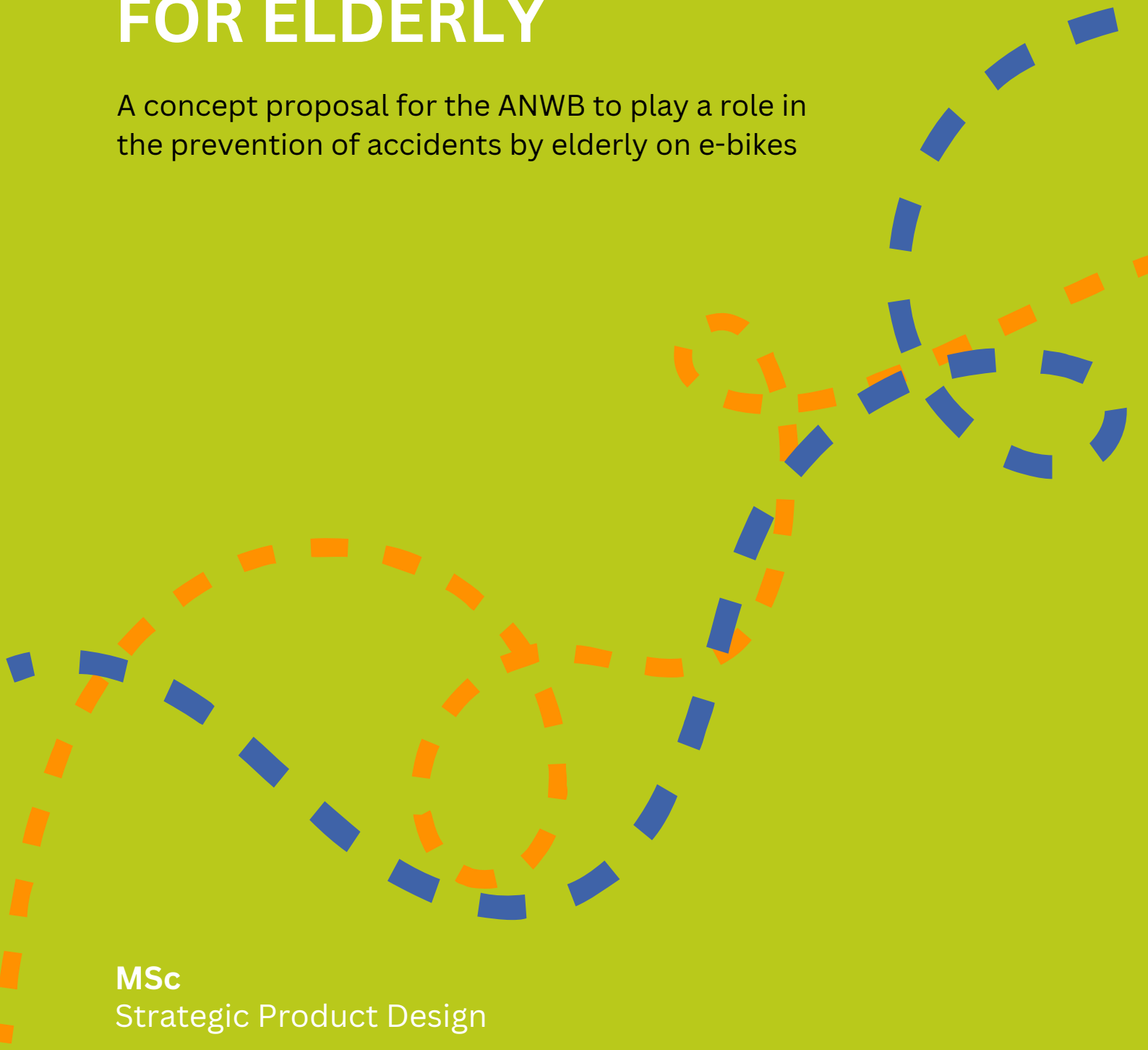
TOWARDS SAFER CYCLING FOR ELDERLY

A concept proposal for the ANWB to play a role in the prevention of accidents by elderly on e-bikes



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Preface

Dear reader,

This thesis is made possible through the opportunity given to me by the ANWB. I was openly welcomed into the Social Innovation team and the corresponding department of Impact & Meedoen (Impact & Engagement).

First and foremost I would like to thank my supervisory team, including both my coaches from the TU, Elmer van Grondelle and Barbera Keukens, and my supervisor at the ANWB, Thijs Komen.

Thank you Elmer and Barbera, for always providing me with clear and constructive feedback. The time you dedicated to our coaching meetings and your inquisitive approach enabled naturally flowing discussions. You made sure to redirect me when needed, leaving me with a feeling of more clarity and direction after every meeting.

Thank you Thijs, for being such an involved supervisor and for putting trust in my capabilities. From the start I could feel your support and drive to make the most out of the project's potential. You stayed informed about the contents of my activities and insights, making it possible to lay a more solid ground at the ANWB for the potential acceptance of the concept proposal.

I would also like to express my gratitude to all the other colleagues at the ANWB who I consulted throughout the project. Your level of interest in my project and sincere willingness to assist, were truly motivating and made the project more enjoyable. A special thanks to Menno Mimpen, for inspiring and supporting me with your innovative mindset, and for making the field of traffic safety data more tangible for me.
Also, I would like to thank the experts outside of the ANWB who were willing to take the time to meet with me and share their knowledge, as well as those who took on the invite to join and be an active part of the creative session. This was truly a valuable and fun afternoon.
To my colleagues at the department of Impact & Meedoen, thank you for including me in the team with such warmth and taking interest in my progress.

Lastly, I would like to express my gratitude to my friends, study mates and family. With you I always had a place to express any wandering thoughts and you gave me that extra spark of energy. I am looking forward to celebrating this milestone with you.

Enjoy reading!

Elvira
05-07-2024

Executive summary

The popularity of e-bikes among elderly presents significant challenges for road safety. An alarming rise in fatal and serious bicycle accidents in the Netherlands has been identified during the past years, particularly among elderly on e-bikes. The most significant increase has been from single-vehicle accidents. The ANWB has always committed itself to improving traffic safety. As the biggest association of the Netherlands, the ANWB has an influential position. The design project investigates how the ANWB can play a role in preventing accidents involving elderly cyclists, aiming to contribute to the national goal of zero traffic casualties by 2050 set by the Dutch Ministry of Infrastructure and Water Management.

Through a comprehensive literature review, inquiries into current projects, and expert consultations, the context of the problem was shaped. Knowledge gaps were addressed through qualitative target group research, providing relevant insights into accident contexts, usage patterns, needs, and behaviors of elderly e-bike users aged 60 and above. All insights were compiled to inform the design of the solution.

The proposed concept centers on offering "pleasant, safe routes" across both functional and recreational ANWB bicycle route planning services, incorporating a variety of new features. Currently, the ANWB provides the Eropuit platform for planning recreational bicycle routes using the knooppunten network (node network). The proposal extends ANWB's offer with a navigation service for A-to-B bicycling, differentiating itself by focusing on pleasant, safe bicycle navigation. This involves building an algorithm that combines various mobility data sources to offer the option of 'the pleasant, safe route'. Subsequently, this algorithm can be applied to enhance the service of the node route navigation. Additional features include clear information sharing on bicycle safety for planning junction routes and enabling users to report risk points.
Elderly cyclists typically maintain similar speeds on e-bikes as they do on regular bicycles. The e-bike does not seem to provide more risks looking at vehicle factors. However, due to the motor assistance provided by e-bikes, elderly individuals tend to cycle more frequently and cover longer distances. Another consequential risk is that it allows elderly to continue cycling despite age-related limitations. The report emphasizes the importance of recognizing that elderly cyclists tend to underestimate their limitations and have a reactive approach to bicycle safety measures.
The target group research shows the most recurring cause for accidents to be startling reactions. These reactions are often triggered by the sudden movements of other road users, causing the elderly to swerve or brake abruptly, leading to falls. A key objective of the concept proposal is to offer routes that minimize factors for startle reactions.

Furthermore, the research brings forward the needs of biking elderly. It showed that elderly can easily feel unsettled by more risky or unpredictable behavior of other road users. Additionally, elderly cyclists, especially retirees, value enjoying their rides. These insights demonstrate the need for pleasant, safe routes. Initial validation research, presenting multiple features of the concept, confirms this need, showing a positive perspective on the concept's effectiveness.

The report presents recommendations for further development, including a strategic and tactical roadmap. The strategic roadmap outlines three phases: the first involves a pilot with a minimum viable product of the pleasant, safe route navigation in the Eropuit app; the second includes the full-service release in both the Eropuit and Onderweg apps; and the third phase focuses on strengthening the unique value proposition, working towards the proposed future vision: "*ANWB is a leader in bicycle safety by applying innovative technology and comprehensive, up-to-date data insights to bicycle navigation*."

Contents

01 INTRODUCTION

This chapter introduces the topic, problem as given and approach of this graduation project.

01 Introduction

While the number of fatal accidents of motorists has been decreasing in past years, the fatal and serious bicycle accidents have increased. The most significant increase has been of single-vehicle accidents by elderly on e-bikes (Krul, 2022; VeiligheidNL, 2024).
E-bikes have grown popular among elderly, who as a result bicycle more often and longer distances. Simultaneously, the share of elderly people in the total population is increasing and the elderly are growing older, meaning a process of 'double-aging'.
As people live longer and prefer to remain independent and healthy, the elderly aim to maintain active independent mobility as long as possible. Besides practical use, the e-bike has become widely used by elderly for recreational purposes.
While there is a correlation that more accidents occur with increased mileage, older individuals actually do face a higher risk of accidents, as well as suffering an injury (SWOV, 2023; Schepers et al. 2020).
This is related to sensory, cognitive and motor impairments that develop with age. Moreover, analyses reveal that seniors often underestimate their limitations.
Looking forward, without interventions, the risk of accidents is likely to rise further due to changing traffic conditions, e.g. busier bike lanes and more silent electric cars, and the aging population (Craen et al. 2022).

Bicycling is something we wish to secure in the Netherlands, since with bicycling come many advantages. As part of the sustainable mobility transition, bike use is promoted to reduce transportation emissions and to keep cities and rural areas livable and accessible (de Haas & Kolkowski, 2023). Being able to move around is seen as a core condition for participating in society. Additionally, cycling supports both physical and mental health. A healthier older generation can lead to significant economic savings and reduce the strain on healthcare systems. Therefore, the government encourages the development of cycling elderly (IenW, 2021). In light of their vulnerability in traffic and the rising trend in accidents, this presents the big and complex challenge to enhance traffic safety with elderly in mind.
The Dutch Ministry of Infrastructure and Water Management (IenW) oversees traffic safety developments. In 2018 the IenW formulated the Zero Ambition, aiming for zero traffic casualties by 2050 (Rijksoverheid, 2018). Although this goal has shown to be improbable to reach, it is still maintained to keep the ambition high and to underscore the importance of traffic safety. Improved mapping of accident conditions, a.o. facilitated by ambulance data being made accessible for road managers and governments since Februari 2024, presents opportunities for more targeted and risk driven solutions. As the occurrence of traffic accidents of elderly on (e-)bikes is a multifaceted, complex problem, it asks for an approach with measures on various aspects and levels. In traffic safety it is often spoken of by 'tweaking on the three E's': Engineering, Education, Enforcement (CROW, n.d.).
The search for effective solutions and initiatives is continuous.

The ANWB, known as the 'Koninklijke Nederlandse Toeristenbond' (the Royal Dutch Touring Club), has a long history of promoting road safety and mobility in the Netherlands. Their mission is to enable everyone to travel carefree and joyfully in a sustainable society. With more than five million members, the ANWB is the biggest association of the Netherlands and has an influential position in the fields of traffic and recreation. The ANWB wants to make their contribution to the traffic safety of elderly. While the ANWB is already active in promoting and selling bicycle helmets, it does not yet run an initiative focusing specifically on preventing traffic accidents among elderly, presenting an opportunity.

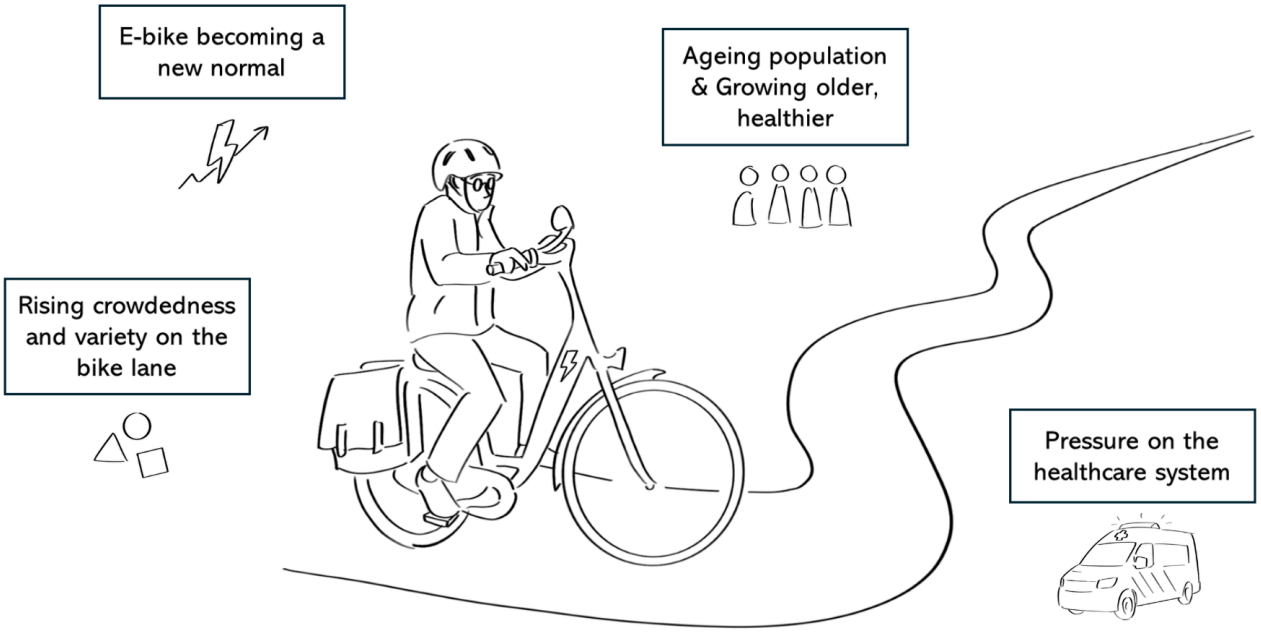
The purpose of this graduation project is to investigate how the ANWB can contribute to the prevention of accidents involving elderly individuals (aged 60+) on e-bikes. This led to the formulation of the following assignment at the start of the project:

Create a new concept along with a roadmap to improve the safety of elderly individuals on e-bikes for the ANWB, in the context of a rising number of single-vehicle accidents involving elderly e-bike riders in the Netherlands.

While existing literature covers factors affecting the safety of elderly cyclists, there is a notable gap in research specific to elderly e-bike users, also including their behavior, needs, and preferences. This project's research aims to fill this gap by providing qualitative data on e-bike usage and related accidents among elderly individuals. Furthermore, it seeks to develop a more nuanced understanding of the target group by acknowledging 'different types' of elderly e-bike users in terms of riding safety and attitudes.
Given that behavior plays a crucial role in any safety solution, understanding the target group is of great importance.

A concept is proposed that promotes the use of safer routes for older e-bike users.
This report details the process, background decisions, and reasoning behind these proposed concepts for the ANWB. Additionally, this report contributes to the field of traffic safety as it aims to offer insights that can guide the development of effective measures that enhance the safety of elderly e-bike riders.

The graduation report is structured as follows: First, the origin of the assignment is explained. In Chapter 2, the context is shaped and presented, highlighting the missing knowledge in the field that will be addressed through target group research. Chapter 3 discusses the research methodology and findings. The insights from the context analysis and target group research are then combined to inform the design of a solution, as described in Chapter 4. The resulting concept design is presented, evaluated, and discussed in Chapter 5. Finally, Chapters 6 and 7 reflect on the research and design process and outcomes.



1.1 The ANWB assignment

The ANWB

The name ANWB is an abbreviation for ‘Algemene Nederlandse Wielrijdersbond’, translated: General Dutch Cyclists' Union. It was founded on July 1, 1883 as a cyclists’ association, however from 1905 it transformed into primarily a tourist association. They quickly expanded to serve a wider mobility and recreational network. ANWB has kept the letters, but since expresses itself as The Royal Dutch Touring Club ANWB (Dutch: Koninklijke Nederlandse Toeristenbond ANWB).

The ANWB is most known and highly recognized among the Dutch public for its roadside assistance service, known as the ‘Wegenwacht’, which provides emergency help for vehicle breakdowns since 1946. Additionally, the ANWB is widely known for offering leisure and travel activities and products. To stay relevant and meet evolving needs, o.a. in the increasing demand for sustainable and efficient mobility solutions, the ANWB continually expands and revises its services. A significant new branche is ANWB Energy. This includes supplying electric energy at cost price, making it an affordable option for consumers, and the ANWB Charging Service for electric cars along highways.

The primary communication channel is De Kampioen, the association's magazine available both digitally and in print. Additionally, the ANWB plays a significant role in lobbying for Dutch traffic safety within Dutch politics. An overview of the ANWB’s services can be found in Appendix B, which the ANWB categorizes themselves into: Roadside assistance, Insurances, Energy, Traffic, Car, Bike, Eropuit (Recreation), Holidays, Shop, Membership and Business.

ANWB bicycle services

In the cycling field, the ANWB offers various products and services:

- **Cycling route planners**: The ANWB provides online tools and apps for cyclists to plan and navigate routes, both for recreational rides (Knooppuntenroutes) and daily commuting.
- **Bicycle insurance**: The ANWB offers insurance policies for bicycles, including theft and damage coverage.
- **Bicycle accessories**: In ANWB stores and the online shop, cyclists can find a range of accessories such as bike lights, panniers, helmets, and pumps.
- **Bicycle repairs and maintenance**: Through ANWB stores and selected partners, cyclists can access repair and maintenance services.
- **Bicycle advice and information**: The ANWB offers advice and information on cycling, including tips for safe cycling, cycling routes, laws and regulations, and bike-friendly locations.

Problem as given

Impact & Meedoen

The graduation project was initiated on behalf of the Social Innovation team within the Impact & Participation department, under the People & Community division. The Social Innovation team, launched in September 2023, develops initiatives aimed at addressing societal frictions within the ANWB domains: mobility, traffic safety, holidays and free time. The Impact & Participation department designs and oversees social projects with a significant focus on participation, see Fig. 1 for an overview of existing projects. Participation within the department is categorized into three levels: experience, participation and co-creation (Dutch: meedoen, meemaken, meebouwen).

Several projects rely strongly on volunteer contributions. ANWB AutoMaatje, for instance, is a successful project across various municipalities in the Netherlands, where volunteer-drivers provide transportation for elderly individuals who are no longer mobile enough to travel independently. Another example is The Kinderfietsen Plan, where people can bring used children bikes that are then made available for families with less resources. In this case the bicycles have to be checked and repaired, which is again performed by volunteers. The ANWB holds a volunteer base of [number] volunteers, primarily consisting of elderly members. The volunteer platform is currently being renewed to encourage more accessible 'low key' forms of volunteer work.

The Impact & Participation department has recently gained increased attention within the organization, as the AWNB has signaled they have to secure and reinforce the ANWB's identity as a community-focused organization. they have to pay more attention to being perceived as a societal organization. A survey conducted within the member panel revealed that 60% of respondents view the ANWB primarily as a commercial enterprise, while 40% see it as a social association. The goal is to bring these perceptions closer together.

Fig. 1: Impact & Meedoen initiatives

Origin of the assignment

The Social Innovation team identified the issue of elderly individuals on e-bikes as a significant concern that could benefit from the contributions of the Impact & Participation department. Previously, the ANWB had undertaken three projects related to this topic, but none resulted in sustained actions.
The first initiative, Lifecycle (2013), explored the development of a bicycle specifically designed for the elderly. The second, following the drawn up Road safety program of the ANWB in 2019, involved a broader investigation into e-bikes and their usage by elderly individuals. In early 2023, the ANWB innovation team, at the behest of Impact & Participation, revisited this challenge, resulting in the development of Bike-Kletsen—a conversational game aimed at promoting safety discussions among senior e-bike users. However, there is no dedicated team continuously addressing this issue, and no new projects followed Bike-Kletsen.

Problem as given

The Social Innovation team reintroduced the issue as a potential focus for this graduation project. The assignment was articulated as follows:
"*How can the Impact & Participation department initiate a social initiative to address the increasing trend of accidents among elderly e-bike users?*".
This problem statement was presented without specific guidelines or frameworks, nor was there an expectation to directly build upon previous insights or proposed solutions.

Since the assignment involves developing a social initiative that would derive from the Impact & Participation department, the solution should incorporate some form of community involvement or participatory elements. Additionally, there is a preference for the solution to achieve public recognition, with the ANWB playing an active and visible role, thereby enhancing the organization's image as a socially engaged association.

A holistic approach

To foster innovation, a holistic approach has been chosen for the design process and engaging with the problem area. With this approach in mind, the problem statement is reformulated.

Firstly, the statement is reformulated to ensure it does not predetermine the role the ANWB might play, thus broadening the scope beyond the Impact & Participation department. While participation remains an element that is aimed to be incorporated due to the project's origin within Impact & Participation, it will only be considered during the concept development phase to avoid influencing the process in advance.

Second, the problem statement is framed with minimal constraints as to avoid steering solutions toward specific measures or preconceived aspects of the problem. The issue and its context are looked at from a fresh perspective. The project aims to put forward developments and knowledge across various facets of the problem. This comprehensive understanding, coupled with insights gathered from the target group, will help identify potential opportunities. Data triangulation will be employed, comparing insights within results, and with existing knowledge.

This approach emphasizes an agile and iterative way of working, in which significant attention is paid for problem finding. By doing so, the project aims to develop its own "problem as perceived," rather than relying solely on the "problem as given" by the ANWB or other sources, as the basis for solution finding. As suggested by the term "iteratively," solution finding and problem finding however also proceed hand in hand.

Scope

Based on a literature review and an evaluation of the current bicycle-related initiatives at the ANWB, along with the previously described holistic approach, the problem statement has been reformulated. This statement has also been discussed during a scope meeting with the Social Innovation team.

Problem statement:
How can the ANWB contribute to the **prevention** of accidents involving elderly individuals, aged **60+**, on e-bikes in **the Netherlands**?

The Netherlands

This project addresses the rise in accidents within the country. While Dutch people also cycle recreationally outside of the Netherlands, the focus therefore remains on the Netherlands. The previous project by the Innovation Team focused on recreational cycling, but this project does not make such a distinction due to the lack of clear evidence indicating whether more accidents occur during recreational cycling or cycling with a practical purpose. Additionally, no frame is placed on whether the accidents occur within or outside built-up and urban areas, as cycling accidents seem to be dispersed and as insufficient detailed e-bike accident data has previously been collected. For more information on current knowledge, see Chapter 2.2.

60+

The term "elderly" is broad and not tied to a specific age category. In both internal and external projects, the definition varies, typically between 55+ (e.g., FietsveiligheidNL), 60+ (e.g. IenW DOORTRAPPEN) and 65+. For this project, the specification of 60+ was chosen, aligning with the ANWB's Traffic Safety Program strategy (Voorhuis, 2022).

Prevention

A *traffic accident* is defined by the SWOV as an event on public roads related to traffic that results in damage to objects or injury of individuals, involving at least one moving vehicle (SWOV, n.d.).
In the problem statement "prevention" is implied to emphasize the goal of avoiding accidents rather than reducing their damage or injury

Image (ANWB ©)

02 UNDERSTANDING THE CONTEXT

This chapter shows the landscape in which the project is executed. As the prevention of accidents involving elderly individuals on e-bikes is a complex societal issue, it is important to understand how the different facets respond to each other and individually have their role. Firstly, the various stakeholders are put forward, second the current knowledge, and the gaps and debated topics within this field. Third, we review previous and ongoing projects. To effectively propose a new concept it is important to know what is already happening in the field. This can offer opportunities to see where collaborations or knowledge transfers are possible and to understand in what fields most value can still be added. Lastly, trends that influence the problem area are identified.

02 Understanding the context

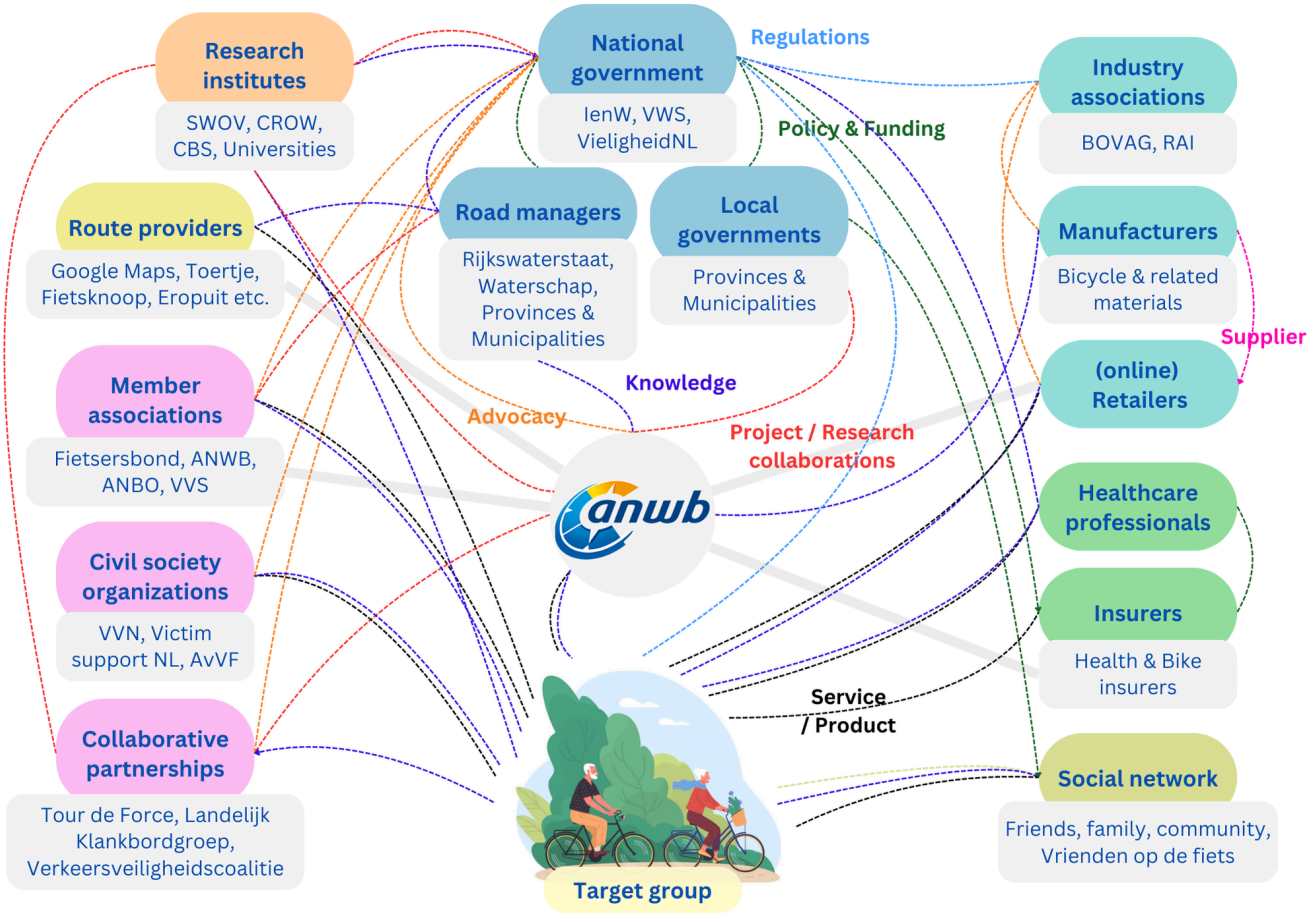
2.1 Stakeholders

Mapping out the stakeholders involved helps to identify the diverse perspectives and interests that are to be considered. Moreover, it shows which parties hold knowledge that can be of value, fueling the research on current knowledge as well as previous and current projects.

There is a diverse range of stakeholders involved in the safety of elderly on e-bikes. The stakeholder map gives an overview and illustrates their roles when looking at the safety of elderly on e-bikes, as well as their relation with the ANWB. Descriptions of roles are provided in Appendix C. In Ch. 2.3 'Running projects' the report dives deeper into the contributions of certain stakeholders named.

The ANWB maintains direct contact with many of the stakeholders. Additionally, it participates in several collaborative groups dedicated to enhancing traffic safety, including the National Advisory Group (Dutch: 'de Landelijk Klankbordgroep') and the Traffic Safety Coalition (Dutch: 'Verkeersveiligheidscoalitie').

The Traffic Safety Coalition is a partnership where the ANWB works alongside government agencies, research institutions, and other civil society organizations. This coalition aims to develop and implement comprehensive strategies to improve road safety across the Netherlands. By combining resources and expertise, the coalition tries to tackle complex traffic safety issues more effectively. Likewise the National Advisory Group is a platform that brings together stakeholders from various sectors to discuss and advise on traffic safety policies and initiatives. This group includes representatives from national and local governments, research bodies, and advocacy organizations



The government

Investment Impulse for Traffic Safety

The majority (96%) of roads are part of the road network called the Onderliggend Wegennet (OWN), which are managed by municipalities, provinces, and the regional water authorities, and not by the national government. Approximately 80% of annual traffic casualties occur on these roads (Tweede kamer, 2022). To address this, the government has allocated €500 million between 2020 and 2030 to boost the traffic safety of roads. The government covers up to 50% of the costs for measures that enhance traffic safety, such as widening bicycle paths, establishing school zones, and constructing speed bumps and roundabouts. The funding is released in three phases. The first phase was initiated in 2020, with the second phase opening in 2022. The third phase is expected to be available in 2024.

SPV 2020

Published in 2018, the Strategic Road Safety Plan 2030 (Strategisch Plan Verkeersveiligheid, SPV 2030) outlines the national government's renewed vision for road safety. This plan emphasizes a 'risk-based' approach to road safety policy, focusing on preventing accidents by proactively addressing the most significant risks within the traffic system. This approach requires road authorities to conduct risk analyses of their road networks. Based on these analyses, all involved parties in each region collaborate to develop an implementation program aimed at reducing those risks.

The governance structure for this initiative is designed to facilitate coordinated action across various levels of government and stakeholders (see Fig. 2). Annually, a national administrative meeting takes place to discuss and set national agreements. These national agreements are then translated into concrete implementation agendas through regional discussion tables.

Fig 2: Governance structure of the government for managing traffic safety initiatives (Kennisnetwerk SPV, n.d.)

2.2 Current state of knowledge

The current state of knowledge is analyzed and presented based on literature research, knowledge sharing at conferences, such as the NVVC 2024, Nationaal Verkeersveiligheidscongres, the Intertraffic 2024 and the Fiets- en wandelbeurs, and expert interviews.

Knowledge development

Knowledge specifically addressing accidents involving elderly e-bike riders remains limited. For a long time, traffic safety measures and infrastructure were developed primarily taking automobiles into account, following the guidelines of the 'Safe System Approach' introduced in 1998. Revised guidelines recognizing the importance of bicycle safety only emerged in 2012 with the 'Beleidsimpuls Verkeersveiligheid.' In 2014, the first research in the Netherlands on bicycle accidents involving the elderly (aged 50+) was published.
The Strategic Road Safety Plan 2030 (SPV 2030), released in 2019, highlighted the elderly as vulnerable road users, emphasizing the need for greater consideration of their safety.

Correspondingly an elaborate SWOV report (translated) "Towards More Safety for Elderly Cyclists. Accidents, Circumstances, and Possible Solutions" was published (Schepers et al., 2020).

Although substantial knowledge regarding the field of cycling in general is present, the effects of e-bikes on the riding behavior and accidents involving the elderly are explored to a limited extent. Furthermore, comprehensive accident data has been sparse, with insufficient distinction between e-bikes and regular bicycles, due to inadequate registration. This is starting to see a change, but a gap in open source data collection remains a significant challenge.

Data registration in traffic safety

Accidents are registered in different ways, corresponding to the outcome of the accident.
In case of a collision where the police are involved, the context of the accident with its circumstances is noted down. However, in incidents requiring ambulance assistance, only essential information relevant to hospital needs is recorded, often excluding descriptions of multiple accident factors. Additionally, the distinction in vehicle type between conventional bicycles and e-bikes is not always made. It is suspected that previous reports have significantly underestimated the proportion of electric cyclists among cycling accident victims, looking at the information about the high purchase rate and use of e-bikes (Mulders et al., 2023).

The emergency departments (Dutch: Spoedeisende hulp, SEH) generally record similar types of data as the ambulance services (RAV). The SEH data is incorporated into the Injury Information System (LIS) managed by VeiligheidNL. Injuries that are self-reported to hospitals at a later moment are not included in this data. The LIS creates an insight into the number of injuries resulting from non-motor vehicle accidents.
To better understand the locations of these accidents, ambulance data has been made accessible for traffic safety policy. The RAV and SEH data are included in the MOVE Dashboard, launched in February 2024. The dashboard collects and analyzes data on the geographical locations of traffic accidents, risk groups in traffic, and the circumstances of traffic accidents. This complements the police traffic data (BRON - Bestand geRegistreerde Ongevallen in Nederland).

Each year, VeiligheidNL produces an infographic on bicycle accidents based on data from questionnaire surveys of cyclists, moped- and scooter riders who visited the SEH after a traffic accident. This annual

infographic provides valuable insights into the trends and patterns of bicycle accidents.
In addition to accident data, data is being collected and mapped out regarding the infrastructure we have, speeds, and the behavior of road users (CROW, 2024) to contribute to the government's risk-based approach to road safety.

Fig. 3: Visualization of traffic accident registration channels (Rijkswaterstaat, n.d.)

Type of accidents & data

In traffic safety, accidents are categorized into two-vehicle accidents and single-vehicle accidents. Furthermore, traffic victims are classified as traffic fatalities, serious injuries, and minor injuries, using international standards to indicate the severity of injuries (MAIS categories).
Two-vehicle accidents (Dutch: tweezijdig ongeval) involve at least two road users. In the case of a car colliding with a cyclist, this is usually referred to as a collision.
A single-vehicle accident (Dutch: eenzijdig ongeval) involves only one road user. This can include incidents where an obstacle or animal is hit (SWOV specifically refers to these in Dutch specifically as 'enkelvoudige ongevallen' (SWOV, n.d.)). In the case of cyclists, these accidents typically result in injury or damage from a fall or collision with something other than another road user.

In the past decade, the most significant increase in traffic accidents has been among the elderly on e-bikes involved in single-vehicle accidents (Krul, 2022). Additionally, among all bicycle accidents treated at the Emergency Department, single-vehicle accidents tend to constitute the largest group (VeiligheidNL, 2021; VeiligheidNL, 2024). In 2023, 21% of accidents were two-vehicle accidents, 70% were

single-vehicle accidents, and 7% were collisions with obstacles.

Fatal accident

Each year, the CBS publishes an update on the number of traffic fatalities for that year. For the past four consecutive years (2019-2023), bicycles have been the deadliest mode of transport: 270 cyclists lost their lives in 2023 (see Fig. 4). Of these, at least 40% were riding an e-bike. Seniors are overrepresented in these fatality statistics, with 122 cyclists aged 75 and older and 91 cyclists aged between 50 and 75. In total, eight out of ten deceased cyclists were aged 50 or older.
The majority of fatal accidents involve two-vehicle collisions, typically with a car. Three in ten are single-vehicle accidents, where a person falls or crashes into an object on the road (CBS, 2024).
A report by the Ministry of Infrastructure and Water Management (IenW) analyzed data from 2012-2021, revealing that nearly three out of five registered cyclist fatalities (58%) occur within urban areas. Moreover, both inside (60%) and outside (55%) urban areas, more than half of these fatalities occur at intersections (SWOV, 2023).

Nearly three out of five registered traffic fatalities among cyclists (58%) occur within urban areas. Both within urban areas (60%) and outside them (55%), more than half of these fatalities occur at intersections (data from 2012-2021; SWOV, 2023)

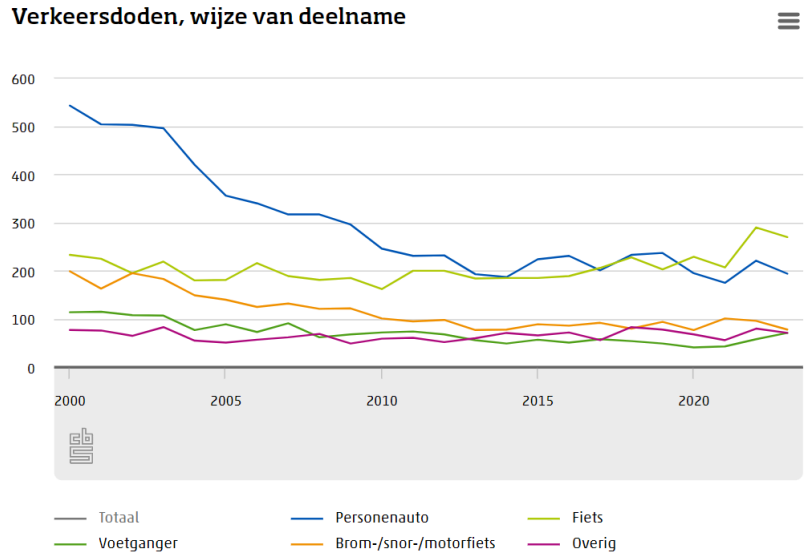


Fig. 4: Traffic casualties in the Netherlands since 2000 by mode of transport (CBS, 2024)

Single-vehicle accidents

Elderly are more frequently involved in single-vehicle accidents compared to younger individuals (SWOV, 2020). A study by Weiermars in 2018 found that among the 50+ age group, 85 percent of accidents were single-vehicle incidents (Weiermars, 2018). These accidents occur both within and outside urban areas. People over 65 in many cases use their e-bikes for recreational purposes, leading them to cycle more frequently in non-urban areas.

Schepers and Klein Wolt (2012) identified four categories of single-bicycle accidents:
collisions with obstacles (such as street furniture), riding off the road or hitting a curb, slipping due to a slippery surface, and losing balance due to holes or bumps in the road.

Injuries

Traumatic brain injury is the most common injury among older adults involved in bicycle accidents. The proportion of head injuries decreases with age, while the proportion of

hip injuries increases (Schepers et al., 2020). Wearing a bicycle helmet reduces the risk of fatal head/brain injuries by an average of 71%

Factors involved in accidents of elderly on (e-)bikes

Over the years, multiple studies have examined the factors contributing to bicycle accidents among elderly, however without distinguishing between regular bicycles and e-bikes. Multiple factors can play a role in an accident simultaneously.

Factors can be categorized into road factors (such as road condition and bike path width), vehicle factors (such as the adjustment and quality of components), human factors (e.g., distraction, physical and mental condition, and behavior of other road users), and 'other factors' related to circumstances like weather and traffic intensity. These factors can interact in various ways. For example, losing balance on a slope due to low speed, wavering off course due to a sudden fright or distraction, or being surprised by obstacles on the road (Davidse et al., 2014).

Researcher Goldenbeld found that cyclists aged 70 and older are more likely to collide with obstacles such as bollards (street poles) and curbs. They also experience more accidents while mounting and dismounting and are more prone to losing balance when reducing speed or stopping. He suggests that the behavior of other road users or a narrowing of the path can cause them to lose balance more easily (IenW, 2021).

Speed

Higher differences in speed among road users can increase the risk of accidents. For instance, the higher speed of an electric bicycle may be underestimated by other road users, leading to errors in judging safe gaps for crossing (Schleinitz, 2017). Observational and experimental studies indicate that the speed of electric bicycle riders is 1 to 4 km/h higher than that of regular bicycle riders (Schepers et al., 2020). However, seniors aged 65 and older tend to ride e-bikes at similar speeds to regular bikes (see Fig. 5).

According to Flügel et al. (2019), the largest speed differences between conventional and electric bicycles occur on uphill road sections. Additionally, the absence of obstacles on the road is related to stronger speed differences (Schleinitz et al., 2017).

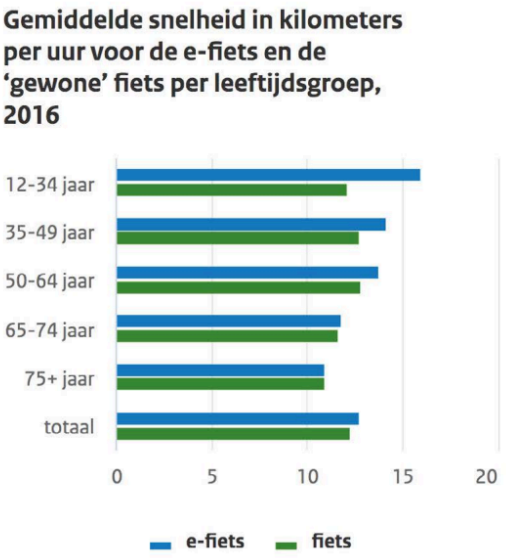


Fig. 5: Average speed in kilometers per hours for the e-bike and the 'regular' bike per age group (Harms & Kansen, KiM, 2018)

Age-related factors

Evidence indicates that cycling performance and overall traffic safety are influenced by aging (SWOV, 2023; Schepers et al., 2020). The needed functions for (safe) cycling, shown in Fig. 6, diminish with age. Sensory functions, including information processing and reaction time, decrease. This can lead to an increased feeling of time pressure when performing complex maneuvers. Besides decreased information processing, the decline in physical strength, flexibility, and balance also impacts the ability to handle risks in complex traffic situations (Schepers & Schagen, 2020). Between the ages of 70 and 80, sensory impairments and functional limitations become more common, such as reduced visual field, arthritis, sensitivity to

glare, dementia, strokes, and heart failure. These conditions carry a relatively high traffic risk (Nägele, Roelofs, & Kuiken, 2015).

Needed functions

COGNITIVE	SENSORY	MOTORIC
Executive functions	Eyesight	Muscle power
Responsiveness	Hearing	Muscle mass
Processing speed	Balance	Flexibility

Fig. 6: Functions used in cycling (Schepers et al., 2020)

The e-bike

E-bikes come in various types. Discussions with cycling experts brought forward that e-bikes with front-wheel drive pose a higher risk of accidents. For instance, front-wheel drive can cause the front wheel to easily lose grip on a loose or slippery surface in a turn, if braking is not done in advance. This is not strongly presented as so and this type is still purchased as a cheaper option.

Debated Topics and Missing knowledge

There is a lack of detailed knowledge on how e-bikes affect the riding behavior and needs of the elderly as well as the contexts of accidents.
It is evident that e-bikes allow elderly to cover more kilometers, which, combined with increased age, raises the likelihood of accidents. However, it is still debated whether or to what extent electric bikes actually increase accident and injury risk compared to conventional bikes for the elderly, concerning vehicle factors. A study by Westerhuis et al. concludes that e-bikes with a mid-motor do not pose more risks than conventional bikes. He notes that e-bikes do not lead to more accidents during mounting and dismounting, and that the balance of most modern e-bikes (those with a mid-motor) is similar to that of conventional bikes.
Older adults aged 65+ generally do not ride at different speeds on e-bikes compared to conventional bikes. However, younger age groups do. The effect this has on older adults and their accident risk has not been researched.
Secondly, the circumstances of accidents involving elderly cyclists have not been extensively studied on a detailed level. Only one study from 2014 provides detailed insights into accident circumstances, based on 42 cases of elderly individuals who had had an accident resulting in injury. Other documents, such as those from VeiligheidNL, offer superficial descriptions, stating, for example, that "own behavior" is the most frequently cited cause of single-vehicle bicycle accidents among seniors, but they do not clarify what specific behaviors are involved.

Next to this report, ongoing studies will supplement the current knowledge. PhD researcher Mr. Uijtdewilligen from SWOV is investigating the safety of cyclists concerning infrastructure, particularly in urban areas, though not specifically focusing on older cyclists. PhD researcher Ms. Boele, however, is focusing on the question: "How can older cyclists safely participate in traffic?".

2.3 Running projects

Nationally, regionally, and locally, numerous initiatives are in place to promote the safe mobility of older individuals on bikes and to improve bicycling safety in The Netherlands in general. To effectively propose a new concept it is important to know what is already happening in the field. This can offer opportunities to see where collaborations or learnings are possible and to understand in what fields most value can be added.

ANWB Projects

The ANWB (Royal Dutch Touring Club) is actively involved in sharing information and lobbying for safe bicycling. 21% percent of its 5 million members are interested in cycling, with most of them being 65 and older (ANWB member data, 2024).

Promoting Helmet Use

The Verkeersveiligheidcoalititie (translated: Traffic Safety Coalition) and the think tank Artsen voor Veilig Fietsen (translated: 'Doctors for Safe Cycling') advocate for normalizing the use of helmets while cycling. Together with the organization Hersenstrijd, they initiated 'the Day of the Bicycle Helmet' in 2023. While there is no intention to introduce a mandatory helmet law, the focus is on encouraging voluntary use. In Denmark, which has a similar cycling culture, efforts to promote helmet use began ten years ago. Now more than half of the Danish cyclists wear helmets (NOS, 2024).

Since the attention, the ANWB has actively promoted helmet use. In 2022, the ANWB offered three regular helmet models, which has since expanded to 28, including helmets specifically designed for e-bikes. On the Day of the Bicycle Helmet, the ANWB launched its first helmet campaign targeting individuals aged 55 and older. This campaign led to a significant increase in helmet purchases (ANWB data). When purchasing a helmet, customers also receive an email with tips and instructions on how to use the helmet correctly. Helmets are primarily sold in the ANWB's physical stores, of which there are 72 in the Netherlands.

The ANWB is also exploring the potential of becoming an online marketplace for e-bikes, assessing whether this could be a lucrative addition to their offerings.

Bypoint: fall detection

In addition to helmets, the ANWB offers other bicycle accessories, including the Bypoint fall detection system (see Fig. 7). This system is aimed at elderly cyclists who may have accidents while cycling alone. The fall detection system automatically calls for help after a bike accident, without needing a linked cell phone or app. The location is sent to three predefined contacts.

Fig. 7: Bypoint fall detection (Bypoint, n.d.)

Traffic Safety Data Explorer

The ANWB's web tool 'ANWB Verkenner Verkeersveiligheidsdata', the Traffic safety data explorer, maps out locations with high-risk of incidents to support policy-making for municipalities and provinces. See Fig. 8 for an image of the tool. This aligns with the government's vision of improving traffic safety through risk-based approaches. Currently, the tool uses data from motorists' driving behavior, known as 'floating car data'. Risk points are identified by collecting the data where cars frequently brake hard (Verkeerskunde, 2024). This data collection method also allows for the measurement of the effectiveness of traffic safety measures. Traditionally, it can take up to three years to determine the effectiveness

of these measures if based solely on accident numbers.

The ANWB aims to extend the tool to develop and utilize Floating Bike Data. The goal is to use raw sensor data from phones to map cycling behavior, identifying where cyclists fall or brake hard.

Fig. 8: The ANWB Traffic safety data explorer (Verkeerskunde, 2024)

Education initiatives

The ANWB sees education as a critical component in improving traffic safety. The ANWB recognized that children cycle less and less, resulting in decreased cycling skills and lack of traffic insight. At the same time acknowledging children as the future road users, the organization has established educational initiatives like Streetwise and Traffic Squares.

Streetwise Program

For primary school groups 1 through 8, the Streetwise program has been developed to teach children the skills they need to take part in traffic safely. This program includes practical lessons and exercises, as well as a digital learning tool (see Fig. 9).

Fig. 9: Streetwise (ANWB, n.d.)

Traffic Squares

ANWB Traffic Squares are specially designed areas that schools can order to provide a safe and practical environment for children to learn about traffic rules and road safety (see Fig. 10). These squares simulate real-life traffic conditions, allowing children to practice and understand the rules in a controlled setting.

Fig. 10: ANWB Traffic square (ANWB, n.d.)

Previous ANWB projects

Lifecycle bicycle

The Lifecycle concept was developed during an ANWB project in 2013 in response to the increasing number of accidents involving elderly cyclists on e-bikes. The Lifecycle was envisioned as a bike that could be used by multiple generations, designed with the physical limitations of the elderly in mind. The goal was to encourage elderly individuals to continue cycling safely into old age.
In this project, the causes of accidents were categorized into lack of stability, unsafe turns, loss of control, and braking issues.

Despite the thorough design, the Lifecycle bike has not been further developed due to the substantial investment required and the lack of recognized demand for a bike specifically for the elderly. This perceived lack of demand persists, hindering further development of the concept.

Bike-Kletsen

The concept Bike-Kletsen was developed in 2022, which involved a conversation game for seniors with e-bikes. The concept aimed to stimulate discussions and raise awareness on safety topics among elderly cyclists. The project went through a pilot phase where boxes of the game were handed out. However, the results were not compelling enough to continue developing the concept

further, with no clear reason identified for its limited success.

Advocacy and lobbying

ANWB Advocacy (belangenbehartiging) monitors developments in the cycling sector and advocates for cyclists' interests where they deem necessary. This includes conducting research on safety, battery maintenance, and the overall cycling experience regarding safety. The ANWB has multiple advocate-employees focused on bicycle safety who also contribute to lobbying efforts for safer cycling infrastructure with the government.
A recent collaborative study with the Cyclists' Union, Bicycle Platform, NTFU, VVN, and SafetyNL for example revealed that cyclists perceive dike roads as unsafe. Following this, the ANWB and its partners have initiated discussions on making dike roads safer for both cyclists and pedestrians.

Canceling of the insurance on Fat-Bikes

Fat-Bikes are electric bicycles that have become increasingly common in the streets over the past two years, especially since the helmet mandate for mopeds was introduced on January 1, 2023. Many young people as a result of this mandate switched to Fat-Bikes, which has led to significant media coverage and public concern due to the bikes often being illegally modified for higher speeds, posing risks in traffic.
The ANWB offers e-bike insurance, which used to include Fat-Bikes. However, in September 2023, the ANWB discontinued insurance for Fat-Bikes due to extremely high theft rates, making it financially unviable

(ANWB, 2023). Additionally, the ANWB decided not to insure Fat-Bikes as long as the trend of illegal modifications or direct deliveries from China with pre-modified speed continues.

External projects and pilots

Social

DOORTRAPPEN

DOORTRAPPEN is a national initiative launched by the Ministry of Infrastructure and Water Management (IenW), directly targeting elderly cyclists (60+). This socially focused program has been running since 2017, aiming to keep seniors cycling safely for as long as possible, under the motto "safer cycling until you're 100." The Ministry coordinates the program, which is implemented by provinces and municipalities with support from partners like VVN, VeiligheidNL, BOVAG, and the Cyclists' Union. Currently, DOORTRAPPEN operates in 267 municipalities, each determining the activities and scale they offer.

The program aims to raise awareness about cycling safety among seniors, encouraging sustainable behavior changes by discussing the topic in familiar settings and motivating adjustments to bikes or cycling habits. Through the trusted networks of the seniors, they receive tips and guidance.
Local coalitions are formed between cycling safety, sports, welfare, healthcare, and fall prevention sectors.

Various regional and local activities are designed to raise awareness about safe cycling alternatives for seniors, including: engaging bicycle retailers, hosting bicycle and e-bike information afternoons
conducting bike checks and organizing cycling tours.
Furthermore, developed interventions include: the Choice Guide for Bikes (regular bikes, e-bikes, and tricycles), FietsFit Exercises, instructions on "Cycling Together", DOORTRAPPEN discussion cards and products for bicycle retailers and posters.

Evaluation of DOORTRAPPEN

An evaluation study indicates that DOORTRAPPEN participants are generally positive about the program, especially appreciating practical tips they can immediately apply to their bikes, which makes them feel safer in traffic. Many participants also value the social aspect, highlighting that combining content and social interaction effectively reaches and engages the target group, thereby enhancing cycling safety (Balk et al., 2022).

However, challenges are that activities are organized in a decentralized way, and regional implementers heavily rely on the support of the national program office. There is also concern that the program may not reach seniors who are hesitant to cycle, who might benefit the most from participation.

Developments at DOORTRAPPEN

Given the numerous initiatives developed by DOORTRAPPEN for elderly cyclists, a discussion was held with the project manager, Juul van Rijn, at IenW.
From this discussion, it emerged that DOORTRAPPEN is investigating and developing fall prevention materials specifically for cyclists. They are also in talks with BOVAG to explore how bicycle retailers can contribute more to cycling safety, such as providing safety tips to older customers at the point of sale. Lastly, efforts are being made to improve the measurability of the program's impact on seniors.
The ANWB's bicycle safety advocate and Juul are exploring how ANWB and DOORTRAPPEN can strengthen each other's efforts.

Campaigns

Education remains a crucial aspect of road safety. Through campaigns and informational programs, both cyclists and drivers are informed about safe traffic rules and behaviors. These awareness initiatives complement the physical measures and contribute to a culture of safety on the roads. An example of such a campaign is the Mono campaign, which promotes traveling without distractions, also emphasizing the importance of not holding or using a phone while cycling.

Rules and enforcement

Ban on tuning kits

In March 2024, a ban was implemented on speed tuning kits for electric bicycles. For electric bikes and fat bikes, the allowed pedal-assist speed is maximum 25 km/h. This is enforced through special rolling test benches that can detect if a fat bike or other electric bike has been modified to exceed this speed limit. If a tuning kit is detected, the cyclist is penalized, regardless of whether the kit was in use at the time (Fietsersbond, 2024).

Speed Pedelecs

Speed pedelecs are e-bikes that can legally exceed 25 km/h, with a maximum speed of 45 km/h. However, these bikes come with stricter regulations, including a mandatory helmet, liability insurance, a rearview mirror, and a license plate. Speed pedelecs are primarily used by commuters.

30 km/h zones

Increasingly, cities are lowering the maximum speed limit from 50 to 30 km/h, as experts believe this enhances safety. Evidence shows that traffic safety improves after implementing 30 km/h zones. Studies have recorded a reduction in traffic accidents ranging from 24 to 64 percent. Interestingly, a "spill-over" effect has been observed in multiple studies, where drivers also reduced their speed in areas surrounding the 30 km/h zones, leading to a decrease in accidents in those areas as well (Koster, 2023).

Amsterdam pilot: Speed-based road usage

In 2024, Amsterdam initiated a pilot project to enhance road safety by categorizing road use based on user speed, creating separate zones for 30 km/h and 20 km/h speeds. Cyclists traveling faster than 20 km/h are allowed to use the main roadway.

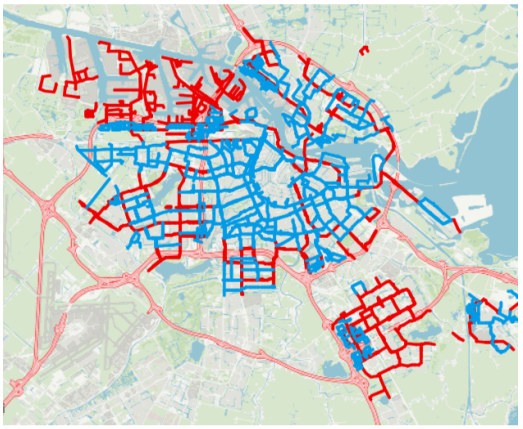


Fig: 11 & 12: Left: Amsterdam pilot of speed-based road usage (Volkskrant, 2024), Right: map of 50- (red) and 30 (blue) km/h zones (Haarman, 2023)

Infrastructure

Significant positive developments have occurred due to the investment impulse, aligning with the Strategic Plan for Traffic Safety's goal to adopt risk-based traffic policies. This approach focuses on road features, conditions and behaviors that can increase the likelihood of hazardous traffic situations. As discussed in 'Current state of knowledge', more data is being mapped to achieve this. Using sensors and cameras to monitor traffic flows and detect potential hazards has become outdated, according to data expert Menno Mimpen. Now, algorithms are being developed to label street features for safety risks, which can be applied more effectively and efficiently across various locations.

Fast cycling routes

The concept of fast cycling routes, known as "doorfietsroutes" or "snelfietsroutes," aims to provide high-quality, direct, and safe paths for long-distance commuting cyclists. These routes encourage cycling as a viable alternative to car travel by offering:

- **Direct and continuous paths**: Minimizing stops and detours for a straight, uninterrupted ride.
- **High-Quality infrastructure**: Featuring smooth surfaces, wide lanes, and safe crossings for a comfortable and efficient journey.
- **Safety measures**: Including clear signage, lighting, and separation from motor traffic to enhance cyclist safety.
- **Integration with public transport**: Designed to connect seamlessly with public transport hubs for multimodal travel.

The Dutch government plans to expand the network further, with additional routes and ongoing infrastructure improvements.

Fig. 13: Fast cycling route (Geerts, 2022)

Safe infrastructure

Improvements from the investment impulse include enhanced road markings and the development of forgiving infrastructure. The latter ensures that minor mistakes by road users do not lead to severe accidents. Key elements include wider bike lanes separated from motor traffic, flattened curbs, and

removal and replacement of obstacles such as lampposts and traffic signs, replaced at safe distances to prevent severe injuries. markings and speed bumps are used to nudge road users into more considerate behavior and slower speeds. Municipalities follow CROW guidelines and experiment with innovative ideas for marking.

Advanced Technology

Technological solutions are employed to improve safety. Smart traffic lights for example respond to approaching cyclists, ensuring a smoother and safer flow of bicycle traffic. Additionally, simulations and innovative research methods are encouraged (IenW, 2022). A cycling simulator project, funded by the province of Friesland and a collaboration between the University of Groningen (RUG) and Delft University of Technology (TU Delft), is active. Moreover, cycling as a mode of transport is gaining increasing attention from academics and governments worldwide.

2.4 Trends

Trends analysis is performed as it provides valuable insights into shifting dynamics, emerging technologies, and changing behaviors that shape the context within which the project operates. By exploring trends, a deeper understanding of societal attitudes, preferences, and needs can be gained. Furthermore, it enables anticipation of future challenges and opportunities.
Incorporating trends research into the design process allows us to stay ahead of the curve, identifying emerging patterns and potential disruptions that may impact our approach.

Trend analysis

The following overarching trends are found, which will be discussed with its sub-trends:
The increasing role of (electric) bicycles in the Netherlands, The healthy and green city, Transportation driven by smart technology, Changing risk factors.

The increasing role of (electric) bicycles in the Netherlands

E-Bike popularity across all ages

The e-bike is experiencing a surge in popularity not only among older adults but across all age groups. Electric cargo bikes and fat-bikes, both forms of e-bikes, have also become common.
For young people living in rural areas, the fatbike or e-bike is a popular means of transportation for covering greater distances.
The migration from the Randstad area is increasing due to the housing shortage, with many people in their 30s moving out of the city and settling in rural areas (CBS, 2022). For them, the e-bike is an attractive option for bridging the distances between amenities and the city. Contrarily, people in their 60s tend to move less. This seems mainly because they are attached to their current living environment and proximity to family and friends (Kooiman, 2020).

Bicycle commuters: using the pedelec to work via fast cycling routes

The number of employers (with 100+ employees) offering purchase subsidies for (e-)bikes is increasing (de Haas & Kolkowski, 2023). Additionally, the per-kilometer reimbursement is also rising to encourage bike use (Klein, 2023). Employees are often purchasing speed-pedelecs. The network of fast cycling routes are continuously being expanded to support bicycle commuting.

Greater variety on bike paths: increased differences in mass and speed

Bike paths are witnessing a growing variety of vehicles. Traditional bicycles now share space with a wide range of e-bikes, cargo bikes, speed pedelecs, and electric scooters. The differences in speed and weight among these vehicles can lead to safety concerns, prompting new questions about bike path design and regulation to ensure safe and efficient use for all.

Bicycle vacations in the Netherlands: a growing market

Since the COVID-19 pandemic, there has been an increased awareness of recreational and vacation opportunities within the country. Bicycle vacations and multiple day trips have gained popularity among all age groups. Recreational cyclists continue to use junction routes, with 58% of Dutch people who occasionally go on day cycling trips utilizing these routes as of 2021. During a bicycle vacation from a fixed location, this figure rises to 79%. Long-distance cyclists often use special long-distance bicycle routes (LF-routes).

The healthy and green city

To achieve sustainability goals, efforts are being made at the European level to create healthy and green cities. This involves several trends.

Integration of mobility as a service: shared transportation systems

A service to make mobility more sustainable is the development of mobility as a service

(MaaS), which moves us towards a sharing economy. MaaS will facilitate the use of shared transportation by offering all public and shared transport options on one platform. This will also involve the establishment of more shared-mobility hubs, which are points in the city where various modes of transport are made available. Users can combine personal transportation with public transport or getting a shared vehicle from a mobility hub. Recently, several companies have started offering electric bikes, including cargo and freight bikes, as shared or rental bikes (examples: Cargoroo, Baqme, Swapfiets).
In developing MaaS, inclusive mobility is an important factor, such as affordability and connecting rural areas.

MaaS can enhance traffic safety in the Netherlands by fostering a more balanced and efficient transportation system. By reducing the number of personal vehicles, optimizing travel routes, promoting safe driving behaviors, and encouraging the use of safer modes of transport, MaaS has the potential to make Dutch roads safer for all users.
At Intertraffic 2024, a morning session was dedicated to the topic with politicians and experts: working towards future-proof mobility in the Netherlands. It was discussed that we should encourage travel at different times to work and educational institutions to reduce traffic jams and crowded trains.

More priority for active transportation: cyclists and pedestrians

Cars are increasingly being discouraged in cities by reducing parking spaces and creating green zones. Additionally, the design of our cities, municipalities, and roads is being revised to shift the former priority from cars to active mobility, namely cyclists and pedestrians. A favored approach in this is the 'repurposing' of streets. Mobility consultancy Goudappel visualizes this prioritization with the STOMP principle (see Fig. 14).

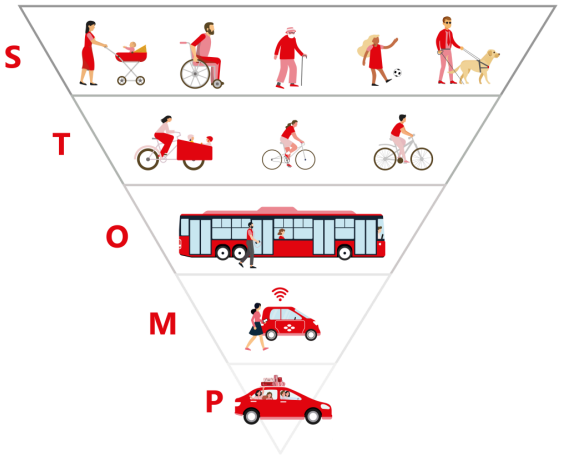


Fig. 14: Visualization of the reprioritization model (Goudappel, n.d.)

For e-bikes, more stations will be established to charge batteries in lockers and bike parking spots will be equipped to allow e-bikes to be parked with double locks.

Air mobility with drones, the third dimension of mobility, is also becoming an increasingly real future. Drones would be used for package delivery and health services (Intertraffic, 2024).

Double aging: more attention to staying fit, independent, and social

In the coming decade, the Dutch population will continue to age. By 2040, one in four people will be 65-plus and one in twelve will be 80-plus (VWS, 2021). In the past 40 years, we have increasingly lived independently, and the number of relatively healthy years of life has increased (VWS, 2020). Exercise classes and initiatives for the elderly are popular. Additionally, health compensations and health tracking devices provide the possibility to remain independent for longer.

Transportation driven by smart technology

Driver assistance systems in both cars and electric bikes

Support systems are now standard in new cars, and the capabilities are growing. Smart car systems support the driver's tasks and can

recognize and prevent unsafe situations. According to a discussion with the ANWB's technical bike expert, similar systems are also being developed for electric bikes, with variants of the smart electric bike coming to market. One example is ABS, which keeps the handlebar straight if you're about to fall, and existing software that adjusts the tires for the right grip on the road surface.

Data-driven approach to improving traffic safety

Modern cars, sometimes referred to as 'data centers on wheels', collect all data from ADAS sensors. Navigation systems will also become increasingly accurate.

Data exchange between devices allows for more personalized products and services

The exchange of data between devices is referred to as the Internet of Things (IoT). By collecting and analyzing data from these interconnected devices, companies can tailor their products and services to meet individual needs and preferences, enhancing user experience and efficiency.

Changing risk factors

Improvements in e-bikes

New battery technologies, such as lithium-ion batteries, make batteries lighter, able to store more energy, and have a longer lifespan (Fietsersbond, n.d.). Improvements in batteries and motors enhance stability while cycling. Additionally, higher-end e-bikes have systems that prevent the user from suddenly lurching forward from a standstill (Bovag, n.d.). Other features include setting a preferred speed and a display that indicates when maintenance is needed.

Normalizing helmet use

More and more elderly people and children are wearing helmets. There are helmets on the market that have a trendy appearance. As the number of users grows, the social norm shifts, normalizing helmet use. The change in norms regarding ski helmets suggests similar patterns may occur in cycling.

Increased risks in traffic due to demographic developments

As mentioned earlier, there is an increased heterogeneity of vehicles and a larger number of risk groups due to demographic developments, which raises the chances of accidents. Young people are increasingly involved in cycling accidents or creating more unsafe situations (VeiligheidNL, 2024).

Extreme weather conditions

Due to climate change, we see an increase in extreme and fluctuating weather conditions. This also has a notable impact on mobility safety and behavior. These conditions can lead to increased road surface wear and a higher likelihood of accidents. Additionally, extreme weather may disrupt public transportation services, forcing more people to rely on less safe modes of travel. As a result, there is a growing need for adaptive infrastructure and navigation.

Smart systems paired with increased distractions

Cars are becoming safer for occupants, but not always for other road users. With more digital stimuli and increased automation of systems, there is a negative side effect of distraction or inattention. Cyclists and motorists in the Netherlands, for example, are increasingly gaming and attending meetings while on the move (Kint & Mons, 2023).

03 UNDERSTANDING THE TARGET GROUP

The project aims to have a human-centered design, which means aligning with the target group. Empathetic understanding enables the creation of solutions that resonate with users on a deeper level, leading to greater acceptance and adoption. It is important to understand the real problem, underlying issues, and associated factors. This chapter highlights the target group, complementing existing knowledge with original research on the use of e-bikes and accident circumstances involving e-bikes.

03 Understanding the target group

3.1 Description of the target group

The target group for this graduation project is individuals over 60 years old who use e-bikes. Most e-bike owners have a moderate to high income, with no significant gender distinction in e-bike ownership (E-Bike Monitor, 2024).

For the elderly, the e-bike is more than just a means of transportation; it evokes positive associations of freedom, enjoyment, fond memories, exercise, and togetherness (Jansen & Stienstra, 2019). In Chapter 2.2 the barriers of aging that influence accidents are described as derived from literature research. Research has also been previously conducted on the behavior and safety perception of older cyclists, which will now be discussed.

Safety perception and behavior of older cyclists

Cyclists aged 66 and older take more measures to ensure safe cycling. They take more time (77%), avoid busy routes (18%) and peak times (16%). They also use more bicycle accessories like bells (58%), mirrors (25%), and helmets (16%), and they maintain their bikes more often (80%). However, many researchers note that older individuals often overestimate their own capabilities, making it difficult to recognize their own vulnerability in time. Accidents are often seen as bad luck (Jansen & Stienstra, 2019). Many elderly individuals are aware that there will come a time when driving or cycling is no longer possible, but they do not prepare well for this (Roest & Stavenuiter, 2017).

In 2021, the ANWB requested the market research bureau Blauw Research to create a report on elderly individuals using e-bikes. Previously, the ANWB had identified four groups of elderly e-bike users: the unaware, the avoider, the safety seeker, and the confident. The aim of Blauw Research was to provide a clearer image of these groups. Their report shows differences in profiles, perceptions of own abilities, vulnerability, and avoidance behavior, as well as the purpose for which they use the e-bike and the time of year they use it. Moreover, the research supports the division into these four groups (see Fig. 15).
The research estimates the following sizes of the groups within the target group: 32% unaware, 7% avoiders, 37% safety seekers, and 24% confident.

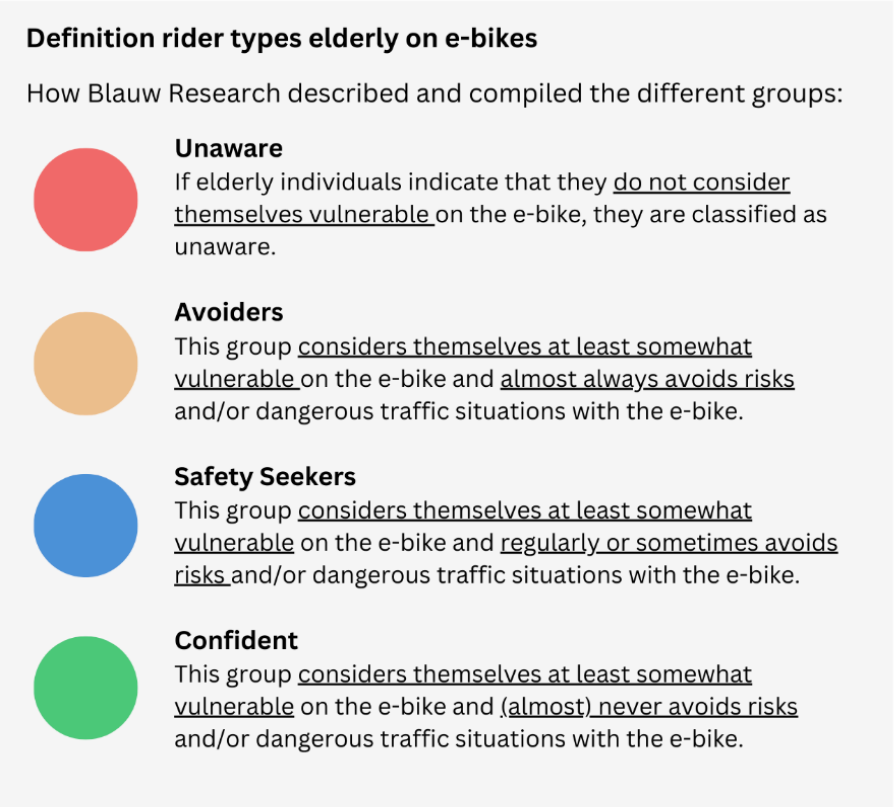


Fig. 15: (Blauw Research, 2021)

Designing for the elderly

When designing and communicating for older adults, it is important to realize that they do not want to be stigmatized. This point emerged in several conversations with experts, including M. Hagezieker. There are significant differences in fitness and limitations among the elderly. It is also important to acknowledge that older adults have more difficulty learning new things, as pointed out by a traffic psychologist from Goudappel (presentation at NVVC 2024).

3.2 Target group research

Research method

Global set up of research design

Qualitative research is performed to gain in-depth understanding of accident contexts of elderly on (e-)bikes, e-bike use and the attitude of the target group towards road safety with the e-bike.
The analysis of the current knowledge raised the following questions to explore further in target group research:

1. What are the circumstances and factors in detail of (e-) bike accidents by elderly aged 60+? Which factors seem to be most recurring?
2. How is the e-bike used from grabbing the e-bike to the last actions related to it? What are underlying needs and values?
3. What are the differences in attitude and behavior in using the e-bike and road safety between the different rider types?
4. What are the attitudes of the target group towards (road) safety related to their e-bike use?
5. Does the target group perceive a difference in safety between e-bikes and conventional bikes?
6. Does the e-bike create more risk on itself looking at vehicle factors?

The research is performed through two primary methods, namely by a qualitative survey and by semi-structured interviews. Research questions 1, 4, 5 and 6 are addressed in both methods. The interview is more specifically used to answer research questions 2 and 3, mapping the use journey of the e-bike, as it gives the opportunity to be in dialogue with the participant and to gather implicit and tacit knowledge. The results of the interviews aim to provide an expansion of insights at the level of the rider types. Blue Research, apart from the factor of risk avoidance, did not examine usage behavior in detail.

The survey is aimed to give a more comprehensive and reliable view on research questions 1 and 4, focussing on accident circumstances, and being able to gain a higher number of respondents.
The interviews were conducted with the target group, including respondents who had had an accident as well as those who didn't. The survey, focussing on accidents, gathered information from only the target group who had had an accident.

By applying two methods, the research seeks to provide a comprehensive understanding of the factors influencing the safety and behavior of elderly e-bike riders. The survey data offers a broad overview with qualitative depth, while the semi-structured interviews provide detailed context, allowing for a nuanced analysis of the issues at hand.

Semi-structured interviews

Semi-structured interviews were conducted with 12 participants using an interview guide. This method allows for the flexibility to elaborate on useful insights, while maintaining intended focus points. The interview was built up in a way to get the respondent sentized and with that to get to more tacit knowledge. The interview consisted of four stages after the introduction. The first three stages were used to map the user journey and gather insights on the use of the e-bike. As the target group uses the e-bike for practical and recreational purposes, the aim was to use the interviews to create a user journey for both. In each interview one type of journey was mapped out elaborately, based on

what type (practical or recreational) the participant does most. If there would not be a big difference in frequency, the ride to elaborate on further was chosen on what type was experienced as more riskful. With the type of ride chosen, the interview went into the first stage.

The first stage is performed in a way to bring the participant into the experience world of the ride. Instead of already asking detailed questions about the journey, the participant is asked to explain what their last or typical journey looked like from preparation of the ride to arriving home again. While the participant is talking, the rough outline of the journey is already noted down on paper or on a digital whiteboard (depending on whether the interview is in person or digital).
Second, the ride is mapped out in detail, by asking the respondent questions for each part of the journey from start to finish. This serves to bring up the information that they did not provide or think of during the first instance themselves. When the main journey is mapped out and there are no more comments on it, we move to stage three or four. In case the respondent uses the e-bike both recreational and practical, the previously non-addressed ride of the two is shortly looked at. The respondent is asked if they do or experience things differently during this other type of ride. During the fourth stage we zoom out from the user journey, where general questions are asked about how safety related to riding the e-bike is experienced and to discuss pains and gains. As they have envisioned the rides they make before, they are more likely to be able to formulate true personal opinions, feelings, needs and values.
After the interview, the respondent is asked to fill in background questions. This is done at last, rather than at the start, as respondents can feel judged by or uncomfortable with these questions if asked for before.
As to give insight into the differences in actions and perceptions of different rider types, the rider type of each participant is identified during the analysis.

Sampling

Purposeful sampling was used to identify and select individuals for the study. The time scope of the project allowed for a maximum of 12 participants. With the target group being a big group age-wise, a deliberate spread was sought for in age selection. For each age category, at least one participant was sought for (see Fig. 16). In age categories 70-74 and and 75-79, more participants were sought for, as the risk of an accident grows with age. The age group of 70-74 seems to make the most kilometers, as it is popular in this age group to use the e-bike for recreational purposes after they are retired. From this age group on, the number exponentially decreases.
An equal distribution was aimed for the demographic of gender, which resulted in five females and six males.
Participants were gathered through personal connections who linked their parents or grandparents to the research. This enabled differences in background of participants, including place of residence, and what the participants use the e-bike for. The participants were linked as regular e-bike users. From this group, individuals were purposefully selected to create a representative group on age with a spread across residence area and gender. To account for geographical differences that might influence cycling behavior and accident contexts, participants were drawn from a mix of urban, suburban, and rural areas.
In total three times a couple was selected to participate as to provide for more information at once, these are analyzed as separate participants.
Regarding rider type, no purposeful sampling is applied. After each interview the participant would be categorized into a rider type. If a rider type would be missing towards the last interviews, purposeful sampling on this aspect would be considered still for the last participants. However, this was not necessary.
Participants were informed with minimal information about the research, as to avoid bias or steered responses.

Age category	**# Participants**
60 - 64	1
65 - 69	1
70 - 74	4
75 - 79	5
80 +	1

Total:	*12*

Fig. 16: Participant age distribution

Data collection

Half of the interviews were conducted in physical presence at the ANWB office and the other half were conducted digitally through Teams. A preference went to physical interviews, however in the case of the digital interviews, the participants were not able to come to the ANWB and the time due to time restrictions it was not possible to visit those participants.

Individual interviews lasted roughly 45 minutes. Interviews with couples (3x) lasted roughly 1h and 15 minutes. The input was manually recorded during the interviews by note-taking. A template was used to ensure orderly note-taking, facilitating the analysis stage, and to enable creating the participant's user journey(s), see Appendix D.3 for the blank template (digital and physical) and an example of a filled-in template.

The participant was invited to watch the note-taking as the user journey was being compiled and discussed, to have a visual reminder of the journey and to help give a structure to their thoughts, since the discussed journeys were elaborate. All interviews were sound recorded and transcribed to read back missed comments and to collect quotes.

Interview questions were developed based on the research questions. The questions were open-ended and allowed participants to share their experiences, thoughts, and feelings related to e-bike use and safety. Attention was paid not to influence participants in their answers.

Data analysis

Creating insightful user journeys

One of the intended outcomes of the interviews is to create user journeys that can provide valuable insights on the level of the different rider types. These journeys will represent two types of rides: the recreational ride and the practical ride.

First, participants are categorized into rider types. This classification is based on the overall responses of each participant, matching them to the definition of the rider types as formulated by Blauw Research.

Next, the individual journeys are compared, divided into the recreational and practical journeys. Based on identified patterns, a representative journey is created for all participants. This journey highlights overlaps and differences at the level of rider types, ensuring that unique characteristics and commonalities are both captured.

General insights

The individual remarks are collected on separate post-its and put in the digital workspace. Afterwards these are categorized on subject, enabling the search for patterns and exploring themes. This method resembles a thematic analysis, however includes a more flexible form of coding.

Data from the survey and the semi-structured interviews are integrated to triangulate findings and enhance the validity of the results. Comparative analysis was conducted to explore similarities and differences between the survey responses and the in-depth interview data. This helped to contextualize the findings and provide deeper insights.

Qualitative survey

A qualitative survey was set out with the aim of getting a more comprehensive understanding of accident circumstances. For more reliable results, a quantitative survey would be a valuable addition to the qualitative results, however looking at the time scope of the project, this would be infeasible.

The set-up of the survey is designed to build up the full image of factors that played a role in the accident, starting with a description of the accident by the respondent and asking about various factors afterwards. It also aims to show the attitude toward safety before and after the accident, through a variety of questions, see Appendix E.1.

Sampling

Random sampling was applied among the target group who have had an accident with the conventional or e-bike. The survey was distributed through the ANWB member panel, which in 2022 had 17,546 participants frequently consulted via online questionnaires and interviews. To mitigate potential biases from regular panel respondents, the survey was also shared through personal connections. The goal was to gather approximately 50 responses to ensure a representative sample while maintaining the ability to analyze open-ended responses effectively.

In total, 57 respondents participated: 27 had accidents with conventional bikes, and 30 with e-bikes. Of these, 45 responses came from the panel, and 12 from personal connections.

Data collection

The survey was composed in Enalyzer, the research tool used by the ANWB.
It was open for both e-bike riders and conventional bike riders, with additional questions for those on e-bikes. In case it could be assumed from the survey and interview results that the target group (e-bike riders of 60+ years old) does not experience a difference in safety between using the e-bike and a conventional bike, the data from conventional bike accidents could also be utilized.

The survey focused on one accident per respondent. If respondents had experienced multiple accidents, they were asked to choose one, likely the most memorable or impactful (on the level of injury, impression or damage). This approach facilitated detailed responses while ensuring respondents remained focused and willing to participate regarding the time frame.

Only background questions were closed-ended. All other questions were either open-ended or multiple-choice with an option for open responses. This format allowed for triangulation of responses within participants and enabled more reliable comparisons between participants.

Data analysis

The Enalyzer results were exported to Excel. Responses were analyzed by clustering answers in various ways per question.
88% of accidents on the e-bike were perceived by the respondents to have happened regardless of riding on an e-bike or on a conventional bike. Also, the majority of the e-bike accident descriptions (28/30) did not show aspects that were typical for the e-bike. Therefore the results of all accident cases are compiled.

Ethical considerations

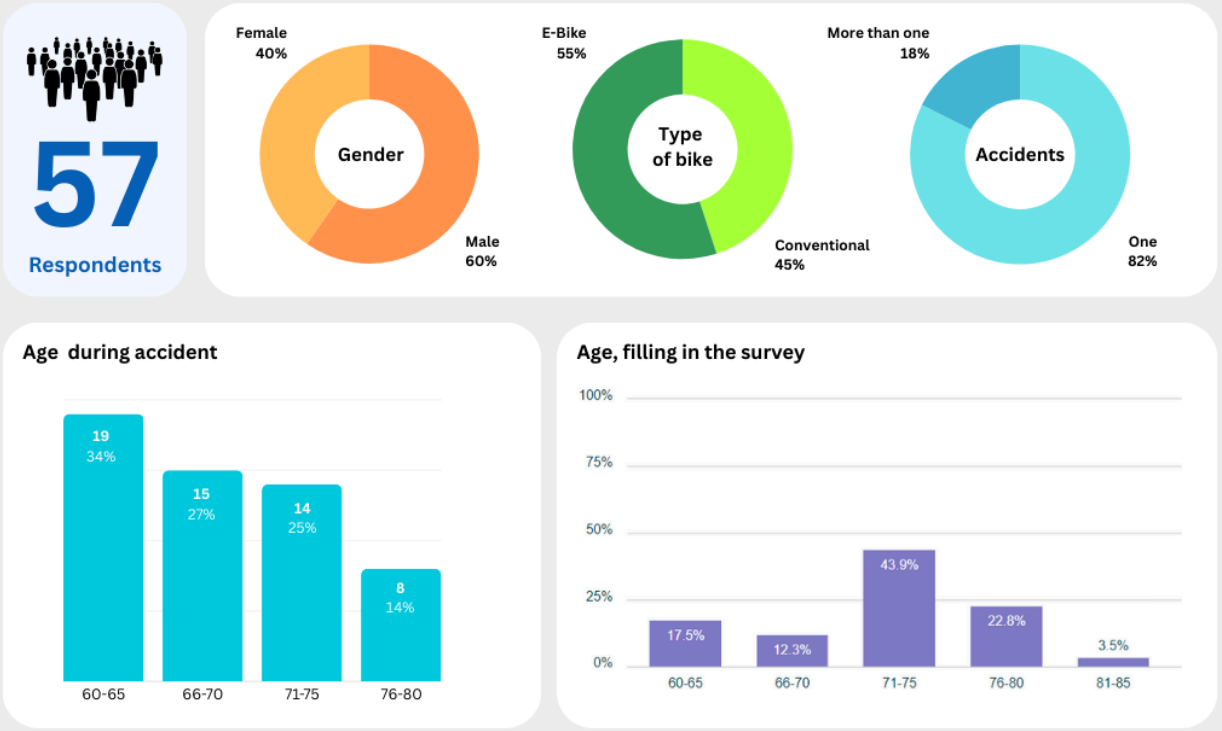
Ethical Considerations Consent was obtained from all participants prior to the interview, see consent form in Appendix D.1. Furthermore, participants were informed of their right to withdraw from the study at any time and their confidentiality was maintained throughout the study.

Analysis

The discussion based on the data analysis follows on page 45.

Survey results

Profile of respondents



Count of exact age during the accident is shown in Appendix D.

Results

Number of accidents

Almost 20% of the respondents have experienced multiple accidents since the age of 60.

Type of e-bike used during the accident

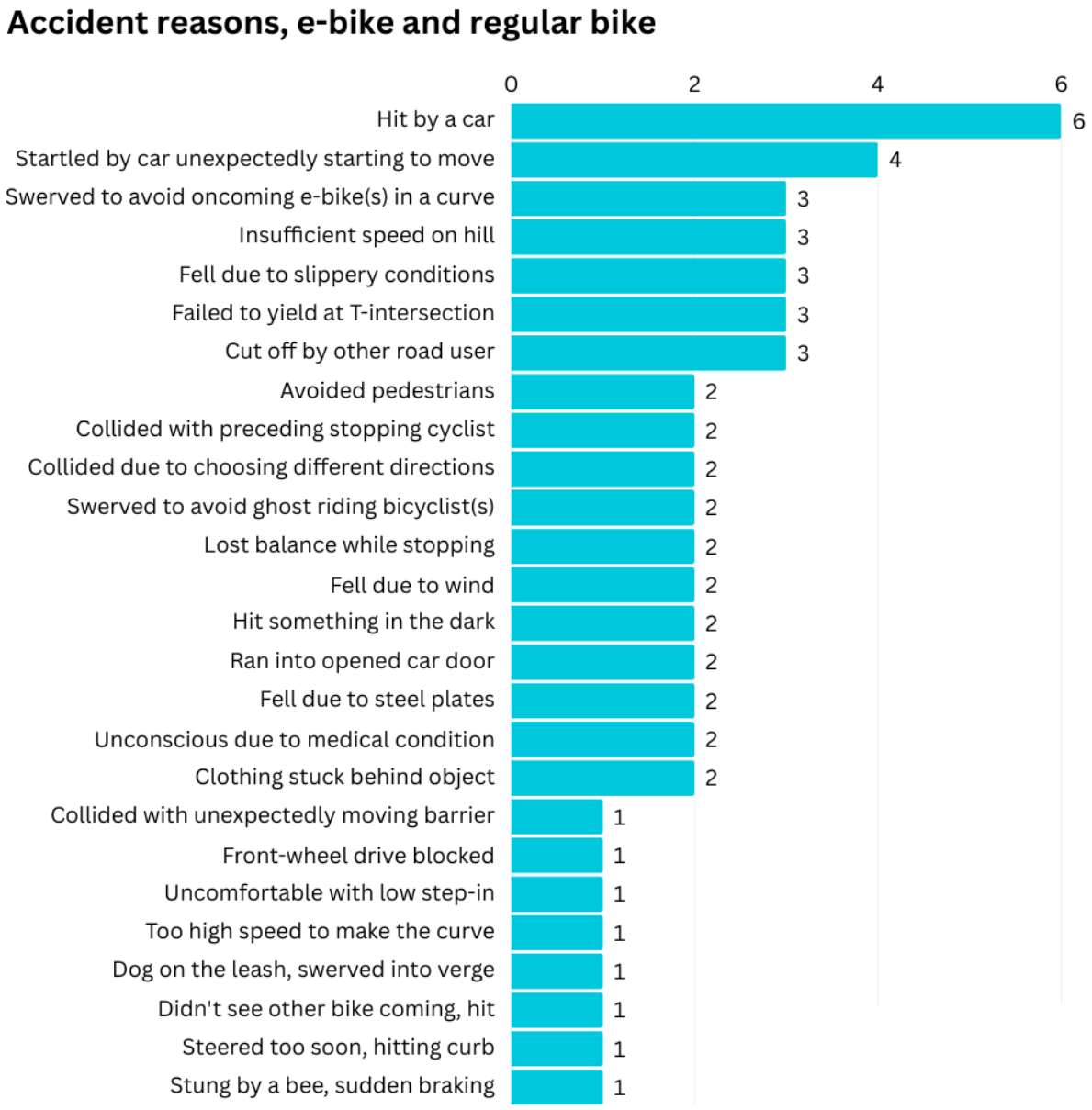
Even though the front wheel motor is known to be more risky, 1/3th of e-bike users had this type of e-bike.
Almost 1/3th (30.3%) had an e-bike with a low frame, enabling safer boarding of the bike.

Experience with e-bike before the accident

Two respondents out of 30 had the e-bike new, owning it less than two months. Four of the respondents had the e-bike in between half a year and a year. The majority, namely 81.8% had the e-bike for more than a year when the accident happened.

Analysis of accident descriptions

Descriptions from e-bike and conventional bikes are compiled.
Graph 1 shows the results of the accident descriptions regarding accident reasons. 56/57 reasons are presented, since one description by a respondent was not clear.



Graph 1: Accident reasons

Inattentiveness or misjudgment by other road users, leading to unexpected movements by other road users, pedestrians, motorists and fellow cyclists, is frequently mentioned as a cause of the accidents (10 times).

Six times a car hit the bicyclist. Five out of those times a car seemed to not have seen the bike, while they should have given the bicyclist priority. The sixth accident, the car passed too closely, hitting the bicyclist with its rearview mirror.

Four times the situation is described of a car starting to move when not expected, resulting in a bicycling maneuver that led up to a fall. Twice this included a car who was trying to park, twice it involved a car that the biker thought to have stopped for them to give them priority.

In total eight times the biker fell as a result of **trying to dodge** another moving person or vehicle, avoiding a collision. Four of these cases, they hit the curb (Dutch: stoeprand) or rode into the ditch or roadside.

Sudden braking as a reaction to another moving person or vehicle, caused a fall five

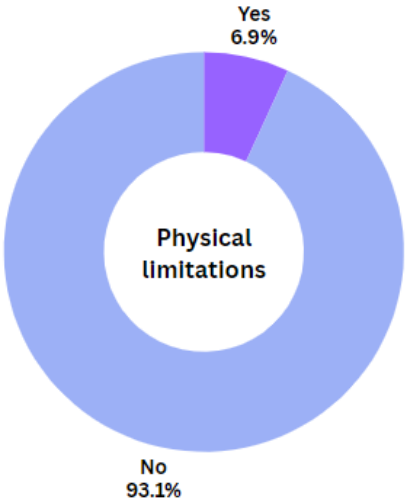
times in total.

'The behavior of others' was chosen 29 times in the multiple choice question that followed the open description, asking to categorize the influencing factors. This means it was seen as a factor in 43.3% of all accidents reported.

Weather conditions were the main cause in seven instances, attributed to strong winds and slippery roads due to wetness. Additionally, rain was cited as a contributing factor in 4 more accidents.
Relatively high-speed riding was cited as a contributing factor in 3 accidents.

Accidents type: 16 two-sided and 41 one-sided.

Physical limitations



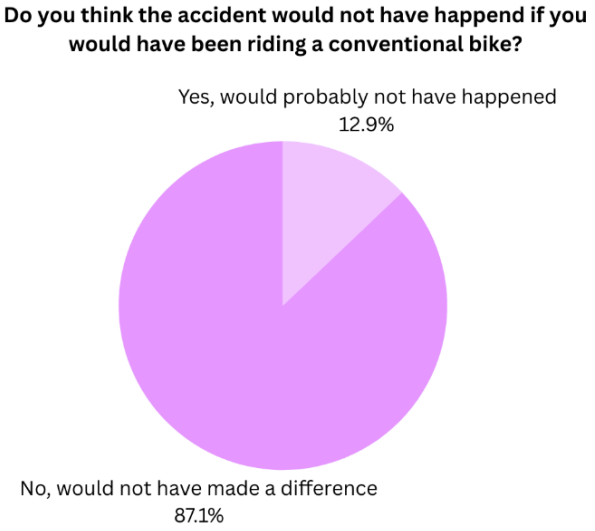
Graph 2: Physical limitations

The following physical limitations were mentioned by the respondents at the multiple choice question "Did you have any physical limitations that could have been of influence to the accident?":

- Left hand that did not function properly for handbrakes
- Weak left elbow
- Balance problems, due to diabetes

The respondent who had described their accident being caused by his cardiac arrhythmia in the open question prior, filled in 'no' in this multiple choice question. This could imply he does not recognize it as a physical limitation or that he put it down to his behavior of hurrying that caused his heart to dysfunction (even though aware of his heart condition), which he described as the cause.

Influence of e-bike



Graph 3: Vehicle factor relevance

The respondents who had had an accident with the e-bike were asked the question: "Do you think the accident would not have happened if you would have been riding a conventional bike?"

Out of the four respondents who replied yes, two of the accident description had made clear why:

- Uncomfortability with low entry model (Dutch: lage instap)
- Front wheel drive that locked while biking

Safety behaviour

Accessories for the bike at the time of the accident:

- 19% had a bicycle mirror
- 17.2% was wearing a helmet
- 74.1% did not have an accessory related to safety

Influence of the accident

Graph 4: Influence of the accident

The respondents were asked: “Have you started doing things differently since the accident? Consider purchasing aids, looking up instructions, adjusting driving behavior, avoiding situations, physical exercises, etc.”

The 55% of respondents who reacted ‘yes’ also were to tell what they changed. This resulted in the following categories of answers (percentage given out of total number of respondents):

- 17% (10x) purchased new materials, of which 7x a helmet
- 26% (15x) became more anticipatory or careful, of which 3x slowing down on speed was specifically mentioned
- 1x stopped biking

Semi-structured interview results

Themes

This section presents the thematic analysis of the qualitative interviews conducted. Quotes are included, which are translations from Dutch, see Appendix J.1 for the original quotes.
The following format is used to document the theme field, theme and subthemes;

#. Theme field
- Theme
    - Subtheme
      Description or elaboration

1. Equipment use

- **Using technology for navigation**
  Navigation is used in case of riding a new route or going on a recreational ride.

    - Eropuit and Fietsknoop apps are primarily used for planning and executing recreational routes
      Multiple participants described first going to the website of the ANWB or Fietsknoop on their phone or computer to plan the route, after which they save the route to their account and open it on the app. Strong positive feedback on node routes (fietsknooppunten) and the related apps was given.

      "Finding your way on a Node route -ride always goes well, it is so easy!"

    - Phone mounted on handlebars on phone holder showing the map and route, well-charged or connected to battery of the bike

    - Pleasant to use voice assistance for navigation, on loudspeaker
      In the case of riding a node route recreationally, two participants mentioned that they appreciate that the voice assistance only speaks when they seem to have missed a node.
      The voice assistance is perceived as desirable, since it enables them to not actually have to look at the digital map while cycling.

- **Putting care into their equipment**
    - Recreational cyclists are well-prepared
      Participants who use the e-bike for recreation regularly, learn from their experiences how they want to prepare themselves for a trip. Side-bags enable them to bring all the equipment they need. Participants are used to checking the battery life of the accu, having it charged full for their rides. Lastly, the participants all bring their e-bike to their retailer once in a while for maintenance.

    - Desire for more bicycle racks that facilitate securely locking the bike
      E-bikes are expensive and are only insured for theft if locked with a double lock.

2. Active cyclists

- **Integration of cycling into active lifestyles**
    - Preference for cycling over car usage
      Participants express enjoying the freedom of not having to drive. In case a distance is doable with their e-bike they will choose this over the car. It gives them a more active, healthy feeling and they enjoy the ride and being outside. They thus use the e-bike often.

"The e-bike, what an invention!"

- Regular cycling combined with other sports or physical activities
  Multiple participants pay attention to their physical health, trying to stay fit.

- Good-weather cyclists who only ride with decent weather conditions
  Participants do not always look up the weather before grabbing the bike for a practical ride. However, when it is already raining, the majority will use the car (all but one).
  Recreational rides are mostly performed in the months and days with sunny weather.

- **Cycling an activity for retired couples**
  - Retired couples take up the hobby of recreational cycling with the e-bike together

- **Adapting to the e-bike experienced as intuitive**
  - Minimal search for instructions
    Using the e-bike is experienced as intuitive from the start, where the majority of the participants described needing little instructions when purchasing the bike. Familiarity with gear shifting from conventional bikes was mentioned as helpful. All participants used high-end (quality) e-bikes, which creates a smoother transition when getting used to an e-bike than low-quality e-bikes. Male participants who were used to having a bar between the legs on their prior conventional bikes, had to get used to mounting their e-bike differently, without a bar.

    "Why would I need instructions? I've always ridden a bike!"

3. Sense of Safety

- **Enhanced safety perceived due to e-bike**
  - E-bikes are seen as safer than conventional bikes due to pedal assistance and higher quality of brakes, tyres and lighting
    The pedal assistance especially is mentioned as creating a safer riding experience, as it keeps them moving in case of an uphill climb and wind. Assisted starts (riding from standing still) especially help elderly who start to feel less balance and power.
    Moreover, changing to an e-bike, the target group usually upgrades in terms of the quality of their bike, enhancing safety.

    "Every time there's wind, I'm grateful for having the e-bike!"

- **Knowing routes by heart**
  - Familiarity with local routes and awareness of potential hazards
    The elderly know the surroundings of where they live well. Their daily practical rides they know by heart and for specific locations they only use navigation for the last part. The benefit is mentioned knowing the locations where they have to pay more attention.

- **Resilient attitude despite accidents**
  - Positive view on using the e-bike and safety despite having had an accident
    All participants that had experienced one or more accidents, retained a positive attitude towards the e-bike. They seemed to see accidents as situational rather than indicative of overall danger. A 79-year-old participant had fallen twice in the past ten years, but still does not wear a helmet.

    "*Maybe if I fall again, I'll buy a helmet.*"

  - Considering additional safety measures, like mirrors, when physical limitations become apparent
    Before physical limitations are noticed to form a risk, safety measures are not applied.
    Only two of the participants used a bicycle mirror, of which one had very limited eye-sight on one side. Both expressed to really benefit from it. *"Such a bicycle mirror is truly amazing"*.
    Helmets are often only purchased after experiencing a serious accident or having heard of one happening to a close acquaintance.

"Someone in my circle of acquaintances had a serious fall... then it hits close to home."
"I'll know when it's necessary to get a mirror."
"I have the intention, but I still actually have to buy the helmet."

4. Cycling behavior related to safety

- **Anticipatory riding style**
  - Paying attention in traffic and trying to anticipate the movements of other road users
    All participants above 70 seemed to not take unnecessary risks. They were confident about their ability to safely participate in traffic, where a life-long driving experience with the car as well is mentioned as aiding in anticipating traffic movements.

    "Having driven a car my whole life, I can anticipate better."

  - Dismounting to use the phone
    If they get a call while on their bike or want to check the route, they stop and get off the bike. If there is no suitable place to get off, they wait till there is.

- **Cycling despite physical limitations**
  - Continuing to ride despite issues like poor vision, hearing, or arthritis, using compensatory aids and accessories
    One of the participants had lost vision in one eye, but kept cycling because the bicycle mirror compensated somewhat for this limitation. Another participant described having less strength and balance, which makes it hard for her to stop, get off the bike, and to mount and start up again. For this reason she often rides through the red light, to avoid having to stop.

  - No major issues with lifting or handling the bike, except for significantly older users with less strength
    Only one participant experienced the heavier weight of the e-bike as an issue.

- **Relaxed cycling with relatively slow speed**
  - More leisurely pace when cycling together and a bit faster when alone (3)

  - Transition from hurried to more relaxed cycling when retired
    The retired participants often ride at a relaxed pace using eco-mode. Also the practical rides they regard as a recreational activity they want to enjoy. Moreover, they view being in a hurry as more riskful. The only participant who seemed to still ride like a 'young' cyclist, e.g. usually not stopping for something but trying to keep moving, was the fit 69 year old.

    "I often ride calmly in eco-mode, and if there's wind, then in a higher one."
    "Before this, I cycled at the same speed; I don't go faster on the e-bike."

5. Risk perception

- **Not taking each other into account**
  - Behavior school children and youngsters perceived as challenging and unsafe
    Several points were mentioned that make the riding experience less pleasant for the participants when they encounter young people on bicycles, namely: school children riding side-by-side in bigger groups, riding too quick and careless on fat bikes, riding against traffic, or being distracted by phones (using the phone while cycling).
    Furthermore, two participants mentioned that they feel like other road participants are impatient with them, which can lead to behavior like cutting them off.

    "It feels like other road users stigmatize elderly and easily become impatient; cutting you off

or a car honking at you."

- Cyclists (wielrenners), e-bikes and scooters passing without signaling is perceived as bothersome and unsafe

  "Speed differences in traffic are the biggest safety concern."

- **Challenges of narrow paths and roads without bike lanes**
  - Single-file riding when together perceived as challenging
    When riding behind each other, especially without having a mirror, communication becomes more difficult. The front rider looks over their shoulder and the behind rider has to anticipate unexpected movements of the rider ahead.

  - Possibility of ending up in the ditch if making a wrong movement
    These types of roads elevate the tension felt when road users try to overtake each other. They also feel less comfortable with cars passing alongside them.

    "Paths are still designed with regular bikes in mind."

- **Rarely crowded paths outside urban areas**
  - Positive experience of riding on bike lines outside the built-up area
    Retirees have more freedom to choose at what time and day they use the bike, which leads to for example not only going on a recreational ride on the weekend, but spread out. Other e-bikers on these paths are not a point of annoyance, runner-cyclists can be.

    "*At the Veluwe it can be busy in the weekend, but there is enough places where it is quiet.*"

User Journey

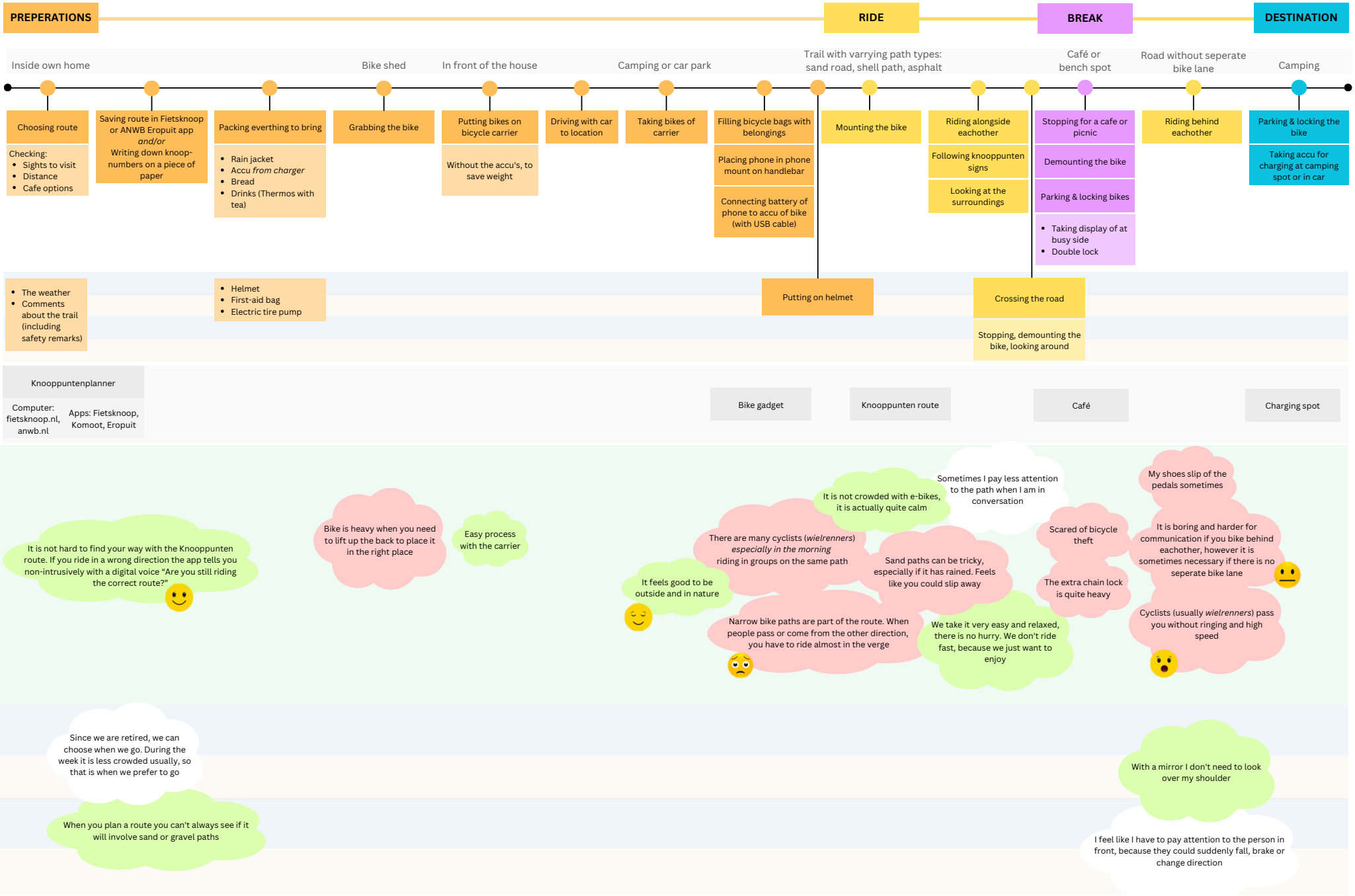
Two user journeys were created based on the analysis of 12 user journeys, created during each interview. Nuances are applied based on rider type. The distribution of rider types among the participants is shown in Fig. 17.
The journeys that were described elaborately by the participants were coincidentally almost evenly distributed on journey type (recreational or practical), which is beneficial for creating representational user journeys.
The user journeys are presented on the following pages.

Rider type	**#Participants**
Unaware	2
Avoider	2
Safety seeker	4
Confident	4
Total	*12*

Fig. 17: Rider type interview profile

USER JOURNEY: RECREATIVE

Type of ride — *'**Recreative**', with another person, 30 - 60 km, driving to the location and biking from there, good weather, speed: 15-17 km/u*



USER JOURNEY: PRACTICAL

Type of ride

*'**Practical**', alone, 5-10 km, going to the shops in the big city, from village, speed: 17-20 km/u*

PREPERATIONS | **RIDE** | **DESTINATION**

Surroundings

Inside own home | Bike shed | Residential area | Main village road | Traffic light | Asphalt 'doorfietspad' going alongside green fields | Residential area | City centre | 'Start' of shopping street | Bike shed at home

Actions

Confident, safety seeker, avoider, unaware

- Preparing to go outside
  - Putting on jacket
  - Accu from charger
- Grabbing the bike
- Mounting the bike
- Riding by memory
- Demounting & mounting the bike at a traffic light
- Passing bridge which has a climb
- Overtaking (inhalen) a regular biker
  - Ringing my bell
- Demounting the bike
  - Parking & locking bikes
  - Double lock
- Doing groceries
- Filling the bike bags with groceries
  - Taking locks off
- Riding the same route back
- Parking the bike

Specifically: Safety seeker & avoider

- Helmet
- Checking the weather
- Putting on helmet
- Crossing the road
  - Stopping, demounting the bike, looking around
- Taking off helmet & putting it in one of the bicycle bags

Touchpoints

Bike gadget | Parking area

Thoughts

Confident

- Great I can take the e-bike now, otherwise I would have taken the car for this distance
- I know when to pay attention, because I know where the risky spots are
- It is dangerous that priority rules for roundabouts are not unambiguous
- Everytime there is wind, rain or when I have to go uphill, I think again "an e-bike is ideal!"
- I can find it hard to anticipate when the car is actually approaching
- it would be nice if there were bicycle racks so you could put your chain on them; is often missing at shopping centers
- I want to be home, so I ride a bit quicker
- The long bike paths are comfortable to ride on and not so crowded, enjoying the nature
- Diversity of cyclists (e.g. fatbikes, e-bakfietsen, flitsbezorgers) pass you without ringing and with high speed
- *Maximum 20km/h on bike lane along with more severe enforcement*

Safety seeker

- Young people are distracted by their phone, creating risky situations
- It is scary when someone comes from opposite direction on the wrong lane
- Mounting the bike isn't the easiest for me & starting peddling is quite heavy, so I would rather go through red than stop unnecessarily
- When I take it slow, another sometimes gets impatient, reacts annoyed or cuts me off

Avoider

- I avoid riding during peak hours in traffic of school and work, so it is not that crowded and risky

Unaware

- I prefer to cycle as fast as possible. I still use the boosting block and keep an eye out for police. When I see them I cycle more slowly.
- A bike mirror... no that is for old foaks

User journey: Recreational ride

This user journey shows the variant of a recreational ride where the user drives to a location with the bikes on a carrier, to start biking from there. As a result, this journey entails a few additional action steps compared to starting a recreational ride directly from home.
The majority of participants engage in recreational rides together with their partner. Those who ride often, also ride occasionally with one friend or a small group of friends.
Using the Knooppunten for recreational rides was mentioned by all participants. The majority of participants who use the e-bike for recreational rides often, expressed strong positive feedback and feelings about the Knooppunten, unprompted by interview questions.
Three of the participants expressed, without being asked, that they enjoy how while using the downloaded route, voice assistance is very gentle and not pushy in her comments.

User journey: Practical ride

The described areas and routes varied, although all participants resided outside of urban areas. In multiple cases, participants detailed cycling journeys to city centers. During such rides, they encountered diverse forms of infrastructure and environments, as depicted in this user journey.

Discussion

In this section, the findings from the data analysis are interpreted by exploring their interrelations and notabilities. The results from the interviews and the survey are compared side-by-side to identify stronger patterns and correlations. By critically synthesizing the data, it is aimed to draw meaningful insights that will inform solution development and future initiatives aimed at improving the safety of elderly individuals on e-bikes.

The analysis reinforced the categorization of the different rider types and provided deeper insights into the e-bike-related behaviors, thoughts, and feelings specific to each type. Additionally, it revealed several general insights that apply broadly across the target group, regardless of rider type. First, the insights related to the different rider types are briefly discussed. Following, the general insights are discussed, including the context of accidents.

Rider types

The user journeys compile the thoughts and actions of the individuals interviewed, providing detailed and specific insights. By analyzing these, a more comprehensive picture is drawn of the characteristics that define each rider type (see Fig. 18).
Notably, it seems to be most riskful when elderly become more careful in traffic, going towards being an avoider. Their behavior becomes unsynchronized and contrasting with that of the surrounding road participants, creating more hazardous situations.

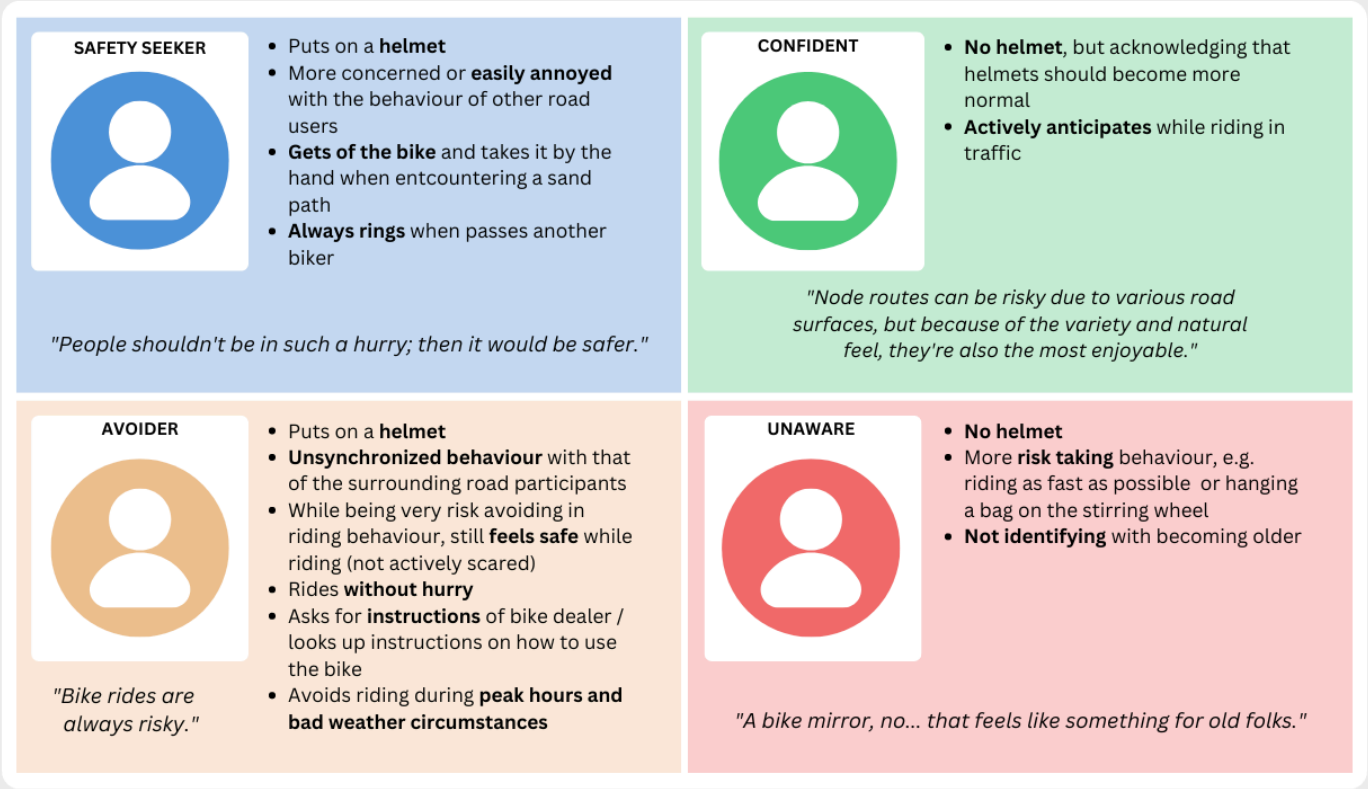


Fig. 18: Rider type characteristics

Transition in rider types

It is interesting to recognize that rider types are not rigid for target group individuals. From character and life experiences, some individuals will start out on the e-bike as one of the types.
Healthy and fit young elderly might start as the "unaware". A tendency is visible of a transition where the target group would move in steps from unaware toward the avoider, as shown in FIg. 19. Here a transition step could be triggered, when they truly start noticing and being hindered by limitations and when they experience an or multiple accidents.

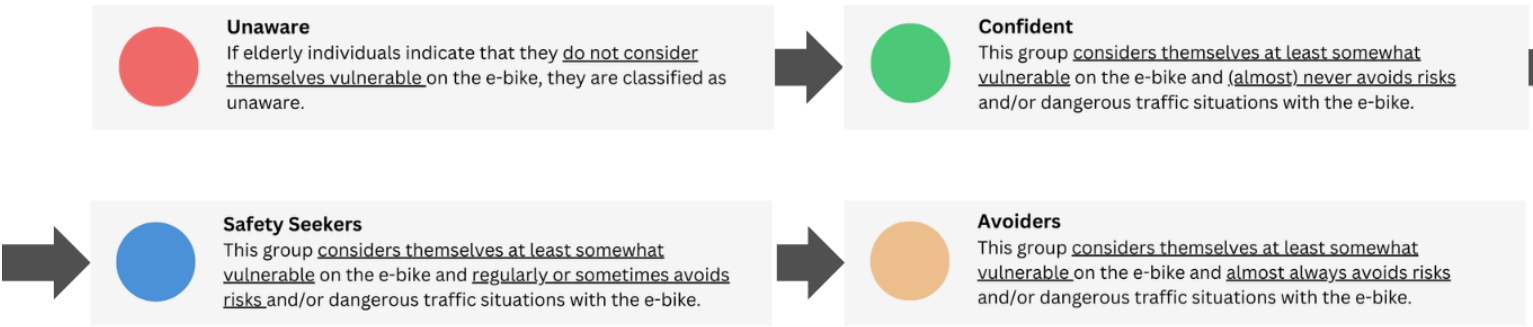


Fig. 19: Transition tendency between rider types

General target group insights

Benefits of the e-bike and its reverse effect on safety

Elderly who own an e-bike, have highly positive attitudes towards the product, especially enjoying having speed assistance with inclines and wind, and not always needing to use a car. They are happy to keep moving and active. When elderly reach an age where their limitations would have meant they could not bicycle anymore on a conventional bike, but the e-bike keeps them cycling, the e-bike results in more elderly with elevated risk for an accident are still cycling.
There are different points at which the target group purchases an e-bike (see Fig. 20). A trend for elderly is to change to an e-bike between the ages of 60 and 70, for biking more often in a relaxed way. However, there is also the group who purchase an e-bike because they notice their physical limitations playing a role in the conventional bike. Lastly, there is a segment that has not cycled for years, but starts using the e-bike due to its compensating benefits or the option to join their friends or partner on recreational rides. The last two segments come with more risks to cycling safety. Those who have not cycled for a long time have to get used to the cycling experience again and might not notice the difference well between a conventional bike and an e-bike.
The analysis of the interviews showed how elderly perceive the e-bike as more safe than a conventional bike, partly because it enables them to keep moving when they would otherwise not have enough power themselves. However, this can also create a misperception of their own capabilities and safety.

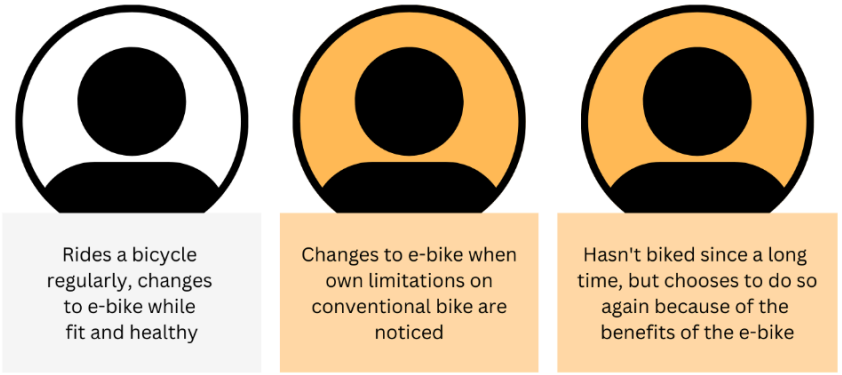


Fig. 20: Target group categorized in purchasing reason, orange: provides risks

Denial of (impact of) impairments

The target group is not quick to acknowledge themselves getting older and the limitations that grow with that. They might be aware of impairments they have, however they tend to not acknowledge the severity of the impairment or the greater risks they pose. This results in them easily overestimating themselves. Additionally, they perceive accidents as situational occurrences, which leads them to resume cycling afterward with little to no adjustment in their behavior. Regarding helmet use, many seem to require a serious injury from an accident or hearing about such an incident from a close acquaintance, before considering purchasing and wearing a helmet. It is only when impairments become apparent and significantly start to limit their abilities that they begin to contemplate making adjustments, such as acquiring assistive devices or opting for a bicycle better suited to their needs.
Furthermore, it takes some time for them to actually make the adaptation, while many continue cycling in the meantime, as depicted in Fig. 21.

The insight aligns with the conversation with traffic psychologist Mrs. Hagenzieker, who highlighted that older individuals quickly feel stigmatized as 'old' and are not easily receptive when addressed as 'the elderly'.

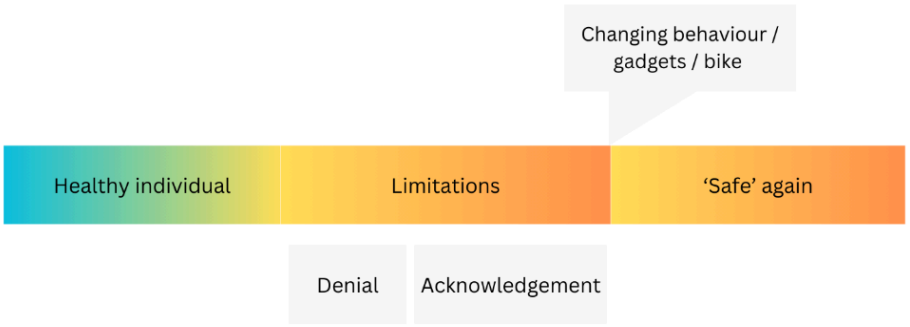


Fig. 21: Risk path of elderly individuals on an e-bike

Feeling of safety, however more on edge and with a need for pleasant circumstances

Elderly individuals on the one hand feel safe while riding e-bikes, while they also have a basic awareness of their vulnerability. They have confidence in their ability to anticipate traffic situations. They tend to be more vigilant in traffic and take fewer unnecessary risks. They find themselves feeling somewhat on edge and can be sensitive to traffic conditions (e.g., too much congestion, too narrow lanes), especially considering that they often cycle for pleasure. Interestingly, retirees, in particular, do not utilize e-bikes to increase their speed. Instead, they appreciate the opportunity to relax (Dutch: onthaasten) and derive greater enjoyment from their rides when cycling at a leisurely pace.
This aligns with the literature research outcomes of two papers, showing that older cyclists seem to place more importance on 'comfort,' by considering not only travel time but also the speed of car traffic, the presence of bike paths, and traffic intensity (Joolink, 2016; Van Overdijk, 2016).

The analysis reveals both positive and challenging aspects of elderly e-bike riders' safety behaviors, as depicted in Fig. 22.

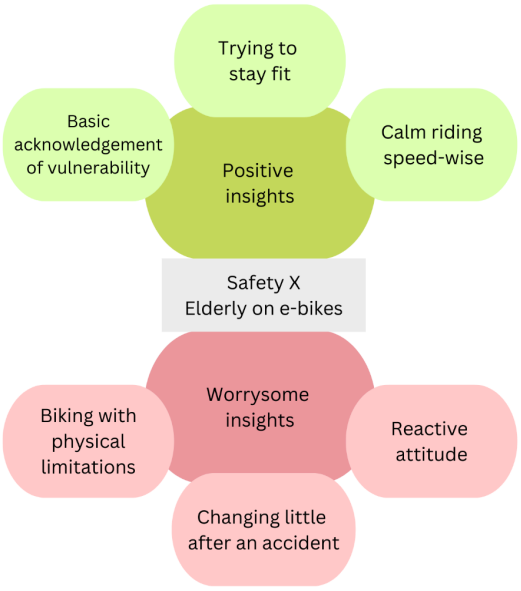


Fig. 22: Overview of insights derived from the qualitative research [survey and interviews]

Accident contexts

A significant portion of the accidents shared a commonality: unexpected traffic situations, causing older individuals to startle, swerve, and subsequently collide with a curb, fall into the roadside, or lose balance when braking abruptly (20 out of 57 reported cases). For one-sided accidents, which was the majority with 41 cases, this thus covered 50%. See next page for an evaluation of the accident reason results, showing overarching categories. Notably, curves with oncoming traffic on narrow paths, and T-intersections emerged as high-risk locations; the first accounting for the traffic location of four accidents, the second accounting for three. At T-intersections or junctions, maintaining situational awareness becomes challenging, leading older individuals to be caught off guard by drivers not adhering to right-of-way rules.

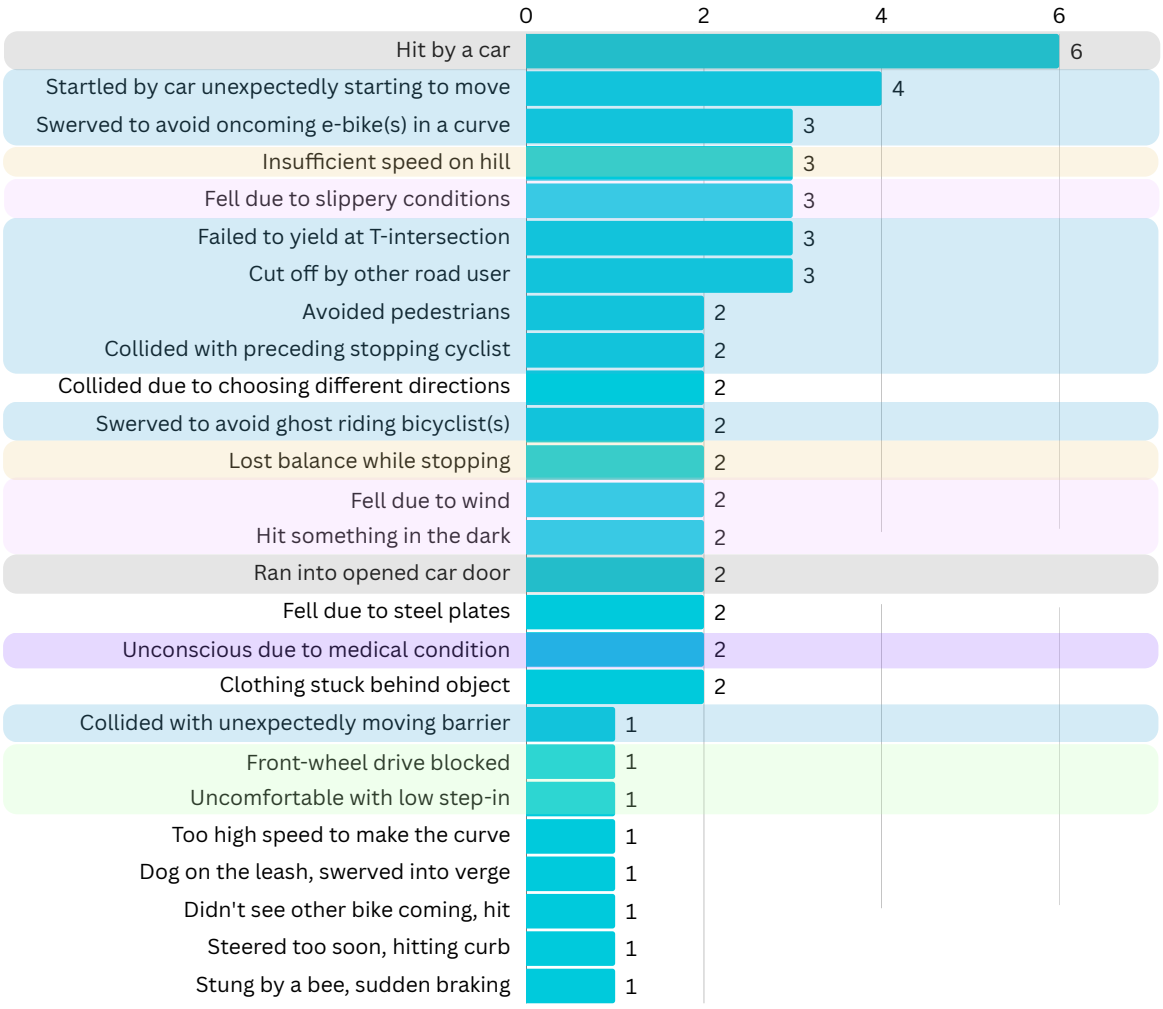
Locations with high traffic density or limited space for multiple road users tend to raise the occurrence of situations where cyclists collide or require sudden maneuvers. As indicated by literature (see p. 17) , older individuals are more prone to accidents in such scenarios due to slower information processing and diminished balance or other limitations. For instance, a survey respondent reported a fall while swerving to avoid a wrong-way cyclist.

Both interviews (three instances) and surveys (five instances) showed cases of elderly individuals cycling with physical limitations, which contributed to accidents on seven occasions.

Interestingly, accidents do not necessarily result from unsafe or 'incorrect' usage of e-bikes by older riders. One accident occurred due to excessive speed while taking a curve. Moreover, 81% of survey respondents had owned their e-bike for over a year when the accident occurred. Interview participants described the transition to using e-bikes as straightforward and intuitive. It could be hypothesized that older individuals who acquire e-bikes later in life, when they may be less sharp and have not cycled for a long time, are more prone to unsafe e-bike use, such as speeding. Nonetheless, prior research indicates that some older individuals mount e-bikes like traditional bikes, leading to fall (conversation with J. van Rijn).

There were also five incidents where the cyclist was hit by a car that failed to see them. This occurrence may decrease in the future due to the increasing prevalence of advanced ADAS systems.

Accident reasons, e-bike and regular bike



Legend

- Startle reaction due to other road user (or object) [20x]
- Car (passangers) doesn’t see bicyclist, two-sided accident [8x]
- Weather conditions [7x]
- Out of balance due to low speed [5x]
- Limitation of medical condition [2x]
- Vehicle factor [2x]

Conclusion

Problem as perceived

The target group research shows it is important to acknowledge the complexity of the issue in terms of psychology, as well as the value to approach the problem holistically.

The insights show that addressing the problem, the following points should be acknowledged:

- There are different types of elderly on e-bikes in behavior and attitude regarding safety
- It is a system: road users interact with each other and with interventions
- Elderly individuals wish to continue cycling. The e-bike enables them to do so, posing an increased traffic risk due to age-related limitations
- 'Older' individuals tend to deny their aging process and underestimate the risks associated with the limitations that come with it
- Retirees see bicycling as a relaxing activity. They feel safe, but are more vigilant and on edge in traffic than younger age groups. Altogether, they seem to feel a need for pleasant circumstances
- E-bike use by elderly is not inherently more dangerous than traditional bicycle use, looking at vehicle factors

04 FROM RESEARCH TO DESIGN

In the preceding chapters, the context, current knowledge, and gaps in understanding of e-bike safety for the elderly were thoroughly examined. Research on the target group was conducted to gather valuable insights on the previous missing knowledge. Through this process, the underlying problems and needs come to the surface. The insights can guide the creation of innovative and effective interventions that enhance the safety and well-being of elderly e-bike riders. This chapter outlines the ideation approach, decision-making processes, and concept development strategies.

04 From research to design

4.1 Ideation approach

The ideation approach was aimed at being continuous, without judgment and with a variety of creative inputs, allowing for flexibility and fluency.

Continuous idea generation
Throughout the research phase, ideas would emerge. These were intermittently noted in a central place. This would function as a parking place for ideas, which were revisited during more deliberate moments were used for ideation and at the reverging stage.

Creative Session
A creative session was organized with a group of experts and non-experts, idea generation for solutions on the problem. This was implemented to break from personal pre-formed thinking patterns and ideas and to potentially get inspired by the ideas of others and by different perspectives.

Personal Brainstorming
Personal brainstorming was carried out in two distinct phases:

- **Free brainstorming**: This phase allowed for unrestricted idea generation without any constraints, encouraging a free flow of innovative thoughts.
- **Stimulated brainstorming**: This phase involved brainstorming stimulated by an overview of the retrieved insights and main findings from the research. Also, the ideas from the creative session were looked at again for inspiration and hitchhiking on these ideas.

Incubation
The planning also provided for incubation time in between and after brainstorming, acknowledging that incubation enhances creativity. Incubation is unconscious processing that can take place when you are working on something else or during relaxation from all mental work. Psychologist Sir Wallas in his work the Art of Thought described the creative thought process in four stages: preparation, incubation, illumination and verification (Wallas, 1926).

The ideation process ensured that the concepts developed could be both innovative and grounded in the research insights.

Creative session

The creative session was an afternoon of 3 hours and 30 minutes with 9 participants, working towards producing 3 concept directions. The session was organized and facilitated based on the knowledge and experience from a course called ‘Deliberate Creativity’ of the Connected Creativity minor at the TU Delft and the experience at the creative strategy agency Fronteer (currently Elemental). The book "Road Map for Creating Problem-Solving Techniques" was consulted to refine and align the creative methods (Heijne & van der Meer, 2019). The approach was also discussed with an expert in creative facilitation. In a creative session, participants are led through the creative process and steps by the facilitator. The facilitator’s actions are aimed at fostering an environment conducive to innovative thinking.
An assistant to the facilitator was present to take notes and help distribute materials. The facilitator and assistant did not take part in the ideating to allow the participants autonomy and to focus on guiding them.

Participants

Multiple aspects were considered in selecting the participants for the session to enhance creative capacity. Firstly, a variety of backgrounds and perspectives was sought. This involved finding individuals with some knowledge of the topic but who were not already engaged with the specific problem. It was desirable to avoid having participants with specific expertise in the subject, as this could limit creativity and the generation of ideas. Also a number of participants were included without direct expertise in the fields of elderly care, traffic, or bicycles, to bring a fresh perspective and think with fewer constraints.
Additionally, a spread in ages and gender was aimed for, to make the participants feel comfortable and to create a wider variety of perspectives.

Creativity benefits from intrinsic motivation and personal willingness to contribute, so participants were asked to participate on a voluntary basis. Moreover, being paid for their participation could make them feel pressured to 'perform'.

Participants were not presented beforehand with the problem statement to prevent them from developing biases or getting stuck on preliminary ideas. However, to sensitize and inspire them for the session, they were sent a homework assignment before the session (Appendix E.2).
The homework assignment was as follows:

Bring an example —in the form of a printed image— of a technology, service, product, or something else that makes traffic more pleasant and safer according to you.

These examples were discussed and used in the creative session to set up 'golden rules for a concept, service, or product that makes traffic more pleasant and safer' together.

Session plan

The session followed a session plan, presented in Appendix E.1. Deviation from the plan was possible, judging in the moment what would benefit the session.

The session consisted of the following elements:

	What
Welcome	Settling down of participants
Icebreaker	Everyone gets to introduce themselves 'ring ring'
Introduction	-Agenda -Way of working
Golden Rules	Discussing the homework and setting up 'golden rules'
Challenge	-Presentation showcasing the problem and trends -Questions
Diverging	Brainstorm through brainwriting on post-its
Reverging	Spontaneous clustering
Converging	Hits or Dots: Voting on favorite ideas and/or

	categories (10 sticker votes each)
Break	*Facilitator: Writing down concept options*
Diverging/Converging	-Creating concepts through worksheets (poster making) -Elevator pitch: Presenting the concepts
Closing	-One word: how do you feel after this day -Ask for words of advice
Total	

During the presentation the problem was showcased, to get everyone on the same level and line of basic knowledge and what to work with. No particular side of the problem was highlighted, to prevent steering the participants into solution directions. Diverse trends were presented to inspire more innovative thinking.
Afterwards, the group was presented with the problem statement to brainstorm on. The way a problem is phrased can have a big influence on the generation of ideas. So the statement was 'SPARKed': Specific and Sharp, Positive, Ambitious, Relevant and Kept simple:

Hoe kunnen we zorgen dat 60+ers blijven fietsen op een veilige manier?
Translation: How can we enable people over 60 to continue cycling in a safe way?

To create an overview and structure of all ideas created, spontaneous clustering was performed by the participants. They were to hover over all ideas and vote on their favorite ones. During the break the facilitator together with the assistant, distilled four idea areas from the patterns in votes. These were worked out in groups on worksheets into concepts.

Throughout the session the participants were reminded with the mindset and 'ground rules' fitting to the stage they were in (Heijne & van der Meer, 2019);

- **Diverging**: Postpone Judgement; quantity breeds quality, hitchhike, freewheel.
- **Reverging**: Use the inquiring mind; be jointly active, listen responsively, move circularly
- **Converging**: Affirmative judgment; protect novelty, trust the hedonic response and have action in mind.

Outcome of the session

It was possible to perform all parts of the session, with enough room for each part.
The participants demonstrated a proactive and inquisitive attitude, contributing to a positive atmosphere for creativity. The flexibility and fluency rate of ideas were satisfactory.
The idea categories and concepts that were created by the participants are presented in Appendix E.4.

Fig. 23: Creative session 17th april 2024

4.2 Choice making

The process going from ideas to the proposal of a single concept, included two key decision points. The first was the selection of ideas to develop further to evaluate their potential. The second was choosing among these developed directions. To guide these decisions, a list of directives for the project outcome was established.

List of directives

The directives are not listed in order of priority:

- ➔ Addresses the underlying needs of the target group
- ➔ Promotes traffic safety
- ➔ A novel and unique solution
- ➔ A structural approach
- ➔ Approaches the problem as a system
- ➔ Avoids stigmatizing the elderly
- ➔ Contains a participatory element

Final four ideas against the directives

Four ideas were selected and developed in detail, informed by conversations with ANWB employees to further understand their potential. These ideas were:

- A campaign directed at all road users with the core message to “Not startle each other”
- A ‘trying out a bike’ service for a safer bike for the elderly
- E-bike insurance benefits based on safety-improving behavior
- Promoting safe cycling routes through digital route planning and navigation

The last idea was identified as the most promising concept direction for further ideation and development. See Appendix G for more elaborated idea descriptions.

Selection of the safe cycling route idea

The safe cycling route was chosen for several reasons. First, it aligns most closely with the psychology and needs of the broader target group.
The *insurance benefits* and the *trying out service* both would aim to normalize safety measures and to lower the threshold of making personal changes that enhance their safety in traffic.
Given that the elderly are often reluctant to acknowledge their developing impairments and aging, it is however uncertain whether the ‘trying out a bike’ service would be effective. A bicycle designed for the elderly, with features like a low step-through frame and a saddle that allows both feet to touch the ground, looks significantly different from the conventional city e-bike. Currently, people tend to choose bikes that from the looks also feel to suit them at the time. Without further research into purchasing behavior, it cannot be assumed that a significant number of the elderly will be convinced to choose safer options "in time" or preventively.
The insurance benefit idea could, among other things, encourage more elderly to exercise alongside cycling and to wear helmets. However, it is also uncertain whether this idea would achieve a substantial effect. Many elderly individuals who are at higher risk will continue to cycle. This includes those

who are relatively fit and have aids on their bikes but are still more susceptible to accidents due to other age-related limitations.

The analysis showed that most accidents occur due to reactions of being startled. When a startle reaction happens, there is a high likelihood that an elderly person will fall or collide with something. The ideas of the campaign and promoting the safe route both aim to prevent these startle reactions from occurring in the first place.
However, the safe cycling route considers more factors and circumstances that can contribute to an accident or startle than a campaign focused on the specific behavioral element of not startling each other. The campaign is still recommended as an idea to present to Stichting Ideële Reclame (SIRE), a Dutch foundation that creates advertising campaigns about topics perceived by the creators as social issues.

Lastly, the idea of promoting the safe cycling route scored well on all points of the list of directives.

Image (ANWB ©)

4.3 Concepting approach

The development of the concept involved prototyping, conducting an initial validation step and creating a comprehensive strategic and tactical roadmap. The tactical roadmap focuses on setting up and executing a pilot. The validation step within this project focuses on a meta-level understanding of how the target group perceives the concept. A medium-fidelity prototype of the concept was created to provide a clearer picture for both the validation step and the organization. The goal is to deliver a concept proposal with enough detail to enable decision making whether the subsequent steps of the pilot should be executed, to clarify the objectives, and to identify what is still needed.
Furthermore, this approach provides an overview of feasibility, desirability, and viability.

The concept proposal was not developed in co-creation with the target group or ANWB stakeholders to ensure that the proposal would not be limited by current thought patterns. However, discussions were held with ANWB employees who would be involved with the proposal, with various objectives in mind:

- ➔ Understanding the playing field: What is already happening? What are the developments? This helps to show you acknowledge the current situation, to suggest how it can be improved.
- ➔ Identifying the doubts and pain points of these stakeholders, to address them in the roadmap.
- ➔ Ensuring that those who would be involved in the execution feel involved and engaged at an early stage.

During these discussions, the concept proposal was not shared in detail.

Golden Rules

In shaping the concept, the "golden rules" for a successful product or service were kept in mind. These golden rules were established during the creative session with the nine participants:

- Attractive to use; convenience & appeal
- Awareness of the product/service; recognizability
- Fits the user; personalization possible (acknowledging differences)
- Use is driven by need; intrinsically motivate

05 CONCEPT PROPOSAL

This chapter goes into the concept proposal, explaining the concept, what it adds to the existing framework of the ANWB services, what is needed to create it and giving an idea of how the user interaction would be. Furthermore, it brings forward how the concept is beneficial for different stakeholders and what competitive advantage the ANWB has in executing it. Lastly, the validity of the concept is discussed and what would be next steps to develop the concept further, along with a strategic and tactical roadmap.

05 Concept proposal

5.1 The concept

Promoting the use of safe routes

The majority of cycling accidents involving elderly individuals are single-vehicle accidents. The target group research revealed that the most common cause for these accidents are startle reactions. When an elderly cyclist is startled, the likelihood of falling is significantly high. These reactions are often triggered by the sudden movements of other road users, causing the elderly cyclist to swerve or brake abruptly, leading to a fall. In the first scenario, they often lose balance after hitting a curb, roadside object, or veering into a ditch. In the case of sudden braking, they come to an abrupt stop and lose balance.

Such startled reactions predominantly occur at relatively unclear traffic points and areas with higher traffic density, such as exits, parking spaces, intersections, traffic lights, narrow roads, bends, T-junctions, and during times of heavy school traffic.
To prevent accidents, it is crucial to minimize the factors that lead to startled reactions while cycling. The concept proposes guiding elderly cyclists along routes that minimize these factors by providing navigation for safe routes.

Elderly cyclists are generally aware of their vulnerability and therefore tend to anticipate traffic conditions and take fewer unnecessary risks. According to a study conducted by market research firm Blauw Research for the ANWB, cyclists aged 66 and older are more likely to take measures to ensure their safety, such as allowing sufficient time (77%) and avoiding busy routes (18%) (Blauw, 2022). Due to their heightened awareness, they often find traffic conditions frustrating or making them feel on edge (too busy, too narrow, etc.), which is heightened by the fact that they mostly cycle for pleasure. It is noticeable that retired individuals, in particular, do not use e-bikes to cycle faster. They prefer a relaxed pace and enjoy their rides more when cycling calmly.

There is a clear need for pleasant, quiet, and consequently safer and more scenic routes. The infrastructure increasingly supports this need, but elderly do not necessarily know where to find the routes with this infrastructure.
Providing navigation that highlights pleasant and safe routes would thus promote the use of safe routes and reduce startled reactions, thereby preventing accidents.

Offering the pleasant, safe route

The concept proposal is to offer a route planner and navigation system for bicyclists that provides pleasant, safe routes while making traffic safety information accessible. This would be an extension of the current services offered by the ANWB. The "Eropuit" platform, available via the website and app, is already used for planning, selecting, and navigating node routes (knooppuntenroutes) for cycling and walking. The "Onderweg" app is an ANWB navigation app that currently provides navigation for cars. Furthermore, the ANWB website features a "Verkeer", Traffic, section managed by the Traffic Information team, with a route planner for cars, bicycles, and pedestrians. However, this planner is not linked to an app and therefore does not include navigational features.

Given that the ANWB already allows users to plan routes with navigation through the Eropuit app, there is an opportunity to integrate a variety of interventions related to offering pleasant, safe routes into this platform. Additionally, Eropuit is already widely familiar and used by the target audience.

The concept includes the following components, which will be further discussed in this chapter:

- A navigation system for A-to-B routes in the Eropuit app and the Onderweg app for cyclists and pedestrians, offering a "pleasant, safe route" option for cyclists.
- Sharing of risk points and scenic routes by users.
- Clear information sharing regarding bicycle safety for planning junction routes.
- Pleasant, safe navigation when cycling junction routes.

Target group

Elderly cyclists have an elevated risk of accidents regardless of whether they are riding an e-bike or a conventional bike. The primary target group of the concept is therefore elderly cyclists, both e-bike and regular bike users. However, the target audience is broader: regular cyclists and e-bike users who need a comfortable, safe route for practical and/or recreational purposes.

Vision

The following vision has been formulated with respect to the concept proposal:

"ANWB is a leader in the field of bicycling safety by applying innovative technology and comprehensive, up-to-date data insights to bicycle navigation"

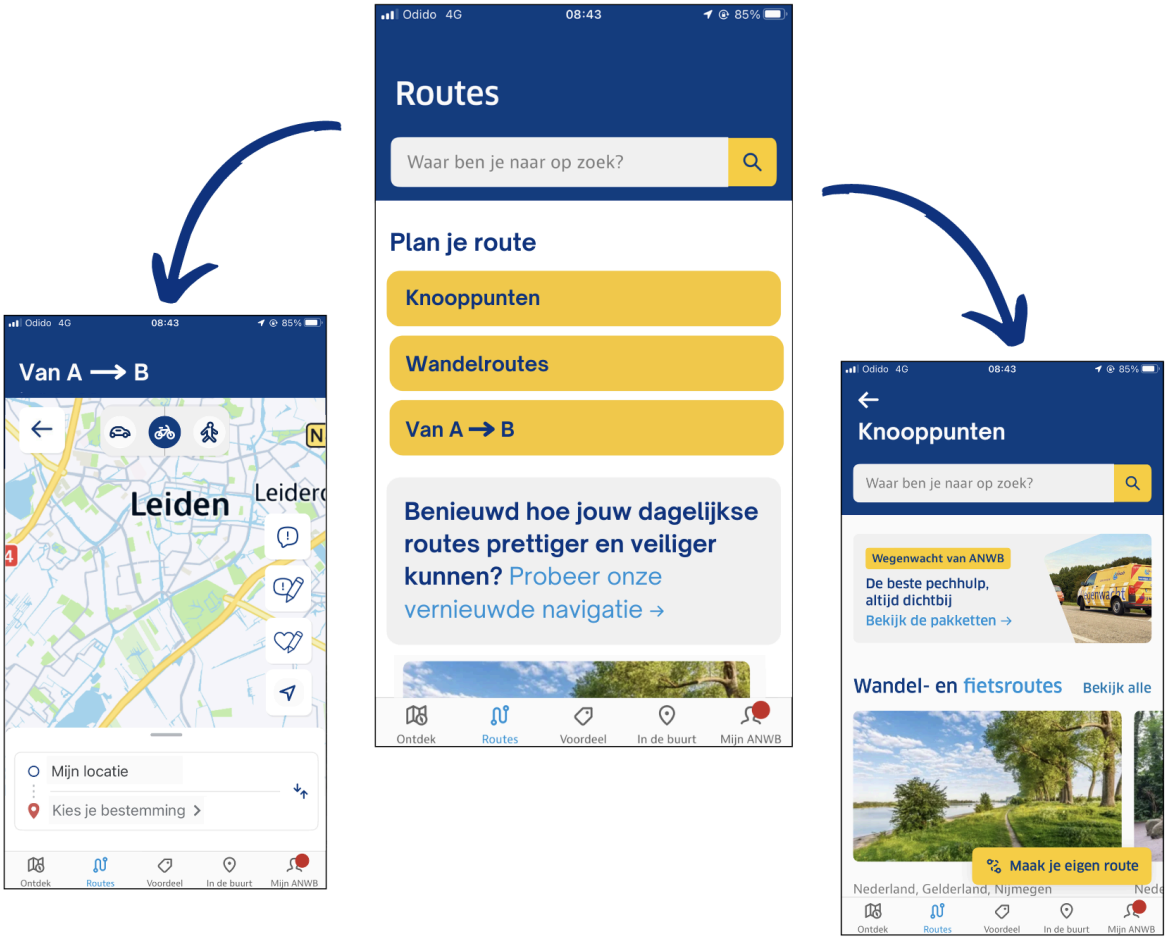


Fig. 24: The expansion of the Eropuit app: adding 'From A to B'

Routeplanning and navigation for A to B

Figure 25 shows the current ANWB service for planning a cycling route from A to B. The bicycle route planner can provide a route description and display the route on a web map. Users can specify whether they are riding a regular or electric bike, which affects the estimated duration and route planning. For e-bikes, routes favor more continuous bike paths with fewer traffic lights and turns, assuming these cyclists prefer routes that enable riding faster. Additionally, users can choose the type of route they prefer: the shortest route "through more populated areas," a route with less delay "over separated bike paths," or a route over (fast) bike lanes "primarily on separated bike paths and (fast) bike routes." Bike routes include fast bike lanes, node routes, and LF-route paths (from LF routes: marked routes for recreational long-distance cycling).

The routeplanner uses an API from data provider Andes, specializing in traffic and travel information in the Netherlands. An API, or Application Programming Interface, allows other systems and software to interact with the system.

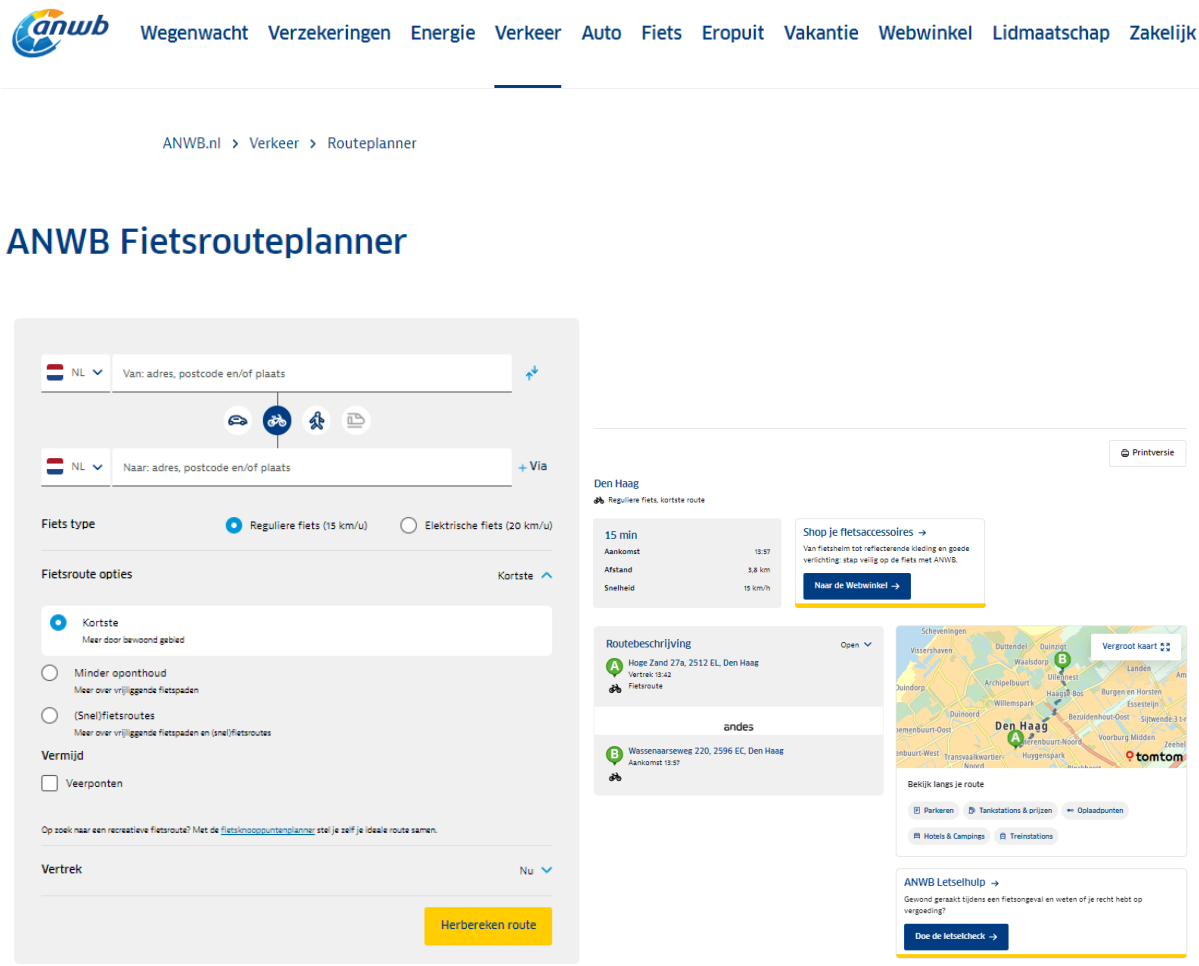


Fig. 25: Current bicycle routeplanner for A to B (ANWB website, 2024)

The pleasant, safe route option

The proposal involves integrating and enhancing the A-to-B bicycle route planner within the Eropuit platform, illustrated in Fig. 14. The key enhancements include the ability to select the "pleasant, safe route" and incorporating navigation. The "pleasant, safe route" would be determined by an algorithm that considers various traffic and road factors, such as traffic density, road width and quality, number of traffic lights, and, if possible, the pleasantness of the surroundings.
Fast bike lanes and large segments of other bike route types naturally include many of these favorable factors. Additionally, the current "less delay" option already implies fewer traffic lights and less congestion. Therefore, only the "shortest route" and the "pleasant, safe route" options would be offered. The current options of "less delay" and "(fast) bike routes" might distract users from selecting the *pleasant, safe route* and could give the 'wrong' impression that less delay and (fast) bike routes are not part of this route.

Users are likely to have a general understanding of what the "pleasant, safe route" entails, but it's also important for clarity and transparency to share what they can expect from such a route. Therefore, it is recommended to label this option with "less traffic, more on separated bike paths." for example. Additionally, pop-ups and marketing can be used to provide more nuanced and detailed explanations of the factors considered. In this way, users can be attracted by one or more factors that specifically appeal to them. Highlighting 'less traffic', 'separated bike paths', and 'scenic routes' is recommended, as these factors

frequently emerged in interviews as user needs.

The naming of the route ‘pleasant, safe route’ (Dutch: ‘prettige, veilige route’) is chosen because "safe route" alone might come across as patronizing or restrictive. "Pleasant" is intended to evoke positive associations and appeal to the positive aspects that come with safety. "Pleasant" is also a relatively broad term, encompassing various factors without promising a specific element.

Electric bike vs regular bike option

Offering an option to choose between a "regular bike" and an "electric bike" can add value to the service. Since other navigation apps do not have this feature, it works distinctively. Additionally, it allows the ANWB to better understand the cycling behavior of its users. Generally, elderly cyclists do not ride significantly faster on electric bikes. However, for those who use the navigation and do ride faster, it is beneficial to know the approximate duration of the route.
Based on the findings during the literature and target group research, there should be no difference in what constitutes a pleasant, safe route for an e-bike compared to a regular bike for elderly riders. Therefore, choosing one option or the other should not result in actual different routes.

Eropuit & the Onderweg app

As previously mentioned, integrating the A-to-B planner with navigation into Eropuit, both on the website and in the app, is a strategic choice. Eropuit is regarded by the ANWB as the platform that offers recreational outings. The focus is on providing a planner and navigation for recreational cycling and walking. The functionality of planning and navigating routes however overlaps with A-to-B navigation. It is strongly expected that this will be considered a logical and practical addition by users. Moreover, centralized services and information can be beneficial for users. The A-to-B navigation enhances the node-based route planner service, as users often do not start from home or may decide to deviate from the node-based route for a coffee stop or other destination.
Node-based routes are often in unfamiliar areas, requiring navigation for these occasions. The user could prefer to walk, use the bike or car, therefore it is valuable to have A-to-B navigation for these different modes of transportation within the same app. When not starting from home, bikes are often transported on a car rack to the starting point, making it especially valuable to have car navigation integrated into the Eropuit app.
The proposal also includes adding navigation for both cyclists and pedestrians in the Onderweg app. The Onderweg app and Eropuit app are distinct entities, with the Onderweg app focused purely on navigation. Some users prefer this straightforward functionality, so it is valuable to keep these apps separate. However, the priority is to add these functionalities to the Eropuit app, as the target group of elderly e-bike users is already well-established there.

Navigation for routes from A to B

Elderly cyclists do not always use navigation for their daily routes, as they often know the routes by heart or are familiar with the area. However, there are various occasions when someone needs to go to a specific store or other location, such as in another city, where navigation is useful. E-bikes are used to cover bigger distances, for which the 60+ target group would otherwise have used the car or public transport. The e-bike thus enables them to bike new routes, which more often asks for navigation. Lastly, the option of a *pleasant, safe route* can also encourage users to reconsider how they cycle their daily routes; Familiarity with the *pleasant, safe bike route* option may lead them to check if their daily routes are already the safest and most pleasant. This aspect can be highlighted in marketing efforts, as shown in Fig. 26.

User interaction: navigation A to B

The user has become aware of the new navigation function. Before setting off on a new cycling route, they open the Eropuit app and search for the location. The app offers both the shortest route and the pleasant, safe route. Both routes are displayed on the map, along with the duration of the ride, so the user knows what they are choosing between. Initially, the shortest route is set as the default to avoid diminishing the feeling of free choice.

Once the user selects the pleasant, safe route, it can then become the default option.

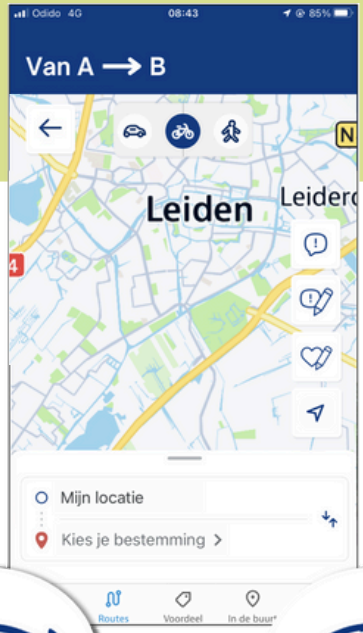
After choosing the desired route, the user presses "start route." Older adults who frequently cycle long or unfamiliar routes often use a mount for their phone (Interviews; Validation results). Those without a mount can use other methods to navigate, such as listening to instructions through earbuds or speakers, and stopping occasionally to check the route if necessary.

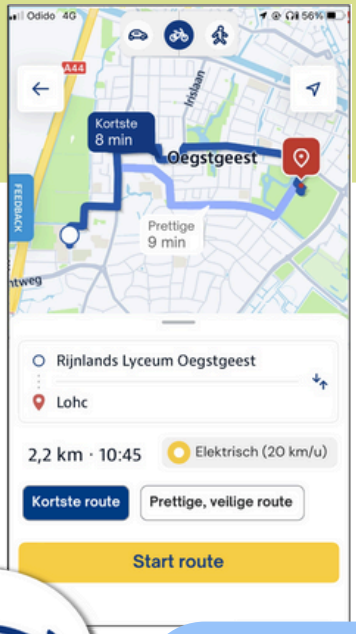
The route can be used in centering mode or with the map zoomed out. At the end of the route, the map will automatically switch to zoomed-out mode, allowing the user to provide feedback on the route (feedback button, report a risk point, and/or input a scenic route).

Fig. 26: Incorporating 'A to B' on the website, including nudging

USER INTERACTION: THE PLEASANT, SAFE ROUTE A TO B

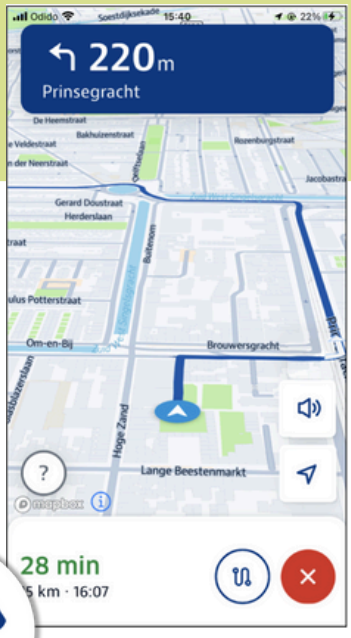
Planning



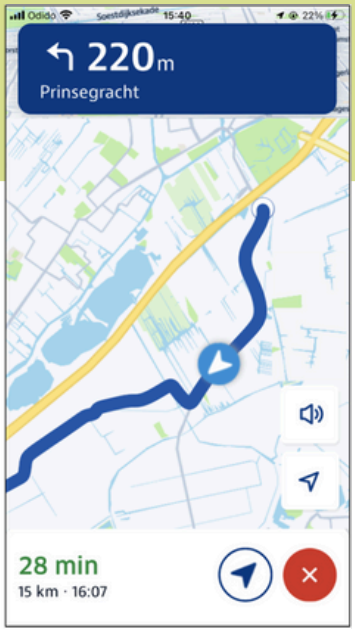


Pleasant, safe route suggested

Navigating

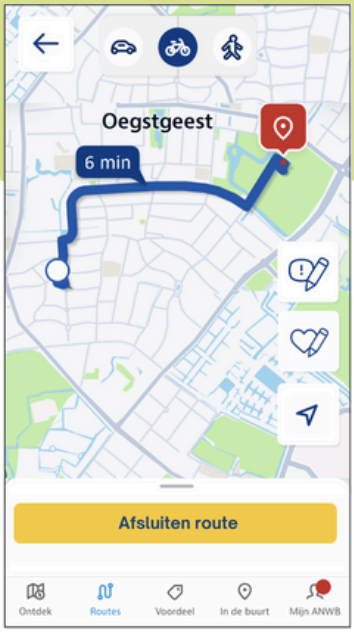


Perspective view



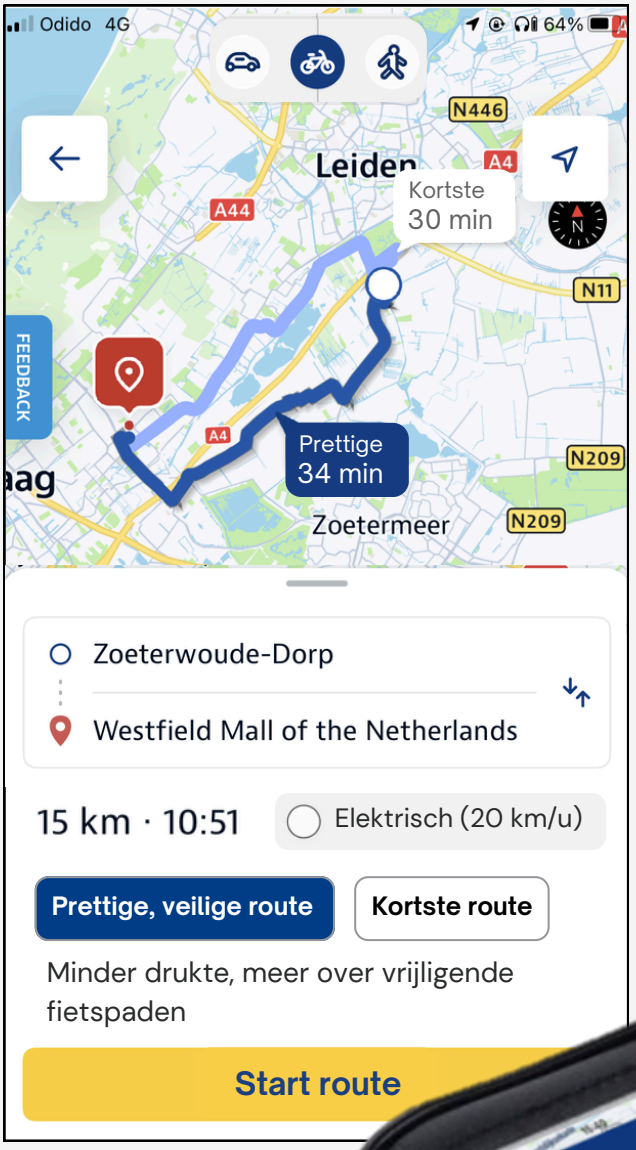
Bird's eye view

Arrived



Route view

Possibility to give feedback



Use of phone mount

Data behind ‘the pleasant and safe route’

The pleasant and safe route would be based on an algorithm that incorporates various data sources, each labeled with a safety value and weighting. Creating this algorithm for the purpose of navigating is an innovative concept, as no such algorithm currently exists, and it would leverage the latest available forms of data.

As described in Chapter 2.2, there has been insufficient accident data recorded to date. This is changing with the MOVE Dashboard, yet as this contains protected ambulance data, it is unlikely that this data will be accessible or usable by entities other than the government and road authorities. However, data indicating safety and risk factors are currently well-documented and largely open-source. Despite the limited accident data, an algorithm could make a useful estimate of safety by combining different data sources. Over time, the algorithm can be refined and expanded.

The algorithm should integrate data from various categories, including road characteristics, accident risk data, intensity data, and subjective data:

Road characteristics
- Bicycle-Friendly & Forgiving Infrastructure * data

Accident risk data **
- Accident data
- Risk-based data: Such as data from the 'ANWB Verkenner Verkeersveiligheidsdata', Floating Bike Data, potentially available in the future.

Intensity data
- Time x density: Static (and dynamic).

Subjective data
- Risk points
- Scenic route data: Could be collected through user participation.

This comprehensive approach allows the algorithm to provide a useful estimate of route safety by combining various data sources, despite the limited availability of detailed accident data. Over time, the algorithm can be continuously refined and expanded to enhance its accuracy and utility.

*
Bicycle-friendly infrastructure refers to roads, paths, and facilities specifically designed to make cycling more comfortable, safe, and attractive. Key features include: wide and separated bike lanes, well-marked and safe crossing of the street, smooth pavement, bike parking and connectivity and flow; which means good connections to other bike routes and smooth flow without unnecessary stops or detours.
Forgiving infrastructure focuses on minimizing the consequences of errors made by road users and if an accident does occur, to reduce its severity. As discussed in Chapter 2.3 on Running Projects, this includes the features mentioned for bicycle-friendly infrastructure with additional features such as flattened curbs, removal and replacement of obstacles and infrastructure that influences traffic to adhere to safe speeds. The latter includes markings, and speed bumps or curves that cannot be taken at high speeds.

**
Accident risk data refers to understanding the likelihood and circumstances of traffic accidents occurring in specific locations. In the end, all above named data types serve to become accident risk data. It is mentioned separately, as there are already sources that have analyzed and compiled data for this purpose.

Recommended data factors

The concept of the *pleasant and safe route* aims to prevent startling reactions among elderly cyclists, both on regular and electric bikes. Therefore, the algorithm should focus on factors that contribute to such reactions. The target group research survey indicated that startling reactions mainly occur at relatively unclear traffic points where it can be hard to have an overview and areas with higher densities of traffic participants. These locations include driveways, parking spaces, intersections, traffic lights, narrow roads, curves, T-junctions, and areas around schools during school commutes. Specifically, curves with oncoming traffic on narrow paths showed to be dangerous for elderly on e-bikes (the location of 4 out of 20 startle reactions in the survey research, see Ch. 3.2).
Additionally, uneven road surfaces can cause stress, contributing to startling reactions. Given that such reactions can still occur, forgiving infrastructure for elderly cyclists is desired for the *pleasant and safe route*, o.a. thinking of smoothed curbs and safe road verges (preferably wide, without obstacles, on the same level as the road and with a sturdy structure).

Furthermore, when developing a route that aims for safety, it is advisable to consider additional factors, such as weather conditions (including road slipperiness) and steep inclines (which pose risks particularly for elderly cyclists on regular bikes). Both were a recurring cause of accidents in the target group research survey.

It is recommended to consult existing guidelines and experts during the development of the algorithm. Relevant guidelines can be found in 'Senioren-proof wegontwerp' (CROW, 2011) and 'Bouwstenen voor een comfortabel en vergevingsgezind fietspad' (Brinker en Schepers, 2018), as well as the forthcoming paper on 'the safety of cyclists concerning infrastructure, particularly in urban areas' by Uijtdewilligen.
For example, research on elderly cyclists in the Netherlands highlighted that intersections are especially dangerous when making left turns at priority intersections. Left turns are problematic for many elderly because they require more attention to surrounding traffic and looking over the shoulder if a bike mirror is absent (Schepers et al., 2020).

Traffic Intensity
Traffic intensity, which refers to the traffic density (crowdedness), is a crucial component for the *pleasant and safe route*. This factor can be incorporated as static data, representing predetermined values of traffic intensity on streets, bike paths, and in areas. Bike intensities have already been mapped, including specific times during morning and evening rush hours (NDW, 2024), see Appendix H for more parameters. The advantage of static data is its predictive nature. For example, if one starts their journey before school children and teenagers begin their commute, however while riding they do, static data can predict this beforehand. In contrast, dynamic data would need to make determinations during the ride. Combining both static and dynamic real-time data could be valuable, leveraging the strengths of each. Real-time traffic intensity data can be especially useful in situations where good weather or special circumstances increase or decrease the number of traffic participants. Moreover, no other navigation system currently offers bike routes based on real-time intensity factors, presenting another differentiating opportunity. A challenge lies in obtaining representative real-time location data from cyclists and pedestrians, which would require data shared from their phone GPS.

Data collection

Width label: road characteristics and intensity combined
The width label ‘breedte label’, developed by Fietsberaad and CROW, provides an assessment of the bike path width for all road segments in the Netherlands. A road segment (Dutch: wegvak) is the smallest functional and administrative section within a road network. It is bounded by an intersection, junction, or a dead end (see Fig. 27). The width label classifies paths in level of accident risk from A to F, where A stands for safe and F for very riskful. The desired width of a bike path depends mainly on its number of road users. The input for calculating the width label is therefore the estimated bicycle intensity (cyclists per hour). Dat.Mobility has estimated

bicycle intensities for all roads in the Netherlands. They use data from the Netherlands Travel Panel and public sources such as CBS (neighborhoods, residences, workplaces, etc.). Additionally, the intensity metric includes the proportion of mopeds/scooters on the bike path, based on an estimated average percentage per type of bike path (NDW, 2024).

Fig. 27: Data registration in road segments (Visualization of accident risk of the road network by DOKdata, n.d.)

Subjective data

While the navigation system is in use, data can be collected from users. The algorithm could be enhanced by incorporating components that consider user input. The proposed elements for this purpose are: risk points as experienced by cyclists and the 'scenic' route (considering the route's surroundings, including nature and architecture). Later in this chapter, under 'Participation,' we discuss how users can provide their input.

Data portals

Since traffic safety is a social issue, related data is mostly open-sourced. Furthermore, IT companies offer their services to create traffic models from the available data.

Firstly, the National Road Traffic Data Portal (NDW) serves as a national hub for road traffic data in the Netherlands. Through NDW, Dutch governmental bodies collaborate to collect, combine, store, and distribute mobility data. Relatedly, the Dutch government makes data available through the Road Characteristics Database (Dutch: wegkenmerkendatabase in het Nationaal wegen bestand NWB), which includes information on road sections such as verge widths (Dutch: berm breedtes), road narrowings, and driveways (Overheid.nl, 2024).

Additionally, the OmniTRANS Spectrum from Dat.mobility provides input data for developing traffic models and has, as previously mentioned, retrieved data on mapping bicycle intensities (Goudappel, 2023).

DOKdata is another entity that builds traffic safety models for road authorities. They offer the option to consider multiple risk factors, such as poorly designed bike paths (based on SPV and CROW guidelines), speeding violations, ANWB Drive Safe driving behavior data and the presence of elementary and high school students. They determine the latter based on CBS data on locations near schools with many students or in neighborhoods with many young residents.

Furthermore, municipalities keep track of where they have made infrastructure improvements, such as The Hague with its "Sterfietsroutes" (Arcgis, 2022).

The ANWB Traffic Safety Data Explorer, discussed in Ch. 2.3, includes data on potential high-risk locations based on for example where cars frequently brake hard (Verkeerskunde, 2024). ANWB is exploring, with research partners, whether they can retrieve Floating Bike Data. Floating data refers to real-time information collected from moving vehicles through GPS or other tracking devices. This data provides insights into various metrics like location, speed, and travel patterns. The goal is to use raw sensor data from phones to map cycling behavior, identifying where cyclists fall or brake hard by making use of the smartphones' g-force sensor.

Node route planner & Node route suggestions

The proposal aims to integrate the "pleasant, safe route" concept across all cycling routes offered by the ANWB, beyond functional A to B routes. To become a leader in bicycle safety, it is crucial to be consistent in promoting safety. The algorithm that would be used to determine *the pleasant, safe route* can and should also enhance the safety of recreational cyclists. Additionally, an opportunity is identified to better inform users about the

safety aspects of routes during the planning process.

The following additional implementations are recommended and will be further discussed in this concept proposal:

- Pleasant, safe navigation during knooppunten (node) routes
    - Avoiding high-risk points
    - Offering the pleasant, safe route for navigation outside the knooppunten network
- Clear communication regarding cycling safety when planning knooppunten routes

Knooppunten routes

The "knooppunten routes," or node routes, are an extensive network of interconnected cycling paths in the Netherlands. These routes are designed to provide cyclists with easy-to-navigate and enjoyable options for recreational journeys. The system is based on numbered junctions, or 'nodes', where cyclists can switch from one route to another. Each junction has a unique number and is signposted along with directions that guide cyclists to the next junctions (see Fig. 28). This allows cyclists to plan their routes by simply following the numbers from one junction to the next, creating a custom route.

The knooppunten network covers both urban and rural areas, connecting cities, towns, the countryside, and recreational locations. Routes are chosen to highlight scenic areas, historical sites, and natural landscapes. The system is very popular among Dutch recreational cyclists because of its recognizability, simplicity, and flexibility. Cyclists can adjust their routes on the go, choosing shorter or longer paths.

The formation of node routes is a collaborative effort involving local and regional authorities, such as municipalities, provinces, and water boards, as well as the organization Dutch Cyclists' Union (Fietsersbond). Junctions (knooppunten) are selected based on several criteria, including safety, scenic value, connectivity, and accessibility. The network is designed to be safe, enjoyable, and practical for (mostly recreational) cyclists. Governments are responsible for the installation and maintenance of signs, as well as the upkeep of the cycling paths. In the case of dyke routes and other water management structures, water boards have the responsibility of maintaining the infrastructure.

Several apps and websites provide planning and navigational tools for the knooppunten network, with the most popular being Fietsknoop, ANWB Eropuit, Toertje, and Fietsroute.nl.

Fig. 28: Node route signage (ANWB)

ANWB's Knooppunten tools

ANWB Eropuit primarily enhances outdoor recreational activities in the Netherlands, offering services through the ANWB website and the Eropuit app, available on both iOS and Android platforms. The service includes two main elements:

- Route suggestions: 262 pre-planned knooppunten routes by the ANWB spread over the Netherlands.
- Knooppunten route planner: to create your own route.

Since the knooppunten are occasionally adjusted, all ANWB suggested routes are

annually checked by volunteers. In one year (06-2023 to 06-2024) the page of the bicycle knooppunten route suggestions was visited 686.000 times on the website and 900.300 times in the app.

User preferences
Users are divided into those who:

- Use the app for all actions
- Use the website to plan the route and then write down or print the knooppunten (nodes)
- First plan the route on the website, save it, and then open it through their account in the app

Users who use the app during cycling typically place their phone in a mount. They only check the navigation to see the next junction and use the route assistant with sound to know when they have deviated from their planned route (missed a junction).

Due to the popularity of the Eropuit service, investments are made to improve it. Recent developments include upgrading the navigation to allow for a centralized view and adding recreational points in the route planner (previously only possible to connect knooppunten), such as cafés and museums.

Pleasant and safe navigation on Knooppunten routes

Avoiding high-risk points

While the node network is designed with safety in mind, the ANWB frequently receives feedback from users and route inspectors about specific points or sections of node routes that are perceived as unsafe or unpleasant. The ANWB does not have the authority to modify the nodes themselves, and municipal responses to ANWB or Fietsersbond recommendations can be slow. Cyclists typically follow the node route without questioning them, trusting the system and preferring not to navigate independently. Research indicates that dike roads, quite often part of these routes, are often perceived as unsafe by cyclists, yet they bike on them as the node system directs them to do so and as they enjoy the vastness of the view (ANWB, Fietsersbond et al., 2024).

Providing detours around high-risk points identified by the algorithm could add value to the node service of the ANWB. It's important to avoid creating the impression that node routes are generally unsafe. Therefore, detours should only address genuinely 'high-risk' points. These detours would follow the *pleasant, safe route* algorithm, leading users back to the node route afterward.

Introducing detours during navigation might cause distraction and confusion, as it requires users to deviate from their usual method of following node signs. To prevent this, users should be given the choice to enable this feature before starting their journey (see Fig. 29). This way they are informed of the function prehand. During the ride, the voice assistant would inform them of any proposed route changes.
It is important to assess through user research whether distractions and confusion can be sufficiently minimized, ensuring the safe implementation of this feature.

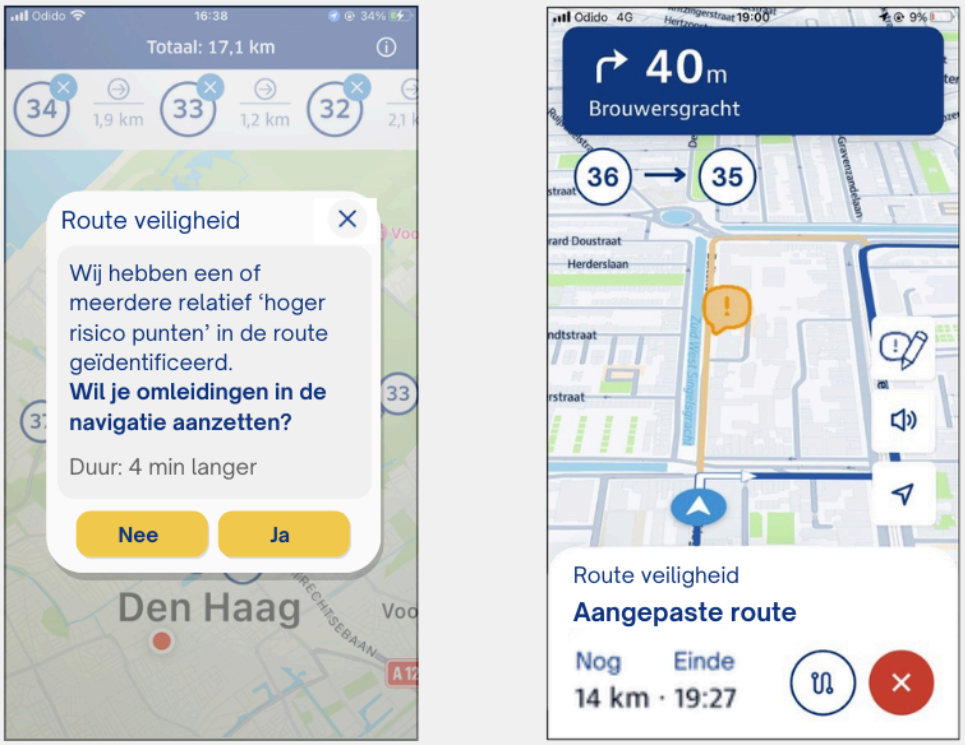


Fig. 29: User interaction; avoiding high risk points

The pleasant, safe route for navigation around the node network

As previously mentioned, it will soon be possible to add recreational points to routes in the node route planner. To navigate these points, it is beneficial to use the algorithm of the pleasant, safe bike route. Users do not need to know that the route selection is based on this algorithm, as it only affects small route segments.

Fig. 30: The pleasant, safe route automatically used for included recreational points in node route

Clear information sharing on bicycle safety for node network route planning

For every bike route offered by the ANWB, there is a section dedicated to bicycle safety and accessibility (see Fig. 31). This section advises users on how to account for route conditions and helps them determine if the route is suitable for them. The information is based on feedback from route inspectors. In March and April 2024, this section was clicked 5735 times (ANWB data, 2024). However, users do not have this information available during the route, and such information is currently unavailable when planning a node network route independently on the ANWB planner.

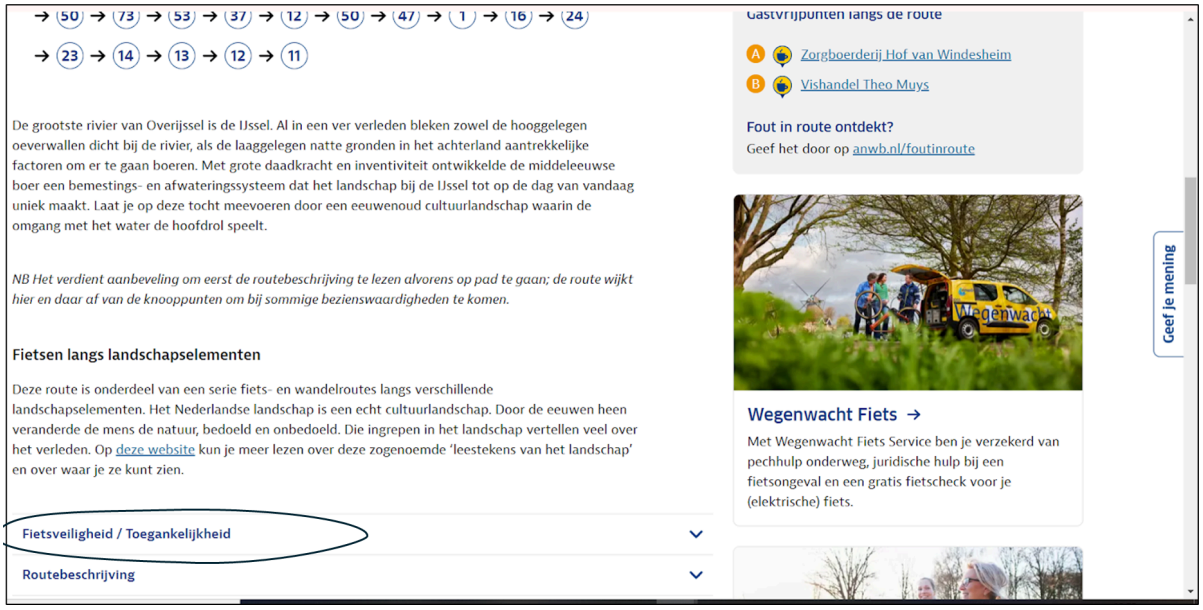


Fig. 31: Current safety information sharing on node routes (ANWB website, 2024). First picture shows the full web-page capture with the tabs for extra information, including 'bicycling safety / accessibility'. Second picture shows the tab after clicking on it.

To ensure that all users are informed about the safety and accessibility of their chosen route, it is proposed to display a pop-up with key information before starting a node route in the app. This feature reduces the likelihood of older users accidentally beginning a route

that is unsuitable for them. The pop-up will highlight any safety concerns between specific nodes and allow users to adjust their route accordingly. In case of the suggested routes, they can search for a more fitting one. In case of the node route planner, users can make alternative node connections. When selecting a node connection, they should also be able to read safety remarks (if applicable), to be able to consider them while laying the connections of their route (see Fig. 32).

Those who do not wish to adjust the route can still appreciate knowing what to expect. For example, target group research indicated that a segment of users especially enjoys routes with varied terrains, such as shell and sand paths.
The feature ensures that safety information is both presented for the node route suggestions, as well as the independent node route planner, enhancing the overall user experience and safety

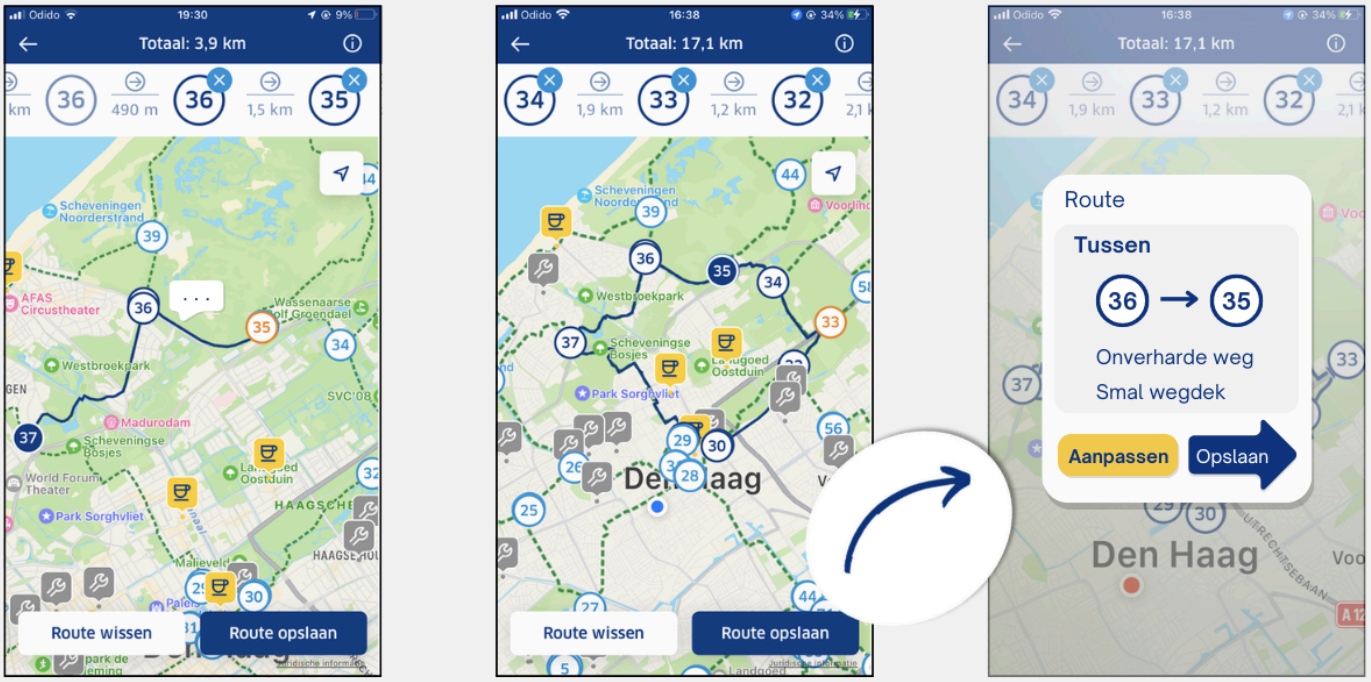


Fig. 32: User interaction; Information sharing on bicycle safety for node network route planning

Note: If a route includes multiple safety remarks, they should still be displayed in this single pop-up (e.g. with a scroll-function) to avoid adding many steps and/or time to the user's planning process.

Participative elements

The concept proposal includes and encourages participation of the user in enhancing traffic safety. There are two elements that highlight participation: asking users for input on risk points and to share what they consider pleasant, scenic routes.

Sharing of risk points by users

By allowing users to share risk points, the navigation for the pleasant, safe route could be enhanced, safety information for node routes can be supplemented, and road authorities can be kept informed of areas needing improvement.

There would be three ways to share a risk point: during navigation, at the end of a trip, and outside of a trip.
Firstly, while navigating, the button to report a risk point is visible and usable when the user is stationary (standing still). The feature is disabled during the ride to avoid distractions. At the end of the trip, the user is asked to describe the risk at the reported point. If the reporting was accidental or incorrect, they can adjust or choose not to share it.
Secondly, at the end of the trip, the screen automatically zooms out, and the button for reporting a risk point appears again (in the row of buttons on the right of the screen).
These two options allow users to accurately mark risk points while the experience is fresh in their minds.
Thirdly, outside of a trip, users can always report a risk point from the home screen and potentially from a traffic safety section, if included (see Fig. 33). This allows users to manually place a point on the map and immediately input the reason for the report.

Currently, the ANWB receives multiple safety comments on node routes but lacks a system to clearly map and share these with road authorities. Only when a route receives frequent negative feedback does a regional manager contact the relevant municipality. This proposal can address the need for users to share their concerns and contribute to traffic safety.
To ensure structured processing of reports, a categorizing system should be in place. Users could be asked to classify their reports under predefined categories. A map with risk point reports, including a category filtering

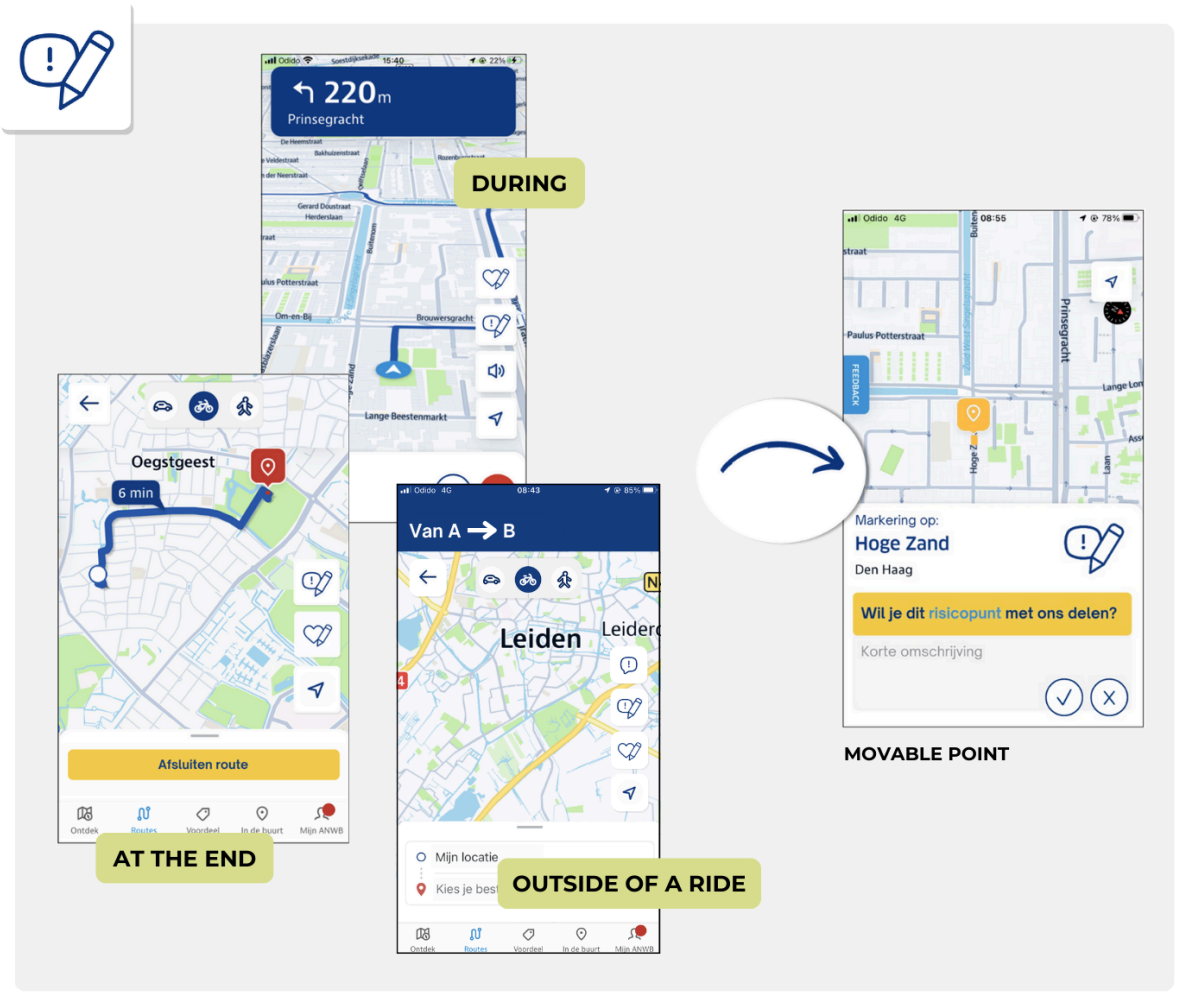


Fig. 33: Three ways to share a risk point

function, could help municipalities and road managers clearly identify areas needing improvement (see Fig. 34).

Risk points may eventually be improved or resolved. Three methods are proposed to keep the status of reports up to date: allowing road authorities to remove or respond to reports; implementing a time frame after which reports are automatically removed; and potentially having ANWB volunteers check the risk points to determine if they have been resolved.

The idea of making traffic safety data transparent, including reported risk points, was explored, as shown in Fig. 34. This functionality was presented in the validation survey but was advised against inclusion in the service. It did not align with the needs of the target group, as detailed in the validation section

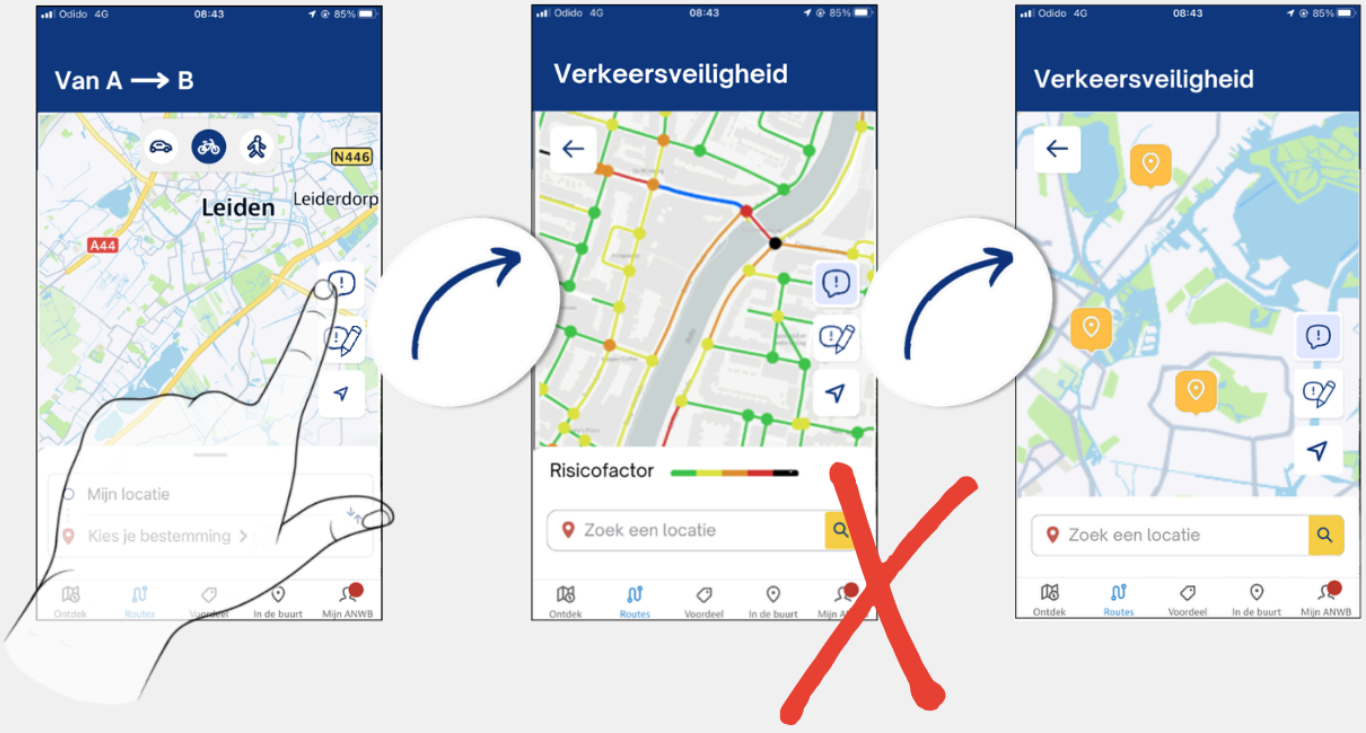
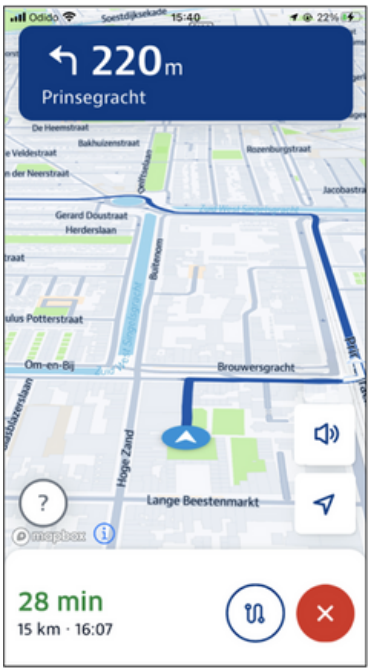


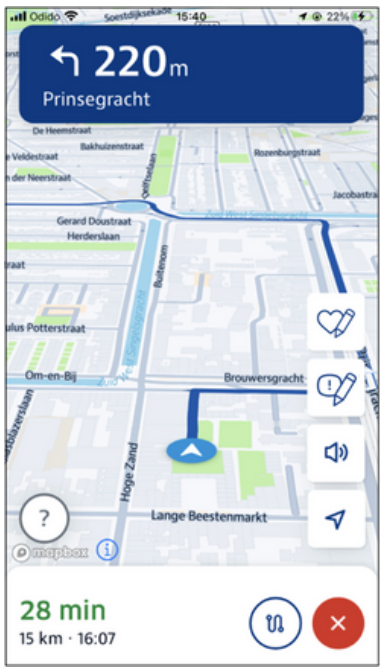
Fig 34: Insightful map of traffic safety data, including map of risk points

USER INTERACTION: RISK-POINT SHARING

DURING NAVIGATION

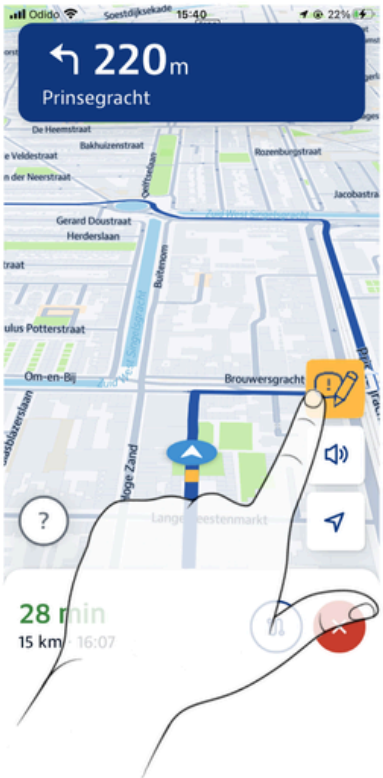


Moving



Not moving

Feedback buttons appear



Ride finished

MARKING A RISK POINT

Possibility to still move the point

Sharing of the scenic route by the user

The goal of this function is to provide input to the algorithm to offer the most pleasant, safe route.
Safety would remain the priority, but when streets score equally well on safety, the deciding factor in the algorithm could be the scenic quality of the route.

The option to share which roads and paths a user finds pretty or pleasant would be made available in the same ways as sharing risk points. Unlike most risk points, a scenic route covers a broad path. Therefore, users would be able to click on a road segment to mark it, as shown in Fig. 35 'outside of ride'. They can mark multiple segments and click a checkmark button when finished. A message will appear explaining the purpose of this function and asking for confirmation to share. It is important to inform users about the purpose of their input to avoid confusion. An example of the message that could be shared is the following: “Help us to provide routes that are enjoyable to ride”.

Consideration could be given to a feature for tracking the scenic, pleasant route during cycling, where the user starts the tracker before riding and stops it when the ride is complete (see Fig. 35 ‘during’). However, it would have to be assessed whether this function might cause distractions, potentially undermining safety.

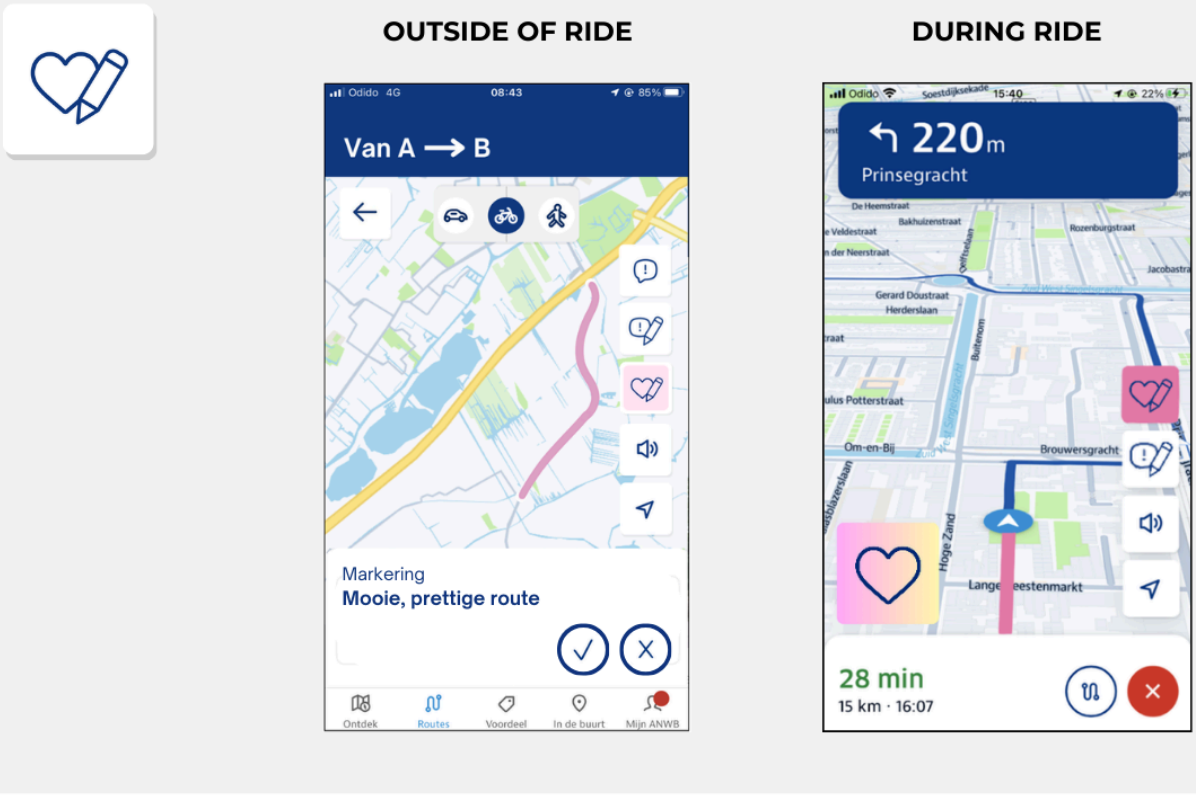


Fig. 35: User interaction; Sharing of the scenic route by user

Design recommendations

Design for safety and for elderly

Ensuring safe navigation involves more than route planning, it also requires an app design that enables safe usage. Since the elderly will be the primary target group for this service, the app should be tailored to their needs. Furthermore, designing for the elderly can inherently create a safer app for all users.

The following elements are recommended:

- **Large fonts and buttons**
  Use relatively large font sizes and big buttons to accommodate short-distance vision deterioration.
- **Intuitive and simple interface**
  The app should be intuitive and as simple as possible, avoiding unnecessary complexity. Elderly users can struggle with learning to use new interfaces.
- **Instructional pop-ups**
  Providing instructional pop-ups on how to use the app's features can be helpful.
- **Minimal distractions**
  In traffic, it's crucial to minimize distractions and confusion. Therefore, relatively complex functions should be avoided during rides

Furthermore, it is recommended to research voice assistance during navigation, as it is a widely used feature for cyclists. Understanding what users find pleasant and effective regarding voice assistance can significantly enhance the user experience.

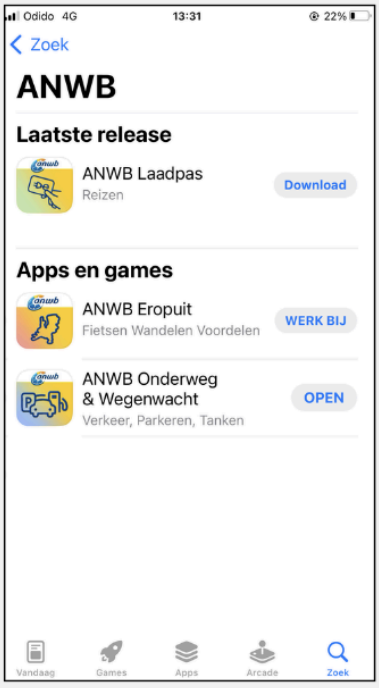
Avoiding stigmatization

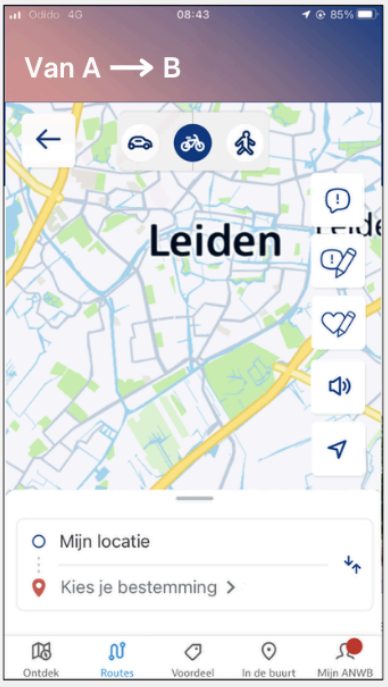
An important aspect of designing for the elderly is to avoid stigmatization and a sense of patronization, which can reduce their willingness to use the service.
A guideline in designing can be to see if the app design corresponds with and balances the 13 fundamental needs, outlined in the 'Design for Happiness' framework by P. Desmet from TU Delft.
Examples of needs included are autonomy, impact, recognition, and competence.

Differentiation between ANWB apps

To emphasize the distinct purposes of different ANWB apps and give them more character, it is recommended to use different color filters for each app. An initial concept for this differentiation is shown in Fig. 36. Simultaneously, it is recommended to integrate apps into each other that have overlapping purposes. An example would be to merge ANWB Laadpas (car charging e-card) into ANWB Onderweg.

Fig. 36: Suggestion of differentiation between apps





Marketing and nudging

By effectively marketing the new features and using strategic nudging, users can be encouraged to take full advantage of the new, safer, and more enjoyable navigation options.

Most of the new features added to the node services (knooppunten services) will automatically present themselves to the current users. For those that don't or require new specific operations, implementing instruction screens to the app(s) about new features, similar to those already used by ANWB, would be recommended.
Regarding the A to B navigation, users and potential users are to be made aware of its presence and benefits. The key is to present the Unique Value Proposition (UVP), which is to offer a pleasant, safe route along with its associated benefits. The UVP refers to the unique benefit or advantage that a product or service offers to its customers or target audience (Harvard, n.d.). Since users prioritize different values, it's important to highlight various benefits related to the pleasant, safe route.

Highlighting key features

When planning a route, it is advisable to mention multiple factors that can be of value to users, such as "less traffic, fewer traffic lights, more scenic routes". Moreover, it is important to realize that reading 'pleasant and safe' without context, can be abstract for people.
Additionally, a comprehensive description of what the pleasant, safe route entails should be made available on the website, the app, and in the Kampioen magazine. Highlighting the quality and special features of the pleasant, safe route can work convincingly.

Prompting like "*Curious how your daily routes can be more pleasant and safer? Try our updated A to B navigation*" can encourage users to take the first step (see Fig. 37).
How a service is presented is important; instead of "a safe bike route for the elderly," suggest: "pleasant and scenic biking for everyone," avoiding stigmatization.

Encouraging route planning

For users of the node routes, it is particularly recommended to suggest the practical link to use navigation to the starting point of a Knooppunten route, with options for car, walking, or biking navigation. When the map identifies that the user is positioned elsewhere, it can suggest: "*Would you like navigation to the starting point?*".

Fig. 37: Example for making users aware of the new function as well as encouraging them to use it

5.2 Benefits

The implementation of the "pleasant and safe cycling route" features bring numerous benefits across different stakeholder groups.

App and website users

Meeting the needs of elderly on regular and e-bikes

The concept primarily addresses the needs of older adults to enjoy pleasant cycling routes free from disturbances by other road users, allowing them to savor their rides, even when they serve a practical purpose. Moreover, the app's user interface is designed with older adults in mind, ensuring ease of use.

Informed decision-making

The app provides comprehensive route information for the node routes, allowing users to choose paths that suit their preferences for safety and path conditions.
The safety-seekers and avoiders identified in the target group analysis will particularly benefit from the enhanced provision of safety information.

Community engagement and leverage power

Users can actively contribute to the quality of the navigation system by providing feedback on risk points and scenic routes, fostering a sense of community and shared responsibility. Similarly, they are enabled to advocate for road safety to local authorities.

Centralized functionalities

By incorporating the navigation for A to B for cars, bikes and pedestrians in both the Eropuit and Onderweg app, the need to switch between different apps is reduced, making the user experience more streamlined.

Other road users

Improved traffic flow and interactions

By guiding cyclists to routes with appropriate infrastructure, the app can help manage traffic flow more efficiently, reducing congestion in high-traffic areas.
Furthermore, with fewer cyclists on more high-risk routes, interactions between cyclists and other road users (e.g., motorists and pedestrians) can be more overseeable.
Looking at the reduction of the number of elderly cyclists at points with a higher traffic intensity or unclear points, other road users especially benefit; as described earlier in the section on rider types, elderly can cause annoyance and risk for other road users when they are more careful or slow in their actions.

Road authorities (wegbeheerders)

Risk-driven planning

The data from the app contributes to accident risk-data and the risk-driven strategy of road authorities to inform their infrastructure planning and improvement projects.

Handling safety issues

Through the identification of risk points by the users, road authorities have an overview of where they are to improve specific measures in the short term, such as improved signage.

The ANWB

Brand enhancement

Offering an innovative and cyclist-centric navigation feature enhances ANWB's reputation as a socially engaged association and provider of mobility solutions, particularly in promoting safe and enjoyable cycling.

Increased app usage

By integrating this feature into the Eropuit and Onderweg apps, ANWB can attract more users, increasing app engagement and usage.

Data and Insights

Collecting data through the app provides ANWB with valuable insights into cycling trends and safety issues, which can be used to further refine their services and advocacy efforts.

Summarizing, by prioritizing safety and pleasantness, ANWB not only enhances the cycling experience for its users but also contributes to overall road safety, supports informed infrastructure development, and strengthens its position as a provider of innovative and safe mobility solutions.

5.3 Competitive advantage

Competitive advantage refers to the attributes that enable an organization to outperform its competitors and maintain market leadership. In this section, the competitive advantage of the ANWB will be discussed in relation to the proposed 'pleasant and safe cycling route' concept.
Firstly, the strengths and capabilities of the ANWB will be discussed that make the organization especially suited to introduce this service. Afterwards, the concept will be placed in the context of potential competitors. Leveraging competitive advantage is important for the successful adoption and differentiation of the concept in the existing market.

First mover advantage

Being the first to introduce the option of a navigation that offers a 'pleasant and safe cycling route' provides ANWB with a first mover advantage. The concept leverages risk-driven data that is already being collected, but has so far only been used to inform policies by road authorities and municipalities. By being the first to utilize this data to directly benefit users, ANWB can establish itself as a pioneer in the field.

Alignment with ANWB's values, strengths, and capabilities

The proposed features align with ANWB's mission, core values and strengths.
ANWB has four brand values: Reliable, Human-Centric, Progressive, and Vibrant. It also has two ambition values: Innovative and Contemporary. By introducing a service that emphasizes 'safety,' ANWB can benefit from its reputation for reliability and sincerity. The concept re-enforces the brand identity as it demonstrates ANWB's commitment to innovation and to addressing current societal challenges. Lastly, the proposal fits with the mission statement of the ANWB:
enable everyone to travel carefree and joyfully in a sustainable society.
(ANWB, n.d. - Translated from Dutch).

Strengths

ANWB has multiple strengths that can be leveraged for the new functionalities:

Large reach, including the target group
The ANWB can use its large membership base and visibility through its wide array of services. Beneficial for the concept, the membership contains a significant representation of elderly. Furthermore, Eropuit is already a highly popular app among recreational cyclers.

Reputation for traffic safety
ANWB has long been active in the field of traffic safety, with recent visibility in promoting bicycle helmets. This established reputation can facilitate the adoption of new features and further enhance ANWB's image.

Utilization of proprietary data
ANWB already collects traffic safety data through the Verkeersveiligheid verkenner, which can be used to enhance the feature. Furthermore, the ANWB has extensive in-house knowledge and capabilities regarding IT and road safety.

Lobbying power
As an association committed to road safety, ANWB has the representability and influence to advocate for necessary infrastructure improvements.

Developments

Several ongoing developments offer additional advantages:

Established Foundations
This feature builds on existing ANWB tools such as the ANWB Onderweg navigation and knooppunten navigation. The cycling route planner (website function) will be removed, which opens up the possibility to re-invest the funds that go to software-provider Andes. Furthermore, the proposed features connect to the current developments of the Eropuit app, namely the addition of navigation for node routes and the possibility to add recreational points.

Improving Infrastructure
With ongoing improvements in infrastructure, supported by initiatives like the Traffic Safety Impulse (Verkeersimpuls), there will be more suitable paths and streets for the pleasant, safe route.

Growing need
As cycling paths become busier and more diverse, the desire for safe and pleasant routes is expected to increase, particularly among older users. Moreover, caring more for being safe on the bike could become a new social standard amongst the older segment of elderly, looking at the growing helmet use.

ANWB's position relative to competitors

In the market for bicycle route planners, several apps are active alongside Eropuit: Google Maps, Komoot, Toertje, Fietsnetwerk, Route.nl, and Fietsknoop. The latter three focus specifically on Knooppunten routes and are backed by relatively small organizations. Komoot targets adventurous users seeking sports challenges. Toertje and Google Maps are more direct and potential competitors for this concept.

Toertje

The Fietsersbond Routeplanner app has merged into the new Toertje app, launched in May 2024. Toertje aims to motivate people to choose the mode of cycling more often, by focusing on tracking and sharing functionalities similar to Strava. Rides are presented with statistics and rewards. During a ride a timer is running, as to show it is tracking the ride. However, the presence of a running timer during rides may for example cause distraction, stress, or pressure for elderly which could undermine safety. Since Toertje's primary goal is not to promote cycling safety, it is unlikely to invest heavily in adding a safe and pleasant route feature. Moreover, functionalities focused on tracking appeal to a specific audience.

Googlemaps

It seems unlikely that Google Maps will add a feature specifically for safe and pleasant cycling routes. Google Maps is a generalized navigation platform that might not want to present such specific features. Moreover, ANWB has the advantage of being involved with government and road authorities regarding traffic safety developments, making it a more logical player to promote this initiative in the Netherlands.

By emphasizing traffic safety for cyclists, ANWB can differentiate itself. ANWB's focus on making navigation suitable and pleasant, particularly for elderly users, further sets it apart.
By differentiating from competitors like Toertje and Google Maps, ANWB can establish itself as the leader in safe and enjoyable cycling navigation, further strengthening its commitment to enhancing road safety and user experience. The unique focus on safety and pleasant routes sets ANWB apart from its competitors, offering a distinctive value proposition.

5.4 Validation

User test

Validation surveys were used to gain a first impression of the perception of the target group and potential users of the proposed service. Surveys allow for a qualitative insight, while also representing a bigger audience than interviews. The medium-fidelity prototypes, namely the visualizations of the UI per function, were used to present the new functionalities. Based on responses, recommendations will be made regarding the development of the functionalities.
For further steps in user testing, it is recommended to conduct interviews with more advanced prototypes (e.g., a Figma prototype of the app). This approach offers additional validation opportunities.

As to give insight in the perception towards multiple proposed functionalities, two surveys were drawn up to facilitate detailed responses while ensuring respondents remained focused and willing to participate. The majority of respondents were part of the ANWB memer panel and a smaller count through connections, where a similar sampling and data analysis method was applied as for the qualitative survey in the target group research, see method description in Ch. 3.2.
Analyzing a multitude of qualitative responses is enabled by making use of a chatbot with AI, in this case ChatGPT. Moreover, it enables generating quantitative results out of qualitative responses.
First categories are identified without the aid of AI. Subsequently, the chatbot is asked to count the frequency of responses that fit each category. All AI-generated answers are reviewed and adjusted in the final results if any inaccuracies or misjudgements are found. No sensitive data is added into the chatbot and respondents remained anonymous.

The focus of this validation lies on the initial target group of the services, namely elderly aged 60+ on e-bikes and regular bikes.

Two surveys, covering the presentation and questioning on the following functionalities:
Survey 1:
- ➔ Adding navigation for A to B to the Eropuit app
- ➔ The option of the pleasant, safe route in the navigation for A to B

Survey 2:
- ➔ Detours to avoid high-risk points in the Knooppunten route *
- ➔ Safety information about specific Knooppunten elements when planning a route *
- ➔ The ability to share a risk point
- ➔ An insightful map of traffic safety data

The new features for planning a node route (*) were specifically answered by current users of the ANWB node route services to ensure the additions were well understood and to obtain more reliable responses.
All survey questions can be found in Appendix I.1 & I.2. The data is presented in English, although the questions were originally posed in Dutch.

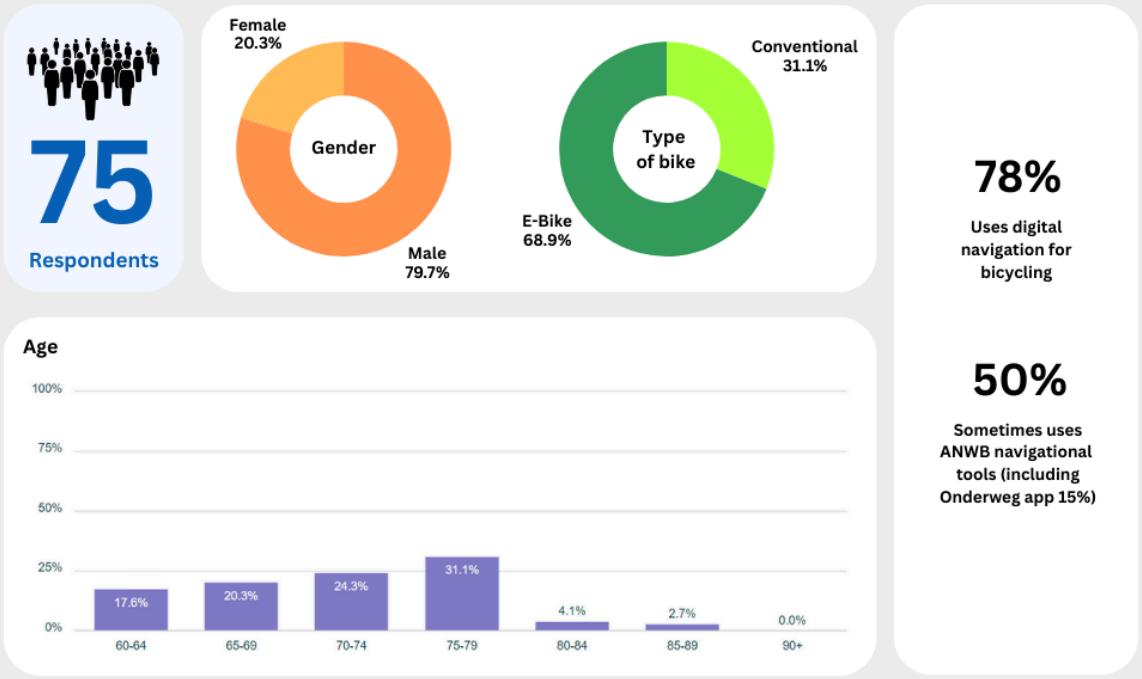
Survey 1:
Adding navigation for A to B to the Eropuit app, with the option of the pleasant, safe route

The survey was aimed to answer the following underlying research questions:

- Does the target group already use digital navigation for bike rides and in what way?
- What is their impression of the new functionality?
- Would they adopt the new functionality?

- What do they expect a *pleasant, safe route* to include?
- What do they find to be the most important factors for a *pleasant, safe route*?

Respondents profile



Analysis of results

An extended presentation of results is presented in Appendix I.3. Quotes are translated to english, original quotes can be found in the Appendix J.2.

Digital navigation usage:
78% of respondents use digital navigation, with 51% indicating they use it for functional purposes, not just recreational activities.

Navigation methods:

- 38% use a phone mount on the handlebar to keep the digital navigation route visible during cycling.
- 40% stop a few times during the route to check their phone.
- 40% always or sometimes use voice assistance for navigation.

Interest in pleasant, safe routes
34% of respondents identified with the statement:
"*I am curious whether my daily routes are already the pleasant, safe routes*".

Open question: would you (sometimes) use the pleasant, safe route and why?

No: Five respondents (7%) said they would not use the pleasant, safe route.
Yes: 70 out of 75 respondents (93%) indicated they would use the pleasant, safe route option. For which the following motivations were expressed:

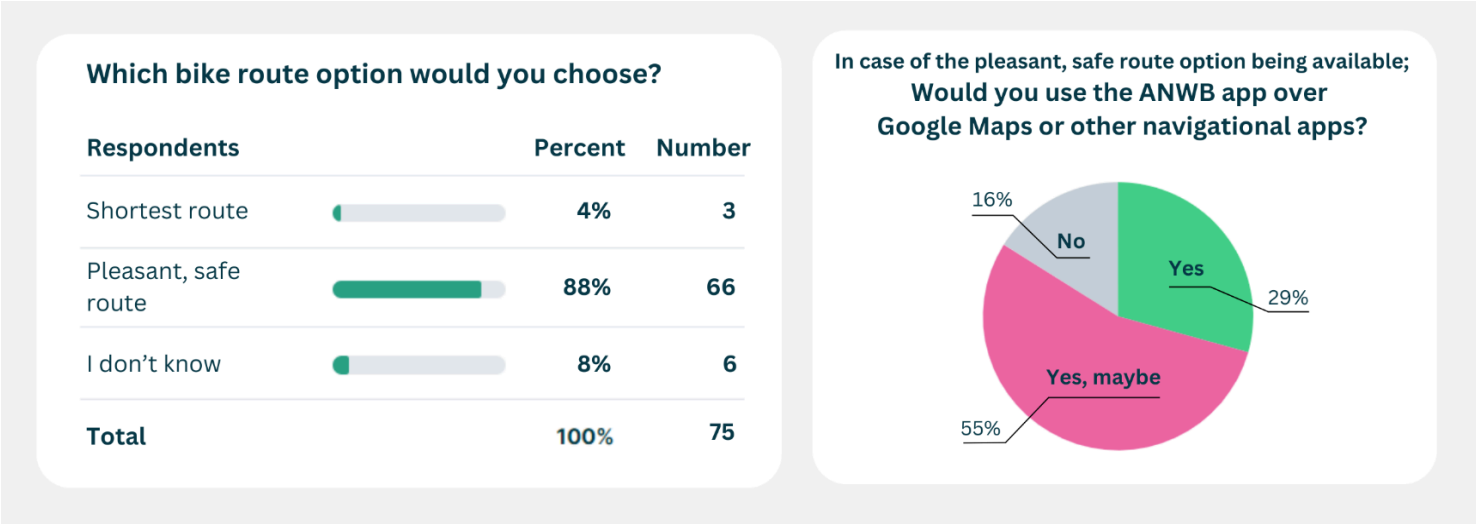
- **Safety**
  10 respondents (14%) emphasized safety as their primary reason for choosing this option. Examples include:
  - *"Safety is more important to me than getting somewhere quickly via the shortest route."*
  - *"Safety above all else."*

- **Enjoyment of biking**
  17 respondents (23%) mentioned they see biking as an enjoyable activity. Examples include:
  - *"Yes, I cycle for fun, so going on maybe a bit of a detour is no problem!"*
  - *"Certainly, I'm not in a hurry and I want to enjoy the surroundings."*
  - *"Definitely, much more relaxation."*

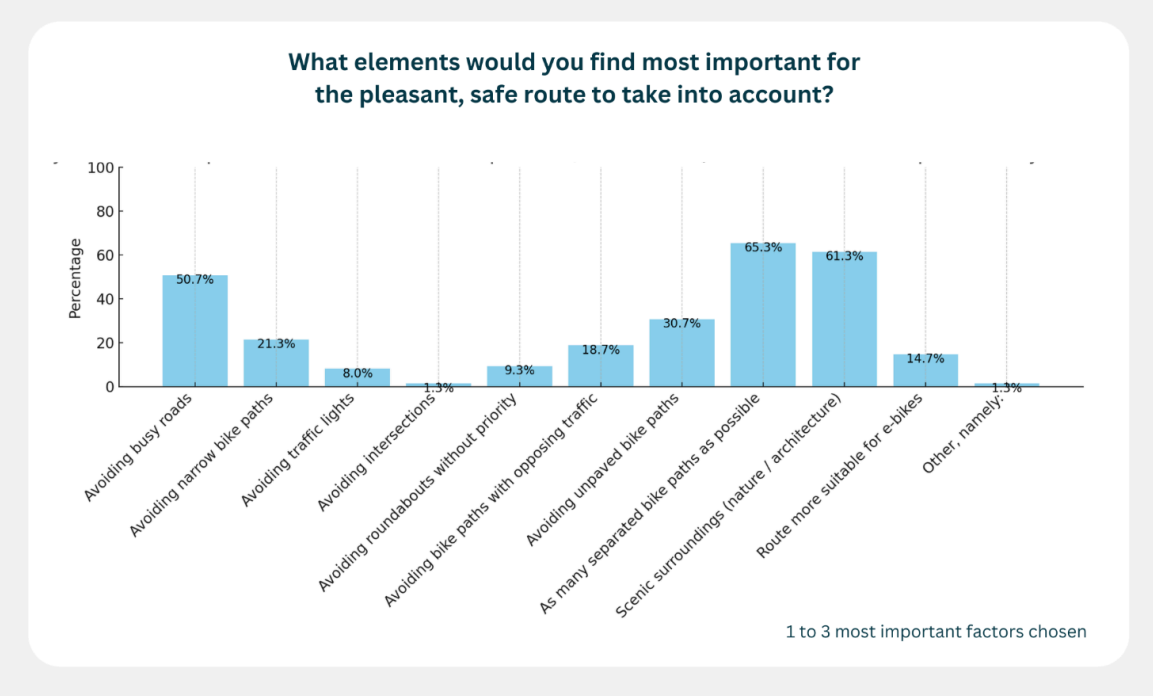
- **Situational use**
  8 respondents (11%) would use it depending on their need for quick travel and the length of the detour. Responses include:
  - *"Yes, but you should not detour too much to follow the route."*
  - *"In principle always, but not if it doubles km/time."*

- **Recreational rides**
  13 respondents (18%) saw value in using the option for recreational rides, wanting to enjoy the surroundings. Examples include:
  - *"Calm and scenic cycling."*
  - *"Certainly, especially if it concerns a leisure bike ride."*

- **General positive responses**
  Other responses were less descriptive, such as:
  - *"Yes, I would like to try it out."*
  - *"Certainly, seems very useful."*
  - *"Yes."*



Graph 5 & 6: Results of closed questions



Graph 7: Result of closed question

Attitude towards adding the navigation for A to B navigation to the Eropuit app

11 respondents already made use of the Eropuit app. They were asked the following question:

'How would you think about having the navigation option for normal cycling routes in the same app as the junction planner (ANWB Eropuit)?'.

Not interested: 1 respondent.
Neutral to positive: 4 respondents, 'Prima'.
Positive: 6 showed to think it a good idea, through reactions such as "Excellent" "Pleasant!' (Dutch: "Fijn!") and "Yes, do it.".

Discussion of results

Attitude towards the pleasant, safe route option

The reaction towards the pleasant, safe route option was generally positive. 93% would want to (sometimes) use the pleasant, safe route, and 88% seem to want to choose the option over the shortest route when they can (see Graph 5). Especially notable is that 29% out of the digital navigation users would use the ANWB navigation instead of Google Maps or the other digital navigation they used, to be able to use the pleasant, safe route. 55% would consider doing so as well, responding with 'yes, maybe' to the question (see Graph 6).

Expectation and preferences regarding the pleasant, safe route

The responses throughout multiple questions showed that the target group finds the following elements excel as important in their preference for a pleasant, safe route: routes that are 'pretty', preferably with nature in the surroundings, and routes that avoid busy roads as well as roads without a bike lane. Notably, 31% find avoiding unpaved paths an important factor (see Graph 7).
Regarding crowdedness, specifically the annoyance was mentioned again a few times of other traffic participants passing them closely with high speed. This was a specific recurring annoyance mentioned during the interviews of the target group research.
In the open question of what users would like to see as factors of the pleasant, safe route, three respondents named charging points for biking long routes.

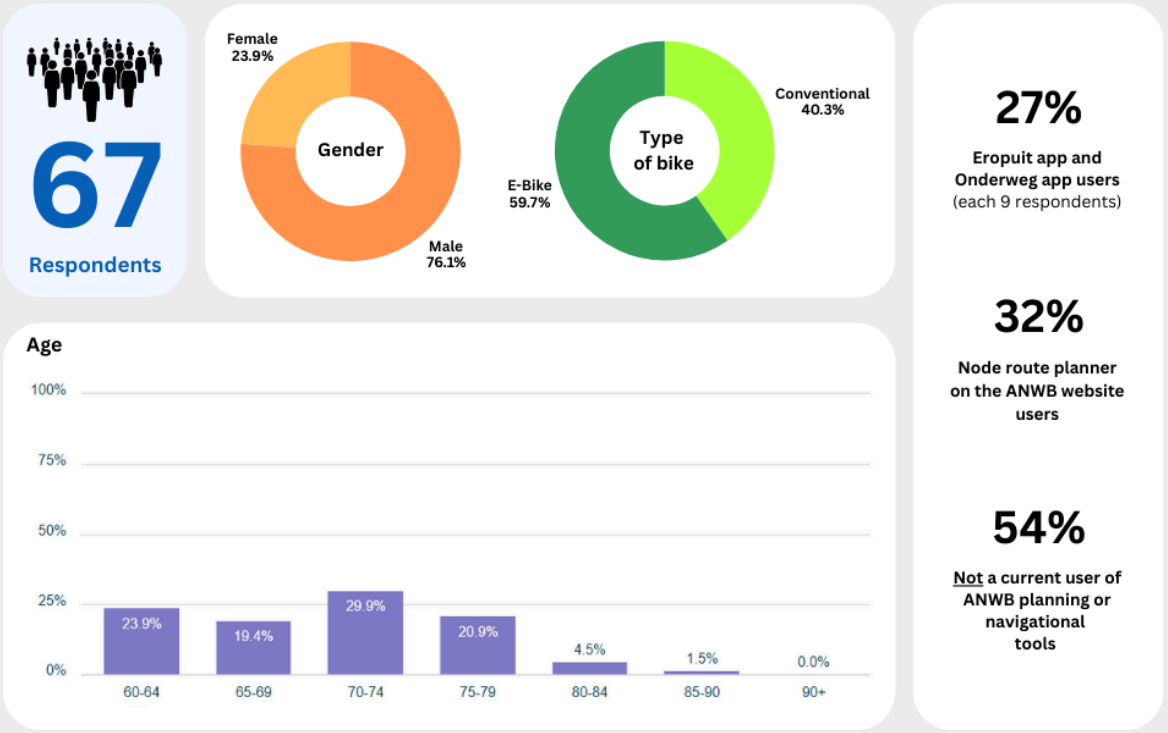
Addition of navigation for A to B to the Eropuit app

No reactions indicated that they would find it an odd addition or that it wouldn't fit within the app.

Survey 2: Additional functionalities

This survey focussed on the perception of the target group on four additional features, mentioned in the start of the Validation section. Each function was individually presented, alongside corresponding questions.

Respondents profile



Analysis of results

Due to a technical issue with the survey tool, the closed questions on the features were unavailable for a period. As a result, these were answered by fewer respondents compared to the open questions.
Quotes are translated to english, original quotes can be found in the Appendix J.3.

Detour to avoid high-risk points in the node network

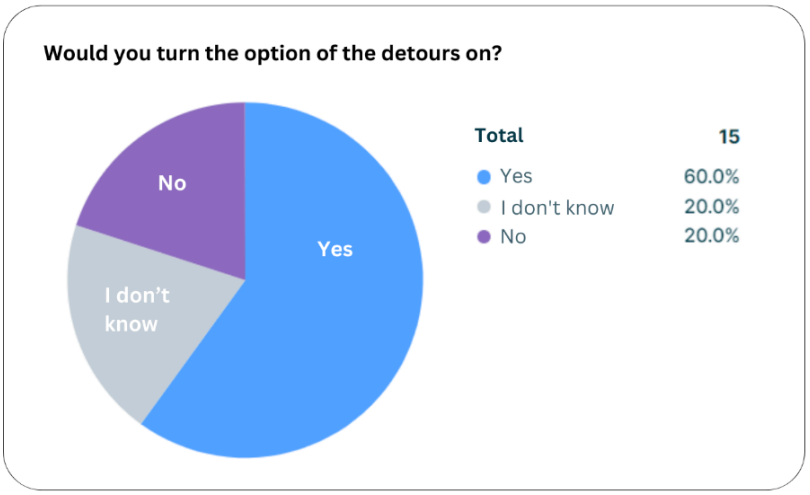
Open question (n=28): *"What would you think of this function? And why?"*

- **Unnecessary:** 25% of respondents found the function unnecessary. No explicit reasons were given.
- **Positive:** 75% were positive about the function.
  Positive responses included remarks such as:

"That would be pleasant" and "*Seems useful and practical to me*"
More detailed answers included:

- "*Would be nice, also if there are changes and the signs are not visible due to various possible causes"*
- "*I hope this will not be at the expense of the beautiful places in a route*"", highlighting the concern of missing scenic routes while avoiding high-risk points.

Close question (n=15 out of 28)

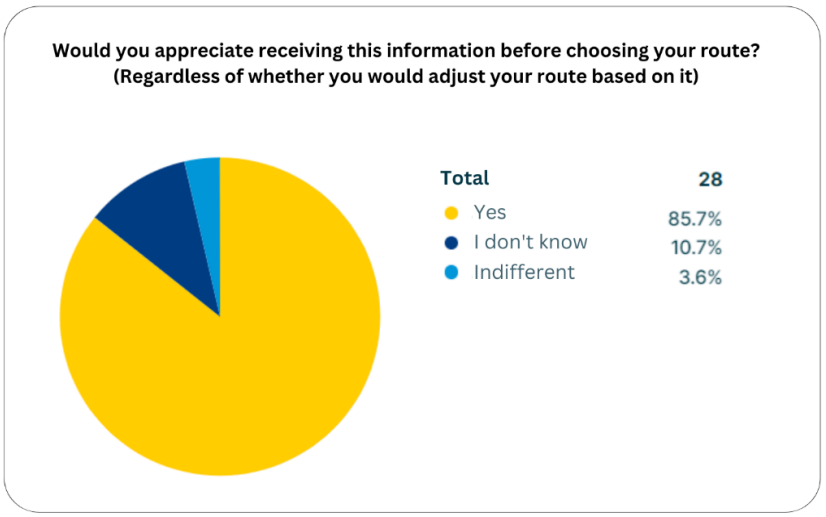


Safety information about specific node parts when planning a route

Open question (n=25): *"Would you make changes in the node route planning if you received this information? Why yes or no?"*

- **Yes**: 6 respondents would adjust their route, 5 would depending on other circumstances (such as weather, energy, company), totaling 11 (44%) who might change their route based on safety information.
- 2 respondents did not know what they would do.
- **No**: 10 respondents (40%) would not adjust their route.

Closed question (n=15 out of 25) :



Ability to share risk points

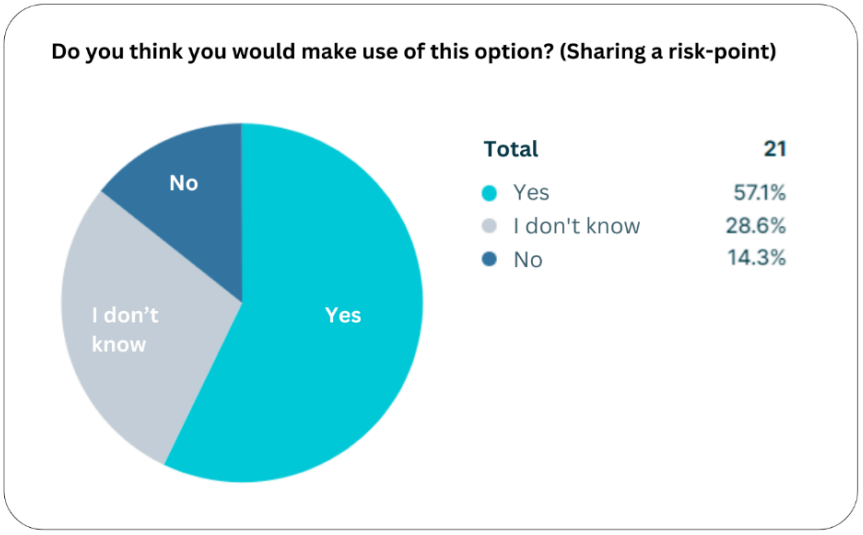
Open question (n=49): *"Would you think this option adds value? Why yes or no?"*

- **Yes**: 38 respondents (73.7%) found the feature valuable.
- **With conditions**: 3 respondents (10.2%) would find it valuable only if they could see actions being taken based on reports, with one specifying the need for being able to do it on the spot.
- **Unsure**: 4 respondents responded “Geen idee” (‘I don’t know’).
- **No**: 4 respondents (8.1%) did not find the feature valuable.

Examples of respondents who see value in the option:

- *“I think this is a good option. When we cycle, we sometimes encounter situations that we think would be good if they were looked at. But then, where can we report that? If that can be done in navigation, that's a bonus.”*
- *“That seems like a sensible solution to be able to use this. For example, if a traffic sign has been driven over, action could be taken immediately.”*
- *“Yes, we can make the road safer together.”*
- *“Yes, with enough reports, something might be done about it.”*

Closed question (n=21 out of 49)



Insightful map of traffic safety data

Open Question (n=45): "*Would you think this function adds value? Why yes or no?*"

- **No**: 20 respondents (42%) did not find the function valuable.
- **Unsure or hesitant**: 8 respondents (18%).
- **Partly or indifferent**: 7 respondents (16%), where 5 would value specific aspects but not the entire function.
- **Yes**: 11 respondents (24%) found the function valuable.
- Conditions for finding it a good option included ‘clarity’, ‘not showing accident details’, and ‘minimizing information overload to reduce stress’.
- General feedback included:
  - *“It seems obvious to me that you put the reported risk points on the map…”*
  - *“I don't really care about figures, however warnings yes.”*
  - *“Functions are nice, but in practice you are cycling and therefore probably not concentrated on this. So it has to be quick and clear.”*

Discussion of results

All functions, except for the detailed traffic safety data map, were generally regarded as valuable additions.

The response to the feature of a detour avoiding high-risk points in the node routes was more positive than expected. Initially, it was anticipated that more respondents would prefer to follow the node route at all times, out of ease. Some responses indicated that having the option to choose is beneficial, as they may still want to take the original route occasionally.

The feedback on the function providing safety information about specific node route components during route planning was notably positive, particularly regarding notifications about unpaved paths. It confirmed that some users prefer these paths, while others do not. Moreover, the first survey revealed that 31% of the 75 respondents find avoiding unpaved paths an important factor for a pleasant and safe route. This indicates that being informed about such paths is beneficial for many.

The positive reactions to the ability to share risk points suggest that users feel a need to contribute to overall safety, which is the intended effect of the functionality. The responses emphasize the importance of knowing what happens with their reports, seeing a system and structure in place, and observing the impact.

There appears to be little demand for a detailed map of traffic safety data. Users do not feel the need to take in much traffic safety information without a clear purpose. However, the responses showed that users would appreciate seeing where they have made reports and the status of those reports. This encourages the development of a map of reported risk points, if cooperation with road managers is possible.

The diversity in motivations given for the appreciation or implied use of the functionalities, correspond to the differences of rider types in needs and behaviour (confident, unaware, safety seeker, and avoider). This demonstrates that each rider type can find their own specific value in the proposed functionalities.

Recommendations based on the insights of both validation surveys can be found in the ‘Recommendations for development section on page 89.

Literature research

The effect of infrastructure on accidents of elderly on bikes

Research has shown that considering elderly cyclists as a vulnerable group in traffic requires more forgiving infrastructure (CROW, 2011). This supports the concept of encouraging the target group to use roads with these features. For example, it has been noted that seniors on regular bikes ride more slowly, making balance more challenging and causing them to weave more. Consequently, they need wider paths (van der Horst et al., 2013). However, the specific infrastructural criteria for safety effects have not been mapped out.

Route preferences and choices of elderly

Limited research has been conducted on the cycling route choices of the elderly. Two studies indicated that older cyclists place more importance on 'comfort,' considering not only travel time but also the speed of car traffic, the presence of bike paths, and traffic intensity (Joolink, 2016; Van Overdijk, 2016). Goldenband's research showed that many elderly cyclists care about the number of traffic lights, the complexity of intersections, the type of road surface, and the presence of mopeds and scooters on the bicycle lane (Goldenband, 2015).

Moreover, it has not yet been researched to what extent the route preferences of the elderly are inherently safe. The target group research in this paper has provided insights into this matter. It showed that while the majority of elderly cyclists prefer biking calmly without too many other road users zooming past them on narrow bike paths, most, consisting primarily of the confident and the unaware, do not consider avoiding peak hours (commuters and school/university go-ers). This majority also tends not to check the weather forecast.
Additionally, the target group research pointed out that elderly cyclists care about enjoying the route, which aligns with scenic routes. However, the scenic routes they choose are not necessarily the safer ones and can include relatively dangerous dike roads and poorly maintained paths.
In conclusion, the route preferences of the elderly do not seem to inherently lead to safer routes.

Stakeholder and expert reactions

Theirlynck, responsible for the cycling and walking routes and route planners at ANWB Eropuit, sees significant value in an automated feedback system, as all comments currently come in via email and cannot be individually addressed.

ANWB's product owner for Data & Traffic Safety, M. Mimpen, believes that an effective algorithm can be developed based on the information already available.

Paul Schepers, traffic safety advisor at Rijkswaterstaat Water, Traffic, and Environment (WVL) and program manager of the Taskforce Traffic Safety Data implementation organization, supports the idea and comments that it would be timely, given the recent availability of width labels of bicycle paths (breedtelabels).

Measurability

The effectiveness of the proposals when put into practice should be measurable. KPIs that could be considered are the number of accidents, user feedback, and the adoption rate of the navigation system. Also KPI's could be related to data factors that the floating bike data could provide if integrated in the future, such as intense braking.

5.5 Roadmap

In this chapter a strategic and tactical roadmap are presented to outline a comprehensive overview of all elements and activities associated with the design interventions. The strategic roadmap visualizes the key outcomes that are to be achieved along a timeframe, to realize the defined vision. The tactical roadmap breaks down the long-term strategic plan into smaller, actionable steps.

Future vision

The future vision serves as a focused direction and strategic reference point, motivating stakeholders involved in the design and guiding decision-making processes (Fiegenbaum et al., 1996). According to Simonse (2017), “A future vision is an expression of a desired future.”

The future vision for ANWB is formulated as follows:
"ANWB is a leader in the field of bicycling safety by applying innovative technology and comprehensive, up-to-date data insights to bicycle navigation”

Strategic Roadmap

The Strategic Roadmap is presented after page 87. Both the Tactical and Strategic roadmaps are in Dutch, since the ANWB is used to communicating its plans in Dutch internally.

Pilot, Fully functional and Advanced

The strategic roadmap illustrates three phases of development: Pilot, Fully Functional, and Advanced. It is valuable to have an overview of what is worked towards, so the goals can already be taken into account in the initial stages.
The purpose of the pilot study is to put the concept into action on a small scale to assess its feasibility, effectiveness, and practical implementation. It also serves as a test phase to identify potential challenges, gather feedback, and make necessary adjustments before scaling up. After the process of building the pilot service into a full-packaged service, with its additional features, it can be launched ‘fully functional’. Subsequently, it can be advanced with additional functionalities and software to make the app more refined, as well as to explore and integrate emerging technologies.

Step by step approach

Implementing the concept should follow a step-by-step approach. This gives the possibility to focus, give space for learning and iteration. This allows for focused development, learning, and iteration. The initial priority should be developing the navigation from point A to point B with a working option for the pleasant, safe route. The algorithm should suffice to perform the basic elements necessary for safer bicycling for the elderly.
The algorithm for the prettige, veilige route is the core innovation. Apart from the proposed function of safety information during the planning of all node routes and the possibility to share risk points, all other functions contain an application of the algorithm or are meant as extensions on the algorithm and navigation service. A pilot of the navigation with the algorithm is therefore needed to both determine whether to develop those other functions and in what way.
Prototyping of all functions can be performed from the start, along with user research.

Users

The app should be developed prioritizing the segment of elderly, as they are the vulnerable group. However, other users can benefit from the USP of the pleasant, safe route as well. As the service would be made available on both the Eropuit app and the Onderweg app, a wide array of users will be in contact with the service. Furthermore, as the service would reach the third stage, a bigger diversity of users would be attracted by its functionalities. Also, as it is a new service, it would most likely

follow the pattern of ‘Diffusion of innovation, by Rogers (2003). This pattern shows how different groups—Innovators, Early Adopters, Early Majority, Late Majority, and Laggards—adopt products at different times.

Further development ‘advanced’

With the basic functionalities established to deliver a desirable and effective service, ANWB should continuously seek to improve the service to remain relevant and further distinguish itself in providing an app that enables safe and comfortable cycling. The strategic roadmap suggests several value-adding functionalities, including machine learning and weather conditions, which have not prior been (extensively) discussed in this report.

Machine learning

Machine learning (ML) could significantly enhance the concept of the 'pleasant and safe cycling route' in various ways, adding value by improving the accuracy, personalization, and adaptability of the navigation system. Firstly, it can personalize routes by understanding preferred cycling speeds and behaviors. It is crucial to avoid over-reliance on personal preferences, as users may not always choose the safest route for themselves.

Moreover, ML enables real-time data analysis. It can process real-time data from various sources, such as weather conditions, traffic density, and accident reports, allowing the system to dynamically assess and update the risk levels of different routes. The system can use reinforcement learning to continuously improve its routing suggestions based on user interactions and outcomes.

With more users of the Eropuit and Onderweg apps, the data from these users' movements can be used in real-time. The Onderweg app is also used by drivers and, with the proposed concept, by pedestrians, creating a more comprehensive traffic picture. For indicating real-time traffic intensity, collaborating with Google could be particularly valuable.

Weather conditions

In an earlier stage it would be beneficial to consider how well paths fare under rain and frost. In a later stage it would be helpful for users to know if it will rain (and how severe the expectation is) during their planned route so they can prepare and adjust their choices accordingly. Currently, no app integrates weather with navigation in this way.

Compatibility with wearables

Given the importance of health, it is expected that more elderly people will wear health-tracking devices, such as smartwatches, in the future (Ict&Health, 2024). With the growing Internet of Things (IoT), such wearables are likely to become more common.During navigation, it can be very convenient to receive signals from your wearable about the route, so you are alerted without needing to check your phone. For instance, a smartwatch can provide subtle vibrations and display information or instructions on its screen.

Public transport

With the rise of MaaS and the societal need for sustainable transport, it could be valuable to consider adding (a link to) public transport to the ANWB navigation in the future. Public transport would additionally be a valuable alternative for bicycling when the weather conditions are poor.

Timeline

The estimation of the timeline is presented, where the Pilot would be concluded in 2025, the launch of the fully functional service would be in 2026 and the first advancements could be in 2027 and onwards.
The preparation, execution and learning from the Pilot, is estimated to take around a year, during which the initial version of the navigation with the algorithm for the safe, prettige route would be developed. Similarly, completing all other functionalities would require around a year as well, as they should also be prototyped, tested and well integrated.
The actions with their time estimation regarding the pilot are described in the section elaborating on the Tactical Roadmap.

STRATEGIC ROADMAP

AANBIEDEN VAN DE PRETTIGE, VEILIGE ROUTE

Navigatie van A naar B, met de prettige, veilige route optie

Toegevoegde functies voor knooppuntenroutes

Inzichtelijk maken verkeersveiligheid data

Waardes

Comfortabel & plezierig fietsen | Veilige mobiliteit | Gemeenschapsgevoel | Autonomie

	PILOT 2025	VOLLEDIG FUNCTIONEEL 2026	GEAVANCEERD 2027>
Platform	1 Regio	Nederland	
	Eropuit: website & app	Eropuit: website & app Onderweg app	
Functies	• Navigatie A > B: auto, fiets & wandel • Fiets A > B: Prettige, veilige route optie • Koppeling tussen knooppunten en navigatie A > B		
Toegevoegde functies/software		• Input gebruiker: risico-punten • Input gebruiker: mooie, prettige route • Kaart risico-punten: wegbeheerders • Fietsveiligheid informatie knooppunten • Prettige, veilige route in knooppunten	
Toegevoegde functies/software			• Machine learning • Real-time drukte • Weersomstandigheden aangeven • Persoonlijke spraakassistent • Floating-bike data gegevens: risico-data

Gebruikers

Doelgroep **Reguliere fietsers en E-Bikers** die behoefte hebben aan een comfortabele, veilige route (praktische en/of recreatieve doeleinden)

Pilot focus: Ouderen 60+

VISIE

De ANWB is een koploper op het gebied van fietsveiligheid door innovatieve technologie en actuele data in te zetten voor fietsnavigatie.

GROTERE DIVERSITEIT OP DE FIETSPADEN

SLIMME FIETS EN AUTO SYSTEMEN

IOT

DUBBELE VERGRIJZING

GROENE STAD

GEDEELDE & GEINTEGREERDE MOBILITEIT

Tactical Roadmap

The tactical roadmap outlines the next steps to implement the pilot (see next page). The priority is to deliver a minimal viable product (MVP) of the navigation from A to B with the 'pleasant and safe route' option. An MVP is a product with enough features to attract early-adopter customers and validate a product idea (Rouse, 2024).
As seen in the Strategic Roadmap, it is also advisable to enable the integration between the node-based service and the A-to-B navigation, prompting users to use the navigation to reach the starting point of their node-based route. The software for car and pedestrian navigation is already available, so these can be added. This approach allows for better testing of the added value and attracts more targeted users of the app to try out the new function.

Regional and Target group specific

The pilot could be conducted in one or two regions, preferably keeping it centralized. By concentrating efforts in one region, comprehensive feedback can be gathered from stakeholders, including participants, local authorities, and community members.

The approach for the pilot should be selected based on how and which users participate; for example, enabling the functions for a preselected group of users with an account and randomized targeting of any user of the Eropuit app. Randomized targeting ensures that new users, who might not otherwise use Eropuit for recreational biking, can also use the functions.

Preparatory activities

The pilot requires a variety of research activities in the preparation phase, which are named in the tactical roadmap. This section serves as an elaboration on these activities.

Capacity and economic feasibility

At the start of taking the proposal further, an estimation should be made of the capacity needed for the project in terms of human and capital resources. Regarding economic feasibility, costs to implement and maintain the service and individual elements should be estimated. Potential savings in terms of reduced accidents and healthcare costs could be mapped out to be used when applying for subsidies.
A project team should be assigned, potentially hiring new personnel.

User testing

Research should be performed, regarding the question: How to create a safe navigational interface for the target group of 60+? This would involve prototyping the bicycle navigation and testing those with users.

Data sources

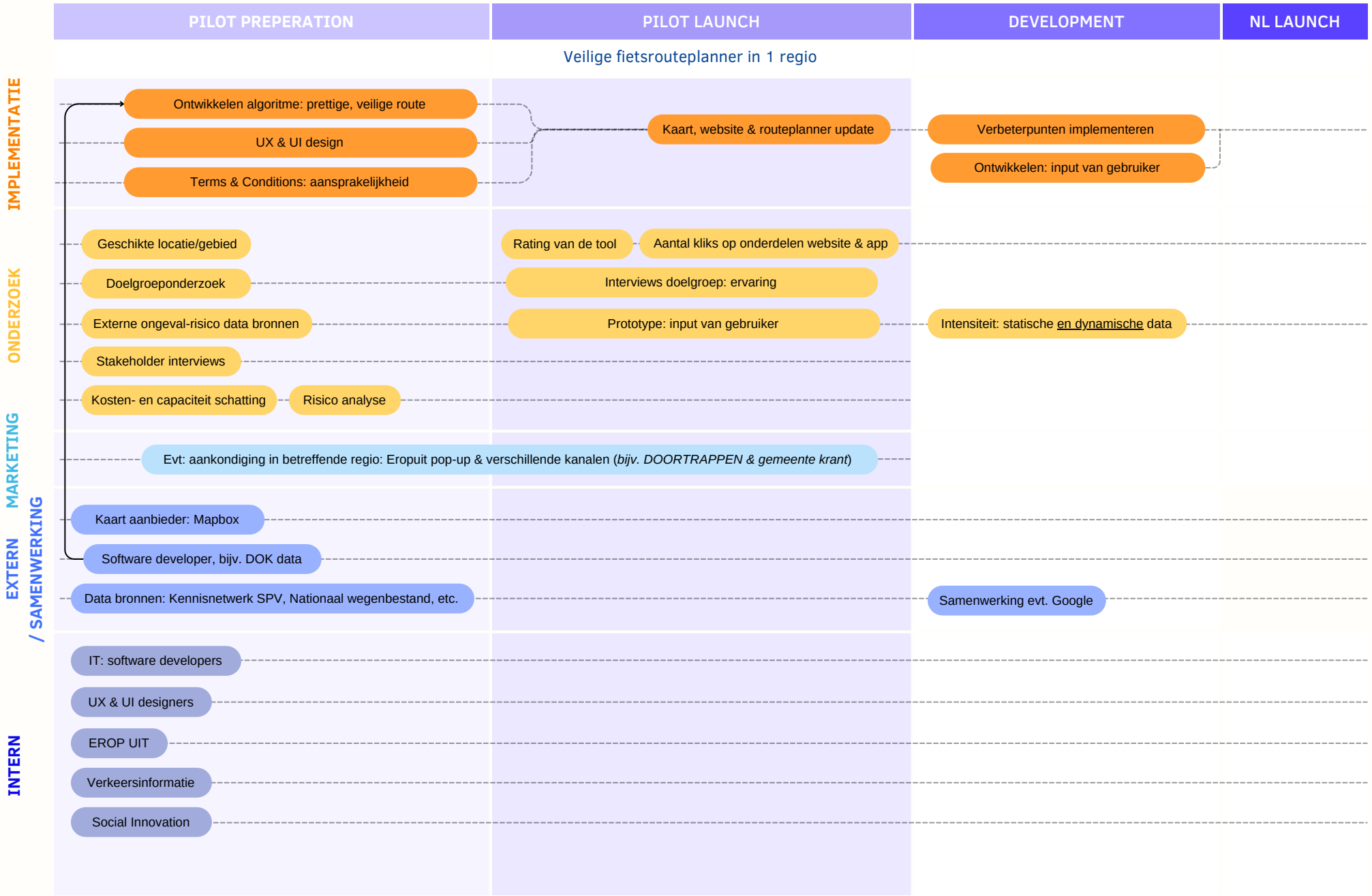
Extensive research should be performed on what factors to include in the algorithm in what way for the initial algorithm(MVP); deciding what weight each factor should receive and perhaps taking into account how factors could interact with each other.
This research would include understanding properly what data can be used, performing literature research and hiring or consulting experts on traffic safety. The recommendations regarding data factors in this paper can serve as a starting point.

Risk analysis

Since the pilot would navigate people in traffic and proclaim safety, safety is important to ensure and monitor. Therefore a risk analysis should be conducted to identify potential obstacles and challenges, and how these can be overcome.

TACTICAL ROADMAP

NAVIGATIE VAN A NAAR B: DE PRETTIGE, VEILIGE FIETSROUTE



Pilot stages

The Strategic Roadmap showed a year for the execution of the pilot. The actions in the tactical roadmap are elaborated upon in this section, framed in pilot stages. These stages show how the estimation is made.

Research

Requirements gathering (1-2 months):

Stakeholder meetings: Understanding the needs of cyclists, road users, and authorities.
Factor definition: Finalizing the data factors and factor weights to be included in the initial version of the algorithm.
Data collection: Identifying and sourcing the necessary data.
User testing: Prototyping the bicycle navigation and testing those with users.
Risk analysis: Identify potential obstacles and challenges, and how these can be overcome.
Pilot scope: Choosing the region, approach and user groups for the pilot.

Data preparation and analysis (2-3 months)

Data cleaning: Ensuring the collected data is accurate, consistent, and free of errors.
Data integration: Combining data from various sources into a unified format.
Exploratory data analysis: Analyzing data to understand patterns and trends.

Implementation

Algorithm development (3-4 months)

Algorithm design: Designing the logic for the routing algorithm for the pleasant, safe route.
Prototype development: Building an initial prototype of the algorithm.
Testing and refinement: Iteratively testing and refining the algorithm based on performance.

User Interface design and development (2-3 months simultaneously)

UI/UX design: Creating user-friendly interfaces for input and output of route information.
Integration: Integrating the algorithm with the app's interface.

Update terms & conditions (simultaneously)

Legal terms: Setting up conditions on liability regarding the safety of users, using the pleasant, safe route

Pilot launch and development

Testing and quality assurance (2-3 months)

Pilot: Gathering feedback in one region from users.
Pilot assessment: Deciding on the continuation of the project and improvements to be made.
Development: Iteratively improving the function based on feedback and addressing any technical issues identified during the pilot.

Recommendations for development

Project team

The project team is recommended to include members from various departments, including Impact & Meedoen, Eropuit, and Customer Journey Bike. Specifically, it is advised to include a project manager from the Social Innovation team within the Impact & Meedoen department who has a background in innovation.

Including a member from the Social Innovation team can help maintain a clear focus on the project's primary goal of reducing the number of accidents involving elderly cyclists. Furthermore, having someone new to the team with an innovation background will bring a fresh perspective and minimize bias.

Additionally, representatives from Eropuit and Customer Journey Bike will ensure that the project aligns with the broader objectives of promoting safe and enjoyable cycling experiences for all users. A multidisciplinary approach can leverage diverse expertise to effectively address the project's challenges and objectives.

Design parameters / Evaluation criteria

The following points can be used as design parameters or evaluation criteria during the design of the concept proposal. The points are presented in a random order, not showing priority.

The design should:

- Prevent startle reactions
  (see p . 45, for factors of startle reactions)
- Take basic bicycle safety factors into account *(e.g. weather and darkness)*
- Not stigmatize elderly
- Enable safe use of the app during navigation *(e.g. minimizing distraction)*
- Have a UI that takes common limitations of elderly into account
  (see p. 71 for first recommendations)
- Regard both regular bikes and e-bikes
- Integrate with existing services
- Be recognizable
- Be easy to use
- Foster a unique value proposition
  (see p. 76: competitive advantage; p. 87 further development 'advanced')
- Use up-to-date data
- Include participatory elements (user engagement)
- Acknowledge different preferences (options of personalization), while prioritizing safety

Challenges

During the first phases of development, it is recommended to address the following challenges and questions:

- Should the algorithm be developed in-house, in collaboration with a partner, or be outsourced?
- How to enable an up-to-date navigation system?
- Should (certain categories of) risk point alerts effect the algorithm and in what way?
- How to ensure a safe UI for bicycle navigation, especially regarding elderly?
- How to create a risk point reporting system in a way that both users and road authorities recognize the benefits?
- How to encourage the target group to use the navigation tool?
- How to create a practical UI for integrating the A to B navigation as well as existing Onderweg functionalities into the Eropuit app?

Prototyping and testing of individual functionalities

It is recommended to perform further validation research with the target group on all functionalities. Interviews presenting more advanced prototypes (e.g., a Figma prototype of the app) could be conducted. This approach offers more in-depth insights on user experience. Additionally, 'fake buttons' could be placed within the current website and app to test user interest in specific features without fully developing them. This method, known as fake door testing (Szerovay, 2017), allows for testing genuine user intentions as they are not aware of being tested.

Collaboration with road managers

Establishing arrangements and agreements with road managers can be highly valuable for a more reliable and up-to-date service. By obtaining notifications in advance from road managers about upcoming road works, navigation can be more accurate. Additionally, if roadworks lead to changes in infrastructure, the new road factors should be shared with the system to be incorporated in the algorithm.

Furthermore, it is important to discuss the potential value of risk point reports for road managers and what best methods for communicating about this information would be. Regarding user satisfaction, it is important for users to see that their risk point reports are effective and lead to actions. Ideally, users would receive feedback on their report; telling them whether the issue is resolved.

Currently, there seems to be a gap between citizens and the government regarding traffic safety. It
can seem like a one way street in which the government poses new regulations or norms that citizens are to adhere to. By enhancing the communication about risk point reports, citizens would be involved more in traffic safety issues.

Fixi is an existing app in which citizens can report public space issues, which is widely used by municipalities to handle and resolve issues. In Fixi, the status of a report is shared with the user, facilitating a form of communication between the municipality and the user. Exploring a partnership with Fixi could be valuable, creating a centralized system and expanding Fixi's reach.

06 DISCUSSION

In this chapter, we will discuss the limitations of the research, followed by recommendations for further research and potential service improvements in the future. The chapter will be concluded with a discussion of the broader implications of the report.

06 Discussion

6.1 Limitations

It is important to acknowledge limitations that may have influenced the findings in this paper. Three research activities have been performed that will be reflected upon individually: the qualitative survey and semi-structured interviews during the target group research, and the surveys for concept testing.

Accident contexts survey

The qualitative survey was directed at elderly people aged 60+ who had had one or more accidents with the bike or e-bike.

Only two respondents had an age in the category of 81-85 and none were older, resulting in little insights on and by the eldest elderly. This could have resulted in less representation of accidents caused due to limitations of becoming older.
In an open question, the respondents were to describe an accident they had had. The usability and representability of these descriptions could vary, due to different factors. Firstly, there were respondents that did not go into as much detail as others. Less detailed descriptions sometimes resulted in not being able to assess in what accident category to place the accident; whether an accident happened due to being startled for example. In those cases, these were not counted as startle reactions, while they could have been. Secondly the recall bias can play a role, where the accident description relies on how well the participant can remember the circumstances of the accident. Furthermore, the accident descriptions could differ from what truly happened, due to the confirmation bias. Confirmation bias is the tendency to recall information in a way that confirms or supports one's prior beliefs or values (Nikolopoulou, 2022). Lastly, through a survey it is hard to get to a deeper level of knowledge. Respondents could be in denial of physical limitations and therefore not share limitations that could have been of influence on accidents.

Interviews

Semi-structured interviews were held with e-bike users of the age 60+.

Firstly, due to time restrictions, the number of participants was limited to 12. A selection had to be made regarding age categories. This resulted in one respondent in age category 60 - 64, one in 65 - 69 and one in 80+. The effect of age is a discussed factor in the research and the concept proposal. Also, age might influence rider type. Due to little representatives of the age categories, these insights might be less valid or comprehensive. Similarly, the insights on rider types regarding the avoiders and unaware may be less valid, as they were represented by two participants each.
Second, three times a couple living together was interviewed, resulting in less diversity of route descriptions and e-bike related actions. On the one hand this resulted in more, reliable and in-depth results, as they were able to comment on eachother, complementing information, and especially bring forward elements about the other person that the participant would not have revealed or said about themselves.
Third, all respondents owned a relatively high-quality expensive e-bike, which could have resulted in more positive comments in regards to e-bike use and safety experience. The target group does seem to generally buy high-quality e-bikes, however the results could have been more valuable if a few respondents owned a less high standard e-bike.

Concept validation surveys

One qualitative survey focussed on adding navigation with the pleasant, safe route option. The other survey addressed separate additional features.

Firslty, a response bias could be present, due to the majority of respondents being part of the ANWB survey panel. Partly, these respondents presumably enjoy giving their opinion on issues. However, many also care in a sense for the ANWB, which could result in more favorable responses to ANWB proposals. To mitigate this, questions directed to the individual's intentions and perceptions were asked, such as 'Would you want to use this option?". Secondly, there was a noticeable uneven gender distribution among the respondents. In Survey 1, 80% of the participants were male, and in Survey 2, 76%. Future user tests should aim to achieve a balanced gender distribution, to ensure representative results.

Thirdly, an online survey might automatically select participants, underrepresenting less tech-savvy elderly individuals. Since the concept concerns a digital service, this could have influenced the results regarding the perception of the concept.

Fourthly, having two different surveys testing different features meant participants could not see the components as a whole, which might affect their perception of the individual features.

Lastly, the findings are based on participants imagining the presented scenario and speculating on their reactions. People may respond differently when confronted with the service in a real-life setting. These limitations re-enforce the value of further prototyping and user testing, as well as setting out a pilot.

Overarching limitation

All research activities were conducted by one researcher, which may have influenced the interpretation of data due to potential researcher bias. Efforts were made to mitigate this bias. Multiple times data was inserted in an intelligent chatbot to assess how AI would interpret it, creating a second perspective.

Furthermore, key insights from the target group research were discussed with experts M. Hagenzieker, T. Uijtdewilligen and P. Schepers to cross-check findings. Lastly, the validation research allowed for verification of insights with the target group.

6.2 Implications

Possible implications of the research and concept proposal are discussed.

Broader traffic impact

The various functionalities enable elderly individuals to cycle safer routes. The A-to-B navigation, focused on cycling, will especially also be used by other age groups. Increased usage may necessitate monitoring dynamic data to prevent certain bike paths from becoming overcrowded. As discussed in the benefits of the concept proposal (Ch 5.2), the concept could contribute to a safer overall distribution of traffic flows, potentially reducing the increase in cycling accidents among both young and elderly cyclists in recent years.

ANWB's image

Offering the 'pleasant, safe route' broadly can re-establish ANWB as a socially responsible organization. With a reputation for being helpful and involved, more Dutch people are likely to trust ANWB, become members, and purchase products. This is crucial for attracting and retaining new generations. Providing the safe route option in A-to-B navigation also brings greater responsibility to ANWB. It is important to acknowledge this and manage it well.

Transparency and involvement

By providing a familiar platform for reporting risk points in infrastructure and traffic, citizens become more involved in traffic safety issues.

Lobby for traffic safety

The traffic safety lobby is strengthened for both ANWB and citizens. The urgency of issues can be communicated more clearly and easily, encouraging municipalities and road authorities to act proactively.

New social norm

With the increasing use of helmets, coupled with the rise in accidents reported in the news and media, as well as the heightened risk associated with fat bikes, the proposal can play a role in establishing a new social norm: caring more for being safe on the bike.

Steps in knowledge on elderly e-bike users

Besides a concept proposal, this report provides in-depth insights into the behavior of elderly e-bike users, particularly regarding safety. This knowledge complements previous research and can be used for follow-up studies and as input in the design process of other projects related to elderly cyclists and/or e-bikes, both within and outside ANWB.

6.3 Recommendations

Incremental implementation

The strategic and tactical roadmaps serve as guidelines for incremental implementation. This approach offers the flexibility needed to adapt to challenges and integrate new insights effectively. By prioritizing the development of core functions first, the time to market can be significantly reduced. This is particularly favorable, given the urgency of the issue of an increasing number of accidents involving elderly e-bike riders.

Dare to innovate

The ANWB is active in staying relevant in a changing society through the innovation team, launching services like ANWB energy contracts, for affordable sun energy use. However, innovation can also mean changing and enhancing existing services. All teams should foster an innovative mindset, also those managing long-standing services. This asks for being open for new ideas, collaborations, taking on fresh perspectives and trying to be alert of traditional thinking patterns and assumptions.

Keep monitoring and improving

It is important to realize that a project is never ‘finished’ and can always be improved, especially taking into account changes in technology and society. Therefore, it is important to be attentive of trends and see how these could form opportunities or threats to the projects and services. Furthermore, data analytics and user feedback should be monitored to identify areas for enhancement.

Target group expansion

While the initial focus may be on older cyclists, expanding the target group to include other demographics could increase the service's impact and user base. Marketing efforts can therefore also be directed at other segments. Furthermore, by understanding and addressing the needs of a diverse range of users, the ANWB can broaden its appeal. The validation- and target group research performed in this project focussed on the needs and wishes of the older cyclists. It is recommended to perform similar research for younger generations, to understand which segments would see value and could benefit from the service of the pleasant, safe cycling route navigational option.

07 CONCLUSION

This chapter provides the project's overall conclusion and includes a personal reflection.

07 Conclusion

7.1 Conclusion

The purpose of this graduation project was to explore how the ANWB can contribute to the prevention of accidents involving elderly individuals (aged 60+) on e-bikes. The complexity of the issue was addressed using a holistic approach in the research and design process.
As previous research on e-bike-specific circumstances regarding accidents and use was limited, qualitative target group research was performed. This research addressed knowledge gaps concerning elderly e-bike users and provided a deep understanding of their needs. By comparing these findings with results from other research papers, a more comprehensive understanding of e-bike users aged 60+ was developed.

All research activities, including trend analysis, expert interviews and literature research, generated insights that informed the development of the concept proposal: offering the 'pleasant, safe route.' Concept validation surveys were conducted to assess user perceptions of the solution. The results indicated a positive reception towards the proposed service and provided valuable recommendations for further concept development.

Literature research showed that the majority of bicycle accidents in the Netherlands are single-vehicle incidents involving elderly e-bike riders. Previous projects seemed to suggest that a big part of the problem is elderly individuals not using e-bikes safely. However, the target group research indicated otherwise. It showed that elderly users find e-bikes intuitive to use and that they generally ride calmly. Moreover, accident descriptions and the interviews revealed little instances of improper or unsafe use, although an observational study would be able to provide further insights. Additionally, the majority of elderly individuals tend to purchase high-quality e-bikes, which facilitate safer usage.

While literature identified frequent causes of accidents, it did not provide a comprehensive picture. The qualitative survey identified startle reactions as the most common cause of accidents for elderly cyclists, both on regular and e-bikes. However, it should be noted that the target group research included a limited number of participants from the older segment (aged 80+). The finding aligns with Schepers and Schagen's literature, which describes elderly's reactions to complex traffic situations and their decreased capacity to handle risks due to impaired information processing and physical decline, including strength, flexibility, and balance. The survey indicated that startle reactions predominantly occur at unclear traffic points and in areas with higher traffic density.

The proposed concept involves offering the 'pleasant, safe route' in various ways. The core innovation is to provide this route in navigation, guiding users through routes with safe traffic and infrastructure factors, aimed at minimizing factors that cause startle reactions in the elderly. It also addresses the notable need for elderly e-bike users to ride comfortably and enjoy their rides. While they generally do not feel unsafe, they can easily feel on edge in traffic. Additionally, as elderly individuals can be overly optimistic about their safety and as their route preferences do not always result in safer routes, it is valuable to guide their choices.
To provide the 'pleasant, safe route' in a wider context, additional features such as clear information sharing regarding bicycle safety for planning junction routes, safe navigation while cycling junction routes, and an insightful map of reported risk-points for road authorities, should be considered. Moreover, consistently demonstrating concern for biker safety would enhance the ANWB's reliability.

Currently, data on traffic and infrastructure is widely collected to enable a risk-based approach in improving traffic safety by road authorities. This data is mostly open-source, and the ANWB also has its own traffic safety

data collection projects. An opportunity is presented to be the first to use the data for a service directly available to the public. The report shows different data sources that potentially combined could be used to create an algorithm for the 'pleasant, safe route'. The widthlabel (Dutch: 'breedtelabel'), which indicates bike lane safety based on its width and user intensity, seems especially promising. Recommended is to perform a pilot for the navigation, already building the basic elements of the algorithm, to understand its effectiveness.
The Eropuit app is already popular among the target group for planning and cycling junction routes. Offering the features of the 'pleasant, safe route' through this app would ensure a wide initial reach. Marketing efforts and attractive UI should make users aware of and interested in the new features.

The project both aligns with the mission and societal ambitions of the ANWB and with the desire of the Impact & Participation department to actively engage users and volunteers. This involvement is reflected in features allowing for user input and transparency in traffic safety. By allowing users to report risk points which are represented in a clear map, road managers gain a better overview and increased motivation or pressure to enhance infrastructure. This approach not only enhances safety conditions for elderly cyclists, but also fosters a community-driven effort to improve traffic safety.

The proposed solution leverages ANWB's resources and strengths. Analyzing the competitive advantage and landscape of the ANWB showed it to be unlikely that other organizations or companies would develop the 'pleasant, safe route' option.
Lastly, seeking subsidies should be feasible, as the safety of elderly bikers is a national concern and as the project contributes to the government's goal of enabling elderly individuals to keep on cycling.

In conclusion, the concept aims to address a primary cause of accidents among elderly cyclists, namely startle reactions. It is a solution that resonates with the target group, which is positive for its effectiveness. Overall, it shows significant potential for reducing the number of e-bike accidents among the elderly. By showing the needs, characteristics and e-bike use behavior of elderly e-bikers, this report lays the groundwork for future research and design interventions related to elderly on (e-)bikes.

7.2 Personal reflection

Overcoming the uncertainty of the unknown

During this graduation period of roughly five months, I was part of the Social Innovation team.
The topic of elderly accidents on e-bikes was new to me, but it was immediately clear to me that this held a complex issue with no straightforward solutions. With that I recognized it would be an especially suitable topic for a Strategic Product Design graduation project.

It was interesting to notice how initially, the unfamiliarity and complexity of the problem drove me towards wanting to frame the issue further. During this early stage, receiving feedback was invaluable in highlighting the danger in premature framing, which could steer towards a solution and hinder innovation. I came to realize that the unease came from a lack of information in the field, and that the value of my approach lay precisely in that: uncovering this knowledge through my own research.
The project taught me that a period of uncertainty at the outset is natural and showed me how I can navigate through it effectively. Participating in the e-bike test day and attending the cycling fair at the project's start, as well as observing elderly e-bike users during my own rides quickly made me more immersed in the topic.

Planning

My challenge lay in delivering a comprehensive project within the agreed-upon timeframe, maintaining quality as a key value. Next to having an outline for the entire process, I continually created and reviewed my planning on a daily, weekly, and monthly level. This ongoing review was necessary, as circumstances, interim results, or activities often differed from initial expectations. It showed me the value of flexibility and of reassessing the relevance and approach of each different step.

Executing the whole project solo, without a project team, was a learning experience. Having previously only worked on larger projects within teams, initially estimating the time required for individual tasks was challenging. I soon realized I could undertake fewer activities than originally planned. At first I viewed this as something negative, but soon I realized that it forced me to make critical choices, which was a valuable learning experience in itself. Additionally, it made me challenge my tendency towards perfectionism.

Consequently, I narrowed down activities throughout the process, focusing on the most valuable and essential components. While I generally prefer team collaboration for task distribution, complementation, and brainstorming, I am pleased with the experience of independently managing a major project. It has given me confidence in my decision making and in independently setting up and conducting research and design projects. I am content with my planning, as it allowed for unforeseen circumstances, iterative design adjustments, and the incorporation of feedback.

As a Strategic Designer in the workfield

I enjoyed positioning myself as the type of strategic designer I envision becoming in the future, particularly in a ‘real-life’ setting. For me, a significant aspect of this role involves approaching problems from a broad perspective and integrating diverse viewpoints. Organizing and facilitating a creative session for ideation with participants from various backgrounds was therefore a special and rewarding experience. Attending the Intertraffic, a trade fair for the mobility sector, is an example of an activity that surprised people, as it seemed outside my immediate domain. I am glad I attended because it provided insights, including trends, to contextualize the solution within a broader framework.

The experience of executing the project in a professional organization showed me how, as a designer, you really have to dare to keep true to yourself, to not let others influence you too much. I learned that to keep your creative space and freedom during the process, you

have to proactively keep your manager(s) on the same line. Steps and methodologies that seemed logical and intuitive to me as a designer differed at times from how they were used to doing things. By sharing my approach and rationale, while considering and discussing their perspectives and feedback, I found it possible to maintain or regain creative autonomy.

Furthermore, as you come up with innovative ideas, I noticed how easily they can be met with resistance to change or risk within the company. It was my challenge to be wary of this and I think it will remain a challenge to learn to deal with it in the best way.
Addressing this and managing stakeholder expectations aligned with a personal ambition of establishing and sustaining support for the project's development and direction within (and outside) the company. Being in touch from the start with multiple stakeholders and keeping them in the loop showed fruitful outcomes and gave me the sense of being part of the company and traffic safety field.

Quality

Throughout the process, I continuously gathered and compared knowledge from various perspectives and sources to identify patterns and enrich existing insights. Furthermore, I paid attention to applying research methods in a way that creates as reliable outcomes as possible. Research insights and the practical integration of those into the concept proposal therefore feel well grounded.
Most studies in the field prioritized generalizability, focusing on quantitative approaches to specific topics. Therefore, it feels like I have been able to really add something to the field, showing a deeper and more comprehensive understanding of the target group and problem.

Final Thoughts

The graduation project was a valuable learning experience. Keeping track of a thought diary and ‘personal learnings’ document helped me to keep reflecting on myself and the process. I am happy to have these lessons noted down for future reference.
Reflecting on myself as a designer, I notice how much I enjoy that tackling a complex problem feels like a puzzle for which new puzzle pieces reveal themselves with every step you take.
Also, my affinity with qualitative target group research was again confirmed. I love working closely with people and uncovering their needs, especially those needs they may not have realized they had.
These things I will certainly take with me as a future professional.

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APPENDICES

Appendices

A. PROJECT BRIEF

TU Delft

IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Schröder	7081	
Initials	EW		
Given name	Elvira		
Student number	4795954		

IDE master(s)	IPD ☐	DfI ☐	SPD ✔	
2nd non-IDE master				
Individual programme *(date of approval)*				
Medisign	☐			
HPM	☐			

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	E.D. van Grondelle	dept./section	HCD / DA
mentor	B.M. Keukens	dept./section	DOS / CP (A)
2nd mentor	Thijs Komen		
client:	ANWB		
city:	Den Haag	country:	The Netherlands
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Elmer van Grondelle - IO

Digitally signed by Elmer van Grondelle - IO
Date: 2024.03.14 13:21:39 +01'00'

Name Elmer van Grondelle Date Signature

CHECK ON STUDY PROGRESS

To be filled in **by SSC E&SA** (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair.
The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total _____ EC

Of which, taking conditional requirements into account, can be part of the exam programme _____ EC

★	**YES**	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Robin den Braber
Digitaal ondertekend door Robin den Braber
Datum: 2024.03.18 11:25:51 +01'00'

Name Robin den Braber Date 18 mrt 2024 Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is ...

★	**ALLOWED** to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Monique von Morgen
Digitally signed by Monique von Morgen
Date: 2024.03.20 11:13:57 +01'00'

Name Monique von Morgen Date 20 Mar 2024 Signature

Personal Project Brief – IDE Master Graduation Project

Name student Elvira Schröder **Student number** 4,795,954

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title A roadmap for preventing accidents of elderly on e-bikes

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

The number of fatal and serious bicycle accidents has increased in past years, see fig. 1. A significant reason behind this is the growing popularity of e-bikes, especially among the elderly. Looking forward, the risk of accidents is likely to rise further due to changing traffic conditions, e.g. busier bike lanes and more silent electric cars, and an aging population, see fig. 2.

As people live longer and prefer to remain independent, the elderly aim to maintain mobility for as long as possible. The government encourages the elderly to continue cycling, promoting a healthier older generation and sustainable transportation. While it is logical that more accidents occur with increased mileage, older individuals actually do face a higher risk of accidents, as well as suffering an injury.
The elderly are therefore recognized as a vulnerable group in traffic and are given special attention in current and future steps taken to enhance traffic safety.

The Dutch Ministry of Infrastructure and Water Management (IenW) oversees traffic safety developments as part of their Zero Ambition; aiming for zero traffic casualties by 2050. Nationally, regionally, and locally, numerous initiatives are in place to promote the safe mobility of older individuals. Improved mapping of accident conditions, facilitated by ambulance data being made accesible, presents opportunities for more targeted solutions.

From the perspective of ANWB's mission to enable everyone to travel carefree and joyfully in a sustainable society, the ANWB aims to actively contribute to the traffic safety of the elderly.

→ *space available for images / figures on next page*

introduction (continued): space for images

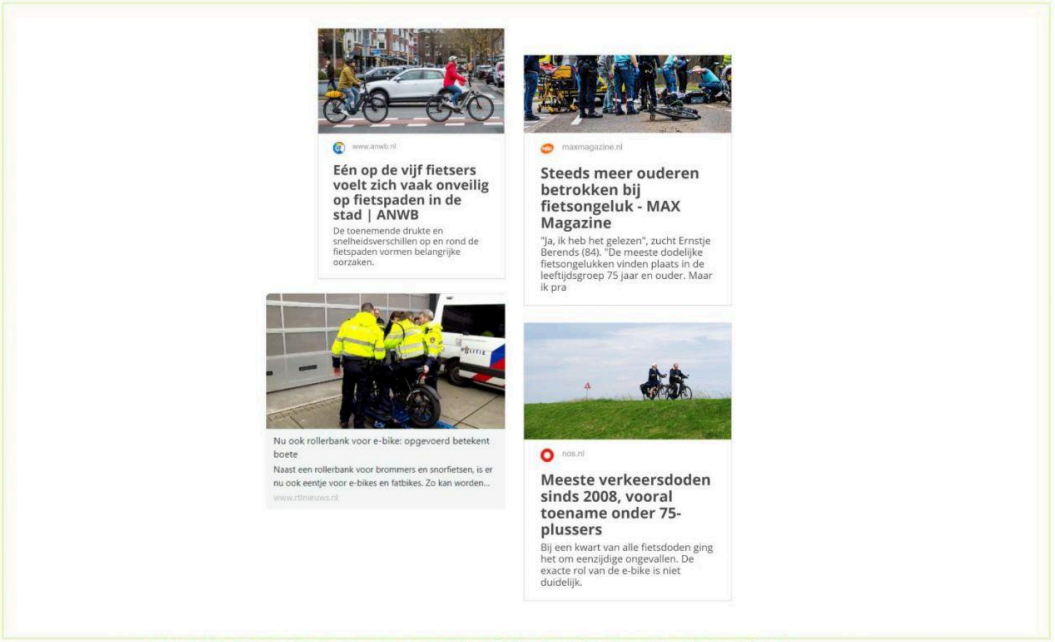


image / figure 1 News articles signalling the rising number of fatal and serious bicycle accidents

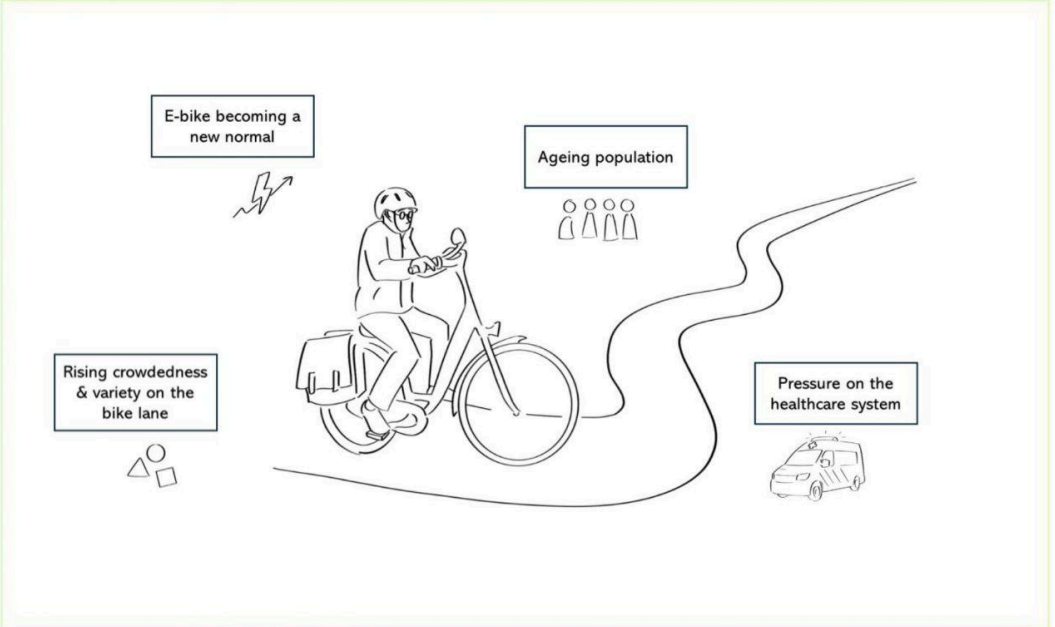


image / figure 2 Context: highlighted trends

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

In the past decade, the most significant increase in traffic accidents has been of single-vehicle accidents by elderly on e-bikes. Additionally, among the bicycle accidents treated at the Emergency Department, single-vehicle accidents tend to constitute the largest group. A single-vehicle accident involves only one road user, in this case usually a fall due to loss of balance (when being startled by an unanticipated situation or while getting on and off the bike) or collision with an obstacle. 'Own behavior' is the most frequently cited cause for these kind of bicycle accidents by seniors, in which there is not a clear destinction made yet between e-bikes and regular bicycles. Furthermore, analyses reveal that seniors often underestimate their limitations.
While the ANWB is already active in promoting bicycle helmets, it does not yet run an initiative focusing specifically on preventing traffic accidents among elderly, presenting an opportunity.

Other opportunities:
> Bring forward data specifically on e-bike use and -accidents
> Create a better, more refined understanding of the target group, acknowledging 'differtent types', and thus potentially segments, of elderly on e-bikes in regards to riding safety and attitude.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Create a new concept along with a roadmap to improve the safety of elderly on e-bikes for the ANWB in the context of a rising number of one-sided accidents in the Netherlands.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

My approach is to work in an agile and iterative way, with problem- and solution finding going hand in hand throughout the entire process.
I plan to apply various research and design methods:
- Literature research / Desk research
- Mapping the internal and external context:
> Stakeholder mapping > Stakeholder & expert interviews
> Trend analysis and creating a Future Vision
- Understanding the target audience and stakeholders, employing a human-centered approach:
> Field research, conducting interviews and observations > Using personas
> Validation: qualitative (method to be determined) and quantitative through questionnaires
- Bringing perspectives together and generating innovative ideas:
> Creative group sessions - following the methods of K. Heijne & H. van der Meer presented in "Road Map for creating problem-solving techniques,", and similarly "Collaborate or die" by J. Veenhof and M. Pater.

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	12 Mar 2024
Mid-term evaluation	2 May 2024
Green light meeting	12 Jun 2024
Graduation ceremony	10 Jul 2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

My interest lies in promoting positive societal change and innovation. This project provides me with the opportunity to address a societal issue from the perspective of a service-oriented organization. Moreover, it can be considered as a complex problem, which makes it an appealing challenge for Strategic Product Design (SPD). It asks for bringing together different perspectives and understanding the needs of stakeholders, including the target audience. This fits with my eagerness to work in a people-oriented way.

During my BSc, I completed the Connected Creativity minor, where I learned to apply creativity consciously, i.e. in the form of creative group sessions with experts and stakeholders. I believe that the complexity and the need for fresh insights and solutions in this project ask for the use of this technique. Additionally, it fits with my desire to develop as a creative facilitator.
Throughout the project I would like to prove and develop that:
-I can switch well between details and main issues, while maintaining a holistic view of the problem.
-I can create a tactical and strategic roadmap that is tailored to a company's capabilities and developments, given my internal involvement with the ANWB for several months.
-I can create and maintain a support base for the project's developments and directions inside (and outside) the company

B. ANWB's services

Service	Description
Roadside Assistance	Providing help for vehicle breakdowns.
Emergency Call Center	A call center offering emergency assistance for both individuals and vehicles.
Trauma Helicopters	Through its subsidiary, ANWB Medical Air Assistance (MAA), providing medical aid via helicopters for severe accidents.
Legal Assistance	Legal support in the areas of mobility, recreation, and tourism.
Advice and Information	Guidance on cars, caravans, camping, and watersports.
Publishing	Producing travel guides, books, maps, and magazines.
Car Sales Service	Assisting with car sales.
Traffic Information	Providing traffic updates for regional and national public radio stations.
ANWB Stores	Operating retail stores.
Training Programs	Offering training for professional drivers and individuals at the Test- en Trainingscentrum in Lelystad.
Driving Schools	Providing driving lessons.
Insurance	Offering various insurance products.
Travel Services	Facilitating travel through multiple subsidiaries.

Ticket Sales	Selling tickets via Land van ANWB (domestic) and ANWB Tickets (international).
ANWB Energy	Supplying energy at cost price.
ANWB Parking	A mobile parking service.
ANWB Charging Service	Fast charging for electric cars along highways and at ANWB locations.
ANWB Golf	A (digital) golf club.
Traffic Lessons	Traffic education for primary schools (Streetwise) and secondary education (Streetwise Next Level).
Private Lease	Leasing options for cars and bicycles.
Credit Cards	Offering credit card services.
ANWB AutoMaatje	Transportation for less mobile neighbors provided by volunteers.
ANWB Children's Bicycle Plan	Ensuring every child has a bicycle.

C. STAKEHOLDER ROLES

Stakeholder Category	Stakeholder	Contribution/Connection to Bicycle Safety
National Government	Ministry of Infrastructure and Water Management (Min I&W), Ministry of Health, Welfare and Sport (Min VWS)	Develop and implement national policies and regulations on traffic safety, provide funding for safety initiatives.
Local Governments	Provinces (Regional Traffic Authorities - ROVs), Municipalities	Implement and support local safety initiatives, provide subsidies for infrastructure and safety programs.
Research Institutes	SWOV (Institute for Road Safety Research), CROW, CBS, Universities, Vilans (well-being)	Conduct research on road safety and target group well-being, develop guidelines and best practices, provide data and insights.
Civil Society Organizations	VVN (Safe Traffic Netherlands), Victim Support Netherlands, Doortrappen, Artsen voor Veilig Fietsen (AvVF), BeterOud	Advocate for traffic safety, provide support and education programs, raise awareness.
Road Managers	Rijkswaterstaat (RWS), Provinces, Municipalities, Water Authorities	Manage and maintain road infrastructure, implement safety measures.
Member Associations	ANWB, Fietsersbond, ANBO (Dutch Association of Senior Citizens), Association of Traffic Victims (VVS vereniging verkeersslachtoffers), Cyclists' Union,	Advocate for the interests of their members, provide education and support, promote safe cycling practices.
Collaborative Partnerships	Tour de Force, Landelijk Klankbordgroep, Verkeersveiligheidscoalitie	Promote joint initiatives and campaigns to improve cycling safety, particularly for the elderly.

Industry Associations	RAI, BOVAG	Represent the interests of the bicycle and automotive industry, promote safety standards and innovations.
Bicycle Manufacturers	Various companies (Examples of big players in the field of e-bikes: Gazelle, Stella, Batavus, Koga (latter two are part of Accell Group))	Develop and produce safer bicycles, including e-bikes, implement safety features.
(Online) Bicycle Shops	Various retailers	Provide access to safety equipment and bicycles, offer information and advice on safe cycling.
Comparison Websites	Consumentenbond, Fietstest.nl	Provide reviews and comparisons of bicycles and safety equipment, educate consumers on safe choices.
Route Providers	Various organizations (o.a. Google Maps, Toertje, Fietsknoop, Eropuit, Komoot)	Develop and promote safe cycling routes, provide navigation tools and maps.
Insurers (health & bike)	Various companies (o.a. ANWB fietsverzekering)	Offer insurance policies that cover bicycle accidents, promote safety through discounts and incentives.
Healthcare Professionals	Various entities	Provide medical support and advice on safe cycling practices for the elderly, rehabilitation support for accident victims.
Social Network	Family, friends, community groups, Vrienden op de fiets	Offer support and encouragement for safe cycling practices, assist elderly individuals in making safe choices.
Target Group	Dutch elderly bicycle users 60+, focus: e-bike users	Directly affected by safety initiatives, provide feedback and participate in safety programs.

D. TARGET GROUP RESEARCH: INTERVIEWS

D.1 INFORMED CONSENT FORM

E-bike gebruik

Dit onderzoek wordt uitgevoerd als onderdeel van de MSc opleiding Strategic Product Design aan de TU Delft, in opdracht van de ANWB.
Student: Elvira Schröder

Contactpersoon:

_____

[NAAM CONTACTPERSOON + EMAILADRES + 06-NR]

Toestemmingsverklaring participant

Ik neem vrijwillig deel aan dit onderzoek.

Ik erken dat ik vooraf voldoende informatie en uitleg heb gekregen over dit onderzoek en al mijn vragen zijn naar voldoening beantwoord. Ik heb de tijd gekregen die ik nodig had om in te stemmen met de deelname. Op elk moment kan ik vragen stellen met betrekking tot het onderzoek.

Mij is bekend dat dit onderzoek bestaat uit:

1. Interview
2. Invullen van achtergrondvragen

Ik ben mij ervan bewust dat tijdens het onderzoek gegevens worden verzameld in de vorm van bijvoorbeeld aantekeningen, foto's, video's en/of geluidsopnames. Ik geef toestemming voor het verzamelen van deze gegevens en het maken van geluidsopnames en foto's tijdens het onderzoek. Gegevens zullen geanonimiseerd worden verwerkt en geanalyseerd (zonder naam of andere identificeerbare informatie). Deze gegevens zijn alleen voor het onderzoeksteam en hun TU Delft begeleiders beschikbaar.

De foto's, video's en/of geluidsopnames zullen worden gebruikt ter ondersteuning van het analyseren van verzamelde gegevens. Video opnames en foto's kunnen tevens worden gebruikt ter illustratie van onderzoeksbevindingen in publicaties en presentaties over het project.

Ik geef toestemming voor het gebruik van foto's en video/audio opnames van mijn deelname:
(selecteer wat van toepassing is)

☐ waarin ik herkenbaar ben voor publicaties en presentaties over het project.

☐ waarin ik niet herkenbaar ben voor publicaties en presentaties over het project.

☐ enkel voor data analyse doeleinden en niet voor publicaties en presentaties over het

project.

Ik geef toestemming om gegevens nog maximaal 5 jaar na afloop van dit onderzoek te bewaren en te gebruiken voor onderwijs- en onderzoeksdoeleinden.

Ik erken dat er geen financiële compensatie gegeven wordt voor deelname aan het onderzoek.

Met mijn handtekening bevestig ik dat ik de informatie over het onderzoek heb gelezen en dat ik de aard van mijn deelname heb begrepen. Ik begrijp dat ik mijn deelname aan het onderzoek op elk moment kan intrekken of kan stoppen. Ik begrijp dat ik niet verplicht ben om vragen te beantwoorden die ik niet wil beantwoorden en dat ik dit kan aangeven bij het onderzoeksteam.

Een kopie van deze toestemmingsverklaring zal aan mij worden gegeven.

_____ _____
Achternaam Voornaam

___ / ___ / 2020 _____
Datum (dd/mm/jjjj) Handtekening

D.2 INTERVIEW GUIDE

KWALITATIEVE METHODOLOGIE
INTERVIEW GUIDE

Eigen onderzoeksvragen:
> Wat zijn de pains & gains in de journeys van voorbereiding tot en met aankomst (thuis) van ouderen op de e-bike?
> Welke momenten en factoren komen vaak terug als risicovol voor het maken van een eenzijdig ongeval?
> Wat zijn de verschillen in pains & gains voor de verschillende type persona's geclassificeerd op basis van veiligheids-perceptie en gedrag?

Checklist voor het starten:
- Geïnformeerd toestemmingsformulier
- Audio-opnameapparatuur (dictafoon)
- Papier met journey template
- Post-its
- Notitieboekje en pen
- Drankje en een taartje of koekje

Inleidend script
> Bedanken voor het meedoen
> Mezelf even voorstellen en het onderzoek inleiden;
Voor mijn studie Strategic Design aan de TU Delft, doe ik een project waarin ik in kaart breng hoe de E-Bike wordt gebruikt en ervaren door 60+ers en hoe de fietsveiligheid verbeterd kan worden. *Zou ik u (/jullie) een aantal vragen mogen stellen? (-In geval van het aanspreken van willekeurige mensen van de doelgroep.)*
> Vragen consent form te tekenen
> Vertel; Het interview is vertrouwelijk en er zijn geen goede of foute antwoorden, ik ben geïnteresseerd in uw mening en persoonlijke ervaringen. U kunt op elk moment onderbreken. Ik zou dit interview graag opnemen om het later te transcriberen. Vindt u dit goed?
> Vraag; Kunt u kort iets over uzelf vertellen over wat u doet in het dagelijks leven?
→*Journey template erbij halen:* uitleggen dat ik deze gebruik om de inzichten mee te schrijven terwijl ze vertellen en om samen de ervaring in kaart te brengen.

Fase I: deelnemer in de belevingswereld laten komen en grof invullen van journey I
Op het journey template is er Journey I, 'de hoofd Journey', en Journey II, 'de alternatieve Journey'. De eerste wordt diepgaand behandeld en ingevuld en de tweede wordt alleen ingevuld met aspecten die afwijken van de eerste. Voor de Journey I gaat de voorkeur uit naar het type rit dat de deelnemer ervaart als het meest risicovol voor het maken van een ongeval. Als de ondervraagde geen type rit specifiek risicovol denkt te ervaren of algeheel geen onveiligheid ervaart, dan wordt het type rit gekozen waar de deelnemer de meeste kilometers in maakt.

- Waar gebruikt u de e-bike voornamelijk voor?
- Gebruikt u de e-bike vaak voor het maken van recreatieve ritjes?
- Is er een type rit waar u meer risico's ervaart om een fietsongeluk te maken, *zoals dat je valt*?

> beslissen welk type rit geschikt is voor de 'hoofd Journey'

- Kunt u met mij delen hoe zo'n rit, dat u gaat ..*type rit*..., er voor u meestal uitziet, beginnend bij de voorbereiding?

- Wat voor omgeving moet ik me hierbij voorstellen? *Een dorp, stad, binnen of buiten de bebouwde kom…*
- Wat voor andere weggebruikers komt u tegen?

Fase 2: gedetailleerd invullen van Journey I

Vervolgvragen en *eventuele verhelderingsvragen als de deelnemer er zelf niet over begint*.

Voorbereiding

- Hoe kies je de route?
    - *Op welk medium kijk je om de route te bepalen?*
    - *Wat zijn je overwegingen bij het kiezen van de route?*
- Neem je iets mee? En hoe neem je dat mee?
- Kan je de e-bike makkelijk pakken?

Tijdens de rit

- Wat voor onderdelen zitten er op jouw e-bike die voor je gevoel invloed hebben op je veiligheid, *positief of negatief*?
- Hoe houd je de route bij?
- Wat doe je als je gebeld wordt of je telefoon even wil gebruiken tijdens de rit?

Pauze moment of aankomst op bestemming / thuis

- In hoeverre heb je het gevoel dat je makkelijk en veilig kan stoppen om ergens af te stappen?
- In hoeverre kun je de fiets makkelijk neerzetten?

Fase 3: 'kort' invullen van Journey II (in het geval dat een ander type rit van toepassing is)

"Je gaf aan dat je ook soms een andere type rit maakt, namelijk …. ."

- Als je van begin tot eind kijkt naar wat we net besproken hebben, wat zijn dan aspecten die anders zijn of gaan als je …..?

Fase 4: vragen betreft verkeersveiligheid, en pains & gains

Notities maken onder de ingevulde Journeys

- Hoe zou jij je fietsgedrag op de e-bike beschrijven?
    - *En als je denkt aan je fietsgedrag in relatie tot verkeersveiligheid?*
- Ben je wel eens met de e-bike gevallen?
  In geval van "ja"
    - wat was er toen gebeurd?
    - In hoeverre bent u dingen anders gaan doen sinds u gevallen bent?
- Tijdens het fietsen kan je wel eens van die momenten hebben dat je het gevoel hebt dat het 'net goed ging', dat je net geen ongeluk had, of net niet was gevallen. Zou je momenten kunnen beschrijven dat je dat hebt gehad of wel eens hebt?
- Als jij een voorstel zou kunnen doen, om je (nog) veiliger te voelen op de e-bike, waar zou je dan aan denken?

Gehele journey (I & II)

Met groene en rode post its de opmerkingen plaatsen in de Journeys

- Als je zo kijkt naar deze ervaringen, zijn er dingen die je als een last ziet bij het gebruiken van de e-bike of niet ideaal?
- Wat zijn punten die je juist als positief ervaart?

Afsluiting: invullen achtergrond vragen

> Geef vel met achtergrondvragen en vraag in te vullen “nog een paar korte achtergrond vragen om in te vullen.”

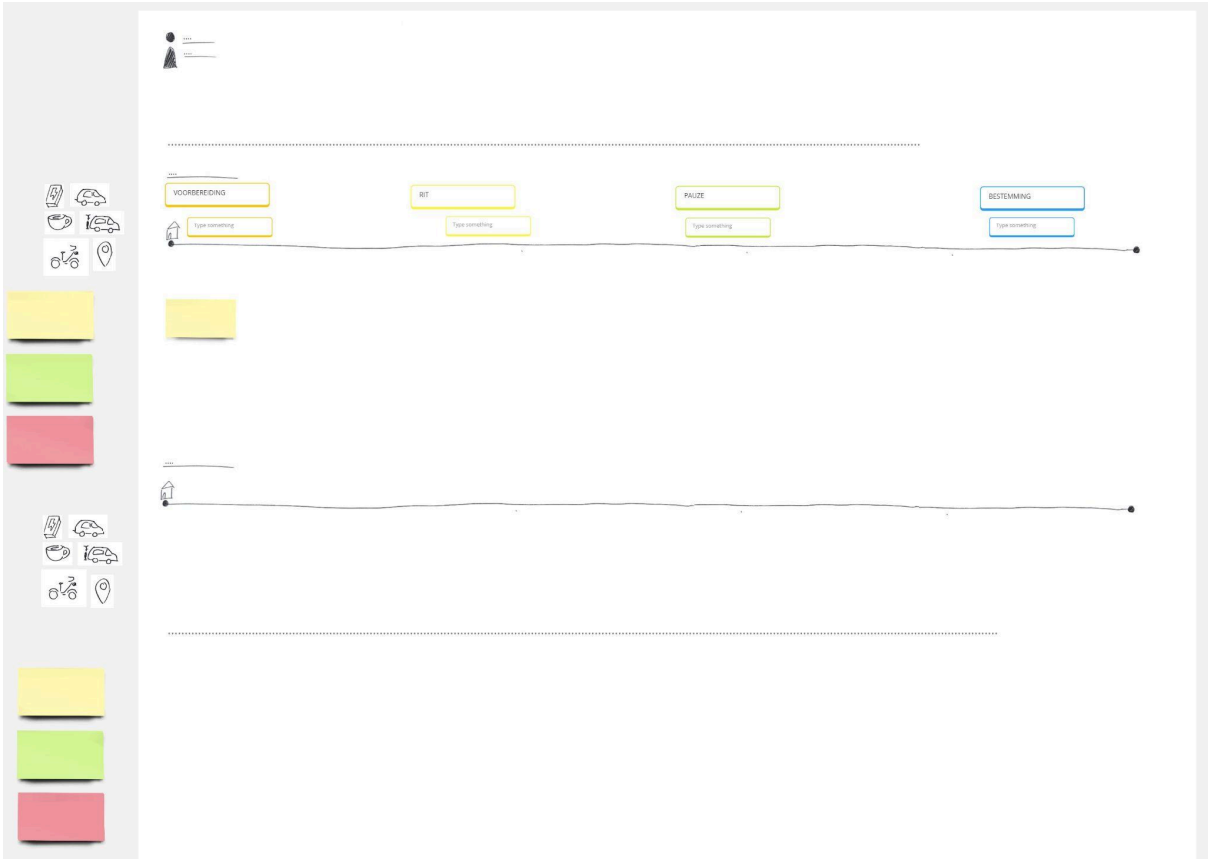
Achtergrond vragen die door de deelnemer zelf worden ingevuld:

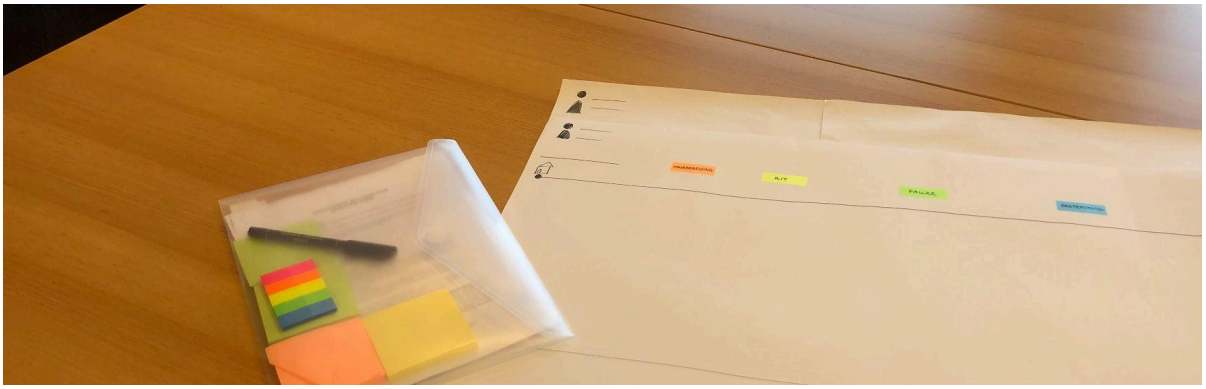
- Naam
- Leeftijd
- Type e-bike
- Wanneer heeft u de e-bike aangeschaft?
- Gebruikt u de e-bike voor alles, of fietst u ook nog op een ‘normale’ fiets?:
- Gebruikt u een helm?: ja nee ik overweeg er een te nemen
- Wat vindt u een fijne snelheid om te fietsen op de e-bike?:
- Heeft u ooit instructies gekregen of opgezocht hoe je de e-bike gebruikt?:
- Zo ja, waar/hoe?:
- Sport u naast het gebruik van de e-bike?
- Heeft u fysieke beperkingen die invloed kunnen hebben op uw fietsrit?

> Heel erg bedankt! Dan heb ik geen vragen meer,

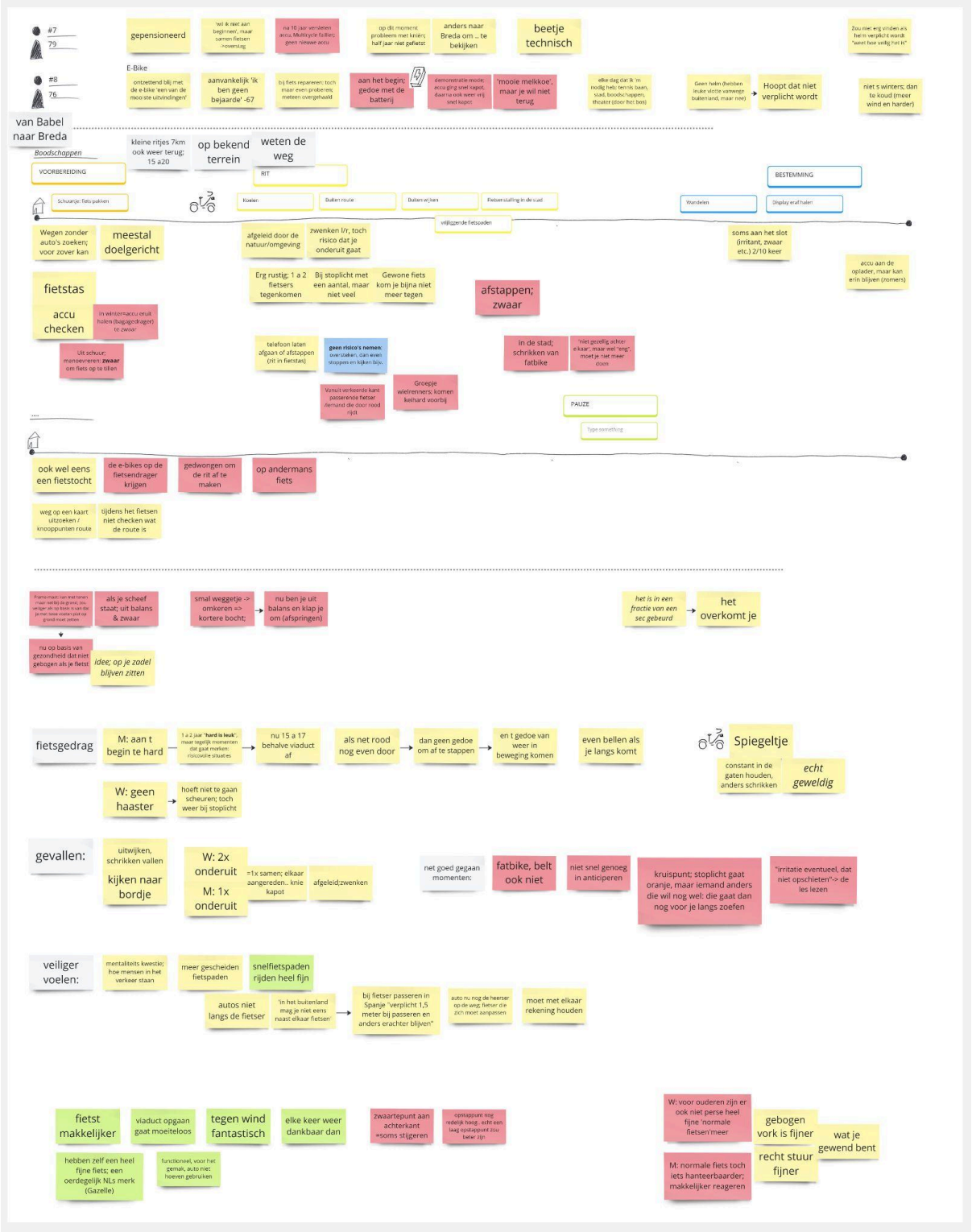
- Is er iets dat je nog zou willen toevoegen aan wat we hebben besproken?

D. 3 TEMPLATES





FILLED IN EXAMPLES:




80
Fiets 4D camping
week
overnachten
RECREATIEF
VOORBEREIDING
VOORlopig makkelijk
RIT
niet vaak STOPpen
PAUZE
BESTEMMING
NXT DAY:
IDEAAL
& Duurzaam
Je laat makkelijker Fietsen (vallen)
START. AFH. Asfalt
1 vd 2 = ROUTE
restaurantje / café
opladen
ROUTE KOUZE:
Domme Doeners
FIETSKNOOP
ACHTERop Fietsenrek
kleding
verband doos
afgesloten
"Klopt de Route nog?"
VTV GOED opladen
Geen plan B mee
soms ook smalle paddies
- zand
- BAGGER
- schelpenpad
- Asvalt
als WARM niet
KNOOPPUNTEN
grandorg
gaat vaak FOUT
Drukte
"LIGT ERAAN"
> keuze WNR
niet op drukke dagen fietsen
Veel Fiets 4daagses
kom je vaak TEGEN
- Geen LAST
BOODSCHAPPER
Boodsch in de Buurt = wandelen
>10km
RUSTIG IS => VOOR PLEZIER
meerendeel VAAK HARDER
ALLEEN => HARDER
Veilig
Oplettend & ANTICIPEREN
TAXI CHAUFF SENSEEST
soms SNELHEIDAUTO INSCHATTEN
GLEEFTYD
- Eigen snelheid
- weer
ZEER
kinderen die ineens oversteken
"je hoeft maar een Stoeprand te raken"
"je AFSTAND Houden" (inroepen)
vallen
uit Brandpunt ONDERUIT gereden
STOEPRAND
BOCHT
zandpad
- BOCHT
VOORWIEL Aandrijving
midden-MOTOR
VEILIGER
zelf MOTOR opgang helpen

E. TARGET GROUP RESEARCH: SURVEY

E.1 QUESTIONS

1. Welkom bij deze vragenlijst
2. Geslacht:
3. Leeftijd:
4. Bedankt voor je deelname. Voor dit onderzoek zijn we op zoek naar leden van 60 jaar en ouder. △ 3 → Einde
5. In dit onderzoek hebben we het over een ongeval. Dat heeft hier een brede definitie; dit kan dus gaan om een val of ander soort ongeluk dat wel of niet eindigde in het ziekenhuis, en waarbij wel of geen andere weggebruikers betrokken waren.
6. Heb je weleens een ongeval gehad met je fiets of e-bike sinds je 60e? → 22
7. Focus je je vanaf hier graag op één ongeval △ 6
8. Hoe oud was je toen je het ongeval had?
9. Met welk vervoermiddel had je een ongeval?
10. Wat voor e-bike gebruikte je op het moment van het ongeval? (meerdere opties selecteerbaar) △ 9
11. Hoe lang had je deze e-bike al toen je dit ongeval had (als je het niet meer precies weet, kun je een inschatting maken)? △ 9
12. Zou je kunnen beschrijven, *zover je het je kan herinneren*:
    - waar je ongeveer fietste
    - waarom je de rit maakte
    - en wat er gebeurde bij het ongeval?
13. Waren er externe omstandigheden die (misschien) bijdroegen aan het ongeval?
14. Passen de antwoorden die je opgaf bij de vorige vraag, bij een van de onderstaande antwoord categorieën? (meerdere opties zijn mogelijk)
15. Kan je aspecten noemen in je eigen rijgedrag, die wellicht bijdroegen aan het ongeval?
16. Passen de antwoorden die je opgaf bij de vorige vraag, bij een van de onderstaande antwoord categorieën? (meerdere opties zijn mogelijk)
17. Had je fysieke beperkingen die invloed kunnen hebben gehad op het ongeval?
18. Denk je dat het ongeval niet was gebeurd als je op dat moment op een 'normale fiets' had gereden? △ 9
19. Gebruikte je tijdens dit ongeval accessoires of hulpmiddelen op de fiets of e-bike? (meerdere opties zijn mogelijk)
20. Ben je dingen anders gaan doen sinds het ongeval? Denk aan rijgedrag aanpassen, hulpmiddelen aanschaffen, instructies opzoeken, situaties vermijden, fysieke oefeningen etc.
21. Als je een voorstel zou kunnen doen om je (nog) veiliger te voelen op de fiets of e-bike, waar zou je dan aan denken? → Einde
22. Bedankt voor je deelname. Voor dit onderzoek zijn we op zoek naar leden die na hun 60e een ongeval hebben gehad op de fiets of e-bike. △ 6 → Einde

Introduction to the survey

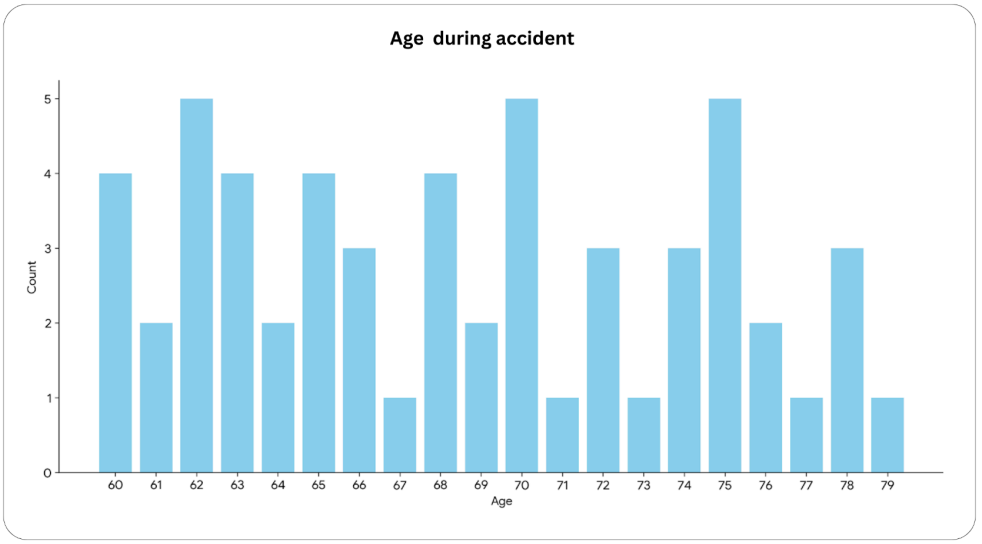
Welkom bij deze vragenlijst

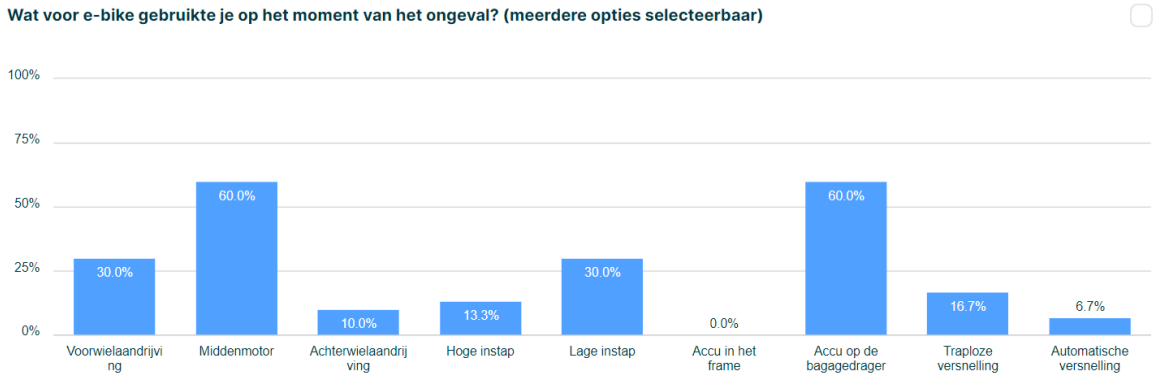
Fijn dat je de tijd neemt voor het invullen van deze enquête. Hiermee draag je bij aan een onderzoek dat in kaart brengt hoe ongevallen op fietsen en e-bikes ontstaan bij Nederlanders van 60 jaar en ouder.

In dit onderzoek hebben we het weleens over een ongeval. Dat heeft hier een brede definitie; dit kan dus gaan om een val of ander soort ongeluk dat wel of niet eindigde in het ziekenhuis, en waarbij wel of geen andere weggebruikers betrokken waren.

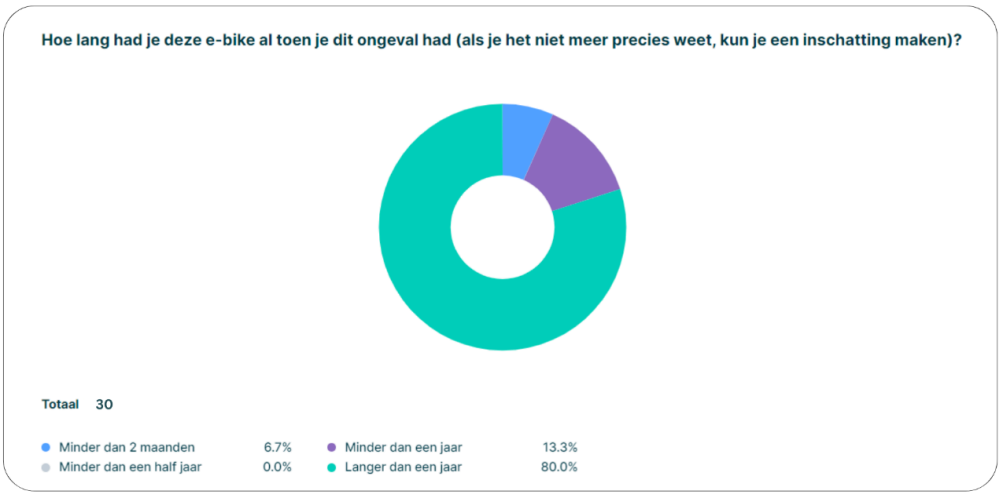
Je antwoorden worden uiteraard anoniem verwerkt.
Deze enquête kost maximaal 10 minuten van je tijd. Nogmaals dank voor je medewerking!

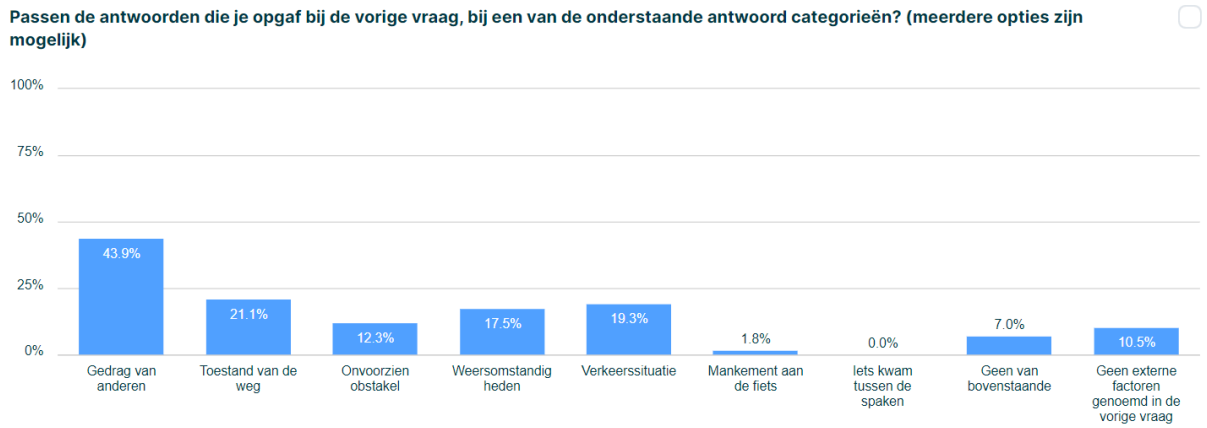
E.2 ELABORATED RESULTS



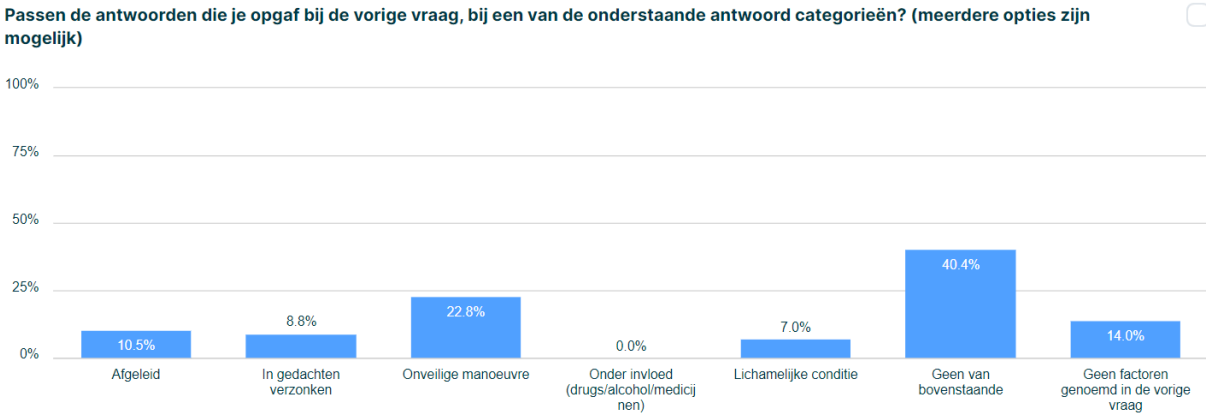


Out of respondents who used the e-bike (n=30)

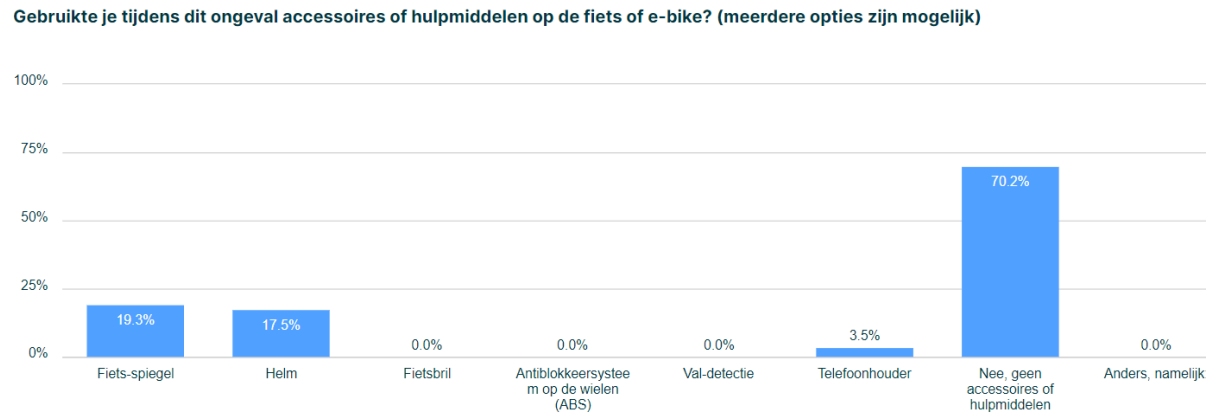




'vorige vraag': **Open question;** Waren er externe omstandigheden die (misschien) bijdroegen aan het ongeval?



'vorige vraag': **Open question;** Kan je aspecten noemen in je eigen rijgedrag, die wellicht bijdroegen aan het ongeval?



F. CREATIVE SESSION

F.1 SESSION PLAN

	What	Time (minutes)	Aimed for starting time
Welcome	Settling down of participants	[5 before]	
Icebreaker	Everyone gets to introduce themselves	25	13:00
Introduction	- Agenda - Way of working	5	13:25
Golden Rules	Discussing the homework and setting up 'golden rules' Examples Golden Rules templates	35	13:30
Challenge	- Presentation showcasing the problem and trends - Questions	20	14:05
Diverging	Brainstorm	30	14:20
Reverging	Spontaneous clustering Coloured post-its for cluster categories	15	14:45
Converging	Hits or Dots: Voting on favorite ideas and/or categories (10 sticker votes each) Stickers	10	15:00
Break	*Facilitator: Writing down concept options*	10	15:10 a 15:15
Converging	- Creating concepts through (poster making) Worksheets -Elevator pitch: Presenting the concepts	40	15:20 a15:25 Max 15:40 start posters Max 16:00 stop posters
Closing	-One word: how do you feel after this day -Ask for words of advice	15	16:15
Total		*3 u 30 min*	*13:00 - 16:30*

List of materials
- Tape
- 10 name stickers / tags
- 13 permanent markers
- 10 stacks of yellow basic rectangular post its, *to hand out during brainstorm*
- 10 pieces of paper, A2 flipchart paper, *to put post its on when brainstorming*

- stack of coloured post its, *to write cluster names on*
- 2 stacks of post its, *to use during clustering*
- 10 strips of 6 voting stickers, green / blue
- Extra printed homework assignment examples
- Paper to write the points of Way of working on (preferably a flipping chart)
- Worksheets for Golden Rules
- Worksheets for the poster making (printed out on A2, 4x)
- Session plan [in Dutch] (printed out 3x)
- Professional camera if possible
- Wear a watch

Preparations
-Arrange flipping chart if not yet present
-Write on flipping chart sheets:
> Agenda
> Way of working
> Golden Rules template
-Make sure there is fresh air coming in the room
-Placing the material; already put the stacks of post its there and multiple papers
-Put flipping chart papers on the wall as well, *ready for clustering*
-Have the presentation set up ready
-Repeat planning, roles and tasks with the assisting facilitator
-Pick up the participants at the entrance hall
-Write down the names on the name stickers, put them on the table to grab

Welcome
- 12:50 pick up the participants, walk them to the room /ask someone to do this
Welcome all participants in the room and tell them to take their name sticker and to take something to drink and or eat. Tell them they can just pick a seat.

13:00 **Icebreaker** **25 min**
- Start 'Tring-tring' introduction: everyone is to 'ride in' with *tring tring* (ringing the bicycle bell) and then telling who they are and how they are feeling
- Firstly introduce myself, how I feel, what I am working on, and introduce my assisting facilitator / in this case also client
-Who rides in next? Tell that the one who *rings* takes the floor (popcorn-style / not in an order)
+- 20 min
The first people set the tone; assistant facilitator should set the example

13:25 **Introduction to the afternoon** **+- 5 min**
- Aim of the session
- Agenda; tell what the session will look like + "there will be a break" "invited for staying for a drink afterwards"
Vandaag gaan we toewerken naar 3 concepten.
Eerst gaan we met het huiswerk aan de slag,
ik zal een presentatie geven om een beter idee van het onderwerp te krijgen,
en dan zullen we gaan brainstormen en ideeën verder uitwerken.
- **Way of working** on flipchart / paper; highlighting the open atmosphere and that it is supposed to be a fun afternoon.
Elke mening telt, Wees open en eerlijk, Constructief "ja, en..", Vraag het als iets onduidelijk is, Iedereen is hier als deelnemer; ook onze ANWB vertegenwoordigers, Veel plezier!
- Ask if it is **okay that pictures** are taken during the session by the assistant facilitator, tell them they would only be used for in the report

13:30 **Golden Rules** **+- 35 min**
Time to discuss the homework question
Een voorbeeld van een technologie, service, product, of iets anders, dat het verkeer voor/volgens jou aangenamer en veiliger maakt.
[Bring an example - preferably a printed image - of a technology, service, product, or something else that makes traffic more pleasant and safer for/in your opinion.]
Eerst een rondje welke voorbeelden er zijn meegenomen en kort waarom deze, dan gaan we daar straks in groepjes verder op in.
-**Let everyone share** their example +- 10 min.
-Divide in **3 groups who can then discuss** their examples; **what makes** those pleasant and safer, and draw up a list of 'Golden Rules' :hand out to each group the *Golden Rules template*
+- 15 min
-Come together again; let a representative of each group present their list of golden rules

-Draw up a common list of Golden Rules +- 5 min
Have a few more examples yourself at hand, in case people don't have any with them. Take the opportunity to have more original examples.

14:05 **Challenge**: Presentation of problem and trends
-Presentation +- 10 min
Straks is er ruimte voor vragen; als je zelf nog gedachtes over het onderwerp hebt of andere ontwikkelingen kent, schrijf deze vooral al op post its; dan kunnen we die nog erbij houden tijdens de sessie
-Room for a few questions +- 5 min
! Be cautious when questions seem to turn into comments and discussions. Remind them there is room for discussions later.

14:20 **Diverging**: Brainstorm **+- 25 min**
! Have a slide on the screen with the SPARKed problem statement (different than the problem statement that is presented to tackle for the overall project)
"The moment for really letting your creativity flow has arrived!"
-Explain that we are going to come up with as many ideas as possible in the upcoming (around) **20 minutes**.
"Probably the first ideas you write down are more obvious ones, also write those down to just have it all out there".
-Remind the group about the mindset and ground rules for diverging:
Stel je oordeel uit; kwantiteit brengt kwaliteit, lift op de ideeën, laat het de vrije loop 'freewheelen'
[Postpone Judgement; quantity breeds quality, hitchhike, freewheel]
-When fluency drops, ask to write # more ideas and also ask for the 'silly' ideas
> flexibility & fluency techniques; e.g. passing on the paper and go on adding ideas
> put fuller sheets up on the wall, to have room for more ideas to come and prevent the feeling of 'I am almost done' because a sheet is filling up.

14:45 **Reverging**: Spontaneous clustering **+- 15 min**
-Introduce reverging & clustering
For everyone to get an overview of the generated options... and to bring a bit of order in these ideas
> Ask them to pick up the post its; each having a stack in their hand and to start clustering
Just start somewhere, and you will notice that it will flow. Also feel free to rearrange.
If something doesn't seem to fit, we can make a cluster 'other'.
Grab coloured post its for cluster naming
> it might help to talk out loud
> don't be too critical and trust your intuition
- Remind the RG about the mindset and ground rules for reverging:
Gebruik de onderzoekende geest, wees gezamenlijk actief, luister responsief, beweeg circulair (blijf

je bewegen over het vlak)
[Using the inquiring mind, be jointly active, listen responsively, move circularly]
! Facilitator and assistant can help by 'thinking along', pointing out options to those who seem to be stuck for example

15:00 **Converging**: Hits or Dots **+- 10 min**
-Hand out voting stickers {pre-cut strips of *10* green or blue stickers}
>Ask to quickly go over the ideas and use the stickers to indicate which ideas and categories you find most interesting, intriguing, relevant... ; *and with that to... 'kill their darlings'*
> Allowed to put a sticker on a category
> Can put a sticker on 10 different ones, but you can also choose to put more on one idea, with a maximum of 3 dots; to show more priority
> Which options feel intriguing, relevant...?
>Remind the group about the mindset and ground rules for converging:
Constructief oordelen, nieuwheid beschermen, vertrouwen op intuïtie en actie in gedachten hebben

15:10a15 **Break**
A short break; 10 minutes; "be back at ..."
-During the break assistant & facilitator: look at votes and based on those, write down 3 concept directions on the board, which the participants can work on after the break

15:20a25 **Converging**: Concept development worksheet (/poster making) **+- 40 min**
-Welcome everyone back; short summary of where we are at and overview of the rest of the session.
>introduce that we have distilled three concept directions, which they will be asked to develop further in groups in the next part. +- 5 min
-Dividing the groups:
Ask if people have a preference to work on
#1, #2, #3, showing hands >pick people per group +- 5 min
-Hand out concept development worksheet and explain how to use them +- 5 min
+tell that we will present them to each other afterwards
>Ask for questions
>Remind the group about the mindset and ground rules for converging:
Constructief oordelen, nieuwheid beschermen, vertrouwen op intuïtie en actie in gedachten hebben
[Affirmative judgment, protect novelty, trust the hedonic response and have action in mind]
! Keep concept directions at hand and, if necessary, allow a group who was not excited to work on any of the proposed directions, to choose for themselves which idea to work out

Max 15:40 -Groups working on the worksheets/posters +- 15 min
While they are working:
> remind them when the last 5 min left +that one person will present the poster afterwards
> help groups out where there seem to be obstructions
> make sure middle is used for visual representation of the concept
Suppose that a group finishes much faster and can still choose its own idea from the cluster wall; a few extra worksheets on hand

Max 16:00 -Poster/worksheet presentations +- 15 min
Have tape ready
> Hang up all three concept posters
> Ask for an elevator pitch by a representative of each group
Geef een pitch van een minuut, dan nog ruimte voor vragen/discussie

16:15 **Wrap up and closing** **+- 15 min**
-Summarize what we have done

We have set up 'golden rules', brainstormed and even worked out concept directions ; I will use these insights to work towards a solution for the graduation project.
- One word: how do you feel after this day
- Ask for last words of advice
Note down on post its (1 per word of advice)

After the session:
'Borrel' and free talking / connecting

-Take pictures of the outcomes
-Thank you for participating e-mail (evt. fotos vraag)

E.2 INVITATION

E.3 WORKSHEETS

5 GOLDEN RULES

...service of product dat het verkeer aangenamer en veiliger maakt.

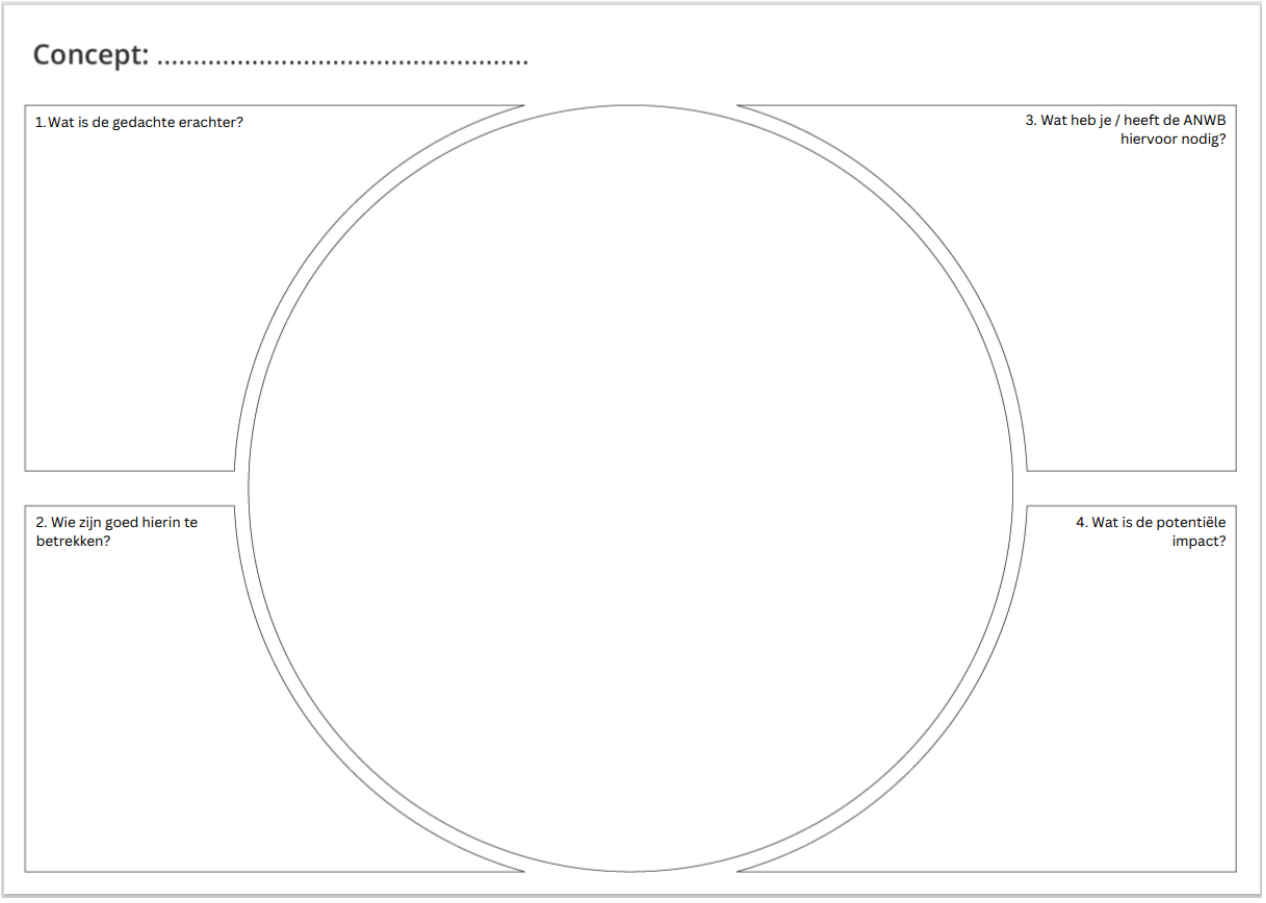
1. _____

2. _____

3. _____

4._____

5._____



Concept: .....

1. Wat is de gedachte erachter?

3. Wat heb je / heeft de ANWB hiervoor nodig?

2. Wie zijn goed hierin te betrekken?

4. Wat is de potentiële impact?

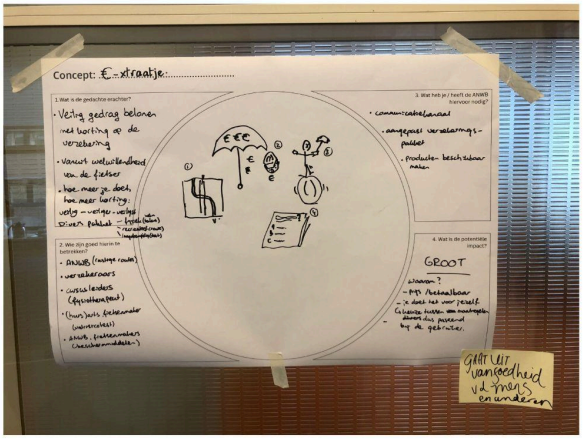
E.4 OUTCOMES

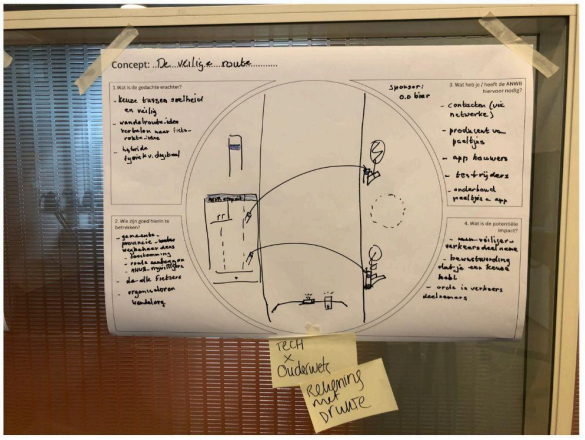
<u>The following categories of ideas were created during the spontaneous cluster:</u>
- Training & courses
- Information sharing & advice
- Buddy systems & Social network
- Events
- Rewards
- Campaigns
- Bike technology
- Gadgets & protection
- Other vehicles & road users
- Infrastructure
- Bike maintenance
- Medical
- Regulations

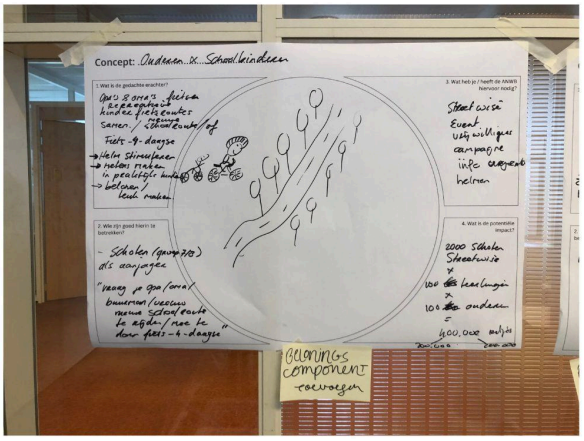
Ideas generated during the session are disclosed to the ANWB only.

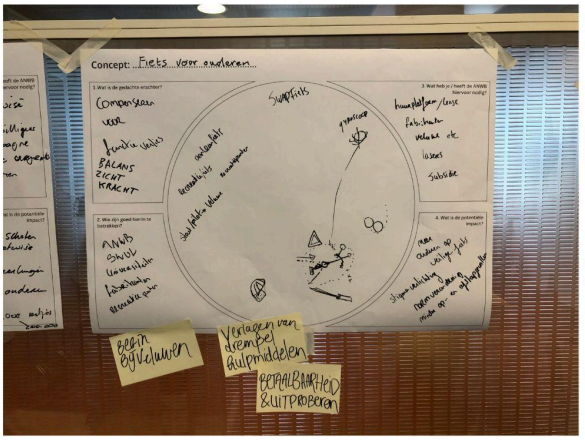
<u>The idea areas, chosen based on the voted on ideas, were worked out in groups into the following concepts:</u>

- ANWB e-bike verzekeringsvoordeel bij veilig gedrag (idea area: verzekeringsvoordeel)
- ANWB lease service voor de fiets voor ouderen (idea area: de fiets voor ouderen)
- Fysieke markering van de fietsvriendelijke routes (idea area: de veilige route)









G. THREE IDEAS DISCUSSED

CAMPAIGN: DON'T STARTLE EACH OTHER

The campaign aims to raise awareness and encourage behavior change among all road users to be more considerate of each other. The core message is "Don't Startle Each Other". This aligns with the key purpose to reduce accidents involving elderly cyclists on e-bikes, who often get startled by risky behavior of other road users. Furthermore, the campaign promotes recognition and acceptance of the various types of electric bikes as an integral part of traffic. It emphasizes that electric bikes are here to stay, the need to adapt, o.a. highlighting the reduced reaction times of fast-moving bicycles.

Suggestion: The message can be effectively conveyed through humorous and relatable parodies of different traffic types, making the campaign memorable while delivering a serious message. Examples include a cyclist swerving and rushing to beat the traffic, a hurried driver breaking abruptly before a cross-over, and depicting an elderly person with slower reaction time on an e-bike.

Channels: The campaign would be visible through multiple channels to ensure broad reach:

- YouTube videos
- ANWB's magazine, "De Kampioen"
- Collaboration with SIRE (Stichting Ideële Reclame) for impactful public service announcements and using JCDecaux outdoor advertising

TRY-OUT BIKE

This concept focuses on guiding individuals aged 60+ who want to purchase an e-bike towards buying a safer e-bike designed for the elderly, equipped with helpful features. A bike designed for seniors typically has a low step-through frame and a saddle that allows feet to reach the ground. The ANWB website will recommend bikes based on safety and offer the possibility to try them out through an extensive test ride. Interested individuals can use the website to find locations where they can try the bike, at participating bike rental shops and/or retailers with whom ANWB has partnered. If the marketplace for bikes is implemented next year, where ANWB becomes a digital retailer of bicycles, it could also expand to offer a safe bike for seniors that can be test-ridden.

INSURANCE BENEFIT

This concept aims to encourage the elderly to be safer on e-bikes in various ways. The ANWB e-bike insurance would include a feature where they can earn discounts on their bike insurance by accumulating points through safety-promoting choices. Points can be earned by participating in sports classes, bike fall prevention courses (currently being developed), and activities or events organized by DOORTRAPPEN, as well as by purchasing ANWB safety accessories. To facilitate this, ANWB would establish connections with the systems of various organizations to link registrations to registrate reward-points.

H. TRAFFIC SAFETY DATA

Toelichting velden

Het resultaat van de schattingen zijn opgenomen in een geopackage. Het coördinatenstelsel van is 28992 (Amersfoort/Rijksdriehoek stelsel). Voor elk wegvak zijn waarden opgenomen voor de volgende attributen:

Veld	Toelichting
fid	een uniek fietspad id in deze dataset
begin_dat	Datum van het Nationaal Wegenbestand waarop de schatting gebaseerd is (01-03-2024)
wvk_id	Het wegvak nummer uit het Nationaal Wegenbestand op de datum 'begin_dat'
fietstype	Type van het fietspad. Dit kan zijn : 'bromfietspad (langs weg)', 'fietspad (langs weg)', 'fietsstraat', 'onverplicht fietspad (langs weg)', 'pedelecfietspad', 'rijbaanwissel pedelec' ,'normale weg', 'solitair bromfietspad', 'solitair fietspad', 'solitair onverplicht fietspad', 'voetgangersdoorsteekje', 'voetgangersgebied', 'voetgangersgebied fietsen toegestaan', 'weg met fiets(suggestie)strook'[3] of 'onbekend'.
breedte	Dit is de fietspadbreedte uit het Nationaal Wegenbestand in centimeters. Dit is de mediane breedte van het fietspad. Als er geen breedte bekend is, dan is de waarde -1.
rijrichtng	De rijrichting van het fietspad. Deze kan 'H' (heen), 'T' (terug), 'B' (beide) of 'O' (onbekend) zijn. Als er geen relatie kan worden gevonden tussen een fietspad in het fietsersbond netwerk en het NWB is de richting ook onbekend. *LET OP : de wegvakken zijn overgenomen uit het NWB en zijn niet altijd in een logische richting ingetekend. Het is bekend dat éénrichtingsfietspaden soms tegengesteld zijn ingetekend. In dat geval is de richting dus 'T'.*
os_int_kl	De geschatte (doorsnede) intensiteit in fietsers/uur voor dit wegvak in de ochtendspits.
os_perc_H	Het geschatte percentage fietsers in de 'Heen' richting ten opzichte van de totale intensiteit voor de ochtendspits.
oS_perc_T	Het geschatte percentage fietsers in de 'Terug' richting ten opzichte van de totale intensiteit voor de ochtendspits.
os_br_lab	Dit is het breedte label zoals bepaald volgens de regels van de breedtetool voor de ochtendspits. Als er geen label bepaald kon worden staat hier X.
as_int_kl	De geschatte (doorsnede) intensiteit in fietsers/uur voor dit wegvak in de avondspits.
as_perc_H	Het geschatte percentage fietsers in de 'Heen' richting ten opzichte van de totale intensiteit voor de avondspits.
as_perc_T	Het geschatte percentage fietsers in de 'Terug' richting ten opzichte van de totale intensiteit voor de avondspits.
as_br_lab	Dit is het breedte label zoals bepaald volgens de regels van de breedtetool voor de avondspits.
breedtelab	Dit is het resulterende label (het slechtste label van de ochtend- en avondspits)

Fig. ...: Parameters mapped by DAT Mobility (NDW, 2024)

I. VALIDATION SURVEYS

I.1 VALIDATION SURVEY 1

1. Welkom bij deze vragenlijst
2. Geslacht
3. Leeftijd
4. Bedankt voor je deelname △ 3 → Einde
5. Welk type fiets gebruik je (het meest)?
6. Gebruik je weleens navigatie om ergens naartoe te fietsen? Zo ja, welke toepassing gebruik je hiervoor? *We hebben het hier niet over knooppuntennavigatie*
7. Hoe houd je bij waar je heen moet tijdens een voor jou onbekende route op de fiets? (Meerdere antwoorden mogelijk) △ 6
8. Gebruik je tijdens navigatie op de fiets de speaker functie voor route meldingen (gesproken navigatie)? △ 6
9. Als de navigatie (fiets) rekening zou houden met meerdere factoren om een route voor jou te bepalen, welke factoren zou jij dan fijn vinden dat het meeneemt? (mag alles zijn)
10. Gebruik je al toepassingen van de ANWB om routes te bepalen? (meerdere antwoorden mogelijk)
11. Afbeelding
12. Wat is je eerste reactie op de ANWB die fiets navigatie van A naar B zou aanbieden, met de optie van de prettige, veilige fietsroute?
13. Welke fietsroute optie zou je kiezen?
14. Afbeelding △ 10
15. Wat zou je ervan vinden om in dezelfde app als de knooppuntenplanner (ANWB Eropuit) de navigatie-optie te hebben voor normale fietsroutes? △ 10
16. Zou je de optie van de prettige, veilige route (soms) willen gebruiken? *Graag een toelichting*
17. In hoeverre identificeer je je met de volgende stelling:

    'Ik ben benieuwd of mijn dagelijkse routes al de prettige, veilige routes zijn.'
18. Stel de optie van de prettige, veilige route wordt toegevoegd aan de ANWB app. Zou je dan eerder de ANWB app gebruiken in plaats van Google Maps of andere navigatie die je al gebruikt?
19. Wat zou je belangrijk vinden dat wordt meegenomen in de prettige, veilige route? (kies één tot drie mogelijkheden die je het belangrijkst vindt)
20. Heb je nog aanvullende opmerkingen voor ons? → Einde

Introduction to the survey

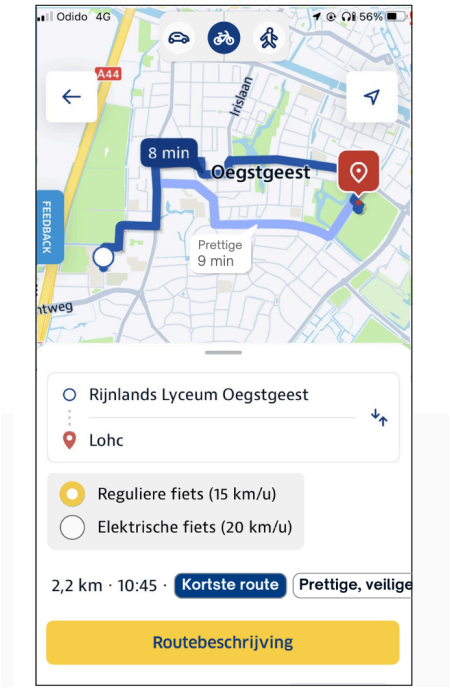
Welkom bij deze vragenlijst

Fijn dat je de tijd neemt voor het invullen van deze enquête. We kijken op dit moment vanuit de ANWB naar mogelijkheden om de navigatie voor fietsers te verbeteren.

Met deze enquête willen we graag inzicht krijgen in wat jij van mogelijke nieuwe functies zou vinden en of deze functies een meerwaarde voor jou zouden hebben.

Je antwoorden worden uiteraard anoniem verwerkt.
Deze enquête kost maximaal 10 minuten van je tijd.
Nogmaals dank voor je medewerking!

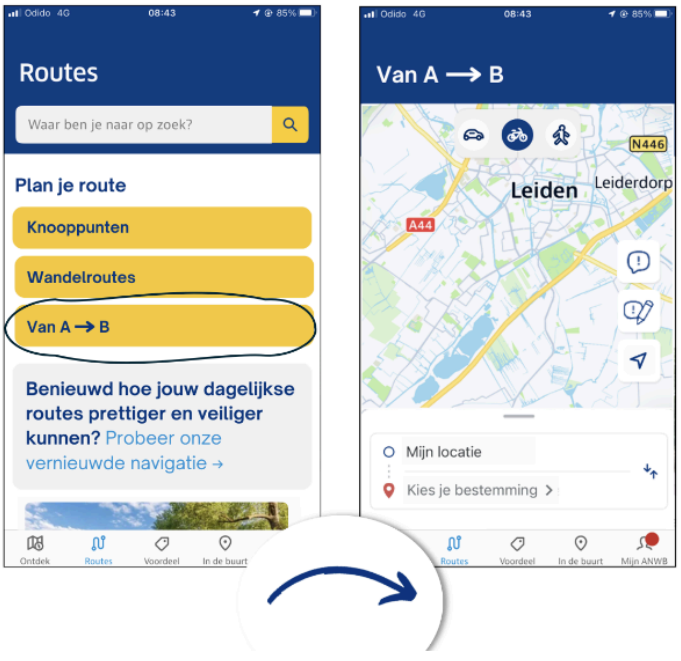
SURVEY ELEMENT 11



We denken aan het toevoegen van navigatie voor de fiets in de Eropuit app en de Onderweg app voor verplaatsingen van A naar B.
Hierin geven wij de optie van de prettige, veilige fietsroute. Deze is onder andere rustiger en gaat meer over vrijliggende fietspaden.
Hierbij zou ook worden aangegeven hoe lang deze zou duren, t.o.v. de kortste route.

De volgende vragen zullen hierop ingaan.

SURVEY ELEMENT 14
(visible for those who implied to use Eropuit already)



De navigatie voor A naar B zou toegevoegd worden in de Eropuit app.

I.2 VALIDATION SURVEY 2

Elements 7 - 13: only presented to those who use the Eropuit services (app & website)
Elements 14 - 18: presented to all respondents except for those who only use Eropuit website functions

Introduction to the survey

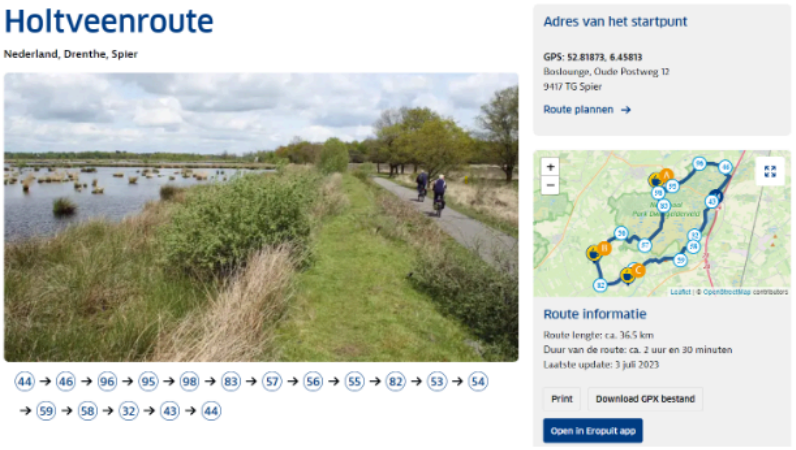
Welkom bij deze vragenlijst

Fijn dat je de tijd neemt voor het invullen van deze enquête. We kijken op dit moment vanuit de ANWB naar mogelijkheden om de navigatie en verkeersveiligheid voor fietsers te verbeteren.

Met deze enquête willen we graag inzicht krijgen in wat jij van mogelijke nieuwe functies zou vinden en of deze functies een meerwaarde voor jou zouden hebben.

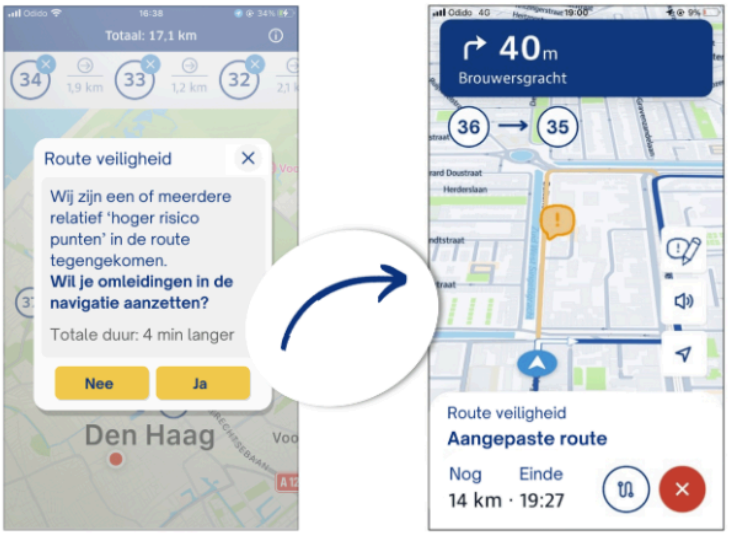
Je antwoorden worden uiteraard anoniem verwerkt.
Deze enquête kost maximaal 10 minuten van je tijd.
Nogmaals dank voor je medewerking!

SURVEY ELEMENT 7



Op de website van de ANWB en in de Eropuit app is het al mogelijk om knooppunten routes te plannen of kiezen. Een gekozen route kan vervolgens opgeslagen worden en in de Eropuit app te vinden zijn. Binnenkort zal navigatie toegevoegd worden voor tijdens het fietsen van een knooppuntenroute. Wij zijn bezig met het vernieuwen en verbeteren van de planner en navigatie functie.

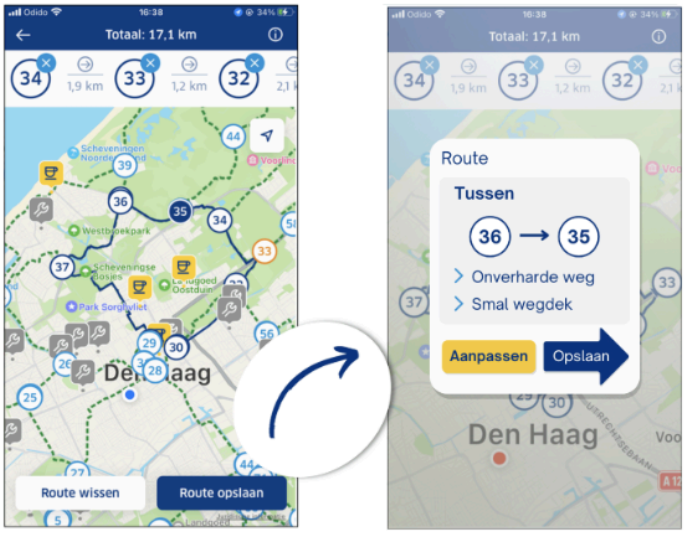
SURVEY ELEMENT 8



Wij denken aan de volgende update van de app:
De navigatie geeft tijdens het fietsen van de knooppuntenroute een aangepaste route aan waarmee een risicovol punt vermeden wordt (zoals een druk kruispunt, of een drukke dijk).
Hierbij zou je vervolgens weer op de route komen naar het volgende knooppunt.

De volgende vragen: Wat zou je van deze functie vinden? Zou je de omleidingen-optie aanzetten?

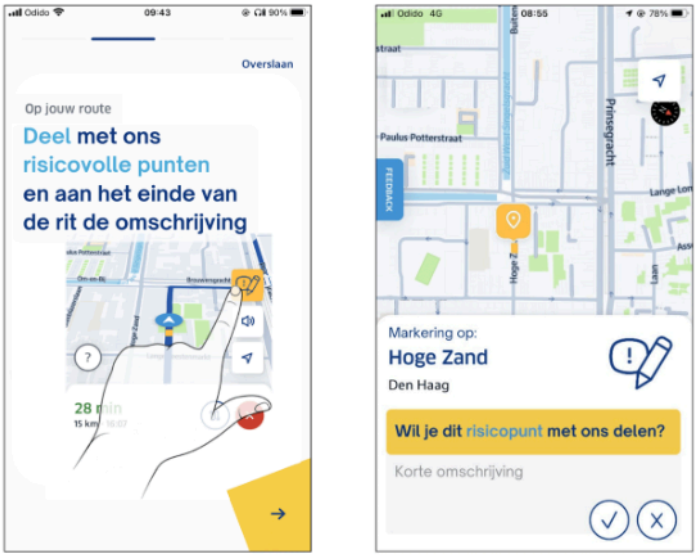
SURVEY ELEMENT 13



Deze afbeelding laat het plannen van een eigen knooppunten route zien. Wanneer je hier op 'route opslaan' zou klikken, komt de pop-up die rechts te zien is.

***De volgende vraag:* Zou je de route aanpassen?**

SURVEY ELEMENT 14



<u>Wij denken aan het toevoegen van de volgende functie:</u>
Als gebruiker aan kunnen geven waar je vindt dat de verkeersveiligheid onvoldoende is. Hierbij kan ook gedacht worden aan het opmerken dat er iets mis is met de infrastructuur (bijv. bewijgwijzering of het wegdek).

Volgende vragen: Zou je deze optie een toevoeging vinden? Denk je dat je gebruik zou maken van deze optie?

SURVEY ELEMENT 17

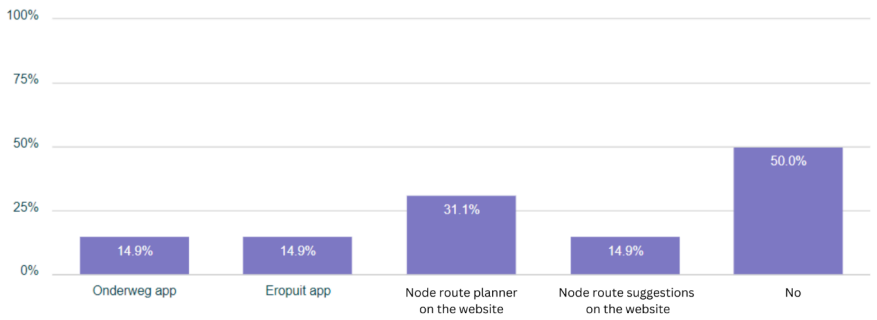
<u>Ook denken wij aan de volgende functie:</u>
een inzichtelijke kaart van verkeersveiligheids data, waarbij je bijvoorbeeld kan zien hoeveel ongevallen er op een plek hebben plaatsgevonden. Ook zou het mogelijk zijn om te zien waar meldingen zijn geplaatst van risicopunten door gebruikers van de app. Deze kaart zou te vinden zijn in de app en op de website.

Volgende vraag: Zou je deze optie een toevoeging vinden?

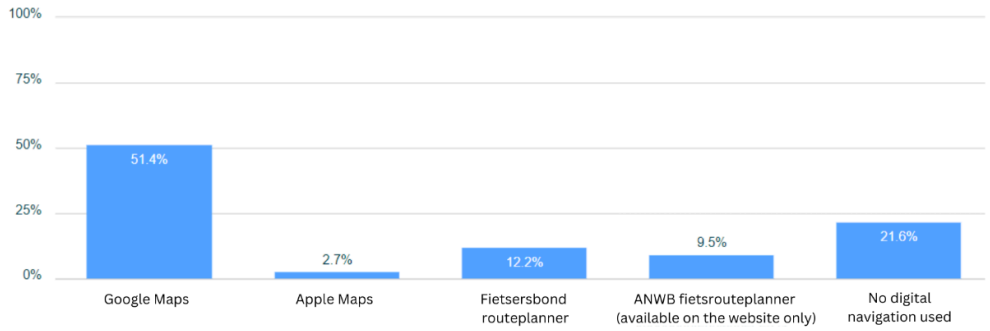
I.3 RESULTS

Extended results of survey 1 *'Adding navigation for A to B to the Eropuit app, with the option of the pleasant, safe route.'*

Making use of ANWB routeplanning

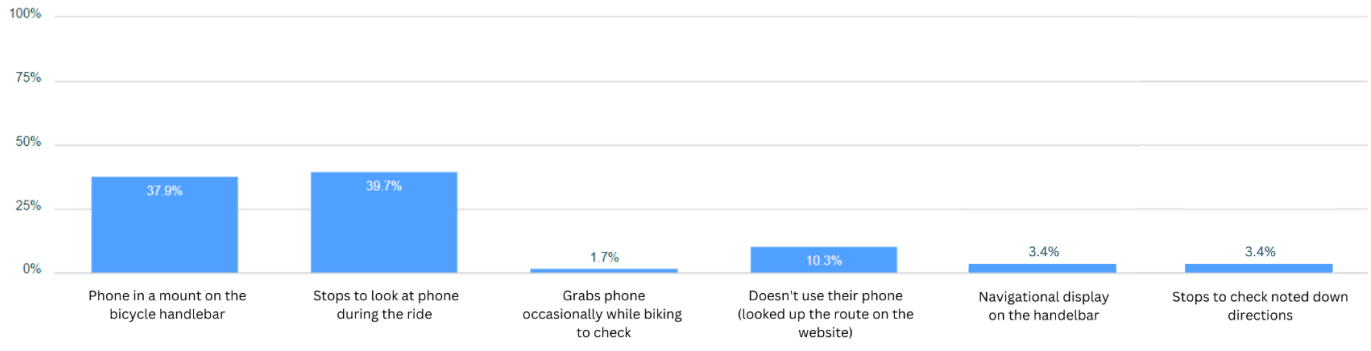


Digital navigation used for functional routes on the bike *(not node route navigation)*



Way of keeping track of digital navigation during an unfamiliar route

Represented: 59 respondents who use digital navigation



J. THE ORIGINAL QUOTES

J.1 QUOTES INTERVIEWS

Theme analysis:

- "Als er wind is, ben ik elke keer weer dankbaar dat ik de e-bike heb!"
- “zo’n spiegeltje is geweldig’
- “the e-bike, wat een uitvinding is dat!”
- "Waarom zou ik instructies nodig hebben, ik heb toch altijd gefietst?!”
- “Misschien als ik nog een keer val, dat ik een helm aanschaf”
- “Iemand in mijn kennissen kring was flink gevallen… dan komt het wel dichtbij"]
- “Ik merk vanzelf wanneer het nodig is om een spiegeltje te nemen”
- Doordat ik mijn hele leven heb auto gereden, kan ik ook beter anticiperen
- “Ik heb wel het idee om het te gaan doen, maar ik moet de helm nog kopen"
- “Ik fiets vaak rustig op eco-stand, en *als er wind is, dan stand hoger”*
- *“Hiervoor fietste ik ook die snelheid, ik ben niet harder gaan fietsen op de e-bike”*
- *"Snelheidsverschillen in het verkeer is het grootste veiligheidsaspect"*
- “Men zou niet zoveel haast moeten hebben, dan zou het veiliger zijn”

Rider type profiles:

- “fietsritten zijn altijd risicovol”
- “Knooppunt paden kunnen door verschillende wegdektypen riskant zijn, maar door de variëteit en het natuurlijke is het toch ook het leukste”

  “Ik draag geen helm, maar ik zou het ook wel begrijpen als er een helmplicht komt”
- “Een fietsspiegel, nee… voor oude lullen voelt dat”

J.2 QUOTES SURVEY 1 VALIDATION

- “Veiligheid is voor mij belangrijker dan ergens snel zijn via de kortste route.”
- “Veiligheid boven alles.”

- “Ja fietsen doe ik voor mijn plezier, dan is wellicht iets om geen probleem!”
- “Zeker, ik heb geen haast en wil genieten van de omgeving.”
- “Zeker, veel meer ontspanning.”

- “Ja, maar mag niet te veel omrijden om de route te volgen.”
- “In principe altijd, maar niet indien km's / tijd erdoor verdubbelt.”

- “Rustig en landschappelijk fietsen.”
- “Zeker, vooral als het een fietstocht in vrije tijd betreft.”

- “Ja, zou het wel willen uitproberen.”
- “Zeker, lijkt me erg nuttig.”
- “Ja.”

- ‘Uitstekend’
- ‘Fijn!’
- ‘Ja, doen’

J.3 QUOTES SURVEY 2 VALIDATION

- “Zou wel fijn zijn, ook wanneer er veranderingen zijn en de bordjes niet zichtbaar zijn door diverse mogelijke oorzaken”
- “Ik hoop niet dat dit ten koste gaat van de mooie plaatsen in een route”

- “Ik vind dit een goede optie. Als wij fietsen komen wij weleens situaties tegen waarvan wij denken dat het goed zou zijn als daar eens naar gekeken wordt. Maar ja, waar kunnen we dat dan melden? Als dat in de navigatie kan, is dat mooi meegenomen.”
- “Dat lijkt me een zinvolle oplossing om deze te kunnen gebruiken, Als er bijvoorbeeld een verkeersbord is om gereden hier gelijk actie door word ondernomen.”
- “Jazeker, zo maken we samen de weg veiliger”.
- “Ja met genoeg meldingen wordt er misschien iets aan gedaan.”

- “Het lijkt mij vanzelfsprekend dat je risicopunten op de kaart zet…”
- “Cijfertjes zit ik niet echt op te wachten maar waarschuwingen wel.”
- “Functies zijn mooi maar de praktijk is dat je fietst en dus hier waarschijnlijk niet op geconcentreerd bent. Moet dus snel en overzichtelijk.”

K. CONVERSATIONS WITH EXPERTS

OUTSIDE THE ANWB:

- **Guide for Cycling Tours**
- **J. van Rijn** | I&W DOORTRAPPEN, Project Manager
- **M. Hagenzieker** | TU Delft Professor, Behavior of Road Users
- **W. Slob** | Province of Utrecht, Policy Officer for Sustainable and Smart Mobility
- **P. Schepers** | Rijkswaterstaat, Traffic & Environment Project Manager, formerly at SWOV, extensive research on bicycle safety

Participated in the creative session:

- **M. Versteeg** | Traffic Safety NL, Behavior Change in Traffic Safety
- **T. Uijtdewilligen** | SWOV, Researcher on Cyclist Safety in Infrastructure

INSIDE THE ANWB

- **M. Mimpen** |Product Owner Data & Traffic Safety
- **W. Duijndam** | Cycling Expert (Contact with majority of bicycle manufacturers)
- **B. Radder** | Customer Journey Lead Bike
- **S. Buijtelaar** | Customer Journey Marketeer Bike
- **M. Theirlynck** | Content Creator Eropuit Routes
- **M. van Halderen** | Product Owner Traffic Information
- **J. van het Zelfde** | Advisor Public Affairs
- **A. Noordegraaf** | Customer Journey lead Eropuit
- **B. Voorhuis** | Product Manager Road Safety
- **S. Laarman** | Manager Impact & Engagement

Een zorgeloze en plezierige reis voor iedereen in een duurzame samenleving.*

- Mission ANWB

**Enable everyone to travel carefree and joyfully in a sustainable society.*

In assignment of the **ANWB**

Delft University of Technology