Redesigning the Tanthofdreef

Is a GOW30 layout a suitable redesign?

CTB3000: Bachelor End Project

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GOW30 on the Tanthofdreef: A suitable redesign for improved road user experience?

A research project on how users experience the Tanthofdreef and its proposed redesign

Bachelor Thesis

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Preface

This report is written as a Bachelor End Project of the BSc Civil Engineering at the Technical University of Delft. This research is done at the Transport & Planning department of the Faculty Civil Engineering.

This report consists of a research into the road Tanthofdreef in Delft. Chapter 1 includes the introduction to the research, the literature review is done in chapter 2. Chapter 3 discusses the methodology used in the past quarter, followed up by the results, discussion and conclusion chapters.

I want to thank Dr. Y. Yuan and Dr. S. Mahesh for helping us getting through this quarter with the Bachelor End Project and Dr. ir. S.C. Calvert as being one or our Examinators. Also special thanks to my fellow students (Lars Keser, Femke Rutgers, Emma van Wely, Isabella Teeuwen and Derk Verhees) as we helped each other out when it was needed.

Delft, June 2025
Xander Mourik

Summary

The Tanthofdreef is a major access road in the southern part of Delft. The road is currently a 50 km/h road with separated cycling and walking paths. The Tanthofdreef has dangerous crossings with recent traffic incidents. As the surrounding area is being redeveloped with livability, walking and cycling as core features, planners are considering a GOW30 redesign in the area. In this context, this research investigates whether a Gebiedsontsluitingsweg 30 km/h (GOW30) redesign make users of the Tanthofdreef feel safer and more comfortable.

This researching combined a literature review and a survey for the road users. The literature part of the research confirmed that a GOW30 redesign could fit into the area's plans. The survey had 72 responses from regular users of the Tanthofdreef. These respondents were asked to participate in the survey through flyers and social networks. The survey examined users' feelings towards the current road design, and aimed to map their attitude towards the 30 km/h redesign. Both single- and multivariate analysis methods were used during the process.

The results of the survey generally show negative perceptions on the current layout of the Tanthofdreef, especially regarding the safety of the active modes (cyclists and pedestrians) and the interaction of the active modes with the motorized vehicles. Regarding the interaction, many respondents show concerns about the intersections, those need to be redesigned with safety in mind. As expected most respondents preferred a 30 km/h redesign. Actually, the mean expected safety change and the mean expected interaction change was significantly positive. The pedestrians and cyclists in particular, expect a safer feeling and better interaction under the GOW30 circumstances, this was confirmed using the Man-Whitney U statistical test. Chi Square test further showed that neighborhood and age were significantly influencing the results. Neighborhoods of Tanthof (East and West) were being less supportive and concerned about possible congestion near their homes. As the middle aged group (35-54) were the most skeptical age group.

Overall, the findings in the research suggest that redesigning the Tanthofdreef to GOW30 would likely improve users experience. All the average scores per user group smoother interaction between cars and active modes under a 30 km/h speed limit. Based on these findings, the report recommends prioritizing by introducing a GOW30 standard with separated cycling paths along side a single shared car lane, and introducing raised pedestrians crossings at the key conflict points of the Tanthofdreef, to slow down traffic and shorten the crossing distance. In addition, the hesitant residents of Tanthof should be actively engaged during the design process, to emphasize that a GOW30 design both fits local traffic demand for Tanthof-East and enhances the neighborhood livability.

Contents

1 Introduction

With the growing interests on sustainable mobility and safer urban neighborhoods, cities are redesigning their roads. One of the options to redesign a road is implementing the new GOW30 roads. On a GOW 30 motorized vehicles and active modes (pedestrians and cyclists) share space and the speed limit is set to 30 km/h. This design is developed to improve the safety and livability around the roads. Improved safety is in line with the approach to further reduce traffic accidents and also promote active modes.

The focus of this research is on the implementation of the new GOW30 road on the Tanthofdreef. A survey is used to map out the experiences of the residents and test their support for a redesign into a 30 km/h road.

The Tanthofdreef is a road in the South of Delft, which is seen as a dangerous road to cross. While the area around the road is developing into a more livable space, the road has no specific future plans. The Tanthofdreef will be the research area for this research project. The Tanthofdreef is currently a road where 50 km/h is the speed limit. On one side of the road there is a two-way cycling path and on the other side of the road there is a pedestrian walkway. Both the cycling path and pedestrian walkway are far from the road itself.

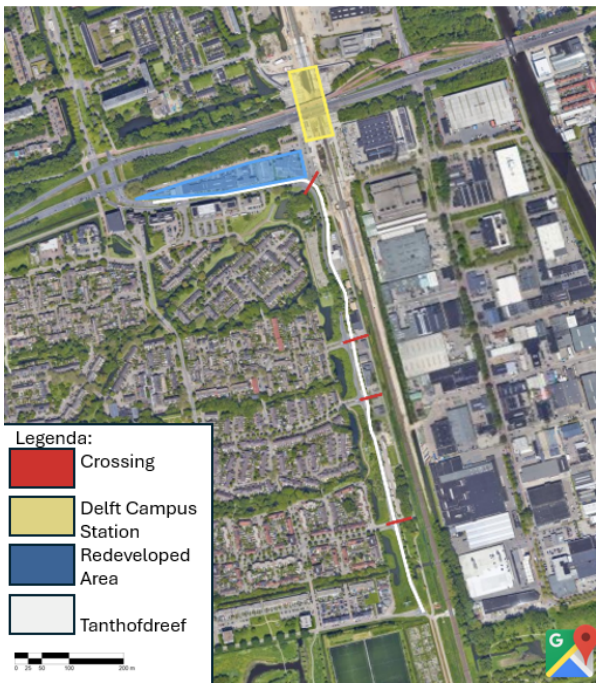


Figure 1.1: Map of Tanthofdreef (Google, 2025)

Figure 1.2: Tanthofdreef traffic light crossing

1.1 Problem statement & goals

The Tanthofdreef is seen as a dangerous area access road in Delft, even lately heavy accidents have happened (van Mourik, 2025). The road goes through an area which is getting developed with the focus on better cycling and walking paths (Gemeente Delft, 2024).

To achieve this better environment for cyclists and pedestrians, the Tanthofdreef has to change too. GOW30 could be an option for a redesign.

By asking the road users about their current experience and their thoughts about the change, the research will investigate if the implementation of a GOW30 zone improves the experience for the Tanthofdreef user and whether the residents and users think that change is needed on the Tanthofdreef.

1.2 Research question

This research focuses on the experience of residents following the implementation of a GOW30 zone on the Tanthofdreef. This leads to the following research question:

How does the introduction of a GOW 30 road on the Tanthofdreef affect road user experience?

Sub-questions:

- Is the GOW 30 road design in line with the future plans of the Station Delft Campus area?
- What would a GOW30 road look like when it is implemented on the Tanthofdreef?
- What is the current experience of the Tanthofdreef users?
- How would residents experience the change of the Tanthofdreef into a GOW30 road?
- What aspects influence the user to support the redesign to GOW30?

As the main objective is to map out the residents' thoughts on a redesign of The Tanthofdreef into a GOW30 road, it is necessary to first investigate whether a GOW30 road is compatible with the research area and if it is in line with the new area development plans. This is answered with sub-question 1, in section 2.1, 2.2 and 2.3. To answer sub-question 2, the traffic demand and options need to be evaluated, this is done in section 2.4 and 2.5. The 3rd, 4th and the 5th sub-questions will be answered by survey research.

Why is this research of importance?
Currently there are no concrete plans to changing the structure of the Tanthofdreef. But the Tanthofdreef's transformation into a GOW30 road directly supports the area's redevelopment into a safe, green, and livable "Stadscampus" (BHTD Bestuur, 2024). By lowering speeds to 30

km/h, street space can be reallocated for wide cycling lanes, bigger sidewalks and trees creating a calmer environment that encourages walking, cycling, and public transport. This slower street improves social interaction, accessibility between neighborhoods, and aligns perfectly with the municipality of Delft's vision of an innovative, people-focused Delft Campus Station area where mobility and livability is the main focus (Gemeente Delft, 2024).

1.3 Stakeholders

The stakeholder analysis has been done by using a power-interest matrix (Figure 1.3), which categorized the stakeholders based on their level of power (influence on the project) and their interest (their involvement) in the redesign of the Tanthofdreef into a GOW30.

Key stakeholders

Municipality of Delft
The municipality of Delft is responsible for the development of the new Delft Campus Station area and the surrounding infrastructure. In order to implement a redesign of the Tanthofdreef, they need solid data and research to justify the design and ensure it is in line with the broader plans.

BHTD (Bewonersvereniging Heel Tanthof Delft)
Agency that stands up for the local community, for example by asking questions to the municipality on their choices concerning the neighborhood.

Keep satisfied

Public transport operators
The NS (dutch railway company) has invested in a high frequency railway connection between The Hague and Rotterdam, passing through Station Delft Campus. The increased capacity must be filled to make it profitable. Projects like this could stimulate the residents of Delft to take the train to Rotterdam or The Hague instead of driving via de A4 or A13.

Keep informed

Road users
Active modes and motorized vehicle drivers who use the Tanthofdreef to reach their destination will be impacted by the redesign of the road.

Residents
The residents live near or along the Tanthofdreef. They are also directly affected by the changes made to the road. The changes might lower the noise and traffic flow, and could increase the crossing safety.

Minimum Effort

Local businesses

With the plans for a more livable and green Station Delft Campus area, local businesses could benefit from the increased pedestrians and improved public space.

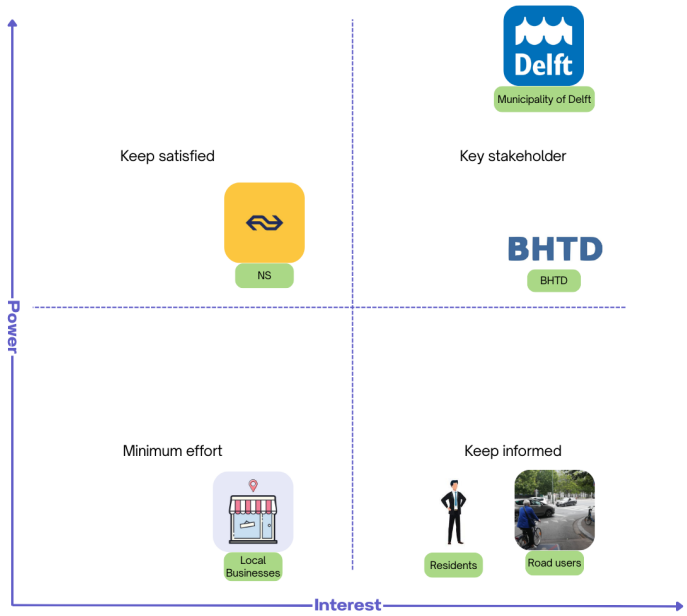


Figure 1.3: Power-interest diagram

1.4 Hypothesis

The resign of the Tanthofdreef into a GOW30 zone will be experienced differently between the users. Using the report of Gemeente Amsterdam (2024) on GOW30 as a reference project, the active modes will have a increasingly positive approach to this project. However, motorized vehicles are concerned about their increased travel times, before the implementation they might be skeptical on the traffic flow on the Tanthofdreef.

This leads to the null-hypothesis and alternative hypothesis:
H_0: *The change in perceived safety, interaction and comfort (between the current situation and redesign) does not differ between use groups (active modes and motorists)*

H_1: *The change in perceived safety, interaction and comfort (between the current situation and redesign) does differ between use groups (active modes and motorists)*

People driving cars or other motorized vehicles will be concerned about the traffic flow and congestion. These respondents will be less positive than the active modes about a possible redesign into a GOW30 corridor. People concerned about the congestion are people who use the road frequently and live nearby.

This leads to the null-hypothesis and alternative hypothesis:
H_0: *The support for the GOW30 design does not differ between living near the Tanthofdreef and other users.*

H_1: *The support for the GOW30 design does differ between living near the Tanthofdreef and other users.*

These were the main hypotheses while designing the survey, resulting in multiple demographic questions and testing the current and expected experience on the Tanthofdreef. As the project progressed, more tests were possible with the survey data. These hypothesis were the main purpose of the survey, but during the data analysis all the possible combinations of demographic questions and follow-up questions were analyzed. The hypotheses for all the different tests are described in the Chapter 3.

2
Literature Study

The literature study explains GOW30 principles and their relevance to the Tanthofdreef. It reviews the benefits of 30 km/h, future Delft campus plans, active mode safety measures, traffic demand criteria and GOW30 cross sections. This is followed up by two reference projects from Amsterdam and Nijmegen.

2.1 GOW30

GOW30 guidelines

Within build-up areas there are currently two different type of roads. Access roads (ETW30) and area access roads (GOWs). Access roads have the purpose to provide access to homes and other location in a neighborhood. They have mixed traffic types and have a low speed (30 km/h). Area access roads have a traffic function, they connect access roads with higher speed (50 km/h) and have separate spaces for different travel options.

In some situation the road has both the traffic purpose and the residential purpose. In those situation it might not be possible to safely design such roads with a speed of 50 km/h. In that case a lower speed limit can improve the desired safety of the road. A GOW30 road should differ in appearance compared to a GOW50 road, the road user should be encouraged to driver slower. The CROW GOW30 guidelines also states that redesigning a existing GOW50 into a safer situation is difficult due to the traffic structures around it (Kennisbank CROW, 2023). The safer versions of GOW50 is easier to develop when developing a whole new road. The GOW30 will not become a fully shared space like the ETW30. Cyclist need wide cycling paths on the road itself or separated from it.

30 km/h speed limit advantages

The introduction of a 30 km/h speed limit on urban access roads can generate large societal benefits, even with minimal intervention. Decisio and Move Mobility estimate that replacing speed limit signs on the 10 - 15 % dutch roads without shared spaces created an annual welfare increase of 520 million and prevents 50 serious injuries each month (Decisio, 2025). For the Tanthofdreef this immediately lowers vehicle speeds at conflict points, reducing the risk for the active modes. When combined with specific infrastructure changes like road narrowings, raised crossings and traffic calming gateways, the annual welfare can increase with 2 billion or more and 40 fewer fatal accidents and 2000 injuries per year(Decisio, 2025).

Whether a road is qualified for the GOW30 is visualized in Figure 2.1.

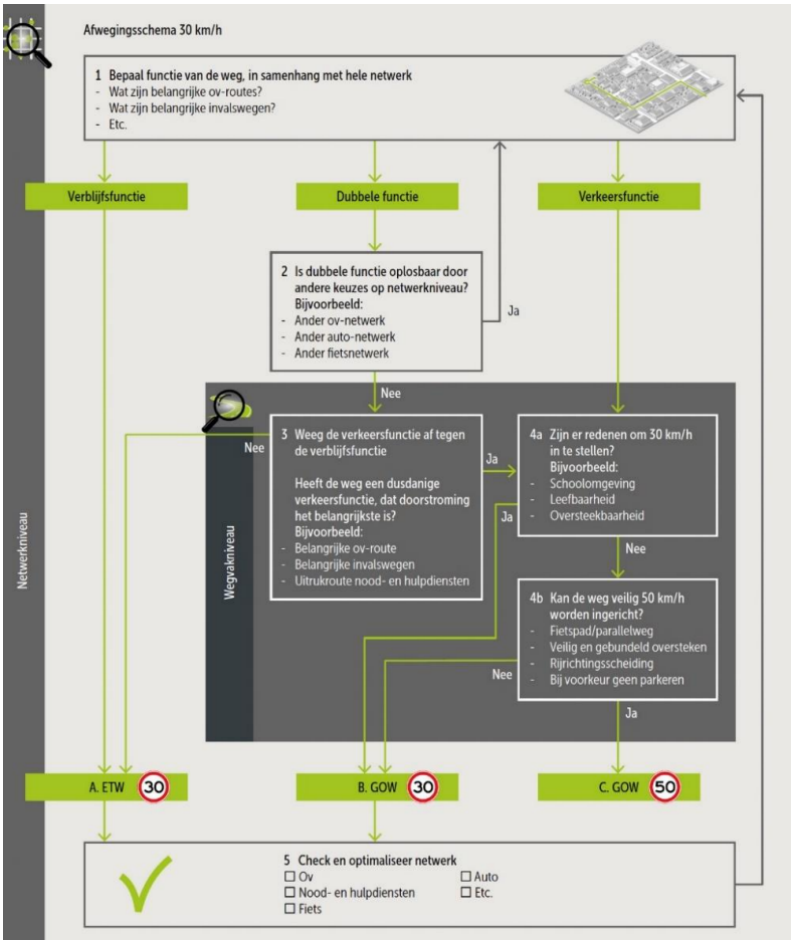


Figure 2.1: Assessment scheme GOW 30 (Kennisbank CROW, 2023)

GOW30 in Delft

Delft currently has no official GOW30 roads. The municipality of Delft is waiting on the feedback in other cities before implementing it in their own city (Valstar, 2024). The Ruys de Beerenbrouckstraat is designed like a GOW30 road, but functions as a GOW50 road at the moment, until the municipality decides to implement the GOW30 guidelines. This road could be the start of the project to enhance the traffic safety.

Figure 2.2: Ruys de beerenbrouckstraat (Goudappel & Fietsersbond, 2022)

2.2 Future plan of the Station Delft Campus area

Delft Campus station is undergoing an enormous re-branding: from changing the whole station to redeveloping the area around the second station of Delft. As the capacity of the station will increase, the active modes (pedestrians and cyclists) traveling to the station will increase as-well (Gemeente Delft, 2025).

The Gemeente Delft (2024) introduced a entire new plan with the area around the station and Tanthofdreef. These are future plan for the time period of 2030 to 2050. The municipality wants to realize a green and safe space, with better cycle- and walking routes. The "Stadscampus" should be focused on innovation with the secondary function to connect each neighborhood divided by the train track and motorway with each other. The plans are also to connect the Delft Campus station via bus with the other parts of Delft.

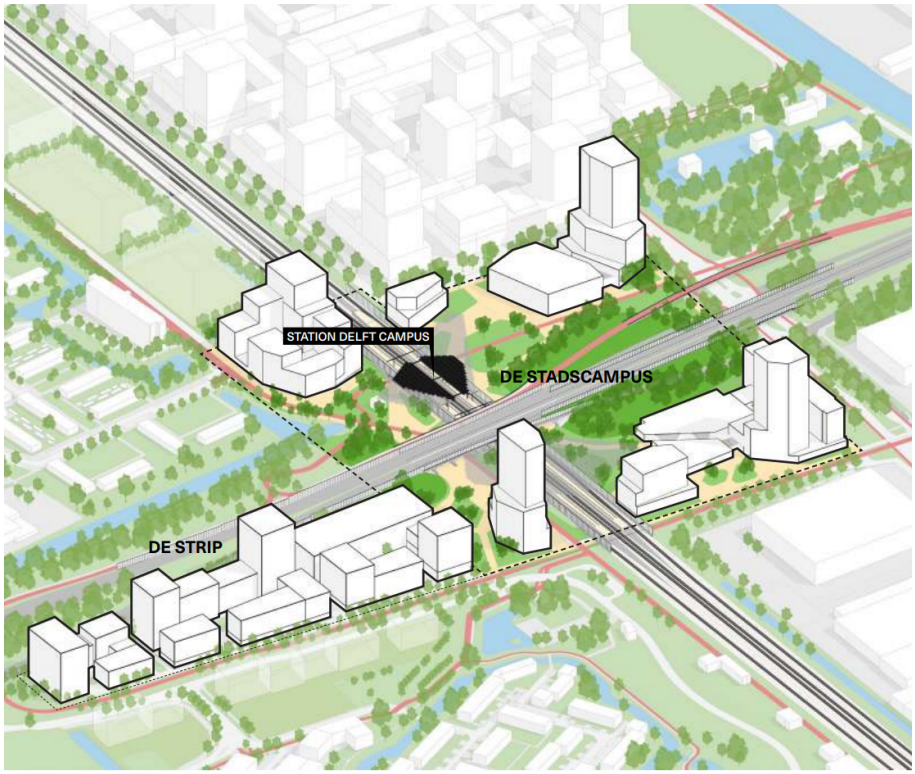


Figure 2.3: "Stadscampus" area future plans (Gemeente Delft, 2024)

2.3 Safety for active modes

With the increasing active transport modes like cycling and walking, ensuring their safety is crucial for sustainable cities and areas. The balance between encouraging the active modes and reducing the risks is essential.

Cycling safety and risks

Cyclists are exposed to risks from motorized vehicles and the road environment itself. Cyclists are vulnerable to crashes, especially when motorized vehicles drive at higher speeds. In that case the risk of serious injuries can be mitigated by separating the cyclists from the road, through dedicated cycling lanes (Wegman et al., 2010).

Pedestrian safety

Pedestrians safety at busy roads like the Tanthofdreef can be improved with specific infrastructure changes. As Martin (2006) stated in his research, changes such as widening and raising crossings, improving visibility and shorter crossing distances help reducing the crossing risks. Especially on roads with high traffic flows. Applying these changes to the Tanthofdreef, where pedestrians must often cross multiple lanes, could make walking more safe and accessible for the inhabitants of Tanthof.

Tanthofdreef

Figure 2.4 shows a heatmap of traffic incidents in Tanthof. It indicates that there are several risk zones near the Tanthofdreef, especially near the intersection and busier junctions. These hotspots of incidents suggest locations where safety improvements for pedestrians, cyclists and cars should be prioritized.

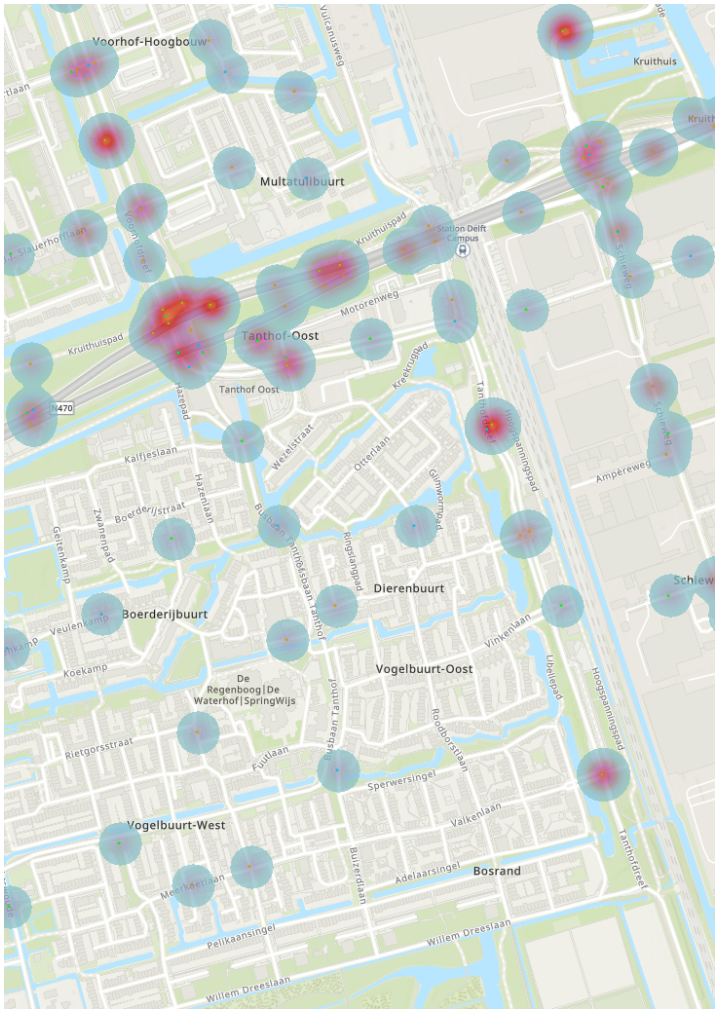


Figure 2.4: Traffic incidents Tanthof. (Rijkswaterstaat, 2023)

2.4 Traffic flow and demand

In 2019 the Antea Group did research on the traffic in Delft. They captured the traffic intensity for several mayor roads in the city. The Tanthofdreef had a daily intensity of 6.346 vehicles (Bout et al., 2019).
Using this measured intensity in the report from Bout et al. (2019) and the road map for GOW30 Design from Goudappel & Fietsersbond (2022) it is possible to check whether the road would fit a 30 km/h zone. The diagram is given in Figure 2.5.

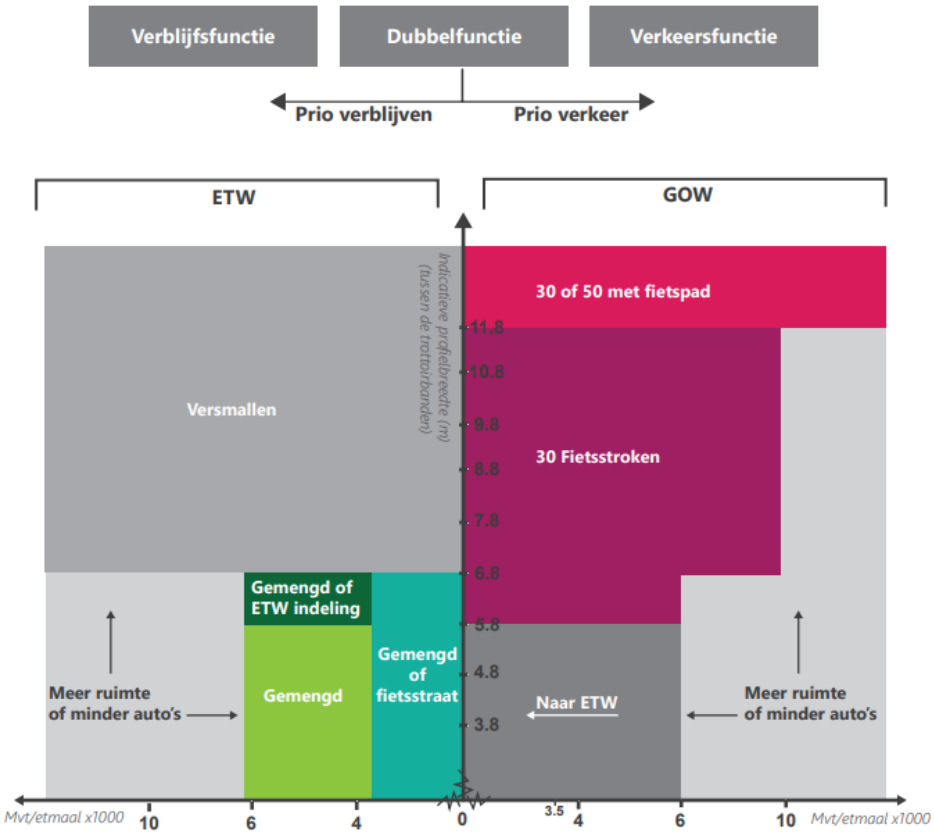


Figure 2.5: Supporting diagram road design (Goudappel & Fietsersbond, 2022)

The Tanthofdreef is current around 15 meters wide. Combined with a intensity of 6.346 mvt/day this would result in a 30 or 50 km/h zone with cycling path (Google, 2025).
Choosing between a GOW30 or a GOW50 road is dependent on the surroundings and the way the road is used, but accourding to the traffic demand both options are possible.

2.5 Implementation on the Tanthofdreef

The toolbox created by Goudappel & Fietsersbond (2022) has several design option for the GOW30 roads. The lowest capacity of a GOW30 road is 6.000 vehicles per day, this situation is a shared space between cars and cyclists. As seen in section Traffic flow and demand, the current intensity is a little above the 6.000 mvt/h vehicles and the current situation has a separated cycling path. When widening the road by a meter to 4.8 meter instead of 3.8, the capacity increases to 8.000 mvt/h. That road design would fit the traffic demand on the Tanthofdreef. Both the options are visualized in Figure 2.6 and 2.7.

Separating the cycling path results in higher capacity for the distributor road, 10.000 mvt/h is the estimate for the design. The safety for the cyclists increases significantly when the lane is separated from the road as in the research from Martin (2006).

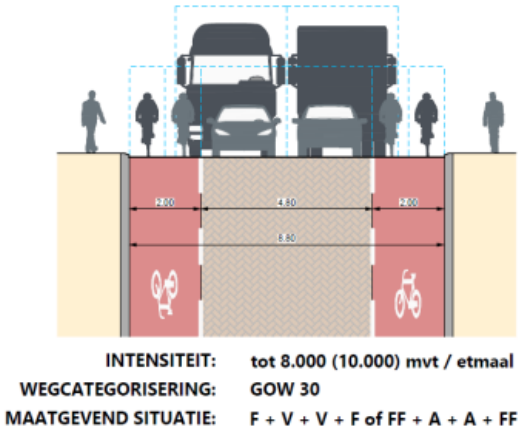


Figure 2.6: Road section GOW30 without separation (Goudappel & Fietsersbond, 2022)

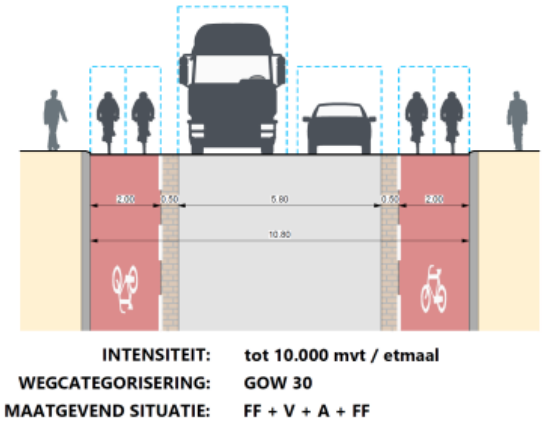


Figure 2.7: Road section GOW30 with separation (Goudappel & Fietsersbond, 2022)

These GOW30 options and the current GOW50 options will be used in the survey. It will become clear what option people prefer for the Tanthofdreef and whether they come up with a alternative solution.

2.6 Reference projects

Amsterdam, The Netherlands

The Amsterdam implementation of GOW30-roads shows that a clear and phased approach works. In December of 2023, the speed limits on nearly all the distributor roads in the city were lowered at once, supported by 4.500 new signs, 140 newly programmed traffic lights and gradual marking updates over 200 km of road. This all lead to a 5% average speed drop in the first half of 2024.
60% of the inhabitants of Amsterdam supported the measurement. The travel time only increased by 5%. For the Tanthofdreef it highlights the importance of new signage, markings, traffic light adjustment and good monitoring of the new situation. Amsterdam's experiences shows that clear communication with the residents on safety and livability helps to gain more public support (Gemeente Amsterdam, 2024).

So a phased implementation supported by clear communication, infrastructure updates and monitoring led to strong support for the residents and resulted in minimal travel delays.

Nijmegen, The Netherlands

The Municipality of Nijmegen started a pilot for GOW30 in collaboration with Royal HaskoningDHV, to develop a data driven tool to analyze the shape, function and usage of urban roads. The pilot provided insights into the which roads should remain GOW50 and which would better fit a GOW30 redesign. This approach prioritized traffic safety, livability and more attractive public space around the roads. This pilot serves as a good example of using data to support urban mobility policy (HaskoningDHV, n.d.).

So a data driven pilot enabled smart road classification, enhancing traffic safety, livability and effective urban mobility planning.

2.7 Summary

In the Literature study, four key design measures were proven essential for a successful conversion of the Tanthofdreef into a GOW30 road. These measures are detailed below.

Default 30 km/h speed limit

A 30 km/h road is a new default recommendation, unless a higher speed can be implemented safely (Goudappel & Fietsersbond, 2022). According to CROW, using different design methods to change the visual representation of the road can encourage drivers into driving slower (Kennisbank CROW, 2023). Decisio and Move Mobility demonstrate that even replacing signage on mixed traffic streets delivers and annual welfare increase of €520 million euros and reduces the change of serious injuries by 50 per month (Decisio, 2025).

Physically separated cycling paths

Curb protected cycling paths on both sides of the Tanthofdreef could greatly reduce conflicts between cyclists and motorized vehicles. Wegman et al. (2010) show that physical separation can cut collision risk by up to 50% on busy roads, making this a imported part of the GOW30 layout for the Tanthofdreef.

Raised and visibility for active modes

Elevated pedestrian crossing, curb extensions, high contrast markings and shorter crossing distances enhance pedestrian safety on the road. Martin (2006) states that these measurements slow down approaching vehicles and improve the sight lines, which is important where pedestrians need to cross several lanes.

Traffic flow and demand

The Antea group measured an average daily intensity of 6.346 vehicles on the Tanthofdreef in 2019. This is in the acceptable range for a GOW30 road, with dedicated cycling infrastructure (Bout et al., 2019).

With the total with of approximately 15 meters, the Tanthofdreef meets the requirements for both a 30 km/h or a 50 km/h design (Goudappel & Fietsersbond, 2022).

Reference projects

The GOW30 projects in Amsterdam en Nijmegen offer valuable lessons for the redesign of the Tanthofdreef. Amsterdam showed that a phased implementation with clear communication and adjusted traffic lights can results in good support from the residents. While Nijmegen show how data driven pilots can help redesign the whole city. Getting a clear picture on which road could benefit from the redesign. The Municipality of Delft could use one of these pilots to improve the safety and livability of Delft.

3
Methodology

The methodology outlines the approach of the research to evaluate how a GOW30 design affect user experience on the Tanthofdreef. It begins by describing the used methods, like the literature study and survey, followed by the details of the survey design and the data collection method. After the survey design, the data analytics part of the research is explained, both the Single-variate and Multi-variate analysis methods.

3.1 Used method

The main objective of this research is to evaluate the Tanthofdreef redesign from the perspective of the actual road users. With the focus on their experiences, preferences and perceived safety under the possible new GOW30 redesign. To capture this data, a survey was chosen as the main method for the research. Surveys are an effective way to gather public opinions from many people in a structure way. It allows respondents to give feedback anonymously, which suits the goal to get broad input in the survey. By asking a large number of respondents standardized question, the public opinion patterns can be mapped out. The survey is implemented using Qualtrics, a platform for designing and distributing such surveys and also the preferred way to conduct a survey (TU Delft, n.d.). Qualtrics makes it easy to create different type of questions (multiple choice-, Likert scale- or open questions), while keeping the data safe within the TU Delft platform. The survey aims to reach at least 50 respondents. For small populations the formula of Cochran (1977) can be used.

$$n = \frac{n_0}{1 + \left(\frac{n_0 - 1}{N}\right)} \tag{3.1}$$

$$\text{with} \quad n_0 = \frac{Z^2 \cdot p \cdot (1 - p)}{e^2} \tag{3.2}$$

Where:

n is the adjusted sample size for a finite population.

n_0 is the initial sample size assuming an infinite population.

N is the total population size.

Z is the Z-score corresponding to the desired confidence level (e.g., 1.96 for 95% confidence).

p is the estimated proportion of the population (use 0.5 if unknown).

e is the margin of error (expressed as a decimal, e.g., 0.05 for 5%).

Using an estimated population of 10.000 of residents and station users, the sample size would be 43 for 15% precision level and 96 for 10% of precision level.

Generally 5 to 10 % is taken as goal for a research. As this research is a local study, respondents are hard to reach. As 96 responses is the goal to achieve the 10% precision margin, 43 will be the minimum to make any data analytics possible.

The distribution among the road users in important with the small sample size, one group must not dominate the findings in the research. The demographic questions will help to determine if the responses are representative spread.

3.2 Survey design

The survey is organized into three main sections: Demographic Questions, Current Experience with the Tanthofdreef, and GOW30 Redesign Evaluation. This structure is used to evaluate the hypotheses given in the introduction.

3.2.1 Demographic questions

This section includes questions about age, gender, neighborhood, travel purpose, frequency of interaction and transportation mode. The demographic questions follow standard categories used in similar surveys. This section creates a context around the response of the respondent and allows grouping for later analysis. According to the hypothesis given in the introduction, there should be a difference between the experiences of different transportation methods, so that is added to the Demographic questions.

One of the demographic questions is in what neighborhood the respondents live. The neighborhoods are visualized in Figure 3.1.

These questions help to test the hypothesis. Demographic data can also be used to validate the responses. The age group distribution in Tanthof is visualized in Figure G.1, in the Appendix.

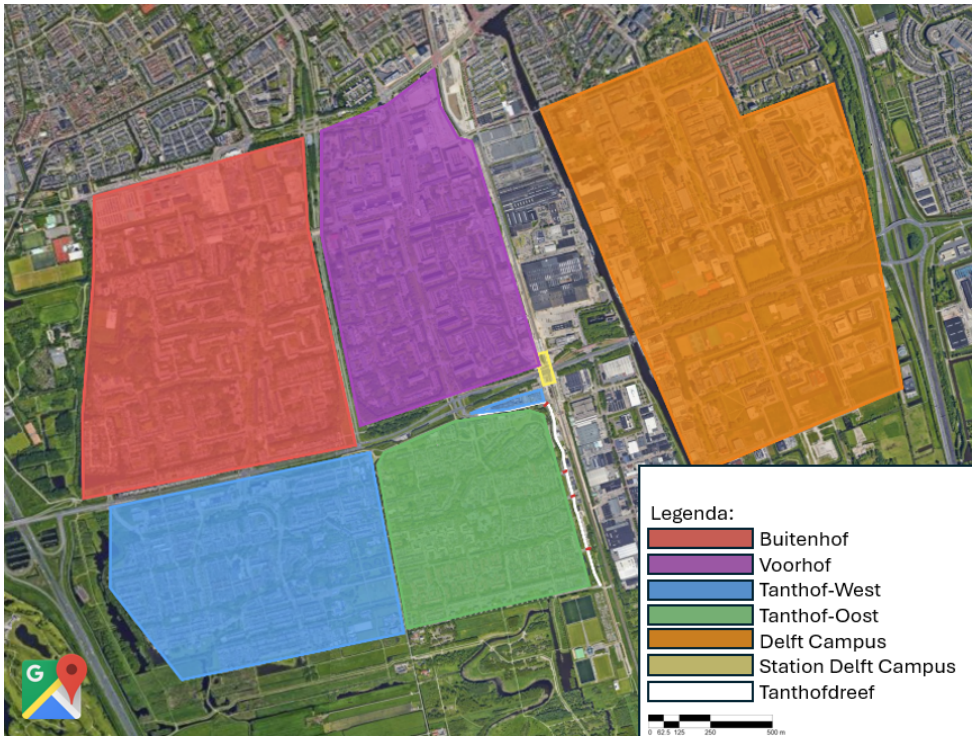


Figure 3.1: Neighborhoods surrounding the Tanthofdreef (Google, 2025)

3.2.2 Current experience with the Tanthofdreef

A set of questions to capture current user experience when they encounter the Tanthofdreef. This is done using three questions with the Likert scale, a multiple choice questions and two multiple choice questions with possible additions. These questions are mostly closed ended to make the answering quick and to allow for quantitative analysis.
This section of the survey can be seen as a benchmark of the Tanthofdreef. It gives insight into the general experience of the users, but also creates a base to compare to in the next section of the survey.

3.2.3 GOW30 redesign evaluation

The third part of the survey focuses on the redesigned layout of the Tanthofdreef as a GOW30 road. In this section of the survey, participants are shown pictures of the proposed redesigns and asked to evaluate different aspects of the new road layout. These questions cover the expected safety, comfort, interaction between different transport modes, ans support for a lower speed limit. The questions include Likert scales, multiple-choice and open formats.

This section is closely connected with the research hypothesis: that the redesign of the Tanthofdreef into a GOW30 road will be experienced positively, but different along the transportation methods. In addition to testing hypothesis, several questions are asked on what users value most in a new road design.

3.3 Data collection

The survey is the main data collection method in this research. The survey was distributed online to reach people living in Tanthof within the researcher's network. This method will mainly result in respondents among the students.

Furthermore, the survey is distributed via a QR code seen in Appendix C. 180 of these flyers are delivered to the houses close to the Tanthofdreef, resulting in currently 34 responses. This method is effective to reach out to older residents of Tanthof. During the delivery people where asked to send the survey to neighbors.

To get more attention for the survey, the BHTD (Bewoners Heel Tanthof Delft), Stichting Stunt and other instances were asked to distribute the survey among their members.

3.4 Data analysis

After the data collection part of the research, data analytics are needed. The results of the survey will are analyzed in python using the packages Pandas & Scify.stats. Both single-variable and multivariate methods are executed.

3.4.1 Single variate

In the single-variable analysis the questions are analyzed separately. As some question are open to give respondents the room for recommendations, those results will be analyzed in a different part of the research. This type of analysis is applied to the multiple choice questions. The expected outcome per question is give below.

Table 3.1: Overview of hypotheses per question

Q	Topic	H_0	H_1
7–8	Road safety and interaction	Tanthofdreef is experienced as unsafe with poor interaction	Tanthofdreef is not experienced as unsafe with poor interaction
9	Layout clarity	Layout of the Tanthofdreef is experienced as unclear	Layout of the Tanthofdreef is experienced as clear
13	Design preference	Respondents choose a GOW30 redesign	Respondents choose to keep the current layout
14	Future safety	Perceived safety improvements for active modes under GOW30	No perceived safety improvements for active modes under GOW30
15	Mode interaction	Expected improvement in interaction under GOW30	No expected improvement in interaction under GOW30
16	User comfort	Expected improvement in comfort for active users under GOW30	No expected improvement in comfort for active users under GOW30
17	Speed limit support	Users support a 30 km/h speed limit	Users do not support a 30 km/h speed limit

3.4.2 Multivariate

To find deeper insight in the data collected, the multivariate analysis is used. This method will compare multiple variables. For example, whether cyclists feel more positively about the GOW30 design than car users, or if younger people feel less safe on the current road than older residents. The Scify packed in python has several statistical tests. These are the ones used and in what cases and what hypothesis is tested during the test:

Mann-Whitney U test

The Mann-Whitney U test is a test that compares differences between two independents groups out of the survey. This test is only used when working with two groups. For example: working with active modes vs car driver or people being postivie or negative about a new road design. This type of test is used to evaluate the difference in experience between active modes (cyclists and pedestrians) vs car drivers. In Table 3.2 the hypotheses are given.

Table 3.2: Hypotheses on differences between transportation modes

Topic	**H_0**	**H_1**
Safety	No significance difference in experience of safety regarding the current Tanthofdreef with different transportation modes	Significance difference in experience of safety regarding the current Tanthofdreef with different transportation modes
Interaction	No statistical significance in experience of traffic interaction between different transportation modes	No statistical significance in experience of traffic interaction between different transportation modes
GOW30 design choice	No statistical significance in choosing the future road design between different transportation modes	Statistical significance in choosing the future road design between different transportation modes

Chi-Square test

The Chi-square method is used to find statistical significance between categorical questions. It compares the observed number of responses in each category to what would be expected if there was no relationship between the two variables (Turney, 2023).

To identify which background factor influences acceptance of the 30 km/h redesign, Chi-square tests were applied. Question 17 (Support for 30 km/h road) was tested against each demographic variable. A significance level of $\alpha = 0.05$ was used. Considering the alpha of 0.05, the null-hypothesis is rejected by a p lower than 0.05.
Each demographic question was tested if it significantly influences the support for the 30 km/h redesign of the Tanthof. The table below summarized which variables have the H_0 to influence the support or not.

Table 3.3: Hypotheses on demographic influence on support for 30 km/h redesign

Demographic variable	**H_0**	**H_1**
Age	No statistical significance in support based on age	Statistical significance in support based on age
Gender	No statistical significance in support based on gender	Statistical significance in support based on gender
Neighborhood	No statistical significance in support based on neighborhood	Statistical significance in support based on neighborhood
Transport mode	No statistical significance in support based on transport mode	Statistical significance in support based on transport mode
Frequency of use	No statistical significance in support based on frequency of use	Statistical significance in support based on frequency of use
Purpose of use	No statistical significance in support based on purpose of use	Statistical significance in support based on purpose of use

4
Results & Analysis

This chapter includes the findings of the survey on the Tanthofdreef redesign into a GOW30 road. It is structured to answer the study's sub-questions through descriptive statistics and multivariate analysis. First, the overall trends in the single variable data in key questions about safety, user interaction and clarity of the design is shown. This followed up by Mann Whitney-U tests between the different user groups. Finally, every question is analyzed using a Chi-Squared test to test what demographic data is significant to the question.

4.1 General trends - single variate

This section will cover findings from single questions. Single questions can show the general opinion on a subject. All the data on the single variate analysis can be found in Appendix A.

Age distribution

Table 4.1 covers the age distribution in Tanthof (Figure G.1) and the age distribution in the survey. Although the 65+ group is slightly overrepresented in the survey, the respondents group includes all the age categories. So, the answers should be diverse.

Table 4.1: Comparison of age group distribution between survey respondents and the general population

Age group	**Survey percentage (%)**	**Population percentage (%)**
18–24	23.61	13.79
25–44	19.44	28.74
45–64	19.44	33.57
65+	37.50	23.90

Current experience with the Tanthofdreef

Current perceptions of the Tanthofdreef are quite negative, especially when it comes down to the safety and interaction among road users. Respondents rate the current safety at a mean of -0.17 (on a -2 to +2 scale), indicating slight concern about the feeling unsafe. While the current interaction on the Tanthofdreef scored even lower with -0.57 (on a -2 to +2 scale), indicating the worries of the users on how pedestrians, cyclists and motorists share the space on the Tanthofdreef. The layout clarity (+0.1) means that the road is not confusing people while using the road. Figure A.1 in the Appendix indicates that the primary conflict points are

the crossings and intersections, while 94% of the respondents experienced conflicts on the road. Together, these statistics show a picture of a road where safety and interactions are aspects to worry about.

GOW30 redesign evaluation

Under the proposed GOW30 redesign, expectations of the Tanthofdreef shift towards improves user experience, especially for the active modes. Future active-mode safety had a mean of +0.39 (on a -2 to +2 scale), while the interaction improvement jumped to +0.80 (on a -2 to +2 scale). Changing the speed limit to 30 km/h boosts the optimism on reducing the conflicts and protection of the cyclists and pedestrians. 66% of the respondents preferred the GOW30 over the current situation (64 % Option 1, 2 % Option 2). This is in line with the support for a 30 km/h road, 66% of the respondents prefer 30 km/h. The GOW30 layout is expected to transform the Tanthofdreef from unsafe into a significantly safer and more livable space for everyone.

4.2 Multivariate analysis

Man-Whitney U test - Transportation mode

In Table 4.2 the groups are divided in 2 groups, active modes (21 respondents) and car drivers (51 respondents). With the groups separated, a Mann-Whitney U test is possible for all the other questions to compare the groups on the results. The Mann-Whitney U comparisons reveal that active-mode users and motorized vehicle users start from a similar base line in the 'Current situation' questions. Only the crash/incident report question is different between the two modes, motorists experience more accidents.

The perceived safety for active modes under the GOW30 redesign is rated much higher by active users than by motorists, relatively 0.81 to 0.20 on a scale from 2 to -2. This difference is statistically significant according to the p-value (0.0127). The expected improvement in interaction between the two groups is also drastically different between the groups, with the mean difference of: 1.24 vs 0.61. This also approaches significance, p-value = 0.0534.

Table 4.2: Mann-Whitney U Test results: active vs. motorized transport users compared with the other survey questions

Question	**Active**		**Motorized**		***p*-value**
	Mean	**Median**	**Mean**	**Median**	
Questions 7: Current Safety	-0.19	0.00	-0.39	0.00	0.42
Questions 8: Current Interaction	-0.43	-1.00	-0.63	-1.00	0.33
Question 9: Layout Clarity	0.10	0.00	0.25	0.00	0.50
Question 11: Crash Reports	0.38	1.00	-0.12	-1.00	0.05
Question 12: Barrier Effectiveness	0.54	1.00	0.52	1.00	0.90
Question 13: Design options	0.52	1.00	0.23	1.00	0.25
Question 14: Active mode safety	0.81	1.00	0.20	0.00	0.01
Question 15: Interaction active modes vs motorists	1.24	1.00	0.61	1.00	0.05
Question 16: Comfort improvements	-0.10	-1.00	-0.02	0.00	0.72
Question 17: Support for 30 km/h	0.52	1.00	0.38	1.00	0.39

Chi Squared tests - Demographic questions

In this section we compare all the questions to the different Demographic questions and check whether there is statistical significance between them. All the tests are given in Appendix B. Table 4.3 combined all the chi test into one table, every statistical significance according to the p value is highlighted. As transport mode is already covered by the Man-Whitney U section, this part will focus on the neighborhood and age questions, and their significance.

Table 4.3: Combined Chi-squared test results: demographics vs. all questions (p-values)

Demographic	**Q7**	**Q8**	**Q9**	**Q11**	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	
Age	0.31	0.43	**0.05**	**0.00**	0.72	0.08	**0.01**	0.93	**0.02**	0.43	
Gender	0.78	0.59	0.36	0.20	0.73	0.75	0.64	0.30	0.59	0.57	
Neighborhood	0.27	0.66	0.13	**0.00**	0.29	0.72	**0.01**	0.16	0.47	**0.01**	
Transport mode	0.14	0.22	0.36	0.46	0.43	0.30	**0.02**	**0.00**	0.09	0.13	
Frequency of use	0.58	0.75	0.26	0.10	0.28	0.64	0.90	0.26	0.96	0.93	
Purpose of use	0.27	0.09	0.53	0.65	0.16	0.06	0.71	0.80	0.53	0.20	

Age significance

The demographic question Age has 4 times significance on: Layout clarity, Crash reports and Active mode safety . The box plots in appendix B show all the results on these connections.

Layout clarity

- Younger respondents (18-44) report better layout clarity than older respondents (45+).
- As the older age groups perceive the current Tanthofdreef as less clear, the redevelopment needs to take the elder people to account for.

Crash reports

- Younger respondents (18-44) report significantly less incidents compared to the older groups.
- Middle age and senior age users have experienced more incidents or near misses in the past. This underscores the target safety measure for older users.

Future active mode safety

- The scores for possible safety improvements under GOW30 circumstances are more positive among younger (18-34) and the oldest groups (55+). Middle aged respondents are skeptical about the possible safety gain.
- Middle-aged users are the most skeptical group. The communications to the residents should emphasize the concrete safety features of the future road, like raised crossing and dedicated cycling lanes to also convince this group of users.

Neighborhood significance

The neighborhood has 3 times significance on: Crash reports, Expected Active mode Safety and GOW30 support.

Crash reports

- All reported incidents came from the residents of Tanthof (East and West), indicating that these areas experience the most safety issues on the Tanthofdreef

Expected Active mode safety

- Residents living closer to the Tanthofdreef were also less optimistic about the possible improvements in safety under a GOW30 redesign.

GOW30 Support

- Support levels vary by distance from the Tanthofdreef. Residents close to the road (Tanthof Ease & West) are less supportive of the 30 km/h speed limit compared to the other neighborhoods.

4.3 Summary

Overall, the single variate analysis shows that the Tanthofdreef users currently experience the road negatively in terms of safety (mean -0.17 on a -2 to +2 scale) and interaction (mean -0.57 on a -2 to +2 scale), even though they are not confused by the layout of the road (mean +0.10 on a -2 to +2 scale). The expectations under the GOW30 design shift towards a more positive view on the Tanthofdreef: Active mode safety rose to +0.39 mean and the predicted interaction improved to +0.80. 64% of the respondents preferred a GOW30 design over the current layout and 66% of the respondents support a 30 km/h speed limit. According to the single variate analysis the respondents expect a more safe and livable Tanthofdreef under the new circumstances.

The multivariate analysis further clarify the patterns behind the responses. Mann-Whitney U results suggest that active users expect significantly greater safety and interaction improvement than motorists. Chi-Square tests reveal that age influences the perceptions on the layout, crash experience, future active mode safety and comfort improvements. Middle age respondents (35-54) are the most skeptical on the redesign. Neighborhood is a key factor as well: only residents of Tanthof incidents and have less confidence in the safety gains of the GOW30 redesign. The residents living close by are also less supportive about a new 30 km/h speed limit.

5
Discussion

This chapter of the research will include the interpretation of the results and limitations of the research. Section 6.1 discusses the results of the survey. In Section 6.2 the methodology is reviewed and criticized on the design choices. In Section 6.3 an outlook for the Tanthofdreef is discussed.

5.1 Interpretation of the survey results

Overall, respondents expect that 30 km/h redesign will be an improvement over the current layout of the Tanthofdreef. Especially pedestrians and cyclists, who expect a safer feeling and better interaction with other users under the redesign circumstances. Although the active modes and the motorized users have similar perceptions on the current layout, active modes expect more improvement in safety and interaction compared to their counterpart.
Supporting the change in speed limit is not tied to any travel habit but to where people live compared to the Tanthofdreef. People living right along the Tanthofdreef are less enthusiastic than residents farther away. People close by might worry about the effect on their daily life, for example about increased congestion.

5.2 Methodology discussion

Hypothesis misalignment
The hypothesis in the introduction was the hypothesis used to design the survey. After the design and distribution of the survey, it was concluded that the questions may not have been optimal to measure the key constructs of the research. So, alternative hypothesis were created to be in line with the questions asked. This misalignment might impact the validity of the results in relation with the stated hypothesis in the introduction. In future studies it is essential to first state hypotheses followed up by suitable questions to test the specific hypothesis. This will make it easier to fit the data and be structured during the data analysis of the research.
Sample bias
The survey is mainly distributed using the researchers' network and flyers in the neighborhood of Tanthof-Oost. This distribution method could lead to selection based bias in the results of the survey. The sample size of 72 is in between the minimum and preferred amount of responses. This amount of responses lead to a 11.5 % error rate according to equation 3.1.

5.3 Outlook

In week 8, the Chair of BHTD, William van Treuren, reached out to talk about the Tanthofdreef situation. He explained that there currently is a work group of Tanthof residents working on an alternative redesign of the area around the Tanthofdreef. Their alternative includes the Motorenweg (road to the north of the Tanthofdreef) as the main area access road instead of the Tanthofdreef. This option creates space to accommodate large flats in the area and a better transition area for Tanthof. As the work group is favor of a 30 km/h road, this road will be a GOW30 road.

6
Conclusion & Recommendations

This chapter is focused on answering the main research question: *How does the introduction of a GOW 30 road on the Tanthofdreef affect road user experience?*. This was done using a literature study followed up by the survey.

The literature study concludes that a GOW30 road design is in line with the redevelopment of the area around the Delft Campus Station, creating a more livable space with safer walking and cycling paths. As the Tanthofdreef is a Area Access road, traffic flow is important. The GOW30 guidelines of Goudappel & Fietsersbond (2022) and the traffic intensity from Bout et al. (2019) combined show that a GOW30 model would fit the traffic demand of the area.

As this research is focused on the experience of the users, a survey was distributed among the users of the Tanthofdreef and the residents of Tanthof. The single variate data analysis of the survey has shown that users feel generally unsafe on the current Tanthofdreef layout and expect clear improvements after a redesign. Most of the respondents support a GOW30 layout, featuring a separate cycling path alongside a single shared lane for cars to encourage slower speeds.

Multivariate analysis concludes that there is a difference in perceptions depending on transport mode, neighborhood and age. Pedestrians and cyclists are consistently more positive about the GOW30 redesign, while the residents of Tanthof (east & west) are more hesitant about lowering the speed limit to 30 km/h and expect less gains in safety for active modes.

Overall, survey results indicate that converting the Tanthofdreef into a GOW30 layout will improve user experience. The design should prioritize safety for active modes at crossings and intersections, to feature better interaction between cars and active modes. The new design should also be in line with the speed limit of the road, and additional traffic calming features are key to ensure that drivers drive slower on interaction points. During the process, the residents of Tanthof (most reluctant group) should be engaged throughout the design process to address their concerns about possible congestion and it should be emphasized that the livability of the neighborhood will significantly be improved.

Recommendations

Prioritize active mode safety

- Install physically separated cycling paths on both sides of the Tanthofdreef, to get higher visibility and to encourage people to drive slower.
- Install raised pedestrians crossing at key conflict points like at the end of the Valkenlaan & Vinkenlaan to slow the motorized vehicles down and to shorten the crossing distance.

Enhance interaction clarity

- Encourage the road users to stick to the speed limit by reducing the field of view. This is also possible with the current layout.

Engage the skeptical users

- Conduct targeted outreach to the residents of Tanthof to talk about their concerns, and why they are not relevant in the possible redesign. Emphasize the gain for the community (financial benefits) and possibilities created by the lowered speed limit.

A
Single variate results

Experience rating questions

Question	Mean (scale: 2 to -2)	Median
Question 7: Current safety	-0.17	0.0
Question 8: Current interaction	-0.57	-1.0
Question 9: Layout clarity	0.10	0.0
Question 11: Crash reports	0.03	0.5
Question 12: Barrier effectiveness	-0.03	0.0
Question 14: Active mode safety	0.39	0.0
Question 15: Interaction active modes vs motorists	0.80	1.0
Question 16: Comfort improvements	-0.04	0.0

Table A.1: Mean and median scores for current experiences and redesign questions

Question 10: Conflict points

Conflict Point	Number of Responses	Percentage (%)
Oversteek plaatsen	39	54.17
Kruispunten	49	68.06
Fietspad	6	8.33
Uitritten	12	16.67
De gehele weg voelt onveilig	14	19.44
Geen conflicten	4	5.56

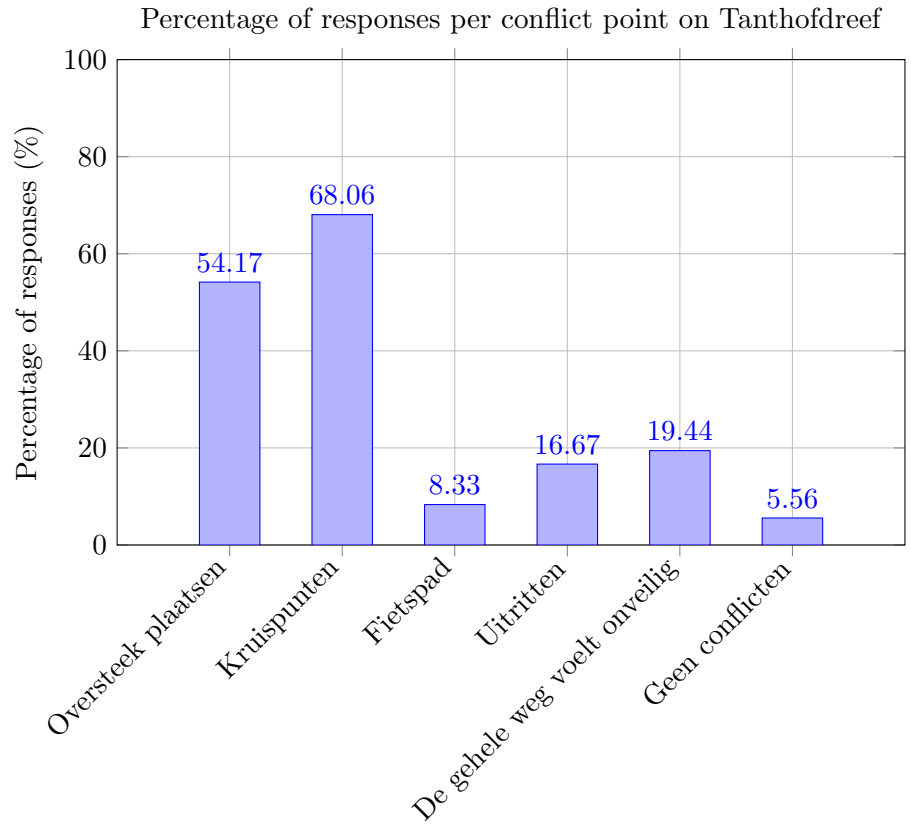


Figure A.1: Question 10: Percentage of responses per conflict point on Tanthofdreef

Question 13: GOW variant choice

Road variant	**Number of responses**	**Percentage (%)**
Optie 1	45	64.29
Optie 2	2	2.86
Behouden huidige situatie	23	32.86

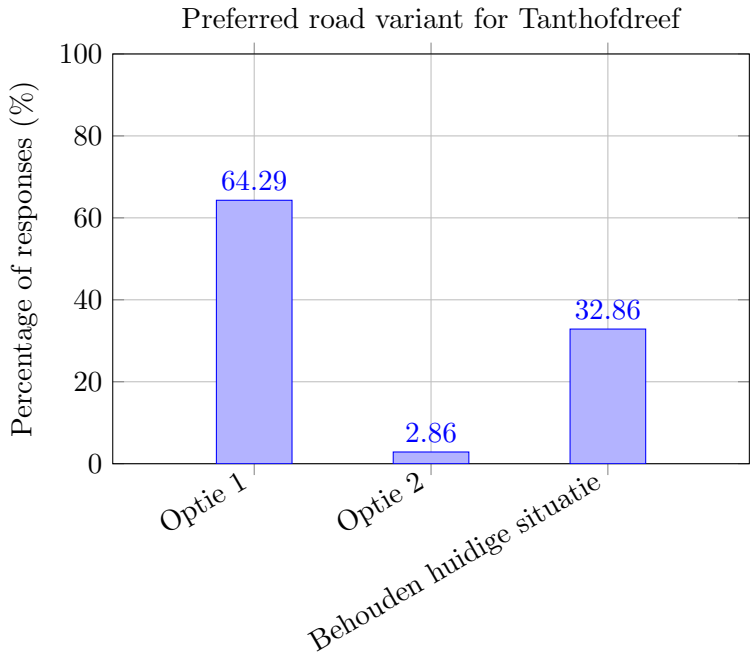


Figure A.2: Preferred road variant for Tanthofdreef (total responses: 70)

Question 17: 30 km/h speed limit support

Opinion	Number of responses	Percentage (%)
Ja, ik steun het	47	66.20
Nee, ik steun het niet	17	23.94
Neutraal	7	9.86

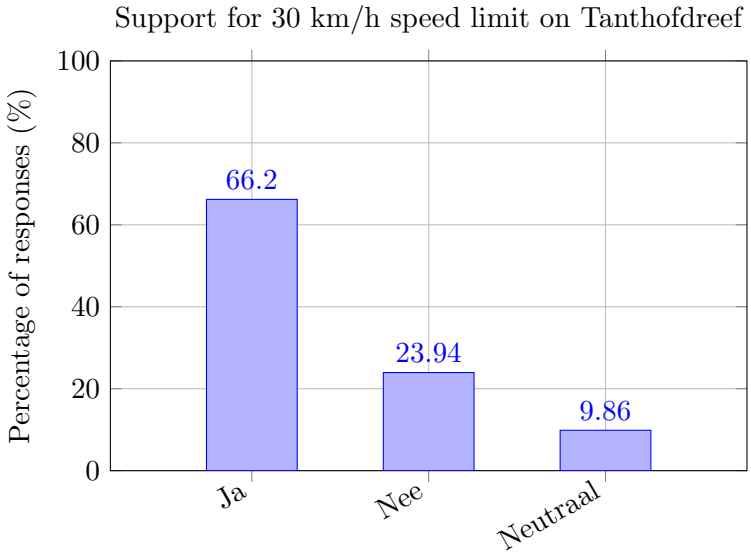


Figure A.3: Support for 30 km/h speed limit on Tanthofdreef (total responses: 71)

Question 18: Other improvements

Improvement	Number of responses	Percentage (%)
Meer groen	23	33.82
Betere verlichting	18	26.47
Meer oversteekplaatsen	31	45.59
Meer voetgangers vriendelijke ruimtes	27	39.71
Anders, namelijk:	20	29.41

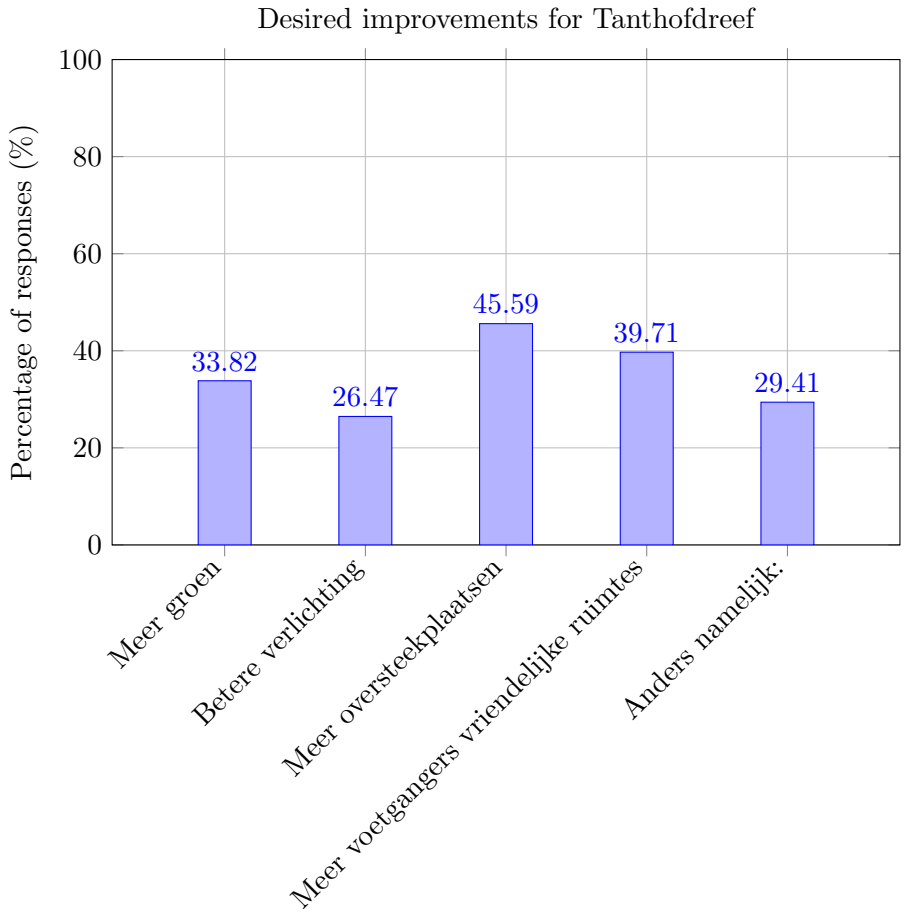


Figure A.4: Desired improvements for Tanthofdreef (total responses: 68)

B
Chi squared tests results

This appendix includes Chi squared test of all the Question vs the Demographic questions. When a tests suggest statistical significance, a graph between the two variables is given too.

Question 7: Current safety

Table B.1: Chi-Squared test results: demographics vs. current safety

Demographic	**Chi2 Statistic**	**p-value**
Age	22.57	0.3104
Gender	1.78	0.7754
Neighborhood	23.45	0.2671
Transport mode	40.84	0.1358
Frequency of Use	18.19	0.5752
Purpose of use	99.93	0.2684

Question 8: Current interaction

Table B.2: Chi-Squared test results: demographics vs. current interaction

Demographic	**Chi2 Statistic**	**p-value**
Age	20.38	0.4343
Gender	2.80	0.5911
Neighborhood	16.90	0.6592
Transport mode	37.75	0.2229
Frequency of Use	15.48	0.7484
Purpose of use	110.47	0.0920

Question 9: Layout clarity

Table B.3: Chi-Squared test results: demographics vs. layout clarity

Demographic	Chi2 Statistic	p-value
Age	31.56	**0.0482**
Gender	4.35	0.3606
Neighborhood	27.02	0.1347
Transport Mode	34.19	0.3628
Frequency of Use	23.56	0.2619
Purpose of use	90.48	0.5254

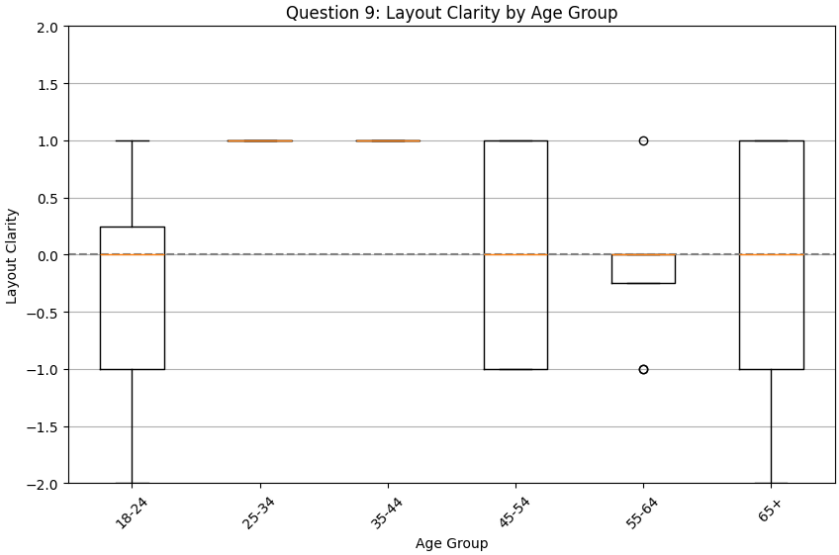


Figure B.1: Layout Clarity rated between really clear (2) and really unclear (-2) against age groups

Question 11: Crash reports

Table B.4: Chi-Squared test results: demographics vs. crash reports

Demographic	Chi2 Statistic	p-value
Age	26.94	**0.0027**
Gender	3.20	0.2021
Neighborhood	32.61	**0.0003**
Transport mode	15.83	0.4646
Frequency of Use	16.13	0.0959
Purpose of use	41.66	0.6544

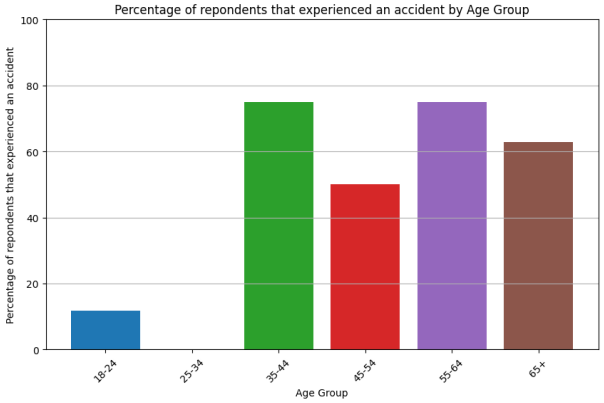


Figure B.2: Accident experiences per age group

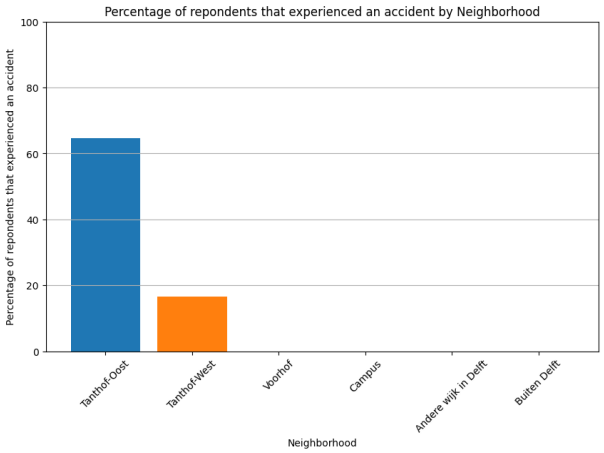


Figure B.3: Accident experiences per neighborhood

Question 12: Barrier effectiveness

Table B.5: Chi-Squared test results: demographics vs. barrier effectiveness

Demographic	**Chi2 Statistic**	**p-value**
Age	7.04	0.7215
Gender	0.64	0.7253
Neighborhood	11.90	0.2916
Transport mode	16.33	0.4302
Frequency of Use	12.13	0.2765
Purpose of use	55.25	0.1649

Question 13: Design options

Table B.6: Chi-Squared test results: demographics vs. design options

Demographic	Chi2 Statistic	p-value
Age	16.60	0.0838
Gender	0.58	0.7501
Neighborhood	7.07	0.7192
Transport mode	18.38	0.3019
Frequency of Use	7.87	0.6412
Purpose of use	61.71	0.0606

Question 14: Active mode safety

Table B.7: Chi-Squared test results: demographics vs. active mode safety

Demographic	Chi2 Statistic	p-value
Age	37.98	**0.0089**
Gender	2.53	0.6385
Neighborhood	37.62	**0.0099**
Transport mode	49.83	**0.0232**
Frequency of Use	12.52	0.8970
Purpose of use	84.14	0.7080

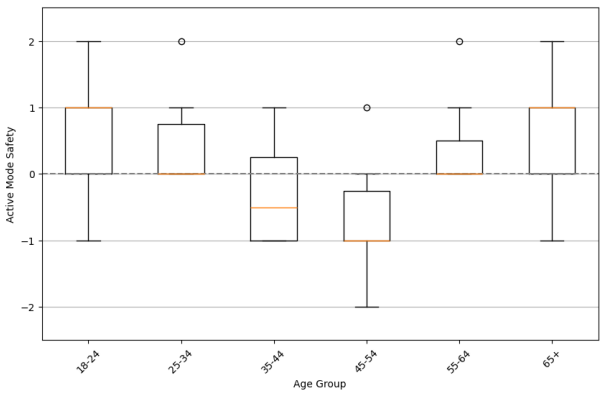


Figure B.4: Active mode safety against the age groups. Significant improvement (2) to become significant worse (-2)

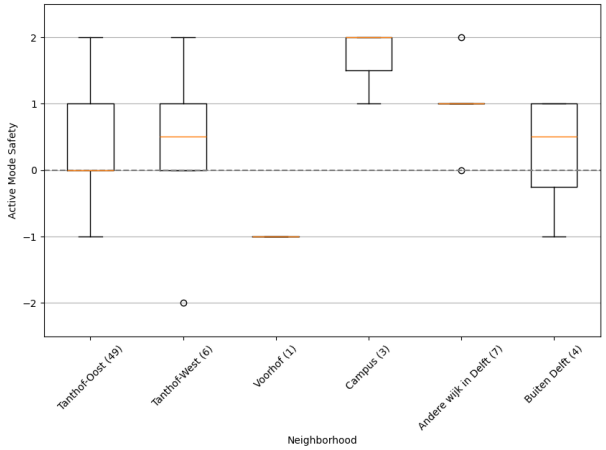


Figure B.5: Active mode safety against the neighborhoods. Significant improvement (2) to become significant worse (-2)

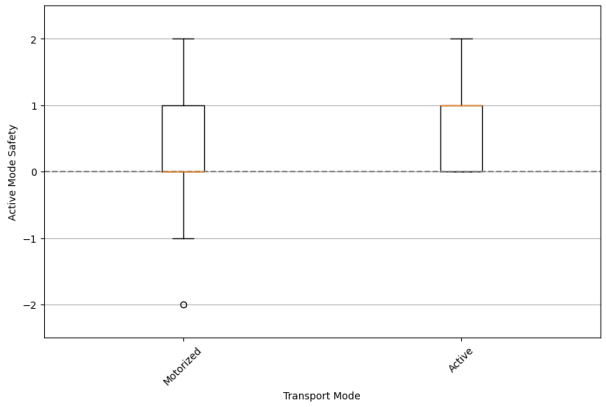


Figure B.6: Active mode safety against the different transportation modes. Significant improvement (2) to become significant worse (-2)

Question 15: Interaction active modes vs motorists

Table B.8: Chi-Squared test results: demographics vs. interaction active modes vs motorists

Demographic	**Chi2 Statistic**	**p-value**
Age	11.41	0.9348
Gender	4.89	0.2993
Neighborhood	26.27	0.1572
Transport mode	58.80	**0.0027**
Frequency of Use	23.61	0.2599
Purpose of use	80.33	0.8024

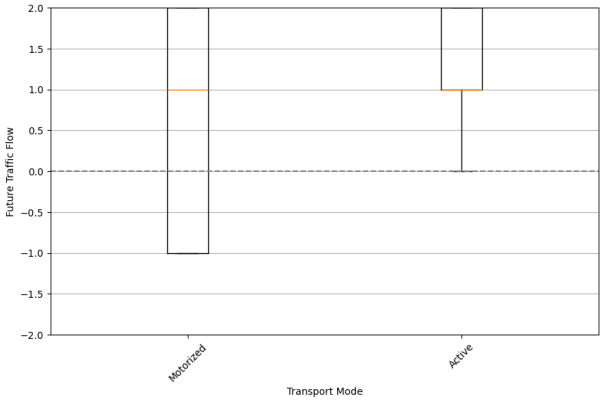


Figure B.7: Expected improvement in interaction between different modes vs the different transportation modes. Significant improvement (2) to become significant worse (-2)

Question 16: Comfort improvements

Table B.9: Chi-Squared test results: demographics vs. comfort improvements

Demographic	**Chi2 Statistic**	**p-value**
Age	34.53	**0.0228**
Gender	2.84	0.5852
Neighborhood	19.86	0.4670
Transport mode	43.31	0.0876
Frequency of Use	10.34	0.9616
Purpose of use	90.29	0.5310

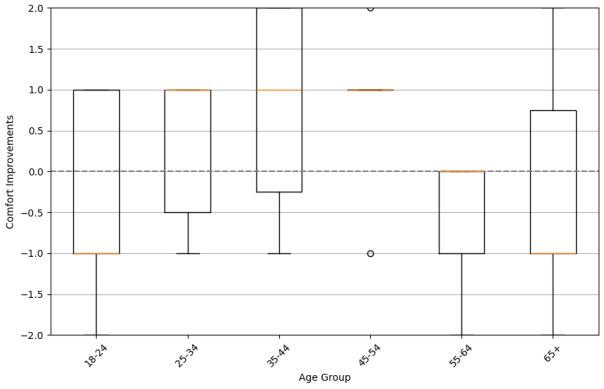


Figure B.8: Comfort improvement against the age groups. Significant improvement (2) to become significant worse (-2)

Question 17: Support for 30 km/h

Table B.10: Chi-Squared test results: demographics vs. support for 30 km/h

Demographic	Chi2 Statistic	p-value
Age	10.13	0.4288
Gender	1.14	0.5661
Neighborhood	24.99	**0.0054**
Transport mode	22.34	0.1326
Frequency of Use	4.31	0.9320
Purpose of use	53.89	0.1982

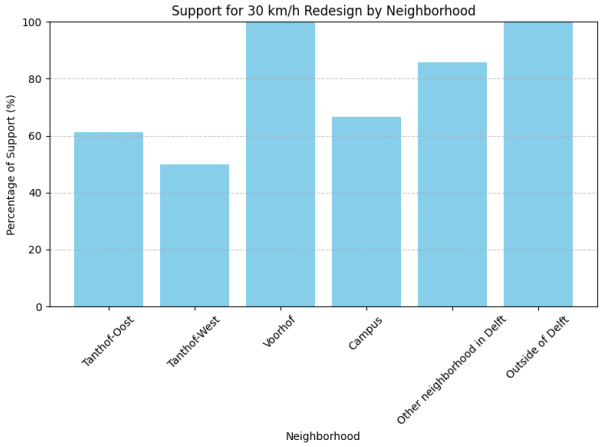


Figure B.9: Support for 30 km/h redesign per neighborhood

C
Distribution flyer

Figure C.1: Flyer used during the Distribution

D
AI code of conduct

D.1 Research & report

As for the research and creating report, ChatGPT has been used to make the text more consequent and easier to read.
With prompts like: *"Analyze this section, mark inconsequent use of language and typo's. And give options to solve it."*

ChatGPT was also used to evaluate the structure of chapters. With prompts like: *"Analyze this section of the report. Would you change the structure of it, explain the changes you suggest."*

As overleaf was the platform for the report, tables and figures are difficult to implement. Gemini by Google was used to convert the data from python into readable tables in LaTeX format.

D.2 Writing code

The code for this project is written in Visual Code by Microsoft. The TU Delft Educational license on GitHub gives the option to integrate the AI into your python editor. The Gemini plugin for Visual code helped me to create the Chi-squared tests and Man-Whitney U tests.

The prompts can be seen in the code. A prompt for AI in python start with a #.

E
Survey questions (English)

E.1 Demographic questions

This section collect background information on the respondents. This data helps to identify which user groups are affected most by the current or future road designs and whether the GOW30 design is beneficial for all the type of users.

What is your age?
Options: Under 18 — 18–24 — 25–34 — 35–44 — 45–54 — 55–64 — 65+ — Prefer not to answer
Age can influence the travel mode of choice and the risk experienced in traffic. Younger and older people might feel less confident in mixed traffic situations. Knowing the age of the respondents shows if certain groups benefit more from the GOW30 redesign.

What is your gender?
Options: Male — Female — Non-binary / Other — Prefer not to say
Gender can affect safety perceptions within traffic. Women might experience the Tanthofdreef different than man.

Which neighborhood do you live in?
Options: Tanthof-Oost — Tanthof-West — Buitenhof — Voorhof — Campus — Other neighborhoods in Delft — Outside of Delft
Home location determines on how often and where the respondent uses the Tanthofdreef. The attitude might vary when it is in your home neighborhood.

What is your primary mode of travel when using or crossing the Tanthofdreef?
Options: Walking — Cycling — Car — Truck — Other (specify)
Different traveling modes might experience a road in different manners. A road might be a fast and nice experience for a motorized vehicle, but might be a pain to cross.

How Frequent do you travel along the Tanthofdreef? Options: Daily — 4-5 times a week — 2-3 times a week — Weekly — Monthly — Rarely — Never
Regular users will have more clear opinions about the safety and design of the road. Occasional users may not see the impact of the measurements. Frequency could be a weight when analyzing the data.

What is the main purpose of the journey when you use the Tanthofdreef?

Options: Work or Educational — Approaching Delft Campus Station — Recreational — Friend or Family — Other (specify)
The purpose of the travel influences the expectation about the road comfort, safety and urgency. For example, commuters may be more sensitive for future delays, while recreational users might prioritize comfort and aesthetics over traffic flow.

E.2 Experiences on the Tanthofdreef

This section is focused on gathering data on the respondents current usage and experience. This data shows the experience safety, clarity of the design and other possible conflicts.

How safe do you feel when using or crossing the Tanthofdreef?
Options: Very unsafe — Unsafe — Neutral — Safe — Very safe
The safety feel is a good indicator for the effectiveness of the current road design. When many users feel unsafe, that can indicate that a redesign to a GOW30 road is needed.

How would you describe the interaction between cars and pedestrians/cyclists on the Tanthofdreef?
Options: Very dangerous — Sometimes risky — Neutral — Usually safe — Very safe
The interaction between motorized vehicles and active modes reflects on the clarity and comfort of the current road design. Unsafe or unclear intersections can lead to conflicts and discourage walking or cycling. This question tests one of the hypotheses parts: improving the experience for active modes.

How clear do you find the current road layout on the Tanthofdreef?
Options: Very unclear — Unclear — Neutral — Clear — Very clear
The layout clarity is essential for a safe and predictable road. If road users are confused by the layout, they might make unpredictable choices in their journey. Unpredictable movement increases the risk of incidents. Understanding the clarity helps access how much the GOW30 design might improve the usability of the Tanthofdreef.

Where do you think the most conflicts happen on the Tanthofdreef?
Options: Crossings — Intersections — Cycling path — Driveway exits — Entire road feels unsafe — No conflicts
When the specific location with conflicts are identified, you can guide targeted interventions. Knowing where the respondents feel unsafe helps validate if the proposed redesigns improve the road in the right areas.

Have you ever had or witnessed a near-accident or conflict on the Tanthofdreef?
Options: Yes, as a pedestrian — Yes, as a cyclist — Yes, as a driver — No — Other (specify)
Experiences with conflict on the Tanthofdreef are good indicators of real or only perceived risks. It helps to distinguish between general unsafe feelings and real unsafe situations.

Does the Tanthofdreef feel like a barrier between Tanthof and the Delft Campus Station areas?

Options: Yes (specify) — No (specify) — No opinion

As the Station Delft Campus gets redesigned in 4 quadrants, and will become more lively and vibrant. This new innovative area can also increase the liveliness of Tanthof-Oost. But to influence the other neighborhoods it must be connected with those areas. When the Tanthofdreef occurs to be a barrier between the areas. Tanthof might not benefit from the redesign.

E.3 GOW30 design questions

This section evaluates the public opinion on the proposed design changes for the Tanthofdreef. It tests whether the respondents are positive about a redesign of the Tanthofdreef into a GOW30 corridor.

Which GOW30 design option would you prefer for the Tanthofdreef?

Options: GOW30 (option 1) — GOW30 (Option 2) — GOW50 (current road) — GOW50 with different intersections

This question tests the respondents preference for diffrent GOW30 Design features, like shared spaces or separated car lanes. These preferences can help to get insight in the most effective ways to prove people perception of safety and comfort. Understanding their choices ensures that the final design of the Tanthofdreef is in line with the public opinion.

How safe do you think the GOW30 redesign will be for pedestrians and cyclists?

Options: Very unsafe — Unsafe — Neutral — Safe — Very safe

The expected safety feeling is directly linked to the first question in the Current experience part. The hypothesis stated that the new road design increases the safety and comfort feeling on the road. In that case the general opinions must be more positive on this question than on the question before. It provides insight into whether the GOW30 redesign is a good solution for the current safety concerns.

How do you think the interaction between cars and active modes will change with the GOW30 redesign?

Options: It will worsen — No change — It will slightly improve — It will significantly improve — Not sure

This question focuses on the second part of the hypothesis of this study: whether the GOW30 redesign improves the interaction between cars and the active modes. A positive result in this question validates the hypotheses that the redesign will make the Tanthofdreef safer and more comfortable for pedestrians and cyclists.

Do you think the GOW30 redesign will improve the overall comfort of walking and cycling along the Tanthofdreef?

Options: Strongly disagree — Disagree — Neutral — Agree — Strongly agree

A journey by foot or by bike must be stimulated. Whether this is stimulated by the new redesign is important. Increased comfort for the active modes can stimulate to use the mode of transportation.

To what extend would you support a 30 km/h speed limit on the Tanthofdreef?

Options: Yes, I support it — No, I do not support it — I am neutral

Acceptance of a 30 km/h speed limit is key for implementation. A readiness under the inhabitants of Tanthof and the Tanthofdreef users is needed. If a significant number of road users reject the 30 km/h zone, it might even get more dangerous, as the road is not designed any more to accommodate 50 km/h or more. This question could state the level of public support for the implementation of the GOW30 road design.

What additional road improvements do you think would benefit the Tanthofdreef?

Options: More green space — Better lighting — More crossing points — More pedestrian-friendly spaces — Other (specify)

This is a open question, which captures futher suggestion from the respondents on how the Tanthofdreef or GOW30 design can be improved. It helps to identify more specific improvements and regular users might have different solution for the redesign to make it more safe and livable.

F
Survey in qualtrics (Dutch)

Introductie:
Voor mijn bacheloreindproject Civiele Techniek aan de TU Delft onderzoek ik de herinrichting van de Tanthofdreef tot een veilige 30 km/h-straat (GOW30). Uw antwoorden blijven anoniem en worden alleen voor academisch onderzoek gebruikt.

Blok 1: Demografische vragen

1. Wat is uw leeftijd?

   - -18
   - 18–24
   - 25–34
   - 35–44
   - 45–54
   - 55–64
   - 65+
   - Ik wil dit niet aangeven

2. Wat is uw gender?

   - Man
   - Vrouw
   - Niet-binair/derde geslacht
   - Ik zeg dat liever niet

3. In welke wijk woont u?

   - Tanthof-Oost
   - Tanthof-West
   - Buitenhof
   - Voorhof
   - Campus
   - Andere wijk in Delft
   - Buiten Delft
   - Ik wil dit niet aangeven

4. Vervoersmiddelen over de Tanthofdreef?

☐ Voetganger
☐ Fiets
☐ Auto
☐ Bus
☐ Vrachtwagen
☐ Anders:

5. Hoe vaak reist u over de Tanthofdreef?

   - Dagelijks
   - 4–6 keer per week
   - 2–3 keer per week
   - Een keer per week
   - Maandelijks
   - Nooit

6. Doel van uw reis?

☐ Werk of Educatie
☐ Station Delft Campus
☐ Recreatie
☐ Familie of vrienden
☐ Anders:

Blok 2: Ervaringen met de Tanthofdreef

1. Hoe veilig voelt u zich bij gebruik van de Tanthofdreef?

   ◦ Zeer onveilig
   ◦ Onveilig
   ◦ Neutraal
   ◦ Veilig
   ◦ Zeer veilig

2. Hoe is de interactie tussen auto's en voetgangers/fietsers?

   ◦ Zeer gevaarlijk
   ◦ Soms risicovol
   ◦ Neutraal
   ◦ Meestal veilig
   ◦ Veilig

3. Hoe duidelijk vindt u de huidige weginrichting?

- ○ Zeer onduidelijk
- ○ Onduidelijk
- ○ Neutraal
- ○ Duidelijk
- ○ Zeer duidelijk

4. Waar vinden de meeste conflicten plaats?

☐ Oversteekplaatsen	☐ Uitritten
☐ Kruispunten	☐ Gehele weg voelt onveilig
☐ Fietspad	☐ Geen conflicten

5. Heeft u ooit een bijna-ongeluk of conflict meegemaakt of gezien?
6. Voelt de Tanthofdreef als een barrière tussen Tanthof en station Delft Campus? Licht toe.
   - ○ Ja
   - ○ Nee
   - ○ Geen mening

Blok 3: GOW30 Design

1. Welke wegvariant heeft uw voorkeur voor de Tanthofdreef?
   - ○ Optie 1
   - ○ Optie 2
   - ○ Huidige situatie behouden
2. Hoe veilig denkt u dat het GOW30-herontwerp zal zijn voor voetgangers en fietsers?
   - ○ Zeer onveilig
   - ○ Onveilig
   - ○ Neutraal
   - ○ Veilig
   - ○ Zeer veilig
3. Hoe denkt u dat de interactie tussen auto's en actieve weggebruikers zal veranderen?
   - ○ Verslechteren
   - ○ Geen verandering

- ○ Licht verbeteren
- ○ Aanzienlijk verbeteren
- ○ Geen idee

4. Denkt u dat het GOW30-ontwerp het comfort voor voetgangers en fietsers zal verbeteren?

   - ○ Helemaal mee oneens
   - ○ Oneens
   - ○ Neutraal
   - ○ Eens
   - ○ Helemaal mee eens

5. In hoeverre bent u voorstander van een snelheidsbeperking van 30 km/u op de Tanthofdreef?

   - ○ Ja, ik steun het
   - ○ Nee, ik steun het niet
   - ○ Neutraal

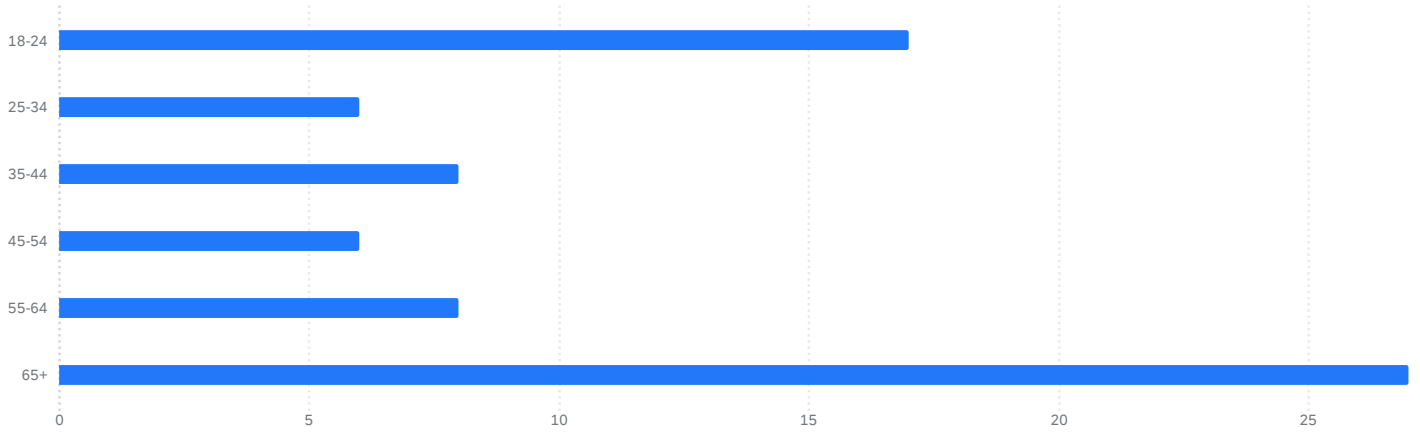
6. Welke aanvullende verbeteringen zouden volgens u de Tanthofdreef ten goede komen?

   - ☐ Meer groen
   - ☐ Betere verlichting
   - ☐ Meer oversteekplaatsen
   - ☐ Meer voetgangersvriendelijke ruimtes
   - ☐ Anders:

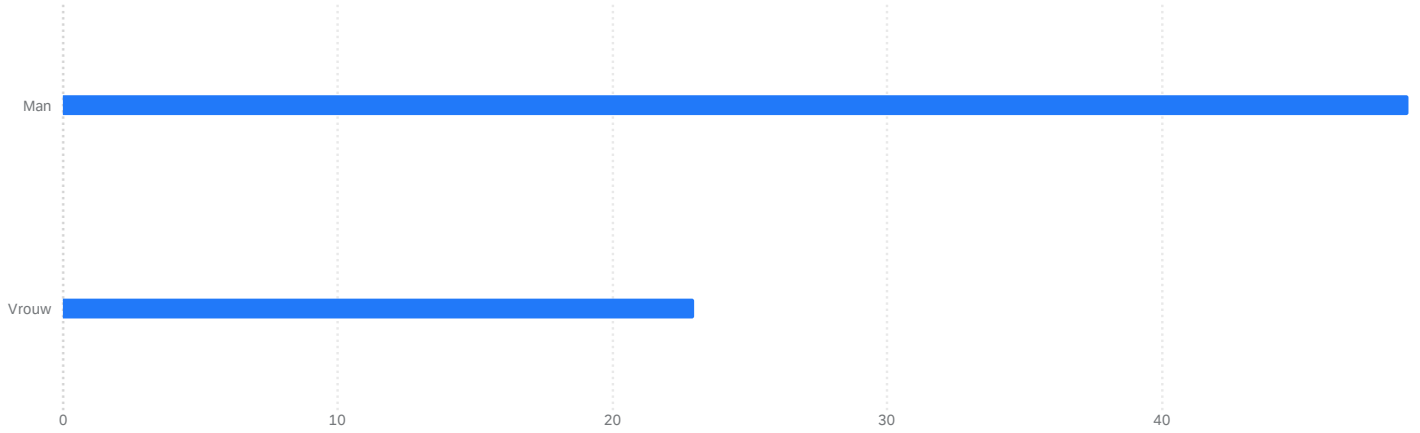
Tanthofdreef Enquête / Pagina 1

Antwoorden: 72

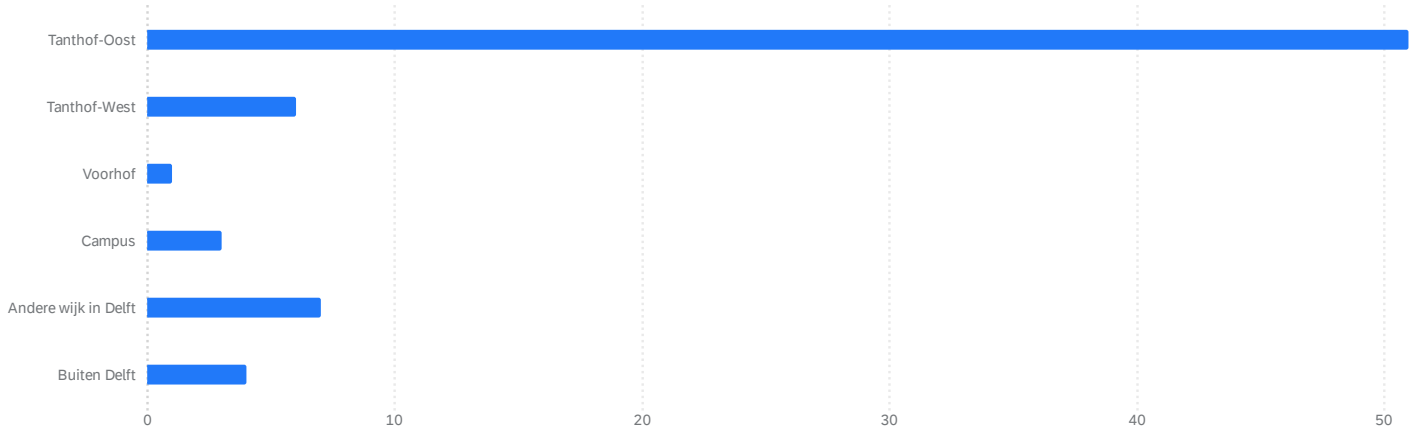
Wat is uw leeftijd? 72



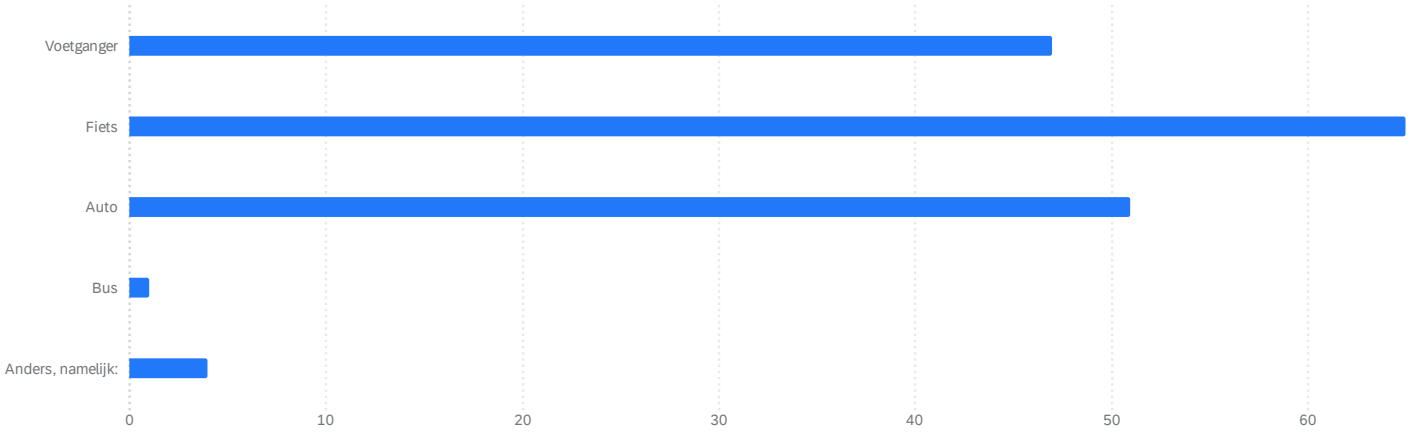
Wat is uw gender? 72



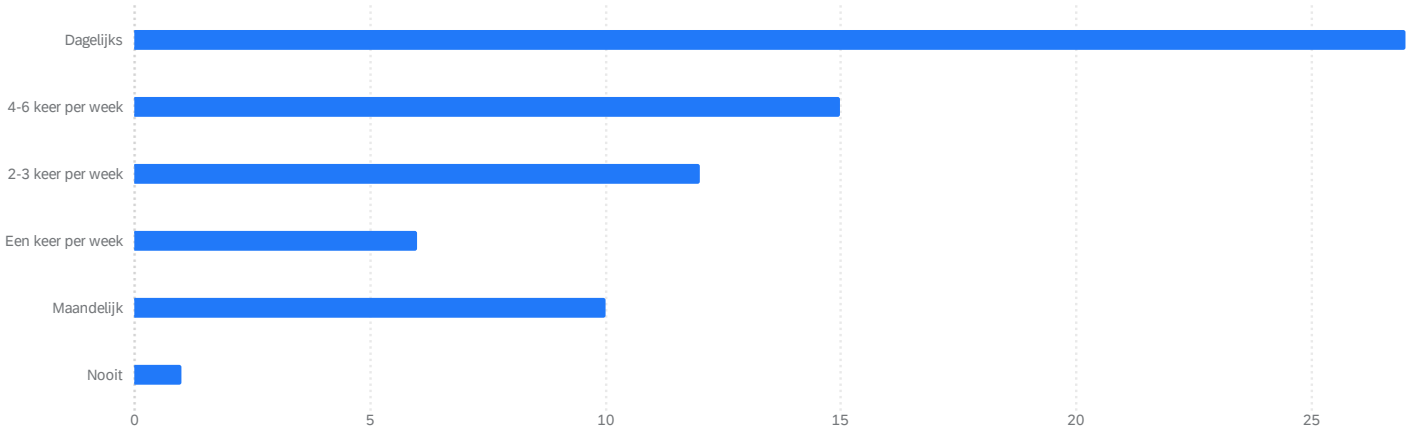
In welke wijk woont u? 72



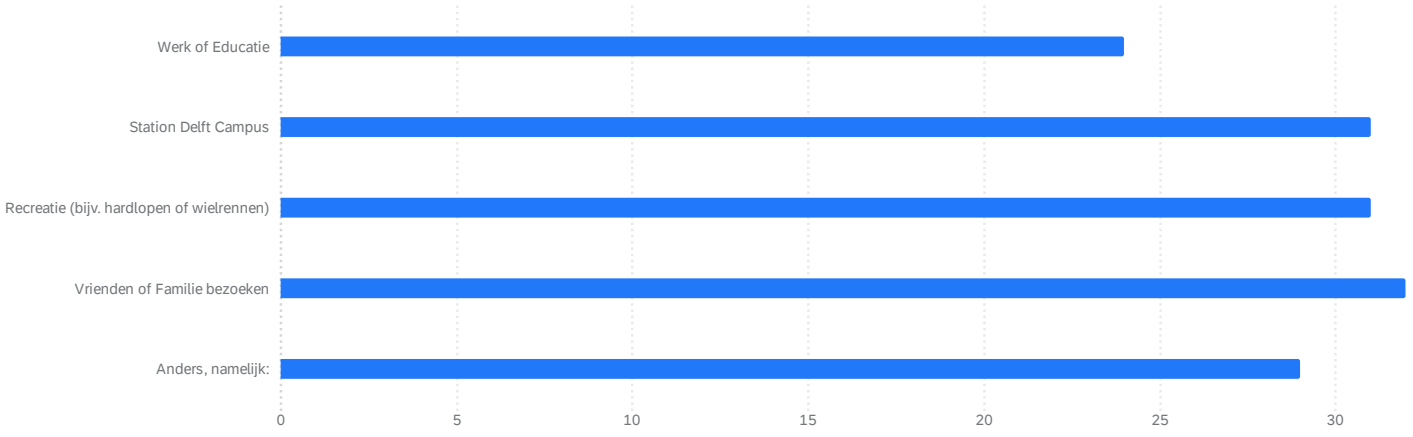
Wat zijn de vervoersmiddelen die u gebruikt wanneer u reist of oversteekt over de Tanthofdreef? 71



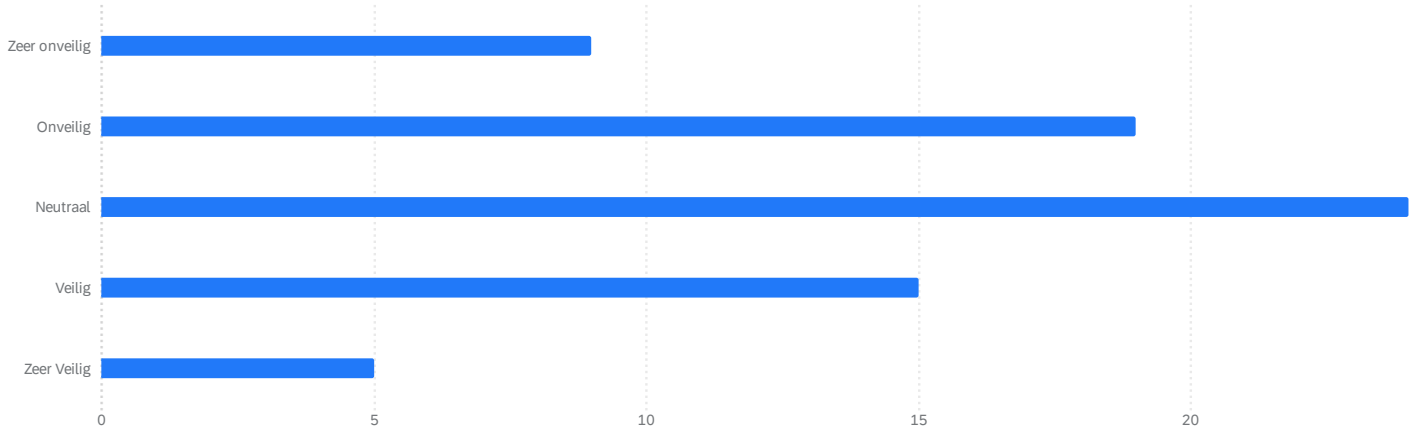
Hoevaak reist u over de Tanthofdreef? 71



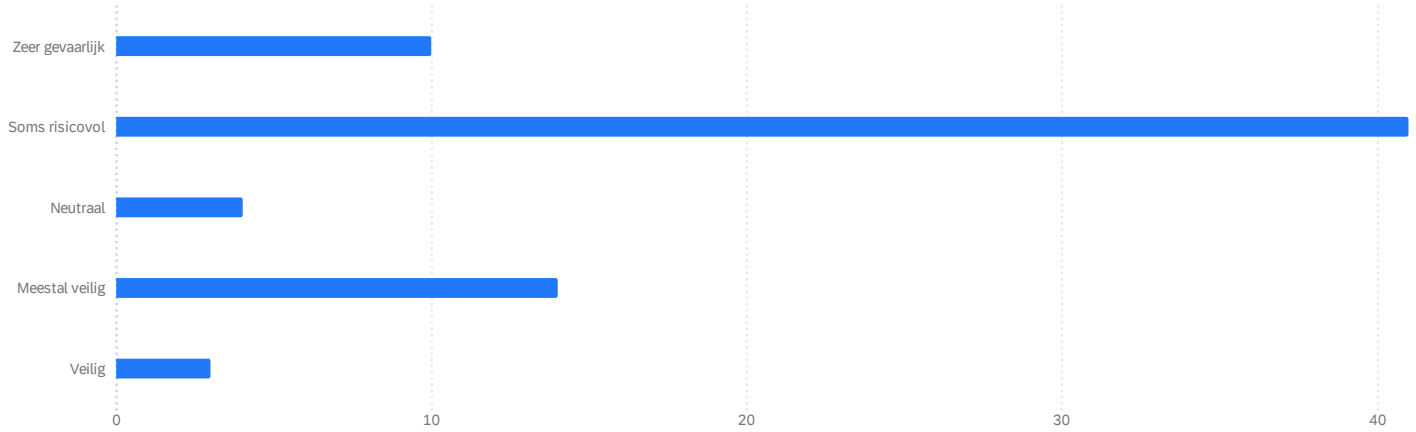
Wat is het doel van de reis als u de Tanthofdreef gebruikt? 72



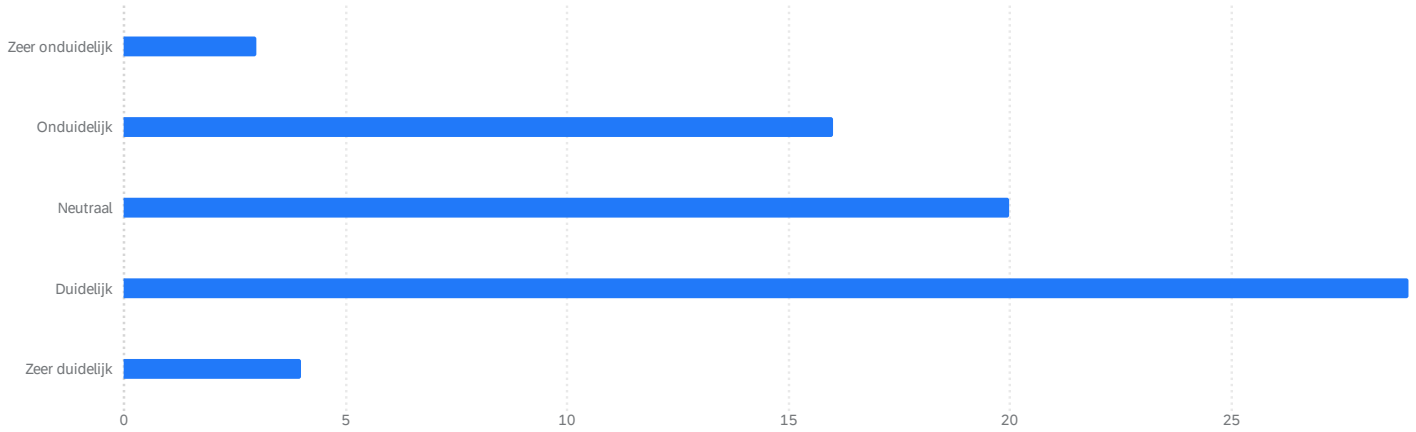
Hoe veilig voelt u zich bij het gebruiken of oversteken van de Tanthofdreef? 72



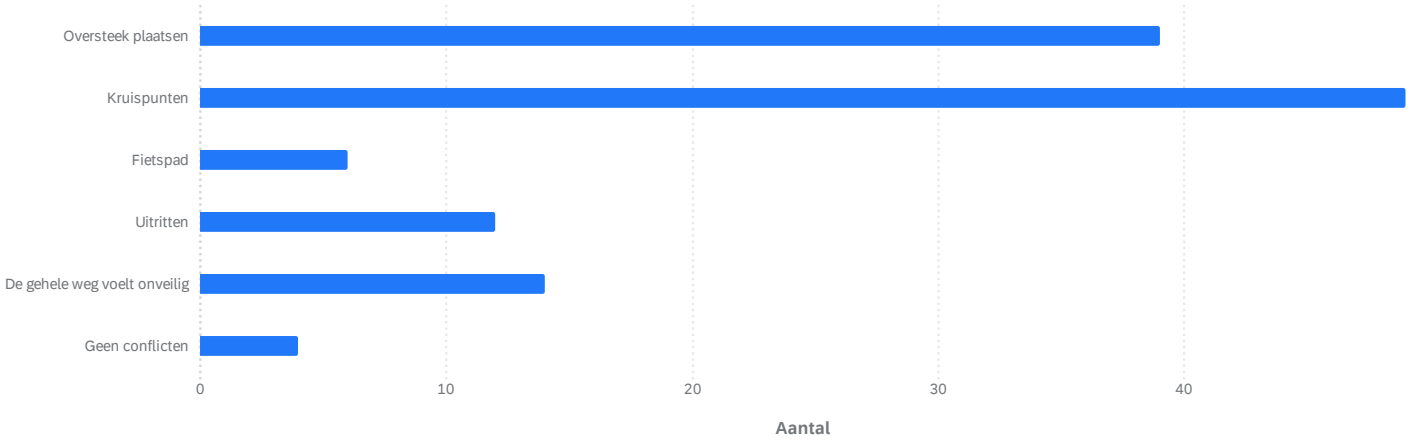
Hoe zou u de interactie tussen auto's en voetgangers/fietsers op de Tanthofdreef beschrijven? 72



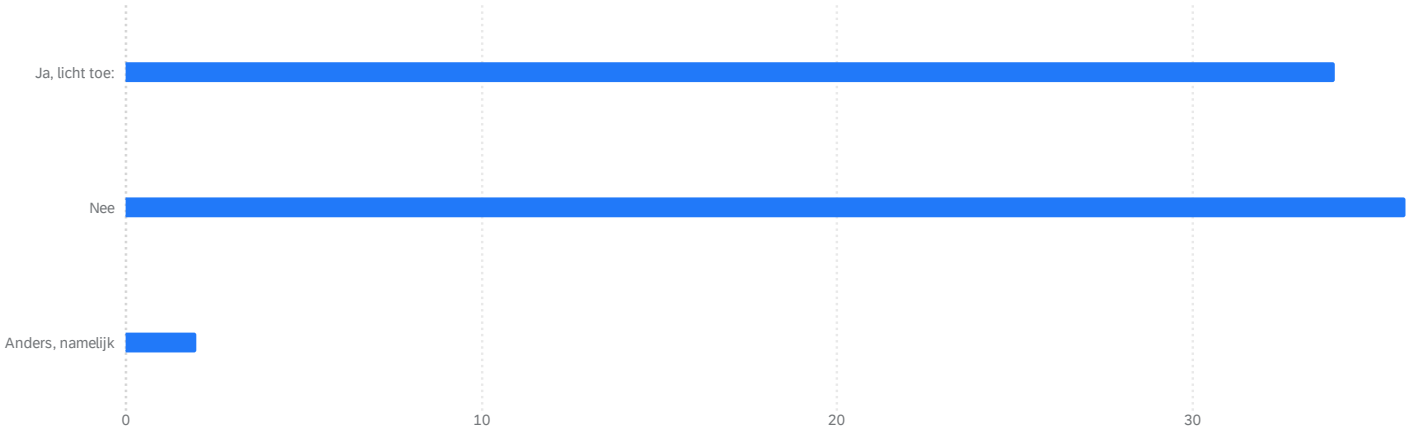
Hoe duidelijk vindt u de huidige weginrichting op de Tanthofdreef? 72



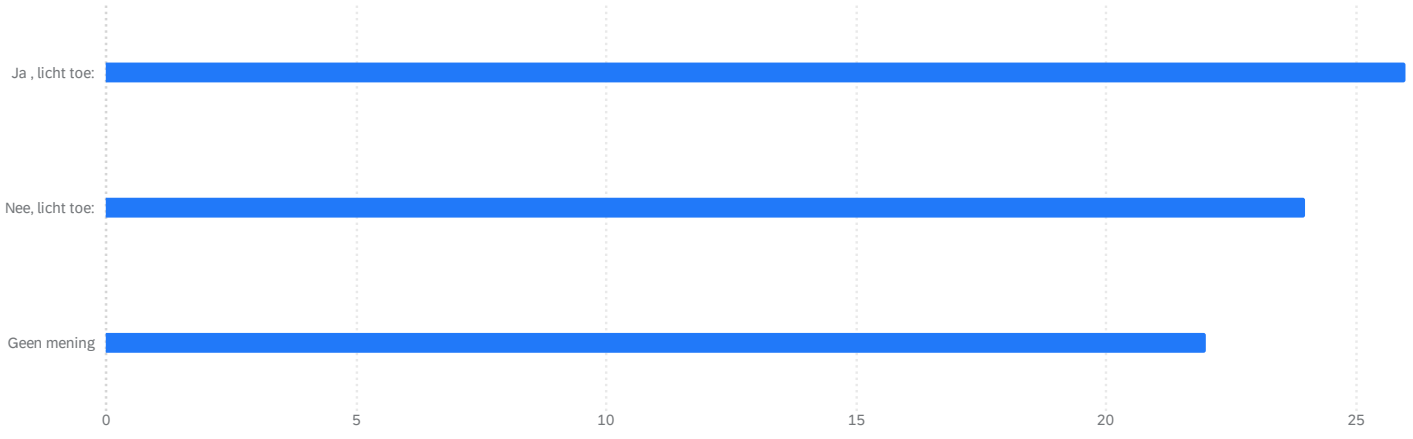
Waar denkt u dat de meeste conflicten plaatsvinden op de Tanthofdreef? 72



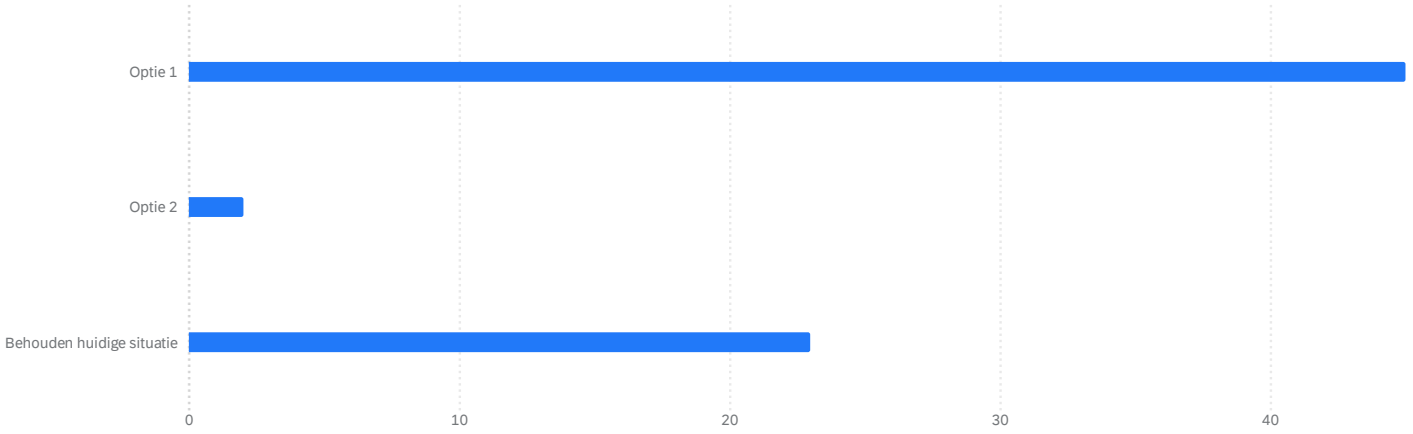
Heeft u ooit een bijna-ongeluk of conflict meegemaakt of gezien op de Tanthofdreef? 72



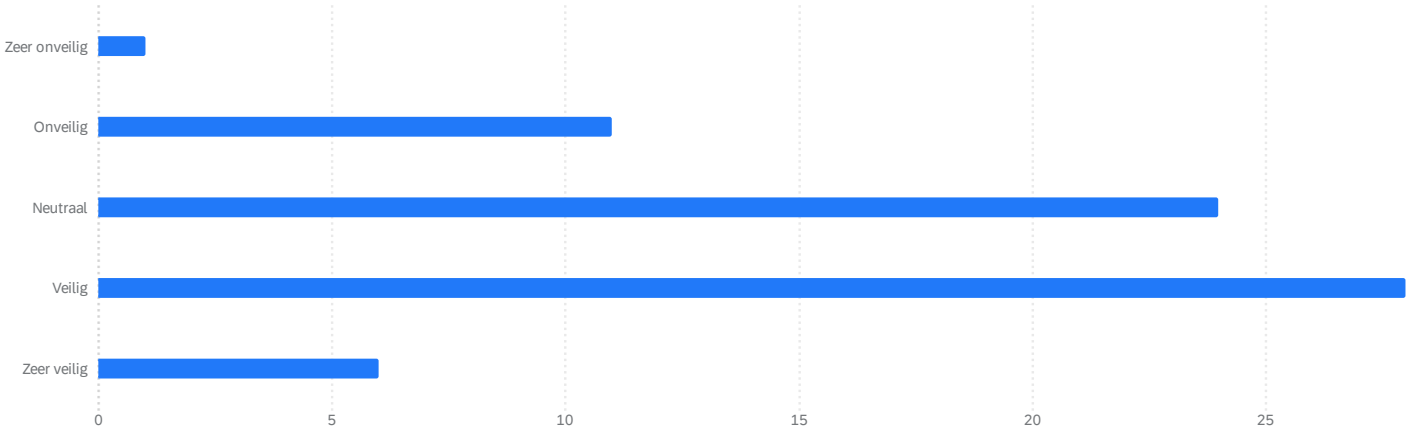
Voelt de Tanthofdreef als een barrière tussen Tanthof en het station Delft Campus? 72



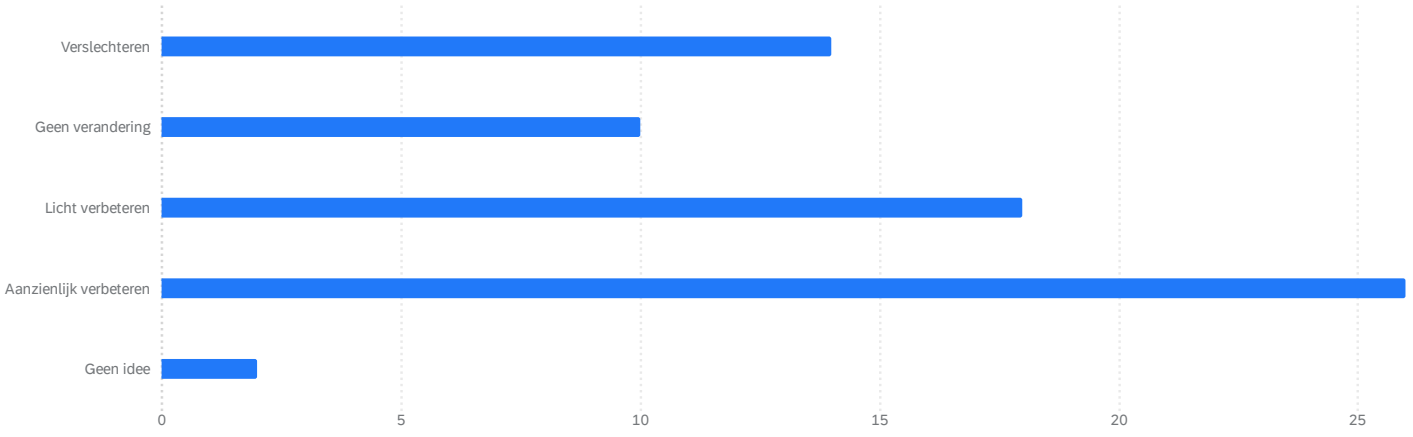
Welke weg variant heeft uw voorkeur voor de Tanthofdreef? (Hierboven weergegeven) 70



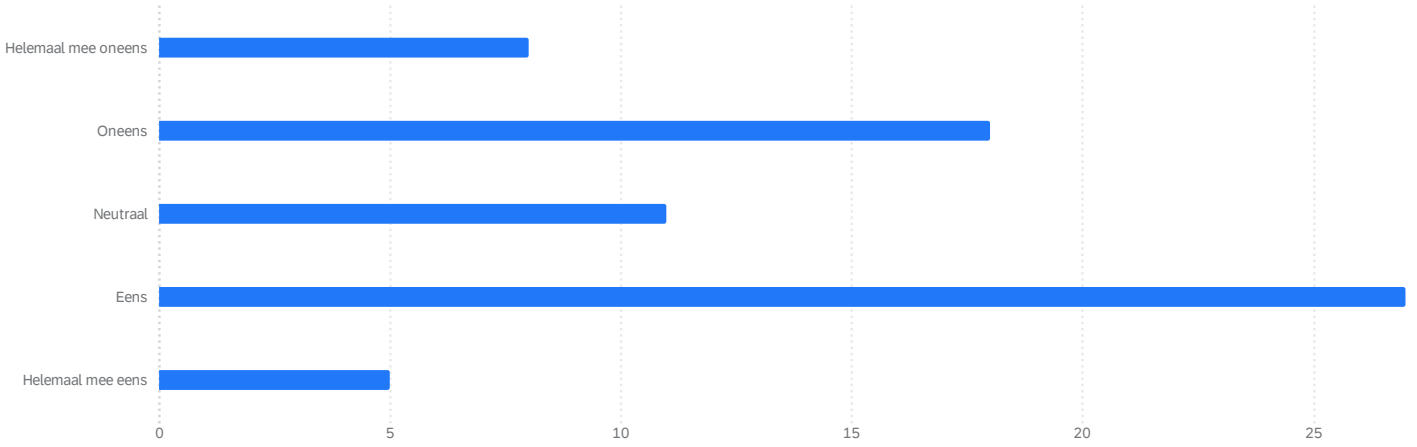
Hoe veilig denkt u dat het GOW30-herontwerp zal zijn voor voetgangers en fietsers? 70



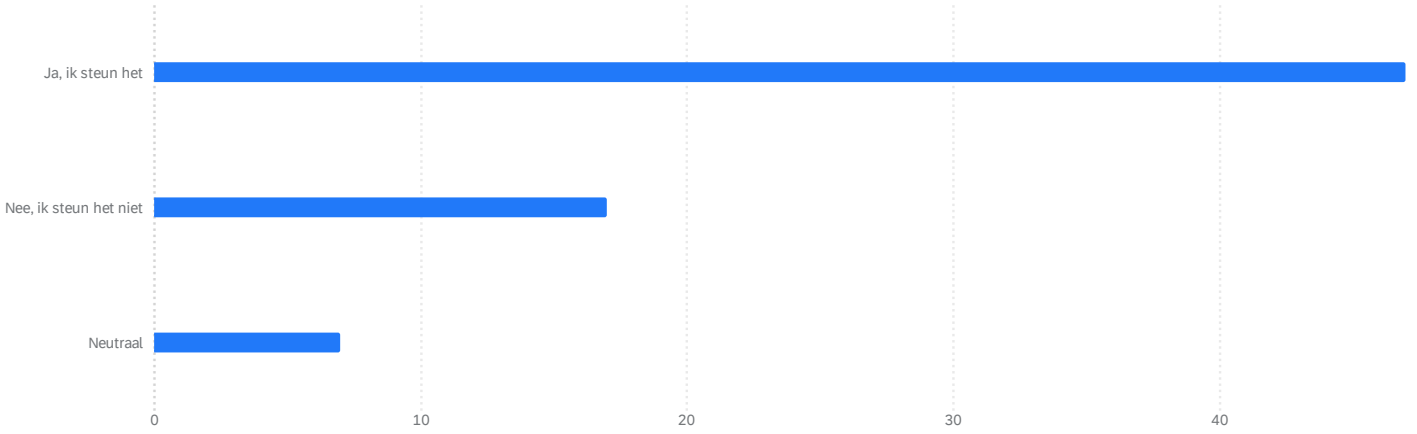
Hoe denkt u dat de interactie tussen auto's en actieve weggebruikers zal veranderen met het GOW30-ontwerp? 70



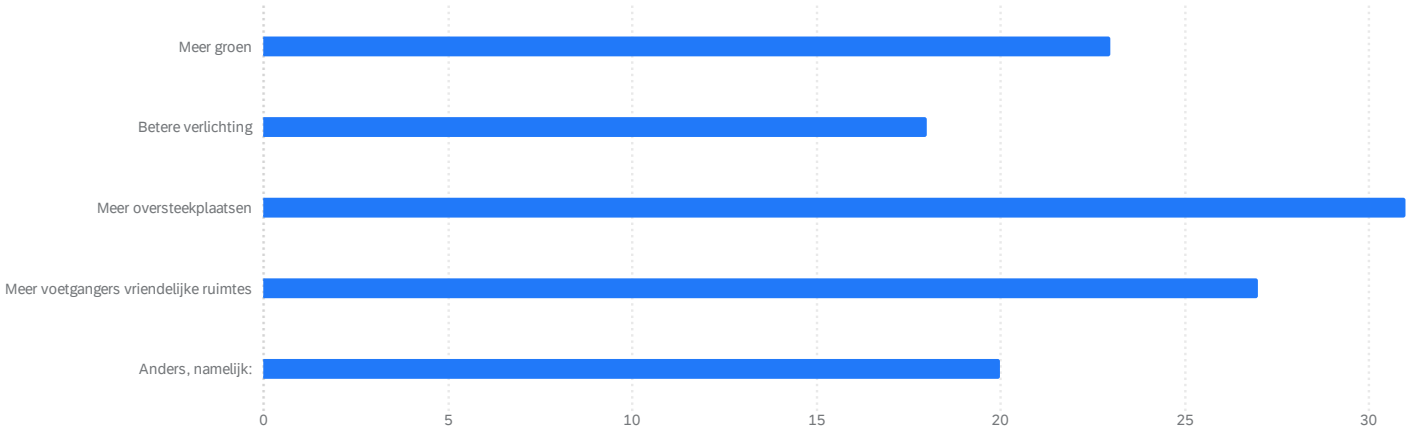
Denkt u dat het GOW30-ontwerp het comfort voor voetgangers en fietsers op de Tanthofdreef zal verbeteren? 69



In hoeverre bent u voorstander van een snelheidsbeperking van 30 km/u op de Tanthofdreef? 71



Welke aanvullende verbeteringen zouden volgens u de Tanthofdreef ten goede komen? 68



G
Supporting figures

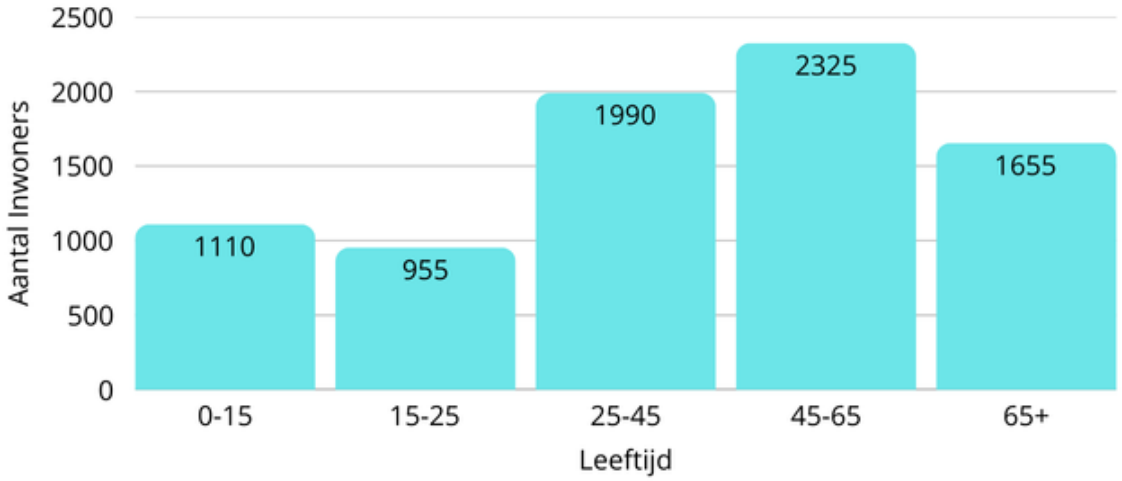


Figure G.1: Inhabitants per age group (AlleCijfers, 2025)

H
Data analytics python code

In [ ]:
```
#Adding the needed packages for the Data analytics

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy.stats import mannwhitneyu, ttest_ind, chi2_contingency


data = pd.read_excel('Datasets/Tanthofdreef+Enquête_25+mei+2025_09.07.xlsx')
data.head()
```

Current experiences

In [ ]:
```
#Data analytics for the current sitation of the Tanthofdreef

df2 = data.copy()

# Categorize transport modes
motorized_mask = df2['Vraag 4:'].str.contains('auto', case=False, na=False)
df2['mode'] = np.where(motorized_mask, 'motorized', 'active')

#Vraag 7

interaction_map_Vraag7 = {
    'Zeer veilig': 2,
    'Veilig': 1,
    'Neutraal': 0,
    'Onveilig': -1,
    'Zeer onveilig': -2
}


df2['Current safety'] = data['Vraag 7:'].map(interaction_map_Vraag7)

motorized_vraag7 = df2[df2['mode'] == 'motorized']['Current safety'].dropna()
active_vraag7= df2[df2['mode'] == 'active']['Current safety'].dropna()
stat_7, p_7 = mannwhitneyu(motorized_vraag7, active_vraag7, alternative='two-sid

#Vraag 8

interaction_map_Vraag8 = {
    'Zeer gevaarlijk': -2,
    'Soms risicovol': -1,
    'Neutraal': 0,
    'Meestal veilig': 1,
    'Veilig': 2 }

df2['Current interaction'] = data['Vraag 8:'].map(interaction_map_Vraag8)

motorized_vraag8 = df2[df2['mode'] == 'motorized']['Current interaction'].dropna
active_vraag8 = df2[df2['mode'] == 'active']['Current interaction'].dropna()

stat_8, p_8 = mannwhitneyu(motorized_vraag8, active_vraag8, alternative='two-sid


#Vraag 9
interaction_map_Vraag9 = {
```

```
    'Zeer onduidelijk': -2,
    'Onduidelijk': -1,
    'Neutraal': 0,
    'Duidelijk': 1,
    'Zeer duidelijk': 2
}

df2['layout_clarity'] = data['Vraag 9:'].map(interaction_map_Vraag9)
motorized_vraag9 = df2[df2['mode'] == 'motorized']['layout_clarity'].dropna()
active_vraag9 = df2[df2['mode'] == 'active']['layout_clarity'].dropna()
stat_9, p_9 = mannwhitneyu(motorized_vraag9, active_vraag9, alternative='two-sid

# #Vraag 10
# interaction_map_Vraag10 = {
#     'Eens': 1,
#     'Oneens': -1,
#     'Neutraal': 0
# }

# df2['feeling_score_10'] = data['Vraag 10:'].map(interaction_map_Vraag10)
# motorized_vraag10 = df2[df2['mode'] == 'motorized']['feeling_score_10'].dropna
# active_vraag10 = df2[df2['mode'] == 'active']['feeling_score_10'].dropna()
# stat_10, p_10 = mannwhitneyu(motorized_vraag10, active_vraag10, alternative='t

#Vraag 11
interaction_map_Vraag11 = {
    'Ja, licht toe:': -1,
    'Nee': 1,
    'Anders, namelijk': 0
}

df2['feeling_score_11'] = data['Vraag 11:'].map(interaction_map_Vraag11)
motorized_vraag11 = df2[df2['mode'] == 'motorized']['feeling_score_11'].dropna()
active_vraag11 = df2[df2['mode'] == 'active']['feeling_score_11'].dropna()
stat_11, p_11 = mannwhitneyu(motorized_vraag11, active_vraag11, alternative='two

#Vraag 12
interaction_map_Vraag12 = {
    'Ja, licht toe:': -1,
    'Nee, licht toe:': 1,
    'Geen mening': 0
}

df2['feeling_score_12'] = data['Vraag 12:'].map(interaction_map_Vraag12)
motorized_vraag12 = df2[df2['mode'] == 'motorized']['feeling_score_12'].dropna()
active_vraag12 = df2[df2['mode'] == 'active']['feeling_score_12'].dropna()
stat_12, p_12 = mannwhitneyu(motorized_vraag12, active_vraag12, alternative='two
```

In [ ]:

```
# Store all question results
question_data = [
    ("Questions 7: Current Safety", active_vraag7.mean(), active_vraag7.median()
    ("Questions 8: Current Interaction", active_vraag8.mean(), active_vraag8.med
    ("Question 9: Layout Clarity", active_vraag9.mean(), active_vraag9.median(),
    ("Question 11: Crash Reports", active_vraag11.mean(), active_vraag11.median(
    ("Question 12: Barrier Effectiveness", active_vraag12.mean(), active_vraag12

#create a table with the questions and the results
results_df = pd.DataFrame(question_data, columns=["Question", "Active Mean", "Ac
```

```
#show the table
print(results_df)
```

Redesign analytics

In [ ]:
```
#Do evevrything done above for the questions 13  to 18
interaction_map_Vraag13 = {
    'Optie 1': 1,
    'Behouden huidige situatie': -1}

df2['Future safety'] = data['Vraag 13:'].map(interaction_map_Vraag13)

motorized_vraag13 = df2[df2['mode'] == 'motorized']['Future safety'].dropna()
active_vraag13 = df2[df2['mode'] == 'active']['Future safety'].dropna()
stat_13, p_13 = mannwhitneyu(motorized_vraag13, active_vraag13, alternative='two

print(f"Question 13: Future safety - Mann-Whitney U statistic: {stat_13}, p-valu

#Vraag 14
interaction_map_Vraag14 = {
    'Zeer onveilig': -2,
    'Onveilig': -1,
    'Neutraal': 0,
    'Veilig': 1,
    'Zeer veilig': 2
}

df2['Future interaction'] = data['Vraag 14:'].map(interaction_map_Vraag14)
motorized_vraag14 = df2[df2['mode'] == 'motorized']['Future interaction'].dropna
active_vraag14 = df2[df2['mode'] == 'active']['Future interaction'].dropna()
stat_14, p_14 = mannwhitneyu(motorized_vraag14, active_vraag14, alternative='two

#Vraag 15
interaction_map_Vraag15 = {
    'Verslechteren': -1,
    'Geen verandering': 0,
    'Geen idee': 0,
    'Licht verbeteren': 1,
    'Aanzienlijk verbeteren': 2}

df2['Future traffic flow'] = data['Vraag 15:'].map(interaction_map_Vraag15)
motorized_vraag15 = df2[df2['mode'] == 'motorized']['Future traffic flow'].dropn
active_vraag15 = df2[df2['mode'] == 'active']['Future traffic flow'].dropna()
stat_15, p_15 = mannwhitneyu(motorized_vraag15, active_vraag15, alternative='two

#Vraag 16
interaction_map_Vraag16 = {
    'Helemaal mee onsoneens': 2,
    'Oneens': 1,
    'Neutraal': 0,
    'Eens': -1,
    'Helemaal mee eens': -2
}

df2['feeling_score_16'] = data['Vraag 16:'].map(interaction_map_Vraag16)
motorized_vraag16 = df2[df2['mode'] == 'motorized']['feeling_score_16'].dropna()
active_vraag16 = df2[df2['mode'] == 'active']['feeling_score_16'].dropna()
stat_16, p_16 = mannwhitneyu(motorized_vraag16, active_vraag16, alternative='two
```

```
#Vraag 17
interaction_map_Vraag17 = {
    'Ja, ik steun het': 1,
    'Nee, ik steun het niet': -1,
    'Neutraal': 0
}

df2['feeling_score_17'] = data['Vraag 17:'].map(interaction_map_Vraag17)
motorized_vraag17 = df2[df2['mode'] == 'motorized']['feeling_score_17'].dropna()
active_vraag17 = df2[df2['mode'] == 'active']['feeling_score_17'].dropna()
stat_17, p_17 = mannwhitneyu(motorized_vraag17, active_vraag17, alternative='two
```

In [ ]:
```
# Store all redesign question results
redesign_question_data = [
    ("Question 13: Design options", active_vraag13.mean(), active_vraag13.median
    ("Question 14: Active mode safety", active_vraag14.mean(), active_vraag14.me
    ("Question 15: Interaction active modes vs Motorists", active_vraag15.mean()
    ("Question 16: Comfort improvements", active_vraag16.mean(), active_vraag16.
    ("Question 17: Support for 30 km/h", active_vraag17.mean(), active_vraag17.m

# Create a DataFrame for redesign questions
redesign_results_df = pd.DataFrame(redesign_question_data, columns=["Question",
# Show the redesign results table
print(redesign_results_df)
```

In [ ]:
```
age_data = df2['Vraag 1:'].value_counts().to_dict()

#combine the 25-34 with the 35-44 and 45-54 with the 55-64
age_data_combined = {
    "18-24": age_data.get("18-24", 0),
    "25-44": age_data.get("25-34", 0) + age_data.get("35-44", 0),
    "45-64": age_data.get("45-54", 0) + age_data.get("55-64", 0),
    "65+": age_data.get("65+", 0)
}

age_data_percentage = {k: (v / sum(age_data_combined.values())) * 100 for k, v i


population_data = {
    "15-25": 955,
    "25-45": 1990,
    "45-65": 2325,
    "65+": 1655
}

#calculate the percentage of the population in each age group
population_percentage = {k: (v / sum(population_data.values())) * 100 for k, v i


# Create a DataFrame for age data
age_df = pd.DataFrame({
    "Age Group": list(age_data_combined.keys()),
    "Survey Percentage": list(age_data_percentage.values()),
    "Population Percentage": list(population_percentage.values())
})

# Show the age data DataFrame
print(age_df)
```

Chi tests

In [ ]:
```
def calculate_chi2_test(df, col1, col2):
    # Create a contingency table (cross-tabulation)
    contingency_table = pd.crosstab(df[col1], df[col2])

    # Perform the chi-squared test
    chi2, p, dof, expected = chi2_contingency(contingency_table)

    return chi2, p, contingency_table # Returning contingency_table as well for



def chi_per_question(df2, question, titel):
    chi2_1, p_1, contingency_1 = calculate_chi2_test(df2, 'Vraag 1:', question)
    chi2_2, p_2, contingency_2 = calculate_chi2_test(df2, 'Vraag 2:', question)
    chi2_3, p_3, contingency_3 = calculate_chi2_test(df2, 'Vraag 3:', question)
    chi2_4, p_4, contingency_4 = calculate_chi2_test(df2, 'Vraag 4:', question)
    chi2_5, p_5, contingency_5 = calculate_chi2_test(df2, 'Vraag 5:', question)
    chi2_6, p_6, contingency_6 = calculate_chi2_test(df2, 'Vraag 6:', question)

        #create table like above to show the results of the chi2 test
    chi2_results_df = pd.DataFrame({
        'Question': ['Age',
            'Gender',
            'Neighborhood',
            'Transport Mode',
            'Frequency of Use',
            'Purpose of use'],
        'Chi2 Statistic': [round(chi2_1, 2), round(chi2_2, 2), round(chi2_3, 2),
        'p-value': [round(p_1, 4), round(p_2, 4), round(p_3, 4), round(p_4, 4),
    })

    # Create a more professional styled DataFrame for chi2 results
    chi2_styled_df = (chi2_results_df.style
        .hide(axis='index')  # Remove index numbers
        .set_properties(**{
            'background-color': '#ffffff',
            'color': 'black',
            'border-color': '#000000',
            'border-style': 'solid',
            'border-width': '1px'
        })
        .set_table_styles([
            {'selector': 'th',
            'props': [('background-color', '#003366'),
                    ('color', 'white'),
                    ('font-weight', 'bold'),
                    ('text-align', 'center'),
                    ('padding', '12px'),
                    ('font-size', '14px')]},
            {'selector': 'td',
            'props': [('padding', '10px'),
                    ('text-align', 'center'),
                    ('font-size', '12px')]},
            {'selector': 'caption',
            'props': [('caption-side', 'top'),
                    ('font-size', '16px'),
```

```
                    ('font-weight', 'bold'),
                    ('padding', '8px')]},
        ])
        .highlight_between(subset=['p-value'], left=0, right=0.05,
                           props='background-color: #ffeb3b; font-weight: bold')
        .format({'Chi2 Statistic': '{:.2f}',
                 'p-value': '{:.4f}'})
        .set_caption(f'Chi-Squared Test Results Question Demographics vs {titel}


chi_per_question(df2, 'Vraag 7:', 'Questions 7: Current Safety')
chi_per_question(df2, 'Vraag 8:', 'Questions 8: Current interaction')
chi_per_question(df2, 'Vraag 9:', 'Question 9: Layout clarity')
chi_per_question(df2, 'Vraag 11:', 'Question 11: Crash reports')
chi_per_question(df2, 'Vraag 12:', 'Question 12: Barrier effectiveness')
chi_per_question(df2, 'Vraag 13:', 'Question 13: Design options')
chi_per_question(df2, 'Vraag 14:', 'Question 14: Active mode safety')
chi_per_question(df2, 'Vraag 15:', 'Question 15: Interaction active modes vs Mot
chi_per_question(df2, 'Vraag 16:', 'Question 16: Comfort improvements')
chi_per_question(df2, 'Vraag 17:', 'Question 17: Support for 30 km/h')
```

Question 9 Follow up test chi squared test

In [ ]:
```
bin1 = df2[df2['Vraag 1:'] == '18-24']['layout_clarity'].dropna()
bin2 = df2[df2['Vraag 1:'] == '25-34']['layout_clarity'].dropna()
bin3 = df2[df2['Vraag 1:'] == '35-44']['layout_clarity'].dropna()
bin4 = df2[df2['Vraag 1:'] == '45-54']['layout_clarity'].dropna()
bin5 = df2[df2['Vraag 1:'] == '55-64']['layout_clarity'].dropna()
bin6 = df2[df2['Vraag 1:'] == '65+']['layout_clarity'].dropna()
#create a boxploot per bin with y axis from 2 to -2
plt.figure(figsize=(10, 6))
plt.boxplot([bin1, bin2, bin3, bin4, bin5, bin6],
            labels=['18-24', '25-34', '35-44', '45-54', '55-64', '65+'])
plt.title('Question 9: Layout Clarity by Age Group')
plt.ylabel('Layout Clarity')
plt.xticks(rotation=45)
plt.xlabel('Age Group')
plt.ylim(-2, 2)
plt.grid(axis='y')
plt.axhline(0, color='gray', linestyle='--')
plt.show()
```

Question 9 Follow up test chi squared test

In [ ]:
```
bin1 =df2[df2['Vraag 1:'] == '18-24']['feeling_score_11'].dropna()
bin2 = df2[df2['Vraag 1:'] == '25-34']['feeling_score_11'].dropna()
bin3 = df2[df2['Vraag 1:'] == '35-44']['feeling_score_11'].dropna()
bin4 = df2[df2['Vraag 1:'] == '45-54']['feeling_score_11'].dropna()
bin5 = df2[df2['Vraag 1:'] == '55-64']['feeling_score_11'].dropna()
bin6 = df2[df2['Vraag 1:'] == '65+']['feeling_score_11'].dropna()


#calculate the percentage of -1's per bin
bin1_percentage = (bin1 == -1).sum() / len(bin1) * 100
bin2_percentage = (bin2 == -1).sum() / len(bin2) * 100
bin3_percentage = (bin3 == -1).sum() / len(bin3) * 100
bin4_percentage = (bin4 == -1).sum() / len(bin4) * 100
```

```
bin5_percentage = (bin5 == -1).sum() / len(bin5) * 100
bin6_percentage = (bin6 == -1).sum() / len(bin6) * 100

#create bar plot to show the percentage of -1's per bin
plt.figure(figsize=(10, 6))
plt.bar(['18-24', '25-34', '35-44', '45-54', '55-64', '65+'],
        [bin1_percentage, bin2_percentage, bin3_percentage, bin4_percentage, bin
        color=['#1f77b4', '#ff7f0e', '#2ca02c', '#d62728', '#9467bd', '#8c564b']
plt.title('Percentage of repondents that experienced an accident by Age Group')
plt.ylabel('Percentage of repondents that experienced an accident')
plt.xlabel('Age Group')
plt.xticks(rotation=45)
plt.ylim(0, 100)
plt.grid(axis='y')
plt.show()

#do the same for the neighborhood question

bin11 = df2[df2['Vraag 3:'] == 'Tanthof-Oost']['feeling_score_11'].dropna()
bin12 = df2[df2['Vraag 3:'] == 'Tanthof-West']['feeling_score_11'].dropna()
bin14 = df2[df2['Vraag 3:'] == 'Voorhof']['feeling_score_11'].dropna()
bin15 = df2[df2['Vraag 3:'] == 'Campus']['feeling_score_11'].dropna()
bin16 = df2[df2['Vraag 3:'] == 'Andere wijk in Delft']['feeling_score_11'].dropn
bin17 = df2[df2['Vraag 3:'] == 'Buiten Delft']['feeling_score_11'].dropna()

#calculate the percentage of -1's per bin
bin11_percentage = (bin11 == -1).sum() / len(bin11) * 100
bin12_percentage = (bin12 == -1).sum() / len(bin12) * 100
bin14_percentage = (bin14 == -1).sum() / len(bin14) * 100
bin15_percentage = (bin15 == -1).sum() / len(bin15) * 100
bin16_percentage = (bin16 == -1).sum() / len(bin16) * 100
bin17_percentage = (bin17 == -1).sum() / len(bin17) * 100

#create bar plot to show the percentage of -1's per bin
plt.figure(figsize=(10, 6))
plt.bar(['Tanthof-Oost', 'Tanthof-West', 'Voorhof', 'Campus', 'Andere wijk in De
        [bin11_percentage, bin12_percentage, bin14_percentage, bin15_percentage,
        color=['#1f77b4', '#ff7f0e', '#2ca02c', '#d62728', '#9467bd', '#8c564b']
plt.title('Percentage of repondents that experienced an accident by Neighborhood
plt.ylabel('Percentage of repondents that experienced an accident')
plt.xlabel('Neighborhood')
plt.xticks(rotation=45)
plt.ylim(0, 100)
plt.grid(axis='y')
plt.show()
```

Question 14 Follow up test chi squared test (1, 3, 4)

In [ ]:

```
bin1 =df2[df2['Vraag 1:'] == '18-24']['Future interaction'].dropna()
bin2 = df2[df2['Vraag 1:'] == '25-34']['Future interaction'].dropna()
bin3 = df2[df2['Vraag 1:'] == '35-44']['Future interaction'].dropna()
bin4 = df2[df2['Vraag 1:'] == '45-54']['Future interaction'].dropna()
bin5 = df2[df2['Vraag 1:'] == '55-64']['Future interaction'].dropna()
bin6 = df2[df2['Vraag 1:'] == '65+']['Future interaction'].dropna()

bin11 = df2[df2['Vraag 3:'] == 'Tanthof-Oost']['Future interaction'].dropna()
bin12 = df2[df2['Vraag 3:'] == 'Tanthof-West']['Future interaction'].dropna()
bin14 = df2[df2['Vraag 3:'] == 'Voorhof']['Future interaction'].dropna()
bin15 = df2[df2['Vraag 3:'] == 'Campus']['Future interaction'].dropna()
```

```
bin16 = df2[df2['Vraag 3:'] == 'Andere wijk in Delft']['Future interaction'].dro
bin17 = df2[df2['Vraag 3:'] == 'Buiten Delft']['Future interaction'].dropna()

bin21 = df2[df2['mode'] == 'motorized']['Future interaction'].dropna()
bin22 = df2[df2['mode'] == 'active']['Future interaction'].dropna()


#create per bin a boxplot with y axis from 2 to -2
plt.figure(figsize=(10, 6))
plt.boxplot([bin1, bin2, bin3, bin4, bin5, bin6],
            labels=['18-24', '25-34', '35-44', '45-54', '55-64', '65+'])
plt.ylabel('Active Mode Safety')
plt.xticks(rotation=45)
plt.xlabel('Age Group')
plt.ylim(-2.5, 2.5)
plt.grid(axis='y')
plt.axhline(0, color='gray', linestyle='--')
plt.show()

#create for question 3 a boxplot with y axis from 2 to -2 add the number of resp
plt.figure(figsize=(10, 6))
plt.boxplot([bin11, bin12, bin14, bin15, bin16, bin17],
            labels=[f'Tanthof-Oost ({len(bin11)})',
                    f'Tanthof-West ({len(bin12)})',
                    f'Voorhof ({len(bin14)})',
                    f'Campus ({len(bin15)})',
                    f'Andere wijk in Delft ({len(bin16)})',
                    f'Buiten Delft ({len(bin17)})'])
plt.ylabel('Active Mode Safety')
plt.xticks(rotation=45)
plt.xlabel('Neighborhood')
plt.ylim(-2.5, 2.5)
plt.grid(axis='y')
plt.axhline(0, color='gray', linestyle='--')
plt.show()

#create for question 6 a boxplot with y axis from 2 to -2
plt.figure(figsize=(10, 6))
plt.boxplot([bin21, bin22],
            labels=['Motorized', 'Active'])
plt.ylabel('Active Mode Safety')
plt.xticks(rotation=45)
plt.xlabel('Transport Mode')
plt.ylim(-2.5, 2.5)
plt.grid(axis='y')
plt.axhline(0, color='gray', linestyle='--')
plt.show()
```

Question 15 Follow up test chi squared test

In [ ]:

```
bin1 = df2[df2['mode'] == 'motorized']['Future traffic flow'].dropna()
bin2 = df2[df2['mode'] == 'active']['Future traffic flow'].dropna()


# Create a boxplot for Future Traffic Flow by Transport Mode
plt.figure(figsize=(10, 6))
plt.boxplot([bin1, bin2],
            labels=['Motorized', 'Active'])
```

```
plt.ylabel('')
plt.xticks(rotation=45)
plt.xlabel('Transport Mode')
plt.ylim(-2, 2)
plt.grid(axis='y')
plt.axhline(0, color='gray', linestyle='--')
plt.show()
```

Question 16 Follow up test chi squared test

In [ ]:
```
bin1 = df2[df2['Vraag 1:'] == '18-24']['feeling_score_16'].dropna()
bin2 = df2[df2['Vraag 1:'] == '25-34']['feeling_score_16'].dropna()
bin3 = df2[df2['Vraag 1:'] == '35-44']['feeling_score_16'].dropna()
bin4 = df2[df2['Vraag 1:'] == '45-54']['feeling_score_16'].dropna()
bin5 = df2[df2['Vraag 1:'] == '55-64']['feeling_score_16'].dropna()
bin6 = df2[df2['Vraag 1:'] == '65+']['feeling_score_16'].dropna()

# Create a boxplot per bin with y-axis from 2 to -2
plt.figure(figsize=(10, 6))
plt.boxplot([bin1, bin2, bin3, bin4, bin5, bin6],
            labels=['18-24', '25-34', '35-44', '45-54', '55-64', '65+'])
plt.ylabel('Comfort Improvements')
plt.xticks(rotation=45)
plt.xlabel('Age Group')
plt.ylim(-2, 2)
plt.grid(axis='y')
plt.axhline(0, color='gray', linestyle='--')
plt.show()
```

Question 17 Follow up test chi squared test

In [ ]:
```
bin1 = df2[df2['Vraag 3:'] == 'Tanthof-Oost']['Vraag 13:'].dropna()
bin2 = df2[df2['Vraag 3:'] == 'Tanthof-West']['Vraag 13:'].dropna()
bin4 = df2[df2['Vraag 3:'] == 'Voorhof']['Vraag 13:'].dropna()
bin5 = df2[df2['Vraag 3:'] == 'Campus']['Vraag 13:'].dropna()
bin6 = df2[df2['Vraag 3:'] == 'Andere wijk in Delft']['Vraag 13:'].dropna()
bin7 = df2[df2['Vraag 3:'] == 'Buiten Delft']['Vraag 13:'].dropna()


bins11 = bin1.value_counts().max() /len(bin1) * 100
bins12 = 50
bins14 = bin4.value_counts().max() /len(bin4) * 100
bins15 = bin5.value_counts().max() /len(bin5) * 100
bins16 = bin6.value_counts().max() /len(bin6) * 100
bins17 = bin7.value_counts().max() /len(bin7) * 100

# Create a DataFrame for the neighborhood data
neighborhood_data = pd.DataFrame({
    'Neighborhood': ['Tanthof-Oost', 'Tanthof-West', 'Voorhof', 'Campus', 'Other
    'Percentage': [bins11, bins12, bins14, bins15, bins16, bins17]
})
# create a histogram to show the percentage of people that support the redesign
plt.figure(figsize=(8, 6))
plt.bar(neighborhood_data['Neighborhood'], neighborhood_data['Percentage'], colo
plt.xlabel('Neighborhood')
plt.ylabel('Percentage of Support (%)')
plt.title('Support for 30 km/h Redesign by Neighborhood')
```

```
plt.xticks(rotation=45)
plt.ylim(0, 100)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.tight_layout()


#create a table to show the percentage of people that support the redesign in ea
neighborhood_styled_df = (neighborhood_data.style
    .hide(axis='index')  # Remove index numbers
    .set_properties(**{
        'background-color': '#ffffff',
        'color': 'black',
        'border-color': '#000000',
        'border-style': 'solid',
        'border-width': '1px'
    })
    .set_table_styles([
        {'selector': 'th',
         'props': [('background-color', '#003366'),
                   ('color', 'white'),
                   ('font-weight', 'bold'),
                   ('text-align', 'center'),
                   ('padding', '12px'),
                   ('font-size', '14px')]},
        {'selector': 'td',
         'props': [('padding', '10px'),
                   ('text-align', 'center'),
                   ('font-size', '12px')]},
        {'selector': 'caption',
         'props': [('caption-side', 'top'),
                   ('font-size', '16px'),
                   ('font-weight', 'bold'),
                   ('padding', '8px')]},
    ])
    .format({'Percentage': '{:.2f}'})
    .set_caption('Support for 30 km/h Redesign by Neighborhood'))

# Display the neighborhood support table
from IPython.display import HTML, display
display(HTML(neighborhood_styled_df.to_html()))
```

In [ ]:

```
### General trends


#Data analytics for the current sitation of the Tanthofdreef

df2 = data.copy()

#Vraag 7

interaction_map_Vraag7 = {
    'Zeer Veilig': 2,
    'Veilig': 1,
    'Neutraal': 0,
    'Onveilig': -1,
    'Zeer onveilig': -2
}

df2['Current safety'] = data['Vraag 7:'].map(interaction_map_Vraag7)
```

```
#Vraag 8

interaction_map_Vraag8 = {
    'Zeer gevaarlijk': -2,
    'Soms risicovol': -1,
    'Neutraal': 0,
    'Meestal veilig': 1,
    'Veilig': 2 }

df2['Current interaction'] = data['Vraag 8:'].map(interaction_map_Vraag8)

#Vraag 9
interaction_map_Vraag9 = {
    'Zeer onduidelijk': -2,
    'Onduidelijk': -1,
    'Neutraal': 0,
    'Duidelijk': 1,
    'zeer duidelijk': 2
}

df2['layout_clarity'] = data['Vraag 9:'].map(interaction_map_Vraag9)


# #Vraag 10
# interaction_map_Vraag10 = {
#     'Eens': 1,
#     'Oneens': -1,
#     'Neutraal': 0
# }

# df2['feeling_score_10'] = data['Vraag 10:'].map(interaction_map_Vraag10)
# motorized_vraag10 = df2[df2['mode'] == 'motorized']['feeling_score_10'].dropna
# active_vraag10 = df2[df2['mode'] == 'active']['feeling_score_10'].dropna()
# stat_10, p_10 = mannwhitneyu(motorized_vraag10, active_vraag10, alternative='t

#Vraag 11
interaction_map_Vraag11 = {
    'Ja, licht toe:': -1,
    'Nee': 1,
    'Anders, namelijk': 0
}

df2['feeling_score_11'] = data['Vraag 11:'].map(interaction_map_Vraag11)


#Vraag 12
interaction_map_Vraag12 = {
    'Ja , licht toe:': -1,
    'Nee, licht toe:': 1,
    'Geen mening': 0
}

df2['feeling_score_12'] = data['Vraag 12:'].map(interaction_map_Vraag12)


#create a questions list which uses the questions from above and the quetions nu
questions = [
    "Question 7: Current safety",
    "Question 8: Current interaction",
```

```
    "Question 9: Layout clarity",
    "Question 11: Crash reports",
    "Question 12: Barrier effectiveness"
]


means = [df2['Current safety'].mean(), df2['Current interaction'].mean(), df2['1
medians = [df2['Current safety'].median(), df2['Current interaction'].median(),

#create a DataFrame with the means and medians
summary_df = pd.DataFrame({
    'Question': questions,
    'Mean': means,
    'Median': medians
})
# Show the summary DataFrame
print(summary_df)
```

In [ ]:

```
#do the same for the questions 13 to 18
interaction_map_Vraag13 = {
    'Optie 1': 1,
    'Behouden huidige situatie': -1}
df2['Future safety'] = df2['Vraag 13:'].map(interaction_map_Vraag13)
#Vraag 14
interaction_map_Vraag14 = {
    'Zeer onveilig': -2,
    'Onveilig': -1,
    'Neutraal': 0,
    'Veilig': 1,
    'Zeer veilig': 2
}
df2['Future interaction'] = df2['Vraag 14:'].map(interaction_map_Vraag14)
#Vraag 15
interaction_map_Vraag15 = {
    'Verslechteren': -1,
    'Geen verandering': 0,
    'Geen idee': 0,
    'Licht verbeteren': 1,
    'Aanzienlijk verbeteren': 2}
df2['Future traffic flow'] = df2['Vraag 15:'].map(interaction_map_Vraag15)
#Vraag 16
interaction_map_Vraag16 = {
    'Helemaal mee onsoneens': 2,
    'Oneens': 1,
    'Neutraal': 0,
    'Eens': -1,
    'Helemaal mee eens': -2
}
df2['feeling_score_16'] = df2['Vraag 16:'].map(interaction_map_Vraag16)
#Vraag 17
interaction_map_Vraag17 = {
    'Ja, ik steun het': 1,
    'Nee, ik steun het niet': -1,
    'Neutraal': 0
}
df2['feeling_score_17'] = df2['Vraag 17:'].map(interaction_map_Vraag17)
# Create a questions list for the redesign questions
redesign_questions = [
    "Question 14: Active mode safety",
    "Question 15: Interaction active modes vs Motorists",
```

```
    "Question 16: Comfort improvements",
    "Question 17: Support for 30 km/h"

]

redesign_means = [
    df2['Future interaction'].mean(),
    df2['Future traffic flow'].mean(),
    df2['feeling_score_16'].mean(),
    df2['feeling_score_17'].mean()

]
redesign_medians = [
    df2['Future interaction'].median(),
    df2['Future traffic flow'].median(),
    df2['feeling_score_16'].median(),
    df2['feeling_score_17'].median()
]

# Create a DataFrame for the redesign medians
redesign_df = pd.DataFrame({
    'Question': redesign_questions,
    'Mean': [round(x, 2) for x in redesign_means],
    'Median': [round(x, 2) for x in redesign_medians]
})
# Show the redesign means and medians DataFrames
print(redesign_df)
```

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