# Healthy, sustainable, and safe school environments in Belgium and The Netherlands

Schmeets, Niels N.P.

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MASTER THESIS

# HEALTHY, SUSTAINABLE, AND SAFE SCHOOL ENVIRONMENTS

STIMULATING CHILDREN TO COMMUTE ACTIVELY TO SCHOOL THROUGH PARTICIPATING IN THE HIGH-FIVE CAMPAIGN

14 SEPTEMBER, 2023 | EINDHOVEN


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**ARCHITECTURE, BUILDING AND PLANNING**
**URBAN SYTEMS AND REAL ESTATE**

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

# COLOPHON

*Master thesis*

## Healthy, sustainable, and safe school environments in Belgium and The Netherlands

*Analysis of the influence of participating in the High-Five campaign on the travel mode choice of primary school children and the impact of the campaign on the social cohesion in the surrounding neighbourhood and school zones. Paired with the analysis of the influence of parents' perceptions of the High-Five campaign regarding the school promotion and gamification elements of its attached digital platform on the travel mode choice of primary school children.*
*Eindhoven, 14 September 2023*

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# Preface

My final academic accomplishment lies before you, a report I worked very dedicated on during my last academic year at Eindhoven University of Technology. This report finalizes my time as a student following the master track Urban Systems and Real Estate as specialization track of the master program Architecture, Building and Planning.

Since September 2020, the Built Environment faculty and especially the Vertigo building has been my second home, and I have nothing but good memories to this wholesome place, the inspiring people, and the entire campus.
My thesis process started in the beginning of the 2022/2023 academic year, and I had the opportunity to pick a topic from a limited selection. Soon my eye was caught by the title: "*A platform for stimulating children's active transport to school in The Netherlands and Belgium - The impact on the social environment and behaviour".*

The affiliation I have with this topic is easy to explain. Since I came into this world, I have known no better than that my mother works as a very dedicated primary school teacher. Hearing my mother mention the dangerous traffic situations around the school and the decline in active commuting children in recent years has motivated me to choose this topic to conduct research towards a healthy, sustainable, and safe school environment.

During the process of writing my master thesis I met and worked with some very driven people, for which I would like to take the opportunity to express my appreciation to these amazing people. At first, I would love to express my enormous gratitude towards my first supervisor Dr. Ir. Pauline van den Berg. She has been an enthusiastic academic mentor and has motivated me through the ups and downs of the project. I want to thank her sincerely for answering my questions, helping me out whenever I was a bit lost and above all for being honest in those difficult moments.
I would also like to thank my second supervisor, Dr. Ir. Astrid Kemperman for her commitment during the process and her insightful feedback. Moreover, I like to thank my third assessor, Dr. Ir. Pieter van Gorp, for his flexibility to join our meetings online on his phone and for his insightful feedback.
However, performing this study would not have been possible without the participation and support of the High-Five team and in particular Authier Degryse and Mahité Cnudde. They were always there for me when I came back with a bulk of questions or recommendations to expand their project further in Limburg, my home province. Also, the warm welcome and inspiring brainstorming session at High-Five's headquarters in Kortrijk, Belgium will always stay with me.
My gratitude for my family and friends which helped me through the tough times is huge and I want to thank them for supporting me along the way.

In the beginning of the process the High-Five team created a personal account for me on their digital platform. Since then I secretly went through life under an alias, which is the random username that High-Five's digital platform assigns to every new user. Therefore, I wanted to reveal in this post that for the past few months, I was going through life as the Funny Chili Mockingbird. However, this is not an invitation to maintain this nickname.

Last but not least, I want everybody to know that my supervisor Pauline van den Berg has tried to convince me numerous of times to put on the High-Five mascot suit. I am for ever grateful that I had the strength to resist this pressure…..

*-The Last Dance-*

*Niels Nicolaas Paul Schmeets*

*September 2023*

# Summary

The rise of digitalisation has made its mark across the world, including on children's overall physical activity. Due to the tremendous digital opportunities such as gaming and social media, children are spending more time indoors behind a screen. Consequently, children become less active and tend to choose indoor time over spending their time outdoors. Besides spending less time outdoors in their free time, children are also using less and less active means of transport to commute to school. Increasingly, parents are bringing their children to school by car, leading to unsafe situations in and around school zones. Less participating in active travelling can lead to unavoidable health problems like obesity.
A potential solution for this issue, is implementing the High-Five campaign which utilises activating technology to enhance children's participation in active travelling to school, with the goal of creating a safe, sustainable, and healthy school environment. Existing literature lacks results regarding the impact of such a concept on children's travel mode choice as well as on the social cohesion in the surrounding neighbourhood. In order to fill both knowledge gaps in scientific literature, the following main research question has been formulated:
*'What are parents' perceptions of the High-Five campaign regarding its digital platform, and school promotion? How does participation in the High-Five campaign affect children's travel mode choice to primary school (controlling for the socio-ecological factors) and (directly, or indirectly via travel mode choice) the social cohesion in the surrounding neighbourhood and school zones?'*

In order to answer the main research question, a profound literature review is conducted followed by a quantitative research approach using a questionnaire designed for parents of children aged between 6-12 years old who attend affiliated schools of the High-Five campaign. Information derived from the questionnaire will be utilized to conduct descriptive analyses. Relevant data from the descriptive analyses will be used to conduct successive bivariate and regression analyses.

From scientific literature came forward that the five layers of the socio-ecological model include factors which significantly influence children's travel mode choice. Therefore, the following factors have been included to control for their effect on children's travel mode choice and social cohesion in the surrounding neighbourhood and school zones: travel distance, traffic safety, peer influence, household size, car ownership, SES, ethnicity, age, gender, grade, traffic skills, and country. Furthermore, descriptive analysis showed that parents and their children perceive the digital platform as a positive tool to stimulate their children to commute actively to school. However, it appeared that schools barely invest in promotional activities concerning the campaign and use outdated communication platforms like email.

Moreover, results from the data analyses showed that participation in the High-Five campaign is positively related with children's travel mode choice, meaning that children who participate in the campaign are more likely to choose to commute actively compared to those wo do not participate. Also, it was found that participation in the High-Five campaign was not related to social cohesion in the surrounding neighbourhood and school zones. Further, people's country of residence appeared to be significantly related to children's main travel mode, meaning that children attending Belgian schools are less likely to commute actively as children attending Dutch schools. Additionally, no relationship was found between children's travel mode choice and social cohesion in the surrounding neighbourhood and school zones.

A limitation of this study is that it examined correlational relationships, meaning that the direction of the relationships is unknown. For future research, it is suggested to investigate the causality of the relationship between participating in the High-Five campaign and travel mode choice. Lastly, it is recommended for school boards to focus on creating active school travel plans such as setting up a school walking bus. The advantage of this concept is that children can travel to school together accompanied by volunteering parents. This is also beneficial for the children of parents who are time-constrained due to work.

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# INTRODUCTION

## CHAPTER 1

# 1. Introduction

Nowadays, in the era in which technological development is moving faster than ever and where the digital world is enhancing globalization more and more, negative side-effects appear. One of them is the rapidly decreasing level of children's outdoor activity. Because of the tremendous digital opportunities and digital platforms such as gaming and social media, children are spending more time indoors behind a screen (Sigman, 2019). Consequently, children become less active and tend to choose indoor time over spending their time outdoors playing with their friends or participating in sports or other outdoor activities like playing football or tennis. If children engage less in active school travel and perceive more screen media exposure, their physical activity (PA) declines, which can lead to unavoidable health problems amongst young children and adolescents like a significant rise in obesity rates (Robinson et al., 2017).

Besides spending less time outdoors in their free time, children are also using less and less active means of transport to commute to school. Today, many children are dropped off by car at school by one of their parents, resulting in a decline of children's outdoor activity. The high level of motorized traffic in school zones also negatively influences the safety perception of parents whose children use active transport modes, with the result that also these children use less active transport modes and hence do not develop a required skillset to participate safely in traffic (Edwards, 2022).

Stimulating children to use active transport modes to commute to school and to spend their free time outdoors in the built environment is a big societal goal for policy makers and urban planners. Stimulating active transportation can help children develop healthy habits, reduce their reliance on motorized vehicles, and lower their risk of developing health problems such as obesity and other chronic diseases associated with a sedentary lifestyle (Booth et al., 2002; Sallis et al., 2004; Schoeppe et al., 2013).

Recently, many studies have focused on which social and built environment factors create barriers for children and their parents to choose an active transport mode to commute to school. From the various study results, built environment aspects like travel distance, road design, travel time, places for nature related activities in and around school, presence of a crossing guard, presence of well-connected streets and cycling lanes were associated as the main factors or obstacles for children to use active transport modes to commute to school or use in their free time (Ahern et al., 2017; Carver et al., 2013; Helbich et al., 2016; Henne et al., 2014; Lin et al., 2017). On the social level, the following aspects are determined as main obstacles; parents perceived traffic safety, neighbourhood cohesiveness, time constraints of parents and social trust and support (Ahern et al., 2017; Amiour et al., 2022; Aranda-Balboa et al., 2020; Carver et al., 2013; Lin et al., 2017; Yin et al., 2022). For example, parents' time constraints, often work-related, make children more likely to be brought by car because it fits better into their parents' daily schedule as it is often quicker and easier to combine their commuting trips with dropping off their children. (Ahern et al., 2017; Trapp et al., 2012).

In Belgium, an average of 33% of children travel to school by active means of transport, while in The Netherlands this percentage is significantly higher at 66% (Bart De Landtsheer, 2017; KpVV CROW, 2016). This significant difference is due to the fact that The Netherlands possesses over a strong bicycle culture and the land-use pattern is organized accordingly, whereas in Belgium the land-use patterns and infrastructure differ from The Netherlands and general bike use is lower.

From these statistics, the conclusion could be drawn that especially the Netherlands has a large share of children that travel to school by active means of transport. However, apart from the fact that there is always room for improving with a remaining winning margin of 34%, the bicycle culture has come under pressure over the last decades. According to a study from Rich et al. (2023), which investigates the dynamics of cycling demand for the population of Denmark, the decline of the Danish cycling demand is the strongest for younger generations, especially those who live outside larger cities. After

The Netherlands, Denmark has the largest cycling population in the EU, relative to its population (ECF, 2017; Harms et al., 2014). The study indicates that children cycle less frequently on average, especially in rural areas. An overarching cause for this downward spiral is the urbanisation trend, which attracts more people to dense urban areas, resulting in a lowered urgency of maintaining underdeveloped infrastructure in rural areas. Also, the centralisation of schools in the last 20 years is a cause of the urbanisation trend and is a logical consequence of the lowering number of pupils, especially in rural areas. However, this has basically doubled the crow flight distance for school trips to 7-8 kilometres in a time span of 13 years (2006-2019) (Rich et al., 2023).

Since Denmark is comparable in terms of cycling culture with the Netherlands, and the declining overall cycling figures of both NL and BE, it is reasonable to assume that this negative trend also occurs in NL and BE. This means that the 66% percent and the 33% that travel actively to primary school in NL and BE have entered a downward spiral. This creates an urgent problem that so-called cycling countries like The Netherlands, Denmark and to a lesser extent Belgium are losing grip on their cycling cultures. The decreasing number of children actively travelling to school also results in children learning their roles in traffic, preventing them from developing independent travel behaviour.

Multiple study results have found that children's independent travel behaviour is strongly influenced by how parents perceive the level of safety of the surrounding built environment of their homes and their children's school (Kerr et al., 2006). In these studies, 'school mode choice' can be seen as the main dependent variable that is influenced by independent social and built environmental factors that were mentioned in the section above, of which parents perceived level of safety is the most frequently mentioned factor. Next to this, also travel distance, travel time and traffic safety were mentioned multiple times. According to Ghekiere et al. (2017), the perceptions of neighbourhood traffic safety were positively associated with independent mobility among girls only, meaning that gender also plays a role in parent's travel mode choice for their children.

## 1.1 Problem description

Scientific research already contains lots of information on the reasons behind why children barely choose active transport modes and prefer using motorized vehicles for travelling to school. Also, research has been performed towards the effects of built environment interventions on children's travel mode choice. Moreover, scientific literature describes the impact of technological activation concepts using gamification elements on children's overall physical activity levels. However, the part that has been missing in scientific literature is what impact participation in a technology activation concept can have on children's travel mode choice to primary school. This constitutes a gap in scientific literature. Moreover, the scientific literature lacks results regarding the impact of technological activation concepts targeting children's physical activity on social cohesion in a neighbourhood. This forms a second gap in scientific literature.

## 1.2 Research objective

This study will focus on a campaign called High-Five, which through a physical campaign, school promotion and digital platform that utilises gamification elements aims to create a safer, more sustainable, and healthier school environment in Belgium and The Netherlands. Since the impact of the campaign on children's travel mode choice is rather unknown, this study aims to investigate whether participating in the High-Five campaign impacts primary school children's travel mode choice.
The insights in the effects of the campaign on children's travel mode choice can be utilized by High-Five and local municipal policymakers focused on primary education to enhance active transport to school amongst young children. Secondly, the study aims to gain insight in the impact of participation in the High-Five campaign on the social cohesion in the surrounding neighbourhood and school zones. These insights can be utilized by local municipal policymakers in Belgium and The Netherlands in establishing initiatives or interventions aiming to enhance social cohesion levels within local communities.

The third research objective is to gain insights in parents' and children's perceptions of High-Five's physical campaign, school promotion and gamification elements of its digital platform. These insights can be used by High-Five to further improve the approach of the campaign and hence achieving their goal of creating a safe, sustainable, and healthy school environment more effectively.

## 1.3 Research questions

The main and sub-questions have been formulated based on the research objectives, described in the previous paragraph. Moreover, the socio-ecological model of Van de Craats (2019) is used for the formulation of the main research question (see figure 1.1). The model clusters the five socio-ecological layers that represent the factors that are believed to influence a child's travel mode choice to school and their satisfaction with travel. The satisfaction with travel is seen as an indicator of subjective well-being resulting from school travel, but this part is not relevant for this study. According to the model of Van de Craats (2019), the five layers which represent the factors that influence a child's travel mode choice are: external, physical, and social environment, school, household, and personal factors.

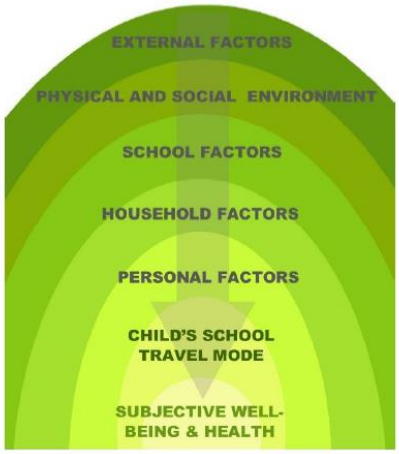



*Figure 1.1: Socio-ecological model of children's active travel to school (van de Craats, 2019)*

The five socio-ecological layers are addressed in the main research question to control for their influences on the relationships between participation in the High-Five campaign and children's travel mode choice and social cohesion in surrounding neighbourhood and school zones. Based on the three research objectives and the socio-ecological model, the main question has been formulated as follows:

*'What are parents' perceptions of the High-Five campaign regarding its digital platform, and school promotion? How does participation in the High-Five campaign affect children's travel mode choice to primary school (controlling for the socio-ecological factors) and (directly, or indirectly via travel mode choice) the social cohesion in the surrounding neighbourhood and school zones?'*

In order to answer the main research question, additional knowledge is required. Therefore, the following sub-questions have been formulated, which also structure this master report:

1. *Which factors that influence children's travel mode choice should be included as control variables for the continuation of this research?*
2. *What activating technology concepts targeting children exist within scientific literature and what gamification elements do they use to capture and hold children's attention?*
3. *How does active transport impact neighbourhood social cohesion according to existing scientific literature?*

4. *What is the High-Five campaign and how is it constructed and in what way does their digital platform differ from existing activating technology concepts? And how does it influence children's choice of transport mode according to the data results?*
5. *What are the personal characteristics of children attending High-Five affiliated schools and what are parents' and children's perceptions of the High-Five platform and its digital platform and school promotion?*
6. *What are the bivariate relationships between participation in the High-Five campaign and the dependent variables, travel mode choice and social cohesion in the surrounding neighbourhood and school zones and between travel mode choice and social cohesion in the surrounding neighbourhood and school zones?*
7. *What is the relationship between participating in the High-Five campaign and children's travel mode choice while controlling for the effects of the socio-ecological factors?*
8. *What is the difference between the influence of participation in the High-Five campaign and children travel mode choice in Belgium and the Netherlands?*

## 1.4. Research methods

In order to answer the main research question and the interconnected sub-questions, multiple research methods will be used. Sub-questions 1, 2 and 3 will be answered by conducting a profound literature study including all available and relevant articles which were found by filtering on title, actuality, abstract, and conclusion. Conducting this literature study aims to create a clear insight in existing socio-ecological factors that influence children's travel mode choice, existing or conceptual activating technology concepts targeting children's active transport levels and the impact of active transport on neighbourhood social cohesion. Subsequently, sub-question 4 is answered using information from the High-Five campaign and data from the analytics and monitoring platform Grafana utilised by High-Five. For answering question 5, a descriptive analysis will be performed. Furthermore, quantitative research will be executed to answer sub-questions 6 to 8 and eventually the main research question. In order to perform quantitative research, a questionnaire will be prepared for parents of children (6–12-year-olds) who attend affiliated schools of the High-Five campaign.
It has been decided to set the study scope on 6- to 12-year-olds because pre-schoolers generally do not participate in the High-Five campaign making it not representative for the entire campaign to include pre-schoolers in further research. Information derived from the questionnaire will be utilized to conduct descriptive analyses. Based on the outcome of the descriptive analyses will be decided which data will be considered in the data analyses. All data considered as relevant will be used in both bivariate and regression analysis to answer the research questions.
In order to visualize how the sub-questions and eventually the main question will be answered, a conceptual model and a sub-model is constructed. The sub-model was constructed because the data regarding the last sub-question was obtained from a reduced respondent sample, which only include respondents and their children that use the digital platform at least once every two weeks. For this reason these variables are not included in the main conceptual model but prepared into a sub-model.

Figure 1.2 shows the conceptual model which is built up out of four boxes and thirteen arrows that illustrate the relevant independent and dependent variables and their corresponding relationships. The left big box contains the independent group of variables that represent the five socio-ecological layers. Both boxes on the right illustrate the dependent variables, with the top one representing the travel mode choice of primary school children and the box on the bottom representing social cohesion in the surrounding neighbourhood and school zones. The lines between the five social layers and the two dependent variables illustrates the (in)direct effect of the socio-ecological factors on both dependent variables. The socio-ecological factors are included in this study to control for its influence on the research outcomes.

Additionally, the left white box represents the participation in the High-Five campaign and how this directly influences both dependent variables. Lastly, the model shows the indirect relationship of the participation in the High-Five campaign through travel mode choice on social cohesion in the surrounding neighbourhood and school zones.

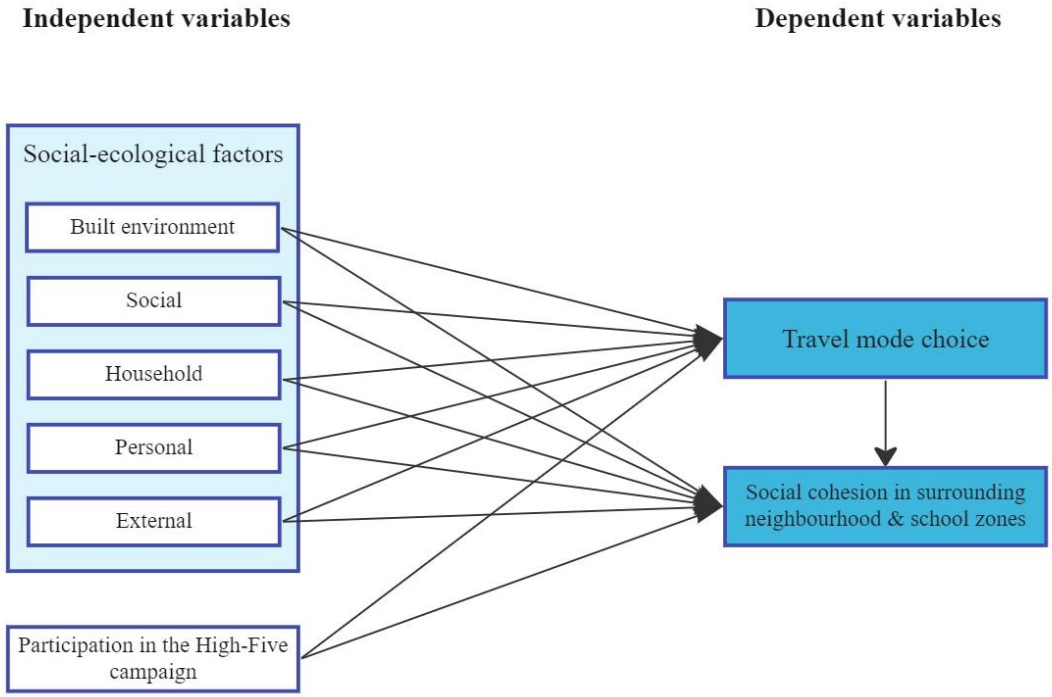



*Figure 1.2: Preliminary conceptual model*

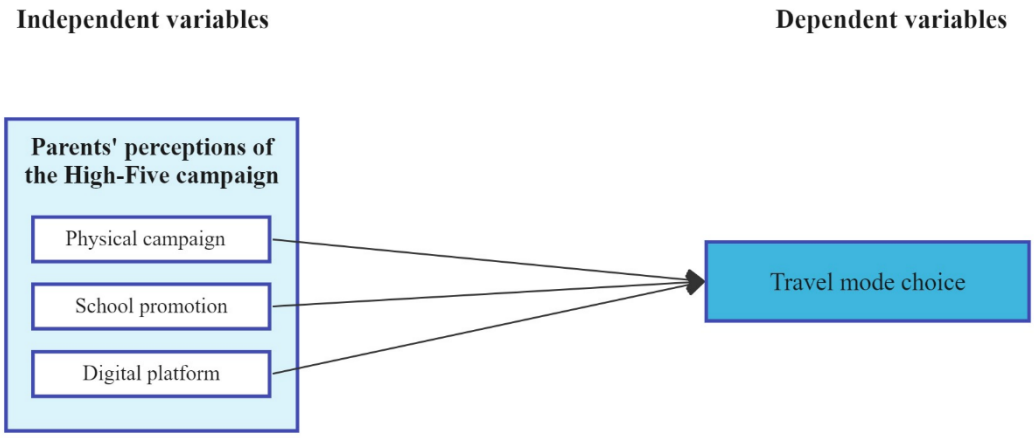



*Figure 1.3: Preliminary sub-model*

The sub-model is shown in figure 1.3 and contains two boxes and three lines that illustrate the dependent and independent variables and their corresponding relationships. The light blue box includes the perceptions of the High-Five campaign. The campaign consists out of a group of three variables: the digital platform, the physical campaign, and the school promotion. The box on the right side represents the travel mode choice of primary school children. The three lines represent the relationships between the three independent variables and the dependent variable.

## 1.5. Thesis structure

This thesis consists out of eight chapters and is structured in a chronological order to answer all sub-questions, ultimately answering the main research question. Figure 1.4 shows the exact structure of the thesis. The first chapter contains the introduction. Chapter two comprises the theoretical framework of this study and discusses all factors that have a significant influence on children's travel mode choice based on existing literature, existing activating technological concepts targeting children and the impact of active transport on neighbourhood social cohesion. Subsequently, chapter three discusses on what the High-Five campaign entails, how the campaign is constructed, how its digital platform differs from existing activating technological concepts and how the campaign influences children's choice of transport mode. Thereafter, the quantitative research is executed and elaborated on in chapter 4, 5, 6 and 7. Chapter four addresses the research methodology, which includes the research design including the final design of the conceptual model and the sub-model, the data collection, and the description of the data analyses methods. Following, chapter five and six contain the descriptive- and data analyses. The data analyses include both bivariate analyses and regression analyses.

Finally, chapter eight contains the conclusion, discussion, and recommendations for future research. This chapter reflects on the main research question and answers it based on results from both theoretical framework and quantitative research.

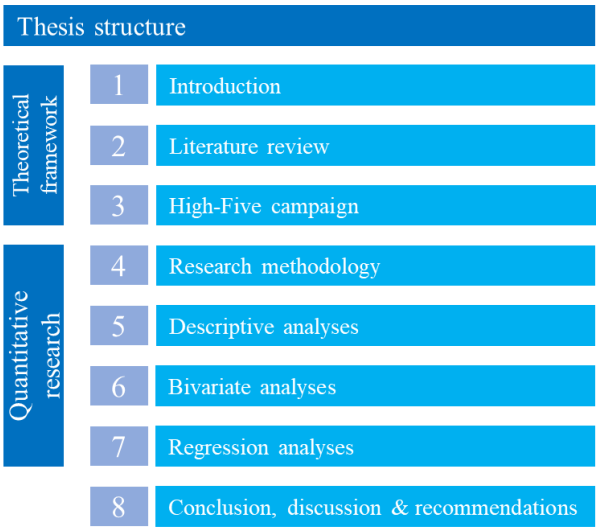



*Figure 1.4: Thesis structure*

# LITERATURE REVIEW

## CHAPTER 2

# 2. Literature review

This chapter contains results from available scientific literature, distinguishing three subjects and will answer the first three sub-questions, formulated in chapter 2. Firstly, the factors that have an influence on children's travel mode choice are described, followed by activating technology concepts related to children. Finally, the effects of active transport on social cohesion are described.

## 2.1 Socio-ecological factors

Based on the socio-ecological model, which is described in the introduction, the factors that influence children's travel mode choice are categorized into the following five layers: external, physical, and social environment, school, household, and personal factors. The factors are discussed in the same top-down order as classified in the socio-ecological model and addressed independently by sub-section. According to results by van de Craats (2019), the school factor has no significant influence on children's travel mode choice, which is why it was chosen to disregard this factor. Additionally, the layer 'physical and social environment' will be split, and the physical environment will be referred to as 'built environment'.

### 2.1.1 External factors

External factors are included in the socio-ecological model as the last layer. These factors can have an influence on children's travel mode choice but are beyond the control these children, their household, or their environment. Factors that are beyond the control of the main characters in this study, primary school children and their parents, but tend to have an influence on their travel behaviour are governmental initiatives like laws and policies including public initiatives, and natural factors of which weather conditions the most dominant factor is.

Increasingly more national or local governmental authorities are looking to encounter their concerns regarding decreasing numbers of children partaking in active transport by setting up promotional laws and regulations, predominantly targeting this subject. Multiple studies have performed research towards the effects of these regulatory initiatives, of which some appeared to be more effective than others. A study found that policies set by a governmental authority on Australian state level and targeting towards building social trust, community connectedness and safety of neighbourhoods could result in enhancing children's active travelling to school (Carver et al., 2013). Initiatives like crossing guards, walk- and cycle days, a walking bus, and co-curricular physical activities are examples of initiatives instigated by laws targeting to promote active transport amongst young children (Curtis et al., 2015).
A project named School Travel Planning (STP) in which different stakeholders were involved from multiple disciplines such as education, transportation, municipal planning, and safety cooperated in planning interventions for specific schools to enhance active travelling to school (Mammen et al., 2015). Also, the study of Buliung et al. (2011) performed research towards the influence of STP as school policy interventions on self-reported transport modes to school. As main objective, STP aims to facilitate and promote active transport modes. The study of Buliung et al. (2011) held a pilot experiment in twelve schools, located in car-oriented neighbourhoods in Canada. Multiple interventions regarding activating school travel were implemented and evaluated. Interventions were practised in varying schools, of which educational interventions like workshops about improving cycling and walking skills and travel planning were the most widely used. Also, further interventions contained special events like walk- or cycle days and minor BE improving interventions such as improving side walk accessibility or repainting pedestrian crossings and interventions which were enforced by law like exerting efforts to respect speed limits (Buliung et al. 2011).

Just as the previous study, the study of (Chriqui et al. 2012) found that state laws involving BE-related interventions had a positive impact on students walking and cycling to school. State laws mandating crossing guards in school zones appear to be successful in lowering barriers to cycling and walking to school, increasing the chances of children travelling actively to school. Also, state laws that obliged low speed limits in school zones contributed to lowering the chances of zero students cycling or walking to school by 51%. On the other hand, laws mandating sidewalks in school zones did not impact the chances

of children commuting actively to school. Reasoning behind this statistic could be that sidewalks is an important basic feature of a safe traffic environment but is not enough to affect the chances of children participating in active transport to school. Lastly, state laws that required traffic control measures in the school environment had a significant effect on the chances of schools mentioning safety as a barrier for active transport.

The reasoning why cycling is one of the most popular travel modes in countries like Denmark, Germany and especially The Netherlands compared to other countries like the USA is because they pay special attention to the vulnerable position of cyclists' vis-a-vis motorized vehicles. In the Netherlands, there is a law that protects active road users by taking into account their vulnerable status by placing them at the top of the traffic pyramid, which means that users of motorized vehicles are pertinently the blaming party in any collision with active road users, even though the cyclist does not abide by the rules (Pucher & Buehler, 2008). Compared to the USA, these rules are strictly enforced by police, making motorised traffic more aware and respectful of the presence of active travellers on the road, leading to an increase in the attractiveness of active travel. The positive impact of laws targeting children's transport activity may be enlarged when aimed at a local neighbourhood level, as compared to a larger geographical level like regional or provincial (Sidharthan et al., 2011; Veitch et al., 2017). Also, the study of van Goeverden & de Boer, (2013) found results in which policy interventions supported the increase of active modes. Both an infrastructural policy which enhances active travel conditions and a school location policy aiming to decrease travel distances to the closest school were found to be effective.

In terms of natural elements, weather is the most frequent factor in daily live, especially in northern European countries like The Netherlands and Belgium. Studies that, among others, performed research towards the influence of natural factors on children's travel mode choice only mentioned the weather as an independent natural factor. The significance of the weather's influence on children's and their parents' travel mode choice is questionable while some studies confirm, and some negate the impact of weather conditions either positive or negative.

Bringolf-Isler et al. (2008) & Buliung et al. (2011) concluded in their respective studies that the weather plays a significant role in parents' decision-making regarding their child's travel mode choice. Parents or caregivers indicated that the weather amongst others was a primary reason to continue driving their children to school. Contrarily, studies have found that weather has no significant impact on children's active school transport (AST). According to Helbich et al. (2016), the effects of the weather alleviated due to shelter that urban morphology provides to active transport users or the fact that children do not have another travel mode choice, basically forcing them to travel actively, regardless of the weather conditions. However, the results are questionable since the overall median AST distance is very short, being 264 meters. Unrealistic short distances are assumed to alleviate the impact of the weather on children's travel mode choice. As weather changes seasonably, some studies misinterpreted the impact of weather conditions by only considering the weather on a daily basis or period of time during one season (Børrestad et al., 2011; van Goeverden & de Boer, 2013). In countries like the Netherlands and Belgium, where weather conditions such as rainfall and temperature vary widely between seasons, results from studies that consider data collected over a short amount of time would not be in alignment with remaining seasons in countries like The Netherlands and Belgium. Different weather conditions between seasons can have varying impact on children's travel mode choice, for instances bad weather can be a reason for parents to take their children to school by motorised transport (car, taxi, bus), while good weather is an incentive for their children to actively travel to school (Ahern et al., 2017).

From the study of van de Craats (2019), it came forward that the weather has a significant association with travel satisfaction, which influences the travel mode choice of children and parents. However, the results also indicate that weather has a different effect on walking as cycling, with no significant relationship found between walking to school and weather. However, it was found that the choice for cycling is influenced by the (rainy) weather, which is consistent with the findings of Sabir (2011), who

found that the choice for cycling is most sensitive to weather conditions, with temperature being the variable that most influences the travel behaviour of Dutch people.

Finally, studies have found results that are fore and against the influence of the weather on travel mode choices of people. However the statements of Helbich et al. (2016) can be questioned, due to differing weather conditions over the four seasons. Based on the study from van de Craats (2019), results show that weather is indeed a significant predictor for travelling actively to school, but particularly on the choice of cycling as transport mode. The minimal effect on walking may derive from the fact that people are willing to walk a relatively surmountable distance and consider another mode of transport choice to cover relatively larger distances. This in turn can be compared with the study of Helbich et al. (2016), in which it was clear that short distances do not significantly affect travel mode choices. Hence, weather conditions are considered influential for travel mode choice but are not included as a control variable in further research because they are not considered an undisputed influential factor in scientific literature. Also, political factors like law and policies have been found to have a significant effect on active travelling, but since collecting data on the influence of political factors is assumed to be very challenging, leading to exorbitantly extending the research scope, it has been decided from practical considerations not to include them. As a result, no external factors are included in further research.

### 2.1.2 Built environment factors

The built environment, which encompasses the physical and social features of a place, can have a significant impact on children's travel mode choice. Travel mode choice refers to the way individuals choose to move from one place to another and can encompass walking, cycling, driving (e.g. car, motorcycle etc.), public transportation (e.g. train, bus, tram, or metro), or a combination of modes. The focus in this study is set on the travel mode choice of primary school children and primarily on how the car, which is currently the most dominant travel mode in Belgium, can be replaced in favour of active means of transport. Due to the fact that primary schools are mostly located close to home and primary school children are often considered too young to travel by public transport independently, public transport is excluded from this study and is specifically focused on the ratio of car to active transport. Active transport is simplified into two modes: walking and cycling, in favour of the transparency and accuracy of the questionnaire results.
Studies have shown that the design and features of the built environment can promote or dissuade active forms of transportation such as walking and cycling. For example, a safe road lay-out with the availability of pedestrian and cycling infrastructure, such as sidewalks, bike lanes, and well-designed pedestrian crossings, as well as access to parks and recreational facilities within walking distance, has been linked to increased use of active transportation among primary school children (Bauman et al., 2012; Li et al., 2022; Smith et al., 2022).

Travel distance and travel time have been mentioned as the main barriers for parents to let their children travel independently in multiple studies (Aranda-Balboa et al., 2020; Kemperman & Timmermans, 2014; van de Craats, 2019; van Goeverden & de Boer, 2013). Also, land-use plays a significant role in children's travel mode choice, in which children that live in highly dense urban areas are positively associated with walking, while children that live in city green neighbourhoods and rural areas were negatively associated with walking and cycling (Aarts et al., 2013; Rich et al., 2023). Other studies that targeted children found that active travelling to school was positively linked with population density, negatively linked with school size, and not linked with street connectivity (Timperio et al., 2006).

The built environment can also affect children's travel mode choice by influencing their parents' perception of safety. Children are less likely to walk or bicycle when their parents feel that the surrounding environment is dangerous, like areas with high traffic volumes, high vehicle speed, intersection density, poor pedestrian facilities, or insufficient lighting (Amiour et al., 2022; Aranda-Balboa et al., 2020; Handy et al., 2002; Veitch et al., 2017). Additionally, Timperio et al. (2006) found

that parental perceptions are negatively associated with their children regularly cycling or walking to local destination, including school, when there is a lack of crosswalks or traffic lights on the road.

According to Bruinsma (2021), a built environment that includes a school and is not child-friendly and hence not supporting children's independent mobility, will have to undergo adjustments. For example, traffic calming measures like speed humps and reduced speed zones, pedestrian friendly streets, restricted parking zones in the school area, and well-accessible play facilities of good quality.

To further elaborate on creating a child-friendly environment which support children's independent activity (CIA), studies have found that well-connected streets and cycling lanes, neighbourhoods that are closer to school, the presence of a crossing guard, low traffic volumes, distance to school and high levels of street lighting can contribute to a safer and more supportive environment that stimulates active transportation (Amiour et al., 2022; Fyhri & Hjorthol, 2009; Handy et al., 2002; Helbich et al., 2016; Lin et al., 2017; Rothman et al., 2014). What also enhances CIA, is higher percentages of tree coverage and soft paving, which are part of urban green spaces (UGS) (Zhou et al., 2022). Also, accessibility to urban green infrastructure (UGI), the size of UGI and places for nature related activities in and around the school have been found beneficial for children's physical activity (Yin et al., 2022). Green spaces benefit children's overall health and enhances their physical, mental, and social development. Research has shown that children who have access to close-by green spaces engage more in physical activity in which even a small form of greenery such as street trees increase the likelihood of children walking and cycling outside. Next to this, if children during their early lives reside in proximity and spend time in green spaces, they are able to better acknowledge the social cohesion in their neighbourhood (UNICEF, 2020). Since the lack of social cohesion in a neighbourhood has been found to be a significant predictor of parents' safety perception, which causes them to choose the car over active transport modes, adding UGS could provide a positive countermovement (van de Craats, 2019).

To conclude, the built environment has a significant impact on children's travel mode choice. Variables like travel distance, and parents' safety perception of the school environment (route to school) were mentioned frequently in scientific literature as impactful influences on children's travel mode choice. These factors are also included as controlling variables in further research, of which parents' safety perception of the school environment (route to school) will be indicated as the variable 'perceived traffic safety'. Specific traffic safety variables like the presence of a crossing guard, high levels of street lighting and access to close-by green spaces are not considered as important for this study as they are not assumed to have such a significant impact on a child's travel mode choice to school like the factors mentioned previously.

### 2.1.3 Social factors

Children's travel behaviour can be significantly influenced by the social environment in which they are growing up (McDonald et al., 2010). Different social factors can influence children's travel mode choice, including the influence of peers, social safety, socio-economic status neighbourhood, safety perceptions of their parents, social connections & social cohesion. The effect of the latter is shown the other way around in the conceptual model, as it has a two-sided effect, which will be described further on in this chapter.

Peer influence is a forceful factor that can impact and shape children's overall behaviour, including their eating pattern and physical behaviour (Salvy et al., 2012; Yin et al., 2022). Peer influence is often associated with peer pressure, however the latter has a more negative perspective in which a person chooses to do something, while normally this person would not choose to do this. As opposed to peer influence which can have a positive impact on children, like when the majority of children travel to school by bicycle, other children who travel by car might be influenced to change their travel behaviour by choosing the bicycle over the car (raisingchildren, 2021). In this way, peer influence can empower sustainable travel mode choices amid children. The physical activity research of Salvy et al. (2012)

found that children emulate the physical activity levels of their friends and peers. Being able to play with friends, potentially promotes physical activity engagement amongst children. Children's physical activity is mostly linked with social play or team sports, where children that are less active tend to be more socially isolated. Youth that is criticised by their peers during physical activity, usually withdraw from these activities due to being afraid to be criticised repetitively.

Besides the influence of children's peers, also their parents' perception of social safety and social cohesion is found to have an influence on children's travel mode choice. Perceived social safety, neighbourhood connections and social cohesion are positively associated with walking and cycling to school (Aarts et al., 2013; Ikeda et al., 2019; Kemperman & Timmermans, 2014). These findings are backed by the study of Lin et al. (2017), in which results suggested that children between the age of 8-13 with parents that perceive their neighbourhood as more cohesive (amongst other BE factors), engage in higher levels of independent travel. Also, McDonald et al. (2010) found that parental perceptions of high-level social cohesion were associated with higher rates of children taking walking trips under a mile to school. Cohesiveness among children living in the same neighbourhood is positively associated with active travel, because social connections reduce parents' safety concerns and elevate independent travel (van de Craats, 2019; Waygood et al., 2017).

Additionally, also parent-perceived level of social control within their child's living environment has been found to be linked with a higher share of children walking and cycling to school (McDonald et al., 2010; Veitch et al., 2017). This aligns with the findings of Hume et al. (2009) that child reported social capital (sufficient number of local residents, children could go to if help is needed) positively influences parents' perception of safety and shows an increase of walking trip frequency and physical activity amongst children. In addition to social cohesion, van den Berg et al. (2020) found that other factors like age of the child, perceptions of neighbourhood infrastructure and income are related to parental safety perceptions. This indicates that social ecological factors also affect each other and could have an indirect effect on children's travel mode choice.

Social support, which is often expressed by parental encouragement, has been found to be associated with active commuting for both longer and shorter distances. The same study also found that parental support is not dependent on parents' personal travel mode choice and that this support is highly influential on their child's travel behaviour, especially in that age group (9-10 years) (Panter et al., 2010)
.
Besides social support, crime-related safety was also reported as a major barrier for parents to choose an active travel mode for their children instead of the car (Aranda-Balboa et al., 2020). Furthermore, abduction and molestation were factors that led parents to choose the car over active transport as the main travel mode choice to commute to school for their children (Timperio et al., 2006).

According to the findings of Aarts et al. (2013), children living in lower SES neighbourhoods were found to be less likely to actively travel to school, which is in line with the findings of Panter et al. (2010), who indicated that children living in disadvantaged neighbourhoods are less likely to cycle or walk. Latter findings could be assumed as illogical since people with lower SES presumably have a lower car ownership rate as higher SES-holders. A factor that could cause this contradicting hypothesis is the dominant ethnicity of a neighbourhood. Studies have found that ethnicity plays a role in children's travel mode choice, and that children of immigrants tend to cycle significantly less compared to natives (He, 2011; Olde Kalter, 2008). However, some studies found that children from low-income neighbourhoods are associated with having higher rates of active transportation (Buliung et al., 2011; McDonald, 2008). One study found no significant association between the SES of a neighbourhood and walking to school (Rothman et al., 2014).

School factors are not taken into consideration in this study, but school policies were mentioned a significant number of times in existing literature as social factors that influence children's travel behaviour, which is why school policies is included as a social factor. School policies are able to have

an impact on children's travel behaviour. One study evaluated multiple policies and actions which a school could implement to promote sustainable mobility amongst their students. Based on these results came forward that four actions need to be implemented as a larger all-inclusive project, which were: identification of walking school bus routes, promoting safety educational programs, planning of walking and cycling routes to schools and modernization of crosswalk lines (Cieśla & Macioszek, 2022). Schools could be able to promote sustainable mobility by taking incentive measures or organizing healthy initiatives for students like "walk to school" events or providing bicycle storages. Nevertheless, health initiatives were found to have no long-term or even short-term effect on children's travel behaviour. Promotional actions like "Walk To School Day" seemed only to be popular on the day it was held and had no effect on the remainder of the schoolyear (Cieśla & Macioszek, 2022; Panter et al., 2010). However, one study acknowledged a positive significant link between promotional events organised by a school and active travel of adolescents (Hollein et al., 2017). These results were acknowledged in the literature study of Van de Craats, (2019) which also performed research towards the effects of school factors on children's travel mode choice. School factors like health initiatives, presence of a bicycle parking, presence of a car parking, car travel attitude and safety measures were considered but did not show any significant association with children travel behaviour. The contradictory results of Hollein et al. (2017) in comparison to other research papers could be explained by the differing target group, of adolescents to children.

At last, social factors play a crucial role in modelling children's travel behaviour to school. Peer influence, and parental safety perception of social cohesion in their neighbourhood were found to be the most impactful social factors of which only the first is included as a controlling variable in further research. In this study, the primary focus is on exploring the opposite effect, the impact of travel mode choice on social cohesion in a neighbourhood. To avoid ambiguity, this factor is not included in further research. Findings on the impact of neighbourhood's SES were contradicting and for that reason not included in further research. Also, crime-related activities like abduction and molestation came forward as determinants that triggered parent's safety perception negatively but are not included due to lack of study results on this factor. Lastly, school policies were found to have no significant impact, which complies with the decision to disregard school factors in the first place.

### 2.1.4 Household factors

Several factors within a household can influence children's travel behaviour. Household factors represent the influence of an individual's family or household on this same individual (IOM, 2021). Significant household factors as family time constraints, socio-economic status (SES), parental encouragement, car ownership and household size are factors that can influence the travel mode choice of the child(ren) from that household.

Socio-economic status (SES) can also impact children's travel behaviour (Ghekiere et al., 2017). Children from a family with a lower SES do not always have the privilege to possess or use luxury items. Car ownership is one of these and is a factor which is associated with independent mobility of children. Households with a lower SES do not always have the financial capacity to own a private car or afford tickets for public transport, making travelling actively their compulsory travel mode choice. On the other hand, children from families with a higher SES, which have access to private transport, are more likely to decide to prefer the car to active modes of transport (Buliung et al., 2011) . Car-owning parents were found to limit their child's active mobility as a reason to minimize the risk of dangers like traffic accidents while cycling (Carver et al., 2013, 2014; Easton & Ferrari, 2015; Kemperman & Timmermans, 2014; Shaw et al., 2015; Timperio et al., 2006; van Goeverden & de Boer, 2013). Parental cycling for transport (e.g. cycling to work, supermarket etc.) is specifically negatively associated with independent mobility among girls with a lower family SES (Ghekiere et al., 2017). An explanation could be that parents with low SES do not always have their own car due to limited financial resources, leading to an increasing use of active transport. As a result, they are more aware of traffic

unsafety, choosing not to send their daughter to school independently but tend to accompany them on their route to school according to the results of Henne et al. (2014).

The biggest influence in a child's household is, without a doubt, the child's parents. For that reason, parental encouragement is one of the most influential household factors. According to the study from Carver et al. (2013), parental encouragement of active transport has been found to be longitudinally associated with girls walking and cycling independently to school, while boys generally were more likely to travel actively than girls.
Parents who choose to bring their children to school, unintendedly reinforce car dependency among their children. Reasoning behind the choice for the car is generally driven by time constraints and comfort. Parents cited family time constraints as the main barrier to accompany their infants in active school travel (Ahern et al., 2017; Trapp et al., 2012). Additionally, trip convenience and trip chaining were found to be primary reasons for prioritizing the car over active means of transport. Trip chaining allows parents or caregivers to drop off their children while commuting, which benefits their work schedules (Buliung et al., 2011). Also, lack of physical ability and lack of motivation were mentioned by parents as barriers to accompany their children in active transportation (Aranda-Balboa et al., 2020).

Additionally, the size of the household was found to have a negative relationship with children's car dependency (Susilo & Waygood, 2012). The study of Van Goeverden & de Boer (2013) found that the larger the size of the household that attends the same school, the safer parents believe it is for their children to actively travel to school because they could do so together. This is in line with the findings in another study, which found that infants from large-sized households learn to travel independently in order to simplify commuting to school (Weigand & McDonald, 2011).

Besides the main household factors, other studies also mentioned ethnicity and cultural background of a child's family or household as an influential factor (Yin et al., 2022). Studies conducted in The Netherlands and the United States have found that immigrants use the bicycle significantly less than native people (He, 2011; Olde Kalter, 2008). For that reason, it is expected that the travel mode choice can differ, depending on the ethnicity composition of the students per school or neighbourhood. In another study, the data results indicated that all other ethnic groups had to travel much larger distances then their fellow native peers (Easton & Ferrari, 2015). Larger travel distances could explain the lower utility rate of active transport. Although the results of these studies were considered by van de Craats, (2019), no significant association between household ethnicity and children's travel mode choice was found.

Overall, several household factors are found to be significantly influential on children's choice of travel mode to school. Most frequently mentioned factors were influences triggered by parental motivations, trip convenience and time constraints that benefit their private or work schedule. Also, families with lower SES have been found to be positively linked with active transport. Car ownership was mentioned by a large number of studies as an influential factor, which is mostly determined by the SES of the household or the place of residence. Household size has been found to be linked negatively with children's car dependency. Also, cultural background and ethnicity was mentioned by some studies, but contradictory results were found. Variables like SES, size of the household, car ownership, and children's ethnicity are valued as important to include in this study.

### 2.1.5 Personal factors

Multiple personal factors can influence children's travel behaviour. Personal factors are the characteristics of an individual that affect their decision-making process, for example a person's consuming behaviour but also their travel behaviour and travel mode choices. Personal factors that can influence children's travel mode choice are age, gender, personal mode preference, physical ability, and traffic/cycling skills.

Age is the first personal factor and the one most commonly cited in several studies as influencing a child's travel mode choice. Studies have shown that participation in active travelling is influenced significantly by age. The older the pupil, the more independent he or she is and the more responsibilities the pupil is given by the parents (Van de Craats, 2019; van Goeverden & de Boer, 2013). Age was also found to be positively linked with travel distance, the older the pupil, the more distance they were allowed to travel independently (Aarts et al., 2013; Easton & Ferrari, 2015). Furthermore, age has been found to have a significant positive impact on children's choice for the bicycle as their main travel mode (Li et al., 2022).

The next personal factor of which the effects on people's travel behaviour have been studied is gender. According to van Goeverden & de Boer (2013), gender played a role in the decision-making of parents on whether or not allowing their child to travel actively and independently to school. Results showed that boys travelled more actively to school than girls, because in parents' perception, they are exposed to greater safety risks than boys. These findings accord with results of other studies in which boys were found to participate significantly more in active travelling to school than girls (Easton & Ferrari, 2015; Ghekiere et al., 2017; Stewart, 2011). He (2011) found deviating results, with gender having a significant impact on children's travel behaviour in Flanders only, while in The Netherlands no impact was found. Most likely, the differing results in both countries can be explained by The Netherlands' higher infrastructure quality for cyclists and pedestrians. Some studies indicated the influence of gender as well but found that gender was highly correlated with perceptions of the physical and social environment like neighbourhood connectivity, social cohesion, travel distance and travel safety (Page et al., 2010; Trapp et al., 2012). This might explain why several studies targeting gender differences in travel mode choice have found opposing data results. Some studies found no significant association between gender and travel mode choice (Kemperman & Timmermans, 2014; Kerr et al., 2006; Martin et al., 2007), while other studies did identify sex differences in active travelling to school (Rosenberg et al., 2006; Timperio et al., 2006). An explanation of these differing results is that they may derive from not properly controlling for parents' perceptions of the physical and social environment (McDonald et al., 2010). However, the study of (van de Craats, 2019) found a significant correlation between gender and physical activity while controlling for other factors, but also found a significant association with parental perception of traffic- and social safety.

Also, parents' perceptions of cycling and traffic skills were positively associated with independent mobility amongst boys living in high urbanized areas, but not in low urbanized areas (Ghekiere et al., 2017). Parental trust in their children's traffic skills was found to have a significant impact on the travel mode choice. If children demonstrated to their parents that they had sufficient traffic skills on foot and by bicycle, they were trusted to travel independently (van de Craats, 2019).

The personal mode preference of a child influences their travel mode choice, of which the preference of boys exerted a higher influence on their travel mode choice than girls did. Also, physical ability was mentioned, with children who are actively involved in structured sport or exercising and participation in play were positively linked to active commuting (Page et al., 2010). Opposing to children with a disability or chronic health conditions like obesity, which were found to be negatively associated with cycling (Kaplan et al., 2016).

Based on findings of multiple studies, it can be assumed that several personal factors have an influence on pupil's travel behaviour. Especially age has been found to be influential. The older the child, the more they are considered responsible enough to actively travel alone. Regarding the gender factor, opposing results from several studies were found, in which came forward that gender is highly correlated with social and physical environmental factors. However, the study of van de Craats (2019) found a significant correlation between gender and physical activity as well as a significant association with parental perception of traffic- and social safety, which indicates a repetitive conclusion that the effect of gender on travel behaviour is correlated with other socio-ecological factors. The variables age and traffic skills are assessed as important to include in the sequel of this study. Despite conflicting results from multiple studies gender is also included to control for its effect, while this variable is seen as an important personal characteristic.

### 2.1.6 Conclusion literature review socio-ecological model

The aim of this section was to answer the first sub-question: *'Which factors that influence children's travel mode choice will be included as control variables for the continuation of this research'.*
Results from available scientific literature regarding children's travel mode choice have shown that each layer of the socio-ecological model includes factors that have an influence on children's travel mode choice. Based on these findings, a number of factors per layer are assessed as important to include as control variables for the continuation of this research. The reasoning behind the selection of all variables has been described in section 2.1.1 to 2.1.5. Figure 2.1 gives an overview of the variables that are included per layer.

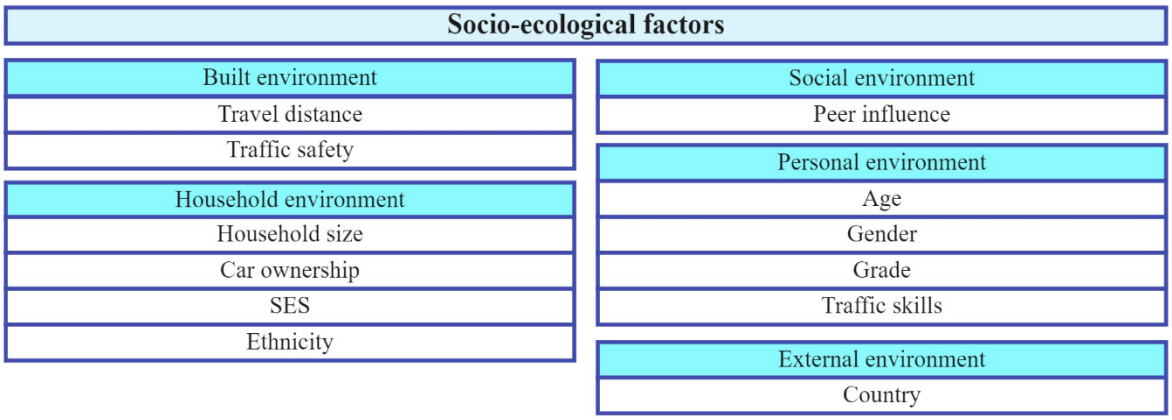



*Figure 2.1: Control variables per layer of the socio-ecological model*

Regarding the personal layer, grade has been added as an additional factor due to the fact that age does not always correspond to the grade a child is in, making the different influence of both variables interesting to investigate. Also, in the external layer, no variables were assessed as important to include as control variables in further research, however, the variable 'country' has been added as an external variable to analyse if participating in the High-Five campaign in Belgium or The Netherlands has a different impact on children's travel mode choice and the social cohesion in the surrounding neighbourhood and school zones.

## 2.2 Activating technology trends

Since the rise of technology, in particular over the last decade, a more sedentary lifestyle has been adopted by people including primary school children. Children spend more time indoors while playing games or watching videos on their console, tablet, computer, or smartphones. Regardless of the negative effects, technology can also be utilized as a tool to activate children such as the High-Five concept with its digital platform. Similarly to the High-Five campaign, other innovative technological concepts like web/mobile applications, exergames, consoles or smart wearable devices have been developed to encourage children to be more active. These innovative technologies can be made useful as targeted health interventions, to increase the PA of healthy children and those with chronic respiratory diseases. Additionally, these emergent tools can be used to counteract the declining trend in PA, deployed during the COVID-19 pandemic (Malizia et al., 2021). In this section, the results of existing scientific literature regarding activating technology concepts and their effect on children's physical activity are discussed.

Exergaming can be defined as technology-driven physical activities like video gaming in which contestants have to be physically active in order to play the game. The concept called 'exergaming' has changed the narrative of gaming being performed in a sedentary position into a potentially more physically active and healthy competitive activity for children but also for adults. Virtual reality and motion-based sensors have contributed to making exergaming more realistic and more interesting for players. Exergaming is beneficial for people's physical and mental condition, encouraging them to have fun while exercising, allowing people to socially interact due to multiplayer options and supporting them in making individual choices while playing the self-paced game (HealthySD, 2023).

### *Nintendo Wii*

The most known and influential exergaming console is the Nintendo Wii on which popular exergames like Wii Sports, Wii Fit and Mario Kart can be played. Children can create their personal avatar, choose different characteristics to play with like in the Mario Kart game, and compete against friends and family while playing the game together. By performing well within the games, users can upgrade the skill level of their avatar and unlock new levels. Through movement and positional sensors in the Wii remote, the console is able to track users' motions (Nintendo, n.d.). Studies have found that the children who play games on the Nintendo Wii console are positively associated with being more active overall. Also, playing exergames on the Wii improves their static and dynamic balance abilities (A. Demir & Akin, 2020).

### *BOOSTH-game*

Another interesting exergame is the BOOSTH concept of which the feasibility and effects on children's physical activity and health have been studied by the department of Nutrition and Movement Sciences of Maastricht University (ten Velde et al., 2020). The utility of the BOOSTH exergame differs from other exergames like the Nintendo Wii where players need to perform physical activity while playing. Opposing to the Nintendo Wii, the BOOSTH exergame requires participants to perform physical activity before playing the actual game. The game consists of an online arcade game in which new levels can be unlocked when a child is physically active (i.e. take steps). Children's physical activity is measured with the BOOSTH activity tracker which children wear on their wrist while using the BOOSTH mobile application. The activity tracker is synchronized with the online game in order to unlock the next level. International guidelines found that children between the age of 5-17 should spend more than two hours per day behind a screen (Anagha Joshi & Trina Hinkley, 2021). Based on these recommendations, the BOOSTH concept modified the ratio of game time to physical activity so that the latter is six times larger than the game time, requiring children to be physically active for 30 minutes before opening and playing the next level, which takes up to five minutes. An additional option called "BOOSTH battle" allows children and teachers to create their own battles, enabling competition between groups. Due to the Covid-19 pandemic, the concept has never been tested, which is the reason why the effects are not available in scientific research.

### *MobileKids Monster Manor*

Another exergaming concept, which goal is to enhance children's overall physical activity, is the mobile device-based exergame MobileKids Monster Manor (MKMM). Just like the BOOSTH exergame, in-game playtime has to be earned by the player by performing physical activity in the meaning of taking steps. A rate of one hour activity for 15 minutes of game time decreases overall screen time compared to other mobile games. Playtime and gaming incentives like creating a personal avatar, unlocked levels, competitive score keeping, peer interaction and special features are rewarded with every step the player takes, indoors or outdoors (Garde et al., 2016). The game is played on a smart phone and is connected with an accelerometer-based activity monitor, that children wear around their ankles. The performed activity is quantified constantly and can be synchronized with the MKMM game when the sensor returns within vicinity of the mobile device (Garde et al., 2015). The effectiveness of the MKMM game on children's physical activity has been researched by Garde et al. (2016) which used a research pool of 42 children aged between 10-12 years old. Results showed that children who played the MKMM game took significantly more steps during the day and were 46 minutes per day more engaged in physical activity. In addition, children with a higher BMI z-score showed 10% more steps and 14% more active minutes per day then children who didn't play the game.

### *FIT-Game*

A low-cost game-based intervention named the FIT-game is another concept which aims to enhance children's physical activity. The FIT-game was designed to increase children's fruit- and vegetable consumption but has been modified into an interventional game concept for enhancing children's physical day-to-day activity during school times. The game is a virtual comic book, where a number of episodes, or pages, are shown to the children on a projector. The storyline involves a battle between a hero and a villain in which the hero must overcome a number of obstacles to defeat the villain. At each obstacle, the hero needs help in the form of PA goals for the children to achieve. Every day a new episode is presented with the prerequisite that the previous day's PA goals have been achieved. Each episode lasts about 2 minutes and is shown about 15 minutes before recess. In order to measure a child's PA, they receive an unique wrist accelerometer (FitBit Flex). The accelerometer provides reliable PA data in the form of daily step counts. To confirm whether or not children have achieved their PA goals, the 'FitBit Connect' is used to link children's accelerometers with their online FitBit accounts. The effects of the FITBIT game have been researched by Joyner et al. (2019), which used a research pool of 29 sixth grade students. Results showed that all 29 participants increased their PA levels while playing the game and that children met their PA goals on 80% of the days (16 of 20), which increased their median step count from 3331 to 4102 per day.

### *Pokémon Go*

Just like the Wii console, the Pokémon Go application was a very popular and worldwide used exergame. The game uses augmented reality and GPS to project animations on the map of the players' direct environment. The goal of the game is to create your own avatar and try to find, catch, and train virtual Pokémon in the real world. In order to catch the Pokémon, users need to go outside and try to find these Pokémon, using the GPS map on their smartphones. Results of up to 17 studies found that the application increased players walking duration, steps per day and distance walked. An increase of 1446 steps more per day has been associated with playing the game (Khamzina et al., 2020). Especially players who regularly resided in a sedentary position benefited the most from playing the game (Wong, 2017). Despite the positive results, the game has also been found to incite unsafe situations. The Dutch social organization for traffic safety 'Veilig Verkeer Nederland' warned users of the game to not focus solely on their smartphone while partaking in traffic. People have already been caught playing the game while walking on a train rail and driving a car, which could potentially lead to fatal accidents (VVN, 2016).

### *Geocaching*

Geocaching is another exergame that is gaining interest from people all around the world. The game includes an adventurous real life treasure hunt with gaming features as skill-based categories, online avatars, and a reward system (Mitchell, 2014). The study of Garney et al. (2014) found that participants of the 12-month study recorded on average a PA duration time of 134 minutes per week. This is just below Centres for Disease control and Prevention's (CDC) recommendation of a minimum of 150 moderate PA per week (CDC, 2022). However, the study of Garney et al. (2014) includes the PA results of 1000 adult respondents with an average age of 44, leaving the association with children's PA levels unclear.

### *Moovosity™*

Similar to basically every game mentioned earlier, the Moovosity™ application allows children to create their own avatar. The application is designed with the purpose of enhancing children's physical activity and development of fundamental movement skills (FMS). Moovosity™ consists out of a digital library which is filled with age-specific active games, which stimulates a parent and their child(ren) to partake in PA. The game includes a total of 27 individual games divided into five domains. After selecting a game, the application offers a video demonstration of the activity, including step-by-step instructions, safety tips and equipment requirements. Each game contains a 10-minute exercise. A child is rewarded after completing a game with points allocated to a specific domain. Every domains displays the amount of points collected as a percentage of the recommended 60 minutes daily moderate to vigorous physical activity (MVPA). To stimulate children's participation and engagement in the game, they can create their own avatar. With the avatar they can collect rewards and accessories which can be used to style the avatar. Also, children are able to share their accomplishments through a SMS-text message. Through this option, family members are able to motivate the child to play the game by showing their approval. After researching the effects of the game, a significant association was found between playing the game and improving children's FMS. However, no significant association was found with children's PA levels (Trost & Brookes, 2021). Presumably, the PA performed while playing the game has substituted the time a child spent performing PA by for example playing outside. Another cause can be the incompleteness of the tool for measuring a child's PA levels. The study used a playtime checklist, which includes the amount of time spent playing in the yard, street, park, playground, or outdoor recreation area but does not incorporate time spent while partaking in organised sport activities or commuting actively to school.

### *iEngage*

The study from Galy et al. (2019) towards the effects of a digital education application on children's PA is an example of a more direct manner of promoting physical health by conveying the importance of exercising. iEngage is an educational program which aims to enhance user's knowledge on health literacy, PA-related skills, and sugar-focused nutrition guidelines. International PA recommendations (11.000 steps and 60 min MVPA per day for a child) were used as measure for PA results. The program is embodied in an application and comprises eight one-hour modules which include learning activities, self-assessment tasks and goal setting. All modules offered learning activities, PA sessions (2-5 min) and quizzes. In total, the accumulated PA-time of all modules was 21 minutes and does not affect participants MVPA. After going through every module, participants were asked to set a physical and social goal, which could be, for example, taking 10.000 steps each day and talk with family/friends about the learning points from the module. In order to stimulate participants to engage in learning activities and reach their personal goals, a competitive factor was added. Multiple groups were made, and when a member of a group reached a personal goal, points were added to the group total, which was tallied at the end of every week when the winners were announced. The participants were equipped with an activity tracker to register their PA before and during the intervention. Results showed that all participants increased their overall PA, especially children that were less active. On a daily basis they increased their steps with 15% and reached 11.000 steps more frequently.

### *Shape-Up (Xbox)*

In order to make commuting actively to school more appealing to children, the High-Five concept utilizes a narrative campaign design in the context of superhero High-Five's adventurous. Simultaneously, the study of Shirong Lu et al. (2019) conducted research towards the effects of a narrative game design on children's PA. By developing four narrative plots which are accompanied by the Shape-Up game for the Xbox console. The shape-up game is a fitness game containing a combination of exercise methods and novel workouts. The four narrative plots are designed to stimulate players to be active, involving specific workout sessions like squatting, stomping, jumping and so on. All stories feature specific genres (mystery, science fiction, adventure, and suspense) and cliff-hangers which are estimated to be appealing for children. Additionally, the plots include main characters with superpowers, character dialogs, and cliff-hangers. Video clips serve as an introduction to the game and maximally have a duration of 3.5 minutes. Subsequently, players need to participate in a specific workout aligning to the genre of the videoclip. Deviating from other games, players do not choose or create an avatar, but through the Kinect sensor on the Xbox console the image and movements of the player are monitored and displayed on the screen, which means that a player plays as itself.

Findings showed that narratives contain characteristics which indeed promote PA among children through active video games. Specifically, children appeared to be gravitating towards positive role models, which performed unique forms of PA. A child's narrative involvement and self-efficacy increased due to the presence of these role models. Furthermore, the science fiction narrative was rated as most popular amongst all children. Narrative characteristics which appeared to be stimulating children to perform PA were interesting villains, kind-hearted characters with extraordinary actions and superpowers, interesting plots, and captivating cliff-hangers. Novel features which appeared to have no association with enhancing PA amongst children were passive protagonists, repetitive characters, and hard-to-follow-storylines.

### *Mini Movers*

All of the studies mentioned above focus on the consequence, but the root of the problem is at the cause. The study of Downing et al. (2018) is interesting because it does not specifically focus on increasing a child's PA, but on decreasing screen time and sedentary behaviour. Deviating from exergames, this study focusses on the Mini Movers intervention which is a primarily text-message delivered intervention. Through text-message delivery the intervention aimed to inform parents about the time their child spent behind a screen. The strategy of the intervention focused on setting goals, self-efficacy, and providing reinforcement. Together with their parents, two goals were set around limiting screen time and reducing sedentary behaviour. All participants wore an accelerometer to track sitting time. Additionally, they received a goal-planning magnet, which aided children to track their progression. Parents received a total of 19 text messages including a welcome message, three standard messages per week (six weeks in total). two out of three messages were of behavioural nature and included active play ideas, suggestions how to limit screen & sedentary time and monitoring & stimulating of achieving personal goals. Only the latter required participants to respond and verify whether or not they had achieved their goals that week. Results showed that children who participated in the Mini Movers intervention perceived significantly less screen time (minus 30.6 minutes) and were less often in a sedentary position (minus 20 minutes).

### 2.2.1 Conclusion activating technology trends

In conclusion, multiple studies have done research towards different kinds of technology aiming to enhance children's physical health through targeting their PA (e.g. number of steps), screen time and sedentary behaviour. All concepts including exergaming, narratives, applications, or text-messages have shown to exert a positive impact on children's physical health levels. These concepts utilized technology containing different features to stimulate children to be physically active or to capture and retain their interest in PA. Based on these studies, the features that were most relevant in activating children in researched activating technology were the creation of a personal avatar, a reward system, narratives, and text-messages. Table 2.1 shows an overview of all activating technology concepts and which gamification elements are used to enhance children's PA level. This answers the second sub-question *'What activating technology concepts targeting children exist within scientific literature and what gamification elements do they use to capture and hold children's attention'.*

*Table 2.1: Activating technology concepts and their gamification elements*

| Activating tech. concept | Exergame | Personal avatar | Reward system | Narrative game design | Text message |
|---|---|---|---|---|---|
| Nintendo Wii | X | X | X | | |
| BOOSTH-game | X | X | X | | |
| MobileKids Monster Manor | X | X | X | X | |
| FIT-game | X | | X | X | |
| Geocashing | X | X | X | | |
| Pokémon GO | X | X | X | X | |
| Moovosity™ | X | X | X | | |
| iEngage | X | | X | | |
| Shape-up (Xbox) | X | | | X | |
| Mini Movers | | | | | X |

Apart from Mini Movers, all concepts are known as exergames that are mainly designed to improve children's physical activity, while Mini Movers is an intervention that aims to decrease children's screen time. Six of the ten concepts use a personal avatar to capture and hold children's attention, while even eight concepts use a reward system for the same purposes. Lastly, four of the activating technology concepts use a narrative game design in order to retain children's attention for participating in PA.

## 2.3 Impact active transport on social cohesion

As described in section 2.1.2, studies explain the association between neighbourhood social cohesion and travel mode choice. However, in this study, the opposite relationship is more relevant. In further research, the relationship between both variables will be analysed, as it is also shown schematically in the conceptual model with travel mode choice as the independent variable and social cohesion in the surrounding neighbourhood and school zones as the dependent variable. As already described in chapter 1, scientific literature on the impact of concepts such as the High-Five campaign on social cohesion in surrounding neighbourhood and school zones is lacking. However, several studies do mention the link between travel mode choice and social cohesion in a neighbourhood, local community, or city.

Multiple studies and sources have mentioned that active transport is positively associated with social cohesion. Increased walking and cycling as the most commonly used active transport modes have been found to improve neighbourhood social cohesion (Public Health England, 2016). Additionally, a study found that commuting by bicycle or foot improves social cohesion, equity and perceptions of liveability and security (Ohlund et al., 2021). Walking and cycling are low-carbon modes of transport and have the potential to not only enhance urban life quality but also facilitate societal cohesion (Basil & Nyachieo, 2023). This is in line with the finding of the Institute of Local Government which found that neighbourhoods with higher pedestrian activity in the streets build social cohesion (ILG, n.d.).

A previous study indicated that walking and cycling positively impacts the amount of social interactions people engage in (Van Cauwenberg et al., 2014) while another study found a positive link with satisfaction of an individual's social life (Weijs-Perrée et al., 2015). The study of van den Berg et al. (2017) complemented the findings of these studies by finding that walking and cycling contributed to the quality of social interactions as well. Stimulating these active modes of transport could be achieved by providing cycle-able and walkable sites, enhancing the overall quality of life.

The study from Demir et al. (2016) addresses the importance of an accessible public space for active transport by finding that people travel more comfortable through a pedestrianized area. This follows up with the findings from the World Health Organisation, which found that if the infrastructure of a public area is designed in favour of active transport, it will provide a low-stress environment, reinforcing social cohesion (WHO, 2022) .

Some municipalities in large cities have tried utilizing active mobility as a means of improving community-level social cohesion within their municipal boundaries. Active mobility programs like shared bicycle programs and group rides have been found to enhance social cohesion and the sense of community within an urbanized area (FMN, 2023). Iván de la Lanza, a Sustainable Urban Mobility Specialist from the Sur Institute in Mexico City stated: "*Active mobility creates sustainable environments and access to the city service and opportunities. The potential is to use mobility as a lever to create increased equity of access to opportunity in cities. Biking in Mexico City has been a powerful tool to build social participation and community engagement."* Almost 20 years ago, the municipality of Mexico City developed a bicycle mobility strategy including infrastructure and equipment, and a bike sharing system which provides individuals with the chance to make connections through a transit system (Wennink, 2021).

Another tool used in Mexico City was the 'Mothers Pedalling without Fear' workshop in the Miguel Hidalgo district. The project had a large social impact, enhancing cycling mobilities of care while enforcing social bonds between mothers in the community.
In Los Angeles, open street events (CicLAvia) were used as a promotional tool to enhance activity mobility while bolstering social cohesion (Snaije, 2022).

### 2.3.1 Conclusion impact active transport on social cohesion

The goal of this section was to answer the third sub-question: *'How does active transport impact neighbourhood social cohesion according to scientific literature?'*
Several studies have found positive associations between active transport like cycling and walking and social cohesion in neighbourhoods and communities. Also, positive links with active mobility and social interactions and the quality of these interactions was found. Finally, utilizing active mobility strategies, supported by tools like open street events, bike-sharing systems, or workshops at a community level, appeared to be affective in enhancing social cohesion and the sense of community. As mentioned earlier in this chapter, the analyses in Chapter 6 and 7 will further investigate the relationship between travel mode choice and social cohesion, in order to either add more value to already existing findings by researchers such as Basil & Nyachieo (2023) or to dispute those findings.

# HIGH-FIVE CAMPAIGN

## CHAPTER 3

# 3. High-Five campaign

This chapter discusses what the High-Five campaign entails, including the description of the three High-Five components: the physical campaign, the digital platform, and the school promotion. It also provides insights into what differentiates the High-Five concept from existing technology activating tools, which all together will answer the fourth sub-question.

## 3.1 Foundation

The founder of the High-Five campaign is Aptus, a Belgian tech company founded in 2015. The mission of the company is to utilise IoT (internet of things) or also called smart technology (combination between hard- and software) to create a better world. The company views themselves as a technological partner who build bridges between the physical and digital world (Aptus, n.d.).

The founder and CEO of Aptus Alexander Vanwynsberge explains his company's core business as follows: *"Technology is an enabler for an interconnected world between devices, machines, environments but also people who are living in this world. Our company offers three things; we advise, implement, and inspire our customers. First part is the consulting part, we challenge our customers in their IoT ideas and opportunities, so we both check the business- and technological aspect, to see if there is a real business case that we can solve with technology. Next to that, we also do end-to-end IoT implementation, meaning that we can engineer custom electronics. We can integrate existing hardware, but the goal is to capture data or information from the physical world. In the inspiration part, we would like to share or knowledge, because sharing is caring. But also, we want to inspire the world about the impact that technology can make. Aptus covers the full spectrum of smart technology, we have the experience, we have the knowledge, but nevertheless we have the passion to help our customers and be the most ideal IoT innovation partner"* (Vanwynsberge, n.d.).

The step towards the High-Five campaign was made in 2020 when Aptus became aware of the unsafe school environments in the municipality of Harelbeke (BE), where their office was located back then. Aptus was already in contact with the municipality and coincidentally this topic was brought up during one of their meetings. The municipality could not find any solution to these problems and only thought of adding parking spaces, which is more an exacerbation of the problem than a solution. Aptus suggested to launch a pilot project accompanied by an application for an innovation grant, which was not approved. Despite the disapproval, the municipality decided to move forward and test Aptus' initiative. From market research, it appeared that every school in the municipality was dealing with the same problem. As this initiative became known by more and more municipalities it became clear that every municipality recognized the same problem. From then on, the project was further scaled up and that is how the High-Five campaign has been launched.

In totality, 66% of all children travel to school by car in Belgium (De Landtsheer, 2017). In the Netherlands this share is much lower with 30% (KpVV CROW, 2016). The difference is mainly in the infrastructure of both countries, where all day-to-day facilities such as the supermarket, schools and work can often be found in the cities, while in the Netherlands these basic facilities are often closer to home. As a result, Belgians are more inclined to take the car than public transport because distances are longer, the car is often faster, more comfortable, and public transport has a negative image because of punctuality problems and poor condition of some stations (Mobiliteitsplan Brussels, 2017). Also, Belgian infrastructure is based on car use, while in the Netherlands it is more spread out and prioritises public transport and slow traffic such as cycling and walking. In Belgium, parking is much greater in cities and around schools, and the maximum speed in residential areas is higher in Belgium (20km/h) than in the Netherlands (15km/h), making school environments more unsafe for active transport (Grenspaal12, 2021). In addition, car traffic is often not allowed around school areas through so-called 'school zones'. Both countries have school zones, but in terms of numbers, Belgium is still far behind its northern neighbours.

The large share of children in Belgium which travel to school by car and to a lesser extent in The Netherlands causes a large car pressure on the school environment which creates chaos around the school gate and produces unsafe situations for children who commute to school by active transport mode. In addition, all these cars cause unhealthy situations for all children. In order to create changes in the unhealthy car dominant school environment, the following three problems need to be acknowledged:

### Unsafe

- Too many cars in the street of the school
- Larger risk of accidents

### Not sustainable

- Too much carbon dioxide emissions
- Noise nuisance

### Not healthy

- Polluted air in the school environment
- Less moving

To improve the situation, Aptus created a campaign called High-Five consisting of three components; a physical campaign, school promotion and a digital platform, which is Aptus' main driver of the project. High-Five has been created to make active commuting to school attractive by means of playing methods and technology which aligns with the slogan 'High-Five is a smart solution that contributes on building a sustainable, safe, and healthy way to school.

## 3.2 Physical campaign

Essentially, the implementation process starts with municipalities that express their interest in the campaign. Subsequently, the municipality links the project with one or multiple schools within its municipal borders, to test the project. Mostly, the project turns out to be successful, leading to more schools following through. Currently, 53 schools are participating in the project, of which 8 in the Netherlands and 45 in Belgium. Implementing the project starts by introducing the school staff with the concept and preparing all necessary equipment like a personal account, wrist-tag, and RFID-tag (bicycle) and the infrastructural analysis for the placing of the High-Five modules along the safest walking- and cycling routes of the children.

*Figure 3.1: Superhero High-Five visiting a school as part of the Physical campaign.*

After this, the physical campaign follows, which introduces the storyline and connected platform by hosting an event where the superhero High-Five visits the school to present himself and enlist the help of the children to support him in his battle with the villain Smog. The event will be organised in a spectacular fashion, with the children being welcomed via a red carpet just like celebrities. Also, the famous Belgian influencer-duo CEMI is involved to promote campaign called Go Five, Go Fluo', which encourages children to wear fluorescent vests that ensure they are highly visible in traffic. Then they can have their picture taken with High-Five. After this, they gather in the school's gym after which the storyline is conveyed by High-Five to the children, getting them excited to support High-Five and travel actively to school on foot or by bicycle.

For each project, the school's wishes are expressed and taken into account. Most schools participate with children between 6 and 12 years old, which in the Dutch school system are divided by age in so-called ‘Groups’. The youngest children, aged between 2.5 and 4 years old can attend kindergarten. After turning 4, these children can advance to primary school. The Dutch primary school system consists out of eight groups with children between the age of 4 and 12 years old. The youngest children are the pre-schoolers, who are placed in the first two groups. However, in the Netherlands children are subject to compulsory education from the age of five, which means that group 1 is not mandatory to partake (Rijksoverheid, 2023). In Belgium, the school system is slightly different, since the schoolyear 2020-2021, children are also subject to compulsory education from the age of five, but children can already go to preschool from the age of 2.5. Children aged between 2.5 and 6 can attend half school days, after which they can advance to primary school if they have attended preschool for at least 290 half-days (Vlaanderen verbeelding werkt, n.d.). In primary school, children between the age of 6 and 12 are included in six so-called ‘classes’ (belgium.be, 2023).

Sometimes schools also participate with pre-schoolers in the High-Five concept, but mostly schools only participate with children between 6 and 12 years old (groups 3-8 in the Netherlands and classes 1-6 in Belgium) because pre-schoolers are not able to cycle or walk a relative larger distance.

## 3.3 The High-Five platform

The High-Five platform fulfils a central role in the concept and in this study. In order to support the attractiveness of the campaign and its digital platform, a complete storyline is attached which translates the important message that being physically active is healthy in a more approachable and fun way.
To connect the platform with the school environment an infrastructural analysis is performed in cooperation with the relevant municipality. High-Five modules are placed at strategic points along the children's walking routes (see figure 3.3). At least three and up to six of these modules are placed in each school environment. Each child will receive an NFC wristband and collects coins by scanning the wristband at the High-Five modules. To register the number of children travelling by bicycle to school, they are RFID-tags are handed out (see figure 3.2). When the children cycle into the bicycle parking, the tag will automatically be read, and real-time coins are transferred to the children’s personal High-Five account and the same applies for scanning wristbands at the modules. Only one scan per day can be made, to prevent fiercer competition between classmates and other schools that can trigger unsafe situations, with the high-five modules becoming pressure points where children go without the presence of traffic guards or parents outside school hours. To collect data regarding amongst others; number of earned credits, high-fives (tags), login and registration data, Aptus uses an open-source monitoring and analytics platform called Grafana, which processes and visibly maps all relevant data. Through this platform, the effects of the project on children’s travel mode choice are presented.

*Figure 3.2: RFID-tag attached to bicycle*

*Figure 3.3: Map of main walking routes to school and location of High-Five modules*

As explained in the previous section, coins which are earned by walking or cycling to school are collected by scanning their wrist-tag at a High-Five module or while entering the cycle parking. These coins are transferred automatically to their personal High-Five accounts which every child receives at the implementation of the High-Five concept.

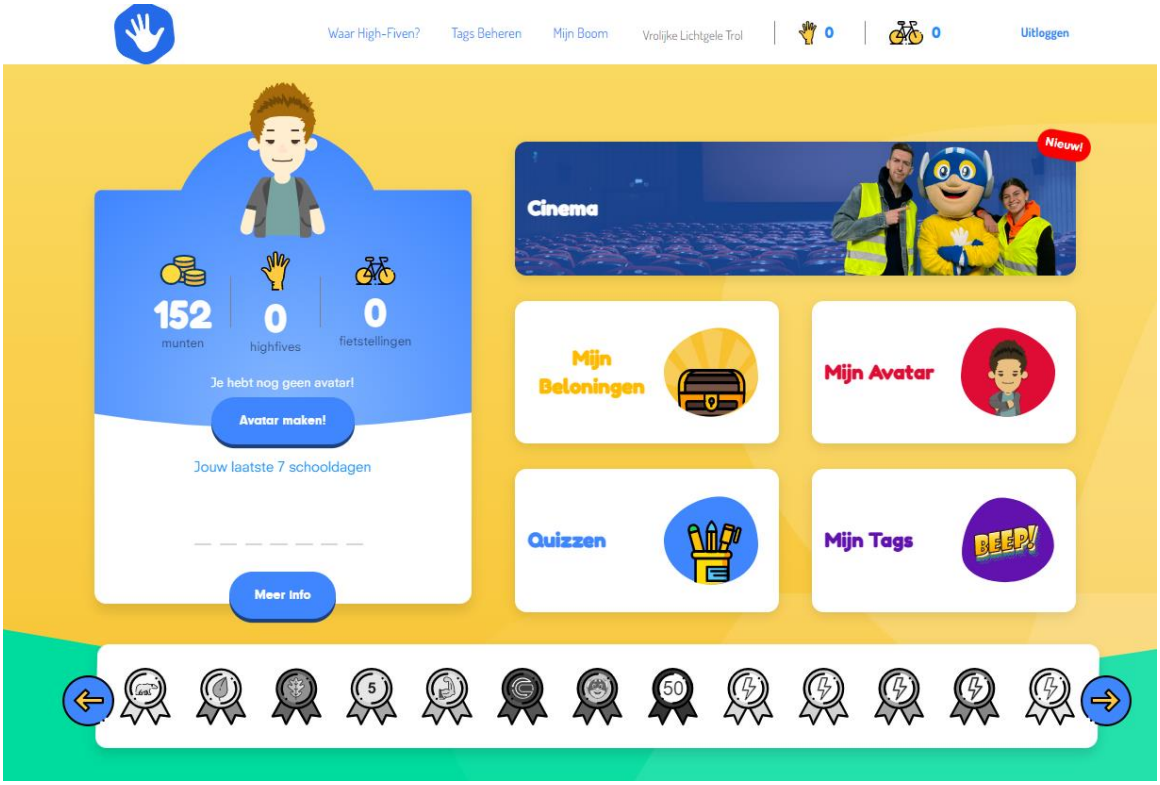



*Figure 3.4: User interface of the High-Five digital platform*

The purpose of the digital platform is not to increase children's screen time, but it is intended for occasional and short-term visits, for example to log into the platform after a school day to check the number of coins they collected that day or week or for watching a short episode of High-Five's adventures.

During the first login the children can choose a unique username, which simultaneously keeps the person in anonymity but also gives a nice funny name (e.g. Happy Luminous Troll) to the child's profile. Figure 3.4 shows the user interface of the platform. As can be seen, the website is only accessible for Dutch speaking children and their parents, since the concept has not been launched outside the borders of the Netherlands and Flanders, where Dutch is the main language. Reading the user interface, all options are structured well. The left bracket shows the users' statistics, like the number of coins, high-fives (number of times they scanned their wristband while walking to school), bike-counts (number of times their bike-tag was scanned) they have collected and their last seven school day track record. On the right side, it shows the quizzes and exercises they can partake in, their tags (number of the wrist- and bike-tag), their self-personalised avatar, and the rewards, where each child can choose for which reward, they want to save coins for. The quizzes are about teaching children traffic rules so that they can move safely through traffic while travelling to school. By way of imagination, the platform also has an option for the user to grow their own plant (displayed in the white bar at the top of the interface). In order to grow their plant to a maximum level, they have to travel actively to school for 75 days (see figure 3.5), so that car emissions do not create acid rain that damages the plant.

Furthermore, the user interface includes a list of medals that can be earned, when reaching certain targets, like walking/cycling 50 times to school.
Lately, extra rewards items have been added to the user interface, where children can achieve goals collectively as a class, like earning an additional 10 minutes of break time if they collect a total of 10.000

coins together. Also, the children can keep track how well they are doing compared to their classmates and to other schools, which creates a healthy form of competition that stimulates them to walk or cycle more often.
The reward selection is done by the associated municipality because the rewards should be locally accessible, one should think of entry tickets to a swimming pool or amusement park in the vicinity of the school. Also, some standard rewards that can be earned by every student are included in the selection like a fidget spinner or a High-Five customized blow-up hand. The differences between the Netherlands and Belgium with regard to the content and offerings of the platform are reflected in the remuneration selection, as this is determined per municipality and therefore also involves cultural differences. Collecting the coins and saving for rewards gives the platform an additional learning dimension, in which children learn how to handle money and make conscious choices about where to spend their coins.

## 3.4 School promotion

After the campaign is implemented by the physical campaign and the introduction of the digital platform, the third component of the campaign comes into play. The role of school boards and teachers is important in encouraging children to travel actively by promoting the campaign during lessons and through promotional messages via school communication channels.
Teachers can use the digital platform to support their lessons by adding exercises, quizzes and even rewards, which children can earn by showing good behaviour, for example.

## 3.5 Narrative design

High-Five is the name of the platform, but more importantly, the name of the superhero, who can be seen in figure 3.1. High-Five has lots of adventures, where he fights against the villain called Smog. Smog wants to pollute the air and endanger people's health. High-Five tries to stop Smog, but to do so he has called on the help of all primary school children. The children are expected to contribute by travelling by foot or bicycle, because cars pollute the air with their dirty emissions just like the villain Smog. In order to stimulate and entertain children simultaneously, the storyline is connected to the previously discussed platform. Lay-out and content of the platform is customised to the storyline. The ongoing High-Five narrative supported by platform features like new episodes and rewards maintains children's attention and encourages them to continue travelling actively.

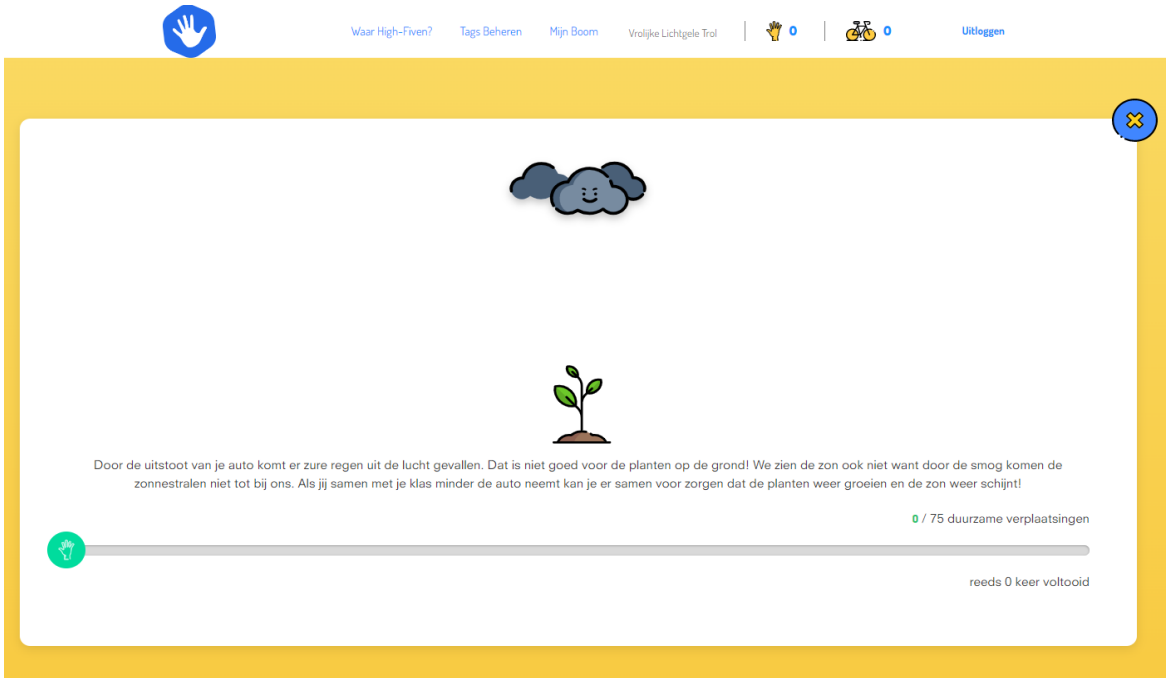



*Figure 3.5: My tree, virtual tree which children can grow by commuting actively to school for 75 days*

## 3.6 High-Five campaign relative to existing technology

As discussed earlier in this report, scientific literature contains multiple studies which performed research towards the effects of activating technology on children's PA. All mentioned concepts found in scientific literature showed great potential in achieving PA goals for young children. Those concepts utilized different technological instruments which contained specific features that make the concept enjoyable for children, capturing and maintaining their attention. Comparing to the High-Five campaign, the concepts studied in scientific literature contain matching features like the possibility for users to create their personal avatar, a reward system, keeping track of results and compete against their peers and a narrative game design containing interesting plots, cliff-hangers, kind-hearted characters with cool features like superpowers and interesting villains.
Similar to the High-Five campaign, is the goal of existing technology, enhancing children's overall PA. However, it also differs in this regard since the High-Five campaign specifically focuses on stimulating children to commute actively to school and therefore creating a safer, healthier, and sustainable school environment, while concepts in available literature mostly aim to enhance children's overall PA or more specifically focus on spare time or during school times. This characterizes the High-Five campaign as a more integral concept which aims to reach environmental and societal goals.

Besides corresponding features, the High-Five campaign differs from existing concepts with features that aim to educate children. The iEngage application researched in the study of Galy et al. (2019) serves also as an educational program but is only focused on informing children about PA, while features of the High-Five platform aim to enhance children's monetary, environmental, and traffic safety awareness. With the 'Mijn boom' feature children learn the importance of the environment through tending and growing their own virtual tree. Available quizzes learn them about traffic and how to move safely through traffic. Other concepts like Moovosity included a reward system, but do not offer rewards that can be used in real life and bought by collecting coins. This playful way of saving coins educates children on how to manage their money.

Compared to other activating technology the digital High-Five platform has a low access threshold because the platform is accessible on every device with internet connection, while other concepts use technological instruments like applications that require the ownership of a mobile phone or instruments that are not easy to carry like consoles.

In addition, the platform is not developed to attach children for a longer time and increase their screen time. Points can simply be scored without using the platform, with the platform mostly serving to keep track of your collected points by logging in once a week. Additionally, the High-Five campaign is unique in terms of involving the Belgian influencer-duo CEMI, in order to support the campaign 'Go Five, Go Fluo' and boost its popularity amongst children (see figure 3.6).

*Figure 3.6: Go Five, Go Fluo campaign, supported by Belgian influencer-duo CEMI*

Besides the concepts researched in scientific literature, High-Five experiences competition from a concept with many common features. In 2018 the Belgian bank Belfius launched a mobility platform for municipalities and schools which is part of their so-called 'Smart Belgium strategy'. Just like the High-Five campaign, children receive an RFID tag or badge for their bicycle when they register as participant. An RFID-scanner is constructed in the school to detect when a child walks or cycles to school. Children receive immediate points, which are transferred in virtual ducats. An algorithm calculates the number of points rewarded per bicycle ride or walk, considering travel distance, weather conditions and season. Bonus points can be collected whenever children wear a helmet while bicycling

to school. Children can save their points to buy actual prices like tickets for the local fair or swimming pool. The platform can be entered through an application on which children and parents can keep track of their collected points and even see how many $CO_2$ emissions they reduced by travelling actively to school. As an affiliated partner, the Belfius bank converts the virtual 'ducats' to euro's, which basically gives children access to their own personal bank account. Because primary school children often do not own a personal smartphone they receive a physical bank card, which they can use to buy swimming pool tickets or tickets at the fair (Petitjean, 2018). So, besides the mutual goal to make school environments safer and healthier, the underlying motivation for Belfius is to engage customers at an early age by offering them a savings account in a playful way.

## 3.7 High-Five results prior to this study

The High-Five campaign has been started in 2020, since then it has gained much interest throughout Flanders, The Netherlands and recently even in Denmark (no school yet). Like mentioned earlier, the campaign has a pool of 53 schools including 10.675 students of which 79% are participating in the campaign. A share of 79% means that in totality 8433 children are participating in travelling actively to school. Over the first semester, from September until November 2021, the High-Five database has registered a total of 184.393 High-Fives, which indicates the number of active trips to school. Hence, children on average travelled 70% of their trips actively to school in the first semester (24 out of 35 school days). Resulting in a total distance of 553.179 km by foot or bicycle.
Due to the large number of participants that travels actively and choose walking and cycling over taking the car, a big environmental impact can be expressed as a reduction of 66 tons of $CO_2$ emissions.

The effects of the campaign on the modal shift in municipalities could also be derived from the High-Five database. As seen in figure 3.7, the High-Five campaign has a big positive impact on the modal shift of students of 4 schools in the Belgian municipality of Wichelen. At primary schools, the Rozelaar, Meander, Belhamel and Belleveer the car usage dropped down with at least 35% and active transport increased with at least 63%. In total, 78% more children are cycling or walking to school since the start of the campaign. Additional results from an earlier questionnaire show that 61% of the parents reported that the school environment is much safer, because less people take the car, and the ones that still travel by car, park farther away. Also, 31% of all parents feel that their child(ren) has become more roadworthy since the start of the campaign.

Also, in the Belgian municipality of Lommel, the High-Five campaign has had a major positive impact on the modal shift of the students of 't Stekske, Sint-Jan, Wegwijs, and Lommel-West. The car usage dropped at least with 5% and maximally with 35%, while the active transport increased with at least 8% and maximally with 108%. Overall, 45% more children travel by bicycle or foot to school in Lommel since the start of the project (Temmerman & Schoofs, 2022).

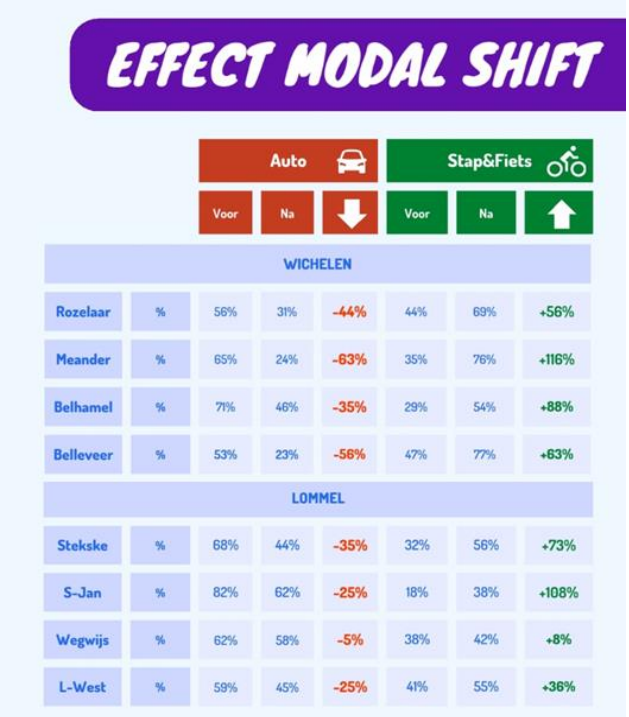



*Figure 3.7: Effect modal shift at schools in Belgian municipalities Wichelen and Lommel*

## 3.8 Conclusion High-Five campaign

The aim of this chapter was to answer sub-question four: '*What is the High-Five campaign and how is the High-Five campaign constructed and in what way does their digital platform differ from existing technological activation concepts? And how does it influence children's choice of transport mode according to the data results?'*

The campaign is an initiative that aims to stimulate children to commute to school by active means of transport like cycling or walking instead of motorized vehicles like the car. The campaign consists out of three main elements: a physical campaign, a digital platform, and the school promotion, of which the former is used to introduce and motivate children to participate in the campaign and the latter two are used to captivate children's attention for the campaign for a longer amount of time.

Compared to existing technological activation concepts, the High-Five platform also utilises gamification elements like a reward system, creating a personal avatar and is driven by a narrative design. However, different from other concepts, the campaign has a low access threshold, being accessible on every device. Also, the platform is not meant to increase children's screen time and only serves for keeping track of coins saved by the user, making one short login moment per week enough.

Finally, according to the data results 79% of all children (N=8433) participates in the campaign. Additionally, in the first semester of 2021, children travelled actively to school in 70% of their trips, resulting in a reduction of 66 tons of $CO_2$ emissions. Since the implementation of the campaign, 45% more children commute actively to school in the municipality of Lommel, which has four different participating schools.

# METHODOLOGY

## CHAPTER 4

# 4. Research methodology

This chapter contains the full step-by-step description of the methodology which is used to answer the main research question: '*What are parents' perceptions of the High-Five campaign regarding its physical campaign, digital platform, and school promotion? How does participation in the High-Five campaign affect children's travel mode choice to primary school (controlling for the socio-ecological factors) and (directly, or indirectly via travel mode choice) the social cohesion in the surrounding neighbourhood and school zones?'* First, the methodology is briefly introduced, after which the research design is discussed. The research design includes the final design of the conceptual model and sub-model, in which dependent and independent variables are further elaborated. In addition, the operationalization of all variables is included and evaluated in the research design. Furthermore, the method of data collection through the questionnaire is addressed, including population description and distribution of the questionnaire. Finally, the statistical data analyses methods are discussed.

## 4.1 Introduction

The goal of this study is to gain insight in the effects of participation in the High-Five campaign on children's travel mode choice, as well as (directly, or indirectly via travel mode choice) on the social cohesion within the surrounding neighbourhood and school zones. As previously stated, there is a gap in existing scientific literature regarding this topic. To perform research towards this topic, descriptive and explorative research is assumed to be the most suitable research strategy. Based on the results from the scientific literature review and the analysis of the High-Five campaign, which was performed earlier on in this study in chapter 2 and 3, the conceptual model was modified. Hence, this model will be used as the underlayer for the following stage of the study, which involves the analyses in quantitative research.

In order to acquire data, a cross-sectional research approach will be applied in which data will be collected from a large number of individuals at a single point in time by using a questionnaire. A cross-sectional study is useful to gather initial data from a large pool of respondents and identifying the prevalence of results at a particular point in time. A cross-sectional study is limited, as causal relations cannot be determined while using this approach.

The questionnaire is designed for parents of pupils attending grades 1-6 in Belgian and grades 3-8 in Dutch primary schools (6-12 years old) where the High-Five project has been implemented. Both parents of children participating and not participating in the High-Five project are asked to fill in the questionnaire. In order to obtain feedback regarding the impact of the campaign on their child's mobility and how they themselves perceive social cohesion in their neighbourhood and school zones, it is important that parents of children not participating in the campaign also fill in the questionnaire. Data obtained from the questionnaire will be utilized for conducting the statistical data analyses in chapters 6 and 7.

## 4.2 Research design

This section includes the research design, in which the modified conceptual model and sub-model are visualized and described. Also, the operationalization of the independent and dependent variables is included in this section.

### 4.2.1 Conceptual model

Figure 4.1 portrays the final design of the conceptual model and the sub-model. The first design of the main conceptual model is modified by adding all relevant independent and dependent variables. All independent variables are placed on the left side of the model and both dependent variables on the right side. In order to make the variables measurable through the questionnaire, additional variables were added, referring to the main dependent and independent variables as group of variables.

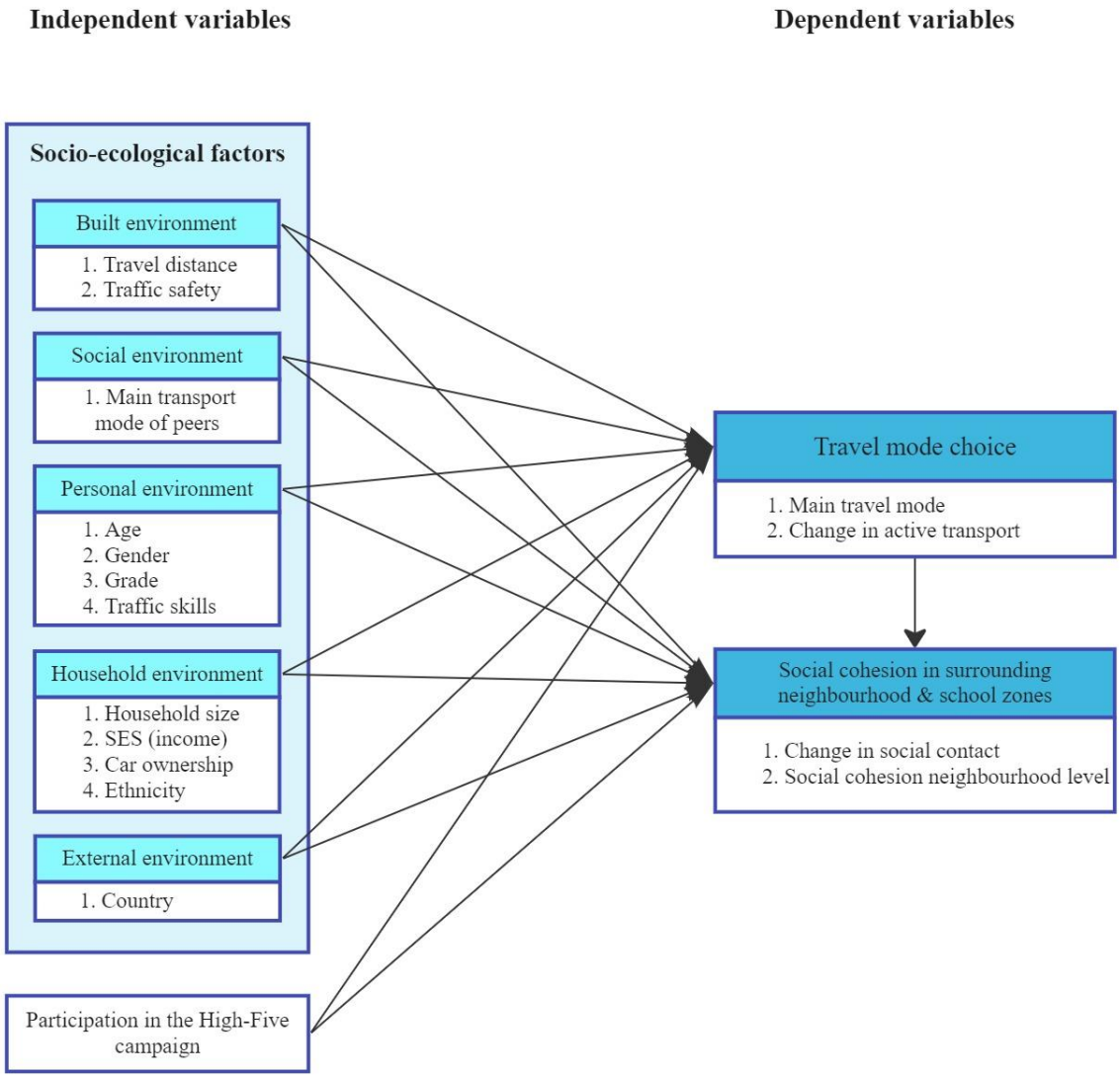



*Figure 4.1: Final conceptual model*

## Social-ecological factors and participation in the High-Five campaign

The independent variables are represented by two boxes, representing the influence of the five layers of the socio-ecological model and the participation in the High-Five campaign. For all five layers, variables identified as having a significant impact on children's travel mode choice according to scientific literature were included in the model. These variables are included to control for their influence on the final outcomes of the study. Regarding the built environment, travel distance, and perception of traffic safety have been found to be associated with children's travel mode choice to school. Secondly, peer influence has been identified as the most influential social factor and has been modified into the variable main transport mode of peers to collect data on children's peers main travel mode to school. The third layer represents the personal factors of which age, gender, and traffic skills were acknowledged to have the most impact on a child's travel mode choice. Grade has been added as an additional factor due to the fact that age does not always correspond to the grade a child is in. Subsequently, the household layer predominantly reflects parents' influences on the way their child commutes to school. Household size, SES, car ownership, and ethnicity have been included as most important household factors. Lastly, country has been included as an external factor in the conceptual model to represent the differences between both Belgium and The Netherlands.

Participation of the High-Five campaign is the second independent variable and influences both dependent variables, travel mode choice and the social cohesion in surrounding neighbourhood and school zones.

### Travel mode choice and social cohesion in surrounding neighbourhood and school zones

The conceptual model contains two dependent variables, which have a direct relationship.
Travel mode choice is the first group of variables, containing the variables main travel mode and change in active transport (since the campaign). Travel mode choice is assumed to be directly influenced by the five layers of the socio-ecological model, as well as by participation in the High-Five campaign. The second dependent variable is the social cohesion in surrounding neighbourhood and school zones. This is a group of two variables, including neighbourhood cohesion level and change in social contact (since the High-Five campaign). It is assumed that this factor has a relationship with travel mode choice and is also believed to be directly or indirectly (through travel mode choice) influenced by the five layers of the socio-ecological model and participation in the High-Five campaign.

## 4.2.2 The sub-model

The sub-model was constructed because the data regarding the perception of the High-Five campaign were obtained from a reduced respondent sample, which only include the answers of respondents and their children that use the digital platform at least once every two week. The sub-model has been constructed the same as the main conceptual model, displaying the independent variables on the left side and the dependent on the right side (see figure 4.2).

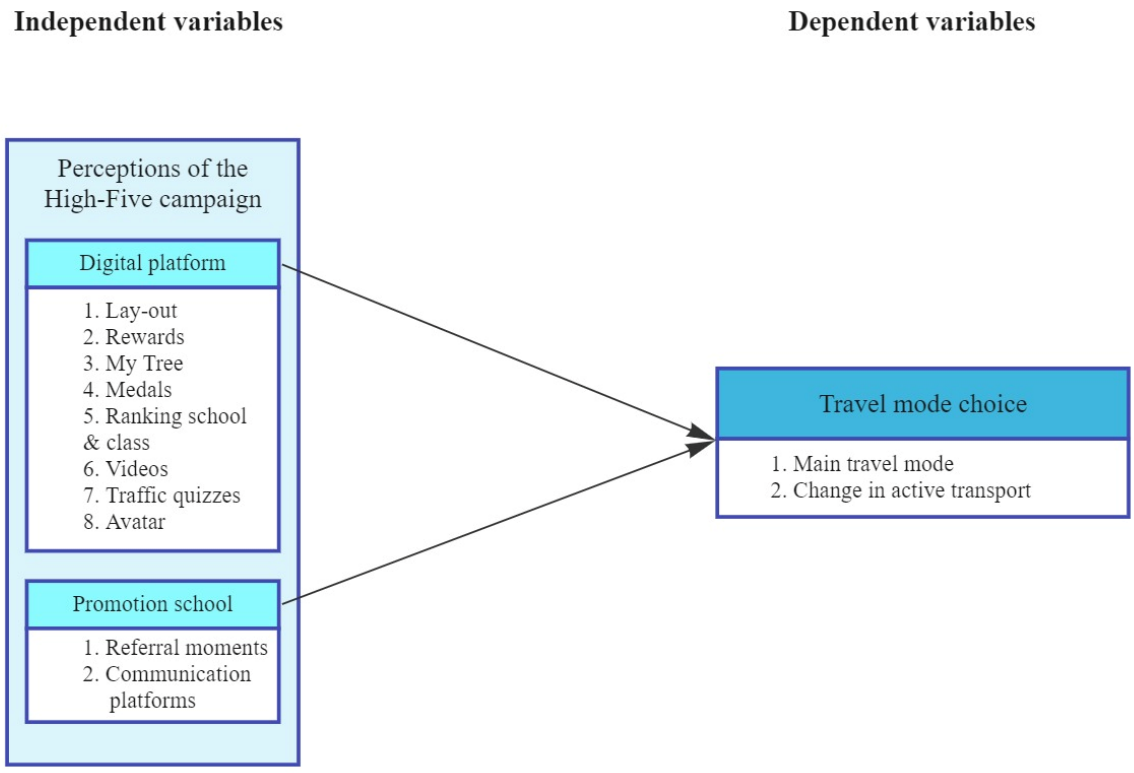



*Figure 4.2: Final sub-model*

### Perceptions of the High-Five campaign

The independent variable, perceptions of the High-Five campaign, involves two groups of variables, the digital platform, and the school promotion. Initially, the group included a third variable, the physical campaign, embodying superhero High-Five's physical visits to the schools. However, from scientific literature came forward that one-time promotional activities had no long-term effects on children's travel behaviour. Based on these findings, it has been decided to exclude the physical campaign from the conceptual model and hence from further research. The digital platform consists of eight variables, the first of which, layout, represents the visual element of the platform. Colour composition and font are lay-out factors that contribute to creating a certain perception of the campaign. An unpleasant colour

composition can for example negatively influence people's first perception of the platform. All other variables of the digital platform are representing the gamification elements which are utilized by the platform to attract and maintain children's attention to the campaign and its objective. The seven variables are: rewards, my tree (virtual tree), medals, ranking of school class, videos, traffic quizzes and personal avatar. Research has shown that gamification elements like creating your own avatar and saving for rewards contributes to enhancing children's physical activity. However, scientific results regarding the impact of gamification elements on active commuting to school is lacking.
Lastly, the second group of variables is the promotion of the campaign by the affiliating schools. The variables that are indicated as important in influencing children's travel mode choice are referral moments and school's communication platforms. Moments when teachers and school boards refer to the platform are important in keeping the children motivated. In addition, using several communication channels is important to promote or inform children's parents about the campaign.

### Travel mode choice

The sub-model contains only one dependent variable, travel mode choice. This is a group of variables, which contains the variables main travel mode and change in active transport. It is hypothesised that the choice of travel mode is directly influenced by both independent variables.

### 4.2.3 Operationalization variables

In quantitative research, the types of variables which are included in the conceptual model need to be precisely defined. Defining these variables requires making them measurable, so that the data is suitable for analysing later on in this study. The questions in the questionnaire were modified to gather information about the variables in the conceptual model. This section addresses the operationalization of all variables included in the questionnaire for the parents of primary school children. For each variable, the methods used to make these measurable within the questionnaire are described. In total, the questionnaire contained 42 questions, split into four chronological sections: Personal details of your child and your household, Perceptions of you as a parent/caretaker and your child regarding the digital platform, Mobility of your child and the Social reach of the High-Five campaign. The dependent variables are discussed first, followed by the independent variables addressed per group of variables.

#### *Travel mode choice*

The dependent variable travel mode choice is measured within the questionnaire by asking which means of transport children mainly use to travel to school (travel mode), and how often children use different means of transport to school during an average school week (change in active transport). The latter was asked for both the situation prior to and after the implementation of the High-Five campaign. The first question was presented in a multiple-choice format and includes the following options: car, bicycle, by foot or 'other'. The last option is to be filled in freely and will be differentiated and recoded later on. It is assumed that these four options are sufficient to capture the transport choices of primary school children. The consideration was based on the assumption that children generally live at a relatively short distance from a primary school, making it accessible by foot or bicycle. Also, primary school children are generally considered too young by their parents to travel alone by public transport, therefore this choice was not included.
The second question uses the same transport means categories, with parents indicating how often they use a type of transport means per week. This can vary substantially, from using one mode of transport throughout the week to using multiple modes of transport.

It is assumed that a normal school week consists of five days (Monday to Friday). The number of transport modes used depends on the number of trips per week including the trip home and back during the lunch break. The use of several transport modes per day is possible, given that in the case of an open lunch break (possibility of going home during the break) there are two back and forth trips.

Through this question, respondents' share of active transport usage to school can be measured relative to children's total transport usage prior to and after the implementation of the High-Five campaign. This results in a statistic that represents the impact of the campaign on children's active transport mode use.

For background information regarding children's travel mode choice, respondents were asked what valid reasons parents have to not allow their child to travel actively to school. This information is not used to measure the variable travel mode choice, but as an additional explanatory reference. The answer to this question can be given by choosing from eight possible reasons that emerged in scientific literature as the most common reasons for parents not to let their children actively travel to school. Reasons were based on the variables parental and child preference, weather conditions, travel distance, road safety and traffic skills. The following eight answers were considered as possible reasons:

1. *My child can and does cycle or walk to school*
2. *I think the route to school is unsafe*
3. *The distance to school is too far*
4. *Bad weather conditions*
5. *It saves me time if I drop the kids off at school and can then drive straight on to work*
6. *I feel that my child does not yet possess sufficient traffic skills to cycle and/or walk to school*
7. *I would rather go by car than by bike or on foot*
8. *My child prefers going by car to cycling or walking*
9. *Other*

Also, respondents were able select multiple answers and to indicate any other reasons they had to not allow their children to travel actively to school.

### *Social cohesion in surrounding neighbourhood and school zones*

The second dependent variable represents how people view the social cohesion within their neighbourhood and school zones. The feeling of social cohesion in one's own neighbourhood, usually also the neighbourhood in which the school is located, is measured using ten statements from the modified version of Buckner's neighbourhood cohesion scale, with eight of the original 18 statements included in the scale (White et al., 2014). To these eight, two more statements were added which were considered of adding value for measuring social cohesion in respondents' neighbourhood and school zones. These two statements were also taken from the original 18 statements of Buckner's Neighbourhood Cohesion Scale and represent the sense of belonging and unity. These two are listed last in the list below (Buckner, 1988).

1. *I visit my neighbours in their homes*
2. *The friendships and connections I have with other people in my neighbourhood mean a lot*
3. *If I need advice, I can approach someone in my neighbourhood*
4. *I believe my neighbours would help in case of emergency*
5. *I borrow things and exchange favours with my neighbours*
6. *I would be willing to work with others on something to improve my neighbourhood*
7. *I often have a neighbour visiting me at home*
8. *I regularly make stops to talk to people in my neighbourhood*
9. *I think my neighbours' ideas about what is important in life match mine*
10. *If people in my neighbourhood were planning something I would see it as something of us together rather than just theirs*

Respondents were asked to indicate how much they agree or disagree with these statements based on a five-point Likert scale (totally agree - totally disagree). The scores of all these statements were added up and divided by the number of statements to form an overall score for the social cohesion neighbourhood level variable.

Social cohesion has also been measured by asking respondents how they perceived social contact with local residents prior to and after the implementation of the High-Five campaign. Based on a Likert scale, respondents could indicate to what extent they had contact with their neighbours, ranging from 'no contact' to 'very good contact'.

### *Socio-ecological factors*

The five layers of the socio-ecological model represent the first five independent group of variables that influence both dependent variables. In the conceptual model, the five layers or environments are combined into one box or variable, but this section discusses all the associated variables of each environment and how they are measured separately.

#### *Built environment*

The built environment is the first layer from the social ecological model. Based on the scientific literature study, two factors were found to be important in influencing both dependent variables. These factors are travel distance and traffic safety. The first variable is measured by using a Likert scale to ask parents how far their child's travel distance from home to school is. The scale is divided into the following intervals:

- *< 0.5 km*
- *0.5 - 1.0 km*
- *1.0 - 2.0 km*
- *> 2.0 km*

The last variable, perceived traffic safety is measured by asking parents how safe they consider their child's route to school is, using a five-point Likert scale, with 1 being 'very unsafe' and 5 being 'very safe'.

#### *Social Environment*

The second layer represents the social environment. The main mode of transport of peers is the only variable that was considered important to include for further research. Main transport mode of peers was measured, using the same scale that was used to measure the dependent variable travel mode (car, bicycle, walking, other). This scale was used to answer which means of transport children's friends used most often to go to school before the implementation of the High-Five campaign.

#### *Personal environment*

The third layer includes personal factors that are likely to have an influence on children's travel mode choice. The personal layer contains the most variables, of which the following four variables were included for further research: age, gender, grade, and traffic skills. The first three variables were measured by including rather simple straight-to-the-point questions in the questionnaire on how old (range of 6-12), what gender (male/female) and what grade the child of the respondent was in. The latter was distinguished into two ranges, 1-6 for Belgian schools and 3-8 for Dutch schools, due to differing grading systems in both countries. The traffic skills variable was measured by asking parents to rate their child's traffic skills on a five-point scale.

*Household environment*

Household is the fourth layer and jointly with the social layer the one that contains the most variables. Scientific literature review has shown that Household size, SES, ethnicity, and car ownership are influential variables. In order to measure the variable car ownership, parents where asked whether their household owns one, two or more or no private car at all.

To measure the variable household size, respondents were asked how many people make up the respondents' household based on a scale ranging from two to six or more. The ethnicity variable was made measurable by asking parents what ethnic background their child has, distinguishing between Dutch, Belgian, western- and non-western migration backgrounds. The socio-economic status variable was made measurable by asking respondents about average household income, divided into five monetary categories. During the course of the survey, it emerged that some parents indicated by e-mail that they did not feel comfortable sharing these details, so the 'I rather not disclose' option was later added to allow these people to complete the questionnaire as well. All household variables and by which scale they were measured and defined are shown in Table 4.1.

*Table 4.1: Measurement all four household variables*

| **Car ownership** | **HH size** | **Ethnicity** | **Socio-economic-status** |
|---|---|---|---|
| No car | 2 | Belgian background | Lower as €20.000,- |
| Yes, one private car | 3 | Dutch background | €20.000 - €30.000 |
| Yes, two or more private cars | 4 | Western migration background (All countries in Europe (Except Turkey), North America, Oceania, Japan, and Indonesia | €30.000 - €40.000 |
| | 5 | Non-western migration background (All countries in Africa, Latin America, Asia (Excluding Japan, and Indonesia) and Turkey | €40.000 - €50.000 |
| | 6 | | €50.000 or more |
| | 6 or more | | I do not know |
| | | | I rather not disclose |

*External Environment*

The last and fifth layer of the socio-ecological model represents external influences on a child's travel mode choice. From scientific literature, no variables were considered as important to include in further research. However, to represent the differences between both Belgium and The Netherlands, the variable country was added as an external factor in the conceptual model. This variable was measured by asking respondents in which municipality there child attends school, after which the results were divided by country.

*Participation in the High-Five campaign*

Participation in the High-Five campaign is the second independent variable in the conceptual model and is the most relevant variable in this study. To measure this variable, the question was asked whether or not a respondents' child participated in the campaign based on a 'yes' or 'no' question.

*Perceptions of the High-Five campaign (Sub-model)*

The perceptions that parents and children have of the High-Five campaign is the only independent variable in the sub-model. This variable contains two groups of variables, the digital platform, and the school promotion. Both contain variables that influence the dependent variable, travel mode choice.

### *Digital platform*

The digital platform is the first group of variables regarding the variable representing the High-Five campaign in the sub-model. This group of variables contains a total of eight variables, seven of which are different gamification elements.

The first and separate variable is lay-out. Lay-out refers to the design of the platform's interface.

A Likert scale, ranging from very nice to very ugly, is used to measure how parents and children perceive the design of the platform. This question is asked in the same way for both parents and children. The question is made child-friendly by using easily recognisable words like nice and ugly.

The following seven gamification elements are included in the digital platform: rewards, my tree, medals, school and class rankings, videos, traffic quizzes and your own avatar. These factors are made measurable by asking both parent and child to give a rating for each element using a five-point Likert scale, with one being the worst score and hence seen as an element not being fun, or not interesting.

In contrast, a rating of five points indicates that elements are considered very nice or very interesting. For parents and children who are not familiar with one or more elements, simply because they have not yet seen or played them, the option 'I am not yet familiar with this element' has been added.

Next, both parent and child were again asked what they like best about the element(s) they gave the highest score. They can answer these questions by choosing from the following six statements:

1. *Learning to playfully save for rewards is a fun way to get my child(ren) to actively travel to school*
2. *Playing the quizzes teaches my child(ren) to participate safely in traffic*
3. *Growing their own tree is a fun way to teach my child(ren) the importance of nature*
4. *Competition among the children who collects the most 'High-Fives' is a fun way to motivate my child(ren) to actively attend school*
5. *Winning and collecting medals is a fun way to motivate my child(ren) to actively attend school*
6. *Watching the exciting episodes of High-Five and Captain Smog*
7. *I do not know*
8. *Otherwise*

Multiple answers could be selected when someone agreed with more than one statement. The option 'do not know' and 'otherwise' are also included in the choice options. In the 'otherwise' option, respondents can provide their own reasoning as to why they like one or more elements best, these are separated and coded later when collecting the data.

### *Promotion school*

The second group of variables is the promotion of the High-Five project in affiliated schools. Promotion of the campaign by schools is important in contributing to children's long-term involvement in the campaign, in order to achieve the objective of a safe, sustainable, and healthy school environment.

This group of variables includes two variables, the number of referral moments at school and school communication channels. The first variable is made measurable by asking in the questionnaire how often teachers or schoolboards actively refer to the campaign and platform during lessons. Using a Likert scale, parents can indicate the regularity of referral moments, varying between never, monthly, fortnightly, weekly, or daily. Again, the 'I do not know' option is included.

The second variable is made measurable by asking through which school communication channels reminders and/or messages regarding the High-Five campaign are shared with parents. With this question, parents can choose from five different communication platforms: email, letter, school portal/platform/website, parental interviews, or personal everyday conversations. The option 'other' is also included, again allowing parents to add which other communication channel they are approached through. This question does not allow multiple answers and is specifically formulated to find the most dominant communication channel.

## 4.3 Data collection

In this section, the data collection process is described, enclosing a population description, the questionnaire distribution, and the definition of the sample.

### 4.3.1 Population description

The population of this study consists out of primary school children from Belgium and The Netherlands. The children are aged between 6 and 12 years old and are attending grades 1 to 6 in Belgium and 3 to 8 in The Netherlands. All schools affiliated to the High-Five campaign were assessed to be eligible for partaking in the questionnaire. A total of 53 schools from 15 Belgian- and 5 Dutch municipalities were contacted, the majority of which participated. Per municipality, all participating schools and their pupil numbers are listed in Appendix B.

Figure 4.3 shows the locational distribution of all participating municipalities. As can be noticed, all municipalities are located in Dutch speaking regions. The High-Five project specifically decided to focus on the Netherlands and Flanders first because of the higher quality of infrastructure around schools and legislation which strongly supports active transport.

As can be seen, most of the participating schools are located in municipalities in western Belgium, which is due to the origin of the initiator of the High-Five project. Aptus is based in Kortrijk, a city in the Belgian province West-Vlaanderen, located close to the French border. As the map shows, the distribution of municipalities with participating schools is rather dispersed but also centralised. This is because the campaign is often noticed online by a municipal employee, after which the popularity of the campaign often spreads to adjacent municipalities due to good experiences from already participating municipalities. Primary education is controlled and directed by both Dutch and Belgian municipalities, which in this case decide in which school or schools within the municipality the project can be implemented whether or not as a pilot project. As a result, usually several schools per municipality participate in the project.


*Figure 4.3: Distribution affiliated 15 municipalities in Belgium and The Netherlands*

### 4.3.2 Questionnaire distribution

At first, a meeting with the board of the High-Five project and the researcher was made. In this meeting, the distribution method of the questionnaire was discussed. It turned out that High-Five had the e-mail addresses of all parents with children attending schools where the campaign was being implemented. As mentioned earlier, the questionnaire is intended for both parents whose child participates in the High-Five campaign and for those whose child does not participate. Before distributing the questionnaire, approval of the TU/e ethical review board was obtained.

In order to not immediately discourage the latter group of people, it was decided not to send the questionnaire through the High-Five project's general email address, but through all school boards. This was done because people who are not participating in the project might drop out when seeing the sender 'High-Five', leading to them not replying to this e-mail because they think this information is not addressed to them. Subsequently, schoolboards have been informed about the questionnaire and its purpose. The school boards then sent out the questionnaire including an introduction message from the researcher to the parents of all children, except the parents of all pre-schoolers. The researcher's introductory message addressed parents by asking the compelling question if they wanted to support the researcher in making their child(ren)'s school environment (even) safer. Furthermore, the researcher introduced himself with some personal information to give the impression that there is a real person behind the questionnaire, who would really appreciate it if children's parents could help him collect the data. Finally, the purpose of the survey was briefly described, and instructions were given to complete the questionnaire together with their child, as the child's opinion on some questions was also important. If a respondent had more than one child attending the same school, the questions about their child had to be completed for the oldest child.

It was also emphasised that the questionnaire is entirely filled in anonymously by the respondent and no one can link the completed data to a specific identity. Before starting the survey, respondents had to agree or disagree with the form of consent.

After twelve days, the response rate was still not sufficient, for instance because the schools wanted to send the questionnaire simultaneously with their monthly newsletters. Therefore, it was eventually decided to email all parents again, this time using High-Five's email address, this way the complete population pool received the email. Eventually, the average completion time of the survey was a little longer than expected with 13 minutes instead of 10.

### 4.3.3 Sample definition

The questionnaire has been sent out towards parents of children (6-12 years old) attending 53 different schools in Belgium and The Netherlands. Two separate questionnaires were made, a Dutch and a Belgian version, differing in terms of colloquialisms and school grading systems (of which the Belgian version is included as Appendix A). In total, the questionnaire was sent to parents of 10.675 pupils attending High-Five schools, of whom 80% (8068 pupils) are registered participants. Depending on the date the school boards sent the questionnaire, it could be completed in a time span of two weeks, from the 2nd of June to the 16th of June 2023.

Based on a population of 10.675 and a 5% margin of error and hence a 95% confidence interval, a minimal response rate was set on 370 responses (SurveyMonkey, n.d). After the second email round, a total of 423 responses were collected, of which 381 responses came from the Belgian version and 42 of the Dutch version. Of these 423 responses, a few were removed that were invalid to include in the analyses, leading to a total collection of 402 sufficient questionnaires, which is a response rate of 3.8%.

### 4.3.4 Data reliability and validity

In terms of validity, this study considered the way questions were formulated. The questions are formulated in such a way that any adult with any level of education should be able to understand them. For some questions that could be interpreted differently, an additional explanation is attached, including an example answer. Also, some questions are addressed to respondents' children, these questions and answers are based on young children's vocabulary.
In addition, an introductory message was sent along with the questionnaire, advising parents to complete the questionnaire together with their child and indicating how to open the questionnaire and change the language settings.

Regarding reliability, the questionnaire was tested by several people for grammatical and practical errors prior to distribution. The questionnaire was tested twice by a parent and a child, the feedback given was processed by the researcher, after which the questionnaire was distributed.

In order not to influence the outcome of a possible relationship between the independent variable participation in the High-Five campaign and both dependent variables, children's travel mode choice and social cohesion in the surrounding neighbourhood and school zones, the variables belonging to the five layers of the socio-ecological model were included to control for their effect on both dependent variables.

## 4.4 Data analysis methods

This section contains the description of the statistical analysis methods that will be performed in SPSS to answer the research questions. In chronological order, the stages of a bivariate analysis and regression analysis method are discussed.

### 4.4.1 Bivariate analysis

A bivariate analysis tests whether there is a relationship between two variables, a dependent variable, and an independent variable. Each variable has its own measurement level, nominal, ordinal, ratio, or interval. If there is insight into which measurement levels belong to the dependent and independent variable, then the correct bivariate analysis can be determined (see table 4.2). The analyses that will be used in this study are: One-way ANOVA, independent sample t-test, chi-squared test, and a Pearson correlation coefficient. The final aim of the bivariate analysis in this study is to determine whether there are significant relationships between the independent variables, the five socio-ecological layers and the High-Five campaign and the dependent variables, travel mode choice and social cohesion in the surrounding neighbourhood and school zones. A relationship is significant when the p-value is lower as 0.05. However, some studies apply a lower threshold of 0.01, for that reason both thresholds are indicated. The independent variables for which significant relationships with one or two dependent variables were found are included in the regression analysis, while those without significant relationships are discarded.

*Table 4.2: Bivariate analyses based on measurement levels*

<table>
<tr><th></th><th colspan="3">Dependent variables</th></tr>
<tr><th>Independent variables</th><td>Dichotome Nominal/ordinal (2 categories)</td><td>Nominal/ordinal (>2 categories)</td><td>Interval/ratio</td></tr>
<tr><td>Dichotome nominal/ordinal (2 categories)</td><td colspan="2" rowspan="3">Chi-square test</td><td>Independent student t-test</td></tr>
<tr><td>Nominal/ordinal (>2 categories)</td><td>One-way ANOVA</td></tr>
<tr><td>Interval</td><td>Spearman correlation</td></tr>
<tr><td>Ratio</td><td>Independent t-test</td><td>One-way ANOVA</td><td>Pearson correlation</td></tr>
</table>

### 4.4.2 Regression analysis

Subsequently, a regression analysis is a statistical method, which is used to analyse a relationship between two or more variables in a way that one variable could be explained or predicted by the other variables. The purpose of this analysis is identifying structural relationships between the independent and dependent variables. Based on the measurement levels of the dependent variables, two types of regression analysis will be used, multinomial logistic regression and multiple linear regression.
For dependent variables with an interval or ratio measurement level (all besides main travel mode), a linear regression analysis will be used. This method is used to investigate the strength of the relationships between two or more independent variables and one dependent variable. The output of the analysis shows the best fitting model, including the most influential independent variables and excluding those which do not contribute to explaining the relationship with the dependent variable.
For testing the relationships with dependent variables that have a nominal ratio measurement level, like main travel mode, a multinomial logistic regression analysis is performed and used to explain the relationship of the independent variables with the dependent variable, which is main travel mode in this study. The output of the analysis shows the relationship between the different nominal categories (bicycle, foot) and the reference category (car).
As with the bivariate analyses, a significance threshold of 0.05 applies to both regression analyses.

## 4.5 Conclusion research methodology

In this chapter the methodology of this study has been described. The aim of this study is to gain insight into the relationships between participation in the High-Five campaign, children's travel mode choice and (directly or indirectly via travel mode choice) social cohesion in the surrounding neighbourhood and school zones. Additionally, the aim is to gain insights into the relationships between parents' perceptions of the High-Five campaign and children's travel mode choice.

In this chapter the conceptual model and sub-model are visualized and described. The main model contains 13 independent variables, of which 12 variables are divided into five variable groups, representing the five layers of the socio-ecological model. and four dependent variables which are evenly divided into two dependent group of variables and the sub-model contains ten independent variables divided into two group of variables, and two dependent variables divided into one dependent group of variables.
Furthermore the operationalization of the variables is described. To gain information regarding all variables included in both models, measurable questions were drawn up, which could be answered based on predetermined answer categories.
The questionnaire was addressed to both parents of children participating and parents of children not participating in the High-Five campaign. The questionnaire was distributed amongst the parents of children aged between 6 to 12 years old which attend Belgian and Dutch schools. In total, 423 completed questionnaires were collected of which 402 were found valid to be included in the analyses of this study.
The upcoming chapters will describe the collected data and the results of both the bivariate and regression analyses.


# DESCRIPTIVE ANALYSES

## CHAPTER 5

# 5. Descriptive analyses

This chapter describes the data obtained from the questionnaire, which is used to answer the fifth sub-question: *What are the personal characteristics of children attending High-Five affiliated schools and what are parents' and children's perceptions of the High-Five platform and its digital platform and school promotion?'* In addition, the data is also used to prepare the dataset for the analyses in the next two chapters.

The questionnaire generated a total of 423 responses, of which 42 were received for the Dutch version and 381 for the Belgian one. Of these, 21 responses were removed due to invalidity, resulting in a total of 402 responses. Eight responses (all Belgian) were removed because these respondents did not agree with the conditions in the consent form. The remaining 13 responses (11 Belgian and 2 Dutch) were removed because the questionnaire indicated that their child was four or five years old despite the exclusion of pre-school classes. The reason for this may be that a school still included pre-schoolers when mailing the questionnaire around or that children passed a class. In this chapter, the data acquired in both questionnaires is merged. For all independent and dependent variables, the specifically per variable acquired data is explained and described. Analysed data of the independent variables (personal characteristics) will be described firstly, followed by the dependent variables (travel mode choice and social cohesion).

## 5.1 Personal characteristics

In this section, the description of the acquired data regarding all personal characteristics is discussed. This includes data regarding the variables representing the five layers of the socio-ecological model, participation in the High-Five campaign and lastly the school promotion and digital platform as part of the sub-model.

### 5.1.1 Social ecological factors

All gathered data regarding the five socio-ecological layers is discussed in this section. Based on the literature review, one or more (sub-)variables were selected for each layer and sorted under the layer name as a group of variables (visualized in the final conceptual model in figure 4.1). The purpose of collecting this data is to control for the influence of these variables on the investigated link between participation in the campaign and the dependent variables travel mode choice and social cohesion in the surrounding neighbourhood and school zones.

#### *Personal environment*

The third layer of the socio-ecological model explains the personal factors that may influence a child's travel mode choice. Table 5.1 shows the acquired data for the social variables age, gender, grade, and traffic skills.

*Table 5.1: Description sample - personal factors*

| Variable | | N in sample | % of sample | Level of measurement |
|---|---|---|---|---|
| **Age** | | | | |
| | **6** | 44 | 10.9% | Ratio |
| | **7** | 66 | 16.4% | |
| | **8** | 61 | 15.2% | |
| | **9** | 53 | 13.2% | |
| | **10** | 73 | 18.2% | |
| | **11** | 78 | 19.4% | |
| | **12** | 27 | 6.7% | |
| **Grade** | | | | |
| **3** | **1** | 82 | 20.4% | Ordinal |
| **4** | **2** | 57 | 14.2% | |
| **5** | **3** | 65 | 16.2% | |
| **6** | **4** | 60 | 14.9% | |
| **7** | **5** | 82 | 20.4% | |
| **8** | **6** | 56 | 13.9% | |
| **Gender** | | | | |
| | **Male** | 218 | 54% | Nominal |
| | **Female** | 184 | 46% | |
| **Traffic skills** | | | | |
| | **1** | 7 | 1.7% | Ordinal |
| | **2** | 33 | 8.2% | |
| | **3** | 133 | 33.1% | |
| | **4** | 190 | 47.3% | |
| | **5** | 39 | 9.7% | |

The age and grade levels of children attending affiliated schools of the High-Five campaign are normally distributed. However, a relatively large decay can be seen in the number of children from 11- to 12-year-olds (19.4% to 6.7%) and the number of children attending grade 7 to 8 in The Netherlands or grade 5 to 6 in Belgium (20.4% to 13.9%). Regarding the variable age this decay is presumably linked to the large number of school leavers attending high school, while this cannot be the case for the variable grade, as a new highest grade is formed every year. As can be seen in cross table 5.2, most children that participate in the High-Five campaign are 10 or 11 years old. In contrast, the age at which children do participate the least in the campaign is 12 years old. However, the proportion not participating in the campaign is fairly evenly distributed across all ages, varying approximately between 1 and 3%.

*Table 5.2: Description results participation rate by age*

| **Variable:** | **Participation in the High-Five campaign** | | |
|---|---|---|---|
| **Age** | **Yes** | **No** | **Total:** |
| **6** | 10.2% | 0.7% | 10.9% |
| **7** | 13.2% | 3.2% | 16.4% |
| **8** | 12.4% | 2.7% | 15.2% |
| **9** | 12.2% | 1.0% | 13.2% |
| **10** | 15.7% | 2.5% | 18.2% |
| **11** | 17.2% | 2.2% | 19.4% |
| **12** | 5.5% | 1.2% | 6.7% |
| **Total:** | **86.3%** | **13.7%** | **100%** |

The variable gender is almost evenly distributed with slightly more boys (54%) than girls (46%). Only one respondent indicated that there child had a different gender then male or female. To simplify the analysis of the data, this answer has been recoded as the most commonly mentioned gender, which is male.

Lastly, the variable traffic skills is also normally distributed. This is consistent with the data of the variable, perceived traffic safety. Over 80% of respondents rated their child's traffic skills with a grade of 3 or 4. As with traffic safety, respondents generally not rate their children's traffic skills as very low. However, statistics shows that there is still plenty of room for improvement, due to the low proportion of respondents rating their child's traffic skills as very good (score of 5).

### *Built Environment*

The Built Environment is the first layer and group of variables of the socio-ecological model. Table 5.3 shows the acquired data for the variables travel distance and traffic safety. The scale used for measuring the variable in the questionnaire is shown in the left bracket of the table. Also, the sample distribution and associated measurement level are shown per variable.

*Table 5.3: Description built environment factors*

| Variable | N in sample | % in sample | Level of measurement |
|---|---|---|---|
| **Travel distance:** | | | |
| *<0.5 km* | 73 | 18% | Ordinal |
| *0.5 – 1.0 km* | 97 | 24% | |
| *1.0 – 2.0 km* | 107 | 27% | |
| *> 2.0 km* | 125 | 31% | |
| **Perceived traffic safety:** | | | |
| *1* | 22 | 5% | Ordinal |
| *2* | 74 | 19% | |
| *3* | 157 | 39% | |
| *4* | 119 | 30% | |
| 5 | 30 | 7% | |

The first variable, travel distance, is not evenly distributed, with the sample percentage increasing by each interval. The intervals are relatively close together, fluctuating between 18 and 31%, with the largest share of respondents indicating that their children have to travel more than two kilometres from home to school. Perceived traffic safety is the second variable within the Built Environment layer. To acquire data regarding this variable, respondents had to rate the safety level of their child's route to school on a five-point scale. Most respondents (39%) graded their child's route to school with a score of 3. It is notable that only 5% of the respondents graded the route to school with a score of 1 and only 7% with a score of 5. From this, it can be concluded that the routes to school are not very unsafe but there is room for improvement.

### *Social environment*

The second layer represents the social environment in the socio-ecological model, and from scientific literature results, one variable has been included as control variable, which is main transport mode of peers. As the data shows in table 5.4, respondents indicated the car (36.3%) as the most dominant travel vehicle amongst their child's peers before the implementation of the campaign. Furthermore, it is remarkable that relatively few children walk to school (7.5%). It must be mentioned that more than one third of all respondents does not know which travel mode choice is the most dominant amongst their child's peers.

*Table 5.4: Distribution main transport mode of peers*

| Variable | N in sample | % in sample | Level of measurement |
|---|---|---|---|
| **Main transport mode of peers** | *Before implementation High-Five* | | |
| *Car* | 146 | 36.3% | Nominal |
| *Bicycle* | 88 | 21.9% | |
| *By foot* | 30 | 7.5% | |
| *I do not know* | 138 | 34.3% | |

### *Household environment*

Household is the fourth variable of the socio-ecological model. Within this group of variables, four (sub-)variables were included, household size, SES, car ownership and ethnicity. The first variable household size is normally distributed, with the vast majority (56%) indicating that their household consists of four people. As shown in table 5.5. Almost no respondents indicate to have a household size larger than five people (3.7%).

*Table 5.5: Description sample - household factors*

| Variable | N in sample | % in sample | Level of measurement |
|---|---|---|---|
| **Household size** | | | |
| *2* | 26 | 6.4% | Ordinal |
| *3* | 67 | 16.7% | |
| *4* | 225 | 56.0% | |
| *5* | 69 | 17.2% | |
| *6 or more persons* | 15 | 3.7% | |
| **SES (Socio-economic-status)** | | | |
| *Low* | 34 | 8,5% | Nominal |
| *Medium* | 89 | 22,1% | |
| *High* | 174 | 43.3% | |
| *I do not know* | 105 | 26.1% | |
| **Car ownership** | | | |
| ***No private car*** | 22 | 5.5% | Nominal |
| *Yes, 1 private car* | 196 | 48.8% | |
| *Yes, 2 or more private cars* | 184 | 45.8% | |
| **Ethnicity** | | | |
| *Belgian background* | 348 | 86.6% | Nominal |
| *Dutch background* | 42 | 10.4% | |
| *Western migration background* | 5 | 1.2% | |
| *Non-western migration background* | 7 | 1.7% | |

The second variable is socio-economic-status. In the questionnaire, the question on household SES could be answered using interval categories, indicating specific income ranges (e.g. €20.000-€30.000). These were then reduced to four categories, low, medium, high and I do not know, where adding the latter resulted in the variable having a nominal measurement level.

The largest proportion of respondents (43.3%) indicated that their household income is within the highest category, representing an income of €50.000,- or more. This relates with the gross domestic product per capita for both The Netherlands (€53.200,-) and Belgium (€47.300,-) (CBS, 2023).

Car ownership is the third household variable. As visible in the table, 94.5% of the households possess one private car, of which 45.6% even possessing over two or more private vehicles. Only 5.5% of the respondents indicated to have no possession of a private car within their household.
Next, is the ethnicity variable, which was measured based on the scale shown in table 5.5. In total, 97% of respondent's children has a Dutch or Belgian background. Respondents were also able to fill in the option other, of which most of them responded with a specific country or region, which were then divided and coded under the correct categories as visible in the table. Due to the lack of variation in the data, it is decided to not include the ethnicity variable in the data analyses in chapters 6 and 7.

*External environment*

In this section the data regarding the external factors is discussed. As mentioned earlier, country is the only variable included as a control factor to reflect the differences between both countries. Respondents were asked to indicate in which municipality their child attends primary school. In total, 90.05% of the respondents had children attending a school in a Belgian municipality and 9.95% attending a school in a Dutch municipality. A logical consequence of the fact that 44 of the 53 affiliated schools are localised in Belgium and hence by far the majority of the population is resident in Belgium.

### 5.1.2 Participation in the High-Five campaign

The last independent variable represents children's participation in the High-Five campaign. From all 402 respondents, 347 respondents indicated that there child participated in the High-Five campaign, representing 86.3% of the total sample. The share of respondents whose child participates in the campaign is even higher as the overall participation rate in the campaign (79%), mentioned earlier in chapter 3.

### 5.1.3 Perceptions of the High-Five campaign (sub-model)

This section describes the data acquired of parents' and children's perceptions of the High-Five campaign, which is the only independent variable included in the sub-model. This variable contains two groups of variables, the digital platform and school promotion. Data is collected to gain insight in people's perception regarding the gamification elements of the digital platform and school promotional activities. The data acquired regarding the digital platform and school promotion is derived from a smaller sample (N=85), because respondents whose child did not participate in the High-Five campaign or did not log on to the platform at least every fortnight skipped the questions on both variables.

*Digital platform*

The first and largest group of variables of the High-Five campaign is measured by multiple variables like the lay-out and design of the platform's interface, seven gamification elements and usage rate by both parent and child. All data collected regarding the measurement of factors belonging to High-Five's digital platform is described in this section. This section discusses the data obtained in part two of the questionnaire (Perceptions of the digital platform).
At first, respondents were asked if there child participates in the campaign, of which 87% indicated that their child did so. Those who indicated that their child did not participate were able to skip the following questions about the digital platform, which explains why the number of respondents is significantly lower in the following data, shown in figures and tables. After this parents and their child's usage rate of the platform was measured.

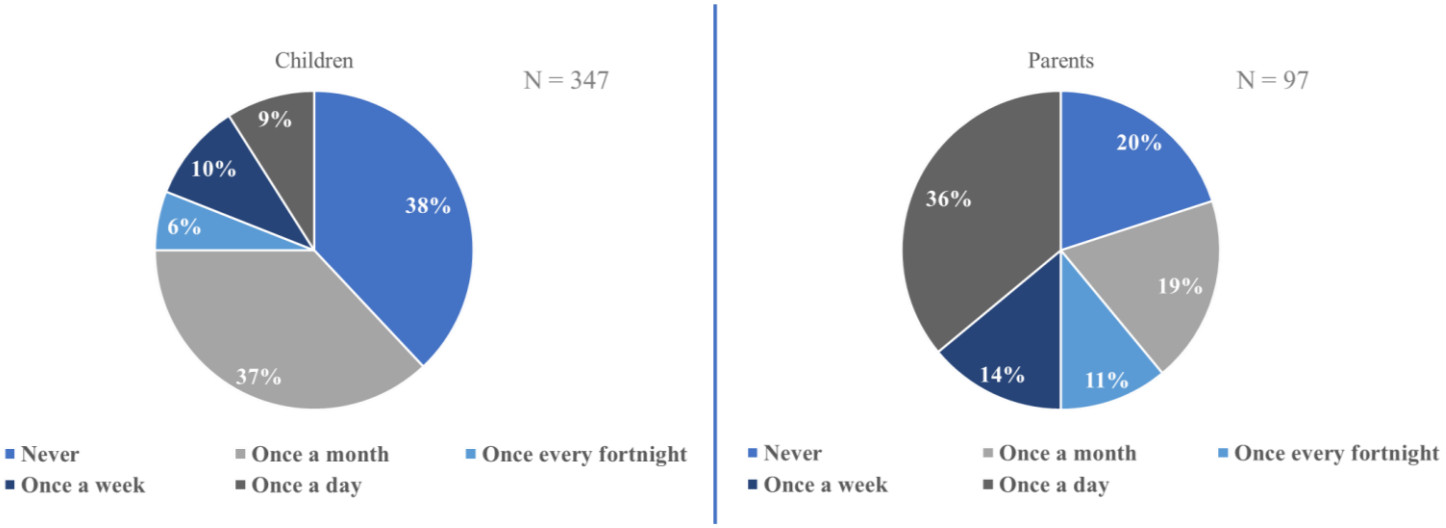



*Figure 5.1: Usage rate digital platform by children and parents*

As can be seen in figure 5.1, most children used the platform only once per month (N=121) or even never (N=112). Only 29 out of 315 children visited the platform on a daily basis. When respondents indicated that their child never or only once per month logged into the platform, they would also skip all following questions regarding the platform, which explains the differing N-values between usage rate of child and parent. The fact that children hardly visit the platform is not a negative indication, since as mentioned earlier, the purpose of the platform is not to increase users screen time. Remarkable is the usage rate of the parent, as most respondents (30.9%) indicate to visit the platform on a daily basis. When parents stated to never use the platform or only once a month, they were asked an additional question as to why they do not use the platform. 45% of parents indicated to not have the time for it. Other reasons included not liking the platform (4.6%), not understanding it (5.7%), or forgetting their password/username (4.6%).

Subsequently, the next question asked parents whether or not they were familiar with all elements of the digital platform and their functionality, of which 68,3% replied to be so. The remaining 31.7% would skip the next two questions, involving the assessment of the seven gamification elements. Both bar charts in figure 5.2 indicate the ratings of all seven gamification elements, given by both parent and child. Dark blue is the largest share in all bars, which means that most respondents have a positive perception of all elements, rating them most frequently with the highest grade (5). Winning rewards has been rated by both parents and children as the most liked element, followed up by earning medals and creating their own personal avatar. Also ranking of school and children's class were graded mostly with a 4- or 5-score by both child and parent. Compared to the ones mentioned, My tree and the videos about the High-Five adventurous were rated the lowest, with 50 to 60% of the respondents grading these elements with a 1,2 or 3-score. It is notable that parents were more familiar with elements than their children, which is probably caused by a significant difference in response numbers. Parents who indicated earlier in the questionnaire that they are not familiar with the platform were not asked this question. As expected, traffic quizzes were rated higher by parents as by their children, although the difference is not substantial.

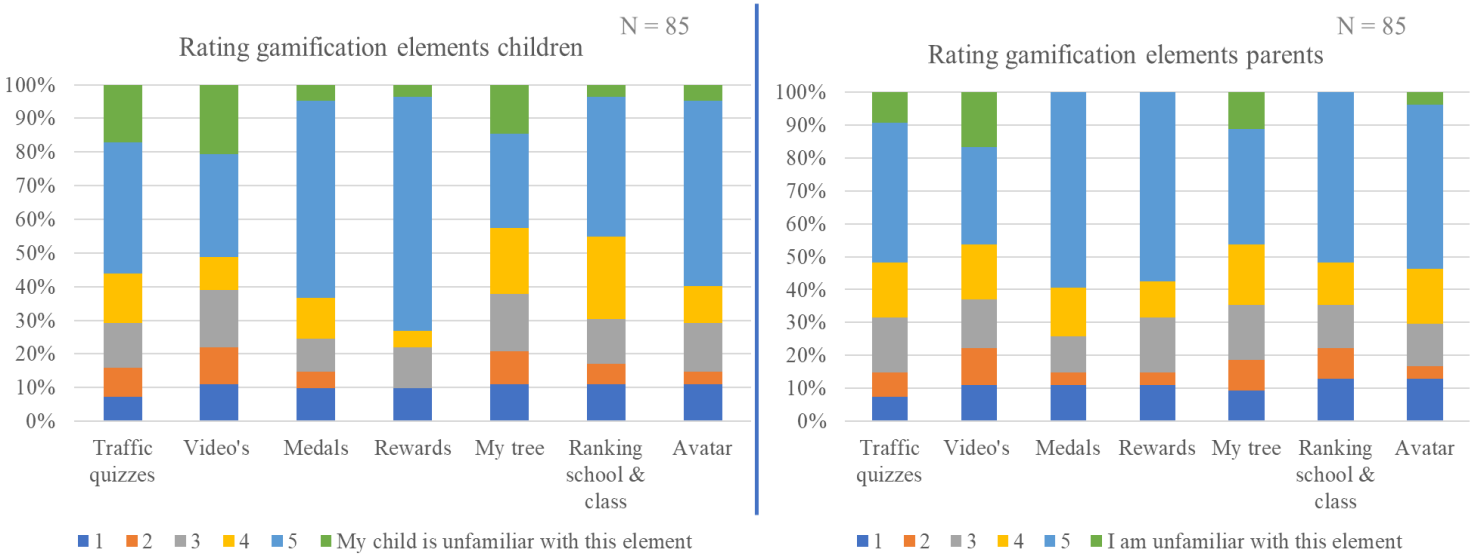



*Figure 5.2: All 7 gamification elements of the High-Five platform rated on a scale of 1-5 by children and parents*

Parents and children were asked in an open-ended question what elements they would like to see added to the platform. Most parents mentioned that the gamification selection on the platform is sufficient and does not need any additional elements. Most children stated they would like to see games added to the platform. Other remarks made, where the lack of rewards on the platform, and more quizzes related to school topics about animals or nature. Videos about traffic hazards, class rewards and visualising the number of kilometres travelled by bike and/or on foot were also raised by parents and children as a nice addition to the platform.

Lay-out is the only non-gamification variable which is measured as part of the digital platform component. As can be seen in figure 5.3, parents and children have an almost equivalent response distribution. Exactly the same number of parents and children (42) reviewed the lay-out of the platform as 'nice' and 18 parents and 23 children even rated the lay-out as 'very nice'. Only, three parents and two children rate the platform as 'ugly' or 'very ugly', which means the Lay-out is liked by the vast majority of users (76% rated it as 'nice' or 'very nice').

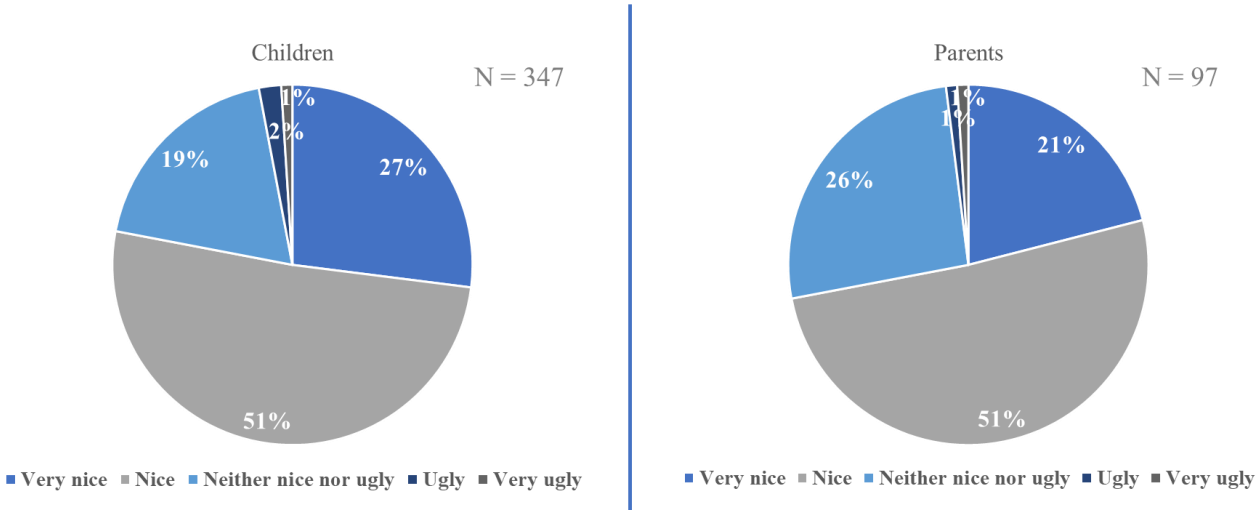



*Figure 5.3: Rating lay-out of the digital platform by children and parents*

Lastly, respondents and their children were asked to indicate what improvements could be made to make the platform more attracting or more user friendly. As can be seen in figure 5.4, most children mentioned games as a good addition to the platform, while adding traffic quizzes was the most mentioned addition amongst parents. Notable, a large share of parents and children indicated that the platform is fine as it is now, and nothing needs to be added.

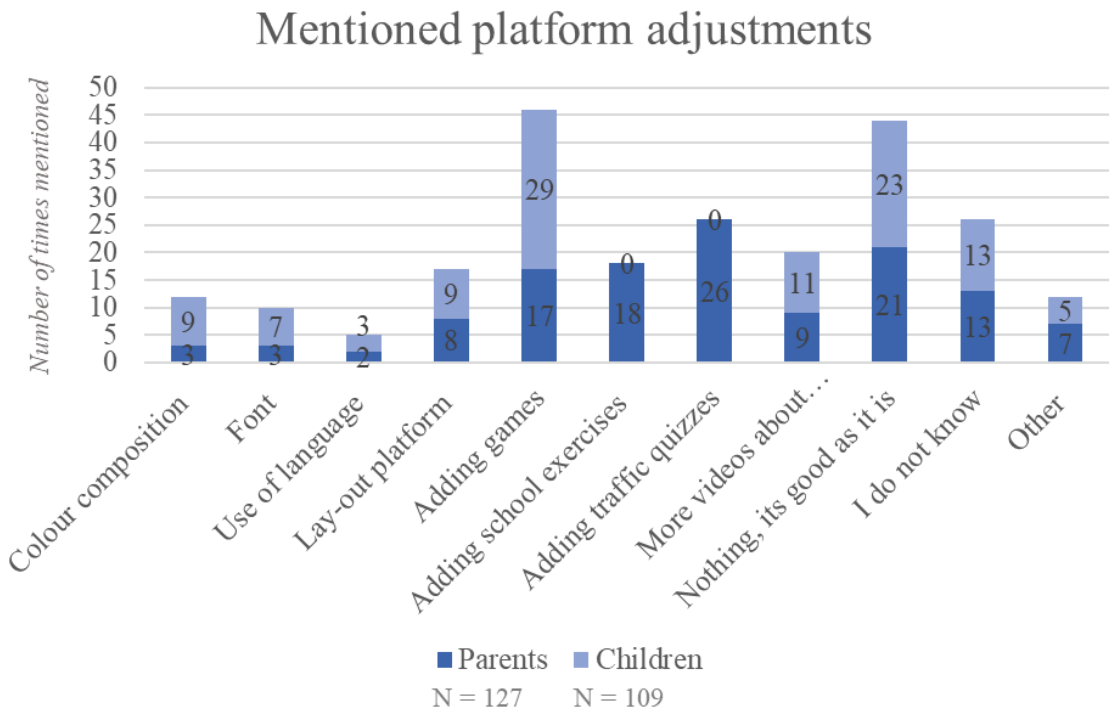



*Figure 5.4: Platform adjustments by children and parents*

Finally, the layout was rated positively as nice or very nice by the vast majority of both parents and children. In addition, it can be concluded that the content of the platform is currently adequate, but the addition of extra traffic quizzes is appreciated by parents. Children indicate that the inclusion of games is as a positive addition to the platform. However, this goes against High-Five's intent of not engaging children with the platform for a longer period of time.

### *Promotion school*

The second group of variables school promotion represents the activities or the effort the school undertakes to promote the campaign. This variable is measured by two variables, the number of referral moments and the most dominant communication channel. Also, for this variable the sample size is smaller, N =85.

*Table 5.6: Sample description - school promotion methods*

| Variable: | N in sample | % of sample | Level of measurement |
|---|---|---|---|
| **Referral moments** | | | |
| *Never* | 16 | 18.8% | Interval |
| *Once a month* | 24 | 28.2% | |
| *Once every fortnight* | 2 | 2.4% | |
| *Once a week* | 10 | 11.8% | |
| *Once a day* | 4 | 4.7% | |
| *I do not know* | 29 | 34.1% | |
| **Communication channels** | | | |
| *Email* | 32 | 37.6% | Nominal |
| *Letter* | 3 | 3.5% | |
| *Portal/platform/and or website of the school* | 49 | 57.6% | |
| *Parental interviews* | 1 | 1.2% | |
| *Personal face-to-face conversation* | 0 | 0.0% | |

Referral moments is the amount of times a teacher or schoolboard refers to the campaign during lessons. Looking at the data in table 5.6, it can be concluded that most respondents indicated that the campaign is never referred to (18.8%) or only once a month (28.2%), which in fact means that almost 50% of schools never or almost never refer to the platform. In addition, 34.1% of respondents also indicated that they had no idea, which basically means that messages regarding high-Five do not reach them.

The variable communication channels is measured by finding out which channel is most frequently used by schools to convey information about High-Five to parents. In total, 57.6% of the respondents mentioned the school portal/platform or website as the most used channel to inform parents about the campaign. Also, email (37.6%) appeared to be a dominant communication channel amongst schools. Some respondents also indicated that the school of their child uses Whatsapp to convey the messages about High-Five.

## 5.2 Travel mode choice and neighbourhood social cohesion

This section contains the description of the acquired data regarding the dependent variables. As visualized in the conceptual model, the dependent variables are travel mode choice and social cohesion in the surrounding neighbourhood and school zones. In order to increase the chances of finding relationships between the independent and dependent variables, (sub-)variables were included as part of the dependent variables, which were therefore indicated as group of variables.

### 5.2.1 Travel mode choice

Travel mode choice is the first dependent variable in the conceptual model. This variable was made measurable by asking respondents in the questionnaire about their children's main travel mode choice prior to the implementation of the High-Five campaign and the change in active transport due to the implementation of the campaign. As can be seen in figure 5.5, 44% of all respondents indicate that their child travels to school by car before the implementation of the campaign. The bicycle was used as main travel mode by 33% of respondents' children and 23% commuted mainly to school by foot.

Respondents were also able to indicate the use of other active means of transport. Four respondents indicated the kick-bike as their child's main travel mode, which has been categorised and as bicycle. Furthermore, two respondents indicated the school bus as main travel mode, which was categorized as car. Also, some respondents indicated a combination of travel modes. If this combination included the car, it was categorised as similar. A fully active combination was categorised as 'by foot'.

Additionally, respondents indicated which possible valid reasons they had to not allow their children to travel actively to school. This information is not used to measure the variable travel mode choice, but as an additional explanatory reference, all parental barriers for allowing their children travel to school actively are included and explained in Appendix C.

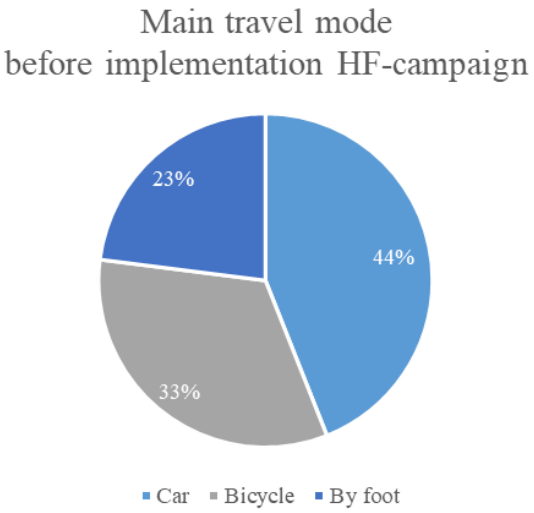



*Figure 5.5: Main travel mode distribution before the implementation of the High-Five campaign*

The second variable which measures the travel mode choice of children, is indicated as the change in active transport since the implementation of the High-Five campaign. Respondents were asked how often and by what means of transport their child travelled to school during an average five-day school week prior to and after the implementation of the campaign. Subsequently, all indicated numbers of all means of transport used were added up to a number representing the complete transport mode use of a child during an average school week. The proportion of active transport was then accumulated and divided by the full mode of transport use. This number represents the percentage of active transport used by a respondent prior and after the implementation of the campaign. In order to test possible relationships in SPSS between change in active transport and both dependent variables, the number representing the percentage of active transport after the campaign is subtracted from the number prior to the campaign, showing the cumulative change caused by the campaign.

Figure 5.6 shows children's change in participating in active transport to school since the implementation of the campaign. As can be seen, the majority of respondents see no to a small negative impact (259 respondents) from the campaign on their child's active transportation (0-10%). However, the figure shows that remaining respondents mostly indicate that the implementation of the campaign has led to a positive change in their children's active transport mode usage with 63 respondents indicating a small growth between 0-20% and 32 respondents a growth between 20 and 40%.

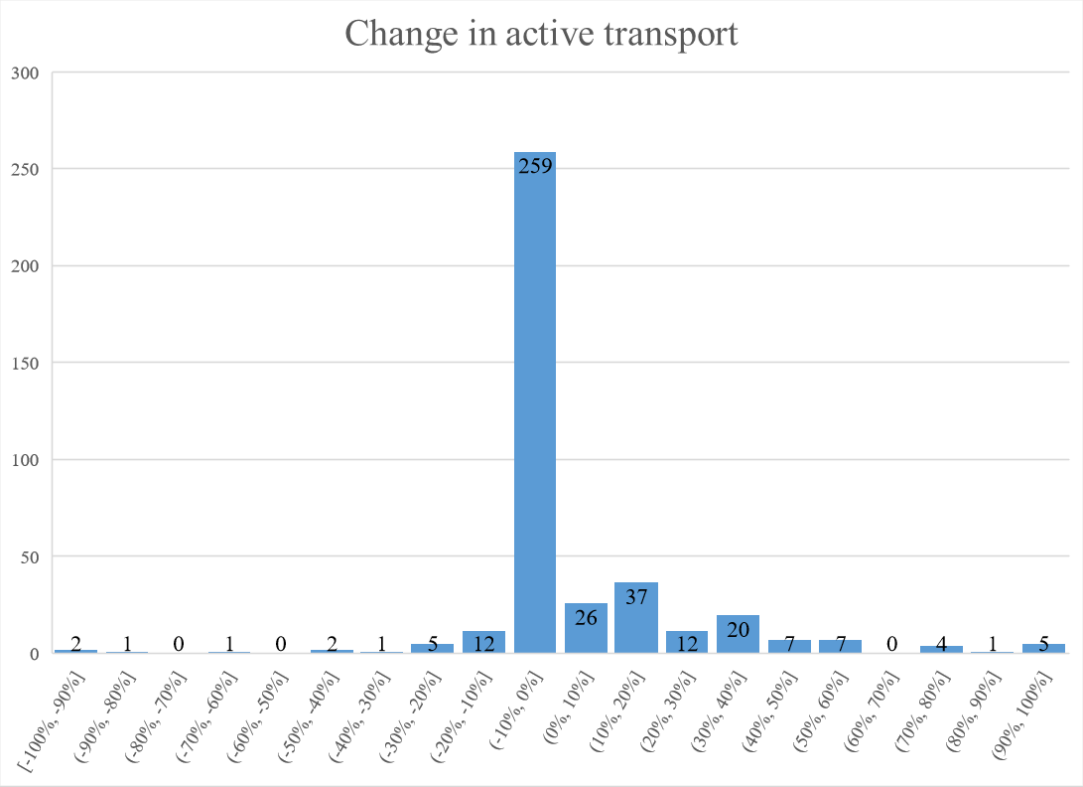



*Figure 5.6: Change in active transport since High-Five campaign*

### 5.2.2 Social cohesion surrounding neighbourhood and school zones

This section discusses the data gathered regarding the last group of dependent variables, the social cohesion in the surrounding neighbourhood and school zones. This group of variables consists out of two variables, neighbourhood social cohesion level and change in social contact. The first one is measured by using ten statements from Buckner's neighbourhood cohesion scale, in which respondents were asked to indicate to which extent they agree or disagree with these statements since the implementation of the campaign (Buckner, 1988). All statements are presented in section 4.2.3. To analyse the data obtained in SPSS, the sum of the scores on all ten statements was divided by the number of statements into one number, ranging between 1-5.

To check whether this variable is reliable, a Cronbach Alpha reliability analysis was performed to show the degree of correlation between all statements.
This revealed a Cronbach Alpha of 0.92, which means that all statements correlate strongly with each other and is therefore considered to be reliable. How respondents perceive the level of social cohesion within their neighbourhood since the implementation of the campaign is visualized through Figure 5.7.

As can be seen in figure 5.7, most respondents value the social cohesion level in their neighbourhood with a score between 2.5 and 4. This means that most respondents rate the social cohesion as rather positive than negative. However, results show that there is still room for improvement, with only 13% of all respondents valuing the social cohesion between 4 and 5 and 22% valuing it below 2.5, which represents the average.

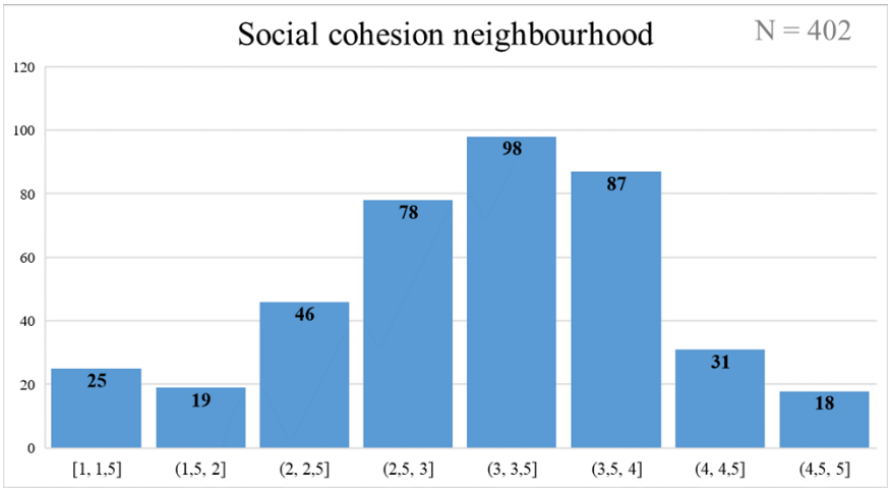



*Figure 5.7: The extent to which parents agree with the 10 statements regarding social cohesion within their neighbourhood*

Change in social contact is the second variable included in the group of variables. This variable was measured by asking respondents how they rated their social contact with fellow neighbours prior to and after the implementation of the High-Five campaign. As can be seen in table 5.7, most respondents indicated to have regular contact (31.1%) with their fellow neighbours prior to the campaign. However, other categories are evenly matched with 23.9% of respondents indicating to have good contact, while 23.1% mentions to have barely any contact. These numbers indicate that the implementation of the High-Five campaign did not have a substantial positive or negative impact on respondents' social contact with their neighbours.

*Table 5.7: Description social contact before and after the implementation of the High-Five campaign*

| Variable | N in sample | % of sample | N in sample | % of sample | Level of measurement |
|---|---|---|---|---|---|
| | Before | | After | | |
| **Social contact** | | | | | |
| **No contact** | 63 | 15.7% | 65 | 16.2% | |
| **Barely any contact** | 93 | 23.1% | 85 | 21.1% | |
| **Regular contact** | 125 | 31.1% | 130 | 32.3% | Ratio |
| **Good contact** | 96 | 23.9% | 93 | 23.1% | |
| **Very good contact** | 25 | 6.2% | 29 | 7.2% | |

Figure 5.8 visualizes the change in social contact after the implementation of the campaign. As the percentages already indicated, only small changes are visible. After the implementation of the campaign, only four more respondents indicated to have very good contact with their neighbours while two more respondents indicated to have no contact at all with their neighbours after the implementation of the campaign. Hence, it can be concluded that the implementation of the High-Five campaign did not lead to substantial changes in parents social contact with their fellow neighbours.

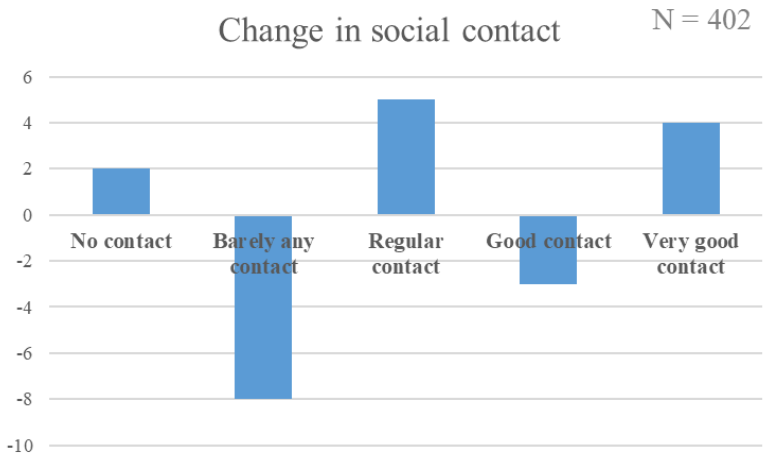



*Figure 5.8: Impact of the High-Five campaign on parents' social contact*

## 5.3 Descriptive analyses conclusion

The aim of this chapter was to answer sub-question five: '*What are the personal characteristics of children attending High-Five affiliated schools and what are parents' and children's perceptions of the High-Five platform and its digital platform and school promotion?'*

Measuring the independent variable travel mode choice before the implementation of the High-Five campaign showed that the car was the most dominant travel mode for 44% of all children, while the bicycle was used as main travel mode by 33% of all children and 23% commuted regularly by foot.

Furthermore, a rather positive than negative effect was measured in the change of active transport. While most respondents barely any effect on their child's use of active transport, the remaining respondents mostly indicated that the campaign led to a positive change in active transport with 63 respondents indicating a small growth between 0-20% and 32 respondents a growth between 20-40%.

Regarding the measurement of independent variable neighbourhood social cohesion level, results showed that 78% of all respondents rated the level of social cohesion in their neighbourhood rather positive than negative with a value of 2.5 up to the maximum of 5. In addition, no substantial changes were shown in parents' social contact with their neighbours.

In total, 87% of respondents' children participate in the campaign, of which 10- and 11-year-olds participate the most in the campaign while on the opposite only 5.5% of the participants is 12 years old.

From the measurement of the socio-ecological variables came forward that respondents (43.3%) indicated to have a household income within the highest category (€50.000 or more). Additionally, parents mainly rate their child's traffic skills and traffic safety of the routes to school with a score of 3 or 4 on a scale of 1-5, leaving room for improvement in both variables.

It is also noteworthy that just as many respondents have two private cars as have one, with only 5.5% having no private car at all. The measurement of the digital platform variable, included in the sub-model, revealed that the lay-out and gamification elements are mostly viewed positively by parents and children. Videos of superhero High-Five's adventurous and my tree were rated the as underperformers. In this regard, adding extra school exercises and traffic quizzes to the portfolio of the digital platform is seen as a valuable addition by both parents and children.

Finally, results showed that schools barely invest effort in promotional messages regarding the campaign, and if so, utilize email which is an outdated mean of communication compared to others available.

# BIVARIATE ANALYSES

## CHAPTER 6

# 6. Bivariate analyses

In this chapter, the results of the bivariate analyses performed in SPSS are discussed, which is used to answer the sub-question six: '*What are the bivariate relationships between participation in the High-Five campaign and the dependent variables, travel mode choice and social cohesion in the surrounding neighbourhood and school zones and between travel mode choice and social cohesion in the surrounding neighbourhood and school zones?'*

The results of the analyses are discussed by variable as stated in the conceptual model. The variables in the sub-model were not included in the bivariate analyses since the sample size was much lower compared to the data collected regarding the variables in the main conceptual model. Therefore, it has been decided that the data regarding the variables included in the sub-model was insufficient to include in the bivariate analyses.

## 6.1 Explanation bivariate analyses

The purpose of the bivariate analyses is to investigate whether or not there is a relationship between two variables, one dependent and one independent. In this section, possible relationships between all independent and dependent variables, which are included in the conceptual model, are examined. Relationships between independent and dependent variables are considered to be significant when the p-value is lower as 0.05. Some studies consider relationships only significant when the p-value is lower as 0.01, for that reason the difference between both threshold values is indicated with different colour tones in the tables. Only variables that have a significant relationship with one or both independent variables are included in the second step of the data analysis, the regression analysis. All unrelated variables are dropped.

All included variables in the conceptual model have different measurement levels, which means that to determine the relationships between the dependent and independent variables, the appropriate testing method is chosen. In this study an One-way ANOVA, Chi-square test, Independent sample t-test or a Pearson correlation test has been conducted to investigate possible relationships between independent and dependent variables. Table 6.1 shows the measurement levels of each dependent variable, including the indication of which group of variables it belongs to.

*Table 6.1: Dependent variables and associated measurement levels and group of variables*

| Dependent variables | Group of variables | Measurement level |
|---|---|---|
| Main travel mode | Travel mode choice | Nominal (3 groups) |
| Change in active transport | | Ratio |
| Social cohesion neighbourhood | Social cohesion in surrounding neighbourhood and school zones | Ratio |
| Change in social contact | | Ratio |

## 6.2 Socio-ecological factors

In this section, the bivariate analyses regarding all socio-ecological variables are discussed. For each independent layer, all associated variables are tested for significant relationships with both dependent variables. Analysing the relationships includes the usage of the following tests: chi-square test, independent sample t-test, one-way ANOVA, and Pearson correlation. Table 6.2 shows the results of all the bivariate analyses. These were conducted to examine whether the control variables, comprising the socio-ecological model, have significant relationships with the dependent variables. Only positive significant relationships were found. The relationships between the independent and dependent variables are described per socio-ecological layer.

*Table 6.2: Bivariate analyses socio-ecological variables*

| **Variables** | **Main travel mode** | | **Change in active transport** | | **Change in social contact** | | **Neighbourhood cohesion level** | |
|---|---|---|---|---|---|---|---|---|
| | ***Chi-square test*** | | ***One-way ANOVA*** | | | | | |
| | *Chi sq.* | *Sig.* | *F-value* | *Sig.* | *F-value* | *Sig.* | *F-value* | *Sig.* |
| ***Built Environment*** | | | | | | | | |
| Travel distance | 181.437 | 0.001 | 4.704 | 0.003 | 0.595 | 0.618 | 1.186 | 0.315 |
| Perceived traffic safety | 31.971 | 0.001 | 0.376 | 0.826 | 0.132 | 0.970 | 0.766 | 0.548 |
| ***Social environment*** | | | | | | | | |
| Main transport mode of peers | 72.000 | 0.001 | 0.606 | 0.611 | 0.350 | 0.789 | 0.646 | 0.586 |
| ***Personal environment*** | | | | | | | | |
| Traffic skills | 42.250 | 0.001 | 0.855 | 0.491 | 0.401 | 0.808 | 2.071 | 0.084 |
| Grade | 9.993 | 0.441 | 1.249 | 0.285 | 0.494 | 0.781 | 0.892 | 0.486 |
| | ***Chi-Square test*** | | ***Independent sample t-test*** | | | | | |
| | *Chi sq.* | *Sig.* | *t-value* | *Sig.* | *t-value* | *Sig.* | *t-value* | *Sig.* |
| Gender | 0.361 | 0.835 | -1.568 | 0.118 | 0.386 | 0.700 | -1.833 | 0.068 |
| | ***One-way ANOVA*** | | ***Pearson correlation*** | | | | | |
| | *F-value* | *Sig.* | *r-value* | *Sig.* | *r-value* | *Sig.* | *r-value* | *Sig.* |
| Age | 0.523 | 0.791 | 0.103 | 0.039 | 0.06 | 0.908 | -0.040 | 0.420 |
| ***Household Environment*** | | | | | | | | |
| Household size | 0.759 | 0.552 | 0.018 | 0.714 | 0.008 | 0.879 | 0.125 | 0.012 |
| | ***Chi-square test*** | | ***One-way ANOVA*** | | | | | |
| | *Chi sq.* | *Sig.* | *F-value* | *Sig.* | *F-value* | *Sig.* | *F-value* | *Sig.* |
| SES (income) | 5.042 | 0.538 | 0.391 | 0.760 | 1.132 | 0.336 | 4.607 | 0.003 |
| Car ownership | 23.922 | 0.001 | 0.870 | 0.420 | 0.215 | 0.807 | 2.741 | 0.066 |
| ***External environment*** | | | | | | | | |
| | ***Chi-square test*** | | ***Independent sample t-test*** | | | | | |
| | *Chi sq.* | *Sig.* | *t-value* | *Sig.* | *t-value* | *Sig.* | *t-value* | *Sig.* |
| Country | 11.973 | 0.003 | 2.482 | 0.015 | -1.017 | 0.315 | 1.062 | 0.294 |

Significant at 0.01 | Significant at 0.05 | Not significant

*Built environment*

In this section the output from the bivariate analyses regarding the examination of the relationships between the independent built environment variables and both dependent group of variables are discussed. To test the relationships of travel distance and perceived traffic safety with both dependent variables, a chi-square test and One-way ANOVA test were conducted.

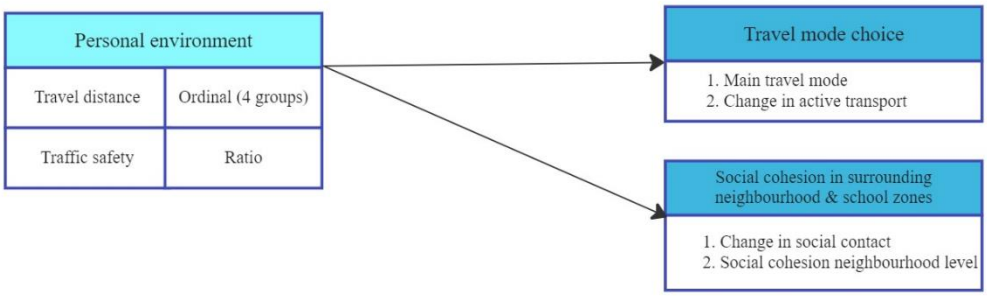



*Figure 6.1: Visualisation bivariate analyses independent BE variables – dependent variables*

As shown in table 6.3, travel distance is positively associated with main travel mode. Meaning that the shorter the distance the more likely children are to travel actively to school. Looking at table 6.3, the statistics confirm the relationship found, with 75.2% of children who have to travel the longest distance to school being brought by car. The shortest distance (<0.5km) is covered on foot by the vast majority (71.2%) and at a distance between 0.5 km and 2.0 km, bicycles are mainly used. Also, travel distance appeared to have a significant relationship with change in active transport since the implementation of the High-Five campaign. This is a logical consequence, since the implementation of the campaign is likely to have an effect on the transport use of children who have to travel the furthest, since this group, as just mentioned, is by far the most frequent user of the car prior to the campaign. The second variable, perceived traffic safety is significantly associated with main travel mode, which is again supported by the results in cross table 6.3. The safer the route to school is rated by parents, the more often children actively travel to school and are brought less by car. None of the BE variables were found to have a significant relationship with the two variables included in the group of variables related to social cohesion.

*Table 6.3: Cross table chi-square test BE variables - Main travel mode*

| **Main travel mode** | | **Travel distance** | | | | | | **Chi-sq.** | **Sig.** |
|---|---|---|---|---|---|---|---|---|---|
| | | <0.5km | 0.5-1.0km | 1.0-2.0km | >2.0km | | Total | | |
| Car | Count | 6 | 26 | 49 | 94 | | 175 | 181.437 | 0.001 |
| | % | 8.2% | 26.8% | 45.8% | 75.2% | | 43.5% | | |
| Bicycle | Count | 15 | 41 | 49 | 29 | | 134 | | |
| | % | 20.5% | 42.3% | 45.8% | 23.2% | | 33.3% | | |
| Foot | Count | 52 | 30 | 9 | 2 | | 93 | | |
| | % | 71.2% | 30.9% | 8.4% | 1.6% | | 23.1% | | |
| Total | Count | 73 | 97 | 107 | 125 | | 402 | | |
| | % | 100% | 100% | 100% | 100% | | 100% | | |
| **Main travel mode** | | **Perceived traffic safety** | | | | | | **Chi sq.** | **Sig.** |
| | | 1 | 2 | 3 | 4 | 5 | Total | | |
| Car | Count | 17 | 44 | 70 | 36 | 8 | 175 | 31.971 | 0.001 |
| | % | 77.3% | 59.5% | 44.6% | 30.3% | 26.7% | 43.5% | | |
| Bicycle | Count | 3 | 20 | 54 | 45 | 12 | 134 | | |
| | % | 13.6% | 27.0% | 34.4% | 37.8% | 40.0% | 33.3% | | |
| Foot | Count | 2 | 10 | 33 | 38 | 10 | 93 | | |
| | % | 9.1% | 13.5% | 21.0% | 31.9% | 33.3% | 23.1% | | |
| Total | Count | 22 | 74 | 157 | 119 | 30 | 402 | | |
| | % | 100% | 100% | 100% | 100% | 100% | 100% | | |

*Table 6.4: Descriptive statistics BE factors – dependent variables*

| Variable | Change in active transport | | Change in social contact | | Neighbourhood cohesion level | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *N* | *Mean* |
| **Travel distance** | | | | | | |
| *<0.5km* | 73 | -0.716 | 73 | -0.03 | 73 | 3.301 |
| *0.5-1.0km* | 97 | 5.138 | 97 | 0.04 | 97 | 3.114 |
| *1.0-2.0km* | 107 | 8.366 | 107 | -0.01 | 107 | 3.126 |
| *>2.0km* | 125 | 10.824 | 125 | 0.06 | 125 | 3.064 |
| **Traffic safety** | | | | | | |
| *1* | 22 | 9.524 | 22 | -0.05 | 22 | 3.136 |
| *2* | 74 | 8.005 | 74 | 0.03 | 74 | 3.023 |
| *3* | 157 | 5.343 | 157 | 0.04 | 157 | 3.105 |
| *4* | 119 | 7.530 | 119 | 0.02 | 119 | 3.215 |
| *5* | 30 | 5.250 | 30 | 0.00 | 30 | 3.263 |

### *Social environment*

In this section the output from the bivariate analyses regarding the examination of the relationships between the independent social environment variables and both dependent group of variables are discussed. To test the relationships of main transport mode of peers with the dependent variables, a chi-square test and One-way ANOVA test were conducted.

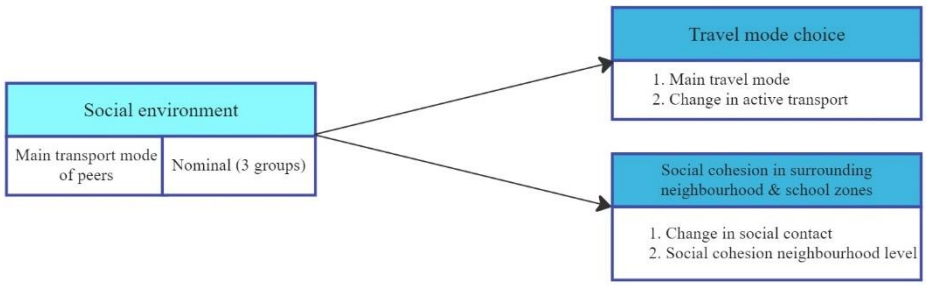



*Figure 6.2: Visualisation bivariate analyses independent social variables – dependent variables*

As can be seen in table 6.5, main transport mode of peers has a significant relationship with main travel mode. Again, by looking at the table, children's main travel mode corresponds with the main transport mode of their peers, for example, when children prefer to travel by foot, 70.0% of their peers also commutes to school by foot. Also for this independent variable, no significant relationships were found with the second group of dependent variables 'social cohesion in the surrounding neighbourhood and school zones'.

*Table 6.5: Cross table chi-square test social variables - Main travel mode*

| Main travel mode | | Main transport mode of peers | | | | | Chi sq. | Sig. |
|---|---|---|---|---|---|---|---|---|
| | | Car | Bicycle | Foot | I do not know | Total | | |
| Car | Count | 86 | 24 | 7 | 58 | 175 | 72.000 | 0.001 |
| | % | 58.9% | 27.3% | 23.3% | 42.0% | 43.5% | | |
| Bicycle | Count | 37 | 49 | 2 | 46 | 134 | | |
| | % | 25.3% | 55.7% | 6.7% | 33.3% | 33.3% | | |
| Foot | Count | 23 | 15 | 21 | 34 | 93 | | |
| | % | 15.8% | 17.0% | 70.0% | 24.6% | 23.1% | | |
| Total | Count | 146 | 88 | 30 | 138 | 402 | | |
| | % | 100% | 100% | 100% | 100% | 100% | | |

*Table 6.6: Descriptive statistics social factors – dependent variables*

| Variable | Change in active transport | | Change in social contact | | Neighbourhood cohesion level | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *N* | *Mean* |
| **Main transport mode of peers** | | | | | | |
| *Car* | 146 | 19.968 | 146 | 0.03 | 146 | 3.151 |
| *Bicycle* | 88 | 16.689 | 88 | 0.03 | 88 | 3.193 |
| *Foot* | 30 | 10.802 | 30 | 0.10 | 30 | 3.243 |
| *I do not know* | 138 | 10.942 | 138 | -0.01 | 138 | 3.059 |

### *Personal environment*

In this section the output from the bivariate analyses regarding the examination of the relationships between the independent personal environment variables and both dependent group of variables are discussed. To test the relationships of age, gender, grade and traffic skills with the dependent variables, a chi-square test, One-way ANOVA test, independent t-test and Pearson correlation coefficient were conducted.

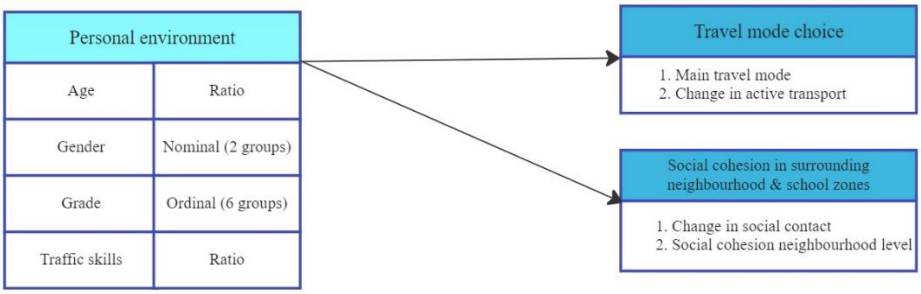



*Figure 6.3: Visualisation bivariate analyses independent personal variables – dependent variables*

As can be seen in table 6.7, traffic skills is positively associated with main travel mode. Cross-table 6.7 shows that the higher parents rate their children's traffic skills, the more their child uses active transport instead of the car. In particular, cycling is most often chosen as the dominant mode of travel when traffic skills are rated high. 53.8% of the children whose traffic skills are rated with the highest score chose cycling as their main mode of travel. This makes sense, as children whose parents rated their traffic skills highly are also likely to use active means of transport on a regular basis. Results showed that gender and grade are not significantly related with any of the dependent variables. The statistics in table 6.7 support these findings. However, remarkable is that children in the highest two grades are much less likely to walk than those in the youngest four groups. Regarding age, a positive significant relationship has been found with change in active transport. The older a child is, the greater the effect of the campaign on children's use of active transport, meaning that the older children are, the more they participate in active transport since the implementation of the campaign. Also, no significant relationships were found between the personal variables and the dependent group of variables, social cohesion in the surrounding neighbourhood and school zones.

*Table 6.7: Cross table chi-square test personal variables - Main travel mode*

| **Main travel mode** | | **Gender** | | | | | | | **Chi sq.** | **Sig.** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Male** | **Female** | | | | | Total | | |
| Car | Count | 97 | 78 | | | | | 175 | 0.361 | 0.835 |
| | % | 44.5% | 42.4% | | | | | 43.5% | | |
| Bicycle | Count | 73 | 61 | | | | | 134 | | |
| | % | 33.5% | 33.2% | | | | | 33.3% | | |
| Foot | Count | 48 | 45 | | | | | 93 | | |
| | % | 22.0% | 24.5% | | | | | 23.1% | | |
| Total | Count | 218 | 184 | | | | | 402 | | |
| | % | 100% | 100% | | | | | 100% | | |
| **Main travel mode** | | **Grade** | | | | | | | **Chi sq.** | **Sig.** |
| | | 1 | 2 | 3 | 4 | 5 | 6 | Total | | |
| Car | Count | 37 | 29 | 29 | 22 | 35 | 23 | 175 | 9.993 | 0.441 |
| | % | 45.1% | 50.9% | 44.6% | 36.7% | 42.7% | 41.1% | 43.5% | | |
| Bicycle | Count | 28 | 13 | 18 | 20 | 31 | 24 | 134 | | |
| | % | 34.1% | 22.8% | 27.7% | 33.3% | 27.8% | 42.9% | 33.3% | | |
| Foot | Count | 17 | 15 | 18 | 18 | 16 | 9 | 93 | | |
| | % | 20.7% | 26.3% | 27.7% | 30.0% | 19.5% | 16.1% | 23.1% | | |
| Total | Count | 82 | 57 | 65 | 60 | 82 | 56 | 402 | | |
| | % | 100% | 100% | 100% | 100% | 100% | 100% | 100% | | |
| **Main travel mode** | | **Traffic skills** | | | | | | | **Chi sq.** | **Sig.** |
| | | 1 | 2 | 3 | 4 | 5 | | Total | | |
| Car | Count | 5 | 23 | 77 | 60 | 10 | | 175 | 42.250 | 0.001 |
| | % | 71.4% | 69.7% | 57.9% | 31.6% | 25.6% | | 43.5% | | |
| Bicycle | Count | 1 | 5 | 30 | 77 | 21 | | 134 | | |
| | % | 14.3% | 15.2% | 22.6% | 40.5% | 53.8% | | 33.3% | | |
| Foot | Count | 1 | 5 | 26 | 53 | 8 | | 93 | | |
| | % | 14.3% | 15.2% | 19.5% | 27.9% | 20.5% | | 23.1% | | |
| Total | Count | 7 | 33 | 133 | 190 | 39 | | 402 | | |
| | % | 100% | 100% | 100% | 100% | 100% | | 100% | | |
| **Main travel mode** | | **Age** | | | | | | | **F-value** | **Sig.** |
| | | | | | | | | | 0.523 | 0.791 |

*Table 6.8: Descriptive statistics personal factors - dependent variables*

| Variable | Main travel mode | | Change in active transport | | Change in social contact | | Neighbourhood cohesion level | |
|---|---|---|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *Mean* | *Mean* | *N* | *Mean* |
| **Age** | | | | | | | | |
| *6* | 44 | 1.84 | | | | | | |
| *7* | 66 | 1.76 | | | | | | |
| *8* | 61 | 1.70 | | | | | | |
| *9* | 53 | 1.92 | | | | | | |
| *10* | 73 | 1.85 | | | | | | |
| *11* | 78 | 1.76 | | | | | | |
| *12* | 27 | 1.74 | | | | | | |
| **Gender** | | | | | | | | |
| *male* | | | 218 | 5.121 | 218 | 0.03 | 218 | 3.063 |
| *Female* | | | 184 | 8.576 | 184 | 0.01 | 184 | 3.222 |
| **Grade** | | | | | | | | |
| *1* | | | 82 | 2.593 | 82 | 0.02 | 82 | 3.181 |
| *2* | | | 57 | 7.047 | 57 | 0.02 | 57 | 3.228 |
| *3* | | | 65 | 5.145 | 65 | 0.03 | 65 | 3.083 |
| *4* | | | 60 | 9.528 | 60 | -0.07 | 60 | 2.955 |
| *5* | | | 82 | 6.861 | 82 | 0.04 | 82 | 3.131 |
| *6* | | | 56 | 10.917 | 56 | 0.09 | 56 | 3.239 |
| **Traffic skills** | | | | | | | | |
| *1* | | | 7 | 15.714 | 7 | 0.14 | 7 | 3.400 |
| *2* | | | 33 | 9.312 | 33 | 0.06 | 33 | 2.782 |
| *3* | | | 133 | 7.157 | 133 | 0.01 | 133 | 3.113 |
| *4* | | | 190 | 5.023 | 190 | 0.01 | 190 | 3.165 |
| *5* | | | 39 | 9.509 | 39 | 0.10 | 39 | 3.323 |

### *Household environment*

In this section the output from the bivariate analyses regarding the examination of the relationships between the independent household environment variables and both dependent group of variables are discussed. To test the relationships of household size, SES, and car ownership with the dependent variables, a chi-square test, One-way ANOVA test and Pearson correlation coefficient were conducted.

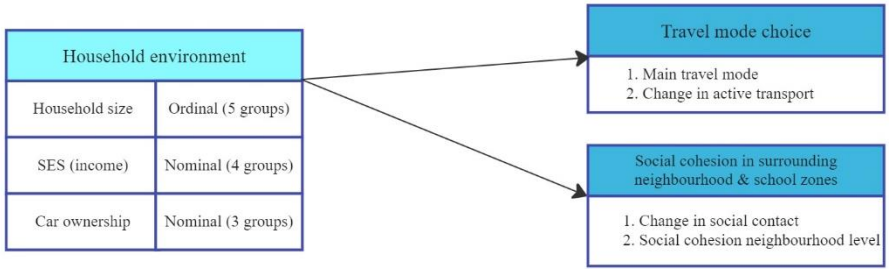



*Figure 6.4: Visualisation bivariate analyses independent personal variables – dependent variables*

As can be seen in table 6.2, a significant association between household size and neighbourhood cohesion level has been found, meaning that the larger the household size, the higher parents indicated they valued social cohesion in their neighbourhood. Subsequently, also SES has been found to be significantly associated with dependent variable social cohesion neighbourhood level. The higher the household income, the higher parents value the social cohesion in their neighbourhood. Household size and SES appeared to have no significant relationship with travel mode choice. However, as expected, a significant relationship between car ownership and main travel mode was found. When a household owns two or more private cars, their child chooses the car as their main travel mode in 54.5% of the cases (see table 6.9). This is a big gap compared to households which own only one private car, in which

only 33.2% of the children prefers the car over walking and cycling. When owning only one private car, 42.3% of the children prefer to cycle compared to only 24.3% when owning two or more cars. The share of children that commute by foot stays more or less the same. Additionally, no significant relationships were found between car ownership and the dependent variables regarding social cohesion.

*Table 6.9: Descriptive statistics household factors - dependent variables*

| **Main travel mode** | | **SES (income)** | | | | | **Chi sq.** | **Sig.** |
|---|---|---|---|---|---|---|---|---|
| | | Low | Medium | High | I do not know | Total | | |
| Car | Count | 16 | 47 | 68 | 44 | 175 | 5.042 | 0.538 |
| | % | 47.1% | 52.8% | 39.1% | 41.9% | 43.5% | | |
| Bicycle | Count | 11 | 24 | 64 | 35 | 134 | | |
| | % | 32.4% | 27.0% | 36.8% | 33.3% | 33.3% | | |
| Foot | Count | 7 | 18 | 42 | 26 | 93 | | |
| | % | 20.6% | 20.2% | 24.1% | 24.8% | 23.1% | | |
| Total | Count | 34 | 89 | 174 | 105 | 402 | | |
| | % | 100% | 100% | 100% | 100% | 100% | | |
| **Main travel mode** | | **Car ownership** | | | | | **Chi sq.** | **Sig.** |
| | | No private car | 1 private car | ≥2 private cars | | Total | | |
| Car | Count | 0 | 65 | 110 | | 175 | 23.922 | 0.001 |
| | % | 0.0% | 33.2% | 54.5% | | 43.5% | | |
| Bicycle | Count | 2 | 83 | 49 | | 134 | | |
| | % | 50.0% | 42.3% | 24.3% | | 33.3% | | |
| Foot | Count | 2 | 48 | 43 | | 93 | | |
| | % | 50.0% | 24.5% | 21.3% | | 23.1% | | |
| Total | Count | 4 | 196 | 202 | | 402 | | |
| | % | 100% | 100% | 100% | | 100% | | |
| **Main travel mode** | | **Household size** | | | | | **F-value** | **Sig.** |
| | | | | | | | 0.759 | 0.552 |

*Table 6.10: Descriptive statistics household factors - dependent variables*

| **Variable** | **Main travel mode** | | **Change in active transport** | | **Change in social contact** | | **Neighbourhood cohesion level** | |
|---|---|---|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *Mean* | *Mean* | *N* | *Mean* |
| **Household size** | | | | | | | | |
| *2* | 26 | 1.85 | | | | | | |
| *3* | 67 | 1.82 | | | | | | |
| *4* | 225 | 1.75 | | | | | | |
| *5* | 69 | 1.93 | | | | | | |
| *6 or more* | 15 | 1.73 | | | | | | |
| **SES (income)** | | | | | | | | |
| *Low* | | | 34 | 9.315 | 34 | 0.18 | 34 | 2.632 |
| *Medium* | | | 89 | 5.356 | 89 | -0.01 | 89 | 3.126 |
| *High* | | | 174 | 6.198 | 174 | 0.03 | 174 | 3.231 |
| *I do not know* | | | 105 | 7.833 | 105 | -0.01 | 105 | 3.150 |
| **Car ownership** | | | | | | | | |
| *1 private car* | | | 196 | 5.262 | 196 | 0.04 | 196 | 3.147 |
| *2 private cars* | | | 202 | 8.001 | 202 | 0.00 | 202 | 3.145 |
| *No private cars* | | | 4 | 11.668 | 4 | 0.00 | 4 | 2.125 |

*External environment*

In this section the output from the bivariate analyses regarding the examination of the relationships between the independent external environment variables and both dependent group of variables are discussed. To test the relationships of country with the dependent variables, a chi-square test and independent sample t-test were conducted.

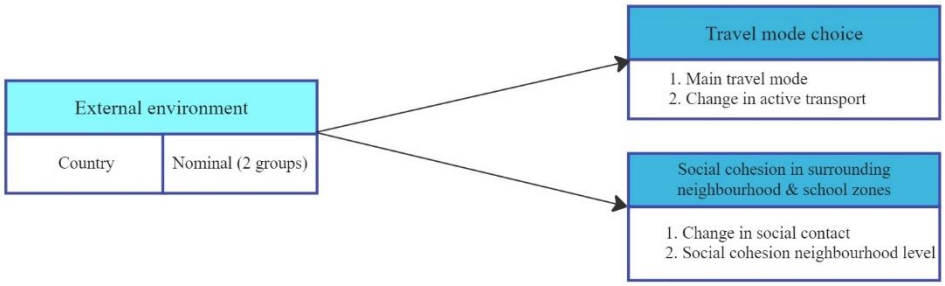



*Figure 6.5: Visualisation bivariate analyses independent external variables – dependent variables*

As can be seen in table 6.11, country is significantly associated with two of the four dependent variables. Looking at the same table, the relationship between country and main travel mode is visible, with people in Belgium preferring mostly the car as main travel mode (46.1%), while Dutch respondents indicated to prefer the bicycle as their main travel mode (55.0%). Also dependent variable change in active transport was found to have a positive significant relationship with people's country of residence. The impact of the campaign on change in active transport is larger among Belgian children than among Dutch children, meaning that since the implementation of the campaign, Belgian children show greater positive change in active transport. This makes sense, since the statistics in the cross table show that Dutch children already chose active means of transport over the car before the implementation. This can be explained on the basis of the statistics in the cross table, which shows that Dutch children already chose the bicycle much more often than Belgian children before implementation. As a result, the impact of the campaign on the change in active transport is also lower.

The country of residence does not have significant relationships with either change in social contact or social cohesion neighbourhood level.

*Table 6.11: Cross table chi-square test social variables - Main travel mode*

| **Main travel mode** | | **Country** | | | **Chi sq.** | **Sig.** |
|---|---|---|---|---|---|---|
| | | Belgium | The Netherlands | Total | | |
| Car | Count | 167 | 8 | 175 | 11.973 | 0.003 |
| | % | 46.1% | 20.0% | 43.5% | | |
| Bicycle | Count | 112 | 22 | 134 | | |
| | % | 30.9% | 55.0% | 33.3% | | |
| Foot | Count | 83 | 10 | 93 | | |
| | % | 22.9% | 25.0% | 23.1% | | |
| Total | Count | 362 | 40 | 402 | | |
| | % | 100% | 100% | 100% | | |

*Table 6.12: Descriptive statistics external factors – dependent variables*

| **Variable** | **Change in active transport** | | **Change in social contact** | | **Neighbourhood cohesion level** | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *N* | *Mean* |
| **Country** | | | | | | |
| *Belgium* | 362 | 7.168 | 362 | 0.01 | 362 | 3.154 |
| *The Netherlands* | 40 | 2.488 | 40 | 0.13 | 40 | 2.968 |

## 6.3 Participation in the High-Five campaign

In this section the output from the bivariate analyses regarding the examination of the relationships between independent variable participation in the High-Five campaign and both dependent group of variables are discussed. To test the relationships of participation in the campaign with the dependent variables, a chi-square test and independent sample t-test were conducted.

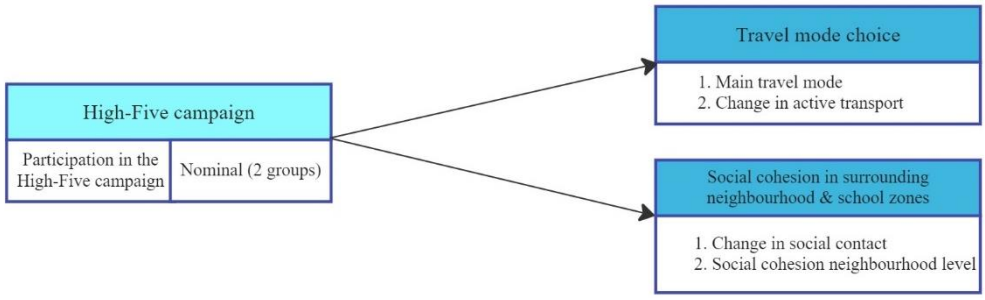



*Figure 6.6: Visualisation bivariate analyses independent participation in the High-Five campaign variable – dependent variables*

As can be seen in table 6.13, travel mode choice is significantly associated with participation in the High-Five campaign. Looking at cross table 6.14, the data shows that children who participate in the campaign more often choose to commute by bicycle and lesser by car than children who are not participating. Interestingly, the percentage that walks to school is almost the same among both non-participating and participating children. Also, change in active transport is significantly associated with participating in the campaign. The positive impact of the campaign on children's change in active transport is higher when participating in the campaign. This makes sense, as participating children are more motivated to travel actively than those who do not participate. Again, the independent t-test shows that none of the variables related to social cohesion has a significant relationship with the independent variable.

*Table 6.13: Bivariate analyses participation in the High-Five campaign variable – dependent variables*

| **Variable** | **Main travel mode** | | **Change in active transport** | | **Change in social contact** | | **Neighbourhood cohesion level** | |
|---|---|---|---|---|---|---|---|---|
| | ***Chi-Square test*** | | ***Independent sample t-test*** | | | | | |
| | *Chi sq.* | *Sig.* | *t-value* | *Sig.* | *t-value* | *Sig.* | *t-value* | *Sig.* |
| Participation in the High-Five campaign | 13.159 | 0.001 | 3.837 | 0.001 | 0.854 | 0.394 | 0.394 | 0.694 |

*Table 6.14: Cross table chi-square test participation in the High-Five campaign – main travel mode*

| **Main travel mode** | | **Participation in the High-Five campaign** | | |
|---|---|---|---|---|
| | | Yes | No | Total |
| Car | Count<br>% | 141<br>40.6 | 34<br>61.8% | 175<br>43.5% |
| Bicycle | Count<br>% | 127<br>36.6% | 7<br>12.7% | 134<br>33.3% |
| Foot | Count<br>% | 79<br>22.8% | 14<br>25.5% | 93<br>23.1% |
| Total | Count<br>% | 347<br>100% | 55<br>100% | 402<br>100% |

*Table 6.15: Descriptive statistics participation in the High-Five campaign variable – dependent variables*

| Variable | Change in active transport | | Change in social contact | | Neighbourhood cohesion level | |
|---|---|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* | *N* | *Mean* |
| **Participation in the High-Five campaign** | | | | | | |
| *Yes* | 347 | 8.115 | 347 | 0.03 | 347 | 3.143 |
| *No* | 55 | -2.212 | 55 | -0.04 | 55 | 3.093 |

## 6.4 Travel mode choice and social cohesion

This section discusses the results of the bivariate analyses regarding the examination of the relationships between both dependent variables, with travel mode choice as the independent variable. To test the relationships of travel mode choice with social cohesion in the surrounding neighbourhood and school zones, an One-way ANOVA test and Pearson correlation coefficient test were conducted.

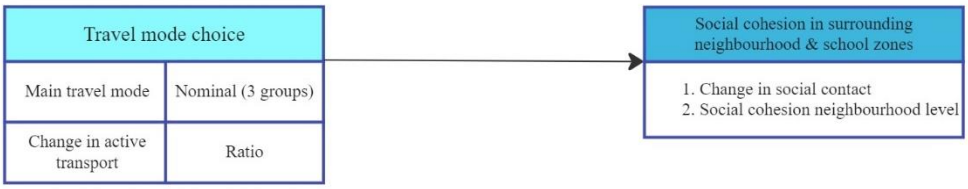



*Figure 6.7: Visualisation bivariate analyses (in)dependent variable travel mode choice – dependent variable social cohesion surrounding neighbourhood and school zones*

As can be seen in table 6.16, none of the relationships are significant, meaning that main travel mode choice does not influence the social cohesion level in the surrounding neighbourhood and within the school zones of both parents and their children. Looking at the results of previous bivariate analyses conducted for testing the relationships between the other independent variables and the dependent social cohesion variable, it is a logical consequence that also between travel mode choice and social cohesion no significant relationship has been found.

*Table 6.16: Bivariate analyses travel mode choice – social cohesion in the surrounding neighbourhood and school zones*

| Variable | Change in social contact | | Neighbourhood social cohesion | |
|---|---|---|---|---|
| | ***One-way ANOVA*** | | | |
| | *F-value* | *Sig.* | *F-value* | *Sig.* |
| Main travel mode | 0.158 | 0.854 | 1.841 | 0.160 |
| | ***Pearson correlation*** | | | |
| | *r-value* | *Sig.* | *r-value* | *Sig.* |
| Change in active transport | 0.043 | 0.385 | 0.010 | 0.846 |

*Table 6.17: Descriptive statistics independent variable travel mode choice – social cohesion in the surrounding neighbourhood and school zones*

| Variable | Change in social contact | | Neighbourhood cohesion level | |
|---|---|---|---|---|
| | *N* | *Mean* | *N* | *Mean* |
| **Main travel mode** | | | | |
| *Car* | 175 | 3.044 | 175 | 3.044 |
| *Bicycle* | 134 | 3.184 | 134 | 3.184 |
| *Foot* | 93 | 3.240 | 93 | 3.240 |

## 6.5 Conclusion bivariate analyses

The goal of this chapter was to answer sub-question six: *'What are the bivariate relationships between participation in the High-Five campaign and the dependent variables, travel mode choice and social cohesion in the surrounding neighbourhood and school zones and between travel mode choice and social cohesion in the surrounding neighbourhood and school zones?'*

A total of 48 possible relationships were tested for significance. The results are visualized in table 6.18, with the norm of significance being distinguished into a p-value threshold of 0.01 and 0.05, indicated in the table by a different colour tone. Hence, from the bivariate analyses, eleven relationships were found to be significant including relationships between seven independent variables and the dependent variable main travel mode. Participation in the High-Five campaign is one of the variables that appeared to have a significant relation with dependent variables children's main travel mode and change in active transport.

However, no significant relationship was found between participation in the High-Five campaign and the dependent group of variables, social cohesion in the surrounding neighbourhood and school zones. Also, no significant relationships were found between both dependent group of variables travel mode choice and social cohesion in the surrounding neighbourhood and school zones.

Only two independent variables, SES, and household size, appeared to have a significant relationship with the dependent variable, neighbourhood social cohesion, while none of the independent variables was significantly associated with change in social contact. Since these two variables are control variables, it is not relevant to include these variables in the regression analysis. Therefore, both dependent variables are not included in the overview of 6.18. In the next chapter the regression analysis will be discussed. All independent variables, which appeared to have significant relationships with dependent variables main travel mode and change in active transport have been included in the regression analyses. As can be seen in table 6.18, eight independent variables have been included in the following step.

*Table 6.18: Results bivariate analyses independent variables*

| Variables | Main travel mode | Change in active transport |
|---|---|---|
| Travel distance | | |
| Perceived traffic safety | | |
| Main transport mode of peers | | |
| Age | | |
| Traffic skills | | |
| Car ownership | | |
| Country | | |
| Participation in the High-Five campaign | | |

Significant at 0.01 | Significant at 0.05 | Not significant

# REGRESSION ANALYSES

## CHAPTER 7

# 7. Regression analyses

In this chapter the results from the regression analyses performed in SPSS are discussed, which are used to answer sub-questions seven and eight: '*What is the relationship between participating in the High-Five campaign and children's travel mode choice while controlling for the effects of the socio-ecological factors?* And *'What is the difference between the influence of participation in the High-Five campaign and children travel mode choice in Belgium and the Netherlands?'*

The results are discussed based on the type of analysis method, which is determined based on the measurement level of the dependent variable. Only control variables (SES and household size) were found to be significantly related to the dependent variable social cohesion in the neighbourhood, as these were included for control purposes only, they are not considered in the regression analysis. Furthermore, the control variables traffic skills and perceived traffic safety are considered to have a different measurement level, to avoid differing p-values for all five grading categories (1-5) in the multinomial logistic regression.

## 7.1 Explanation regression analyses

Regression analysis is used to predict the relationship between two or more independent variables and one dependent variable. Two types of regression analyses methods are used in this study, multiple linear regression, and multinomial logistic regression. Multiple linear regression is used to investigate the strength of the relationships between two or more independent variables and one dependent variable, which were found to be significant in the bivariate analyses, and to find out the value of the dependent variable at a certain value of the independent variables. Multinomial logistic regression is used to explain the relationship between one nominal dependent variable and two or more independent variables. Table 7.1 schematically shows all significant relationships between the independent and dependent variables taken from the bivariate analyses, only these are included in the regression. To test the predictive strength of the independent variables on the first dependent variable main travel mode, the multinomial logistic regression method is used, since main travel mode has a nominal level of measurement with more than two levels (car, bicycle, and foot). For testing the strength of the independent variables with the remaining two dependent variables, a multiple linear regression is conducted, because all have a ratio level of measurement. Again, just as in the bivariate analyses, a relationship is considered to be significant when the p-value is lower as 0.05.

*Table 7.1: Variables included from bivariate analysis*

| Independent variables | Main travel mode | Change in active transport |
|---|---|---|
| *Travel distance* | X | X |
| *Perceived traffic safety* | X | |
| *Main transport mode of peers* | X | |
| *Traffic skills* | X | |
| *Age* | | X |
| *Car ownership* | X | |
| *Country* | X | X |
| *Participation in the High-Five campaign* | X | X |

## 7.2 Results multinomial logistic regression

In this section, the results of the multinomial logistic regression are described. As in the bivariate analyses came forward, seven independent variables appeared to have a significant association with main travel mode. All of them have been included in the multinomial logistic regression analysis, apart from main travel mode of peers due to multicollinearity between the latter and the external variable country. The analysis is performed with the car being the reference category, which means that all coefficient values indicate the probability that a child travels by bicycle or by foot compared to the car. The exponentiated value (Exp. (coefficient)) is the odds ratio which represents the predicted change in odds for the increase of one unit in the predictor. Table 7.2 shows the results of the regression per independent variable, including each variable's scale.

The intercept value in this model, which indicates the value of the logit model when all predictor values are zero, is 11.095 for bicycle and 10.932 for foot, both being significant. Regarding the built environment layer, the independent variables travel distance and perceived traffic safety are included in the analysis, of which the former is found to be significantly associated with travelling by bicycle and by foot as opposed to the latter which was only found to be significantly associated with travelling by bicycle.

All distances related to the variable travel distance have positive coefficients and exponentiated values, which decrease as the distance increases, expressing that the longer the travel distance, the more likely the car will be favoured over cycling or walking. However, since all coefficients are positive, this indicates that children who have to travel the longest distance are still more likely to travel actively rather than by car. Children of which parents perceive their route to school as safe are more likely to choose walking over the car. This means that for every increasing unit, the probability of children choosing walking over the car, increases by 1.514.

*Table 7.2: Results multinomial logistic regression analysis for main travel mode*

| **Main travel mode** | **Bicycle** | | | **Foot** | | |
|---|---|---|---|---|---|---|
| **Variables** | **Coefficient** | **Sig.** | **Exp. (coeff.)** | **Coefficient** | **Sig.** | **Exp. (coeff.)** |
| **Intercept** | 11.095 | <,001 | - | 10.932 | <.001 | - |
| **Travel distance** | | | | | | |
| *<0.5km* | 1.835 | 0.002 | 6.265 | 5.968 | <.001 | 390.729 |
| *0.5km-1.0km* | 1.372 | <.001 | 3.943 | 3.810 | <.001 | 45.134 |
| *1.0-2.0km* | 1.073 | 0.001 | 2.924 | 2.087 | 0.010 | 8.060 |
| *>2.0km* | 0[b] | - | - | 0[b] | - | - |
| **Perceived traffic safety (as continuous variable)** | | | | | | |
| | 0.249 | 0.101 | 1.283 | 0.415 | 0.031 | 1.514 |
| **Traffic skills (as continuous variable)** | | | | | | |
| | 0.738 | <.001 | 2.092 | 0.087 | 0.711 | 1.091 |
| **Car ownership** | | | | | | |
| *1 private car* | -15.258 | <.001 | 0.000 | -16.573 | 0.000 | 0.000 |
| *2 private cars* | -16.280 | <.001 | 0.000 | -17.144 | 0.000 | 0.000 |
| *No private cars* | 0[b] | - | - | 0[b] | - | - |
| **Country** | | | | | | |
| | -1.234 | 0.017 | 0.291 | -0.128 | 0.846 | 0.880 |
| **Participation in the High-Five campaign** | | | | | | |
| | 1.457 | 0.005 | 4.292 | 0.798 | 0.150 | 2.221 |

a. The reference category is car
b. The parameter value is set to zero because it is redundant

| | Significant at 0.01 | | Significant at 0.05 | | Not significant |
|---|---|---|---|---|---|

The personal layer is represented in the regression model by the variable traffic skills. The relationship between traffic skills and travel mode choice is found to be significant for the bicycle but not for travelling by foot, compared to the reference category. When children's traffic skills are rated highly by their parents, they are slightly more likely to travel by bicycle then by car.
Looking at the only household variable included in the analysis, car ownership is significantly associated with main travel mode. When children are part of a household that owns one, two or more cars, they are less likely to travel by bicycle or by foot compared to the reference value.

Country is the only external variable considered in this study, and results from the analysis show that the association is significant for cycling but not for walking. Moreover, data showed that children from Belgium are less likely to choose the bicycle over the car for commuting to school compared to Dutch children. Looking at the exponentiated value it can be concluded that for every increasing unit in the number of Belgian students, the probability of choosing the bicycle over the car is 0.291, which means that the odds of choosing the bicycle over the car is decreasing since this value is lower as 1.0.

Participation in the High-Five campaign is the last independent variable included in the regression and is significantly associated with travel mode choice for cycling, but not for walking. The coefficient value of cycling is positive, meaning that children who participate in the High-Five campaign are more likely to travel to school by bicycle compared to the car. Looking at the exponentiated value, the odds of children cycling to school increases with 4.292 when the number of participants rises with one unit.

## 7.3 Results multiple linear regression

The second section of this chapter describes the results of the multiple linear regression considering the significant associations between the independent variables and dependent variables change in active transport and neighbourhood social cohesion, found through the bivariate analyses. The analysis is performed per dependent variable, meaning that the associations of independent variables which had a significant relationship with one dependent variable were analysed in one regression together. The unstandardized beta value represents the slope of the line between the independent and dependent variable, meaning that an increase of every unit in the independent variable causes an increase of the dependent value by the value of the beta. The regression analysis excludes variables from the model that do not contribute to explaining the strength of the relationship with the dependent variable. Table 7.3 show the results of the conducted test including the variables that fit the model.

As can be seen in table 7.3, the constant value is significant, with both travel distance and participation in the High-Five campaign being included in the model. Both variables were found to be significantly associated with change in active transport. Further on, the analysis excluded the variables age, and country from the model as they did not contribute to explaining the strength of the relationship with change in active transport. Whenever the travel distance increases by one unit, the chance of children intensifying their usage of active transport increases with a value of 3.654. This may be due to the fact that children who live furthest away are more frequently brought by car, causing the biggest impact in this group. However, the B-value of the second variable shows that for every child that participates more in the campaign, the change of children intensifying their usage of active transport increases by 10.338, meaning that participating in the High-Five has a positive association with change in active transport which leads to activating children to commute more often by bicycle or by foot to school during a school week.

*Table 7.3: Results multiple linear regression change in active transport*

| Model | | Unstandardized coefficients | | Standardized Coefficients | | | 95.0% confidence interval for B | |
|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Lower bound | Upper bound |
| **2** | (Constant) | -12.110 | 3.924 | - | -3.086 | 0.002 | -19.823 | -4.396 |
| | Travel distance | 3.654 | 0.979 | 0.181 | 3.731 | <.001 | 1.728 | 5.579 |
| | Participation in High-Five campaign | 10.338 | 3.112 | 0.161 | 3.322 | <.001 | 4.221 | 16.456 |

a. Dependent variable: Change in active transport

| Significant at 0.01 | Significant at 0.05 | Not significant |
|---|---|---|

## 7.4 Conclusion regression analyses

The goal of this chapter was to answer sub-questions seven and eight: '*What is the relationship between participating in the High-Five campaign and children's travel mode choice while controlling for the effects of the socio-ecological factors?* And *'What is the difference between the influence of participation in the High-Five campaign and children travel mode choice in Belgium and the Netherlands?'*

Following on from the bivariate analyses described in Chapter 6, two types of regression analyses were conducted to assess the predictive power of the independent variables on the two dependent variable groups. Figure 7.1 shows all relationships found between the independent and dependent variables in both regression analyses. As visualized in figure 7.1, participation in the High-Five campaign has been found to be a predictor for children's main travel mode to school in combination with control variables travel distance, traffic safety, traffic skills, car ownership and country. Furthermore, participation in the High-Five campaign was found to be a predictor for change in active transport together with travel distance. Both variables age and country were excluded from the model in the linear regression and hence were not found to be significantly associated with change in active transport.

Since participation in the High-Five campaign and travel distance are the only variables that predict both dependent variables, these two are the main predictors of the dependent group variables, travel mode choice.

As mentioned, country was found to be a predictor for children's main travel mode. From multinomial logistic regression came forward that this relationship was found to be negative with a coefficient value of -1.234, meaning that children attending Belgian schools are less likely to travel actively to school compared to children who attend Dutch schools.

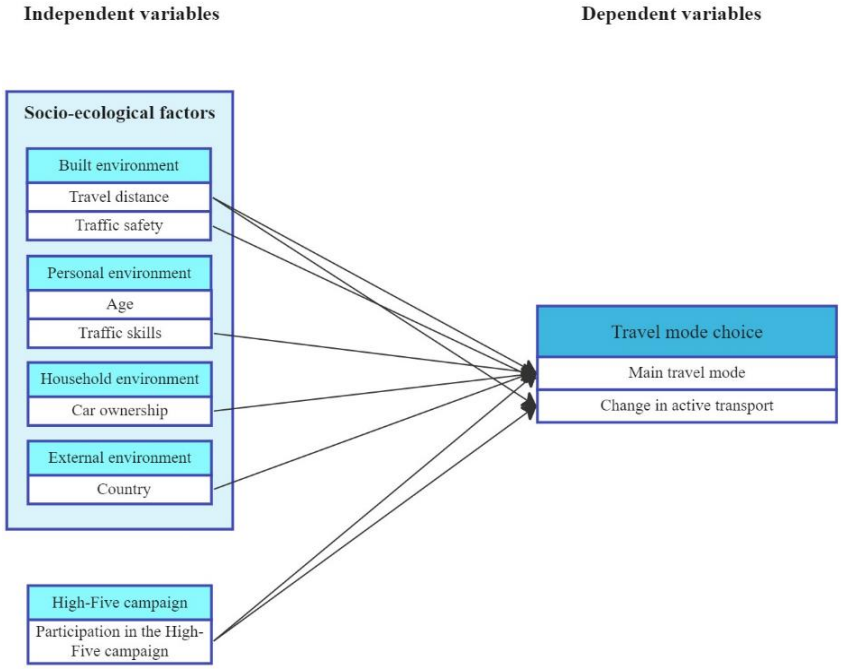



*Figure 7.1: Finalized conceptual model significant relationships*

# CONCLUSION, DISCUSSION & RECOMMENDATIONS

## CHAPTER 8

# 8. Conclusion, discussion, and recommendations

This chapter contains the conclusion in which the sub-questions are used to answer the main research question. Furthermore, this chapter contains a discussion which includes the limitations of this research, recommendations for future research and managerial implications.

## 8.1 Conclusion

The goal of this study was to investigate whether participating in a concept like the High-Five campaign contributes to encouraging primary school children to actively travel to school. Additionally, the aim was to investigate the relationship between participating in the High-Five campaign and the social cohesion in the surrounding neighbourhood and school zones. Furthermore the variables belonging to the five layers of the socio-ecological model are included to control for their effect on children's travel mode choice The main research question embodies the influence of both dependent variables and has been formulated as follows:

*'What are parents' perceptions of the High-Five campaign regarding its digital platform, and school promotion? How does participation in the High-Five campaign affect children's travel mode choice to primary school (controlling for the socio-ecological factors) and (directly, or indirectly via travel mode choice) the social cohesion in the surrounding neighbourhood and school zones?'*

In order to answer the main question, a thorough literature review was conducted. From scientific literature came forward that all five socio-ecological layers include factors which significantly influence children's travel mode choice. Based on these findings the following factors have been assessed as important to be included as control variables for this research: travel distance, traffic safety, peer influence, household size, car ownership, SES, ethnicity, age, gender, grade, traffic skills, and country. Furthermore, it is important to know what has already been researched within scientific research on concepts using active technology. Scientific literature showed the existence of multiple activating technology concepts which influence children's physical activity. To capture and retain children's attention these concepts mostly used activating technology like exergames which incorporated gamification elements like creating a personal avatar, reward systems and narratives, with the goal of enhancing users PA levels. This information is used to compare those concepts and the gamification elements it uses with the High-Five campaign. Scientific literature has also shown that active transportation, such as walking and cycling, is positively related to social cohesion at a neighbourhood level, with active travel found to be positively related to engaging in social interactions. This information is used to compare with the findings of this study regarding the influence of children's travel mode choice on social cohesion in the surrounding neighbourhood and school zones.

Information from the High-Five team revealed that the campaign is designed to encourage children to actively travel to school using a physical campaign, digital platform, and school promotion. The campaign is supported by a storyline and corresponding reward system to retain children's attention for a longer period of time. Similar to other concepts that use active technology is the utilisation of a reward system. Otherwise, the campaign has a low accessibility threshold, expressing that no console is needed to access the platform. In addition, the goal is not to increase children's screen time, with the platform primarily serving for tracking their points once a week.
Since the start of the campaign a big impact was made on the travel mode choice of pupils from 53 schools, with 79% of the pupils (8433) participating in the campaign. In the first semester of 2021 it was recorded that children travelled actively to school in 70% of their trips.

Descriptive analysis showed that the car is the most dominant travel mode for 44% of all children. On the other hand, a rather positive than negative effect was measured in the change of active transport with most respondents (259) indicating no to a small negative effect on their child's use of active transport, while the remaining respondents mostly indicated that the campaign led to a positive change in active

transport. Additionally, 78% of all respondents rated the level of social cohesion in their neighbourhood rather positive than negative with a value of 2.5 up to the maximum of 5.
Further on, children and parents viewed the lay-out and gamification elements of High-Five's digital platform positively. However, the videos of superhero High-Five's adventures and my tree were rated as relatively underperformers. In this regard, adding extra school exercises and traffic quizzes to the portfolio of the digital platform is seen as a valuable addition by both parents and children. Next, results showed that schools barely invest effort in promotional messages concerning the campaign, and if so, utilize email which is an outdated mean of communication compared to others available.

From the bivariate analysis came forward that participating in the campaign was found to be significantly and positively related with children's main travel mode choice. Further on, no significant relationship was found between participating in the campaign and social cohesion in the surrounding neighbourhood and school zones. Additionally, no significant relation was found between both dependent variables, children's travel mode choice and social cohesion in the surrounding neighbourhood and school zones.
Further, from regression analysis came forward that participation in the High-Five campaign was one of the predictors of children's main travel mode in combination with control variables travel distance, traffic safety, traffic skills, car ownership and country. Together with travel distance, participation in the High-Five campaign predicted dependent variable change in active transport, which means that both variables are the main predictors of the dependent group variables, travel mode choice.
Moreover, a negative significant relationship was found between the external variable country and travel mode choice, implying that children from Belgium are more likely to commute by car than children attending Dutch schools.

Together, these results answer the main research question, which means that parents perceive the High-Five campaign as a positive initiative, of which the digital platform is considered to be a functional tool to captivate children's attention. Furthermore, participating in the High-Five campaign is proven to be influencing and predicting children's travel mode choice. Also, it has been proven that participating in the campaign, either directly or indirectly through travel mode choice, does not influence social cohesion in the surrounding neighbourhood and school zones.

## 8.2 Discussion

This section contains the discussion of the study results compared to results found earlier in scientific literature. Also the limitations, recommendations for future research and managerial implications are discussed in this part. The output of the bivariate and regression analyses showed similarities with results of previous studies discussed in the literature review.
Results showed that travel distance is correlated with children's main travel mode choice, which is in line with the findings of Ahern et al. (2017) and Carver et al. (2013). Also, car ownership was found to be associated with main travel mode which is in line with the findings of Easton & Ferrari (2015 and Kemperman & Timmermans (2014). The personal variable gender was not found to have a significant relationship with travel mode choice. This is in line with the studies of Kerr et al. (2006) & Martin et al. (2007) who also didn't find a correlation between both variables. Additionally, traffic skills perceived by parents was found to be associated with main travel mode, which aligns with the results of Ghekiere et al. (2017) & van de Craats (2019).

Regarding main travel mode, it was found that children barely commute by foot to school compared to the bicycle or car. This may have to do with the fact that walking increases the travel time substantially compared to both the bicycle and car. Therefore, parents could prefer to bring their child to school by a faster mode, due to work related time constraints.
From the results it appeared that mostly 10- and 11-year-olds participate in the campaign. Interestingly, 12-year-olds participate much less. This may have to do with the fact that these pupils leave school for

high school in that same year. Another reason could be that 12-year-olds lose interest in the campaign because they see the storyline as something childish. During one of the physical campaign moments at SBS Kuringen, in Hasselt, Belgium, the mission of superhero High-Five was conveyed to the children. However, the contrast in enthusiasm between the oldest pupils and the other pupils was very high. Pupils from the highest grade were standing at the back of the PE hall and hardly seemed interested in the campaign. However, the aim of the campaign is to make active travel a default choice for pupils, so losing interest in the campaign does not negatively affect the proportion of active travellers as these children will continue to travel actively anyway since it has become a habit to walk or cycle to school.

Also, country came forward to have a negative relationship with travel mode choice, meaning that Belgian children chose the car more often as their main travel mode compared to Dutch children. The reason behind this may be because of the Dutch infrastructure, which is more focused on active transport, driven by governmental policies (De Vos et al., 2012). This makes the Dutch infrastructure more accessible for cyclists and walkers compared to the Belgian infrastructure, which is more focused on the car as main mode of transport. Lastly, no significant relationship was found between travel mode choice and social cohesion in the surrounding neighbourhood and school zones. This goes against the findings of Van Cauwenberg et al. (2014) and van den Berg et al. (2017) who found that active travelling impacted the amount and quality of social interactions in neighbourhoods. The reason why no link was found between active travel and social cohesion may be due to the fact that the impact was measured relatively short after the implementation of the campaign, as it was not introduced until 2020. Therefore, it may be that more time is needed before impact on the campaign's social cohesion becomes evident. Another reason may be that parents no longer have to bring and pick up their children, which means that their social contact with other parents while waiting for their children at the school gate decreases.

### 8.2.1 Limitations

In this section the limitations of this research study are discussed. At first, the questionnaire has been published in the first two weeks of June 2023, which means that differing weather conditions, such as in winter time, can considerably influence the collected data regarding children's main travel mode choice. Also, great differences appeared in terms of response rates amongst affiliated schools. Schools located in the municipalities Anzegem, Ichtegem, Schoten, Tremelo, Arnhem, Aalten and Nijmegen had a very low response rate below ten respondents. Reasoning behind these results is that these schools have lower pupil numbers, because they are located in smaller municipalities or in relatively sparsely populated neighbourhoods of larger municipalities such as Nijmegen. However, some municipalities contain several schools that collectively have a large number of pupils, as in the municipalities of Schoten (570 pupils) and Arnhem (638 pupils). The low response rate in these municipalities may have been caused by the late distribution of the questionnaire by school boards. Some schools included the questionnaire in their monthly newsletter, so it was not communicated immediately at the time of distribution. Along with the fact that only 9 of the 53 schools are located in the Netherlands, the late distribution of the questionnaire partly explains the large difference in responses between Belgian and Dutch schools, where only 10% of the total response came from Dutch parents. Due to dependence on the answer to some questions in the questionnaire, the four sections into which the questionnaire was divided show different n-values. This makes the response to the questions about the digital platform and school promotion very limited. It was therefore decided to show these results only in the descriptive analyses and to not include them in the data analyses.

### 8.2.2 Future research

Besides the limitations of this study, there are some recommendations for future research following this study. This study investigated correlational relationships, meaning that the direction of the relationships is unknown. Therefore, it is recommended to investigate the causality of the relationship between participating in the High-Five campaign and travel mode choice in future research. Cited also as a limitation, future research is recommended on the correlation between the various gamification elements of the digital platform, school promotion and children’s travel mode choice.

Furthermore, it is recommended to include and control for the effects of more variables related to the five layers of the socio-ecological model. As in this study, it was decided to include only the most important variables according to the literature review in order not to overload the respondents with too many questions in the questionnaire. Finally, this study focused on performing research towards the impact of the campaign on social cohesion in surrounding neighbourhoods and school zones experienced by parents. For future research, it would be interesting to find out if the campaign does have an impact on the way children experience social cohesion.

### 8.2.3 Managerial implications

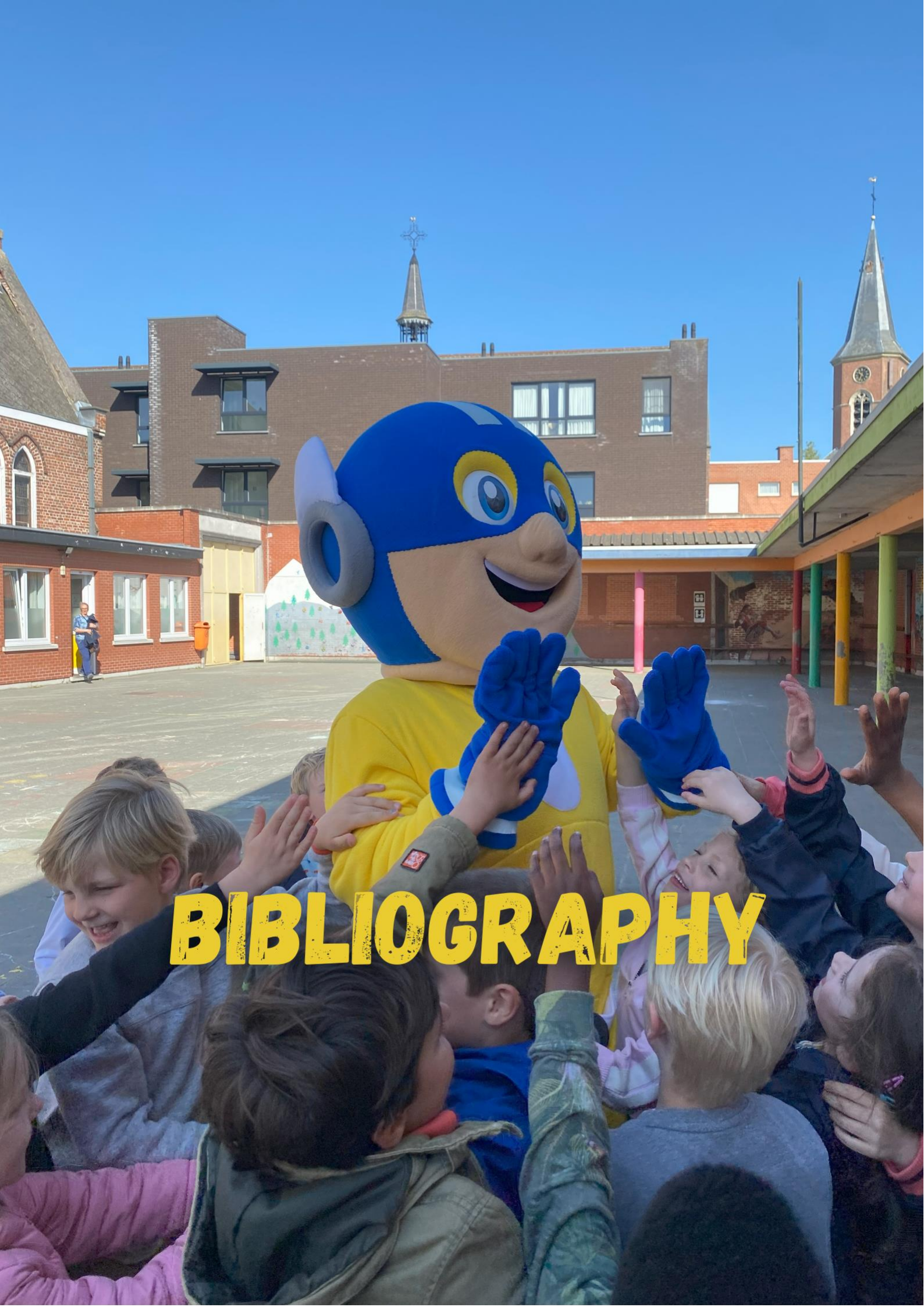
This study contributes to the knowledge of school boards, local municipal planners, and policy makers regarding the influence of socio-ecological factors on primary school children's mode choice and social cohesion in the surrounding neighbourhood and school zones. In addition, this study also contributes to optimising the High-Five campaign. Multiple implications are proposed for achieving the goals of these stakeholders.

The results showed that age is positively correlated with change in active transport, meaning that as a child gets older, they use active means of transport more. In addition, participation in the High-Five campaign is highest among 10- and 11-year-olds, which is also the age where parents rate their child's traffic skills highest. This shows municipal planners that parents of children aged under ten perceive their children's route to school as too unsafe to allow them to travel actively. A potential strategy for municipal planners is to focus on creating safer walking and cycling routes to primary schools for children under the age of ten. Especially for Belgian school boards this would be a valuable recommendation, since results have shown that children attending Belgian schools are less likely to travel by active means of transport than children attending Dutch schools.

For school boards it would be recommended to focus on creating active school travel plans such as setting up a school walking bus. The advantage of this concept is that children can travel to school together accompanied by volunteering parents. This is also beneficial for the children of parents who are time-constrained due to work. It would also be a good strategy for school boards to focus on improving children's traffic skills from an early age by providing annual education on traffic safety. This could be achieved by making the traffic exam of Veilig Verkeer Nederland (VVN) compulsory and repeating it annually instead of only taking the exam in the two highest school grades as is advised by the VVN organisation (VVN, 2023). In Belgium, there is not a similar association which organises national traffic exams for primary school children, however, VVN's traffic exam is also accessible to Belgian schools in Vlaanderen.

Finally, a strategy to optimise engagement in the High-Five campaign is proposed, focusing on communication and promotion of the High-Five campaign and monthly events by school boards to parents. Currently, school boards hardly communicate or promote the campaign. Therefore, it is recommended to find a better communication platform. Some respondents indicated that their school boards used Whatsapp as communication platform to communicate High-Five updates, which could be a possible solution for other schoolboards to convey their messages more effectively.

Altogether, this study has contributed to scientific literature by conducting quantitative research towards the effects of participating in a concept that utilises activating technology on children’s travel mode choice to school and social cohesion in the surrounding neighbourhood and school zones. The results showed that participation in the High-Five campaign had a positive impact on children’s main travel mode in Belgium and the Netherlands, with children attending Dutch schools participating more in active commuting than those attending Belgian schools. Despite the fact that more research is still needed to determine the causality of the relationship between the High-Five campaign or any other concept targeting children’s travel mode choice to school, this study has provided many relevant insights for municipal planners and policymakers to create a safer, more sustainable, and healthier school environment, in which parents feel safe letting their children go to school by bicycle or by foot.



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MOGELIJK FLUO
OP
High-Five

# APPENDICES

# Appendix A: Questionnaire

This appendix contains the Belgian version of the questionnaire sent to all parents of pupils attending the 53 schools where the High-Five campaign has been implemented. Due to differences in terms of colloquialisms and school grading systems both a Belgian and Dutch version were prepared. However, the differences are minimal. Since the questionnaire was prepared for Dutch-speaking parents, the questionnaire has also been prepared and included in this appendix in Dutch.

**Helpt u mee met het nóg veiliger en gezonder maken van de schoolomgeving van uw kind?**

**Introductie**

Onderzoek: Een gezonde, duurzame en veilige schoolomgeving in België & Nederland.

Doel: De impact van het High-Five project op de vervoerskeuze van basisschoolkinderen meetbaar maken. Ook wordt de sociale impact van het project in het kerngebied van de school gemeten. Met behulp van de resultaten van de online survey kan het High-Five project verder doorontwikkeld worden.

- Op deze manier hoopt het onderzoek bij te dragen aan een nog veiligere schoolomgeving, waarin nog meer kinderen met de fiets of te voet naar school komen.
- Op deze manier leren de kinderen stapsgewijs hoe zij om moeten gaan met het verkeer.
- Om dit doel te bereiken is een groot aantal ingevulde survey 's nodig.

**Details:**

- De survey gaat over het gebruik van het High-Five platform door uw kind, uzelf en eventueel uw partner/medeverzorger.
- De survey dient door enkel één ouder/verzorger van uw kind ingevuld te worden.
- Invullen duurt ongeveer 10 minuten.

Lees de onderstaande informatie alstublieft zorgvuldig en vraag de onderzoeker voor uitleg als u vragen heeft. U kunt de survey online invullen tot en met 29-05-2023.

N.N.P. (Niels) Schmeets

n.n.p.schmeets@student.tue.nl

Faculteit Bouwkunde
Technische Universiteit Eindhoven

*Deze survey is onderdeel van de afstudeerscriptie van student Niels Schmeets aan de Technische Universiteit Eindhoven (TU/e). Niels voert dit onderzoek uit namens de TU/e in samenwerking met High-Five, een initiatief van Aptus B.V. dat met behulp van een slimme oplossing helpt bouwen aan de duurzame, gezonde en veilige stad van morgen.*

# Verklaring van toestemming

## Inleiding

U bent gevraagd om deel te nemen aan het onderzoek “Een gezonde, duurzame en veilige schoolomgeving in België & Nederland”.

Omdat u ouder/verzorger bent van een leerling op een school dat meedoet aan het High-Five project, verzoeken we u (ongeacht of uw kind WEL of NIET deelneemt aan het project) om deze online survey in te vullen over de mobiliteit in de schoolomgeving van uw kind.

Deelname aan dit onderzoek is vrijwillig: U besluit zelf of u mee wilt doen. Voordat u besluit tot deelname, willen wij u vragen de volgende informatie door te lezen, zodat u weet waar het onderzoek over gaat, wat er van u verwacht wordt en hoe wij omgaan met de verwerking van uw persoonsgegevens. Op basis van deze informatie kunt u middels de toestemmingsverklaring aangeven of u toestemt met deelname aan het onderzoek en met de verwerking van uw persoonsgegevens.

U bent natuurlijk altijd vrij om vragen te stellen aan de onderzoeker via n.n.p.schmeets@student.tue.nl, of deze informatie te bespreken met voor u bekenden.

## Doel van het onderzoek

Dit onderzoek wordt geleid door Niels Schmeets. Het onderzoek betreft een samenwerking tussen de TU/e, High-Five en de deelnemende basisscholen.

Het doel van dit onderzoek is om te achterhalen wat de perceptie van ouders/verzorgers en hun kinderen is van het High-Five project en het digitale platform. Ook is het doel van het onderzoek om te achterhalen wat de invloed van het High-Five project is op de sociale cohesie tussen ouders/verzorgers, sociale kringen van ouders/verzorgers en buurtbewoners (woonachtig in de kern waarin de school zich bevindt).

## Verwerkingsverantwoordelijke in de zin van de AVG

TU/e is verantwoordelijk voor de verwerking van uw persoonsgegevens in het kader van het onderzoek. De contactgegevens van TU/e zijn:

Technische Universiteit Eindhoven
De Groene Loper 3
5612 AE Eindhoven

## Wat houdt deelname aan de studie in?

U neemt deel aan een onderzoek waarbij we informatie zullen verzamelen door het afnemen van een online survey. Wij vragen u gedurende 10 minuten 1 keer een vragenlijst in te vullen over de kenmerken van uw kind, percepties van het High-Five concept en de reikwijdte van het project, welke u online kunt invullen.

U ontvangt voor deelname aan dit onderzoek geen vergoeding.

## Potentiële risico's en ongemakken

Er zijn geen fysieke, juridische of economische risico's verbonden aan uw deelname aan deze studie. U hoeft geen vragen te beantwoorden die u niet wilt beantwoorden. Uw deelname is vrijwillig. Dit betekent dat u uw deelname op elk gewenst moment mag stoppen door dit te melden bij de onderzoeker. U hoeft niet uit te leggen waarom u wilt stoppen met deelname aan het onderzoek.

## Intrekken toestemming en contactgegevens

Deelname aan dit onderzoek is geheel vrijwillig. U kunt als deelnemer uw medewerking aan het onderzoek te allen tijde stoppen, of weigeren dat uw gegevens voor het onderzoek mogen worden gebruikt, zonder opgaaf van redenen. Het stopzetten van deelname heeft geen nadelige gevolgen voor u.

Als u tijdens het onderzoek besluit om uw medewerking te staken, zullen de gegevens die u reeds hebt verstrekt tot het moment van intrekking van de toestemming in het onderzoek gebruikt worden.
Wilt u stoppen met het onderzoek, of heeft u vragen en/of klachten? Neem dan contact op met de onderzoeker via n.n.p.schmeets@student.tue.nl.

Indien u specifieke vragen hebt over de omgang met persoonsgegevens kun u deze richten aan de functionaris gegevensbescherming van TU/e door een mail te sturen naar functionarisgegevensbescherming@tue.nl. U hebt daarnaast het recht om een klacht in te dienen bij de Autoriteit Persoonsgegevens.

Tot slot heeft u het recht een verzoek tot inzage, wijziging, verwijdering of aanpassing van uw gegevens te doen. Dien uw verzoek daartoe in via privacy@tue.nl.

### Grondslag voor het verwerken van uw persoonsgegevens

De grondslag waarop wij uw gegevens verwerken is toestemming.

### Welke persoonsgegevens verzamelen en verwerken wij van u?

In verband met het onderzoek verwerken wij de volgende persoonsgegevens:

| **Categorie** | **Persoonsgegevens** |
|---|---|
| *Sociaal-demografische gegevens* | *Gemeente van de school van uw kind, leerjaar van uw kind, geslachtkind, leeftijd kind, aantal kinderen op school (ouder), huishoudelijke samenstelling, bruto huishoudelijk inkomen per jaar (ouders/verzorgers), etnische afkomst (kind), eigendom privéauto(s)* |

In het kader van het onderzoek zullen uw persoonsgegevens worden gedeeld met
Naam organisatie: Aptus B.V. (oprichter High-Five project)
Vestigingsland: België.
Persoonsgegevens worden gedeeld met deze organisatie omdat de data wordt gebruikt om de impact van het High-Five project op de vervoerskeuze van basisschoolkinderen te meten en daarnaast ook de sociale impact op de kern waarin de basisschool zich bevindt. Deze data ondersteunt het doel van High-Five om in de toekomst nog een grotere positieve impact te hebben op de vervoerskeuze van basisschoolkinderen in Nederland en België.

Opslagoplossing: SURF Drive (Nederland)

Survey tool: MS Forms (NL)

Data-analyse tool: IBM® SPSS® Statistics

## Vertrouwelijkheid van gegevens

Wij doen er alles aan uw privacy zo goed mogelijk te beschermen. De onderzoeksresultaten die gepubliceerd worden zullen op geen enkele wijze vertrouwelijke informatie of persoonsgegevens van of over u bevatten waardoor iemand u kan herkennen, tenzij u in ons toestemmingsformulier expliciet toestemming heeft gegeven voor het vermelden van uw naam, bijvoorbeeld bij een quote.

De persoonsgegevens die verzameld zijn via online surveys, en andere documenten in het kader van deze studie, worden opgeslagen op de SURF drive, gedurende het onderzoek. Wanneer het afstudeerproject is afgerond. De gepseudonimiseerde data worden aan het eind van het project gearchiveerd bij een TU/e faciliteit.

De gegevens worden opgeslagen op de SURF drive, gedurende het onderzoek. Wanneer het afstudeerproject is afgerond. De gepseudonimiseerde data worden aan het eind van het project gearchiveerd bij een TU/e faciliteit.

De ruwe en bewerkte onderzoeksgegevens worden bewaard voor een periode van 10 jaar. Uiterlijk na het verstrijken van deze termijn zullen de gegevens worden verwijderd of worden geanonimiseerd zodat ze niet meer te herleiden zijn tot een persoon. De onderzoeksgegevens worden indien nodig (bijvoorbeeld voor een controle op wetenschappelijke integriteit) en alleen in anonieme vorm ter beschikking gesteld aan personen buiten de onderzoeksgroep.

Dit onderzoek is beoordeeld en goedgekeurd op 14-04-2023 door de ethische toetsingscommissie van de Technische Universiteit Eindhoven.

Door dit toestemmingsformulier te ondertekenen erken ik het volgende:

Ik ben voldoende geïnformeerd over het onderzoek door middel van een separaat informatieblad. Ik heb het informatieblad gelezen en heb daarna de mogelijkheid gehad vragen te kunnen stellen. Deze vragen zijn voldoende beantwoord.

Ik neem vrijwillig deel aan dit onderzoek. Er is geen expliciete of impliciete dwang voor mij om aan dit onderzoek deel te nemen. Het is mij duidelijk dat ik deelname aan het onderzoek op elk moment, zonder opgaaf van reden, kan beëindigen. Ik hoef een vraag niet te beantwoorden als ik dat niet wil.

Ik geef toestemming om de persoonsgegevens die gedurende het onderzoek bij mij worden verzameld te verwerken zoals is opgenomen in het informatieblad.

**Bij deze ga ik akkoord met de voorwaarden zoals in de toestemmingsverklaring zijn benoemd.**

- Ja
- Nee

## Deel 1: Kenmerken kind

*Deze vragen gaan over de algemene kenmerken van uw kind (8 vragen). Indien u meerdere kinderen op deze school heeft, vul in voor het oudste kind.*

**Hoe oud is uw kind?**

- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12

**In welke Belgische gemeente gaat uw kind naar school?**

- Anzegem
- Avelgem
- Diest
- Gullegem
- Harelbeke
- Hasselt
- Houthulst
- Ichtegem
- Kortenberg
- Lommel
- Peer
- Schoten
- Tremelo
- Wichelen
- Zoutleeuw

**In welk leerjaar zit uw kind?**

- 1
- 2
- 3
- 4
- 5
- 6

**Wat is het geslacht van uw kind?**

- Jongen
- Meisje
- Anders

**Hoeveel kinderen heeft u in totaal op deze school zitten?**

- 1
- 2
- 3
- 4
- 5 of meer

**Uit hoeveel personen bestaat uw huishouden?**

- 1
- 2
- 3
- 4
- 5
- 6
- Meer dan 6

**Wat is grofweg uw bruto huishoudelijk inkomen per jaar? (Inkomen van u en eventueel uw partner)**

- Lager dan €20.000,-
- €20.000 – €30.000,-
- €30.000 – €40.000,-
- €40.000 – €50.000,-
- €50.000 of meer
- Weet ik niet
- Wil ik niet kwijt

**Beschikt uw huishouden over 1 of meerdere privéauto's?**

- Ja, over 1 privéauto
- Ja, over 2 of meer privéauto's
- Nee

**Wat is de etnische afkomst van uw kind?**

- Belgische achtergrond
- Nederlandse achtergrond
- Westerse migratieachtergrond *(Alle landen in Europa (behalve Turkije), Noord-Amerika, Oceanië en Japan en Indonesië.*
- Niet-westerse migratieachtergrond *(Alle landen in Afrika, Latijns-Amerika en Azië (exclusief Japan en Indonesië) en Turkije.*
- Anders, namelijk: ……..

**Hoe vaak speelt uw kind online games?**
*(Bijvoorbeeld, Xbox, Playstation, smartphone, tablet)*

- Nooit
- Enkele keren per maand
- Enkele keren per week
- Dagelijks

**Doet uw kind mee met het High-Five project?**
*Meedoen betekent minimaal 1 keer per week het polsbandje of de fietstag scannen.*

- Ja, mijn kind doet mee met het High-Five project
- Nee, mijn kind doet niet mee met het High-Five project (wordt doorgestuurd naar deel 3 in online survey)

## Deel 2: Platform interpretatie van kind en ouder/verzorger

*Deze vragen gaan over hoe u en uw kind het High-Five platform beoordelen (20 vragen)*

**Hoe vaak maakt uw kind gebruik van het online platform per week?**

- Nooit
- 1 keer per maand
- 1 keer per 2 weken
- 1 keer per week
- 1 keer per dag
- Meer dan 1 keer per dag
- Weet ik niet

**Hoe vaak maakt u zelf en eventueel uw partner gebruik van het platform?**

- Nooit
- 1 keer per maand
- 1 keer per 2 weken
- 1 keer per week
- 1 keer per dag

**Waarom maakt u geen of nauwelijks gebruik van het platform?**
*(Meerdere antwoorden mogelijk)*

- Ik vind het niet leuk
- Ik begrijp het niet
- Ik heb er geen tijd voor
- Ik heb geen middelen om erop te geraken
- Ik ben mijn wachtwoord/gebruikersnaam kwijt/vergeten
- Anders, namelijk:_____

**Bent u als ouder/verzorger bekend met alle onderdelen op het platform en hoe deze onderdelen werken?**

- Nee
- Ja
- Weet ik niet

**Wat vindt u zelf als ouder/verzorger van de beschikbare onderdelen op het platform? Geef ieder onderdeel een rapportcijfer tussen 1-5.**

| *Cijfer:* | *Eigen avatar* | *Verkeersquiz* | *Afleveringen cinema* | *Medailles winnen en verzamelen* | *Beloningen* | *Eigen boom laten groeien* | *Tussenstanden van uw kinds klas en school* |
|---|---|---|---|---|---|---|---|
| *1* | | | | | | | |
| *2* | | | | | | | |
| *3* | | | | | | | |
| *4* | | | | | | | |
| *5* | | | | | | | |
| *Met dit onderdeel ben ik niet bekend* | | | | | | | |

**Wat vindt u als ouder/verzorger het leukst aan het hoogst scorende onderdeel of onderdelen bij de vorige vraag?** *(Meerdere antwoorden mogelijk)*

- Het spelenderwijs leren sparen voor beloningen is een leuke manier om mijn kind(eren) actief naar school te laten reizen
- Het spelen van de quizzen leert mijn kind(eren) om op een veilige manier deel te nemen aan het verkeer
- Het laten groeien van een eigen boom is een leuke manier om mijn kind(eren) te leren hoe belangrijk de natuur is
- De competitie tussen de kinderen wie de meeste ‘High-Fives’ verzameld is een leuke manier om mijn kind(eren) te motiveren om actief naar school te gaan.
- Het winnen en verzamelen van medailles is een leuke manier om mijn kind(eren) te motiveren om actief naar school te gaan.
- Het kijken van de spannende afleveringen van High-Five en Kapitein Smog.
- Weet ik niet
- Anders,
  namelijk:……

**Wat vindt uw kind van de beschikbare onderdelen op het platform? Geef ieder onderdeel een rapportcijfer tussen 1-10.**

| *Cijfer:* | *Eigen avatar* | *Verkeersquiz* | *Afleveringen cinema* | *Medailles winnen en verzamelen* | *Beloningen* | *Eigen boom laten groeien* | *Tussenstanden van uw kinds klas en school* |
|---|---|---|---|---|---|---|---|
| *1* | | | | | | | |
| *2* | | | | | | | |
| *3* | | | | | | | |
| *4* | | | | | | | |
| *5* | | | | | | | |
| *6* | | | | | | | |
| *7* | | | | | | | |
| *8* | | | | | | | |
| *9* | | | | | | | |
| *10* | | | | | | | |
| *Ik heb dit onderdeel nog niet gespeeld* | | | | | | | |

**Wat vindt uw kind het leukst aan het hoogst scorende onderdeel of onderdelen bij de vorige vraag?**
*(Meerdere antwoorden mogelijk)*

- Mijn kind vindt het leukst om te sparen voor beloningen.
- Mijn kind vindt het leukst om te leren over het verkeer door het spelen van de quizzen.
- Mijn kind vindt het leukst om een eigen boom te laten groeien door actief naar school te gaan.
- Mijn kind vindt de competitie om wie de meeste ‘High-Fives’ (het vaakst naar school loopt of fietst) verzameld met klasgenoten of schoolgenoten het leukst.
- Mijn kind vindt het winnen en verzamelen van zoveel mogelijk medailles het leukst.
- Mijn kind vindt het kijken van de spannende afleveringen van High-Five en Kapitein Smog het leukst.
- Weet ik niet
- Anders,
  namelijk……

**Welke onderdelen zou uw kind graag toegevoegd zien worden aan het platform?**
*(Open vraag)*

_____

_____

**Welke onderdelen zou u graag toegevoegd zien worden op het platform voor uw kind?**
*(Open vraag)*

_____

_____

**Wat vindt uw kind van de lay-out (vormgeving van de webpagina)?**

- Heel mooi
- Mooi
- Neutraal
- Lelijk
- Heel erg lelijk
- Weet ik niet

**Wat vindt uzelf van de lay-out (vormgeving van de webpagina)?**

- Heel mooi
- Mooi
- Neutraal
- Lelijk
- Heel erg lelijk
- Weet ik niet

**Wat kan er verbeterd worden volgens uw kind?**
*(Meerdere antwoorden mogelijk)*

- Kleurtjes van de website (Nu blauw en geel)
- Leukere vorm van de lettertjes
- Makkelijkere zinnen, nu is het moeilijk te begrijpen
- Indeling van het platform, ik wil bijvoorbeeld dat de resultaten van mijn klas en van mijn school bovenaan de pagina staan in plaats van onderaan.
- Er moeten spelletjes toegevoegd worden aan het platform.
- Meer afleveringen over de avonturen van High-Five en Smog toevoegen.
- Niets, het is goed zoals het is.
- Anders, namelijk:
  _____

**Wat kan er veranderd worden om het platform te verbeteren en/of gebruiksvriendelijker te maken?**

- Kleurencombinatie
- Lettertype
- Taalgebruik
- Indeling
- Toevoegen van spelletjes
- Toevoegen van schooloefeningen zoals rekenen, taal etc.
- Toevoegen van meer verkeersquizzen
- Meer afleveringen over de avonturen van High-Five en Smog toevoegen.
- Niets, het is goed zoals het is.
- Anders, namelijk:
  _____

**Hoe vaak wordt er volgens uw kind actief verwezen naar het platform tijdens de lessen door leraren of directie personeel?**

- Nooit
- 1 keer per maand
- 1 keer per 2 weken
- 1 keer per week
- Enkele keren per week
- 1 keer per dag

**Via welke communicatiekanaal van de school wordt voornamelijk herinneringen of berichten over het High-Five project gedeeld met u als ouder/verzorger?**

- Email
- Brief
- Platform school
- Ouder gesprek
- Niets
- Whatsapp

## Deel 3: Mobiliteit van uw kind en uzelf

*Dit deel gaat over de mobiliteit van uw kind en van uzelf voorafgaand aan het High-Five project en na de intrede van het High-Five project (10 vragen). De vragen zijn specifiek aan u, de ouder/verzorger gericht.*

**Wat is de afstand die uw kind moet afleggen van huis naar school?**

- < 0.5 km
- 0.5-1.0 km
- 1.0-2.0 km
- >2.0 km

**Met welk vervoersmiddel gaat uw kind meestal naar school VOOR de start van het High-Five project?**

- Auto
- Fiets
- Te voet
- Weet ik niet
- Anders, namelijk:……

**Met welk vervoersmiddel gaan de meeste vriendjes/vriendinnetjes van uw kind naar school VOOR de start van het High-Five project?**

- Auto
- Fiets
- Te voet
- Weet ik niet
- Anders, namelijk:……..

Hoe veilig vindt u de route naar school van uw kind op een schaal van 1-10?
*(Waarbij 10 heel veilig is en 1 zeer onveilig)*

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Beoordeel de verkeersvaardigheden van uw kind op een schaal van 1-10.
*(Waarbij 10 heel goed en 1 heel zwak)*

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

**Wat zijn redenen waarom uw kind eventueel niet met de fiets of met de voet naar school gaat?**
*(Meerdere antwoorden mogelijk)*

- De route naar school vind ik onveilig
- De afstand naar school is te groot
- Slecht weer
- Het scheelt mij tijd als ik de kinderen op school afzet en daarna direct door kan rijden naar mijn werk
- Ik vind dat mijn kind nog niet voldoende verkeersvaardigheden heeft om met de fiets of te voet naar school te gaan
- Ik ga liever met de auto dan met de fiets of te voet
- Mijn kind gaat liever met de auto dan met de fiets of te voet
- Anders, namelijk: ……..

**Hoe vaak en welke transportmiddelen gebruikte uw kind om naar school te gaan tijdens een gemiddelde school week voor de start van het High-Five project?**

| Aantal: | Auto | Fiets | Te voet | Anders, namelijk: |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

**Heeft u het idee dat er nu meer kinderen te voet of met de fiets naar school gaan sinds de start van het High-Five project?**

- Ja
- Nee
- Weet ik niet

**Hoe vaak en welke transportmiddelen gebruikte uw kind om naar school te gaan tijdens een gemiddelde school week sinds de start van het High-Five project?**

| Aantal: | Auto | Fiets | Te voet | Anders |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

## Deel 4: Sociale reikwijdte van het High-Five platform

*Dit deel gaat over de sociale verbindingen die u maakt met andere mensen door middel van het High-Five platform. In dit deel is deelname aan het High-Five project niet van toepassing. (6 vragen)*

**Hoe goed was uw algemene contact met uw buurtbewoners VOOR het High-Five project? (Sociale relaties)**

| Geen enkel contact | Nauwelijks contact | Regelmatig contact | Goed contact | Zeer goed contact |
|---|---|---|---|---|
| | | | | |

**Hoe vaak maakte u ongeveer een praatje met de volgende mensen voor de start van het High-Five project?** *Meerdere antwoorden mogelijk. Alle onderwerpen behalve het High-Five project.*

| | Nooit | 1 keer in de maand | 1 keer per twee weken | 1 keer per week | Meerdere keren per week |
|---|---|---|---|---|---|
| Buurtbewoners | | | | | |
| Andere ouders | | | | | |
| Sociale kring | | | | | |

**Hoe goed is uw algemene contact met uw buurtbewoners sinds de start van het High-Five project?**

| | Geen enkel contact | Nauwelijks contact | Regelmatig contact | Goed contact | Zeer goed contact |
|---|---|---|---|---|---|
| Buurtbewoners | | | | | |
| Andere ouders | | | | | |
| Sociale kring | | | | | |

**Hoe vaak praat u met de volgende personen over High-Five sinds de start van het project?** *Meerdere antwoorden mogelijk. Alle onderwerpen behalve het High-Five project.*

| | Nooit | 1 keer in de maand | 1 keer per twee weken | 1 keer per week | Meerdere keren per week |
|---|---|---|---|---|---|
| Buurtbewoners | | | | | |
| Andere ouders | | | | | |
| Sociale kring | | | | | |

**Geef aan hoe oneens/eens u het bent met de volgende stellingen NA de start van het High-Five project (dus op dit moment)?**

| Nr. | Stellingen: | Helemaal niet mee eens | Niet mee eens | Niet mee eens en niet mee oneens | Mee eens | Helemaal mee eens |
|---|---|---|---|---|---|---|
| 1 | Ik bezoek mijn buurtgenoten bij hen thuis. | | | | | |
| 2 | De vriendschappen en connecties die ik heb met andere mensen in mijn buurt betekenen veel voor mij | | | | | |
| 3 | Als ik ergens advies over nodig heb, kan ik bij iemand uit mijn buurt terecht. | | | | | |
| 4 | Ik geloof dat mijn buren zouden helpen in geval van nood. | | | | | |
| 5 | Ik leen spullen en wissel gunsten uit met mijn buren. | | | | | |
| 6 | Ik zou bereid zijn om met anderen samen te werken aan iets om mijn buurt te verbeteren. | | | | | |
| 7 | Ik krijg vaak een buurtgenoot bij mij thuis op bezoek. | | | | | |
| 8 | Ik stop regelmatig om met mensen in mijn buurt te praten. | | | | | |
| 9 | Ik denk dat de ideeën die mijn buurtgenoten hebben over wat belangrijk is in het leven overeenkomen met die van mij. | | | | | |
| 10 | Als de mensen in mijn buurt iets van plan waren, zou ik het eerder als iets van ons samen zien dan alleen van hen. | | | | | |

**Wat heeft het High-Five project voor u betekent op het gebied van sociale verbondenheid?**
***(Open vraag)***

_____

_____

_____

# Appendix B: Overview affilliated schools High-Five campaign

This appendix contains the list of all 53 schools affiliated to the High-Five campaign including their total pupil numbers and the municipality in which the schools are located (see table B.1). This information is taken from the High-Five database.

*Table B.1: All 53 affiliated schools to the High-Five campaign*

| ***Municipality*** | ***Country*** | ***Schools*** | ***Students*** |
|---|---|---|---|
| Anzegem | Belgium | • Ingooigem | 103 |
| Avelgem | Belgium | • De Toekomst<br>• Sint-Jan Berchmans | 381<br>488 |
| Diest | Belgium | • De Buitenkans<br>• De Kleine Prins<br>• KSD Sint-Jan | 154<br>288<br>263 |
| Gullegem | Belgium | • De Gulleboom (2 locations) | 547 (total) |
| Harelbeke | Belgium | • Centrumschool Harelbeke<br>• De Vleugel<br>• Heilig Hart<br>• GO! Ter Gavers<br>• Mariaschool | 158<br>131<br>220<br>155<br>142 |
| Hasselt | Belgium | • De Hazelaar<br>• De Puzzel<br>• SBS Kuringen<br>• Tuinwijk | 254<br>176<br>453<br>397 |
| Houthulst | Belgium | • ‘t Jonkerschooltje<br>• VBS Houthulst<br>• Schooltrio afdeling Klerken<br>• Schooltrio afdeling Sint-Kristoffel<br>• VBS Kouterkind | 84<br>170<br>87<br>155<br>142 |
| Ichtegem | Belgium | • ‘t Mozaïek | 181 |
| Kortenberg | Belgium | • De Klimop<br>• VBS Mater Dei | 150<br>274 |
| Lommel | Belgium | • ‘t Stekske<br>• Lommel-West<br>• Sint-Jan<br>• XCL Wegwijs | 114<br>203<br>156<br>119 |
| Peer | Belgium | • ‘t Perenboompje/De Uitvinder<br>• De Puzzel<br>• Dommelbrug Linde<br>• Dommelbrug Wauberg<br>• Magneet<br>• Pieter Brueghel<br>• Ticheleer | 224<br>112<br>143<br>105<br>303<br>153<br>202 |
| Schoten | Belgium | • Campus Kajee<br>• Openluchtschool Sint-Ludgardis | 194<br>444 |
| Tremelo | Belgium | • De Cocon | 258 |
| Wichelen | Belgium | • GIBO Belhamel<br>• GIBO De Rozelaar<br>• GIBO Meander<br>• Het Belleveer | 132<br>204<br>252<br>135 |
| Zoutleeuw | Belgium | • De Bron | 140 |
| Aalten | The Netherlands | • De Triangel | 124 |

| | | | |
|---|---|---|---|
| Arnhem | The Netherlands | • De Boomhut<br>• De Laarhorst<br>• De Lingelaar | 241<br>111<br>218 |
| Doetinchem | The Netherlands | • CBS De Haven | 202 |
| Nijmegen | The Netherlands | • De Vossenburcht | 129 |
| Veenendaal | The Netherlands | • De Achtbaan<br>• De Vuurvlinder<br>• Mozaïk | 112<br>213<br>179 |
| **Total:** | | | **10.675** |

# Appendix C: Parental barriers

Next to questions regarding the dependent variable children's travel mode choice, parents were also asked to indicate possible valid reasons to not allow their children to travel actively to school. Respondents were able to indicate multiple reasons to answer the question in the questionnaire. As can be seen in figure C.1, most respondents (206) indicated that their child is allowed to travel actively to school. However, the most frequently mentioned reason is related to parental motivation, specifically time constraints (117). Also, bad weather conditions (84) and unsafe traffic routes (87) are indicated frequently as valid factors for parents to not allow their child. Preference for the car by parents or children has been indicated the least by respondents as a valid reason.

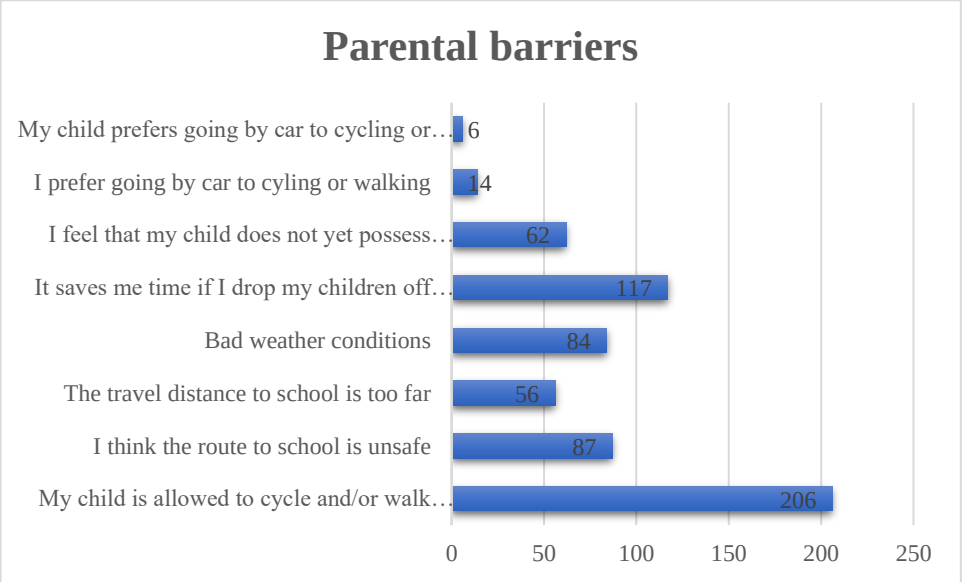


*Figure C.1: Parental barriers for allowing their children to commute actively to school*

Respondents also used the option other in the questionnaire to indicate other reasons for not allowing their child to actively commute. From these responses, it became clear that the first option (my child is allowed to cycle and/or walk to school) contained an error. Only bicycle was named, so many respondents indicated that their children may and do go to school by foot. These responses were merged with the former option when coding. Also, multiple respondents used this option to provide additional explanation on why their child does not travel to school by active means. These were removed during the preparation of the dataset for the analyses in SPSS.