Erasmus University Rotterdam
Erasmus School of Economics
Master Thesis Behavioral Economics

Walking Works

A field experiment on behavioral interventions and their ability to motivate walking

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Date final version:	08-03-2022

Abstract: In western cities, there has been stagnation or even a decrease in walking for the past decades (Wernbacher et al., 2020). The Ministry of Infrastructure and Water Management and the Municipality of Rotterdam are trying to stimulate walking with pedestrian policy plans. Overschie, a neighborhood in Rotterdam, has multiple social problems such as too little exercise among the elderly and children, and loneliness. Walking can contribute to a solution for these problems (Rowe & Kahn, 1997). This research tries to remove barriers and offers creative incentives to motivate people to walk. I have designed behavioral interventions to facilitate or motivate walking. I examine which behavioral intervention stimulates local residents to walk more frequently, and a longer distance in Overschie. The interventions are tested during a field experiment in Overschie. I have used a Probit model to find out which interventions stimulate residents to walk a longer route, which has the same destination as the shorter route. In addition, I have used the Chi-Square test to find out which intervention is the most popular, based on interviews. I have not been able to find statistically and economically significant evidence for the behavioral interventions. However, the findings hint towards focusing more on facilitating walking behavior, instead of motivating walking behavior.

Keywords: Behavioral Economics, nudging, walking, behavioral interventions, field experiment

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1. Introduction

1.1 A rising problem

In western cities, there has been stagnation or even a decrease in walking for the past decades (Wernbacher et al., 2020). There has been given little importance to pedestrian traffic compared to other means of transportation. In the Netherlands, spatial planning focussed on making places accessible for cars, buses, and bicycles. Only the residual space is used for pedestrians or children playing in their neighborhood (Lopen als Kans, 2020). This spatial planning focus on cars instead of pedestrians led to unaccessible supermarkets, stores, or work. For instance, this led to unsafe situations where children could not safely play on the street, or blind persons could not continue their walk as the guidelines for the blind were interrupted. Walking was not a problem that needed policy attention for a long time. However, the Dutch government is starting to understand that a more central focus should be on active mobility when designing the public space and the corresponding infrastructure (Lopen als Kans, 2020). More emphasis on walking can play a key role in transitioning to this more human-focused policy.

Walking contributes to solving traffic safety, livability, urbanization, climate, and health problems. For example, walking contributes to densification, which is part of urbanization. Pedestrians use at least ten times less space than cars, respectively 2m² and 20m². In a densified city this could leave more space for building houses instead of roads for motor vehicles. More space for walking and less space for motor vehicles lead to fewer emissions (Langstraat et al., 2014). Also, when people walk more, there are economic benefits. Pedestrians save money that could have been spent on transport means. In addition, pedestrians are more likely to spend money on local stores. Furthermore, enough daily exercise is necessary for a healthy lifestyle. Since 1990, more evidence has been found for health gains due to physical activity in the form of walking. However, this positive association between walking and health benefits is influenced by other factors such as a healthy lifestyle and other sorts of physical activity (Lee & Buchner, 2008). In other words, supporting people to walk more offers many chances in many different domains.

Since the Corona crisis, more people have started walking more regularly in the Netherlands (Wandelnet, 2020). Around 11 million people walked intensively in 2020, which is a growth of a half million, compared to 2018. Reasons to walk are divergent. Most stated reasons are enjoying the outdoors, relaxing and exercising, and as a social activity to meet with people.

Around 20 percent of the people expect to walk more compared to pre-Corona. (Lopen als Kans, 2020).

This nationwide rise in appreciation of walking aligns with the policy plan '*Lopen als Kans*' of the Ministry of Infrastructure and Water Management (IenW). The goal of the policy plan is to enhance active mobility, which includes walking and cycling. Active mobility is seen as the solution for present problems in cities such as accessibility of the city center and public transport, livability, (traffic) safety, and sustainability (Lopen als Kans, 2020). Therefore, the Ministry of IenW has stated three ambitions. Firstly, by increasing walking on the first and last mile. This means that the combination of walking and public transport should be made the more obvious choice to transport from A to B. For instance, by offering better walking provisions such as a flat footpath to make public transport better accessible on foot for the elderly. Increased walking on the first and last mile should then lead to a decrease in car usage. Secondly, cities should be restructured to be more attractive to walk than using a car. Thirdly, by more stimulating and lobbying for pedestrian safety at local governments. This should then lead to better pedestrian policies in the long run, which are specific for each city or area. An example of a frontrunner is Rotterdam with its policy plan *Rotterdam Loopt*, which is discussed later.

Not only is the Dutch government stimulating walking, but municipalities also understand the importance of changing the view on spatial planning and stimulating people to walk more. Multiple municipalities across the Netherlands are working together on a project called *City deal: ruimte voor lopen*. This project aims to increase livability in cities and share knowledge on walking. The project is divided into three subdomains. The third subdomain aims to stimulate walking. Participating municipalities are Rotterdam, Zwolle, Tilburg, Groningen, Leeuwarden, Nijmegen and Amsterdam. Specifically, the Municipality of Rotterdam developed the policy plan '*Rotterdam Loopt*'. This program aims to create a more accessible and healthier city for pedestrians by starting neighborhoods to stimulate walking behavior. Each neighborhood needs a different behavioral approach because every neighborhood has different cultures and ethnic backgrounds.

1.2 Motive

For this research, I focus on a neighborhood in Rotterdam called Overschie. This neighborhood is chosen because the Municipality of Rotterdam conducted a spatial analysis that showed more than enough challenges to encounter.

Firstly, the elderly above 60 years perform too little exercise compared to the average of the rest of Rotterdam, respectively 47 and 52 percent. (Concept ruimtelijke analyse, 2021). This is a serious problem as 14 percent of the local population is 60 years or older. Furthermore, 53 percent of the local population experiences loneliness, which is remarkable compared to the nationwide average of 44 percent. Besides, 35 percent of the local population experiences bad health compared to 25 percent nationwide. (Gezondheidsmonitor & RIVM, 2019). Also, 46 percent of the locals who are 18 years and older experience being overweight.

The previously stated dominant social problems could have a common partial solution: recreational walking. When walking, an individual is physically active and could get in touch with others. This is in line with the findings from the Municipality of Rotterdam. They found that the main reason inhabitants of Overschie exercise is the social aspect (Concept ruimtelijke analyse, 2021). Conversely, the reasons for not exercising are anxiety, laziness, loneliness, being too expensive to join a sports club, and ignorance. More specifically, physical complaints and lack of motivation are reasons to not walk. These are barriers that need to be considered when designing behavioral interventions. I try to remove these barriers and to offer creative incentives to motivate people to walk. Therefore, I address the following research question:

Which behavioral intervention motivates local residents to walk more frequently and a longer distance in Overschie, Rotterdam?

1.3 Location

The neighborhood Overschie has little space for walking and social meetings. One of the few attractive spaces in the neighborhood is Park16Hoven, a local park. However, this park has limited accessibility. The most used route is short but unsafe due to loaded traffic and a small footpath (Appendix 1.1). Therefore, it would benefit the local residents to have a more attractive route to the park, stimulating walking. This is in line with the finding of the spatial analysis performed by consultancy PosadMaxwan commissioned by the Municipality of Rotterdam (Concept ruimtelijke analyse, 2021). They made an overview of physical challenges and opportunities in Overschie. The following became clear based on the spatial analysis: *‘Along the Schie lies a wide cycling and footpath which includes a lot of green, playground and afternoon sun.’* This path is selected based on this recommendation, conversations with locals, and my reconnaissance throughout Overschie (Appendix 1.2).

The path will be referred to as the treatment path from now on. Making this path more attractive for local residents could stimulate walking behavior. Therefore, the target behavior is:
local residents make more use of the treatment path, and walk more frequently and longer.

The behavioral interventions are based on the behavior and preferences of the inhabitants to realize the target behavior. Therefore, I must get clear behavioral insights to create profiles of the target groups and their walking motives. The behavioral interventions are tested during a field experiment (Appendix 1.3.)

The societal relevance is to enhance walking in Rotterdam. The importance of walking is getting more recognition on both local and national government levels. Both the Ministry of IenW and the Municipality of Rotterdam are the stakeholders of this research. Next, I aim to expand the literature on which determinants motivate people to walk more in terms of scientific relevance. There is plenty of theoretical research on walking and its motivators. However, few empirical studies have been conducted on which determinants influence the walking decisions made in the Netherlands. The use of behavioral science to design interventions concerning walking is still new in the Netherlands.

Firstly, I discuss the literature regarding walking in chapter 2. Secondly, I perform the behavioral analysis of local residents based on interviews. Here I explain which behavioral framework I use and how I have gathered information about the local residents and their preferences regarding walking. Then, I propose the designed interventions based on the behavioral analysis in chapter 4. In chapter 5, I describe the methodology and state the hypotheses. Then in chapter 6, the results are interpreted. Further, I discuss the findings and the limitations of this research in chapter 7. Finally, I answer the research question and give recommendations concerning walking policy in chapter 8.

2. Literature Review

2.1 Why walking matters

There has been a rise in inactive lifestyles, which leads to an increase in obesity cases in the United States (Centers for Disease Control & Prevention, 1999). The striking decline in physical activity worried a large number of health experts, because numerous researches showed a strong association between a low level of physical movement and increased exposure to strokes, heart diseases, and other health problems (Centers for Disease Control & Prevention, 1999; Pedestrian and Bicycle Information Center, 2000).

The Dutch National Institute for Public Health and the Environment (RIVM) (2020) states guidelines for individuals older than 18 for sufficient physical exercise. For instance, an adult needs to exercise intensively for minimally 150 minutes a week. This could be walking or cycling. According to the RIVM, only 52,7 percent of the population follows these guidelines (Gezondsheidsmonitor & RIVM, 2019). When zooming in on this percentage, two age groups stand out who are far below this average. Namely, the group of 12 to 17 years old, and 65 years and older, with 41.2 percent and 41.9 percent.
For the last ten years, cities have been trying to enhance active mobility, including walking and cycling, to counter this rise in inactive lifestyles (Woodruff, 2017). For example, the Municipality of Haarlem designed low-traffic streets to counter space problems, stimulate walking and enhance livability (Gemeente Haarlem, 2021). Subsequently, the COVID-19 pandemic has boosted the focus on walking. About 150 cities worldwide like Rome and Barcelona are increasingly investing in walking infrastructure to stimulate walking (Paydar & Kamani Fard, 2021)

Walking brings a range of positive effects concerning health, which can be categorized into mental and physical health. It enhances mental health by reducing symptoms of anxiety, stress, and depression. In addition, there is increasing evidence that walking counters social isolation (Kelly et al., 2018). Walking is mainly done in a context with others, leading to socializing with peers. This socializing aspect of walking counters social isolation, which is related to mortality (Rowe & Kahn, 1997).
In terms of physical health, walking decreases the chance of cardiovascular diseases, overweight, and dementia (Lee & Buchner, 2008). Furthermore, walking enhances creativity because walking and other forms of physical exercise enhance positive emotions and regenerate energy, which could lead to new ideas and increased productivity (Oppezzo &

Schwartz, 2014). In addition, physical activity such as walking is related to a decreased chance of getting colon and breast cancers (Lee, 2003).

An example where walking has had positive effects on both mental and physical health is the research from Morgan et al. (2010). Thirty participants of around 60 years were randomly assigned into either the walking group where individuals had to walk 10.000 steps a day or the control group where no objectives were given. They found that walking on average 10.000 steps a day for 15 weeks has varying positive effects on health. Altogether, walking enhances cardiovascular performance and improves physical and mental well-being (Kelly et al., 2018).

2.2 Determinants of walking behavior

It is necessary to understand which determinants are essential for walking before creating a behavioral intervention. Alfonzo (2005) created a Maslow pyramid, describing the hierarchy of walking needs. The most determining factors are at the bottom of the pyramid, the least determining are at the top of the pyramid. The pyramid of walking needs is the basis for the interviews and possible interventions (Figure 2.1).

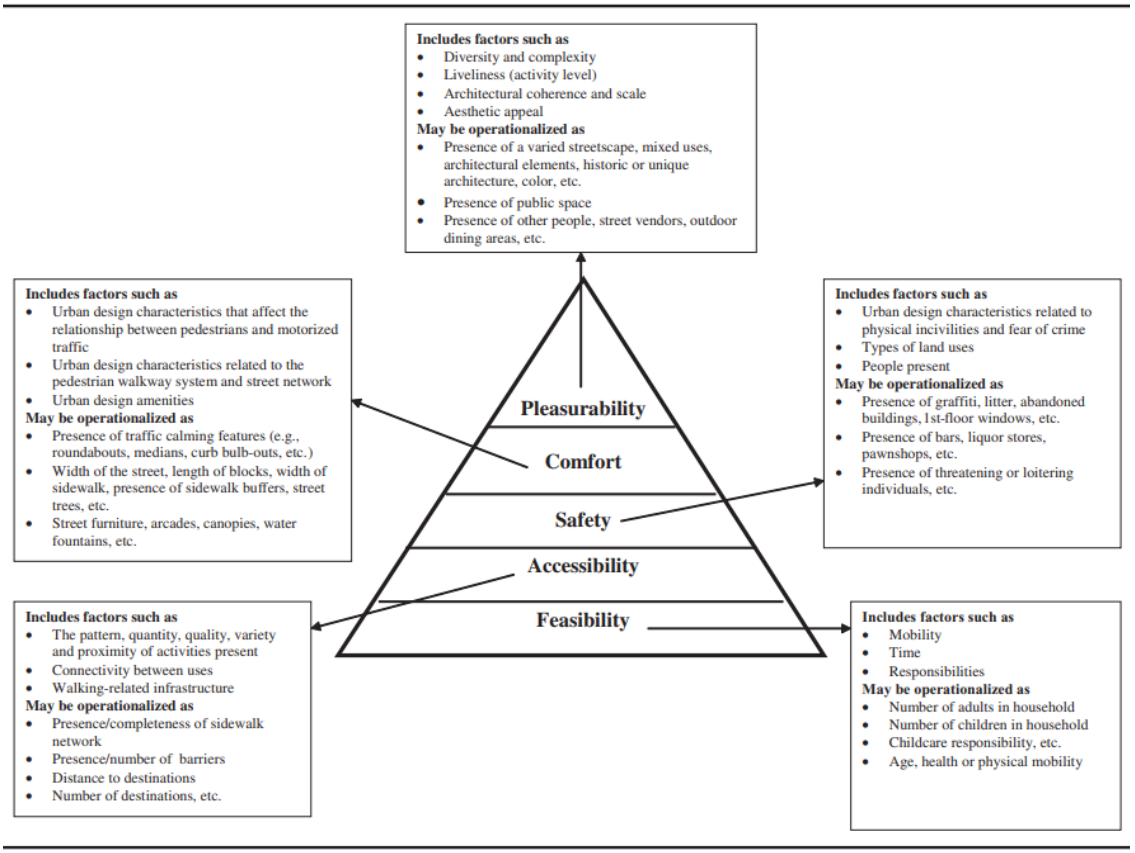


Figure 2.1.: Maslow's Pyramid of walking needs, extracted from Alfonzo (2005)

The first layer of the pyramid is feasibility which is at the bottom of the pyramid. Feasibility is a requirement for walking behavior. Feasibility means how practicable it is for an individual to walk. Feasibility includes factors as time, mobility of the individual, and its responsibilities. Generally, these factors are exogenous, as one can have limited influence on these factors and is for each individual different. For instance, an average elderly woman has more time but less mobility than a 30-year-old who is busy working and has a family.

The second level of the pyramid is accessibility. Accessibility facilitates walking behavior, which could be in the form of trails and paths. Also, possible destinations such as supermarkets are being captured within accessibility. People are less reluctant to walk if a destination is not perceived as nearby. For instance, Southworth (1997) showed that 70 percent of individuals in the United States walk 150 meters for groceries, while for 320 meters, the percentage is only 40 percent. This shows that people are reluctant to walk increased distances in this case, and prefer other means of transportation.

Subsequently, when the previous two levels are fulfilled, an individual starts looking at the following level, namely safety. Safety refers to the absence of crime or other forms of intimidation. An individual's level of safety depends on the surroundings and the presence of other individuals and groups. For instance, young males hanging on the street are considered more threatening than other demographic groups (Day, 1999).
Concerning the surroundings, litter and graffiti have a negative effect on the feeling of safety of most individuals (Hope & Hough, 1988). Conversely, according to Gillis et al. (1992), street lights, block watch signs, and garden decorations positively affect the feeling of safety of most individuals. Whether places such as pawnshops, liquor stores, and bars are perceived as safe depends on the demographic group (Taylor et al., 1984). For instance, it is more attractive for students to walk past a bar than for the elderly.
Furthermore, perceived safety especially affects the decision to walk for recreational walking (Alfonzo, 2005). When an individual feels a lack of safety, those trips are more likely to be canceled than necessary trips such as getting groceries or going to the doctor, also referred to as destination walking (Alfonzo, 2005). Altogether, safety is a decisive determinant for walking behavior that should be considered when designing a behavioral intervention.

The fourth layer of the pyramid of walking is *comfort*, which refers specifically to traffic safety, unlike the previous pyramid layer of safety. Comfort means that a person can freely and joyfully wander without facing barriers that lead to stress. Comfort is mainly determined by conditions that stimulate walking. For instance, wider sidewalks have been associated with

increased walking, as the walking experience is less influenced by obstacles such as bicycles, scooters, or other people (Alfonzo, 2005). Furthermore, the availability of street provisions such as street benches, water taps, or trash cans enhances comfort (Alfonzo, 2005).
In addition, environmental conditions can also remove barriers, especially the interaction between pedestrians and mechanized vehicles such as cars and scooters. According to Frank et al. (2006), traffic-calming tactics positively increase walking. Examples of these traffic-calming tactics are speed bumps, speed limits, crossings, trees, and other floriculture (Clark & Dornfeld, 1994).
To sum up, environmental adjustments or provisions mainly influence pedestrians' comfort and, therefore, their walking behavior. However, a limitation is that these adjustments and provisions need to be facilitated by a municipality or another form of governmental organization.

Lastly, at the top of the pyramid of walking is pleasurability. Pleasurability refers to the attractiveness and joyfulness of the walking routes for pedestrians (Alfonzo, 2005). This is subjective and therefore differs for each individual. According to Alfonzo (2005, p. 23) *“Diversity, complexity, liveliness, architectural coherence and scale, and aesthetic appeal may all affect a person’s level of satisfaction with pleasurability”*. In other words, a wide range of observable yet subjective factors influence a pedestrian’s walking experience. However, some aspects are generally well-received such as plantings, architecture, restaurants, historical constructions, and facing other people (Ball et al., 2001). Research from Lindelöw et al. (2017) showed that individuals with the same preferences generally live in neighborhoods, which could help design behavioral interventions.
In addition, diversity in landscape and retail stores on the walking route is positively associated with walking (Cervero, 2001).

To sum up, the pyramid of walking needs by Alfonzo (2005) has five layers. The five layers are feasibility, accessibility, safety, comfort, and pleasurability from bottom to top.
These layers have increasing importance from the most determining factor to the least determining factor of walking. The pyramid helps in designing the interventions in section 4.

3. Behavioral Analysis

3.1 Theoretical Framework

For this research, I use the COM-B model, which stands for Capabilities, Opportunities, Motivation, and Behavior model, combined with the Behavioral Change Wheel framework (BCW). The BCW is widely used in varying disciplines to realize behavioral change.
First, I will describe the COM-B model. Then I will explain the BCW framework and its relation to the COM-B model.

The COM-B model has three components: Capability, Opportunity, and Motivation. These three components exist out of two split-offs, as seen in figure 3.1. These components lead to the desired behavior. The desired behavior is increased walking in Overschie.

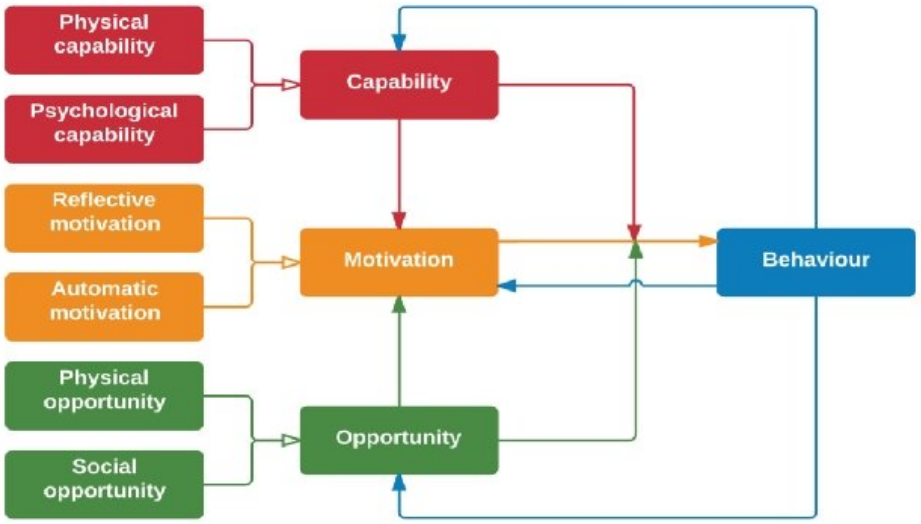


Figure 3.1.: COM-B model derived from Michie, Atkins & West, 2014

- **Capability**, divided into Psychological and Physical capability. Psychological capability refers to possible mental barriers that prevent residents from walking in their neighborhood. Next, Physical capability refers to the possibilities an individual has concerning their body.
- **Opportunity**, categorized as a Physical and Social Opportunity. Physical opportunity refers to the provisions a resident needs to walk, such as a footpath. Next, Social Opportunity refers to whether it is socially acceptable or normal to walk, especially at the treatment location.
- **Motivation**, existing out of Reflective and Automatic Motivation. Reflective motivation refers to whether residents understand the importance of walking. More specifically, it

also refers to whether a resident understands the importance of walking on the treatment path. Next, Automatic Motivation refers to a habit an individual has formed, such as walking the dog or jogging.

Next, the BCW framework is used when one is trying to realize behavioral change based on intervention and policy. The BCW framework is a fusion of 19 other behavioral models (Michie et al., 2014). Some of these behavioral change models solely focus on biases or beliefs, while others emphasize individuals' perceptions or the social context. However, behavior and behavioral change are determined by many factors (Michie et al., 2014). The BCW framework captures most of the possible factors.

The BCW framework contains three phases: understanding the behavior, identifying the intervention options, and identifying policy implications (Figure 3.2). Firstly, the green center refers to the COM-B model, which describes and understands the current behavior. Secondly, the red layer describes the nine possible behavioral intervention goals linked to the COM-B model's outcomes. Thirdly, the gray layer refers to seven possible policy outcomes. Altogether, each layer is intertwined with other layers. So, it is essential to understand the residents' behavior to get to the outer rim.

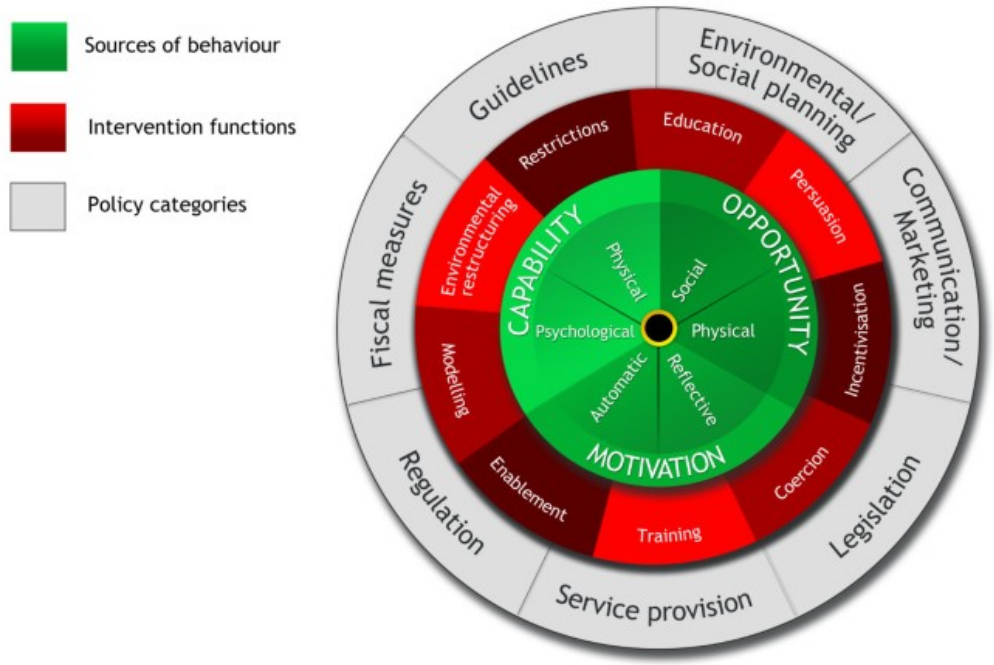


Figure 3.2.: BCW Framework retrieved from Michie, Atkins & West, 2014

First, the current behavior of local residents needs to be determined. The COM-B model is specifically used to discover the current behavior of subgroups of the residents. Next, I need to find out what kind of behavior needs to change to achieve the target behavior. The target behavior is *"local residents make more use of the treatment path, and walk more frequently and longer,"* as stated in section 1.3. Therefore, I need to gather information on the residents, which is done by conducting interviews in the neighborhood and on the path.

3.2 Findings field research

In the previous paragraph, I have set up a behavioral framework. Now I need to gather insights about the neighborhood to fill in the COM-B model. With the COM-B model, I can use the BCW framework, which allows me to create behavioral interventions that are in line with the preferences of the local residents.

I have conducted semi-structured exploratory interviews for six days (Table 3.1). The purpose of the interviews is to understand the current behavior of the local residents. Each shift is two to three hours. The most crowded moments in the midweeks are between 17:00 and 19:00. I have chosen this time frame on the recommendation of the neighborhood manager. The explanation is that inhabitants are done with working and want to walk before eating. In total, I have conducted 65 interviews.

First, I discuss the general findings. Then, I assign the findings to the subgroups that come forward. Then, I determine which target groups to focus on. Finally, I design behavioral interventions based on those target groups.

Table 3.1.: Exploratory interviews in 2021

Variables	**Friday (12-03)**	**Saturday (13-03)**	**Thursday (18-03)**	**Friday (19-03)**	**Friday (2-03)**	**Saturday (3-04)**	**Total**
Time (hours)	2	3	1,5	2	2	2,5	**13**
Users path	44	53	28	51	57	46	**279**
individuals interviewed	12	16	4	15	10	8	**65**
Temperature	8°C	7°C	10°C	9°C	8°C	7°C	

The main questions asked are

1. *Which factors determine an attractive walking route?*
2. *Which factors are attractive to this specific route, and what could be improved?*

In order to create profiles of the pedestrians, I also had to ask profile questions:

- *In which postal code are you living*
- *Do you visit Park16Hoven regularly?*
- *How long do you spend at Park16hoven*
- *How much do you walk on the treatment path?*
- *Do you also take other routes to Park16Hoven?*

Firstly, I discuss the main findings from the first main question. I have categorized the findings based on the Maslow Pyramid for walking needs (Alfonzo, 2005). As stated in the literature review (section 2.2.), the main determinants of walking behavior are discussed in this article.

Pleasurability: Residents value flora and fauna. Further, they enjoy walking along the water. Moreover, local residents like sightseeing. This could be in the form of a mill, an artwork, or a historic building.

Comfort: Respondents clarified that they prefer to have enough space to walk. This result could be due to Corona and the social distancing recommendations. In line with this finding is that respondents like a quiet route. However, young pedestrians indicated the opposite, as they also enjoy a more vivid environment. Next, respondents indicated that it would be appreciated if they could rest during their walk. This is by sitting on a bench, plaid, or at a restaurant to eat, drink and rest. By extension, this also indicated that bins are needed.

Safety: This category can be divided into two categories—namely, social safety and traffic safety. Social safety refers to the fact that enough other pedestrians look after each other. This is to counter unsafe (perceived) situations with loitering youths and possible thieves, which mainly applies to the elderly. Generally, this is stated when it is dark outside because there is less overview and social safety. Alternatively, traffic safety refers mainly to motorized vehicles that annoy pedestrians.

Accessibility: Local residents refer to a paved, walkable path and clear signage. Moreover, eating and drinking destinations also come forward to be favorable when choosing a walking route.

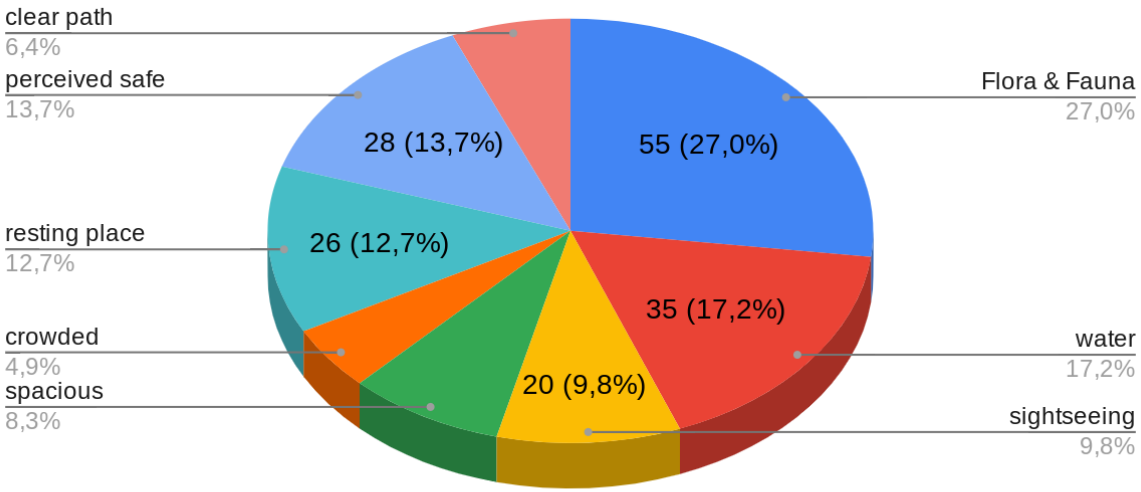


Figure 3.3.: Factors that determine an attractive walking route according to pedestrians of Overschie

Secondly, I have asked the second main question, '*Which factors are attractive* to this *specific route, and what could be improved?'.* This specific route refers to the treatment path.

Attractive: The most stated factor of this specific route is that local residents can walk their dogs safely. No cars are allowed on this path, and other motorized vehicles are underrepresented compared to pedestrians. In line with this finding, local residents appreciate that the path is relatively quiet. Also, pedestrians on the path like that they are walking along the Schie, which is a historic water stream. Moreover, the pedestrians appreciate that they can watch the gardens and homes of other local residents.

Weakness: The most stated negative component is that the path is perceived as unsocial. Pedestrians do not feel that others are approachable. Moreover, there are no facilities to elicit this social connection. Also, this finding could be biased due to the Corona pandemic as residents try to keep their distance. Next, respondents indicated they dislike cyclist and scooter drivers, as this path is officially available for those. Another weakness is the lack of historical information on the Schie's water stream and walking information with routes.

Improvements: The most stated improvement is the placing of benches. According to the respondents, this would facilitate a resting place and a social meeting place. Additionally, there are no bins on the path, so adding this would also be an improvement. Further, the

facilitation of information is also stated such as walking routes or historical background of Overschie. Local residents would also appreciate reducing or excluding scooter drivers and cyclists.

The weaknesses and suggested improvements are used to develop the behavioral interventions in section 4. I need to keep in mind the attractive factors. For instance, residents appreciate the quietness of the path. So, I should not create an intervention with loud sounds.

3.3 Profile

In the previous paragraph (section 3.2.), I have summed up the main findings from the exploratory interviews. In this paragraph, I discuss who the most frequent users are. I discuss the findings from the profile questions to form the target groups. Then based on those target groups and their profiles, I can design matching behavioral interventions with the BCW framework.

Firstly, I have asked the respondents to which postal code they belong. Around 90 percent stated the postal code 3042 and 3043, which refers to the area of Overschie, existing out of the neighborhood Overschie (3043) and Kleinpolder (3032). This finding makes sure that I am mainly dealing with local residents (Appendix 3.1). Then, I asked how frequently the respondents were walking on the path. Three groups come forward, namely

- Daily: people who walk their dog or get some fresh air (30%)
- Weekly: recreational walkers, mostly in combination with a walk to the park (50%)
- Sporadically: as a coincidence, or chosen to walk here for recreational purpose(20%)

Afterwards, the respondents had to answer how frequently they visit the park and how long they spend there. There are two groups of park visitors, namely weekly and sporadically (Appendix 3.3). Sporadically refers to less than one time a month. The time spent in the park is also divisible by groups, namely short and long. Short refers to 30 minutes or shorter, and extended to longer than 30 minutes. Additionally, respondents were asked which route they mostly use if they go to the park from their home. Indeed most local residents (80%) took the short route, which is the control route (Appendix 3.2 & 3.3).

3.4 Target groups

The path has three kinds of users, namely, pedestrians (6/10), scooters (1/10), and cyclists (3/10). Scooters and cyclists mainly use this path as a passageway but they do not fall under the research question. Therefore, I exclude them from the behavioral interventions.
The pedestrians can be divided into three groups (Figure 3.4). There is a big group of local residents who are walking their dog daily, which is around 20 percent of the pedestrians. This clarifies that they do not need to be motivated to walk daily, as their dog does this for them.

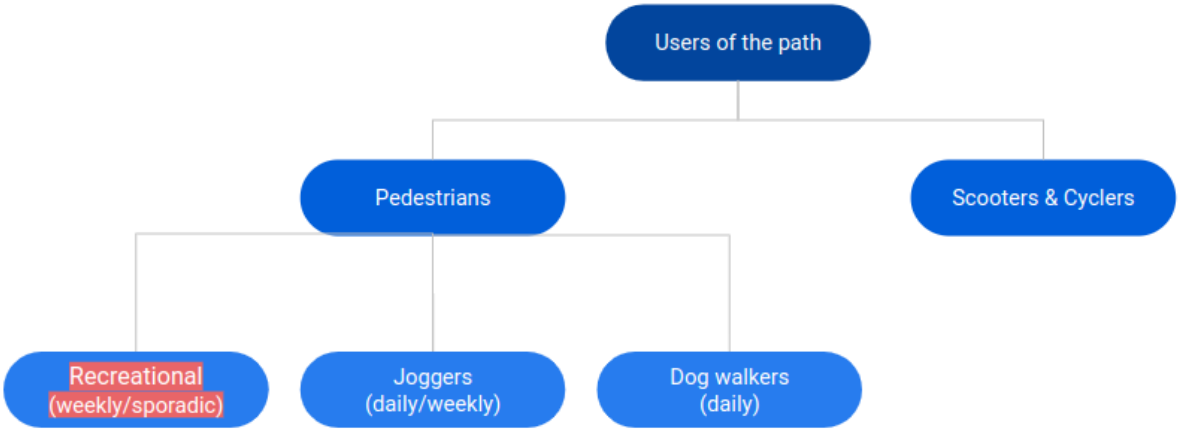


Figure 3.4: Users of the treatment path, with a focus on recreational users (red)

There is also a group of joggers, around 15 percent of the pedestrians. The joggers that responded indicated that they have their jogging routes and are not in immediate need of an improved path. Yet, they indicate that if the path along the Schie improves, they will use it more frequently. Especially in combination with the use of the park.

Then, the largest group of pedestrians is recreational users, around 65 percent of the pedestrians. The majority of this group mainly exists out of three categories: families, elderly (60+), and children younger than 14 years. They strongly indicated that they would walk there more if the path got adjusted according to their preferences.

Besides the findings from the exploratory interviews, there is also research-based evidence that the elderly and children should be targeted. The elderly in Rotterdam are considered as a group that hardly exercises (Gemeente Rotterdam, 2019). This is in line with findings from RIVM that the elderly perform below average in terms of sufficient exercise

(Gezondsheidsmonitor & RIVM, 2019). Similarly, the policy plan of the Ministry of IenW states that the elderly above 60 years are a target group to be motivated to walk more frequently. (Deelprogramma voetgangers, 2020). The elderly are overrepresented in traffic accidents (SWOV, 2015). By offering an attractive route that is car-free, they have the opportunity to stay active and reduce their chances of accidents.
Alternatively, children are the pedestrians of the future. So, when they have a positive association with walking at a young age, they are more likely to walk more in the long run when they are growing up (Giles-Corti et al., 2009). In addition, The RIVM found that children at the age of 12 to 17 are exercising below average in the Netherlands. (Gezondsheidsmonitor & RIVM, 2019).
To sum up, based on the findings of the interviews, I decided to focus on the three recreational groups: families, elderly (60+), and children younger than 14 years.

3.5 Application to the COM-B model

In the previous paragraph, I have determined the three target groups. These are families, elderly (60+), and children younger than 14 years. It is important to realize the target behavior: *local residents make more use of the treatment path and walk more frequently and longer*. I compose the COM-B model for the three target groups in this paragraph. This means that I describe the Capabilities, Opportunities, and Motivation for the target groups to achieve the behavioral change. By filling in the COM-B model for each target group, I can determine which behavioral interventions from the BCW framework are most suitable.

To start with the families composed of parents and their children (*Table 3.5.1*). Remarkably, there are plenty of *social* and *physical opportunities*. The Opportunities are mainly of facilitating nature, such as benches, as seen in the COM-B model. The responding parents state that they understand the advantages of enough exercise. Yet, it is important for a family to have plenty of facilities like toilets, benches, bins, and play areas for their children. In addition, the safety of a route is a recurring subject in the interviews of the parents.

When the previous information is linked to the BCW framework (section 3.1), it comes forward that I need to focus on physical change. This physical change is in the form of facilitating the wished objects. In addition, a way to make a path more attractive for children needs to be found. Therefore, I focus on *environmental restructuring* and *persuasion,* which are mentioned in the red layer of the BCW framework (Figure 3.2).

Table 3.5.1.: COM-B model families, that shows current needs and which change is necessary in order to realize target behavior.

	COM-B components	What needs to happen to achieve the target behavior?	Is a change (in behavior) necessary?
Capabilities	Physical	Members of the family need to be physically capable of walking.	No change is needed when assuming that no physical incidents have occurred. The average age for fathers and mothers is 34,2 and 29,9 (CBS, 2019). Therefore, in general, parents will be physically capable.
	Psychological	Being aware of the benefits of regularly walking.	Provisions of information could help to raise awareness of the benefits of walking. Yet, this need for information comes not forward in the interviews.
Opportunities	Social	Families need to feel attracted to and safe on the route.	Based on the interviews, families feel safe on the route. Yet, most people do not greet or talk with each other. Therefore, stimulating social interaction would make the path more attractive.
	Physical	Provision of physical attributes makes the path more attractive.	The placement of benches and bins. Families sometimes want to rest. In addition, benches could facilitate social interaction. Furthermore, litter is regularly found.
Motivation	Reflective	Families are convinced that sufficient walking is important.	Generally, families are aware of the benefits. Yet, any form of a reminder or nudge could help.
	Automatic	Families need to create a routine that enhances walking behavior.	Most families would be prepared to regularly visit the path when the path is more attractive for their children. Suggestions based on the interviews are placing benches and making it more child-friendly.

Secondly, we look at the elderly, consisting of adults of 60 years and older. What stands out is that they mainly appreciate the social aspect of walking (*Table 2*). This social aspect refers to social safety, but also to meeting other people. Especially, staying in contact with other local residents is one of the main features of the neighborhood Overschie, as this is a working-class district, where everyone used to know each other. In addition, many local residents are born and raised in Overschie and are planning to stay there indefinitely. The previous findings are mainly *social opportunities* from the COM-B model (Table 3.5.2). Therefore, *persuasion* is the suggested intervention based on the BCW framework. This could be realized by *environmental planning (Figure 3.2)*.

Table 3.5.2.: COM-B model Elderly, *that shows current needs and which change is necessary in order to realize target behavior.*

	COM-B components	**What needs to happen to achieve the target behavior?**	**Is a change (in behavior) necessary?**
Capabilities	Physical	The elderly need to be physically capable of walking.	Many elderly stated that they struggle with walking, especially long distances. This struggle can be softened by offering more resting places.
	Psychological	Being aware of the benefits of regularly walking.	Many elderly walk to stay fit. In addition, their doctor and children stimulate them to stay active. Yet, most elderly who are interviewed are the ones who already perform that behavior. So there is selection bias.
Opportunities	Social	The elderly need to feel attracted to and safe on the route.	There is a lot of demand for creating a social meeting place where the elderly can rest and have a chat with others.
	Physical	Provision of physical attributes, which make the path more attractive.	The placement of benches is a clear demand.
Motivation	Reflective	The elderly are convinced that sufficient walking is important.	Many elderly are aware of the benefits of walking. Yet, the mental threshold can be lowered if the resting places are facilitated.
	Automatic	The elderly need to create a routine that enhances walking behavior.	The elderly interviewed state that they exercise sufficiently. Yet, to come back to the path, it needs to be more elderly-friendly.

Subsequently, the main observation made for young children from the neighborhood is that they are bored. Corona has increased this problem as many activities are canceled. Furthermore, the interviews made clear that there needs to be an interactive element or interaction to interest the youth to walk a certain route, which is in line with *opportunity* from the COM-B model (*table 3*). When linking this observation to the BCW framework, it suggests that I should focus on *persuasion* and *incentivization*, which are in the red layer of intervention functions (3.1). The optimal execution would be a form of *marketing* or *communication*, as seen at the outer layer of the BCW framework.

Table 3.5.3: COM-B model children, that shows current needs and which change is necessary in order to realize target behavior.

	COM-B components	**What needs to happen to achieve the target behavior?**	**Is a change (in behavior) necessary?**
Capabilities	Physical	Children need to be physically capable of walking.	In general, no change is needed as most children are physically fit
	Psychological	Being aware of the benefits of regularly walking	Education in terms of physical exercise can help. Yet, this needs to be done in a creative and unforced manner.
Opportunities	Social	Children need to feel attracted to and safe on the route	Children state that they do not particularly feel attracted to the route. Yet, they state that they want to have a 'spot to chill'
	Physical	Provision of physical attributes which make the path more attractive	Children would like to see the path "pimped". They want to have a meeting place. Realistically this would mean placing benches and bins.
Motivation	Reflective	Children are convinced that sufficient walking is important	Are not aware of the benefits. The children interviewed stated that they just wanted to play outside. Further, it is mentioned that many peers are gaming and not exercising enough. This could suggest that creating a game could attract that group
	Automatic	Children need to create a routine that enhances walking behavior	The routine could be only created if children want to return to the path. This is feasible by a combination of facilitating and motivating interventions.

4. Behavioral interventions

In this paragraph, I discuss the behavioral interventions based on the findings of the interviews for each target group (section 3.4) and its corresponding COM-B models (section 3.5). In total, I have designed four behavioral interventions within the parameter that road safety is guaranteed. I visualize these interventions with figures. Furthermore, each intervention needs to be vandalism proof according to the Municipality of Rotterdam.

During the behavioral interventions, I have conducted interviews to measure the response. When it becomes clear that the residents enjoy this intervention, this study could be used as support to convince the Municipality of Rotterdam not to remove the interventions after the measurement period. This way it could generate long-term (health) benefits.

4.1 'Socialize'

This intervention consists of placing two benches in the middle of the path, with 200 meters in between. From the beginning of the path until the park, the total length is 800 meters. This way, pedestrians can rest while walking this path. Especially families and the elderly asked for a resting place (section 3.5). People who sit there could produce garbage while eating or smoking. Therefore, these benches will be combined with bins. Placing benches and trash cans enhance comfort (Alfonzo, 2005).
The book trading library is based on the *reflective motivation* of the elderly, as described in the COM-B model (section 3.5). The local residents indicated that they would like to have a reason to return to this path. By placing the book trading spot in the middle of the path, people are forced to walk the whole path, in case they only come to get a book or bring a book (Appendix 4.1) (Figure 4.1).

In figure 4.1. the two benches with bins with the bins are marked by the blue point with the yellow circle. The book trade location is placed in the middle of the path, indicated by the orange dot. These provisions are placed on a remote path, so they must be vandalism proof.

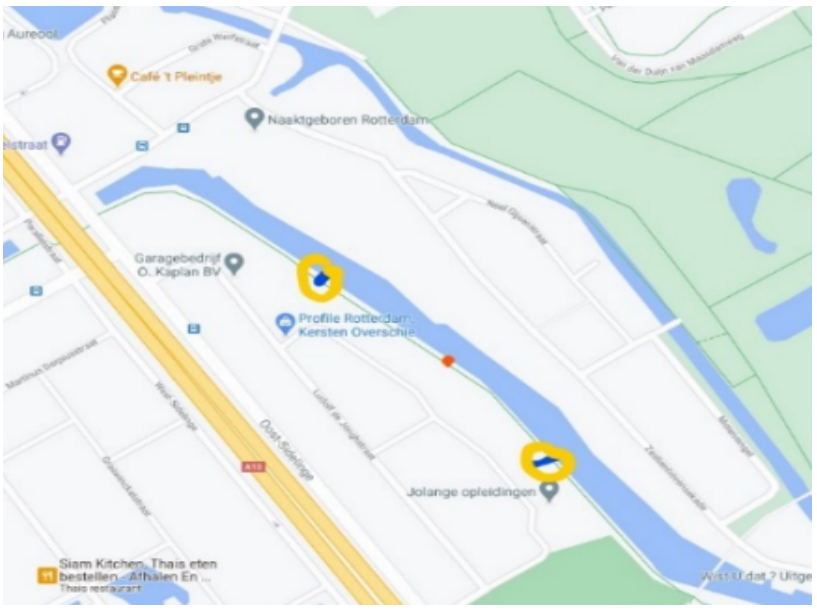


Figure 4.1.: Location benches & bins (yellow/blue) and library (orange)

This intervention comes most clearly forward based on the interviews and the behavioral analysis, as discussed in section 3.5. Placing benches is an essential and recurring provision for each target group, either directly or indirectly. For the elderly, the benches came directly forward as a solution for physical capabilities in the COM-B model. In addition, many elderly experience loneliness (Concept ruimtelijke analyse, 2021). I hope to create a social meeting place where people need to walk by, allowing local residents to meet and sit. This is in line with Kelly et al.'s (2018) finding that walking counters social isolation as it is mostly done with other peers. So, *environmental restructuring* is a suggested solution based on the BCW framework as mentioned in paragraph 3.1. This is due to the limited ability to walk long distances for the elderly.

Based on the COM-B for families and children (section 3.5), placing benches and a book trading spot is more a *social opportunity* to make the path more attractive. For instance, to have a snack or read a book. When connecting the COM-B model with the BCW framework, it comes forward that *social opportunity* leads to *persuasion* in the form of *environmental planning (*section 3.1*).* I have chosen *persuasion* as I believe that walking is a social activity. By giving people a good reason to walk, I can stimulate local residents to walk.

4.2 ‘Nudge the Walk’

This intervention consists of placing green footsteps in the surroundings of the treatment path in the neighborhood (Appendix 4.2). These green footsteps function as a nudge towards the treatment path and the park. This nudge is based on research from Hansen and

Jespersen (2013), who used green footsteps to lead people towards trash cans. In addition, feet steps are successfully used for multiple behavioral interventions to nudge an individual into a specific direction (Weghorst, 2016).

This intervention is straightforward and temporary as the paint is biodegradable. The intervention focuses on all the local residents by first gaining curiosity and awareness. I expect that this intervention will stand out and gain much attention. This way, the intervention and its purpose will be discussed between local residents and could potentially get shared via social media. So, I expect to enhance the consciousness of local residents concerning walking. This enhancement of consciousness refers to the *reflective motivation* for all three target groups in the COM-B model (section 3.5).

Figure 4.2.1.: footsteps locations through the neighborhood

4.3 Information and descriptive norm

This intervention consists of two parts. One part is information provision, which is more focussed on the elderly. In contrast, the other part consists of a descriptive norm that aims to target recreational pedestrians in general.

4.3.1 Information

The following intervention is specially designed for the elderly. They indicated in the exploratory interviews that they would like to have more information provision. This is done in the form of historical information about the water stream *de Schie*. Furthermore, there is also demand for a map of the local sights. These findings of the elderly from the interviews correspond with *social opportunity* from the COM-B model (section 3.5). Therefore, a solution in the form of *education* and *persuasion* is logical given the BCW framework

(section 3.1). In addition, I want to suggest two walking routes on the map. The two routes that lead pedestrians to the park are a short and a long route, respectively around 30 and 60 minutes walking. I created two routes based on the profiles (section 3.3). It became clear that most people want to walk short routes, but some prefer long routes in the park. The information provision anticipates on the needs of the recreational pedestrians by providing them suggestions during their walk. The information is provided by brochures and placing them in a holder, where pedestrians can easily take one (Appendix 4.3).

4.3.2 Descriptive Norm

Based on the interviews, it came forward that visitors of the path appreciate the nature around the path and the peaceful place. I want to use this finding by communicating it with other local residents by using a positive descriptive norm. A positive descriptive norm can positively affect the intention to perform a specific behavior by adding credibility by peers (Elgaaied-Gambier et al., 2018). Especially as Overschie is a working-class district, where peers are more likely to follow each other's behavior (Gemeente Rotterdam, 2019).

The descriptive norm is executed by placing brochure with the following text: *'Liefhebbers van natuur en rust komen op dit pad aan hun trekken'.* This text states that people who love nature and peace can have a good time on this path (Appendix 4.3).

4.4 Smiley Route

The following intervention is especially developed for children and families. Based on the COM-B model of children, there are mainly *physical* and *social opportunities* to make the path more attractive (section 3.5). This finding indicates that I should use the intervention functions of *incentivization* and *persuasion* (section 3.1). Therefore, the BCW framework suggests using *environmental planning* and *communication* as policy categories (**figure 3.1**).

The intervention consists of two elements, namely an eye-catcher and an interactive game for children (Appendix 4.4). The eye-catcher is a big smiley that is visible from the streets. (Figure 4.4.1). This sign aims to attract children and possibly their parents to walk the treatment path. Once they arrive at the attractive sign, it is made clear that the children can play a game on the Smiley Route. This is by placing the explanation of the game next to the big smiley (Appendix 4.4).

On the path, multiple smileys are hidden. The Smiley Route was realized by using cuddly toys and biodegradable paint. The player who finds all smileys first wins. At the end of the route, Park16hoven is indicated as a recommendation. The desired effect of this

Smiley Route is to make the path more attractive and interactive, especially for children and families.

Figure 4.4.1.: Location eye-catcher and smileys used for Smiley Route

The four proposed interventions will be tested in two weeks. In the first week, the facilitating interventions will be tested, existing of *socialize (4.1)* and *nudging the walk (4.2)*. In the second week, the cumulative effect is tested of the facilitating and motivating interventions. The motivating interventions exist out of *information and descriptive norm (4.3)* and *Smiley Route (4.4).*

5. Methodology

I have chosen to use a probit regression to test whether the facilitating or the motivating intervention has a statistically significant effect on path choice. The following chapter explains the data collection method, the corresponding ethical concerns, and the experimental procedure. Then, I state the hypotheses based on the expectations from the COM-B model. Subsequently, I give the reasoning and background information of the use of the probit regression. Finally, I explain the Chi-square test, testing the last two hypotheses.

5.1 Data

5.1.1 Data collection

I conducted a natural field experiment to test which intervention effectively works. The quantitative research is realized by manually counting and allocating pedestrians to their target group and chosen path. For the baseline measurement, there was one observer. Two observers counted for the two intervention weeks. The observers were myself and coworkers from the Ministry of IenW or friends. The choice has been made only to consider one direction to ensure that there will not be double-counted. Due to the natural placement of both routes, it is not plausible that a resident takes both paths in three hours **(**Appendix 3.2**)**. In Microsoft Excel, the data is collected where passers-by are sorted by each route, target group, and demographics, which are discussed later in this chapter. The relevant characteristics are group size, age, gender, and whether one has a dog. The observations are registered in Excel. STATA is used as a tool for data analysis.

5.1.2 Ethical concerns

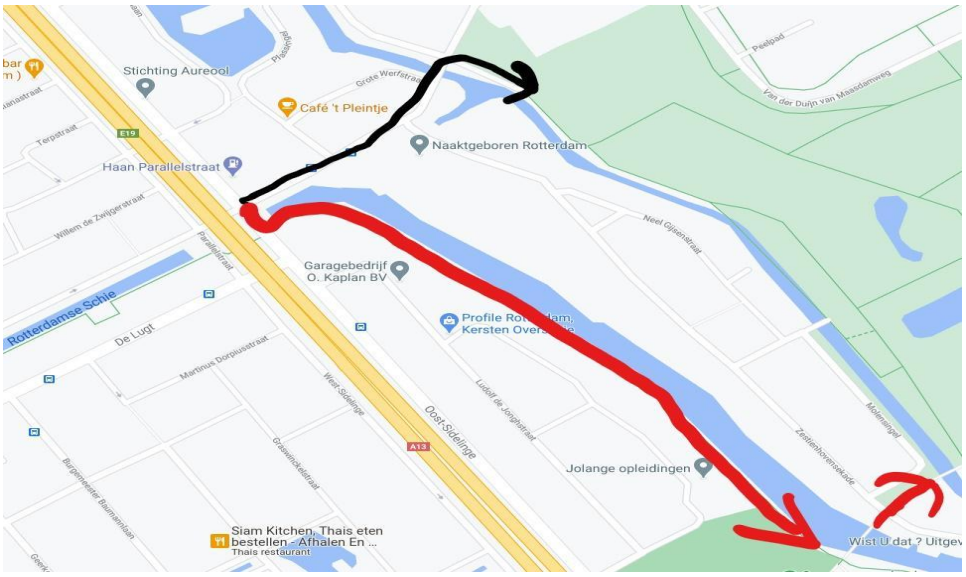
Field experiments with humans are a source of ethical concerns. Allen (2017) states that observed persons are not aware they are being observed during a field experiment and thus did not give permission to participate in the experiment. In contrast, it is a precept to notify participants in a lab experiment. Knott (2019) recognized this problem with field experiments, but the problem is minimized as long the data is anonymized and is confidential. The data in this study has been anonymized. According to Shen et al. (2022), an ethical concern is that participants are harmed. For instance, participants get into an unsafe situation due to the field experiment. In this field experiment, pedestrians are nudged towards the safer route with no cars. So, this is not an ethical concern.

5.2 Field experiment details

The total duration of the field experiment is three weeks. Each measurement week consists of four days of three-hour sessions. In total there are twelve measurement days.The days and the chosen time frame are the same for each week to have comparable data. The standard and treatment route have the same starting point and destination that is the park. The standard and treatment routes are respectively 400 meters and 800 meters long. Thus, the treatment route is twice the distance, suggesting double the health benefits of walking towards the park. The black line indicates the standard route, and the red line indicates the treatment route (Figure 5.5.1).

For each measurement period, there are two data collectors. The first data collector stands unnoted underneath a viaduct to gather quantitative data (Appendix 5.2). The collector notes the characteristics of the pedestrians, which are the group size, the path of choice, age category, target group, gender, and whether the pedestrian has a dog.
The second data collector stands between the library spot and the second bench (Figure 4.1). The second data collector conducts interviews with the pedestrians of the treatment route. The second collector asks for the motive of walking, their appreciation, and possible recommendations of the treatment path and the pedestrian (Appendix 5.1).

Figure 5.1.: Control (black) and treatment (red) route to the park



First, I have made a baseline measurement during the first week for both routes. The baseline measurements are referred to as time period 0. During this baseline measurement, there are no changes made. Then, in the second week, the facilitating interventions are tested. The facilitating interventions contain the behavioral interventions *socialize* (section 4.1) and *nudge the walk* (section 4.2). Subsequently, the motivating interventions are added in the third week, existing out *information (4.3)* and *Smiley Route (4.4)*. Hence, this means that the third week contains both facilitating and motivating interventions. The measure of the cumulative effect is to see whether the motivating interventions could boost the facilitating interventions.

A possible complication with the field experiment is the Hawthorne effect. This means that as soon as participants of the field experiment know that they are in an experiment, they give biased results. For example, pedestrians could be wrongly motivated to choose a path because they do (not) want to be in the experiment. This is an upwards bias in most cases, as people think an intervention should work or have a positive effect (Jones, 1992). I have chosen to be hidden under a tunnel to count pedestrians unnoted to minimize the Hawthorne effect (Appendix 5.2). Nevertheless, pedestrians should be aware that something unordinary is happening, as there is a clear setting change.

5.3 Implementation of quantitative research

The main task of the first observer is to count how many pedestrians use the control and treatment route. This way, I can observe a possible increase in traffic. First of all, I start with executing the facilitating intervention. This intervention exists out of *socialize* and *nudge the walk* (section 4). Based on the interviews and the analysis made based on the BCW framework, I expect that the facilitating intervention will be the most effective. Therefore, I state the following hypothesis:

H_1: *The facilitating interventions increase the probability of walking the treatment path*

Secondly, I perform the motivating intervention, which contains the behavioral interventions *information, descriptive norm,* and the *Smiley route* (section 4). In the same manner, based on the findings of the interviews and the analysis based on the BCW framework, I expect a gain in foot traffic. Note, in this week, the cumulative effect is tested of the facilitating and the motivating intervention. Consequently, this gives the following hypothesis:

H_2: *The cumulative intervention increase the probability of walking the treatment path*

Based on the COM-B model and the BCW framework, I expect that the facilitating intervention has bigger influences compared to the cumulative intervention. This as the facilitating intervention serves all three target groups and other pedestrians, while the motivating intervention is mainly focussed on families and the elderly. Therefore, I state the following hypothesis

H_3: $Both\ \ interventions\ increase\ the\ probability\ of\ walking\ the\ treatment\ path,\ \ for\ target\ groups$

The interviews are conducted to get a complete understanding of local residents' opinions on the interventions. In addition, it gives a possible explanation of the findings found in the quantitative research. For the first implementation, the facilitating intervention, I expect that the benches are most appreciated. All the target groups have stated directly or indirectly that this would improve the path (section 3.5). Therefore, I state the following hypothesis

H_4: $The\ benches\ are\ the\ most\ appreciated\ intervention,\ \ compared\ to\ the\ other\ facilitating\ interventions$

For the second implementation, the cumulative intervention, I expect that the Smiley route is the most appreciated. The COM-B model for children indicated *physical* and *social opportunities* to make the path more attractive, which resulted in the Smiley route (section 4.4). I expect this to be positively received as this is an interactive intervention that should stand out. Therefore, I state the following hypothesis:

H_5: $The\ Smiley\ route\ is\ the\ most\ appreciated\ intervention,\ \ compared\ to\ the\ other\ interventions$

5.4 The probit model

In this paragraph, I discuss the choice and mathematical reasoning of the probit model. Then, I specify which variables I used for the model estimation. Lastly, I discuss the Goodness-of-Fit test, which assesses how well the probit model can predict the dependent variable *path choice.*

5.4.1 Mathematical reasoning probit

The goal of this field experiment is to find out which behavioral intervention increases the chance of walking the longer and more safe path, also referred to as the treatment path. The most straightforward option would be to use an Ordinary Least Squares (OLS) regression with a binary dependent variable, also known as a linear probability model (LPM). This

model is intuitive in terms of interpretation. However, LPM has two disadvantages (Wooldridge, 2015). The first disadvantage is that the predicted probability can be greater than one or less than zero, while probabilities are always equal to or between zero and one. The second disadvantage is the assumption of constant marginal effects of the independent variables. For example, an increase of age from 20 to 21 would have been given the same effect as from 60 to 61 due to the linear characteristics of the LPM model. Probit counters both disadvantages.

The probit regression has a binary outcome variable. This means that the outcome variable can only have two values, namely 0 or 1. In this case, the outcome variable is whether a pedestrian chooses to take the left side of the path ($y_i = 0$) or the right side of the path ($y_i = 1$). The probit regression is estimated by Maximum Likelihood Estimation.The benefit of this method is that it can be used under general conditions. For instance, probit can control non-constant error variances (Wooldridge, 2015). The probit model estimates the probability p_i that the outcome variable of path choice is equal to $y_i = 1$, indicating the probability a pedestrian chooses the right side of the path. Whether the event $Pr(Y)$ occurs, depends on the series of independent variables $\{X_1, X_2,..., X_i\}$ and their respective parameters $\{\beta_1, \beta_2,... \beta_i\}$, which gives the index function $F(x'_i\beta)$ (Berry et al., 2010). Altogether, this gives the function:

$$p_i = Pr(y_i = 1|x) = F(x', \beta)$$

The estimated probability p_i is always between 0 and 1.The probit model $F(x'_i\beta)$ uses the Gaussian normal cumulative density function (CDF). Therefore, this gives the following function:

$$\Phi(x'\beta) = \int_{-\infty}^{x'\beta} \Phi(z)dz$$

Here Φ stands for standard normal density function. In terms of interpretation, this means that an increase of independent variable X makes the probability that $y = 1$, more or less likely. Note, I cannot interpret the magnitude of this effect. I can only explain the sign of coefficient β_1, due to the nonlinear nature of the probit function (Berry et al., 2010.

For the probit model, I can only interpret the magnitude of the independent variables $\{X_1, X_2,..., X_i\}$ by estimating the marginal effects. Estimating the marginal effects is done by taking the derivative of those independent variables with respect to the outcome variable. This gives the following equation:

$$\frac{\partial p}{\partial x_i} = \Phi(x'\beta)\,\beta_i$$

Both the sign and the magnitude can be interpreted as the average marginal effects. When x increases, this leads to an increase or decrease of the probability that $y = 1$, by the marginal effect as a percentage point. In the case with binary independent variables, the marginal effect is with respect to the base category($x = 0$).

5.4.2 Model estimation

The following probit model has been estimated to test the first two hypotheses discussed later in this section.

$$Pr(Path\ choice) = \beta_0 + \beta_1 * Week + \beta_2 * Target\ Group + \beta_3 * Gender + \beta_4 * Age + \beta_5 * Number\ pedestrians + \beta_6 * Dog + \beta_7 * temperature + \epsilon$$

Here is path choice the dependent variable that equals 0 for the short route, and 1 for the wished route. *S*even variables predict *path choice*. The variable of interest $Week$ is a categorical variable that indicates which intervention week has the most effect on path choice. In total, there are three weeks, where week 0 is the baseline measurement. Week 1 and week 2 are respectively the facilitating intervention and the cumulative intervention. The variable $Target\ Group$ is a categorical variable that shows whether a certain target group has a preference for the path chosen. The three target groups are families, children, and the elderly (section 3.4). I have decided to add the continuous variable number of pedestrians as walking is considered a social activity. Lastly, I have added the dummy variable dog, which has a value of 1 when the pedestrian has a dog, and 0 otherwise. It came forward from the exploratory interviews that dog owners are more willing to walk the longer path (section 3.2). Furthermore, I have included the control variables gender and age. Gender is a dummy variable with 0 for men and 1 for women. The variable age is a continuous variable.

5.3.3. Goodness-of-Fit

To assess how well the probit model can predict the dependent variable *path choice*. This test compares the actual outcomes with the predicted outcomes for the likelihood that $\hat{y} = 1$. Every predicted value above 0.5 is considered a prediction of 1, and every predicted value smaller than 0.5 is considered a correct prediction of 0. I have decided to use McFadden's pseudo-R-squared, which is commonly used to test the fit for binary probit models (Veall & Zimmermann, 1994). McFadden’s pseudo-R-squared has the following mathematical description:

$$R^2_{MF} = 1 - \frac{\curvearrowleft u}{\curvearrowleft 0}$$

$\curvearrowleft u$ stands for the log-likelihood function for the unrestricted probit model, including the six explanatory variables. $\curvearrowleft 0$ refer to the log-likelihood for the probit model without any explanatory variables, but only the intercept. This function approaches 1 if $\curvearrowleft u = 0,$ and 0 if $\curvearrowleft u$ is almost equal to $\curvearrowleft 0$. The rule of thumb is that McFadden's pseudo-R² between 0.2 and 0.4 reflect an ideal fit (McFadden, 1977).

5.3.4 Chi-square test

I use the Chi-square test as a statistical tool to test whether the interventions are all equally appreciated or not. The Chi-square test is a nonparametric test that is used to find out whether there is a significant difference between expected and observed outcomes. The formula of the Chi-square test is as follows:

$$X^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i}$$

Where O_i is the observed frequency, E_i is the expected frequency, and X^2 is the Chi-square value. The Chi-square value is small when the difference between expected and observed frequency is small and vice versa.

The null hypothesis of this test is that the expected frequency is equal to the observed frequency. The alternative hypothesis is that the expected frequencies are not like the null hypothesis. I work with a 5 percent significance level. This implies that there is a five percent chance of falsely finding enough evidence to support the null hypothesis. This error is known as type 1 error.

6. Results

First of all, I give an overview of the descriptive statistics in section 6.1. Then, the results from the probit regression are shown in section 6.2. Subsequently, the findings from interviews are analyzed in section 6.3.

6.1 Descriptive statistics

Firstly, I display the descriptive statistics. This gives an overview of the variables used and their corresponding characteristics. A comparison of the median, mean, minimum, and maximum helps to understand the skewness of the distribution. The correlation between these variables can be found in appendix 6.1.

Table 6.1.: Summary statistics

Variable	Obs	Mean	Median	Std. Dev.	Min	Max
1. Choice	1,030	.30	0	.46	0	1
2. Number	1,030	1.99	2	1.06	1	4
3. Age	1,030	33.78	30	17.96	1	80
4. Gender	1,030	.41	0	.49	0	1
5. Dog	1,030	.17	0	.38	0	1
6. Temperature	1,030	23.63	24	1.83	21.5	26

The descriptive statistics above display the characteristics of the variables from all three measurement weeks. The dependent variable *choice* is a dummy variable that indicates 0 for the standard route and 1 for the treatment route. The mean indicates that 70 percent of the pedestrians choose the standard route, and 30 percent choose the treatment route. The variable *number* indicates the group size an individual pedestrian is walking in. The median is two and the mean around two, which indicates that walking is a social activity that most people like to do with a peer. This is in line with the finding from the interviews that people walk to interact socially (section 3.2). The variable *age* is the estimated age. *Gender* is a dummy variable that indicates 0 for males and 1 for females. The variable *dog* is a dummy variable with a value of 1 indicating the pedestrian walks with a dog and a value of 0 for no dog. The mean interpretation is that 17 percent of the pedestrians have walked with a dog.

Table 6.2.: Categorical variable Target Group

Target Group	N	Percent	Cum.
0. None	514	49.90	49.90
1. Families	235	22.82	72.72
2. Elderly	143	13.88	86.60
3. Children	138	13.40	100.00
Total	1030	100.00	

Furthermore, I have used the categorical variable *Target group* (Table 6.2.)**.** I have specially designed behavioral interventions to stimulate walking for these target groups (Chapter 4). More than 50 percent of the observations are categorized as one of the target groups.
The variable *week* is a categorical variable that indicates the different experimental weeks (***Table 6.3***). There are three weeks: baseline week, motivating week, and cumulative week. This variable is used to check whether there is an increased probability of walking the treatment path in one of the weeks.

Table 6.3.: Categorical variable of interest Week

Week	Freq.	Percent	Cum.
0. Baseline	354	34.37	34.37
1. Facilitating	386	37.48	71.84
2. Cumulative	290	28.16	100.00
Total	1030	100	

During the cumulative intervention, the number of observations is much lower compared to other weeks. This has to do with the fact that there was extreme rain and wind during one of the measurement days.

6.2 Probit results

I discuss the probit results of the first three hypotheses in this paragraph. The full models can be found in appendices 6.2 and 6.3.

H_1: *The facilitating interventions increase the probability of walking the treatment path*

I have conducted a probit regression to test whether the facilitating interventions lead to a significant increase of pedestrians on the treatment route. The variable of interest is *week*, which is a categorical variable (Table 6.3.). I have controlled for all registered confounders (Appendix 6.2).

The facilitating week has a positive coefficient $(\beta = .097)$. The magnitude of the probit coefficient cannot be interpreted. Still, I can state that pedestrians in the facilitating week are more likely to choose the treatment path than pedestrians from the baseline week, ceteris paribus.

For the effect size of the facilitating intervention week, I need to look at the average marginal effects. The facilitating interventions week increase the probability of walking the treatment path on average by 3.2 percentage points, compared to the baseline week, keeping other variables fixed $(\beta = .032)$. Yet, both findings are not statistically significant (Table 6.4).

Table 6.4.: Probit regression

Dependent variable: Pr(path *choice*)						
	Probit regression			**Average Marginal Effects**		
Variable	**Coef.**	**[95% Conf.**	**Interval]**	**Coef.**	**[95% Conf.**	**Interval]**
Facilitating	.097	-.101	.296	.032	-.033	.097
	(.101)			(.033)		
Cumulative	.013	-.203	.229	.004	-.065	.074
	(.110)			(.036)		
Constant	-.567**	-.906	-.228			
	(.173)					
Controls	Yes					
N	1030					
Pseudo R^2	.058					

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

H_2: *The cumulative intervention increase the probability of walking the treatment path*

For the second hypothesis, I have also conducted a probit regression to test whether the cumulative interventions lead to a significant increase of pedestrians on the treatment route. The variable of interest is *week*, which is a categorical variable (Table 6.3.). For this regression, I have controlled for all registered confounders (Appendix 6.2). The Pseudo R^2 is .058 (Table 6.4). The rule of thumb is that McFadden's pseudo R^2 between .2 and .4 reflect an ideal fit (McFadden, 1977). So, the model has limited goodness of fit.

The cumulative week has a positive coefficient $(\beta = .013)$. The magnitude of this coefficient cannot be interpreted. Still, I can state that pedestrians in the cumulative week are more likely to choose the treatment path than pedestrians from the baseline week, keeping other variables fixed. I need to look at the average marginal effects, to find the magnitude of the effect of the cumulative intervention week. The cumulative interventions week increase the probability of walking the treatment path on average by 0.4 percentage points, ceteris paribus, compared to the baseline week $(\beta = .004)$. Again, both findings are not statistically significant (Table 6.4).

H_3: *Both interventions increase the probability of walking the treatment path, for the target groups*

Previously, I found that pedestrians are more likely to walk the treatment path in the two intervention weeks compared to the baseline week, but those findings are not statistically significant (Table 6.4).
Now I look at the effects of the interventions on the target groups for each week. The target groups are families, the elderly, and children (Table 6.2). To test the third hypothesis, I have conducted a probit regression to test whether the facilitating and the cumulative interventions increase the probability of walking the treatment path, for the target groups (appendix 6.3).
I find that target groups are less likely to walk the treatment path in both intervention weeks compared to the baseline week, ceteris paribus (Table 6.5). Again, these findings are not statistically significant ($p<0.05$).
For the effect size of the facilitating intervention week, I need to look at the average marginal effects. The facilitating interventions week decreases the probability for individuals of the target group walking the treatment path on average by 4.7 percentage points, compared to the baseline week, ceteris paribus $(\beta = -.047)$.
For the effect size of the cumulative intervention week, I also look at the average marginal effects. The cumulative interventions week decreases the probability of walking the

treatment path on average by 6.7 percentage points compared to the baseline week, keeping other variables fixed $(\beta = -.067)$.

Table 6.5: Probit regression target groups

Dependent variable: Pr(Choice Target groups)						
Probit regression				**Average Marginal Effects**		
Variable	**Coef.**	**[95% Conf.**	**Interval]**	**Coef.**	**[95% Conf.**	**Interval]**
1. Facilitating	-.134	-.418	.149	-.047	-.146	.052
	(.145)			(.050)		
2. Cumulative	-.193	-.494	.17	-.067	-.169	.037
	(.154)			(.053)		
Constant	-.829***					
	(.224)					
Controls	Yes					
N	516					
pseudo R^2	.063					

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The pseudo R-squared of the model is 0.063 (Table 6.5). The rule of thumb is that McFadden's pseudo R² between 0.2 and 0.4 reflect an ideal fit (McFadden, 1977). So, this model has a limited Goodness of fit.

6.3 Findings interviews

I have conducted interviews in order to get a complete understanding of local residents' opinions on both behavioral interventions. Also, I can compare the interest and appreciation of the different interventions. I conducted 40 interviews each week. These interviews were conducted on the treatment path. So, these findings are from the pedestrians who got treated.

H_4: *The benches are the most appreciated intervention, compared to the other facilitating interventions*

To test the fourth hypothesis, I have asked respondents which intervention they most appreciated, during the facilitating intervention week. More specifically, I have asked respondents which facilitating intervention they would like to have implemented permanently. The possible answers were benches, green footsteps, or the library trading spot. The most stated intervention were the benches (*N=20).* The book library performed above expectations *(N=16).*

Table 6.6.: Chi-square test Facilitating

	observed	expected	classic	Pearson
Benches	20	13.33	6.67	1.83
Library	16	13.33	2.67	0.73
Footsteps	4	13.33	-9.33	-2.56
Pearson Chi^2	Pr = 0.006			
likelihood-ratio Chi^2	Pr =0.002			

I tested whether the interventions are equally preferred or not by performing a Chi-square Goodness of fit test. The Pearson Chi-Square value of the model is .006, which is statistically significant *(p=.05).* So, I reject the null hypothesis of this test that all interventions are equally preferred. This finding gives indirect evidence supporting the hypothesis that the benches are the most preferred. However, it is not hard evidence.

H_5: *The Smiley route is the most appreciated intervention, compared to other interventions*

For testing the fifth hypothesis, I have asked respondents which intervention they most appreciated during the cumulative intervention week. More specifically, I have asked respondents which facilitating or motivating intervention they would like to have implemented in the long run. The possible answers were benches, library trading spot, information provision, or the Smiley route. Again, benches were the most stated intervention (n=17). The information intervention and the Smiley route did not convince the respondents, as both performed under expectations (Table 6.7).

Table 6.7.: Chi-square test Cumulative

	observed	expected	classic	Pearson
Benches	17	10	7	2.214
Library	11	10	1	0.316
Information	7	10	-3	-0.949
Smiley	5	10	-5	-1.581
Pearson Chi^2	pr = 0.038			
likelihood-ratio Chi^2	pr =0.042			

I tested whether the cumulative interventions are equally preferred or not by performing a Chi-square Goodness of fit test. The Pearson Chi-Square value of the model is .038, which is statistically significant *(p=.05).* I can reject the null hypothesis of this test that all cumulative interventions are equally preferred. The Smiley route was against expectations the least favorite intervention, while the benches were against the most stated intervention.

7. Discussion

I tried to find out which behavioral interventions to stimulate walking works best. These interventions were designed specifically for local pedestrians of Overschie after conducting exploratory interviews. I have used the information from those interviews in combination with the COM-B model and the Behavioral Change framework (section 3.5). I have created and tested facilitating and motivating interventions in a field experiment. This study aims to answer the question:

Which behavioral intervention stimulates local residents to walk more frequently and a longer distance in Overschie, Rotterdam.

I try to answer this research question by testing five hypotheses. First, I discuss the findings for each hypothesis in paragraph 7.1. Then I discuss the limitations of this research. Finally, I give suggestions based on the findings and limitations in paragraph 7.3.

Table 7.1.: Overview of hypotheses tested

Hypothesis	Result
H1:The facilitating interventions leads to a significant increase of pedestrians on treatment route	Rejected
H2: The cumulative intervention leads to a significant increase of pedestrians on treatment route	Rejected
H3: Both interventions increase the probability of walking the treatment path, for the target groups	Rejected
H4:The benches are the most appreciated intervention, compared to the other facilitating interventions	Rejected
H5: The Smiley route is the most appreciated intervention, compared to other interventions	Rejected

7.1 Discussing main results

7.1.1 Facilitating week

To test the first hypothesis, I conducted a binary probit regression to test whether facilitating interventions stimulate pedestrians to walk the treatment route. Based on COM-B and the BCW framework, it comes forward that there is a broad demand for environmental restructuring to create a social meeting place on the path (section 3.5.). For instance, all

three target groups explicitly stated that placing benches would make the path more attractive.

I found that pedestrians are more likely to walk the treatment route during the week of the facilitating interventions than the baseline week, ceteris paribus $(\beta = 0.097)$. The facilitating interventions week increase the probability of walking the treatment path on average by 3.2 percentage points, compared to pedestrians from the baseline week, ceteris paribus $(\beta = 0.032)$. The magnitude of this effect is small, making this finding not economically relevant. Also, both findings are not statistically significant (Table 6.4). The statistical insignificance could be due to a limited sample size $(n = 386)$. Furthermore, pedestrians were only directly nudged to the path by the green footsteps. The benches and the book trading spot are only visible when walking the treatment path.

In other words, pedestrians who walked the treatment path did this because of the nudge or were planning to walk the path beforehand.

Concluding, I find that the facilitating interventions did not lead to a significant increase of pedestrians on the treatment route. Therefore, I reject the first hypothesis.

7.1.2 Cumulative week

To test the second hypothesis, I also conducted a binary probit regression to test whether the cumulative interventions significantly increase pedestrians on the treatment route. The cumulative intervention exists out of the motivating intervention from the previous week and added motivating interventions. These motivating interventions tried to directly influence the choice of pedestrians to walk the treatment path instead of the standard path. The intervention *Information provisio*n focuses more on the elderly, and the *Smiley Route* focuses on families and children (section 4.3, 4.4).

Pedestrians in the cumulative week are more likely to choose the treatment path, compared to pedestrians from the baseline week, keeping other variables fixed $(\beta = 0.0131)$. The cumulative interventions week increase the probability of walking the treatment path on average by 0.4 percentage points, compared to pedestrians from the baseline week, ceteris paribus $(\beta = 0.004)$. Again, the magnitude of this effect is small, which makes this finding not economically relevant. Also, both findings are not statistically significant (Table 6.4). The statistical insignificance could be due to a small sample size $(n = 290)$. This small sample size was caused by bad weather during this week. This is in line with research from Hong (2016), which shows that seasonality and weather conditions influence walking behavior. In this case, people walk due to the weather conditions. Furthermore, the treatment path is the longer, more recreational path. So, I expect fewer pedestrians to walk the treatment path due to extreme rain and wind, therefore negatively impacting the outcome variable *choice*.

Concluding, I find that the cumulative interventions did not lead to a significant increase of pedestrians on the treatment route. Therefore, I reject the second hypothesis.

7.1.3 Effect interventions on target groups

I have conducted a binary probit regression to test the third hypothesis, whether both behavioral interventions increase the probability of walking the treatment path, for the target groups. Both interventions have been specially designed to enhance walking for those target groups: families, the elderly, and children. These target groups have been chosen because most health benefits could be gained, compared to other possible groups such as joggers or dog walkers (section 3.4). For instance, the elderly from Overschie exercises less than average (Concept ruimtelijke analyse, 2021). In addition, 35 percent of the local residents experience bad health. Furthermore, the main reason to exercise for local residents is the social aspect. I try to make walking more attractive with behavioral interventions.

Against expectations, I find that target groups are less likely to walk the treatment path in both intervention weeks than the baseline week (Table 6.5). Again, these findings are not statistically significant (*p<0.05*). I need to look at the average marginal effects to interpret the magnitude of these effects. The facilitating interventions week decreased the probability for individuals of the target group walking the treatment path on average by 4.7 percentage points, compared to the baseline week, ceteris paribus $(\beta = -.047)$. The cumulative interventions week decreases the probability of walking the treatment path for target groups on average by 6.7 percentage points, compared to the baseline week, ceteris paribus $(\beta = -.067)$. Both findings are disappointing as the behavioral interventions were especially designed for the target groups.

A possible explanation for this unexpected result is wrongly categorizing the pedestrians into target groups. Every day, there was another observer with a subjective interpretation of the elderly above 60 years, a child below 14 years, or a family, even though they were clearly instructed.

In conclusion, both interventions did not increase the probability of walking the treatment path for target groups. Therefore, I reject the third hypothesis.

7.1.4 Most appreciated intervention: facilitating week

To test the fourth hypothesis, I have asked respondents which facilitating intervention they would like to have implemented in the long run. The respondents were asked which specific facilitating intervention should be kept *(Figure 7.1)*.

I expected that the benches would be the most appreciated intervention based on the findings from the COM-B models of all three target groups (section 3.5). They all explicitly

stated that placing benches on the treatment path would make the path more attractive to walk on. Furthermore, the availability of street provisions such as street benches or trash cans enhances comfort, which is the fourth layer of the pyramid of walking needs (Alfonzo, 2005).

The respondents had three options: benches, book trading spot, and footsteps. Half of the respondents *(N=20)* stated that the benches were their favorite. However, a surprising finding is that the books were almost as popular as the benches *(N=16)*. Some pedestrians stated that they came back especially to see whether new books were placed. In addition, some people came back to place old books for other passers-by. This intervention elicited positive reactions (Appendix 4.1).

I tested whether the interventions are equally preferred or not by performing a Chi-square Goodness of fit test. The Pearson Chi-Square value of the model is .006, which is statistically significant *(p=.05).* So, I must reject the null hypothesis of this test that all interventions are equally preferred. This finding could mean that the benches are performing above expectations, but also that the footsteps *(N=4)* are performing under expectations (Table 6.6). I have not found direct or indirect evidence to support my hypothesis. Therefore, I reject the fourth hypothesis that the benches are the most appreciated intervention.

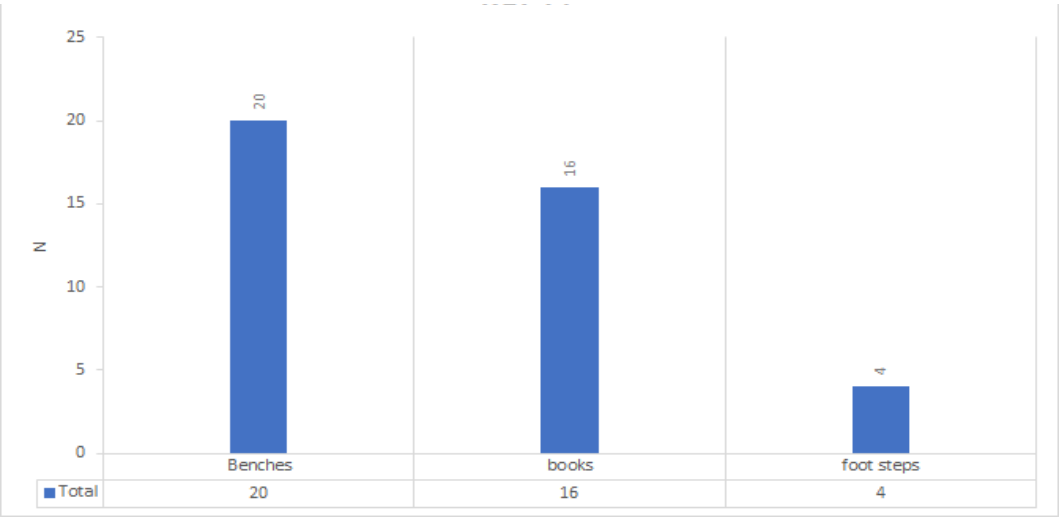


Figure 7.1.: most popular facilitating interventions, where benches are the most popular

7.1.5 Most appreciated intervention: cumulative week

To test the fifth hypothesis, I asked respondents during the cumulative week which intervention they would like to have implemented in the long run. The respondents were asked which specific intervention should be kept. There were four options: benches, book trading spot, information provision, and Smiley route.

I expected that the Smiley route would be the most appreciated intervention based on the findings from the COM-B model for families (section 3.5). Families stated that the path should be made more attractive for children. The Smiley route is specially designed to target children and families (section 4.4). Based on the COM-B model of children, there are mainly *physical* and *social opportunities* to make the path more attractive (section 3.5).

The most stated intervention is again the benches *(N=17) (Figure 7.2)*. At the end of this measurement week, it became clear that one bench was the victim of vandalism. This led to negative feedback as the bench was demolished into trash. Still, the benches were the most stated intervention to be implemented in the long run, if and only if the benches are vandalism proof.

The Pearson Chi-Square value of the model is .038, which is statistically significant *(p=.05)*. I can reject the null hypothesis of this test that all interventions are equally preferred. Furthermore, the Smiley Route was the least stated intervention to be kept.
Concluding, I reject the stated hypothesis that the Smiley route is the most appreciated intervention.

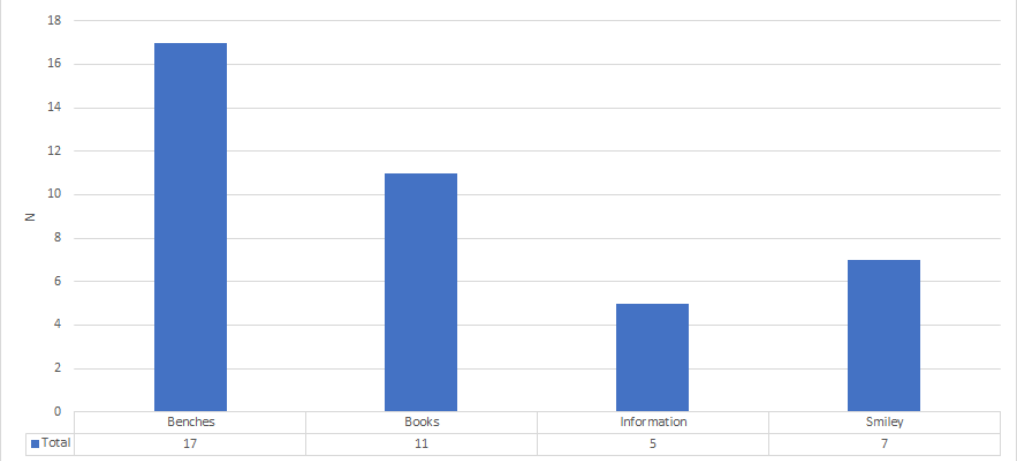


Figure 7.2.: most popular intervention during cumulative week

7.2 Limitations

The findings from this study are not spared from limitations. First of all, the usage of the exploratory interviews for the COM-B model and the BCW framework is to some extent sensitive for subjective interpretation (section 3.5). It helps with identifying what component of behavior needs to be changed. Nevertheless, the classification of behavior is not purely

objective. For instance, the COM-B model exists out of six components. Some components overlap, like *psychological capabilities* and *reflective motivation*, making it hard to classify certain behaviors (Figure 3.1). The classification of behavior in the COM-B model affects the outcome in the BCW framework and, therefore, possible interventions.

Regarding the interventions, the execution of the facilitating week went as planned. The only drawback was that one bench got vandalized on the third day of the cumulative week. This led to negative feedback during the interviews. Regarding the cumulative week, the descriptive norm (4.3.2) and the eye-catcher (4.4) were not well executed in practice. The descriptive norm was only displayed on the brochure instead of a sign (Appendix 4.3). The eye-catcher of the Smiley route was placed on a carton instead of a sign (Appendix 4.4). The Municipality of Rotterdam did not permit to change the surroundings in the form of signs due to traffic safety rules.

A limitation of the experimental procedure is that the observers changed daily. This most likely harmed the classification of the pedestrians because every observer has a different interpretation. For example, the estimated age is subjective. Estimated age is an important variable as pedestrians aged 60 years and older are categorized for the target group *elderly.* One more limitation is that some pedestrians are observed multiple times during the three weeks, leading to double counting their characteristics. Another possible complication with this field experiment is the Hawthorne effect. This means that as soon as participants of the field experiment know that they are in an experiment, they give biased results. For example, pedestrians could be wrongly motivated to choose a path because they do (not) want to be in the experiment. Alternatively, they give answers during the interviews that are not their real opinion, also known as response bias. Generally, this is an upwards bias, as people think an intervention should work or have a positive effect (Jones, 1992). The observer is hidden under a tunnel to count pedestrians unnoted to minimize the Hawthorne effect (Appendix 5.2). Nevertheless, pedestrians could be aware that something unusual was going on, as there is a clear change in the setting.
Altogether, the previously stated complications harm the reliability of this field experiment.

Also, when to use a behavioral intervention, is as important as how to intervene. This field experiment was conducted in June 2021 (Appendix 1.3). During the intervention, there were varying weather conditions, from hot days to extremely rainy. The weather has a huge impact on individuals' walking behavior (Shaaban et al., 2018). I have added the week's average temperature, but it got removed due to collinearity with the week variable. This occurred because I took the average temperature of that week, which is perfectly correlated

with the variable week. In addition, I should have added variables for wind and rain, as they have a big impact on the walking decision (Alfonzo, 2005).
Furthermore, time has been a constraint. This field experiment consisted of two behavioral interventions conducted for four days, each with sessions of three hours. Thus, I was limited to its ability to data. Also, I can only interpret the short-term effects of the intervention and cannot say anything about changing the behavior. To summarize, the timing, the time constraints and weather conditions influenced the execution of the field experiment. Furthermore, the second week's results are a cumulative effect of the motivating intervention with the facilitating intervention. I have not fully captured the motivating interventions' effect on its own. The limitations stated in this paragraph harm the internal validity of this natural experiment.

Next, this field experiment has only been done in Overschie, Rotterdam. So, all the findings are only locally applicable. The behavioral analysis and the interventions were designed specifically for this neighborhood. Given this fact, this sample is not representative of the Dutch population. Altogether, this natural field experiment has low external validity.
Lastly, I have not measured any long-term effects of the interventions. For instance, the book trading spot and the benches were positively received, as discussed in the previous paragraph. The benches and book trading spot are facilitating interventions that could have lasting effects. These interventions are not visible when you have never walked on the treatment path. So, it will take some time before more local residents know that such environmental changes have been made.

7.3 Suggestions

As stated in the limitations (section 7.2), I have not measured the long-term effects of the interventions, especially of the benches and the book trading spot. A possibility was to come back a month later to interview pedestrians on the path about the two facilitating interventions concerning the usage of the treatment path.
Furthermore, I think a better execution of interventions could be realized with a higher budget and more compliance with the Municipality of Rotterdam. For instance, counting by a hidden camera would counter the possibility of pedestrians seeing the observers registering the moves of local residents in order to get rid of the Hawtorne effect. However, this would bring some ethical concerns. Furthermore, I would recommend focusing on facilitating interventions to stimulate walking. Walker et al. (2015) found that facilitating interventions work better than motivating interventions to change habits. Although I have not found statistically significant results, I surmise that the benches and book trading spots are simple and not too expensive interventions that have positive effects for everyone.

8. Conclusion

Local residents of all age categories from Overschie perform too little exercise. This study tried to determine which behavioral intervention to stimulate walking works the best in Overschie, Rotterdam. I have created and tested a facilitating and a cumulative intervention, which contains the facilitating and motivating interventions. The behavioral interventions were tested during a field experiment in Overschie, Rotterdam.

First, I found that pedestrians are more likely to walk the treatment route during both intervention weeks than the baseline week. Yet, both effects have a minimal magnitude and are not statistically significant. Then, I focussed on the target groups consisting out of families, the elderly above 60 years, and children below 14 years old, as the behavioral interventions were mainly designed for them. I expected the interventions to have positively affected choosing the treatment path for target groups. Against expectations, I found that target groups are less likely to walk the treatment path in both intervention weeks than the baseline week, again not statistically significant.

During the two intervention weeks, I wanted to determine which interventions were most appreciated. It comes forward that the benches and the book library trading spot received the most appreciation with potentially long-run effects. Altogether, these findings help answer the research question:

Which behavioral intervention motivates local residents to walk more frequently and a longer distance in Overschie, Rotterdam?

This study has not found statistical evidence for any behavioral intervention to stimulate local residents to walk more frequently and a longer distance in Overschie, Rotterdam. Although the interventions have been received positively by local residents, there has not been a statistically significant increase of pedestrians walking the treatment path compared to the standard path.
Still, a takeaway from this study is that facilitating interventions are more appreciated than motivating interventions. This is in line with the findings from Alfonzo (2005) that offering accessibility and comfort increases the probability of walking. The benches and library trading spot are possible interventions that enhance accessibility, offer comfort, and improve the walking experience.

I would recommend municipalities, ministries, and other governmental bodies to facilitate walking. Each neighborhood has different characteristics with other barriers and possibilities, which need specific behavioral interventions. The design of specific interventions is time and cost-intensive. In addition, they could potentially not have a statistically and economically significant effect as they target a small group. While general interventions target all ages and subgroups, such as benches, bins, enough light, and pedestrian paths. These stated interventions have long-run benefits such as increased perceived safety and comfort, besides facilitating walking.

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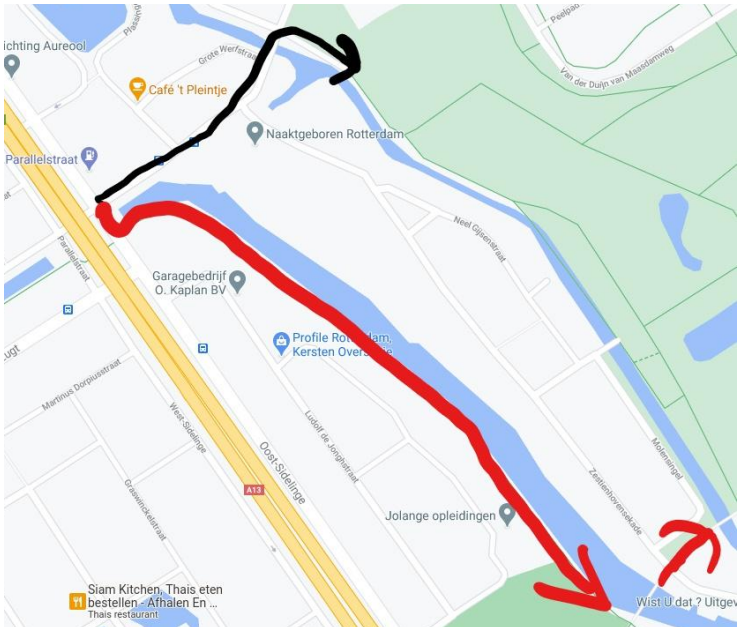
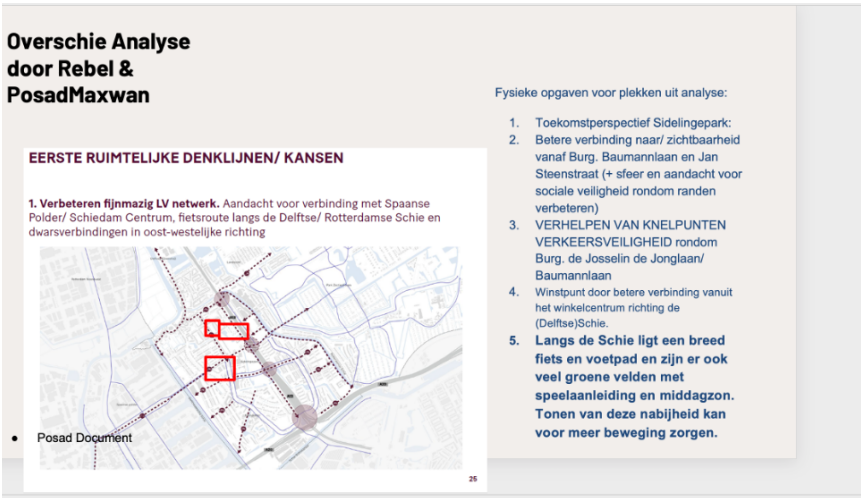
Appendices

Appendix section 1:

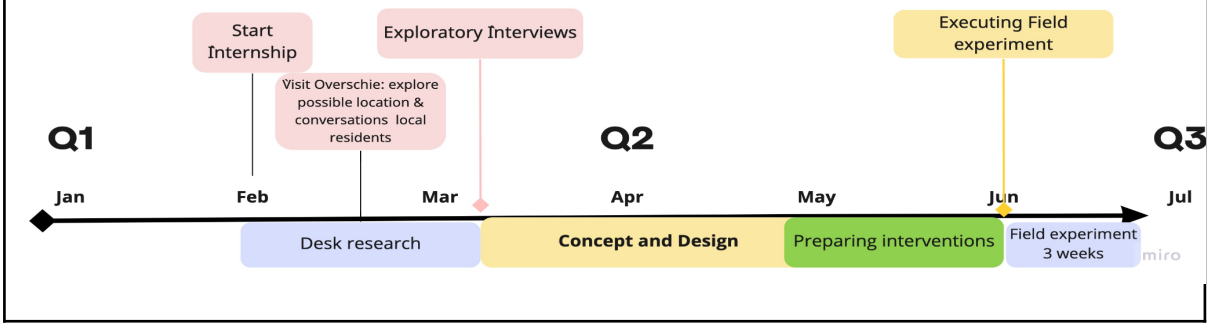
Appendix 1.1.: Shortest route in black, treatment route in red.



Appendix 1.2.: Spatial analysis conducted by Rebel & PosadMaxwan commissioned by the Municipality of Rotterdam



Appendix 1.3.: Timeline of designing the field experiment, which is done during the internship at the Ministry of Infrastructure and Water Management



Appendix Section 3

appendix 3.1.

Questionnaire exploring interviews

general questions:

1. *Which factors determine an attractive walking route*
2. *Which factors are attractive to this specific route, and what could be improved?*

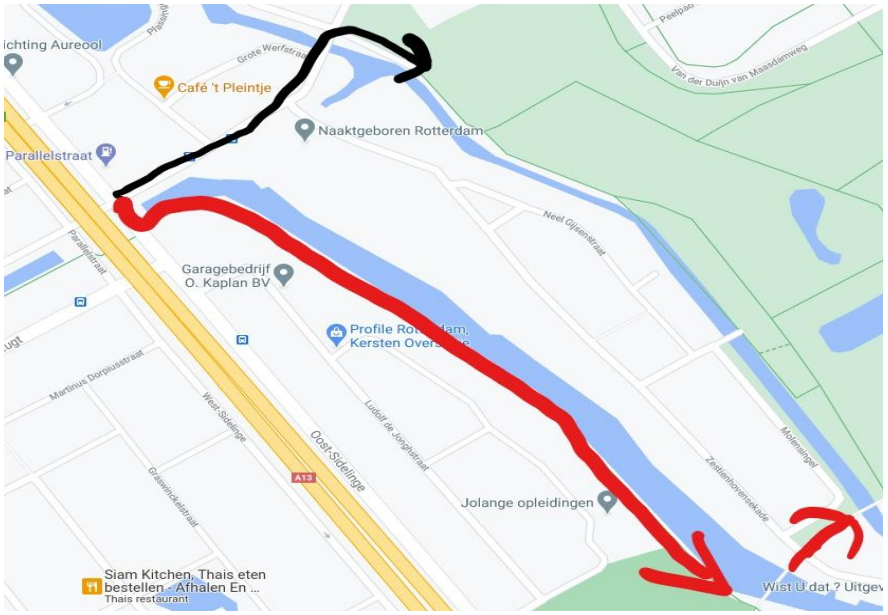
-Answers to the first questions are categorized according to the Pyramid of walking needs of Alfonzo (2005), namely pleasurability, comfort, safety, accessibility.
-Answers to the second question are divided into three categories namely attractive factors of the route, weak factors of the route, and suggested improvements of the route.

profile specific questions:

1.) *In which postal code are you living*
2.) *How much do you walk on the treatment path?*
3.) *Do you visit Park16Hoven regularly?*
4.) *How long do you spend at Park16hoven*
5.) *Which route do you prefer to Park16Hoven?*

-The answer to the first question is every postal code possible from the Netherlands.
-Answers to the second question are categorized as daily, weekly, and sporadically which is anything less than weekly.
-Answers to the third question are categorized as weekly and sporadically which refers to less than one time a month.
- Answers to the fourth question are categorized into short which is less or equal to 30 minutes, and long which is longer than 30 minutes.
- Answers to the fifth question are divided into two categories namely the short route (black) or the long route (red).

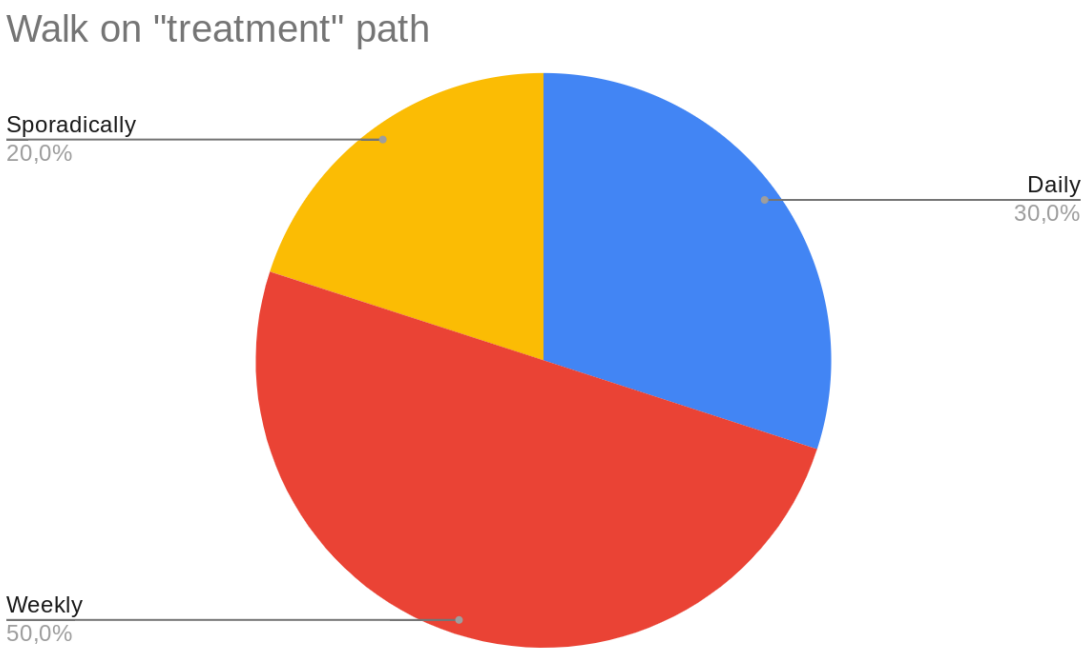
Appendix 3.2.: Shortest route in black, treatment route in red.



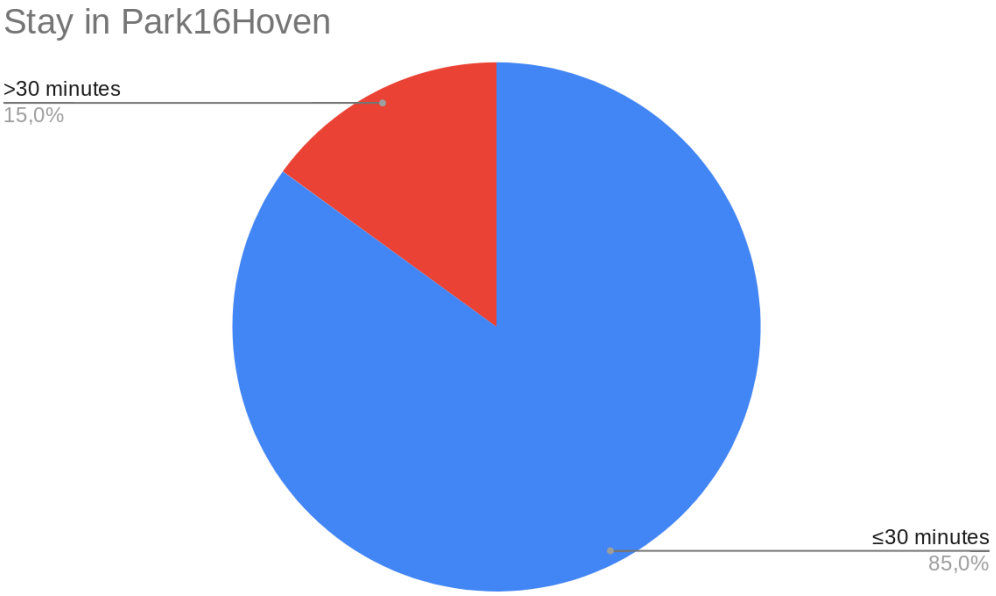
Appendix profile section 3.3.

findings exploratory interviews

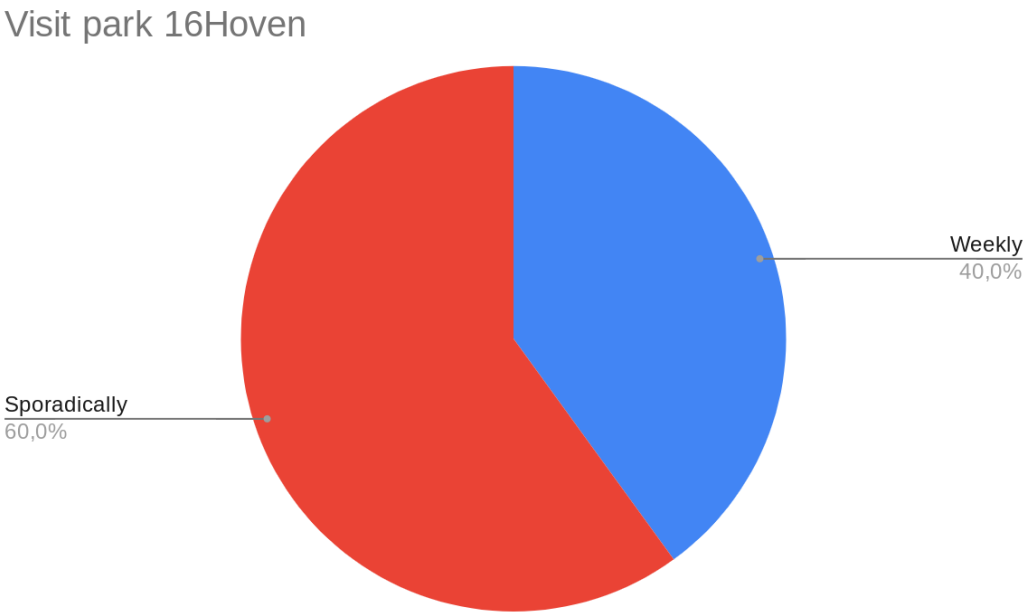
1. walk on treatment path



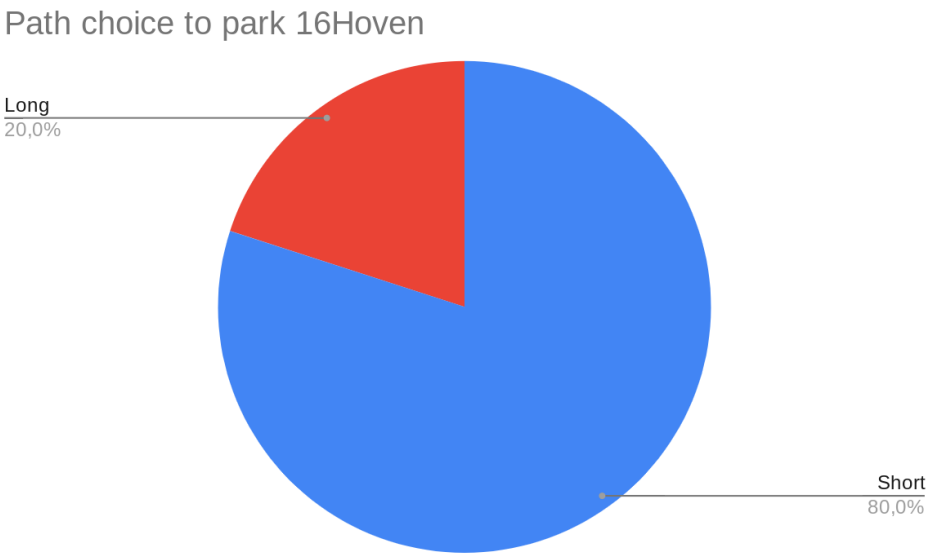
2. Stay in park



3. visit park 16hoven

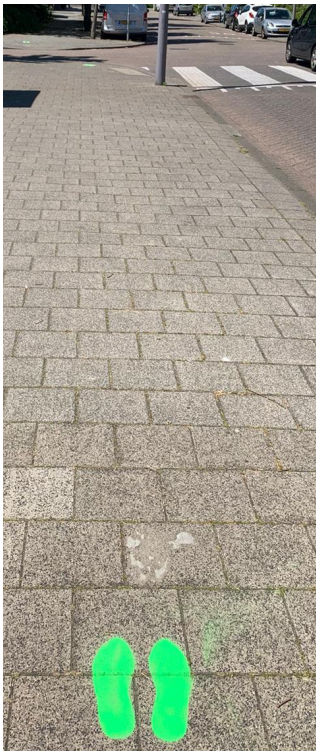


4. path choice park16hoven



Appendix section 4

Appendix 4.1. Socialize with book trading spot, benches and bins	
	
	

Appendix 4.2.:nudge the walk	
	

Appendix 4.3.: Information provision: the brochures and the execution of the intervention.

Feitjes van Overschie

- Stadsdeel Overschie bestaat uit de wijken Kleinpolder, Landzicht, Noord Kethel, Overschie en Zestienhoven
- Inwoners: circa 19.000 inwoners in het stadsdeel
- oppervlakte: 15,80 km^2

Wist u dat…

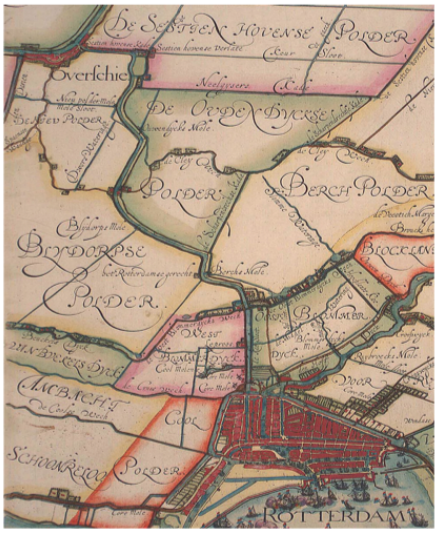
-er in de Schie ecologische zones zijn aangelegd. Dit houdt in dat er oever- en waterplanten, zoals gele lis, zwanenbloem, witte waterlelie en verschillende soorten fonteinkruiden zijn geplaatst. Hierdoor hebben de vissen voldoende ruimte om te schuilen. Bovendien zuiveren deze planten het water. Kortom, de ecologische zone draagt bij aan het verbeteren van de waterkwaliteit en de biodiversiteit.

-er in Overschie een dementievriendelijke route is aangelegd? Mensen met dementie hebben vaker moeite de weg te vinden in hun wijk. Door de route kunnen zij toch een ommetje maken zonder te verdwalen. Daarnaast loopt de route langs diverse voorzieningen- en verblijfsplekken. De route loopt in een achtvorm zodat je altijd op de plek van vertrek terugkomt.

Door het gebruik van gekleurde stickers en sjaals op en/of om onder meer lantaarnpalen is de route herkenbaar. De route is extra goed toegankelijk gemaakt voor gebruikers van een scootmobiel, rolstoel of kinderwagen. Bovendien stellen meerdere ondernemers langs de route hun toilet beschikbaar.

Geschiedenis van Overschie

Overschie is een voormalige gemeente in Zuid-Holland. De naam Overschie wordt reeds in de tiende eeuw genoemd (‘Ouwer Schie’), toen het dorp een kleine nederzetting in een groot moerasgebied was. In Overschie komen de vier wateren bij elkaar die alle vier kortweg met Schie worden aangeduid: de Delfshavense Schie, de Delftse Schie, de Rotterdamse Schie en de Schiedamse Schie. De Schie werd een belangrijke transportroute in de dertiende eeuw, toen de Schielands Hoge Zeedijk werd aangelegd tussen Vlaardingen en Gouda, waarbij twee havens werden gecreëerd bij de Schie en de Rotte. De eerste werd belangrijk voor de ontwikkeling van Overschie, de tweede voor die van Delfshaven (Delfts Haven geeft aan dat deze haven belangrijk was voor de stad Delft). De Schiedamse Schie dateert uit ca. 1250. In 1340 kreeg de stad Rotterdam toestemming om een kanaal te graven tussen het centrum en Overschie: de Rotterdamse Schie. De Delfshavense Schie werd in 1389 gegraven.



Schieland van 1611 van Floris Balthasarsz. van Berckenrode

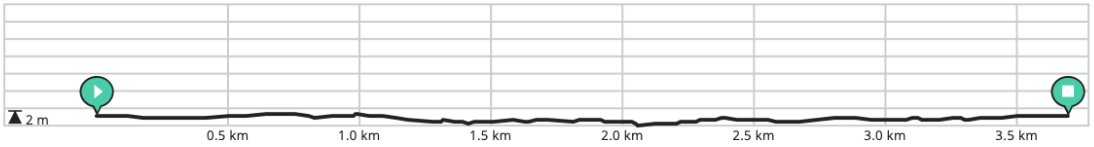
Rondje Park16Hoven

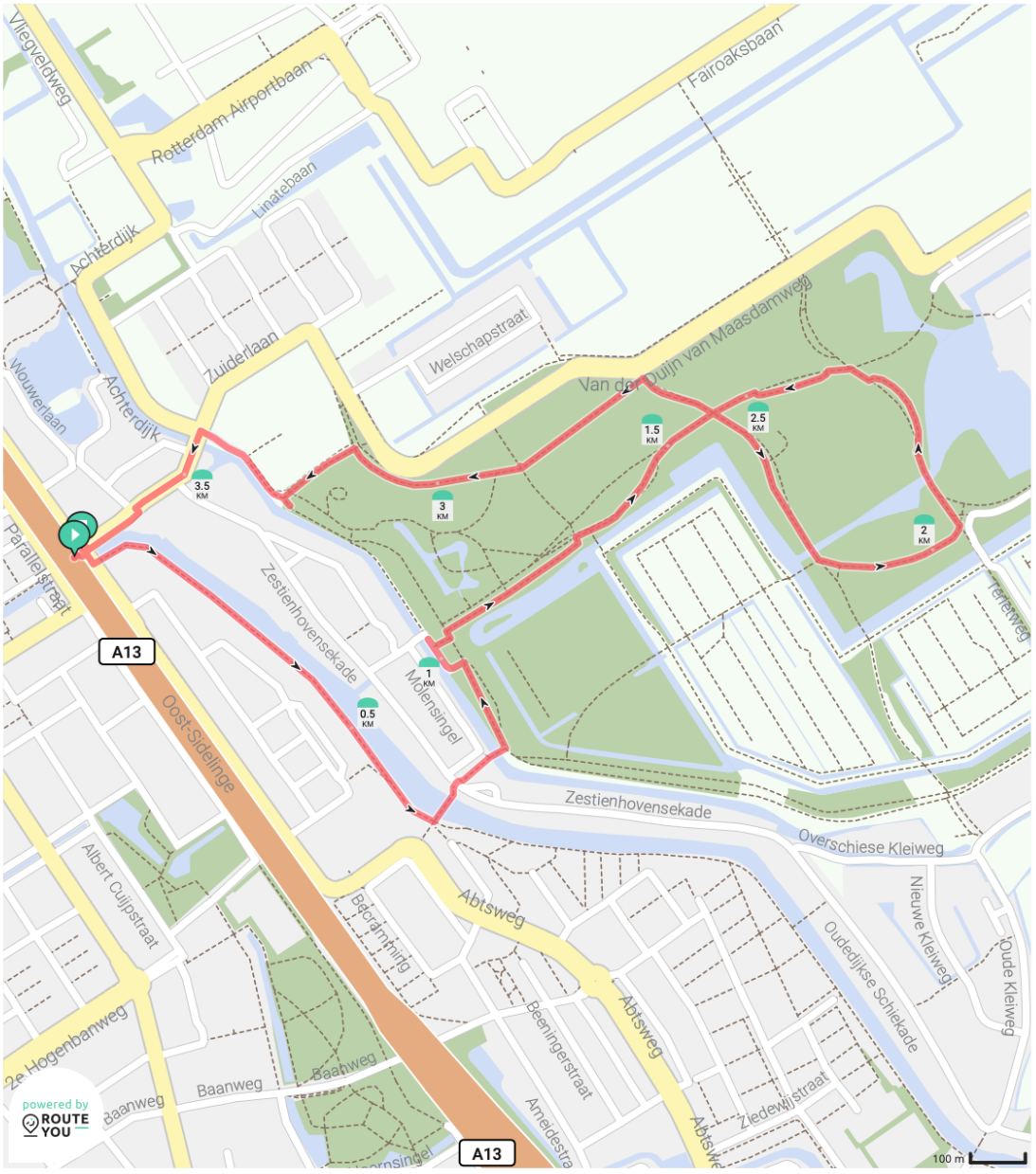
Door RouteYou Public Account

Lengte: 3.69 km
Stijging: 7 m
Moeilijkheidsgraad: 1/10

Zestienhovensekade, 3043GD Rotterdam, Nederland
Zestienhovensekade, 3043GD Rotterdam, Nederland

Bekijk op mobiel





Map Data: © OpenStreetMap Contributors; Cartography: © RouteYou

Appendix 4.4 Smileyroute

Uitleg SmileyRoute Overschie

Welkom op de SmileyRoute!

Op het pad langs de Rotterdamse Schie (Kleinpolderkade) liggen er meerdere smileys verstopt. Weet jij ze allemaal te vinden?

Hoe werkt het?

1. In totaal liggen er 6 Smileys over het hele pad verstopt.
2. Van elke Smiley die je vindt maak je een foto.
3. Degene die de Smileys het snelst allemaal vindt, heeft gewonnen!

Waarom de SmileyRoute? (voor ouders)

De SmileyRoute is vergelijkbaar met paaseieren zoeken. Kinderen maar ook ouderen worden enthousiast van een zoektocht onder druk.
Het doel van de SmileyRoute is ten eerste een leuke ervaring creëren. Daarnaast wordt geprobeerd lopen aantrekkelijk te maken voor kinderen.
Zowel de Gemeente Rotterdam als het Ministerie van Infrastructuur en Waterstaat proberen in de toekomst loopgedrag voor jong en oud te stimuleren. Daarom wordt er nu een pilot gehouden om te kijken wat men aanspreekt.

Voor vragen: davy.de.jong@minienw.nl

P.S.: Laat de Smileys alstublieft liggen op de plekken voor de volgende personen!

SMILEYROUTE

Vind jij ze alle 6?

KLEINPOLDERKADE

16 /19 JUNI

Appendix section 5.1

Observation Protocol for data collector 1. (Below viaduct)

1. Note the **group size**
2. Note the path of choice
   0. control
   1. treatment
3. Guess the age
4. Note whether an individual belongs to one of the target groups
   0. None
   1. Family
   2. Elderly
   3. Children
5. Note the gender
   0. man
   1. Woman
6. Note whether an individual walks with a dog

Observation protocol for data collector 2. (interview)

1. Why did you choose this path?
   0. Work/fastest route
   1. Recreational
   2. Sport
   3. Hond
   4. intervention

2. Did something stand out on this path?
   0. No
   1. Yes

   ->if not, explain that some things have changed

3. Do you have any clue what the reason behind it is?
   0. No
   1. Yes, ...

   -> explain the reason behind the behavioral intervention

4. What do you think about it? (likert scale)

5. Which change should be kept?
   1. Benches
   2. Foot steps
   3. Book spot
   4. Information
   5. Smiley

6. Why so?
7. Note whether one belongs to the target group?
   0. None
   1. Family
   2. Elderly
   3. Children

Appendix 5.2.: hidden spot under viaduct for observing pedestrians

Appendix section 6

Appendix 6.1.) Correlation Table

Variable	1	2	3	4	5
1. Choice	1,000				
2. Number	0.0946	1,00			
3. Age	-0.0263	-0.1882	1		
4. Gender	0.0429	0.1763	0.1206	1	
5. Dog	0.0722	-0.1685	0.0254	-0.0024	1

Appendix 6.2) Full probit model (hypothesis 1 & 2)

	LPM	Probit
Week 1	0.0235	0.0971
	(0.0330)	(0.101)
Week 2	-0.00650	0.0131
	(0.0363)	(0.110)
number	-0.0833***	-0.263***
	(0.0236)	(0.0728)
1.families	0.413***	1.217***
	(0.0638)	(0.197)
2.elderly	-0.125*	-0.399*
	(0.0543)	(0.171)

3.children	0.0977*	0.303*
	(0.0493)	(0.149)
age	0.00202	0.00575
	(0.00113)	(0.00331)
gender	-0.0138	-0.0362
	(0.0306)	(0.0913)
dog	0.113**	0.324**
	(0.0377)	(0.111)
_cons	0.289***	-0.566**
	(0.0584)	(0.173)
N	1030	1030
adj. R^2	0.062	
pseudo R^2		0.058

Appendix 6.3.) Full probit model for target groups (hypothesis 3)

	Choice target group
1.week	-0.134
	(0.145)
2.week	-0.193
	(0.153)
number	0.285***
	(0.0543)

age	0.000248
	(0.00272)
gender	-0.474***
	(0.121)
dog	0.209
	(0.167)
_cons	-0.829***
	(0.223)
N	516
pseudo R^2	0.063

Standard errors in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$