitative question to residents of the streets: "To what extent is the amount of autonomy that you grant to your children influenced by your perception of your street safety?" The residents in Woonerf streets believe that there is a degree of correlation between the two variables (M = 63). A low standard deviation (SD = 15), meaning that the answers are most likely to be the same if the research is repeated (Figure 21). The data shows that the parental perception of the safety of Woonerf residential areas affects to some extent the autonomy of children.
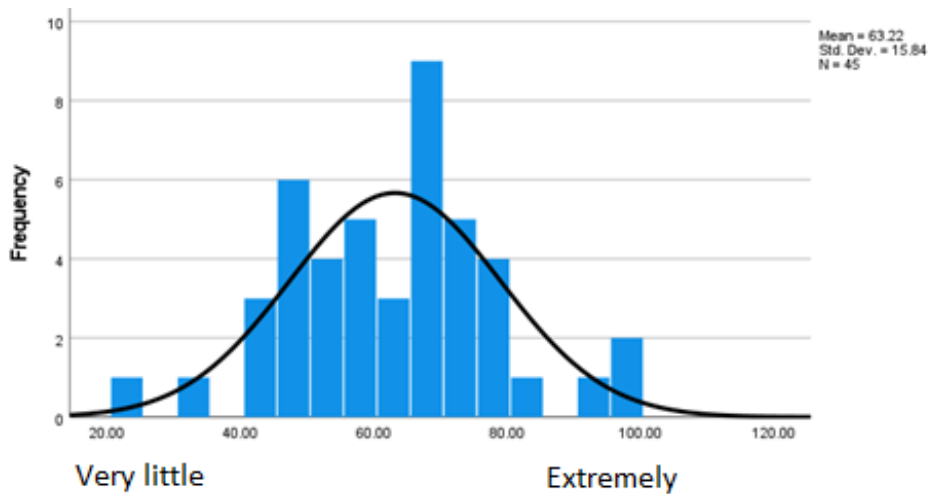
Figure 21: Correlation between parental perception of safety and autonomy

In addition, the correlation between parental perception of safety and children's autonomy is also examined in an indirect way. A statistical analysis by using Pearson's correlational

test allows for exploring the relationship between the two variables. In a normally distributed environment, Pearson's correlational tests showed that the correlation between the parental perception of safety and children's autonomy is significant and positive (r = 0.622, p = 0.004). Furthermore, the relationship is moderately strong, meaning that the variables move in the same direction. The data analysis proposes that if the parental perception of safety is increased (streets are perceived as safer) the autonomy levels are to be increased as well.

Parental perception of safety and children's autonomy in the High-traffic residential area

Following the same method as in the previous section, this part presents the data for the correlation between parental perception of safety and children's autonomy in High-traffic residential streets. Both the direct and indirect correlations are discussed. Data answering the questions: "To what extent is the amount of autonomy that you grant to your children influenced by your parental perception of safety?" were quite dispersed, with a high standard deviation (SD = 23). The mean answer showcases that the variables correlate with one another (M = 63), but the high standard deviation and dispersed answers suggest that If the research is repeated different patterns may be noticed.
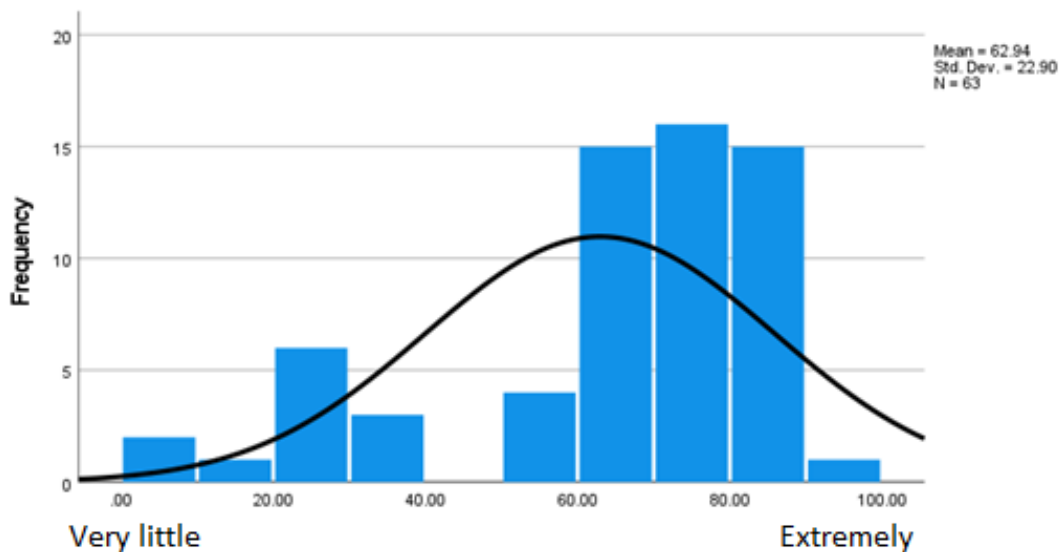
Figure 22: Correlation between parental perception of safety and autonomy

In addition, the indirect approach, which manually correlates the variables of parental perception of safety and children's autonomy is assessed as well. A statistical correlational analysis using Pearson's shows that the correlation between the two variables is significant and positive (r = 0.681, p = 0.001). This means that the two variables move in the same direction and that the relationship between the two could be considered strong.

Although the differences in parental perception of safety and children's autonomy levels between Woonerf and High-traffic residential areas, the correlation between the two variables in both the areas seems to have similar patterns. A positive moderately strong correlation between the two variables is noticed in both Woonerf and the High-traffic residential streets. This means that according to the data from the Questionnaire, the two variables move in the same direction and are interrelated. If a variable is subject to change the correlated variables are subject to change as well. For this research, due to the positive strong correlation between the two variables, the safer, the parents perceive the residential area the more autonomy the children relish. The opposite stands as well, if parents perceive the residential areas as more unsafe it could be the case that children get granted less autonomy. The statistical correlational analysis is in line with the theoretical framework which proposes a correlation between the two variables. This section explored that the power of correlation between the articles is pretty similar, meaning that independently of a residential area being Woonerf or High-Traffic, the parental perception of safety is correlated with the children's autonomy.

4.4 URBAN BUILD ENVIRONMENT CHARACTERISTICS

This section presents the results for Sub-question 4 regarding the urban built environment characteristics of the case studies and the effects on children's wellbeing. Both quantitative and qualitative data are used to answer Sub-Question 4.The two case studies have noticeably different urban built environment characteristics which could be one of the causes that affect the differences in the variables between them. The Woonerf residential streets are constructed in a manner that gives priority to pedestrians and cyclists. The streets are denser and all of the houses look at the residential street, creating overall street security. The narrow street paths are ideally constructed so that cars decrease their speed and pay more attention to the surroundings, thus minimizing and preventing accidents from occurring. The urban build environment of the Woonerf residential streets Is

constructed in a way that the streets feel like a communal urban environment and not just an accessibility tool used by cars. Furthermore, the Woonerf streets have developed several playgrounds in the middle of the roads**.** The designated areas are a place in which children can use unsupervised and perform outdoor and social activities with friends.

On the other hand, the urban built environment in the High-traffic areas is "*not designed for the residents but solely focused on its primary transport function*" (Questionnaire respondent). As it can be noticed the urban build environment is designed so that it facilitates more cars. There is not a clear indication between the cyclist road and the car road, while the pedestrian paths are narrow and in some segments non-existent. The car roads are straight and with double lanes which according to Mutabazi & Russell (1998) is one of the main reasons why drivers exceed the speed limit and do not pay attention to their surrounding environment. The urban-built characteristics of the two types of residential streets are quite profound. Below, quantitative and qualitative data from the Questionnaire are presented which underline the effects and variance that the urban built environment characteristics have on children's autonomy and wellbeing in Woonerf and High-traffic residential streets. The quantitative data explore the resident's opinions on the degree of relationship between urban characteristics and children's autonomy and wellbeing, while the qualitative data explore valuable insights into parents' opinions on the aforementioned variables.

4.4.1 Effects of the urban characteristics in the Woonerf residential area

Quantitative data acquired from the Questionnaire filled by Woonerf residents explored that the residents believe that the urban characteristics influence the children's autonomy and wellbeing to a certain degree. Residents of the Woonerf residential area believe that the urban characteristics have an affect to a certain degree on children's autonomy and wellbeing (M = 61). According to Figure 23, residents in Woonerf areas believe that urban characteristics influence the children's autonomy and wellbeing to a certain degree but not to a great extent.
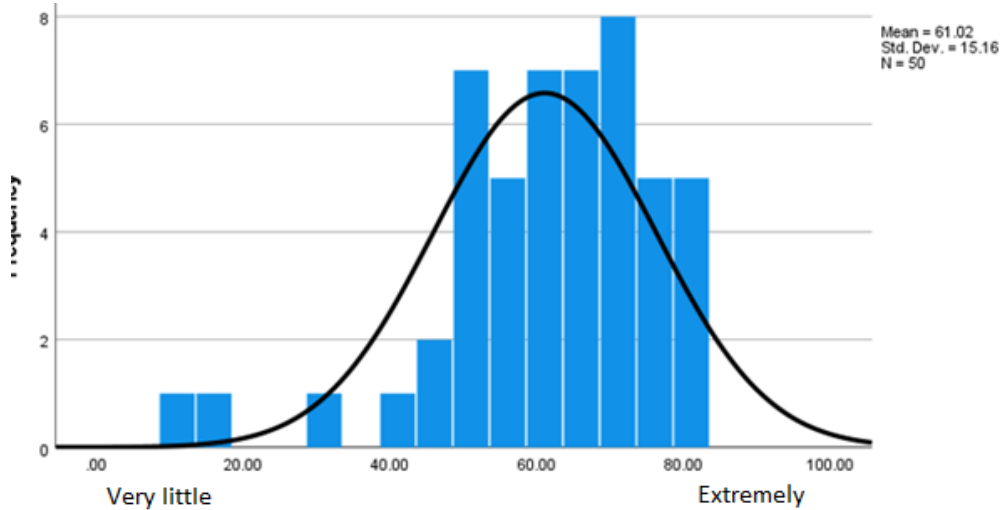
Figure 23: Urban built environment effects

Various qualitative data acquired by open questions filled by parents living in a Woonerf residential area established interesting insights on the relationship and importance of the urban built environment characteristics and children's autonomy and wellbeing. While analyzing the data it was found that two residential characteristics that affect the variables and are mentioned more frequently by the parents. Firstly, the existence of designated playgrounds in the Woonerf streets, and secondly, the various speed bumps established to lower the car traffic speed. Parents living in Woonerf residential streets find these two residential characteristics to influence the children's autonomy and wellbeing and explicitly mention the benefits. Some open-ended answers from residents of that street are used to show a small preview of the resident's insights on the urban characteristics and children's autonomy and wellbeing. These open-ended answers stress the importance of having designated playgrounds in the Woonerf streets:

" If it was not for the playground just around the corner, I would prefer my children to stay at home when I cannot supervise them. There they meet with other neighborhood children and most of the time they play with a ball."

Questionnaire Respondent

"My daughter goes to the nearby playground at least 4 times per week after her school. When she was younger, I used to take her there myself but now I have the trust to let her go and play with her friends alone."

Questionnaire Respondent

In addition, this answer of a respondent regarding the benefits of the speed bumps in Woonerf streets was extinguished by others. The insights of Woonerf residents appear to establish a relationship between the urban characteristics and children's autonomy.

" My son goes out unsupervised very often, I am not worried about the car traffic and cars speeding in my living street, there are speed bumps every 5 meters and drivers drive extremely slow"

Questionnaire Respondent

4.4.2 Effects of the urban characteristics in the High-traffic residential areas

In a normally distributed environment, the mean answer of residents on whether the urban characteristics affect the children's autonomy and wellbeing is 73 (on a scale of 0 to 100) (see Figure 24). The responses are clustered around the mean and the standard deviation is low which means that the results are valid and replicable. According to the graph, residents in High-traffic areas believe that urban characteristics influence the children's autonomy and wellbeing to a large extent.

Mean = 73.42
Std. Dev. = 14.67
N = 64
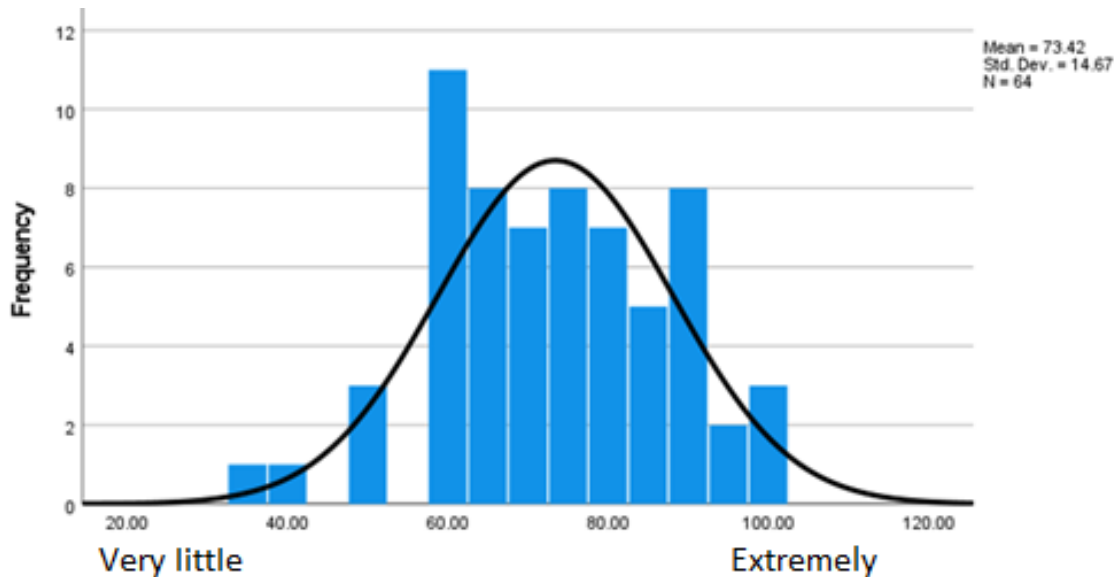
Figure 24: Urban built environment effects

On the other hand, various qualitative data gave valuable insights into the High-traffic residential areas as well. In general, residents living in High-traffic residential streets expressed their concern regarding their children performing unsupervised outdoor activities. While analyzing the qualitative

data it was explored that the unavailability of outdoor activity designated areas and the high speed of cars on the roads near the pedestrian streets are two of the main reasons why children's autonomy and wellbeing are influenced in the High-traffic residential streets. Some open-ended answers from residents of that street are used to show a small preview of the resident's insights on the urban characteristics and children's autonomy and wellbeing. These open-ended answers stress the importance of the inexistence of designated play areas, where children can perform physical activities safely:

" I have to drive for 25 minutes into a nearby football facility so that my son can perform outdoor activities. Because I am quite busy with work, I only manage to bring him to the football practice twice per week. There is nothing close to the neighborhood that we live in."

Questionnaire respondent

" Since I moved to this area I have come to realize that there is nowhere where my child can go and play with his friend. There is a lack of playgrounds and open areas all around this neighborhood and it is one of the reasons why my son only stays indoors"

Questionnaire respondent

Furthermore, quite a few respondents underlined the issue regarding high car traffic speeds in the residential streets:

" I am 43 years old and I daily worry about the car traffic when I drive my bike in this area. Drivers are careless and there are segments where bike paths join the car roads. I do not allow my child to ride his bike alone in the neighborhood and I really believe that several measures have to be taken."

Questionnaire respondent

" Although the speed limit in our street is 30 km/h, I believe that none of the cars that commute through respects it. The high-traffic levels and the high speed of cars create a really dangerous environment, especially for my children. One year ago, while riding her bike back from school my daughter was slightly hit by a car. Thankfully nothing serious happened but since then I am trying to address the issue to the city hall."

Questionnaire respondent

4.5 DIFFERENCES AND VARIATIONS IN CHILDREN'S WELLBEING BETWEEN THE TWO RESIDENTIAL AREAS

This section presents the results for Sub-question 5 regarding the children's wellbeing variance levels between the two case studies. Children's wellbeing for this research is solely measured by their physical activity and psychosocial activity levels. These two variables are among the most detrimental factors that can influence children's wellbeing. The data for the measurement of these two variables were acquired by the Questionnaire. Before exploring the difference between wellbeing levels in the two types of residential levels to be able and determine whether the children are achieving the minimal physical and psychosocial health levels, literature research was used to determine the minimum threshold number of days per week children have to perform physical and psychosocial activities. It was found that children must perform outdoor physical activities at least three times per week, in order to lead a healthy and fulfilled lifestyle (Landry & Driscoll, 2012).

Furthermore, children need to perform social activities with other people at least three times per week, in order to ensure a healthy social side (Landry & Driscoll, 2012). Firstly, the measured physical and psychosocial levels of children in each of the researched areas are compared to the minimum threshold that children need to perform for a healthy lifestyle. Then the variables are compared with each other, to determine the variance in wellbeing levels between Woonerf and High-traffic residential streets.

4.5.1 Wellbeing levels in the Woonerf residential area

Compared to the minimal threshold for sustaining a healthy lifestyle the vast majority of children living in Woonerf residential streets perform according to the Questionnaire and their parents are found to fulfill at least three days of physical activity per week. In detail, 48% of respondents mention that their child performs outdoor physical activity unsupervised more than three times per week. As seen in the Figure 25 around 25% respondents mentioned that their children do not fulfill the minimum physical activity levels per week. However, different patterns are noticed concerning the psychosocial activity levels of children living in Woonerf residential streets. Literature research provides insights that children achieve healthy psychosocial levels when they meet with friends and perform activities together at least three times per week. The vast majority of parents suggest that

their children interact with friends in an outdoor environment less than three times per week. According to the respondents, the children that do not fulfill the minimum levels of psychosocial activity are double in size of the ones that fulfill them (see Figure 25).
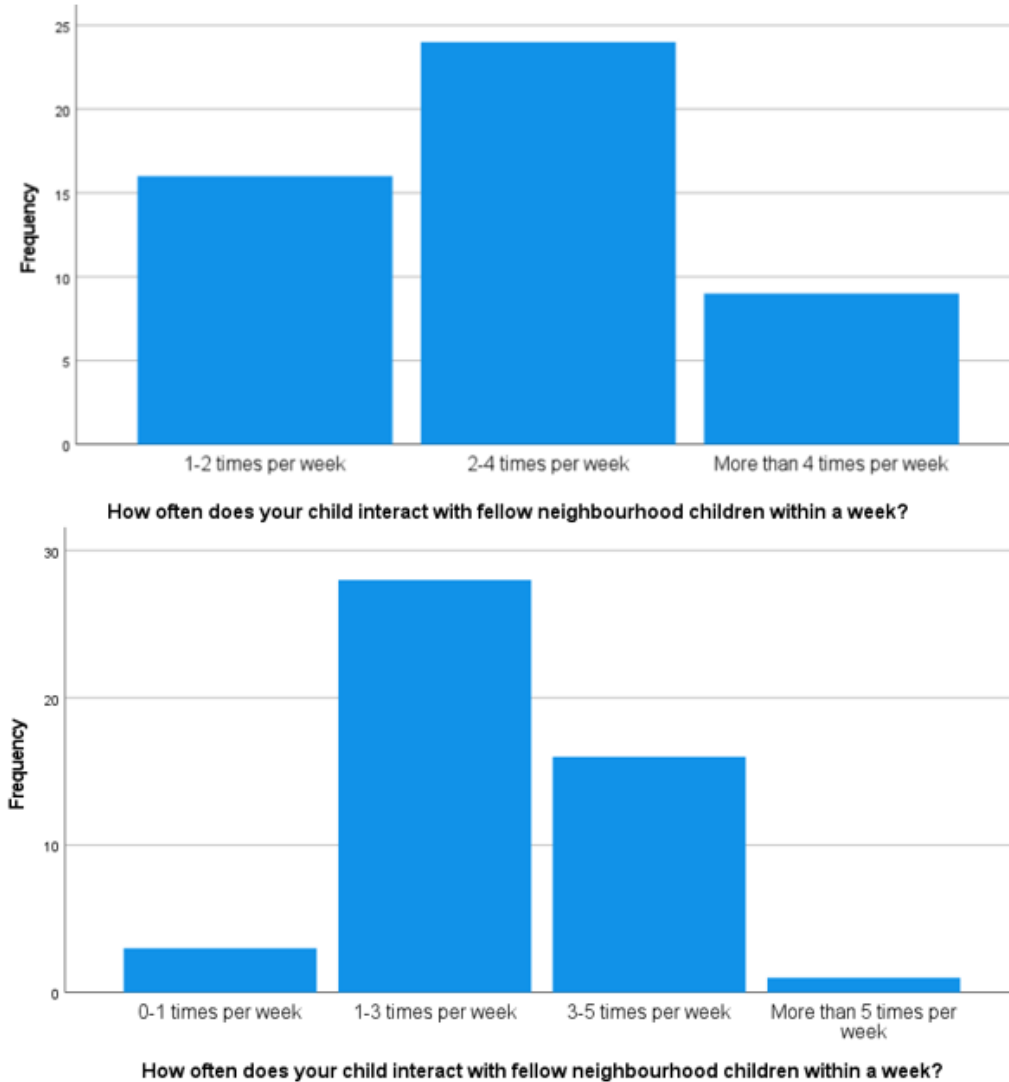
Figure 25: Descriptive data Woonerf area

4.5.2 Wellbeing levels in the High-traffic residential area

While analyzing the Questionnaire responses it was found that compared to the minimal threshold for sustaining a healthy lifestyle, the vast majority of respondents believe that their children perform physical activity outdoor less than three times per week. More than

60% of the respondents suggest that their children are not meeting the minimal physical activity threshold. Furthermore, 90% of the respondents suggest that their child is not meeting the minimal psychosocial activity threshold as well (see Table 12). It is quite surprising to notice that children living in high-traffic residential streets according to the Questionnaire responses do not interact with friends outdoor at all.
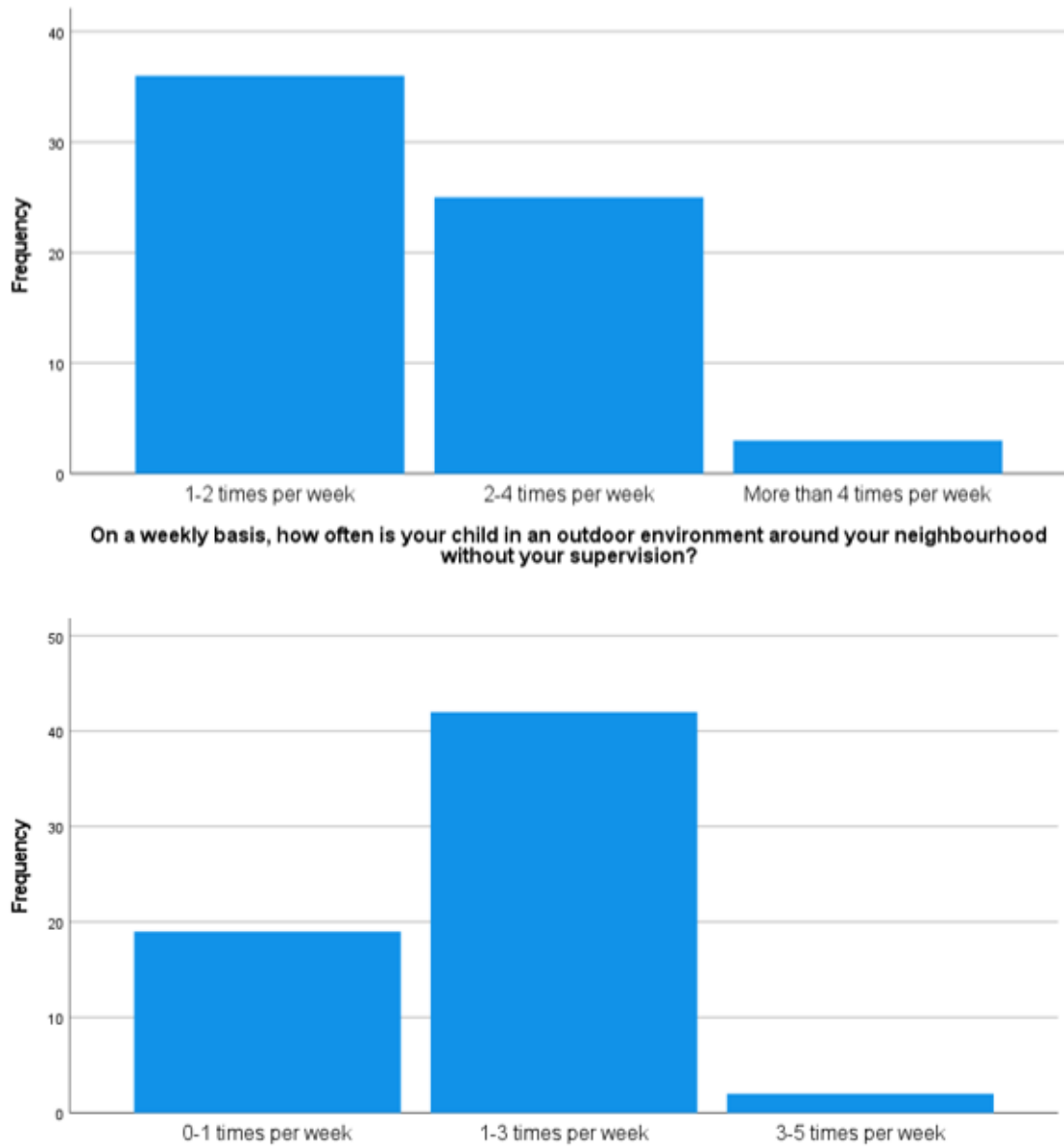
Figure 26: Descriptive data High-traffic area

4.5.3 Variations in wellbeing between the two types of residential areas

After conducting a simple comparative statistical T-test the difference between the children's physical levels appeared to be significant (p = 0.003). The significance of the difference between the physical activity levels of children living in Woonerf and High-traffic streets means that children living in Woonerf areas perform unsupervised outdoor physical activities more often than children living in High-traffic residential streets. The same comparative statistical T-test, explored the significance of the difference between the psychosocial levels between the two types of residential areas. Adding both the contributing factors, it is assumed that for this research and according to the data from the Questionnaire that the children's wellbeing levels in Woonerf areas are significantly higher than children's wellbeing levels in High-traffic areas. While the difference in levels is apparent in both areas, children are performing fewer psychosocial activities than physical activities. In both areas, the psychosocial levels are still well below the minimum threshold.

The next chapter discusses the data results from a holistic viewpoint and summarizes the results in the words of the conceptual model (see Figure 8). Then the hypothesis is discussed and whether it is accepted or refused is determined. Then discussion and conclusion follow aiming to give definite answers to the research questions and discuss how this research contributed to planning theory, planning practice, and Woonerf areas.

5

Chapter 5 Discussion

This chapters begins with the Discussion in 5.1 where the empirical findings are discussed in relation to the theoretical framework of this research (5.1.1) and the planning implications of this research are presented in 5.1.2. Finally 5.1.3 discusses the adoption of the Woonerf concept in the Dutch planning system.

5.1 DISCUSSION

5.1.1 Empirical findings in relation to the theoretical framework

This section discusses the empirical findings in the relation to the theoretical framework and relevant literature. Overall the empirical findings were in line and complementary to the current academic framework. Till now, research regarding the Woonerf residential areas have been focused solely on the relation between the spatial interventions and car traffic levels. In their researches Hand (2007) & Nio (2010), explore how the Woonerf spatial interventions decrease, calm and allocate car traffic. In his article Hand (2007) briefly explores that Woonerf residential areas positively affect the social cohesion between residents and safety levels in the residential streets. However, this is as far as the research goes for exploring the societal benefits of the Woonerf streets, this study adds value and insights on Woonerf societal benefits such as parental perception of safety, children's autonomy and wellbeing not covered by previous researchers.

Based on the theoretical frameworks, car traffic was placed in the conceptual model as the main factor that affects parental perception of safety. The importance of car traffic as emphasized by Prezza et al. (2005) is in line with the results to a certain degree. Prezza (2005) suggest that car traffic levels are the main cause that influences the parental perception of safety for parents living in dense traffic streets. However, Santos et al (2013) mention that in the Brazilian slums social dangers were the biggest cause that effected the parental perception of safety. Causes vary depending on the researched urban environment and it is also noticed by the empirical findings of this study. In high-traffic residential areas, the main cause that affected the parental perception of safety was indeed car traffic. However, for residents living on Woonerf street, this was not the case. Although the most popular causes are distinguished by research, the causes per context vary to a large degree and this is the case causing a difference in causes in this research

as well (Galaviz et al., 2016). From that perspective, the results are in line with both the 'contrary' researches of Prezza (2005) and Santos et al. (2013), as they explore that the causes vary depending on the environment that the research is taking place.

For children aged lower than 15 years old, the parental perception of the residential street's safety either grants or restricts children's autonomy to perform unsupervised movements. In principle, the safer a residential street is perceived the more autonomous children are and vice versa. According to Alparone (2005) and Galaviz et al. (2016) the safer the urban residential area the children live, the higher the autonomy for unsupervised outdoor activities the children get granted at a younger age. In this research, children living in Woonerf streets had significantly higher autonomy levels than children living in High-traffic areas, as they are perceived as safer streets from their parents. The results of this research are in line with the theoretical framework based on Alparone (2005) and Galaviz et al. (2016) regarding this relationship.

According to Clark & Dumar (2020) children that are more autonomous participate more often in unsupervised outdoor activities. Furthermore, according to Bou- Habib, (2015) children that are more autonomous at a young age, they are more eager and have more opportunities to participate in outdoor physical and social activities. Similar patterns are also noticed from the empirical findings. The results show that children with low autonomy levels living in High-traffic areas participate less often in physical and social outdoor activities than children living in Woonerf areas. Children which were granted more autonomy to practice unsupervised movements within their residential area performed a significant higher number of outdoor physical and social activities.

However, in a digitalizing world emerging patterns of children playing with their gaming consoles or watching TV in most of their free time also leads to less physical and social activities in the outdoor environment (Voinea & Sitoiu, 2021). Independently from the autonomy levels, children are progressively preferring to spend their leisure time performing indoor activities (Christie et al., 2007). From the empirical findings of this research, it was explored that independently from the autonomy levels children in both the case studies perform social activities quite rare. Additional research is needed to create a strong argument about this correlation but the theoretical researches and the research empirical findings create a strong base hypothesis.

5.1.2 Planning implications

The starting point of this research was a knowledge gap in the relationship between Woonerf urban areas and children's wellbeing, which was used as an initiation to conduct case-study research. This study establishes a step in the relationship between the two variables by empirically looking at the car traffic levels, the parental perception of safety, children's autonomy, and wellbeing in an attempt to contribute to the knowledge gap. The case study research sheds light on how Woonerf residential areas contribute to increasing children's wellbeing by positively affecting the parental perception of safety and increasing children's wellbeing.

There is a substantiate amount of research related to the relationship of the variables used in this research but there is a lack of research regarding the quantitative correlation between the variables in an actual practical case study. This research also showcased that spatial plans across the Netherlands are quite under-researched as also mentioned by Grijzen (2010). Research is focused only on the primary goals of the spatial interventions and planning implications often remain unexplored (Friedmann, 2004). However, as derived from this research extensive research on implemented spatial plans could explore additional benefits and increase the overall value of the spatial plan. Therefore, this research emphasizes to the research world that more multidisciplinary researches in different domains (societal aspects, traffic aspects, wellbeing aspects) have to be conducted to already implemented spatial plans.

Considering the societal contribution and implications for planning practice, the findings of this study lead to insights into the unexplored benefits of Woonerf-related interventions that can contribute to the rate at which residential streets across the Netherlands adopt the Woonerf concept. Looking at the range of this study and the fact that the empirical findings are dependent to the context and the selected case-studies, it is hard to generalize into a wider context. However, as Woonerf streets share the same ideology it could be suggested that they have similar affects to the children wellbeing levels independently of the case-study. Furthermore, the differences in variables were put into perspective when compared into a specific high-traffic case study which affects the generalisation. However, considering the overall low levels of car traffic in the Netherlands compared to other European countries, the car traffic levels in the selected High-traffic

case study are considered average in most of the European countries (Pucher & Buehler, 2008), This means that repeating this study between a Woonerf residential area and a random residential area outside of the Netherlands could derive to similar findings. This study aims to be used as a starting point for other residential streets on how the urban environment transformation could improve the children's wellbeing levels.

In the recent years, municipalities and town halls all around the Netherlands are focusing on spatial policies and plans which aim to increase the wellness an quality of life of people (Gerrits et al., 2012). Deriving from the results of this research the Woonerf spatial intervention could be used as a tool to calm the levels of car traffic while increasing the overall wellbeing of its residents. This research's implications could be used in practice by the municipalities and Town Halls in order to improve the overall life quality of the residents and especially of the children.

5.1.3 Adoption of the Woonerf concept in the Dutch Planning system

Based on the results of this study, the added value to the Woonerf concept can be used to enhance the application and adoption of Woonerf in multiple residential streets across Dutch cities.

Woonerf concept for decreasing car traffic levels

The theoretical framework of the Woonerf concept is built around limiting car traffic in residential and creating an open safe environment for its residents. The research underlined the decreasing car traffic patterns in Woonerf streets and revealed that the Woonerf urban interventions are quite effective for significantly decreasing car traffic. By implementing a higher number of Woonerf streets within a city, shifts to transit, cycling, and walking could be encouraged. In the long run, cities that adopt the Woonerf concept in their residential streets could reduce their carbon emissions and air pollution levels by promoting safer and more liveable urban environments, with less car traffic in residential streets.

Currently, in the Netherlands, there are over 6000 streets that have adopted the Woonerf characteristics and over 2 million residents currently live in a Woonerf street (Tira, 2016). Although Woonerf's visible success as a traffic engineering measurement, the adaption rates in the last 5 years have been decreasing (Tira, 2016). This means that fewer

residential streets are becoming Woonerf, the reason behind this are the high implementation costs which involve complicated engineering and design practices. An innovative approach could be to give the responsibility and authority of transforming a residential street into a Woonerf to its own residents.

A small reminder that the first-ever established Woonerf street was transformed by its own residents due to the incapability of their municipality to take measures in order to decrease the levels of car traffic in their residential street. By focusing on the residential-street level, it more achievable for the residents to develop a tailor-made project that fits the needs of the streets while keeping the implementation costs to a minimum as no external professionals would need to get hired. This innovative approach could be a method of implementing more Woonerf areas. However, municipalities should consider that the short and long-term benefits of the Woonerf areas, justify the initial costs.

Woonerf concept for increasing children's wellbeing levels

In addition to the car traffic calming, this research explored that children living in Woonerf residential streets have high wellbeing levels. In a global context where children's wellbeing levels are worryingly decreasing, such patterns appear to be hopeful for the future. According to Bradely et al. (2011), one out of six children does not meet the minimal criteria of physical and psychosocial activity levels for sustaining a healthy life. The car-oriented urban environment around the world makes matters worse by limiting the urban space where children can perform safely physical activities and interact with friends.

Consequently, the possibilities for children to perform physical and social activities are decreased. Child-responsive spatial planning has been on the main agenda of cities and municipalities across the globe (UNICEF, 2019). Successful examples of this practice are the car-banning city centres in European cities, introduction and investment in designated areas where children can perform activities safely in US and China and the spatial interventions promoting "eyes on the street" (Yassin, 2019 & Cohen et al., 2020 & McMillen et al., 2019). It is noticed that the Woonerf concept shares same ideologies as all of these successful examples.

This research underlined that the urban built environment of Woonerf residential streets creates opportunities and possibilities for children to perform outdoor activities and

socialize with friends. By promoting a safe environment the children are invited to go outdoors more which positively affects their wellbeing levels. These secondary benefits should be seriously considered by municipalities and used as a starting point for the implementation of the Woonerf streets in cities and regions where children are not meeting their physical and social activity thresholds. By investing in the children's wellbeing you are investing in the city's future.

Chapter 6 Conclusion

This chapter concludes the research by giving definite answers to the research questions (6.1), configures the limitations of this research via critically reflecting the process (6.2) and suggests follow-up research (6.3).

6.1 Answering the Research Questions

In line with the main research aims discussed in chapter 1 of this research, the study research this main research question: *How does the presence of car traffic in Woonerf and High-traffic areas affect the parental perception of safety and children's wellbeing?* So that a substantial answer is given to this research question is divided into five sub-questions that collectively provide the answer to the main research question.

The first sub-question was: *How does the car traffic vary between Woonerf and High-traffic areas?*

- High-traffic streets get commuted by cars eleven times more than the Woonerf streets, establishing a high variation in car traffic between the two areas.
- Residents living in Woonerf streets perceive their residential area as significantly safer than residents living in High-traffic areas.
- In the last 10 years the researched high-traffic streets in Groningen had 38 car-related accidents while Woonerf streets only 4.

The second sub-question was: *What are the main causes and variations of parental perception of safety in Woonerf and High-traffic areas?*

- The most important cause that affects parental perception of safety according to literature is car traffic. This was the case for residents living in High-traffic areas. Car traffic is the main cause that influences their parental perception of safety.
- Woonerf residents consider social dangers as the main cause that affects their perception of safety. Car traffic levels difference between the two areas is a logical estimation of the cause difference.
- Woonerf residents perceive their residential area as significantly safer (twice as much) than High-traffic residents perceive theirs.

Answering the third sub-question: *To what degree is the children's autonomy affected by the parental perception of safety in both Woonerf and High-traffic residential streets?*

- Correlational tests found that there is a positive significant strong correlation between the two variables in both the researched areas.
- With the two variables being highly related in both cases, it is concluded that changes in parental perception of safety levels bring changes in children's autonomy levels. The safer a residential street is perceived the more autonomy children get granted. The results are in line with the theoretical framework.

The fourth sub-question was: To *what degree are the children's autonomy and wellbeing affected by the characteristics of the residential street they live in?*

- Qualitative insights from residents of the Woonerf residential area underlined that the availability of designated playgrounds in their streets is an urban characteristic factor that affects their children's autonomy and wellbeing in an extensive manner. It is due to the designated playgrounds that the parents are less concerned and they grant their children more autonomy which then promotes their wellbeing.
- It is the lack of designated playgrounds that lead to the high-traffic residents having a higher level of concern for their child performing outdoor activities.
- Depending on the urban characteristics in residential streets, children's autonomy and wellbeing are either promoted or restricted.

The fifth and last sub-question was: *How does the children's wellbeing vary between a Woonerf and a High-traffic residential street?* The final sub-question builds around the previous sub-questions and aims to establish whether a difference in children's wellbeing levels between children living in Woonerf and High-traffic areas exists.

- According to the parents, children that live in Woonerf residential streets participate in physical and social outdoor activities more often than children that live in High-traffic residential streets.
- Therefore, the children's wellbeing levels in Woonerf residential areas are higher than the children's wellbeing levels in High-traffic residential areas. The

significance levels established that in a repeated research scenario, the same pattern of results is expected again.

Going back to the main research question which was as follows: *How does the presence of car traffic in Woonerf and High-traffic areas affect the parental perception of safety and children's wellbeing?*

- The presence and levels of car traffic have a direct influence on the parental perception of safety.
- Due to the decreased amount of car traffic in the Woonerf areas, residents perceive their residential area as safe. On the other hand, due to a very dense amount of car traffic in the High-traffic areas, residents perceive their residential areas as highly unsafe.
- The difference in perception of safety caused by car traffic has an effect on the autonomy levels of children. Children in Woonerf areas have significantly more outdoor autonomy than children in High-traffic areas. The higher level of autonomy the higher the opportunities and possibilities for children to perform physical and social activities.
- Children living in Woonerf areas appear to have higher wellbeing levels than children living in High-traffic areas based on their outdoor physical and social activity levels.

6.2 Limitations and Critical reflection

Self-evaluating back the process in general terms, went as planned. However, some general remarks about the process and the limitations of this research are still visible. Although finding a suitable research field given the countless opportunities appeared to be a straightforward task, a lot of time was allocated to narrowing down the topic and deciding on the main research question. The concept of Woonerf was introduced to this research three weeks after the draft research proposal. The conceptual model was adjusted quite sometimes since the first preliminary draft, the further the research was developed the more it became clear that the relationship between the concepts should be linked differently. Once the theoretical framework was set, the conceptual model was

established without any issues. The conceptual model served as the backbone of this research explicitly well.

Regarding the methodology choices, some reflections can be made. Firstly, the choice of a comparative case study while using triangulation for validating the data and evidence turned out to achieve satisfactory levels. The case comparison was ideal to stress out and underline the main concepts of this research. However, given the time availability, only one residential area (three residential streets) per case study was studied. Considering that Woonerf streets have different characteristics and patterns from each other, including a wider number of Woonerf streets in the research would provide more generalizable and robust results. The Questionnaire appeared to be a very satisfactory research tool, considering the Covid-19 outbreak an online Questionnaire form was feasible and safe for both the researcher and the respondents. The ability to combine both quantitative and qualitative questions in the Questionnaire was a great advantage for this research. A higher amount of respondents would increase the robustness and the quality of the research as well. The response rate for this master's thesis was still satisfactory.

Children's variables such as autonomy, and physical and psychosocial levels were measured indirectly by their parents. Meaning that the parents responded on behalf of their child, this could have had an effect on the accuracy, credibility, and legitimacy of the data acquired. Due to the young age of the children researched, the ethical considerations appeared to increase the difficulty in measuring those variables directly from children.

Reflecting on the validity of accurately measured data in the study, the Questionnaire questions were constructed in a simple and direct manner focused directly on the variable in focus. The questions were not misinterpreted and the respondent's answers were relevant to the questions. The car traffic, parental perception of safety, and children's autonomy were accurately measured in this research. The second measure that influences the quality of quantitative-based research is reliability. Based on the high significance levels of the statistical methods and the low standard deviation numbers for all the measured variables (see Results) it is believed that the same results would be achieved if the research repeats itself. The data was mostly clustered and the participation rate was satisfactory, making this research reliable and accurate.

The research provides valuable insights and points of discussion for future research concerning the Woonerf residential streets and their societal effects.

6.3 Suggestions for follow-up research

Contemplating on the implications for planning practice and the limitations, this research calls for follow-up research. Based on the mentioned limitations and results of this research, certain follow-up research suggestions are formulated. Firstly, the quality of this research could be increased by adding the variables of children's age and gender as part of the research. The two variables are independent variables that influence the autonomy levels and including them in the research with more detailed patterns and insights would increase the value and quality of the research. The two variables could potentially explore the gender inequalities regarding autonomy levels and explore when children start to get autonomous in Woonerf areas and when in High-areas and explore whether there is a significant difference in that. More extensive research by including a higher number of respondents could contribute to the significance and quality of the research and could also benefits the generalization process of this research.

Further research might also include multiple Woonerf and High-traffic streets dispersed across the city of Groningen. The current researched residential streets were concentrated in the same area and they were part of the same patterns and characteristics. For example, a Woonerf residential street (Lodewijkstraat) is currently receiving a lot of backlashes. While the street has decreased levels of car traffic, the street is a popular commuting route for bike riders (PvdA Groningen, 2020). The street is used by thousands of bike commuters every day, creating high traffic patterns and appearing as dangerous for pedestrians (PvdA Groningen, 2020). Reckless and high bike traffic could also affect the parental perception of safety, which adds to the point that research on different Woonerf residential streets might have different results. More in-depth research could shed light on how different Woonerf residential streets can influence the parental perception of safety and children's wellbeing.

Finally, insights about variables that concern children, namely children's physical and psychosocial activity levels were measured indirectly by asking their parents. To increase the quality and get more valid insights, additional research could focus on acquiring those

variables directly from children. By including the children in the data acquiring process, valuable insights, patterns, and data which are currently not visible could influence the result patterns.

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Appendices

Appendix A – Introduction letter with Questionnaire QR

Appendix B – Questionnaire

Appendix C – Geodienst Data , contact researcher

Appendix D – Demographic data of the case studies

Appendix E – Extensive table of used methods

Appendix F – Descriptive Statistics for Woonerf residential areas

Appendix G – Descriptive Statistics for High-traffic residential areas

Appendix A – Introduction letter with Questionnaire QR

Introduction:

Dear Participant,

My name is Eriko Cekrezi and I am a Master's Student of the Faculty of Spatial Sciences from the University of Groningen currently working on my **Master Thesis**. The **purpose** of this Questionnaire is to discover how the parental perception of neighborhood safety is affected by car traffic and how it does affect your children's wellbeing. The Questionnaire will approximately take **7 minutes to fill** and from there, your data will remain **anonymous** and will be **used only** for the thesis purpose. The data analysis will be confidential, will not be shared and the anonymity of the respondents is much valued and protected in this research.

Instructions:
Carefully read the question before answering. Only fill in the questions if you feel comfortable answering, remember that the Questionnaire is voluntary so you are allowed to stop filling the Questionnaire whenever you want. You can also skip specific questions that you do not prefer to give an answer to. Make sure you read the questions carefully before choosing an answer. Type **Agree** if you agree with the terms of this Questionnaire.

Open the link via this QR Code:

Manual link**:** https://qfreeaccountssjc1.az1.qualtrics.com/jfe/form/SV_d9Uq2BjUTK9EvT8

Appendix B – Questionnaire

 Dear Participant, My name is Eriko Cekrezi and I am a Master's Student of the Faculty of Spatial Sciences from the University of Groningen currently working on my **Master Thesis**. The **purpose** of this Questionnaire is to discover how the parental perception of neighborhood safety is affected by car traffic and how it does affect your children's wellbeing. The Questionnaire will approximately take **7 minutes to fill** and from there, your data will remain **anonymous** and will be **used only** for the thesis purpose. The data analysis will be confidential, will not be shared and the anonymity of the respondents is much valued and protected in this research.
Instructions

 Instructions

 Carefully read the question before answering. Only fill in the questions if you feel comfortable answering, remember that the Questionnaire is voluntary so you are allowed to stop filling the Questionnaire whenever you want. You can also skip specific questions that you do not prefer to give an answer to. Make sure you read the questions carefully before choosing an answer. Type **Agree** if you agree with the terms of this Questionnaire.

Intro **Introductory questions**

INTRO Do you have children that are aged from 9 to 16 and live with you?

⚪ Yes (1)

⚪ No (2)

⚪ Prefer not to say (3)

Intro Do you live in this neighborhood?

⚪ Yes (1)

⚪ No (2)

Intro Are you aware that you are part of a Woonerf neighborhood?

○ Yes (1)

○ No (2)

Intro Are you aware of what a Woonerf concept is?

○ Yes (1)

○ No (2)

Page Break

Q1 **Living conditions and car traffic in your neighborhood.**

Q2 Please rate the overall living conditions of your neighborhood?

○ Very bad (1)

○ Fairly bad (2)

○ Average (3)

○ Firmly good (4)

○ Very good (5)

Q4 To what extent does the car traffic in your neighborhood affect your daily life? From a scale of 0 (not at all) to 100 (a lot).

	0 10 20 30 40 50 60 70 80 90 100
Car traffic effects on daily life ()	

Q5 If so, how?

_____

Q3 Rate the car traffic in your neighbourhood on a typical week based on the scale below.

0: low levels of traffic, overall calm neighbourhood
100: dense levels of traffic, overall ruffled neighbourhood

0   10   20   30   40   50   60   70   80   90   100

Car traffic levels in your neighbourhood ()	

Q40 **Safety and perception of safety in your neighborhood.**

Q6 How safe would you consider your neighborhood?

0: very unsafe
100: extremely safe

0   10   20   30   40   50   60   70   80   90   100

Safety in your neihgbourhod ()	

Q7 Please re-order the main causes that you think they influence the safety in your neighborhood from the most to the least significant.

_____ Car traffic (1)
_____ Crime (2)
_____ Social danger (bullying, sexual abuse, racism etc.) (3)

Q8 Mention other causes that influence the safety in your neighborhood, if applicable.

_____

Q9 As a pedestrian how safe do you feel from the car traffic in your neighborhood?

0: very unsafe
100: extremely safe

	0 10 20 30 40 50 60 70 80 90 100
Safety as a pedestrian ()	

Q10 As a cyclist how safe do you feel about the car traffic in your neighbourhood?

0: very unsafe
 100: extremely safe

	0 10 20 30 40 50 60 70 80 90 100
Safety as a cyclist ()	

Page Break

Q12 How does the level of traffic in your neighborhood influence your perception of safety regarding your child/children?

○ None at all (1)

○ A little (2)

○ A moderate amount (3)

○ A lot (4)

○ A great deal (5)

Q13 How concerned do you feel with your child performing outdoor activities on your house street compared to social areas (such as playgrounds etc.).

○ Not concerned at all (1)

○ Little concerned (2)

○ Moderate amount of concern (3)

○ A good amount of concern (4)

○ Much concerned (5)

Q22 To what degree do the road interventions designed to slow down cars in your neighborhood (speed barriers, narrow twisted roads etc.) affect your perception of safety in your neighborhood?

0: very little
100: extremely

	0 10 20 30 40 50 60 70 80 90 100
Road interventions for slowing cars ()	

Q28 How concerned are you for your child's safety when he/she is outdoors in your neighborhood?

0: very little
100: extremely

	0	10	20	30	40	50	60	70	80	90	100
Child safety concern levels ()											

Page Break

Q41 **Children's autonomy and outdoor activity levels**

Q26 How important are the levels of car traffic in your neighborhood when considering granting your child more outdoor autonomy?

0: not at all
100: extremely

	0	10	20	30	40	50	60	70	80	90	100
Car traffic and children outdoor autonomy ()											

Q27 On a weekly basis, how often is your child in an outdoor environment around your neighbourhood without your supervision?

○ 1-2 times per week (1)

○ 2-4 times per week (2)

○ More than 4 times per week (3)

Page Break

Q31 To what extent is the amount of autonomy that you grant to your children influenced by your perception of your neighborhood safety?

0: very little
100: extremely

	0 10 20 30 40 50 60 70 80 90 100
Autonomy granted by the perception of safety levels ()	▬▬▬▬▬▬▬▬▬

Q32 How often does your child interact with fellow neighbourhood children within a week?

○ 0-1 times per week (1)

○ 1-3 times per week (2)

○ 3-5 times per week (3)

○ More than 5 times per week (4)

Q33 Please rank your children's favorite activities when he/she is outdoors in the neighborhood from the most to the least favorable.

_____ Walk in the neighbourhood (1)
_____ Cycle in the neighbourhood (2)
_____ Participate in outdoor activities (basketball, football, skipping the rope etc.) (3)
_____ Meet with friends (4)

Q34 If your children have any other outdoor activity preferences, if so please mention.

_____

Q35 To what degree do you think that the levels of car traffic in the neighborhood, decrease your children's outdoor activity levels?

0: not decrease at all
100: decrease a lot

	0 10 20 30 40 50 60 70 80 90 100
Car traffic availability and children outdoor activity levels ()	

Appendix D – Demographic data of the case studies

Woonerf case study:

Population	Value	Unit	Year
Inhabitants	5.595	number	2021
Men	2.805	number	2021
Women	2.790	number	2021
Ages 0 - 15	260	number	2021
Ages 15 - 25	2.090	number	2021
Married	665	number	2021
Divorced	315	number	2021
Widowed	115	number	2021
Births	25	number	2020
Births relative	4	number per 1000 inhabitants	2020
Mortality	35	number	2020
Mortality relative	6	number per 1000 inhabitants	2020
Crime total theft house and barn	4	number per 1000 inhabitants	2018
Crime vandalism	4	number per 1000 inhabitants	2018
Crime violance and sexual abuse	6	number per 1000 inhabitants	2018

High-traffic case study:

Population	Value	Unit	Year
Inhabitants	1.530	number	2021
Men	735	number	2021
Women	795	number	2021
Ages 0 - 15	185	number	2021
Ages 15 - 25	345	number	2021
Ages 25 - 45	645	number	2021

Mortality	0	number	2020
Mortality relative	1	number per 1000 inhabitants	2020
Crime total theft house and barn	3	number per 1000 inhabitants	2018
Crime vandalism	7	number per 1000 inhabitants	2018
Crime violance and sexual abuse	6	number per 1000 inhabitants	2018

Appendix E – Extensive table of used methods

	Which information	Moment of retrieval	Method of retrieval (source)	Documentation method	Method of analysis
Main Research Question: How does the presence of car traffic in Woonerf and High-traffic areas affect the parental perception of safety and children's wellbeing?	The role of decreased car traffic in Woonerf residential streets affecting the parental perception of safety, children's autonomy, and wellbeing.	January 2022 to April 2022.	Comparative case study: literature research and Questionnaire.	The main research question is answered by the data from the sub-questions.	Data analysis is based on combining the answers from each of the sub-questions both derived from literature and Questionnaire data.
Sub-Q1: How does the car traffic vary between Woonerf and High-traffic areas?	Exploring the variation in car traffic levels between the selected Woonerf and High-traffic residential streets.	February 2022 to March 2022.	Open data on car traffic levels in Groningen by Geodienst & Questionnaires completed by residents.	Exporting both types of the acquired quantitative data to SPSS.	Statistical comparative analysis T-tests, to explore significance and variance between the two sets of data.
Sub-Q2: What are the main causes and variations of parental perception of safety in Woonerf and high traffic areas?	Exploring the main causes that affect the parental perception of safety in each of the areas. Exploring the variation in levels of parental perception of safety between the two areas.	February 2022 to March 2022.	Questionnaires completed by residents (quantitative data used). Literature research used to establish the main causes that affect the parental perception of safety presented in the Questionnaire.	Exporting the acquired data to SPSS.	Descriptive statistics to explore the main causes that affect the parental perception of safety in each of the areas. Statistical comparative analysis T-tests to explore variance between parental perception of safety in the two areas.
Sub-Q3: To what degree is the children's autonomy	Exploring the correlation between the parental	February 2022 to March 2022.	Questionnaires completed by residents	Exporting the acquired data to SPSS.	Descriptive and correlational statistics (Pearson's test) to

affected by the parental perception of safety in both Woonerf and High-traffic residential streets?	perception of safety levels and their children's autonomy levels for each of the areas separately.		(quantitative data used).		explore the correlation between parental perception of safety and children's autonomy in each of the areas separately.
Sub-Q4: To what degree are the children's autonomy and wellbeing affected by the characteristics of the residential streets they live in?	Exploring the correlation between children's autonomy and wellbeing and the characteristics of the residential streets they live in.	February 2022 to March 2022.	Literature research & Questionnaires completed by residents (quantitative data & qualitative data)	Theoretical framework and linking concepts with a relationship. Exporting the acquired data to SPSS and Atlas.ti accordingly	Descriptive statistics to explore parents' insights on these questions. Using keywords as codes to explore the qualitative data.
Sub-Q5: How does the children's well-being vary between a Woonerf and a High-traffic residential street?	Exploring the variance in wellbeing levels between children living in Woonerf residential streets and High-traffic residential streets.	February 2022 to March 2022.	Questionnaires completed by residents (quantitative data used)	Exporting the acquired data to SPSS.	Two datasets from the two different Questionnaires merged. Statistical comparative T-tests to explore variance and significance.

Appendix F – Descriptive statistics for Woonerf area

		To what extent does the car traffic in your neighborhood affect your daily life? From a scale of 0 (not at all) to 100 (a lot). - Car traffic effects on daily life	Rate the car traffic in your neighbourhood on a typical week based on the scale below. 0: low levels of traffic, overall calm neighbourhood 100: dense levels of traffic, overall ruffled neighbourhood - Car traffic levels in your neighbourhood	How safe would you consider your neighborhood? 0: very unsafe100: extremely safe - Safety in your neihgbourhod
N	Valid	50	50	51
	Missing	12	12	11
Mean		50.1400	26.1000	68.6471
Median		58.0000	19.0000	70.0000
Mode		30.00	14.00[a]	70.00
Std. Deviation		25.99844	18.24577	17.08078
Variance		675.919	332.908	291.753
Skewness		-.007	1.172	-1.103
Std. Error of Skewness		.337	.337	.333
Kurtosis		-1.358	.513	4.481
Std. Error of Kurtosis		.662	.662	.656
Minimum		9.00	.00	.00
Maximum		98.00	73.00	100.00
Percentiles	25	26.5000	13.0000	59.0000

	50	58.0000	19.0000	70.0000
	75	72.2500	33.7500	80.0000

		To what degree do the road interventions designed to slow down cars in your neighborhood (speed barriers, narrow twisted roads etc.) affect your perception of safety in your neighborhood? 0: very little100: extremely - Road interventions for slowing cars	How concerned are you for your child's safety when he/she is outdoors in your neighborhood? 0: very little100: extremely - Child safety concern levels	How important are the levels of car traffic in your neighborhood when considering granting your child more outdoor autonomy? 0: not at all100: extremely - Car traffic and children outdoor autonomy
N	Valid	50	50	50
	Missing	12	12	12
Mean		61.0200	31.8600	63.6400
Median		63.5000	29.0000	66.5000
Mode		70.00	19.00	70.00
Std. Deviation		15.15968	20.27767	15.10205
Variance		229.816	411.184	228.072
Skewness		-1.346	1.294	-1.500
Std. Error of Skewness		.337	.337	.337
Kurtosis		2.555	1.992	5.180
Std. Error of Kurtosis		.662	.662	.662
Minimum		11.00	3.00	.00
Maximum		81.00	100.00	90.00
Percentiles	25	52.0000	18.0000	54.5000
	50	63.5000	29.0000	66.5000
	75	71.2500	40.0000	72.7500

Appendix G – Descriptive statistics for High-traffic area

		To what extent does the car traffic in your neighborhood affect your daily life? From a scale of 0 (not at all) to 100 (a lot). - Car traffic effects on daily life	Rate the car traffic in your neighbourhood on a typical week based on the scale below. 0: low levels of traffic, overall calm neighbourhood 100: dense levels of traffic, overall ruffled neighbourhood - Car traffic levels in your neighbourhood	How safe would you consider your neighborhood? 0: very unsafe100: extremely safe - Safety in your neihgbourhod
N	Valid	64	64	64
	Missing	0	0	0
Mean		70.4219	71.2188	47.6250
Median		70.0000	72.0000	48.5000
Std. Deviation		15.14879	12.41922	18.03568
Variance		229.486	154.237	325.286
Kurtosis		1.044	.558	-.551
Std. Error of Kurtosis		.590	.590	.590
Minimum		22.00	32.00	7.00
Maximum		99.00	95.00	92.00
Percentiles	25	61.2500	62.2500	34.2500
	50	70.0000	72.0000	48.5000
	75	80.5000	81.7500	60.0000

To what degree do the road interventions designed to slow down cars in your neighborhood (speed barriers, narrow twisted roads etc.) affect your perception of safety in your neighborhood? 0: very little100: extremely - Road interventions for slowing cars	How concerned are you for your child's safety when he/she is outdoors in your neighborhood? 0: very little100: extremely - Child safety concern levels	How important are the levels of car traffic in your neighborhood when considering granting your child more outdoor autonomy? 0: not at all100: extremely - Car traffic and children outdoor autonomy	On a weekly basis, how often is your child in an outdoor environment around your neighbourhood without your supervision?	To what extent is the amount of autonomy that you grant to your children influenced by your perception of your neighborhood safety? 0: very little100: extremely - Autonomy granted by the perception of safety levels
64	63	63	64	63
0	1	1	0	1
73.4219	72.1111	71.9524	1.48	62.9365
73.5000	74.0000	71.0000	1.00	70.0000
14.66970	16.41214	12.82818	.591	22.90011
215.200	269.358	164.562	.349	524.415
-.239	5.361	1.370	-.341	.574
.590	.595	.595	.590	.595
35.00	.00	29.00	1	.00
100.00	96.00	97.00	3	98.00
61.7500	65.0000	65.0000	1.00	59.0000
73.5000	74.0000	71.0000	1.00	70.0000
85.5000	84.0000	79.0000	2.00	80.0000