Mobile tracking application that supports people making sustainable mobility decisions

Master Graduation Thesis | Min Chan | August 2021

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Mobile tracking application that supports people making sustainable mobility decisions

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Executive Summary

This project is in collaboration with a start-up company: Thrivey. The product produced by Thrivey is an automatic tracking application (mobility tracker), also named Thrivey, that can track the movement of the user when they carry their smartphone with them. Furthermore, the future vision of Thrivey is to expand its user group and promote more sustainable mobility activities.

Global warming and climate-changing are topics that raise many concerns at all levels in society. Many aspects result in the extreme condition we are facing now. Among them, mobility contributes to significant pollution on the air quality due to the emission of carbon dioxide and other substances, such as SO2. During the COVID-19 pandemic, people's mobility activities have been reduced significantly. However, how people will travel after the pandemic ends is still unknown. Therefore, it creates an opportunity for this project to investigate how to support people toward more sustainable mobility decisions during and after the pandemic.

The main objective of this project is to use self-tracking travel data to support people toward more sustainable mobility decisions.

A series of literature research and qualitative user research was carried out. Through the research, the design goal and the final design direction were refined. The design also went through iterations, inspired by insights gathered from user-involved sessions.

The final design presented four features that support users toward sustainable mobility decisions. These four features are: personalized advice & indicating restrictions (see chapter 5.3.1), community (see chapter 5.3.2), challenges (see chapter 5.3.3), and informed infographics (see chapter 5.3.4).

Through the final design evaluation, the four features were evaluated. The community (with group challenges) feature was found out to be the most motivating feature that can keep the users engaged with the mobility tracking application and hold on to their sustainable mobility goals.

Moreover, personalized advice was found out to be the most supportive feature that enables and guides users to travel more sustainably. Additionally, the "indicating restrictions" feature provides a feeling of being understood by the mobility tracker.

Furthermore, the informed infographic provides users with insights about their travel behaviour they usually do not aware of. By showing how much restriction the users were facing and what keeps them from travelling more sustainably, users were given a new perspective into their travel behaviour. As a result, this supports, motivates and inspires them to make sustainable mobility decisions.

Contents

Chapter 1
Introduction of the project

In this chapter, the main objective of this project, the user group, different mobility trackers, the problem definition, the assignment, and the approach used in the project are introduced.

1.1 Introduction

The project "Mobile tracking application that supports people making sustainable mobility decisions" is a project in collaboration with a start-up company: Thrivey.

The product produced by Thrivey is an automatic tracking application, also named Thrivey, that can track the movement of the user when they carry their smartphone with them. It tracks the geographical route that people travel and recognizes the type of transport and location names (see figure 1.1). The current Thrivey application targets self-employed people who require tracking the mobility costs during work hours, for taxes and reimbursement. Nevertheless, the future vision of Thrivey is to expand its user group and promote more sustainable mobility activities. Therefore, it creates an opportunity for this graduation project to investigate how self-tracking travel data can enable people's decisions toward more sustainable mobility behaviour.

One thing to note is that the project started in February 2021, during the global pandemic of COVID-19. While this places unprecedented challenges in the process, such as limitations in human-involved research, this project can also provide an example of how to overcome these limitations by remote human-involved research and the knowledge of how people change their mobility behaviour during the pandemic situation.

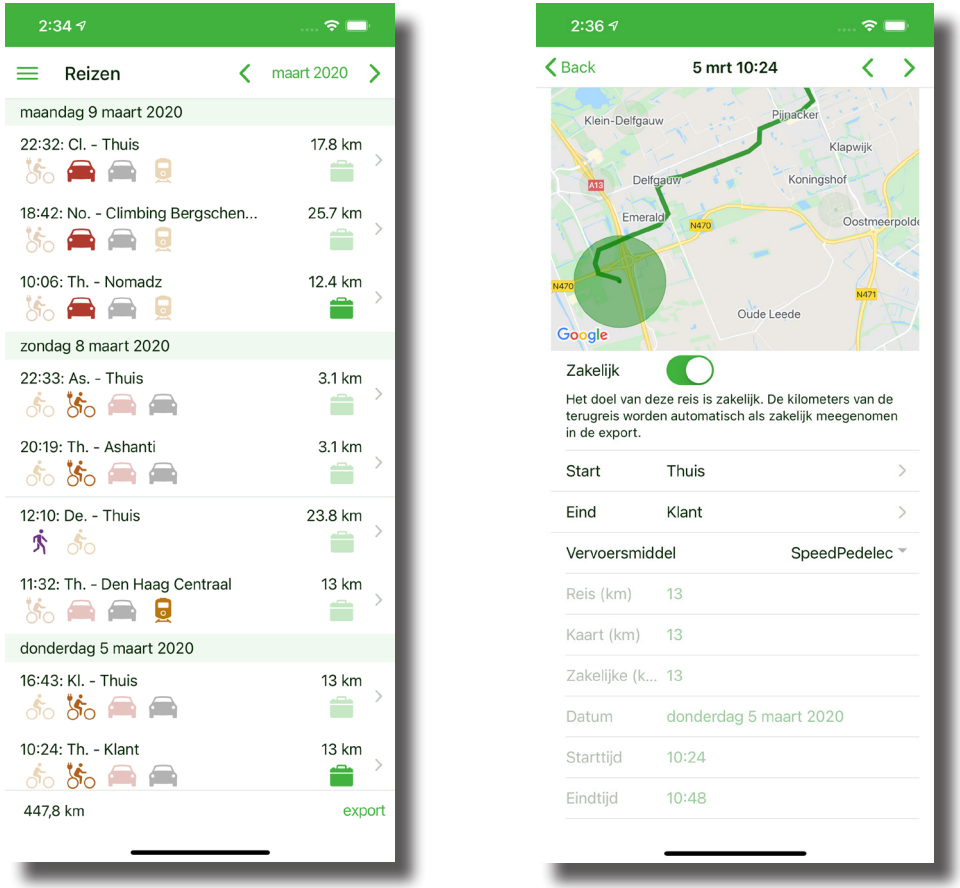


Figure 1.1 Screen shot of the current (March 2021) Thrivey application

1.2 Main Objective & User Group

The main objective of this project is to **use self-tracking travel data to support people toward more sustainable mobility decisions.** Therefore, in this project, the user group will be **people who have adequate mobility options and intend to change their travel behaviour more sustainably**. The “adequate mobility options” in this project is defined as people who at least own a bike and a car. This means they at least have 3 options (bike, car, public transportations) in their mobility decisions. The decision to select people who "intend to change their travel behaviour more sustainably" was based on the literature review’s findings (see chapter 2.2.2).

In this thesis report, the term “user(s)” or “user group” will be used to describe people who have adequate mobility options and intend to change their travel behaviour more sustainably.

1.3 Mobility Trackers

The mobility tracker here refers to mobile applications that use mobile available sensors to track travel data. It can provide self-tracking travel data to the users. There are uncountable mobility trackers on the current market. Since Thrivey's main function is to track the mobility costs during work hours, for taxes and reimbursement purposes and the future vision of Thrivey is to expand its user group and promote more sustainable mobility activities, two similar product research were conducted. The first one is mileage/kilometres tracking applications research, and the second is sustainable mobility applications.

1.3.1 Mileage/kilometre tracking applications

The selection of the mileage/kilometre tracking applications are based on the following criteria:

- Only focus on mobility tracking (If the application also keeps track of other expenses than the mobility cost, it will be excluded).
- No need to embed in any hardware. (for example, the application that needs to be attached to a car or other hardware will be excluded.)
- The keyword "most recommended mileage trackers" are used for the selection. [1]

In the initial research, there were five applications selected. However, only four applications are chosen: MileIQ [2], SherpaShare [3], TripLog [4], and Everlance [5]. The application that was left out is Huldlr due to its ability to track multiple expenses other than the mobility cost and distance[1]. Figure 1.3.1-1 shows the comparison of the different features of these applications. These features can be divided into two main sectors. One is price related, including price, free version available, and limitation of the free version; The other is accounting capabilities related, including accounting capabilities, photo capture for expense, SmartShare analytics for rideshare drivers (only SherpaShare has this feature), and automatic mileage/kilometre tracking.

Km/Mileage Tracker

Logo	Name	Free version available	Limitation of free version	Accounting capabilities	Photo capture for expense	SmartShare analytics for rideshare drivers	Automatic mileage / km tracking	Price
	MileIQ	●	Up to 40 trips per month				●	Free version: Up to 40 trips per month Full version: $5.99/month, or $59.99/year (paid annually)
SherpaShare	SherpaShare			●		●	●	Basic version: $5.99/month or $59.88/year (paid annually) Full version: “Super Premium” starts at $10/month
	TripLog	●	No automatic tracking, five vehicle limit	●	●		●	Free version: No automatic tracking, five vehicle limit Full version: Basic plan is $2/month, Premium is $4/month. Enterprise pricing available by request.
		●	Up to 30 trips per month	● Automatically generate IRS forms	●		●	Free version: Up to 30 trips per month Premium version: $8/month or $60/-year (paid annually)
	Thrivey						●	Premium version: 3 euros /month

Figure 1.3.1-1. Mileage/kilometre tracking applications (Green dot means the app has present functionality of the corresponding category; Red dot means the app has present a malfunction of the corresponding category.)

MileIQ focus on automatic mileage tracking and it does not offer other accounting capabilities; SherpaShare does not have a free version, however, it has accounting capabilities, unlimited automatic mileage tracking and a function named SmartShare analytics which is designed for rideshare drivers, for example, Uber drivers; TripLog and Everlance both have automatic mileage tracking function, accounting capabilities and photo expense tracking functionality. Everlance can also automatically generate IRS forms itemizing your mileage deductions, however, based on the reviews, it has some malfunction in automatic mileage tracking. Furthermore, their price difference can also be found in Figure 1.3.1-1.

Built on these insights, a diagram (see figure 1.3.1-2) was made to position mileage/kilometre tracking applications based on the price and their accounting capabilities. Compared to these applications, Thrivey is low in price. Therefore, once Thrivey improves its accounting capabilities it will have the advantage compared to the above competitors if the price of Thrivey remains lower than most of the competitors. Although the outcome of this similar mileage/kilometre tracking applications research is not closely relevant to the project goal, it can provide the company, Thrivey, with an insight into its future development.

1.3.2 Sustainable mobility applications

The selection of the Sustainable mobility applications are based on the following criteria:

- Only focus on mobility (If the application includes other aspects of sustainability, for example, food, product consumption, etc, it will be excluded).
- The keyword "most recommended sustainable mobility applications" is used for the selection.

In the initial research, there were eight applications selected. However, only five applications are chosen: Ciclogreen [6], Map My Emissions [7], GoEzy [8], FYNCH [9], and Environmental Footprint Insights [10]. Oroeco and EcoCRED were left out due to their abilities to track or provide information on other aspects of the sustainability issue. For example, they can provide insight into the users' diet, product consumption and waste; Commute Greener was left out because the application stopped updating four years ago. One thing to note is that the Environmental Footprint Insights by the PWC has not been launched on the market yet. Their product concept can be found on their website, however, the application can not be found on the app store nor google play. Therefore, in figure 1.3.2-1 it is highlighted by the yellow rectangular.

Figure 1.3.2-1 shows the comparison of the different features of these applications. The method of comparison focused on whether the application provides the feature or not. However, it does not look into how accurate or detailed the features are. All the selected applications can keep track of their carbon footprint emission and give personalized feedback and recommendations to the users. However, they have different features, such as goals setting, providing challenges, availability to compare data with other users, availability to form a private group within the application, providing carpooling function, providing physical or virtual rewards, providing real-time traffic information and whether it is targeting companies and employees. Thrivey was not included in the table since it had not implemented the sustainability aspect in the application when this similar products research took place.

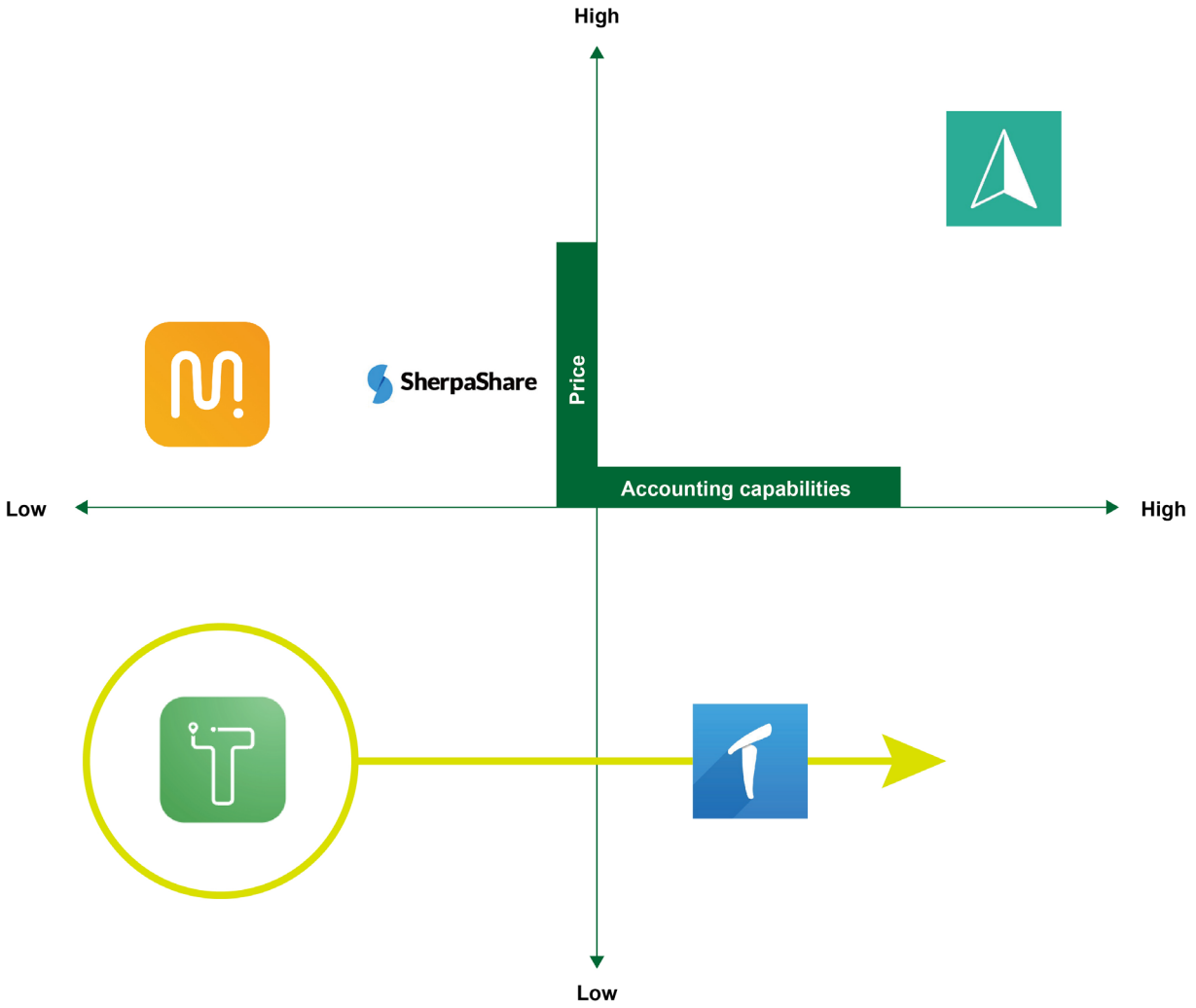


Figure 1.3.1-2. Position of the mileage/kilometre tracking applications regarding the price and accounting capabilities

Sustainable mobility

Logo	Name	Data (CO_2) tracking	Provide personalized feedback	Provide Challenges/ Goal setting	Available to compare data with others	Available to form private group	Provide Carpooling function	Provide Rewards	real-time traffic information	Focus on the company and employees
	Ciclogreen	●	●	●	●	●	●	●		●
	Map My Emissions	●	●							
	FYNCH	●	●	●	●	●		●	●	●
	GoEzy	●	●				●		●	
	Environmen-tal Footprint Insights	●	●	●	●	●				●

Figure 1.3.2-1. Sustainable mobility applications (Green dot means the app has present functionality of the corresponding category; Environmental Footprint Insights by the PWC has not been launched on the market yet, therefore, it is highlighted by the yellow rectangular.)

A diagram (see figure 1.3.2-2) was created to position both the mileage/kilometre tracking applications and the sustainable mobility applications based on the function of mileage/kilometre tracking and to what degree does the app focus on sustainability. Map My Emissions and Ciclogreen are placed in the top-left corner since Map My Emissions doesn't keep records of the kilometres after the trips were made and Ciclogreen requires manual inputs to indicate which means of transport they are going to use before the trip takes place; GoEzy was placed in the below-left corner since it is more focused on the system-benefiting modes of the entire mobility of one's city than the sustainability aspect of that trip; Environmental Footprint Insights by the PWC has a grey-dotted-line around it since it is not yet on the market, and it is placed at the top-right corner since it has semi-automatic mileage tracking ability and it is focusing on sustainable mobility; FYNCH was placed at the top-right corner since it has automatic mileage/kilometre tracking ability and it is also focusing on sustainable mobility; Thrivey was placed in the below-right corner since it can keep track of the kilometre data and it had not implemented the sustainability aspect in the application when this similar products research took place. Therefore, once Thrivey implements the sustainability aspect into the application, it will stand out from most other chosen applications. However, FYNCH and Environmental Footprint Insights by the PWC (once it is launched) will be Thrivey's biggest competitors.

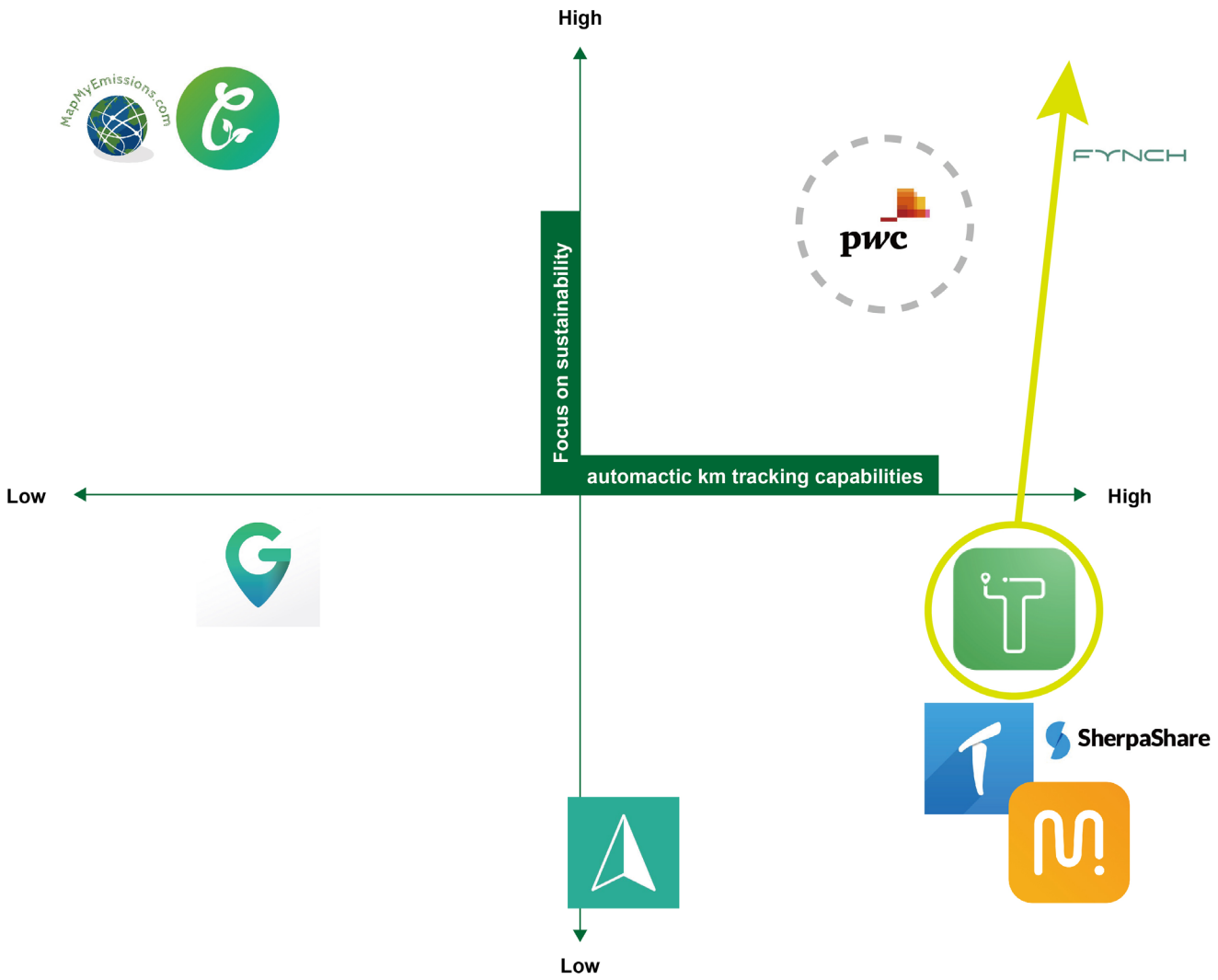


Figure 1.3.2-2. Position of the mileage/kilometre tracking applications and sustainable mobility applications regarding automatic kilometre tracking capabilities and to what degree does the application focus on sustainability

1.4 Problem Definition

Global warming and climate-changing are topics that raise many concerns at all levels in society. Many aspects result in the extreme condition we are facing now. Among them, mobility contributes to significant pollution on the air quality due to the emission of carbon dioxide and other substances, such as SO2. During the COVID-19 pandemic, people's mobility activities have been reduced significantly. However, how people will travel after the pandemic ends is still unknown. Therefore, it creates an opportunity for this project to investigate how to support people toward more sustainable mobility decisions during and after the pandemic.

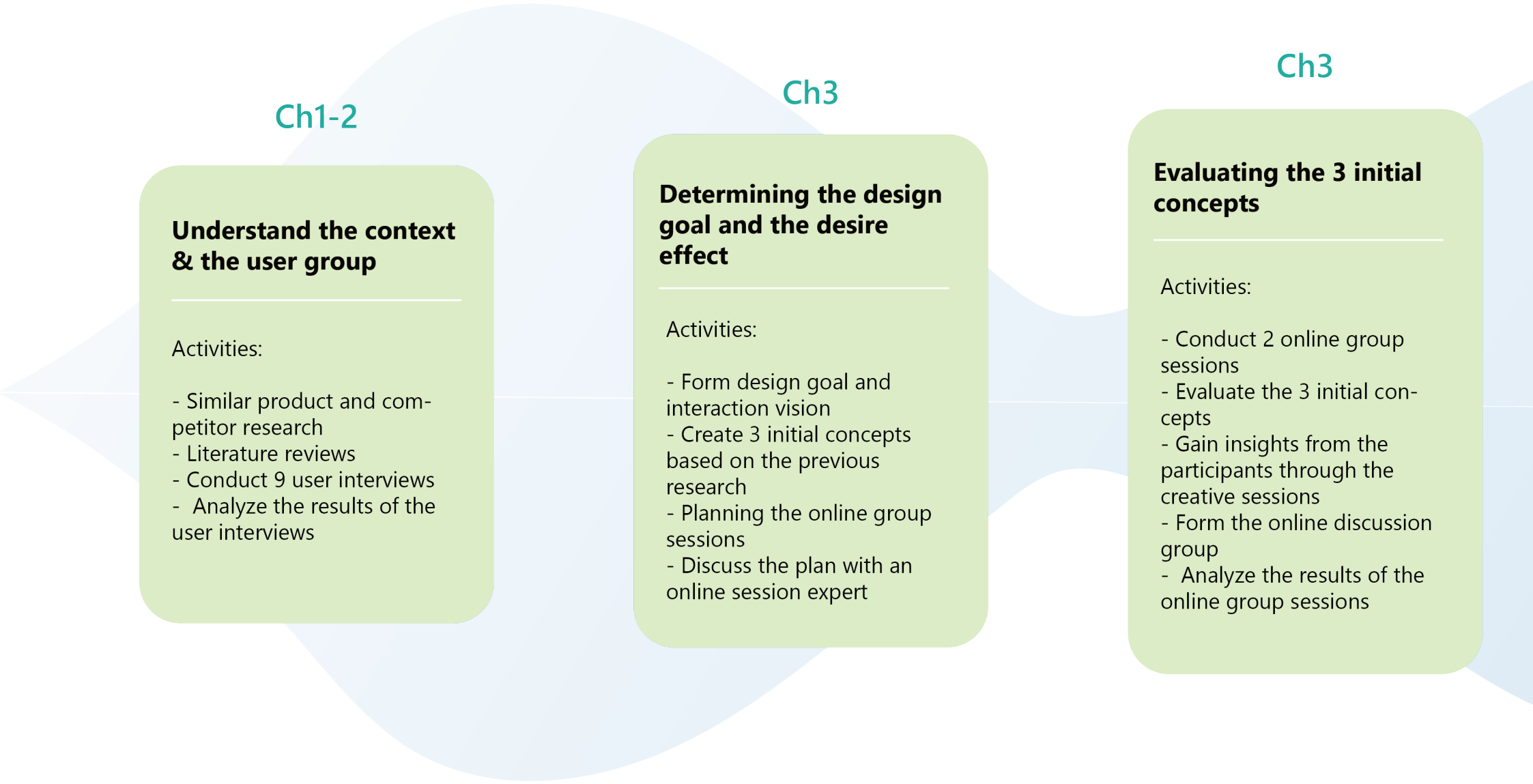
1.5 Assignment

The project aims to understand how self-tracking travel data (provided by the mobility trackers) can support the user toward more sustainable mobility decisions within the current context and afterwards. To achieve this goal three initial research objectives were created.

1. Understand the mobility context and the needs and concerns of our user group while they are making their mobility decisions.
2. Understand what is our user's view on sustainable mobility.
3. Understand the desired interaction between our users and the mobility trackers.

1.6 Approach

The graph below shows the approach and activities throughout the project.



Ch4

Refining the final design direction

Activities:

- Identify the issues of the early design direction
- Gain insights from the participants through the online discussion group
- Design iteration
- Produce final design direction

Ch5

Detailing the final design

Activities:

- Prototyping
- Detailing the main features of the final design
- Planning the final design evaluation

Ch6-7

Evaluating and reflecting on the final design

Activities:

- Conduct 6 final evaluation sessions
- Analyze the results of the final design evaluation
- Reflecting on the results and the project

1.7 Reference

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9. FYNCH 2021, accessed 23 March 2021, <https://fynchmobility.com/en/>

10. Environmental Footprint Insights, PwC 2015-2021, accessed 23 March 2021, <https://www.pwc.nl/en/topics/sustainability/environmental-footprint-insights.html>

Chapter 2
Context & User Exploration

The project context was studied through literature research and user interview. Meanwhile, user interviews offered validations and new insights about the literature research on the user.

2.1 Research Objectives & Research Questions

Based on the assignment (See Chapter 1.5), several research questions were formulated according to the three research objectives.

Research objective 1: Understanding our user and their travel context

Research questions:

- How do our user group travel and how do they make their mobility decisions?
- What are the user's needs and concerns when they are making their mobility decision?

Research objective 2: Understanding our users' view toward sustainable mobility

Research questions:

- What is the users' view on sustainable mobility?
- What motivates them to travel more sustainably?

Research objective 3: Understanding the desire interaction between our users and the mobility trackers

Research question:

- What motivates users to start using mobility trackers?
- What are the needs and concerns when users are using the mobility trackers?
- How do mobility trackers influence users' mobility decisions?
- What effect does presenting the personalized environmental impact data have on the user's mobility decisions?

2.2 Literature Review

Several studies and literature are analyzed according to the research questions in 2.1. The following are insights generated from the literature review.

2.2.1 The complexity of Travelling

Travel and commute behaviour are complex activities [2,8]. Various factors need to be taken into account, ranging from the means of transports, the abilities and preferences to take these transports, the personal goals of the trip, the weather, the time, the distance, the local context and infrastructure, and the side-effect behind people's mobility decision, and so on.

Due to the complexity of travelling, organizing the travel or commute routine is also complex. Therefore, there is little incentive for people to change their travel routine since it required them to go through the organizational effort and take many factors into account again [6].

2.2.2 Different stages of the user

Travel and commute behaviour are complex activities [2,8]. Various factors need to be taken into account, ranging from the means of transports, the abilities and preferences to take these transports, the personal goals of the trip, the weather, the time, the distance, the local context and infrastructure, and the side-effect behind people's mobility decision, and so on.

Due to the complexity of travelling, organizing the travel or commute routine is also complex. Therefore, there is little incentive for people to change their travel routine since it required them to go through the organizational effort and take many factors into account again [6].

According to Gouveia [3], people who are in the contemplation or preparation stages have a higher possibility (56%) to engage with the tracker. The tracker is also referred to as personal informatics (PI) tool. Furthermore, when people are in the other stages (pre-contemplation, action, and maintenance), they tend to have a lower possibility (20%) to engage with the tracker or PI tools (see figure 2.2.2).

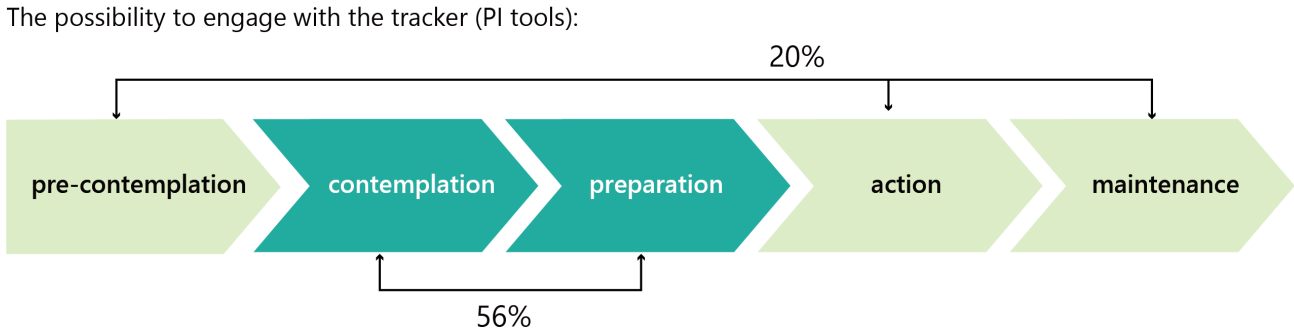

Figure 2.2.2 Five stages of behaviour change and its possibility to engage with the trackers

Through previous research [3, 8, 10], it is important to take people's current motivational stage and mindset into account when evaluating the efficacy of behaviour change technologies. Therefore, the segmentation of the users needs to be done. In this project, the user group will be people who intend to change their travel behaviour more sustainably, which means they are in the contemplation or preparation stages.

2.2.3 Users' needs: interacting with personal informatics (PI) tools

Based on previous research [2, 7], users' needs when interacting with mobility trackers or personal informatics (PI) tools can be divided into two categories, users' acceptance and the engagement of the self-tracking data.

Users' acceptance of self-tracking data

The self-tracking data, also known as quantified-self and personal informatics (PI), is being accepted when it is convincing to the users. To be convincing, the self-tracking data needs to be accurate, understandable, trustable and fair [2].

Users' engagement of self-tracking data

The engagement of self-tracking data has been discussed by many researchers [2, 3, 7]. The factor that has the most influence on user's engagement on self-tracking data is "relevant". Self-tracking data should represent in a way that the user can relate to. It should fit into the users' daily practice and natural environment, and it should be able to represent users' lifestyles. Furthermore, when it comes to influencing users behaviour through smartphone applications, some aspects worked in concert with the "relevant". Based on Andersson [10], providing customized and contextualised information to the users is the key to promote behaviour change through smartphone applications.

Other aspects that influence users' engagement in self-tracking data are interpreting self-tracking data, setting goals, and sharing self-tracking data. One problem that the users may encounter when interacting with self-tracking data is interpreting the data. The abstract visualization and the lack of suggestion and feedback do not provide useful insights for users [5, 7]. Therefore, users easily lose interest in it and stop interacting with the trackers;

Goals setting and sharing self-tracking data are two methods that can sustain users' engagement. With concrete goals, users can make a personal commitment to their behaviour and create a checking habit. Thus, increase the user's physical interaction with the tracker [3]. Shareable data can also stimulate users to keep engaging with the tracker. Some users even showed that they have the desire to share and compare their self-tracking data with those of significance [7]. However, Self-tracking data is perceived as private. Most users would only share with their close friends or groups. Furthermore, frequent reminders or notifications are seen as a "noise" to the users. As a result, it would decrease users' engagement with the tracker [7].

2.2.4 Limitations

Some multiple designs and solutions aim to use personal informatics (self-tracking data) to support people toward certain desired behaviour. However, Kersten-van Dijk, E. T. [4] pointed out that the current PI technology or PI tools have a lack of support between contemplation, preparation, and action stages [1]. Most of the PI technology or tools available support users best in the first stage (pre-contemplation) and the last stage (maintenance).

On the other hand, Andersson [10] points out that when it comes to promoting sustainable travel behaviour through the use of smartphone applications, it is common to notice an attitude-behaviour gap [11], where people express concerns about environmental issues but fail to translate this into sustainable actions.

2.2.5 Related works

There are many research and scientific experiments that aim to promote sustainable travel behaviour. For example, Strömberg, H.[8] suggested that trial behaviour is a key element for encouraging new travel behaviour adoption and to embark on the travel behaviour change process. He pointed out that trial initiation can serve as a bridge between "desire to act" and "acting". Moreover, the trial process can be breakdown into three parts: acclimatisation, normalisation, and established phases (See figure 2.2.5). In her research, she concluded that the after trial set-up stands out as especially important to consider, as it affects the conditions for the changed behaviour to be maintained by the participants after the end of the trial.

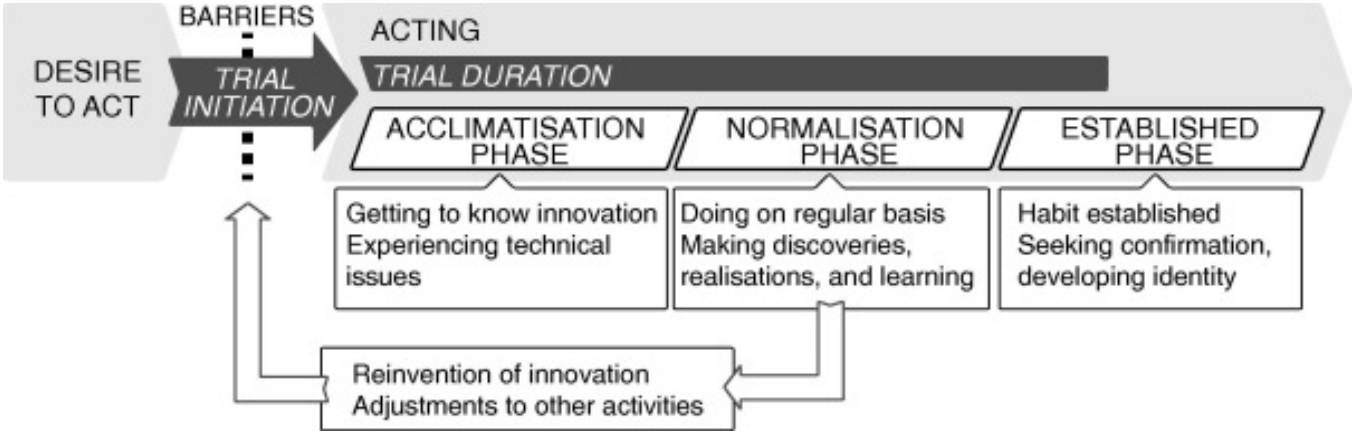

Figure 2.2.5 The trial process by Strömberg, H [8]

One experiment conducted by Boulard [2] provides many insights into promoting sustainable travel behaviour. Apart from providing tailored, accurate, fair, trustable information to the users, Boulard also emphasized the importance of connecting individual environmental impact with the collective one. He suggested that self-tracking data need to be contextualized to give the user a feeling of collectiveness. The contextualized data can give the user a holistic view of the real context, which may be a promising way to evoke the feeling of collectiveness.

Another experiment conducted by Zhu, X. [9] suggests that personalized incentives have an average acceptance ratio of 0.68 for all participants when being promoted with alternatives ways of travelling. This response with Andersson's conceptual model for combining behavioural change techniques with ICT (Information and Communications Technology
) to create a BCSS (Behaviour Change Support System) [10]. In Andersson's conceptual model, the key point is "customization", which resonates with Zhu's "personalized incentives" and the users' needs in "relevant" data.

2.2.6 Emerging research questions

Based on the insights from the literature review, two additional research questions were added under the second research objective: Understanding our users' view toward sustainable mobility. The two research questions are:

- What is the relationship between sustainability and collectiveness to our user group, and if it can support sustainable behaviour change, if so, how?
- What are the concerns about taking a more sustainable trial trip?

These research questions were therefore used as the foundation of the interviews' questions.

2.3 User Interview

Nine semi-structured interview sessions were conducted with 9 participants.
The interview questions were based on the research questions in chapter 2 (2.1) and the emerging research questions in chapter 2 (2.2.6) :

Research questions

Travel context & needs and concerns while travelling:

- How do our user group travel and how do they make their mobility decisions?
- What are the user's needs and concerns when they are making their mobility decision?

View on sustainable mobility:

- What is the users' view on sustainable mobility?
- What motivates them to travel more sustainably?
- What is the relationship between sustainability and collectiveness to our user group, and if it can support sustainable behaviour change, if so, how?
- What are the concerns toward taking a more sustainable trial trip?

Interaction between users and the mobility trackers:

- What motivates users to start using mobility trackers?
- What are the needs and concerns when users are using the mobility trackers?
- How do mobility trackers influence users' mobility decisions?
- What effect does presenting the personalized environmental impact data have on the user's mobility decisions?

Procedure

The procedure of the first users' interview is shown in figure 2.3. The interviews were conducted through online meetings due to the global pandemic of COVID-19. Moreover, a pilot interview was conducted before the actual interviews with the participants. This pilot interview helped the process of the actual interviews to go smoothly and without hitches.

The interview questions and detailed results can be found in Appendix B.

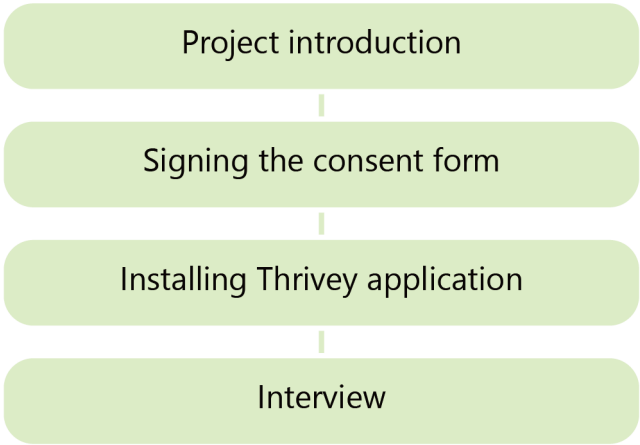

Figure 2.3 The procedure of the first users' interview

Participants

The user interviews involved nine participants of mixed genders (6 females and 3 males), including people who have a car and a bike and people who don't (4 people who have cars and bikes; 4 people with bikes; 1 person without any private means of transports). All participants intend to change their travel behaviour more sustainably in different degrees. Furthermore, all participants signed the informed consent form before the interview took place. After the user interviews, these participants continued to participate in this project and joined the following activities (online group sessions, online discussion group, and the final design evaluations). However, some participants did not join all the activities due to personal or time reasons. In this thesis report, participants are quoted as P1, P2, P3, etcetera.

Combined methods (thematic analysis, personas, and ethnographic methods [12]) were used to analyze the interview results. The following are insights generated from these analyses which can be separated into three aspects according to the research questions in chapter 2 (2.3.1).

2.3.1 Travel context & needs and concerns while travelling

Travel context

The travel context can be divided into three categories, past (pre-pandemic), current (pandemic), and future (post-pandemic) since the research was conducted during the global pandemic of COVID-19. This also provides this research with an opportunity to understand how people change their mobility behaviour during the pandemic situation and how they imagine the future travel context.

A graph was made to illustrate participants' travel context over time (see figure 2.3.1-1). In the past, participants had a face-paced travelling style, more outdoor life, more usage of public transport, and they seldom considered mobility as the main means to exercise to stay fit and healthy.

However, after the outbreak of COVID-19, participants are required to stay at home as much as possible due to the lockdown measurements. Therefore, they travel less and they travel more flexibly. For example, P8 used to travel 5 days a week to his office. However, during the pandemic, he only needs to travel zero to three days depending on the pandemic situation. Also, most indoor public spaces were closed due to the pandemic, such as gyms, public swimming pools, etc. As a result, all participants started to use mobility as the main means of exercise and staying healthy. They walk and bike more during the pandemic. For example, P2 used to bike to the supermarket for grocery shopping. However, she decided to walk to the supermarket during the pandemic; P5 wanted to stay active and healthy, therefore, he created an activity called "My Covid Walk". This helps him to keep motivated to walk 10 km per day. Furthermore, most participants were afraid to use public transport due to the fear of getting Infected.

About the future travel context, participants pointed out that it would be a balance between the past and current travel context. Moreover, participants imagine the style of travelling would move from flexible to purposeful. For example, P6 mentioned that people had realized they can still get the job done without travelling to the office every working day. As a result, people start to question the necessity of staying in the office and start to think of the reasons why

they need to go to the office and why they want to stay at home instead. As people start to question and understand the reason they travel, their travel behaviour will become more purposefully. Last but not least, most participants mentioned that they would keep the walking and cycling habits they developed during the pandemic even after it ends.

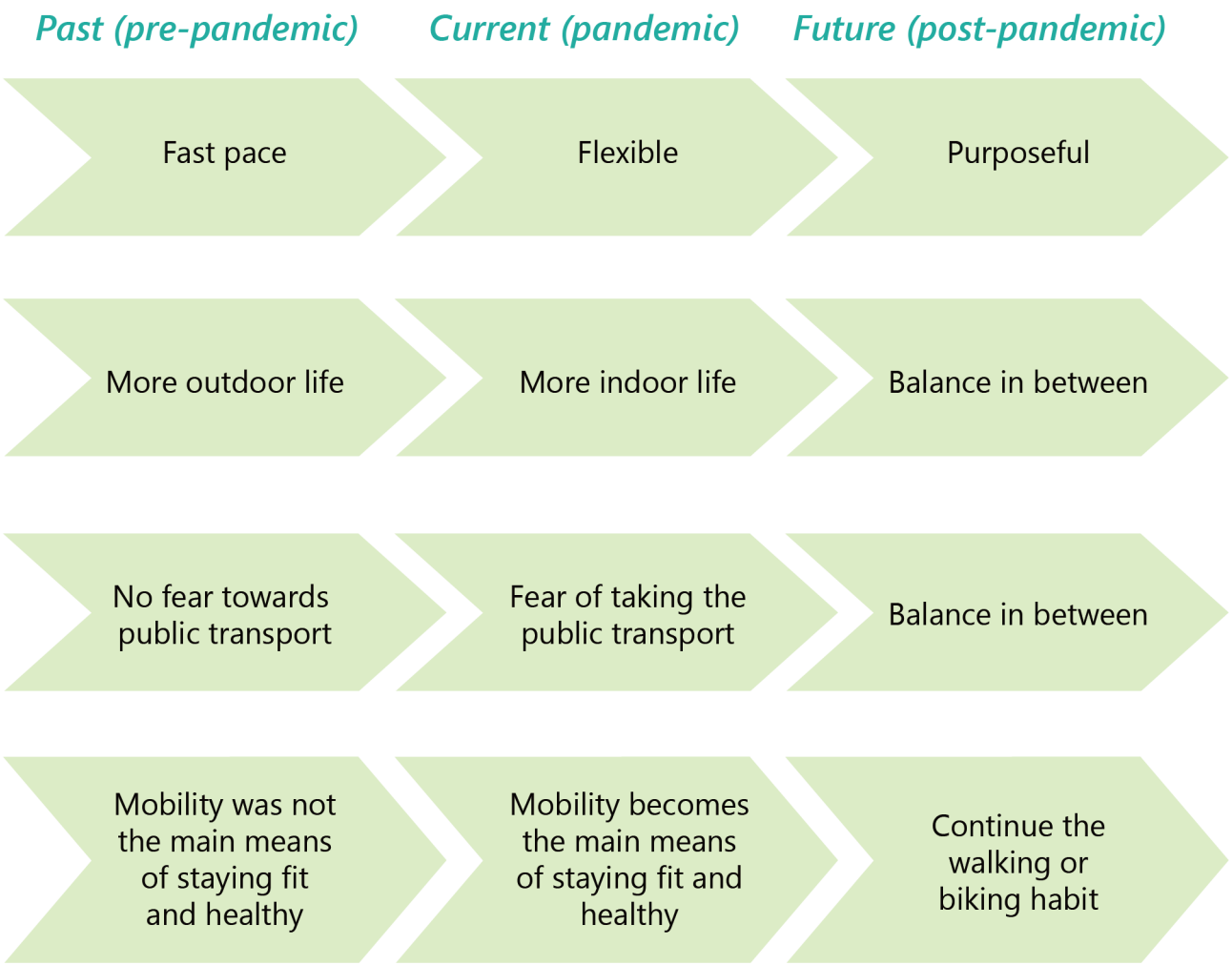

Figure 2.3.1-1 Participants' travel context over time

Needs and concerns while travelling

A graph was made to illustrate the needs and concerns while participants are making their mobility decisions (see figure 2.3.1-2). It turns out that the participants do consider many factors when they need to travel. This resonated with the complexity of travelling in the literature reviews (see chapter 2.2.1). The factors can be divided into external factors, such as distance, weather, cost; internal factors, such as mood and sub-goals; and emerging factors, such as safety & social. These factors are interrelated with each other.

The main goal of a mobility activity is to move more from one location to another. Therefore, the sub-goals of a mobility activity in this report is referred to as the other goals people have other than the main goal. For example, working during the transit, looking fresh when showing up at the office, enjoying the experience of the trip, exercising during the trip, etcetera.

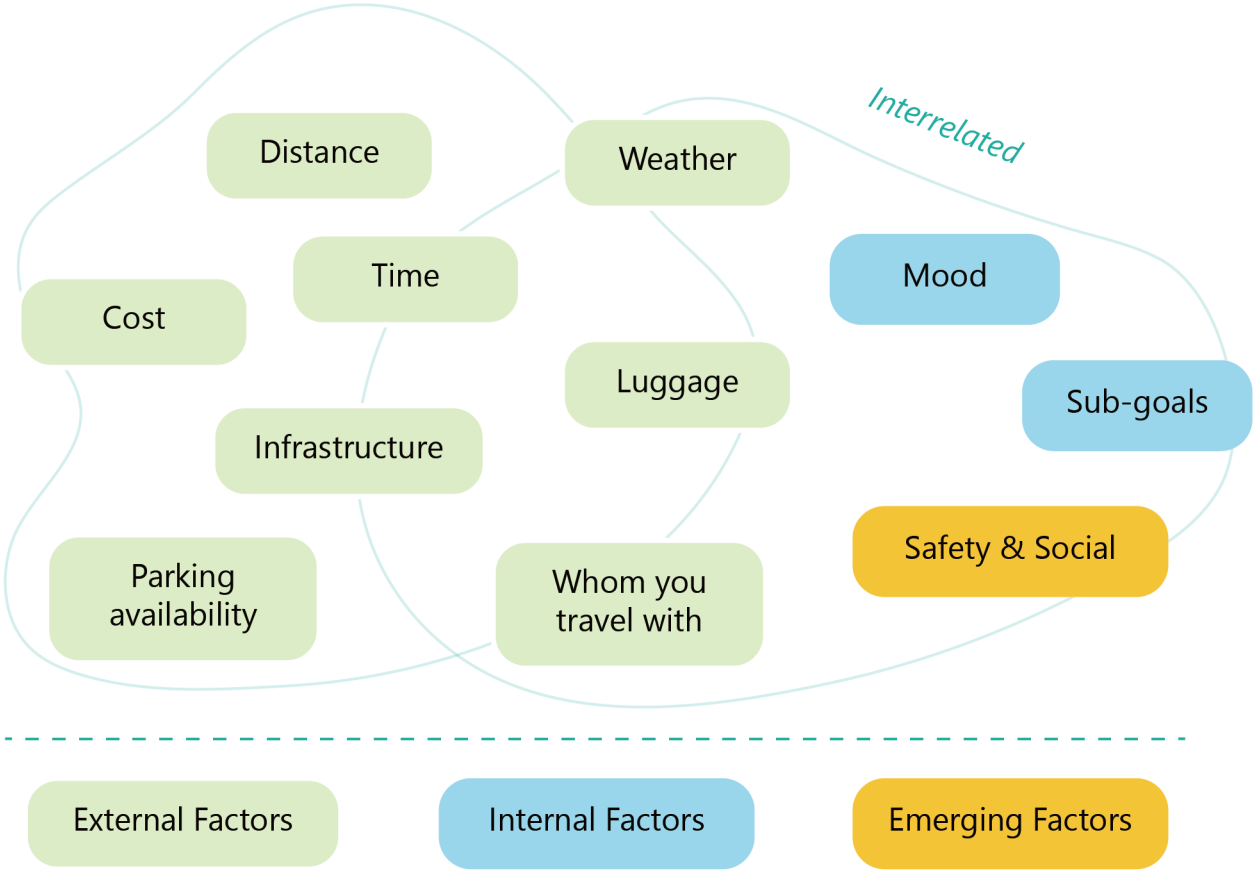

Figure 2.3.1-2 The needs and concerns while participants are making their mobility decisions

Apart from these factors, participants also pointed out that in certain situations, certain factors will be dominating. For example, when they are in a hurry, the most important factor will become “time” regardless of other factors. Commonly, these factors will be conflicted with each other. Therefore, the mobility decisions are depended on different situations and different priorities of needs and concerns. Finally, participants also indicated when the situation allows and when they have no other priorities or restrictions, they are willing to conduct a more sustainable travel behaviour.

2.3.2 View on sustainable mobility

Connected with the previously mentioned insights, people are willing to conduct a more sustainable travel behaviour when the situation allows and when they have no other priorities or restrictions. This is because nowadays people **see sustainability as a new normal** and they value this idea. Furthermore, to better understand what does sustainable mobility means to our participants, more in-depth questions were asked. In conclusion, participants considered sustainable mobility is not always choosing the most sustainable mobility options, but making **smarter and better mobility decisions** when the situation is appropriate (when participants have no other priorities or restrictions); Also, mentioned by several participants, sustainable mobility is connected **between one’s health and the health of the earth**. For example, P8 said, "It's important that we try to work in such a way that you are healthy yourself, and what's healthy for the environment at the same time". Therefore, we can see that whether people make a more sustainable mobility choice depends on the situation and whether it is positive toward one’s health or not.

A graph is made (see figure 2.3.2) to illustrate participants’ views on sustainable mobility and what factors would influence their views. Through the interviews, three factors have shown their ability to affect people’s views on sustainable mobility. They are “people around the user”, “natural surroundings” and “education”. Furthermore, when people value sustainable mobility more, they may commit to it or take it as a responsibility, therefore, conduct more sustainable travel behaviours.

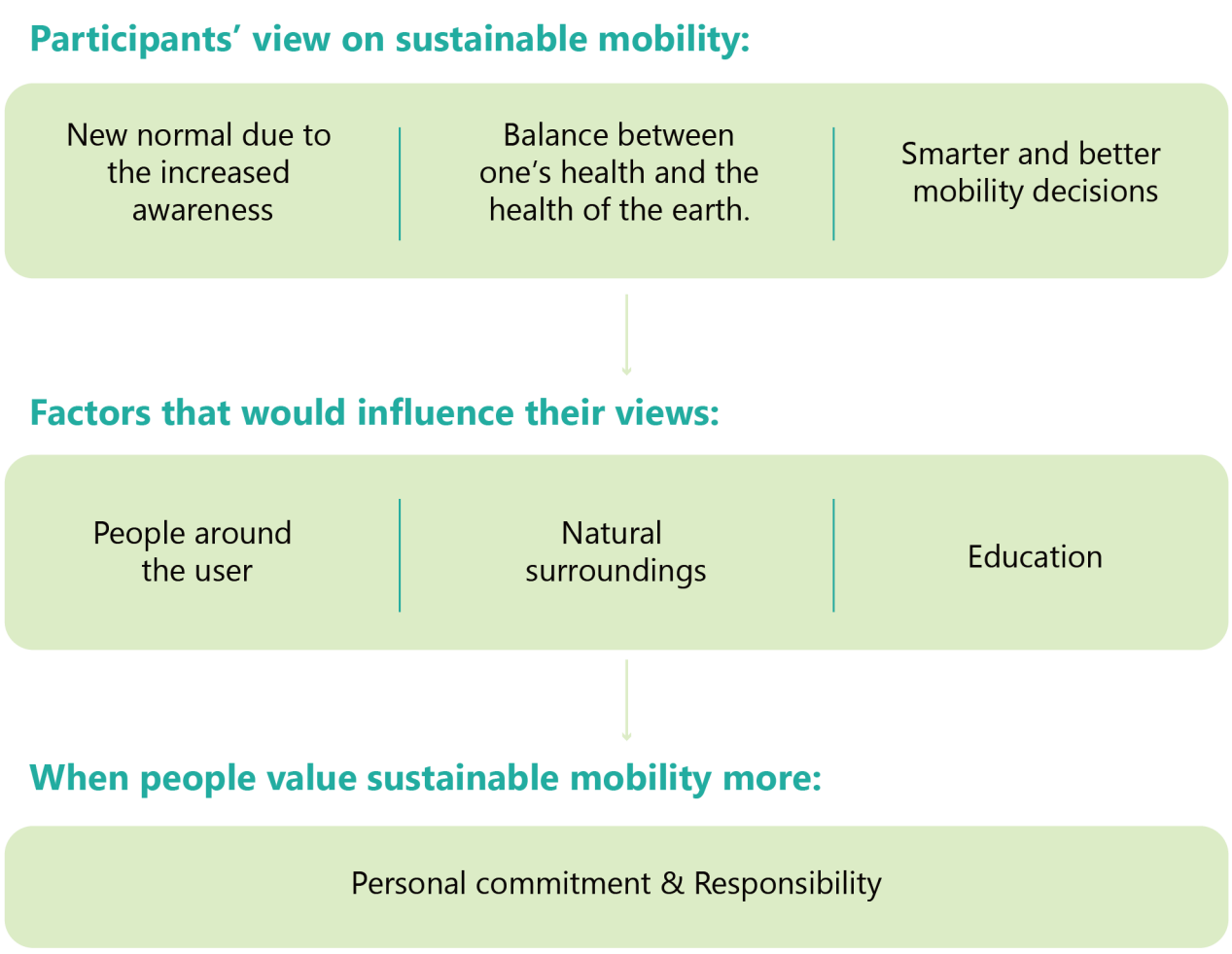

Figure 2.3.2 Participants' views on sustainable mobility and what factors would influence their views

People around the user

For "people around the user", one example is that P7 said, "if I would see that everyone is making a conscious effort to be more sustainable in mobility, then I guess I would also be move along with them." This showed that people's views and/or decisions on sustainable mobility can be influenced by the people around them.

Natural surroundings

For "natural surroundings", one example is that P2 mentioned, "when I go for a walk every day in the park, or when I go to the forest, I see a lot of birds, and lots of trees, flowers, these sort of things, I do have a feeling that I am a part of this eco-system.". Later on, she and other participants also mentioned that when a person feels being part of a "bigger whole" (for example, a community, a group, a society, an eco-system) this person has a higher chance to contribute to the "bigger whole".

Education

As for “education”, P1 shared her experience “I had a research course, and it was about flight shaming. Therefore, I want to change my behaviour. I want to take more trains instead of flights when it's when it is possible.” This indicates that peoples’ views and/or decisions toward sustainable mobility can also be influenced by education.

Personal commitment & Responsibility

Another insight gained from the interview is that, when peoples’ attitude toward sustainable mobility becomes a personal commitment or a responsibility, they are more motivated to make sustainable mobility decisions. For example, P6 mentioned, “I kind of have committed myself to other parts of a more sustainable lifestyle, and that transportation is a very important part of that, in terms of what I can do for my personal ambitions.” Also, P5 mentioned “Because it is our responsibility. I am a responsible citizen. You and I are part of the earth and the earth is part of us.” Apart from these quotes, P5 and P6 also have a more sustainable travel behaviour based on the first part of the interview (travel context).

2.3.3 Interaction between users and the mobility trackers

In terms of the interaction between users and mobility trackers, the insights gained from the interviews can be divided into 4 sectors: motivation, needs & concerns, current usage, and user engagement.

Motivation

Based on the interviews, there are three main reasons that motivate participants to start using mobility trackers. First, to stay healthy and fit. Since the mobility tracker can provide information such as, how many kilometres the user has walked for one day, or how much time has the user spent on cycling for one week; second, to achieve users’ personal goals. Some participants have set their personal mobility goals, for instance, P5 has set a goal to walk 10 km per day, and he named the challenge “My COVID Walk” and a mobility tracker can help him to keep track of his progress; third, the enjoyment to record the mobility activities. Some participants mentioned that they just like to see an overview of the data that is related to them, and mobility data is one of them. Also, P4 mentioned that she likes to see where she has been to after she went on a vacation.

Needs & Concerns

When interacting with a mobility tracker, participants care about whether the information presented by the tracker are trustworthy, relevant to the user, novel (reveal new information to the user), and visualized in a way that is easy to be interpreted. These four aspects are crucial for a mobility tracker to fit the needs of the users. On the other hand, participants mentioned that the two main concerns while using mobility trackers are

being annoyed by the continuous notifications and the privacy issue. P3 stated that he prefers weekly notifications on his mobility activities. With weekly notifications, he can gradually form a habit to check on his mobility activities at a certain time in a week, which can keep him engaged with the tracker. For privacy issues, participants have shown a different level of concern. For example, P1 stated that "I don't really mind sharing my travel data." However, P2 mentioned that "I never thought of sharing my travel data, I think it is scary to let another person know that where and when I am." Some participants do not mind sharing their travel data, however, the other participants are afraid to do so. However, a mobility tracker requires data from the users in order to function. Therefore, it is important to ensure the users how the data collected from the mobility trackers will be used, who has access to these data, and who has the right to edit or erase these data. There should be clear information to address how, when, why, and what data will be used. Also, to give users the option to select what data to be shared.

Current usage

One of the research questions is to understand how mobility trackers influence users' mobility decisions. Through the interviews, it was discovered that mobility trackers do not influence participants' mobility decisions much. **They see mobility trackers as a reference tool, to reflect on their mobility behaviours.** However, some participants also stated that if they saw they are emitting too much carbon footprint or if they are not active enough, which will make them feel less healthy, they will consider changing their mobility behaviour. For instance, P7 said, "if it would show me that, walking somewhere, would provide a large benefit compared to going somewhere by train or car, when it's feasible, I guess it would really motivate me to go there more sustainably." And P9 said, "Sometimes if my step count was too low, then I would think, Oh yeah, maybe I should walk more." Therefore, although most of the time mobility trackers are used as a reference tool, however, it is also possible that it **can provide users with another perspective of their travel behaviour** and support them to make more sustainable mobility decisions.

User engagement

Based on the findings of the interviews, goal setting, community feeling, and sharing data are three methods to enhance users' engagement with mobility trackers. For goal setting, participants like this idea because it can keep them motivated. Also, when the mobility tracker enables them to set their own goals, participants would feel more attached to it and consider the activities provided by the tracker are relevant to them. Furthermore, P7 mentioned that "I think if you have like good results over time. And you'll see that nicely in a graph. You don't want to break your record. So you keep sort of showing good behaviour because you feel bad if you break it." This shows that the infographic provided by the tracker can support the user to continue reaching their goals.

Community feeling and sharing data are often linked together. Connected to the experiment conducted by Boulard [2], participants do value the idea of forming a community that can support each other toward more sustainable travel behaviour. P1 said "it would be nice to have a community like you can say you want to do 10 kilometres today or you

want to take a walk today. Yeah, in that case, I would like to share my travel data, I think it is useful and inspiring. For example, sharing a photo of a pizza because I walk a lot on that day, etcetera." Also, P8 said, " to share it (the travel data/results) with other people to get more stimulation to do it again." These indicated that having a group of people to share and compare travel data/results together can keep users motivated and engaged with the mobility trackers.

2.4 Conclusion

This chapter aims to understand the travel context of our user group, their needs, value, and concerns towards sustainable mobility, and how they interact with the mobility tracker. Therefore, the conclusion of this chapter can be divided into three parts according to the research questions in chapter 2.1. All research questions for the literature review and the users' interviews were answered. The answers are presented in the list below.

2.4.1 Travel context & Needs and Concerns

- Travel and commute behaviour are complex activities [2,8]. Various factors need to be taken into account.
- People's travel context has changed due to the COVID-19 pandemic.
- People have different needs and concerns when making a mobility decision. In certain situations, people will prioritize some factors when making decisions. For example, time becomes the most important factor when a person is in a hurry.

2.4.2 Users' view towards sustainable mobility

- In conclusion, participants considered sustainable mobility is not always choosing the most sustainable mobility options, but making smarter and better mobility decisions when the situation is appropriate (when participants have no other priorities or restrictions).
- People are willing to conduct a more sustainable travel behaviour when the situation allows and when they have no other priorities or restrictions. This is because nowadays people see sustainability as a new normal.
- Three factors have shown their ability to affect people's views on sustainable mobility. They are "people around the user", "natural surroundings" and "education".
- Furthermore, when people value sustainable mobility more, they may commit to it or take it as a responsibility, therefore, conduct more sustainable travel behaviours.

2.4.3 Interaction between the users and mobility trackers

- According to Gouveia [3], people who are in the contemplation or preparation stages have a higher possibility (56%) to engage with the tracker.
- The factor that has the most influence on user's engagement on self-tracking data is "relevant". Self-tracking data should represent in a way that the user can relate to.
- Three main reasons that motivate participants to start using mobility trackers are staying healthy and fit, achieving personal goals, and the enjoyment to record the mobility activities.
- When interacting with a mobility tracker, participants care about whether the information presented by the tracker are trustworthy, relevant to the user, novel (reveal new information to the user), and visualized in a way that is easy to be interpreted.
- While using mobility trackers, the two main concerns are being annoyed by the continuous notifications and the privacy issue.

- Goal setting, community feeling, and sharing data are three methods to enhance users' engagement with mobility trackers.
- Participants value the idea of forming a community that can support each other toward more sustainable travel behaviour. Having a group of people to share and compare travel data/results together can keep users motivated and engaged with the mobility trackers.

The insights gathered from the research phase (chapter 2) would form the foundation for design cycle 1 (see chapter 3).

2.5 Reference

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Chapter 3
Design Cycle 1

In this chapter, three initial concepts were introduced and evaluated through the online group sessions with eight participants. Furthermore, through the online group sessions, more insights were gained to form the starting point for the next design cycle.

3.1 Design Goal and Interaction Vision

A design goal and the interaction vision [1] are formulated at the beginning of design cycle 1. It aims to inspire the qualities of the design.

The design goal and interaction vision are formed based on the insights gained from the research phase (chapter 2). Based on the research, one major motivation to start using a mobility tracker is “staying healthy and fit”. In fact, during the interviews, participants are more interested in the health aspect than the sustainability aspect. This opens an opportunity for this project to see how the health aspect can be brought into sustainable mobility and support people toward it. Therefore, the design goal is formulated as the following:

“To activate user’s curiosity about how sustainable mobility decisions can influence their health condition when interacting with the Thrivey application. ”

Connected with the design goal, the interaction vision is defined as “Taking a personality test”(see figure 3.1), and its qualities can be found in table 3.1.

Figure 3.1 Interaction vision: Taking a personality test

Taking a Personality Test

Characteristics	Affordances
Curious	The personality test quenched the curious thirst for getting a bit of insight into who we are.
Novelty	The personality test reveals previously unknown information about ourselves.
Relevant	The result of the personality test is closely relevant to the person who took the test.
Connected	The personality test helps people to get a better understanding of others.

Table 3.1 The qualities of the interaction vision: Taking a personality test

3.2 Three Initial Concepts

Based on the design goal, interaction vision, and previous research, three concepts that contained different design elements were refined.

3.2.1 Overview of the three initial concept

A graph is made to illustrate the features of the three initial concepts (see figure 3.3.1). More detailed information about each concept and feature can be found in chapters 3.2.2 to 3.2.4.

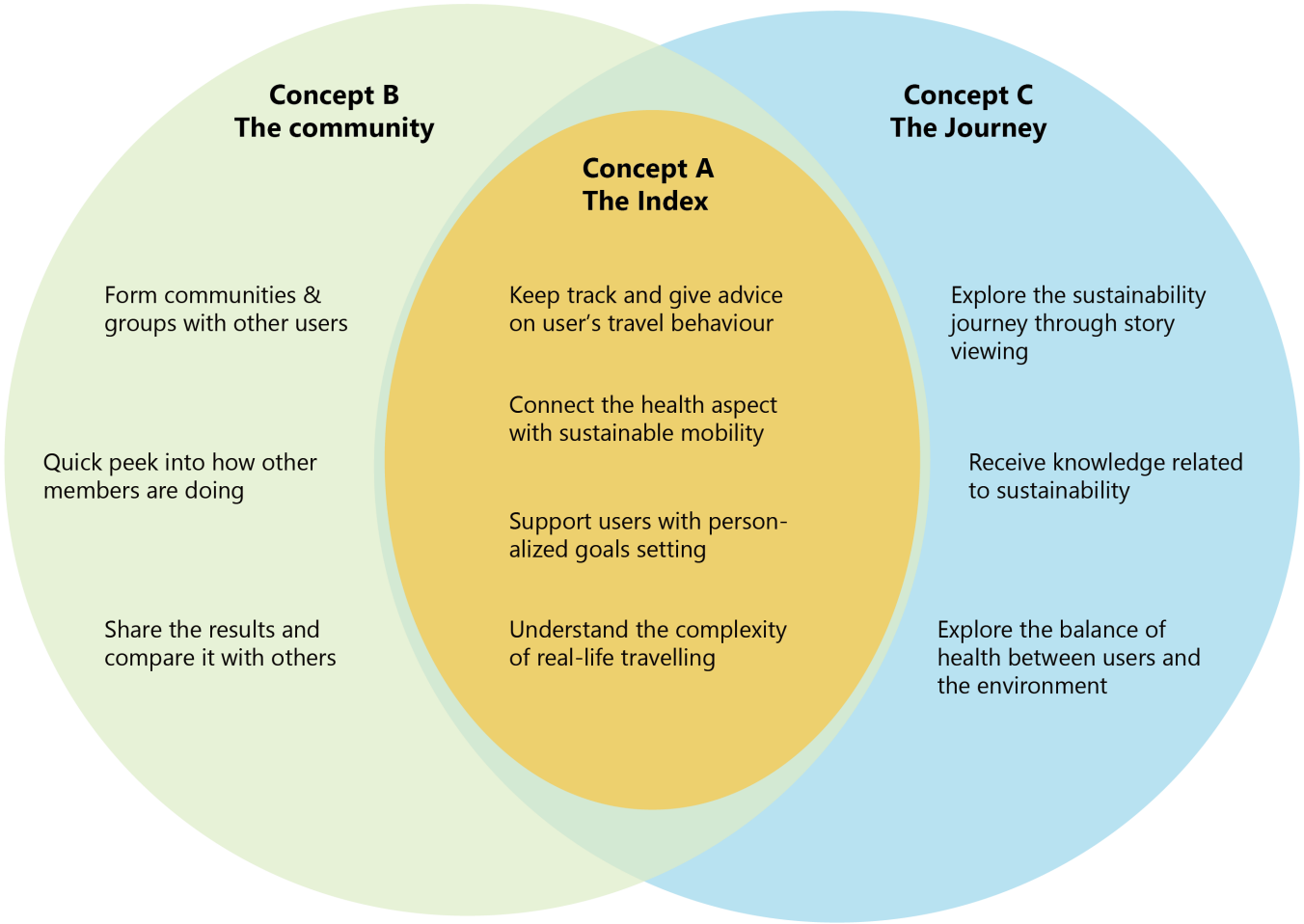


figure 3.2.1 The features of the three initial concepts

3.2.2 Concept A: The index

Through the research and the interaction vision, “relevant” stands out to be a crucial factor in this project. Therefore, in concept A: the index, a personalized mobility tracking application is created.

In this concept, the user will receive personalized advice on their travel activities. The user can select different types of advice, for instance, advice on sustainability or the health aspect of that journey. Through the advice, users can know the benefit of selecting a more sustainable means of transport. For example, how much CO2 they can save and how many calories they can burn (see figure 3.2.2-1). Furthermore, due to the understanding of the complexity of real-life travelling, the application also provides users with an opportunity to state their restriction of not being able to make a sustainable decision for travelling (see figure 3.2.2-1).

Apart from the advice feature, the user will also receive the suggestion for setting a mobility goal. For example, “take five more trips by bike than a car per week”, or “burn 500 cal by travelling per week” (see figure 3.2.2-2). These potential goals are suggested based on the inputs from the user (travel routine, age, height, weight) when they onboard with the application.

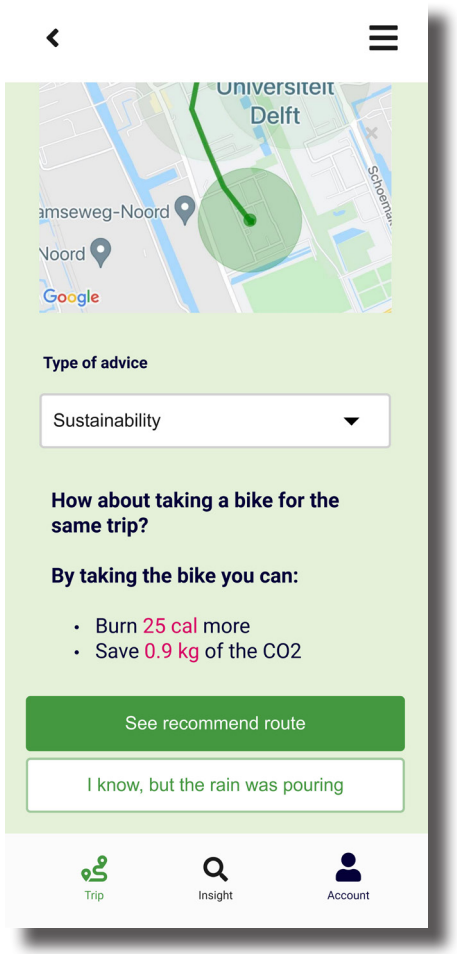


Figure 3.2.2-1 Personalized advice & opportunity for users to state their restriction

Figure 3.2.2-2 Personalized suggestion for setting a mobility goal

3.2.3 Concept B: The community

Connected back to the research and the interaction vision, the feeling of collectiveness and the affordance to share and compare travel data/results together can keep users motivated and engaged with the mobility trackers. Therefore, concept B: the community was born. Although this concept includes all the features in concept A, this concept aims to focus on the community feature.

In this concept, users can join and form multiple groups. Within the group, there will be group goals to achieve together (see figure 3.2.3-1). Depending on the group goals, there will be different infographics for the user to have a quick peek into how other members are doing in their travel activities (Focus both on the sustainable mobility and health aspect). With this feature, users can share and compare their travel data together (see figure 3.2.3-2).

Figure 3.2.3-1 Form groups & group's goal

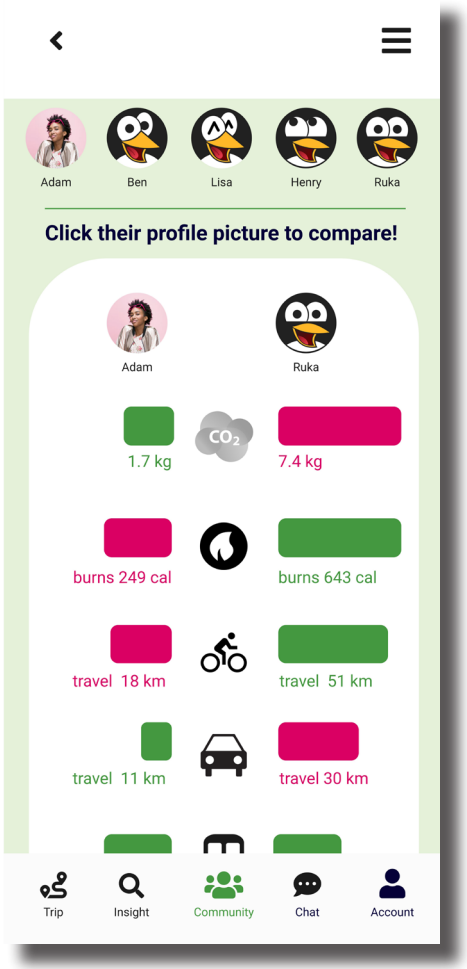


Figure 3.2.3-2 Share and compare travel data

3.2.4 Concept C: The journey

Linked to the research and the interaction vision, providing “novel information” can arouse users' curiosity. Therefore, concept C: the journey was introduced.

This concept includes all the features in concept A, however, its objective is to focus on the “journey feature”. The journey feature is a “story” provided by the application. The user can build their avatar in this application (see figure 3.2.4-1) and by completing their personal goals (linked with concept A), they can view a chapter of the story. This story is about “a journey toward sustainable mobility”. By viewing the story, the user can experience how the avatar becomes more and more sustainable in the storyline. Furthermore, each chapter of the story will reveal certain knowledge of sustainability to the user, therefore, provide new and relevant information to the user (see figure 3.2.4-2).

Figure 3.2.4-1 Users can build their avatar

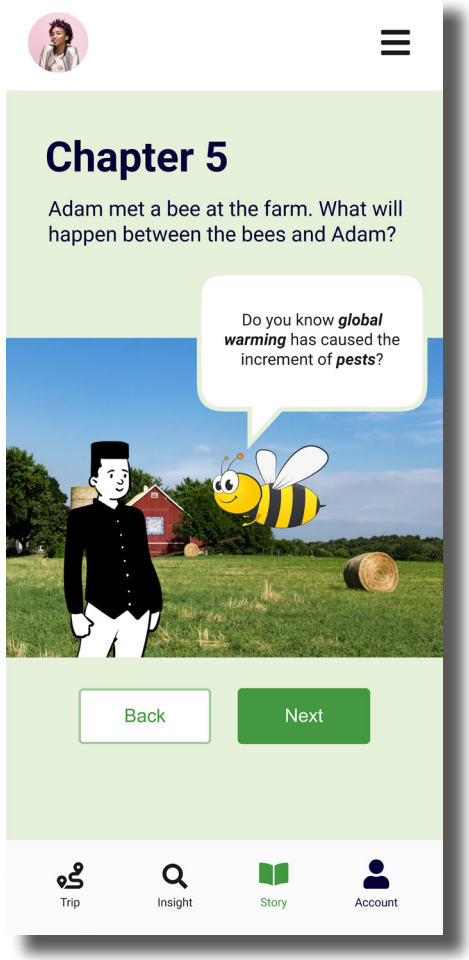


Figure 3.2.4-2 Receive knowledge related to sustainability through story viewing

3.3 Online Group Sessions

The objectives of the online group sessions are to evaluate the three initial concepts with the participants and to gain insights for the second design cycle.

3.3.1 Procedure of the online group session

The procedure of the online group session is shown in figure 3.3.1. There are two online group sessions with the same structure, each one with 4 participants attending. The group sessions were conducted via online meetings tools (Miro & Zoom) due to the global pandemic of COVID-19. Moreover, the set-up of the group session was discussed with an online session expert, Lina Li (design researcher at TU Delft IDE). Also, a pilot group session was conducted before the actual group sessions. This pilot session helped the process of the actual group sessions went smoothly and without hitches.

The co-creation session is a collaborative way to develop new ideas, concepts, solutions together with experts and/or stakeholders (such as customers, end-users, etc.) [6]. Through the co-creation sessions, the ideas would be shared and improved together.

The template designed for the group session can be found via this link: https://miro.com/app/board/o9J_lDiNtP4=/

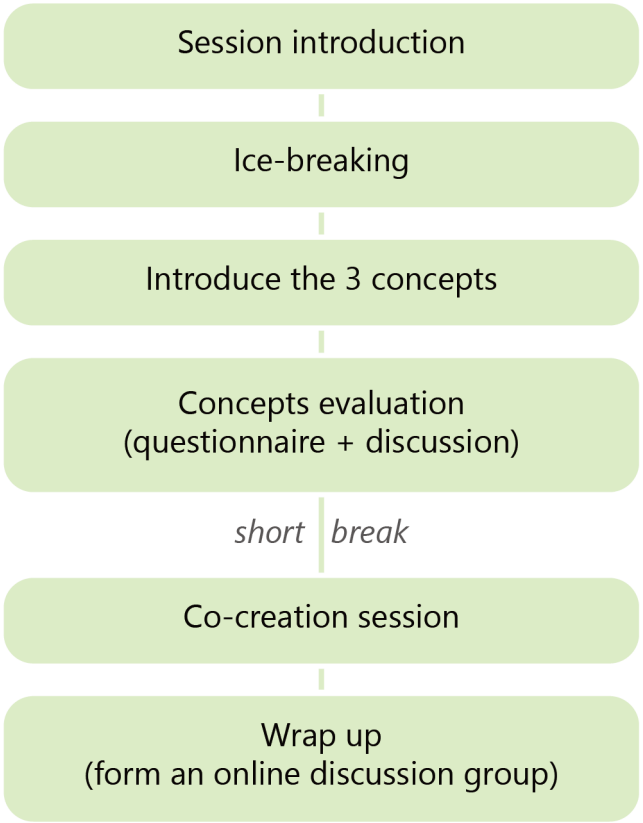


Figure 3.3.1 Procedure of the online group session

3.3.2 Concepts evaluation

Research questions

The concepts evaluation aims to understand how users perceive the three initial concepts. Therefore, research questions are formulated before setting up the concept evaluation:

- How do users feel after experiencing the concepts? (Do they feel curious about their travel data? Do they feel relevant to their travel data? Do the concepts motivate them?)
- How do the users perceive the three concepts? (Do they consider the concepts novel or likeable?)
- What effect do the concepts have on the users? (Do the users feel support toward sustainable mobility decisions after experiencing the concepts?)

Data collection

The data collection methods include questionnaires and group discussions. The questionnaires are modified AttrakDiff scale [2] (ranging from -3 to 3); The group discussions were stimulated by the questions based on the research questions. Both the questionnaires and the group discussions aim to understand if the concepts have met the users' needs and the desired effect in the design goal.

Results of the questionnaires & group discussions

The results of the questionnaires can be found in figure 3.3.2. The scores are averaged scores by the 8 participants.

The detailed results of the group discussions can be found in Appendix C.

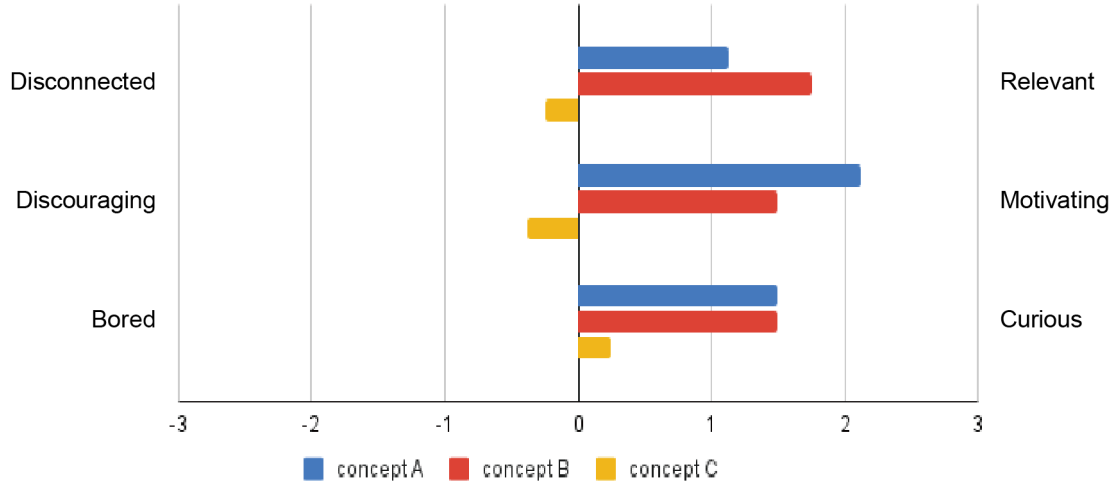
Interpretation

The following are the key findings gained from both the questionnaires and the group discussions.

Overall, participants appreciated the idea of connecting personal health to sustainable mobility. They felt more attached to the sustainability issue because of this. Among the three concepts, participants felt most supported by concepts A and B towards more sustainable mobility decisions. However, they felt less supported by concept C.

For concept A, participants pointed out that the personalized advice, goals setting, and alternative options give them a feeling of support toward sustainable mobility decisions. In addition, P3 mentioned that the personalized advice on their travel activities was his favourite part of concept A. This is the feature that made him feel supported by the application. Furthermore, participants like the on-point infographics and the humanness of the application due to its understanding of the complex reality of travelling. Moreover, based on the questionnaire, concept A is the

How ..... do you feel after experiencing the design prototype?



How do you feel about the design prototype?

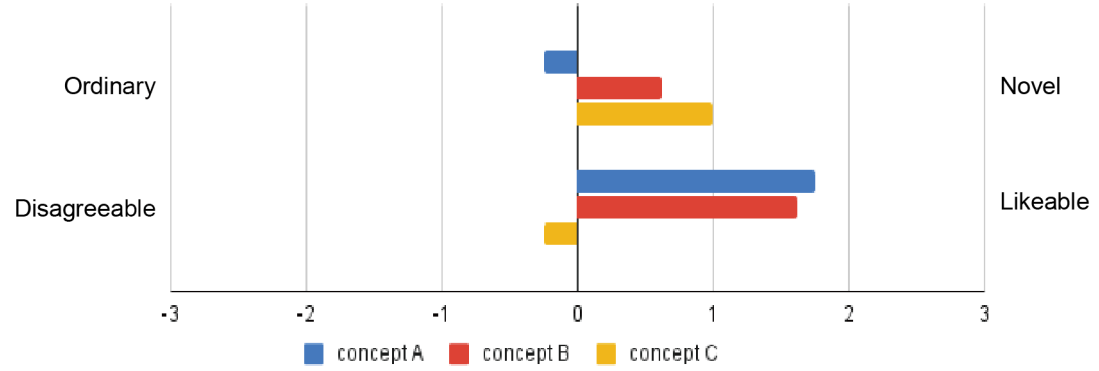


Figure 3.3.2 Results of the questionnaires (averaged scores by the 8 participants)

most likeable and the most motivated concept. However, it is also considered the least novel one.

For concept B, participants considered the community function enables them to discuss, reflect, compare and gain knowledge together during the process of achieving their group goals. These features are the reasons that make them feel supported and motivated to travel sustainably. Furthermore, they like the at-ease feeling that losing the weekly group challenge is not a big deal. However, two concerns were pointed out by the participants. One is the size of the group and the relationship between the members. Based on the participant's discussion, the community feature would work only when the size of the group is not bigger than 50 people, preferably under 10 people, and when people are not strangers to each other; the other concern is the privacy issue of sharing personal travel data in a group. Some participants stated that they don't mind at all since they considered travel data is not sensitive. However, one participant stated that she feels less secure sharing data with others and she prefers to select what she wants to share before sharing.

Based on the questionnaire, concept B and concept A were considered to have the best ability to arouse users' curiosity. Furthermore, concept B was considered the most connected one in all three concepts.

As for concept C, most of the participants feel less connected to the story provided by the application. Furthermore, one of the participants said she does not like the feeling of being educated by the application; another participant said he does not need a game (storyline) to keep him motivated. Therefore, they feel less supported by concept C. However, concept C was considered the most novel one among all three concepts. Participants liked the aspect that they can receive "instant knowledge" from it, plus the knowledge provided would be scientific and closely related to them.

3.3.3 Co-creation session

Objectives & Research question

The co-creation sessions aim to gain new insights from the participants and come up with a design strategy for the second design cycle. Therefore, a research question was formulated before the co-creation session took place. This research question is:

- From users' perspective, how can a mobility tracker stimulate curiosity on the connection of sustainable mobility and personal health?

Procedure

Connected with the research question, a problem statement was formulated at the beginning of the session to frame the scope of the co-creation sessions. The problem statement is: "How to stimulate curiosity on the connection of sustainable mobility and personal health?"

A graph (see figure 3.3.3-1) is made to illustrate the setup of the co-creation session.

Throughout the creative sessions, the participants are encouraged to discuss and present their ideas. This enables the participants to spark different ideas and perspectives together.

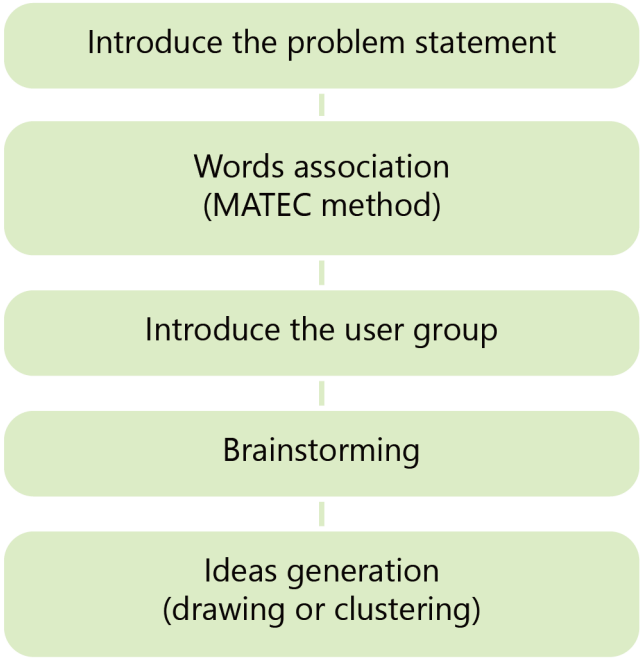


Figure 3.3.3-1 Procedure of the co-creation session

First, the problem statement was introduced; Second, participants were invited to generate four matrixes of word association together and then randomly picked two words from each matrix to come up with the connections between these two words (See figure 3.3.3-2). This method is a modification of the MATEC method developed by J.P. Sol [3, 4];

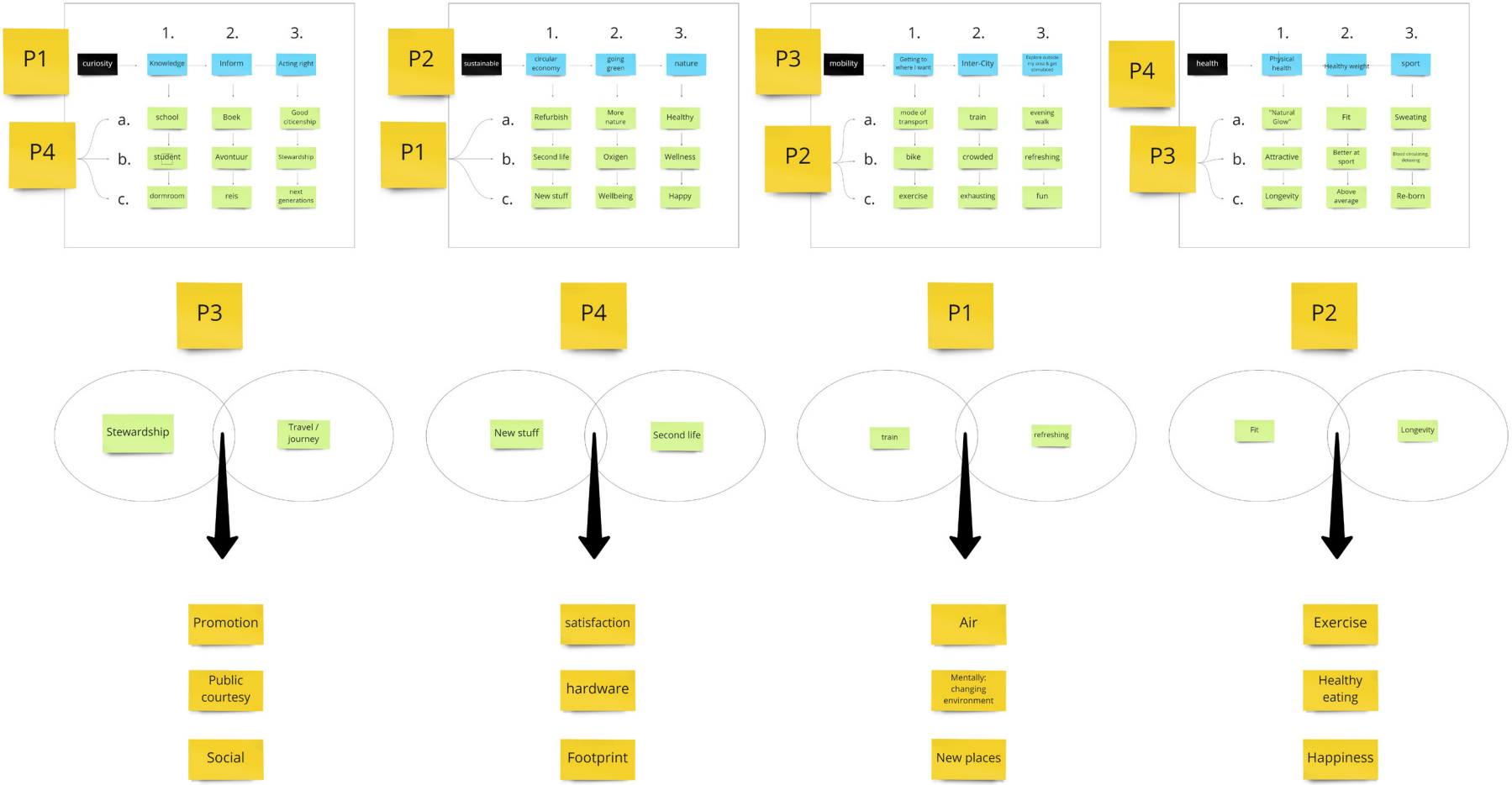


Figure 3.3.3-2 Word associations from the MATEC method [3, 4]

Third, a simplify persona was introduced to the participants. This persona is based on the user group defined in chapter 1.2 (see figure 3.3.3-3).

Hello! This is Dan.

I have a car and a bike, therefore, I have many mobility options. I can walk, bike, taking a car or taking public transports.

I believe sustainability is a new normal to everybody.

I am willing to be as sustainable as possible when there are no restrictions. (For example, when the weather is nice; When I am not in a hurry; When I don't need to carry my children.)

I care about my health a lot. Therefore, the COVID-19 pandemic makes me feel concern when taking the public transport.

Figure 3.3.3-3 Persona based on the user group

Fourth: (a modified version of) brainstorming [5], the participants are invited to use the outcome of the word association to answer the questions in figure 3.3.3-4. Afterwards, the participants voted the four best answers (see figure 3.3.3-5);

How to use _____ to stimulate the curiosity of ***Dan*** on the connection of sustainable mobility and his own health?

How can _____ add value to the 3 concepts above (concept A, B, C) ?

What does _____ suggest for the Problem statement?

What does _____ make you think of in relation to the problem statement?

Figure 3.3.3-4 Questions for brainstorming

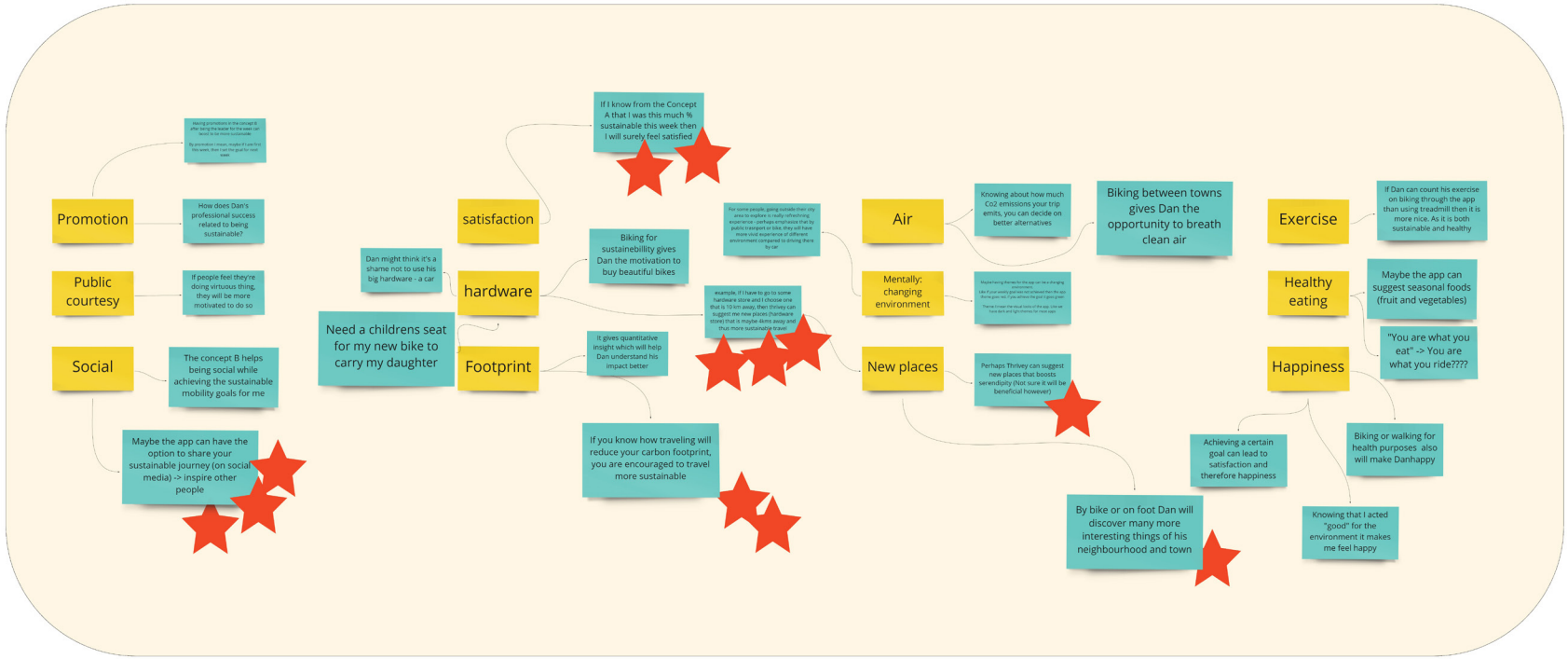


Figure 3.3.3-5 Four best answers were voted by the participants

Fifth, ideas generation, the participants were invited to draw or make a cluster to illustrate their ideas based on the voted outcomes (see figure 3.3.3-7). An imageboard was provided to stimulate creativity and support the clustering (see figure 3.3.3-6).

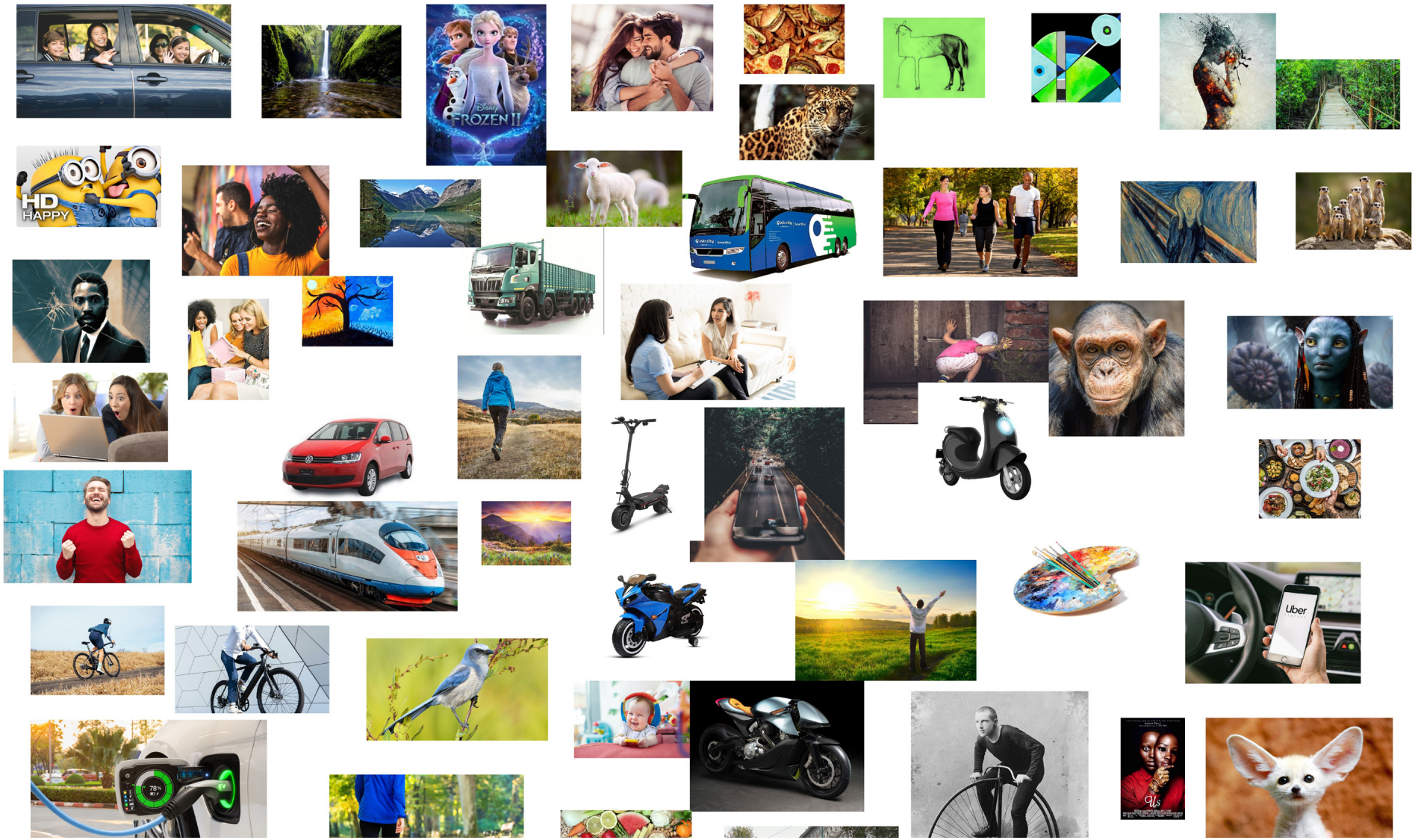


Figure 3.3.3-6 Imageboard for stimulating creativity and supporting the clustering

Figure 3.3.3-7 Ideas generation: the drawing and clustering by the participants

Results

Ten different ideas, including drawing and clustering, to answer the problem statement were generated. Later on, the ten ideas were analyzed and classified into seven categories (see figure 3.3.3-8).

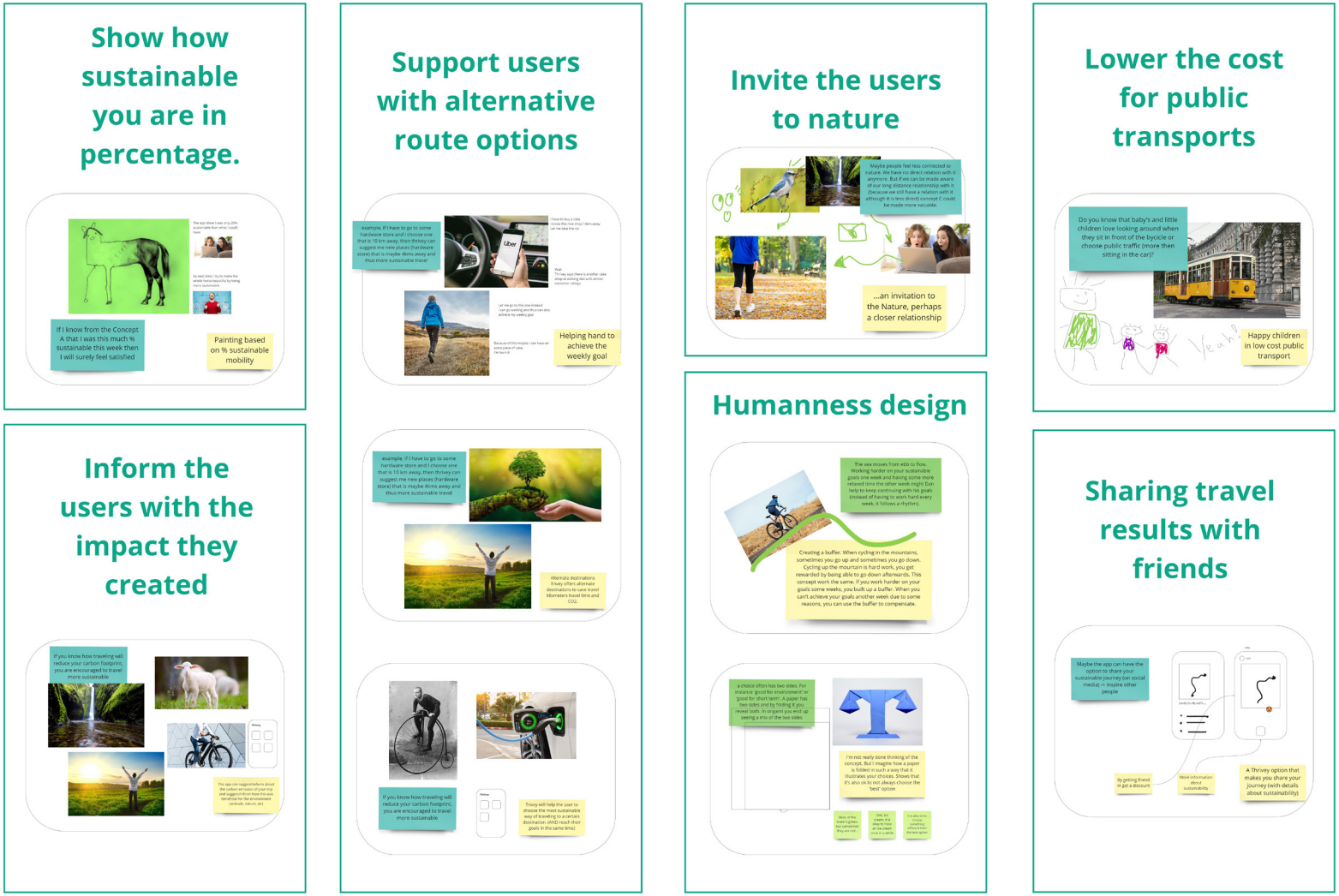


Figure 3.3.3-8 Seven categories of the ideas

Interpretation

Among them, the category “Show how sustainable you are in percentage” is closely related to one of the findings in the literature review: “the factor that has the most influence on user’s engagement on self-tracking data is relevance. Self-tracking data should be represented in a way that the user can relate to.” P3 and P5 stated that if the challenges or goals provided by the application can inform them about how sustainable they are in percentage (for example, I am 20% more sustainable than last week), they will feel more related and curious to the challenges or goals.

On the other hand, three ideas have been classified as “support users with alternative route options”. This indicated that participants considered receiving alternative route advice from the application can help them to become more sustainable in the mobility aspect; Furthermore, due to the complexity of real-life travelling, it is hard to always select the most sustainable route. Therefore, two participants came up with the ideas under the “Humanness design” category. What these two ideas have in common is to show that the application understands the users’ situation, and to let the users know it is okay to have a break and it is okay to not be perfect.

The other four categories are “inform the users with the impact they created”, “invite the users to nature”, “lower the cost for public transports”, and “sharing travel results with friends”.

Together with the results of the evaluation of the concepts, these ideas were analyzed and formed as the starting point of the second design cycle.

3.4 Conclusion

Through the two online group sessions, the three initial concepts were evaluated and more insights were gathered to form the base of the second design cycle. The conclusion for the online group sessions can be divided into two parts, the concepts evaluation and the co-creation sessions.

3.4.1 Concepts evaluation

- All three research questions (see chapter 3.3.2) were answered during the evaluation of the concepts. The answers are presented below in a list.
- Overall, participants appreciated the idea of connecting personal health to sustainable mobility. They felt more attached to the sustainability issue because of this.
- Participants felt more supported and motivated to travel sustainably through concepts A (The index) and B (The community).
- The personalized advice, goal setting, and alternative options in concept A (The index) gave participants a feeling of support toward sustainable mobility.
- The on-point infographics and the humanness of the application in concept A (The index) were considered the reasons why the participants felt attached to it.
- Concept A (The index) is the most likeable and the most motivated concept. However, it is also considered the least novel one.
- For concept B (The community), participants considered the community function enables them to discuss, reflect, compare and gain knowledge together during the process of achieving their group goals. These features are the reasons that make them feel supported and motivated to travel sustainably.
- Concept B (The community) was considered the most connected one in all three concepts.
- Concepts A (The index) and B (The community) had higher rates on their ability to arouse users' curiosity.
- Concepts C (The journey) was considered the most novel one among all three concepts. Participants liked the aspect that they can receive instant knowledge from it, plus the knowledge provided would be scientific and closely related to them. However, concept C (The journey) was considered the least supportive one.

3.4.2 Co-creation sessions

- The research question (see chapter 3.3.3) was answered during the co-creation session. Besides the research question, additional insights were also gathered through the co-creation sessions. The answers and insights are presented below in a list.
- Participants stated that if the challenges or goals provided by the application can inform them about how sustainable they are in percentage (for example, I am 20% more sustainable than last week), they will feel more related and curious to the challenges or goals.
- Participants considered receiving alternative route advice from the application can help them to become more sustainable in the mobility aspect.
- It is important to show the application understands the users' situation and to let the users know it is okay to have a break and it is okay to not be perfect.

- An online discussion group was formed to gain more insights from participants' perspectives.
- The results of the online group sessions were analyzed and formed as the starting point of the second design cycle.

Through the online group sessions, the early design direction is refined. Concept A (The index) and B (The community) would be taken as the foundation of the early design direction due to its ability to support and motivate users toward sustainable mobility. Concept C (The journey) provided users with "instant knowledge" that would activate users' curiosity. Therefore, this specific part of concept C (The journey) would also be taken into account. More information regarding the early design direction can be found in chapter 4.

3.5 Reference

1. Pasman, G., Boess, S., & Desmet, P. (2011). Interaction vision: expressing and identifying the qualities of user-product interactions. In DS 69: Proceedings of E&PDE 2011, the 13th International Conference on Engineering and Product Design Education, London, UK, 08.-09.09. 2011.
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Chapter 4
Design Cycle 2

In this chapter, the early design directions were introduced. Followed by the iterative process and the insights gained from the online discussion group, the direction of the final design were presented.

4.1 Early Design Directions

Through the first design cycle, five features that have positive effects on reaching the project goals were identified. They are “connect health with sustainable mobility”; and “personalized advice and goals setting” and “humanness alternative options” from concept A; The “community” from the concept B; Last but not least, the “instant knowledge” from concept C. A graph is made to illustrate the early design direction (see figure 4.1).

4.1.1 Connect health with sustainable mobility

Based on the online group sessions, participants had reacted positively to the idea of connecting the information of the user's health with sustainable mobility. They felt more attached to the sustainability issue because of this.

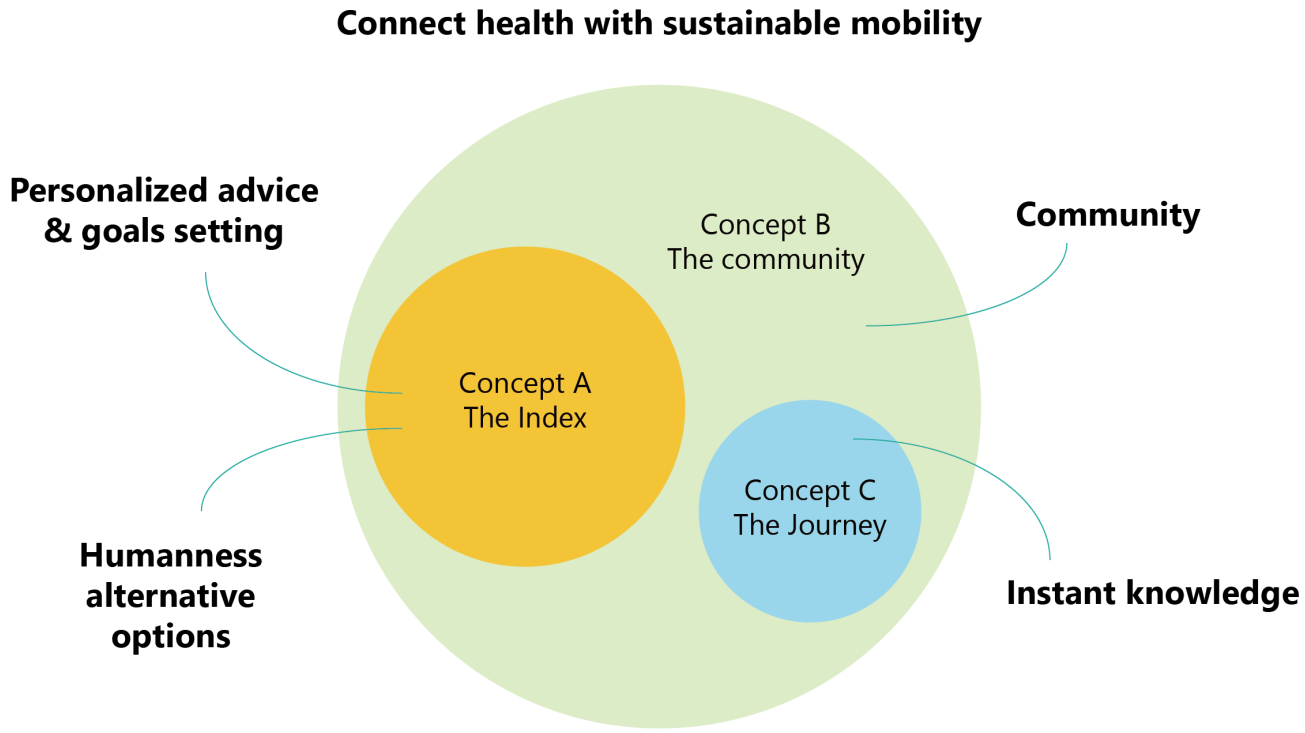

Figure 4.1 Early design direction

4.1.2 Personalized advice and goals setting

The personalized advice and goals setting can motivate users to engage with the application. Also, the infographic provided based on the progress of the goal would make users feel more supported toward sustainable mobility. Furthermore, the personalized goal should be relevant to the user and can provide users information about their conditions.

4.1.3 Humanness alternative options

The design should understand the complexity of real-life travelling and provide alternative travel options that are realistic to the users. There should be a channel that the users can communicate the difficulties that occur when they are trying to travel sustainably.

4.1.4 Community

The community feature stands out because it enables users to discuss, reflect, compare and gain knowledge together during the process of achieving their group goals. This makes the user feel supported and motivated to travel sustainably. Also, this gives users a feeling of companionship via achieving a similar goal together.

4.1.5 Instant knowledge

In this feature, users will receive a small piece of information that relates to their travel activities. This would give users some instant knowledge about their travel behaviour. This knowledge would be related to health or sustainable mobility.

4.2 Issues of the Early Design Directions

4.2.1 Issue

Through the discussions within the study team (supervisory team + company mentor), a major issue of the early design direction was uncovered. The issue was the loose connection between the five features. Therefore, an iteration of the design direction was made.

4.2.2 Iteration

The five features had undergone a round of re-analysis. An ethnographic approach was applied during the re-analysis [1]. First, the five features were re-defined again to have a deeper understanding of their usages; Later on, the connections between these usages were identified. This process helped the researcher to understand what does interacting with mobility trackers means to participants.

Below are the research questions for the re-analysis:

Re-define the five features
- What does "connect health with sustainable mobility" means?
- What does "personalized goals setting" means?
- What does "humanness alternative" means?
- What does "community" means?
- What does "instant knowledge" means?

Understand its usage
- How does it connect health with sustainable mobility?
- How does it support users toward sustainable mobility?
- How does it stimulate curiosity toward the relationship between health and sustainable mobility?

Seek for connection
- What are the connections between these usages?
- What do these connections mean to the users?

4.2.3 Results

Through the re-analysis, the connection between the five features has been found. It is the human desire to understand ourselves, others, and our surroundings (see figure 4.2.3).

Understand ourselves

When users interact with the mobility trackers, they want to know how they are doing in the mobility aspect. For example, users would like to know how sustainable or healthy they are in the mobility aspect; how far they can reach in the sustainable mobility aspect; and how sustainable mobility can influence their health.

Understand others

Users are interested in knowing how other people are doing in the sustainable mobility aspect; how other people achieve their goals, what challenges they faced, and how they overcome them; Furthermore, users also want

to know how other people see them through their travel behaviour due to the desire to be understood by others. This inner desire for social interaction drives us to get in contact with other people in order to seek belonging [2]. Also, it makes us curious about what other people are doing in order to know ourselves and others better.

Understand the surroundings

Curiosity is human nature. In fact, in the 1930s, Abraham Maslow and Harry Harlow observed Rhesus monkeys [3]. They noticed that the monkeys enjoyed solving puzzles, without requiring any reward. Wrote Harlow, the task itself "provided intrinsic reward." Moreover, George Loewenstein proposed the Knowledge Gap theory [4] in a paper published in 1994 on the psychology of curiosity. In this paper, George Loewenstein described curiosity as "a cognitive induced deprivation that arises from the perception of a gap in knowledge and understanding". This means when people realized there is a gap in knowledge and understanding, they will try to fill that gap. Therefore, combined with the results of the re-analysis, users' desire to understand novel knowledge has been revealed.

In this project, the participants are interested in understanding how much impact they have on the world, how much positive impact they might create by travelling sustainably, and how they can improve their health by travelling more sustainably.

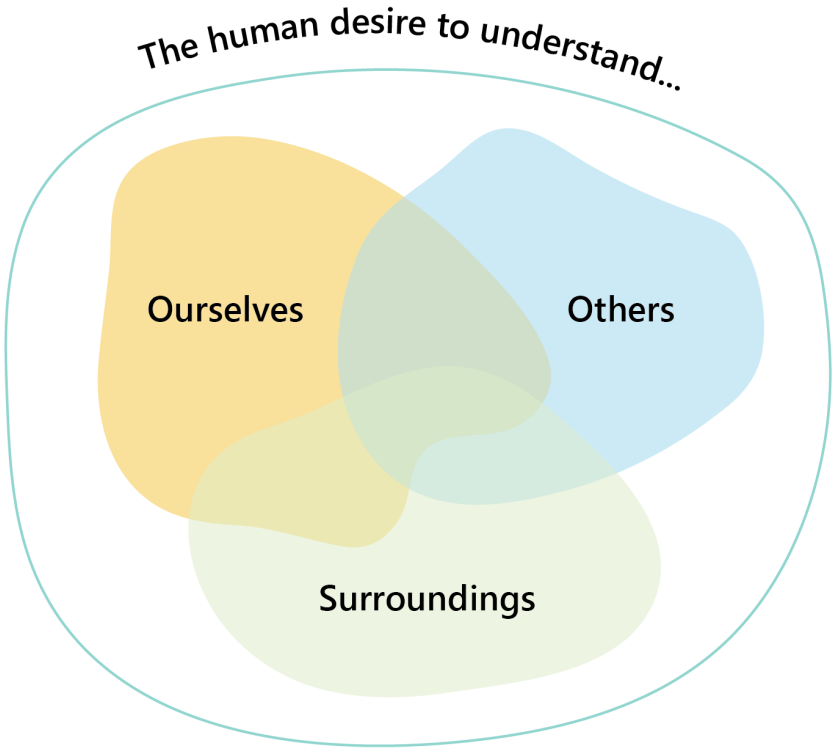

Figure 4.2.3 The human desire to understand ourselves, others, and our surroundings

4.3 Insights from the Online Discussion Group

4.3.1 Reasons to form the online discussion group

An online discussion group was formed at the end of the online group sessions. “Signal” [5], a social media that offers end-to-end encryption to keep all conversations secure, was used to form the online discussion group. There are two reasons to form this online discussion group. First, a channel where the researcher can gain additional insights from the participants by asking questions or sparking discussions; Second, to create a channel where the participants can voice their opinions whenever and wherever they have a thought regarding this project or any issue of the current Thrivey application since participants had started using the Thrivey application after the user interviews.

4.3.2 Input from the participants

On the 3rd of June 2021, P3 shared his experience of travelling in the online discussion group. He stated that he would check 2 to 3 apps before he travels. He would check the weather app, Google Maps, and 9292 (a route planning app in the Netherlands). Therefore, he suggested that it would be nice for Thrivey to combine all these functionalities in one application. However, after the discussion between the researcher and the company mentor, this idea is not feasible for Thrivey. Because Thrivey wants to develop its product in the direction of a mobility tracker, instead of a route planner. In fact, a similar idea has been discussed in the early stage of this project, however, the same outcomes applied. The feedback from P3 can be found in Appendix D.

4.3.3 Insights regarding one design idea: the support system

Halfway into the design cycle 2 was the process of concepts prototyping, several ideas were embodied in the prototype. One of the ideas is to develop a “support system” between the users. On the 17th of June 2021, questions about “the support system” were asked in the online discussion group. The following were the questions:

Dear participants,

In the future version of Thrivey, the group challenges feature may be added. In this feature, there will be a "support system" where the people who perform well during the group challenges share their experiences with other members. The following images (see figures 4.3.3-1 & 4.3.3-2) are made to illustrate the support system. I have a few questions according to this image:

Question 1
Do you feel supported by knowing other member's experiences of becoming more

sustainable in the mobility aspect? Why and why not?

Question 2
Does the discussion area below each post make you feel supported? What do you think of this discussion area (see figure 4.3.3-2, below)?

Question 3
What if there is NO discussion area. However, you can export the image of your travel route and share it and discuss it on other platforms (for example, Whatsapp). Would you prefer this way (to discuss on other platforms)?

Any comments can help me to improve.
Hope to hear from you!

All the best,
Min

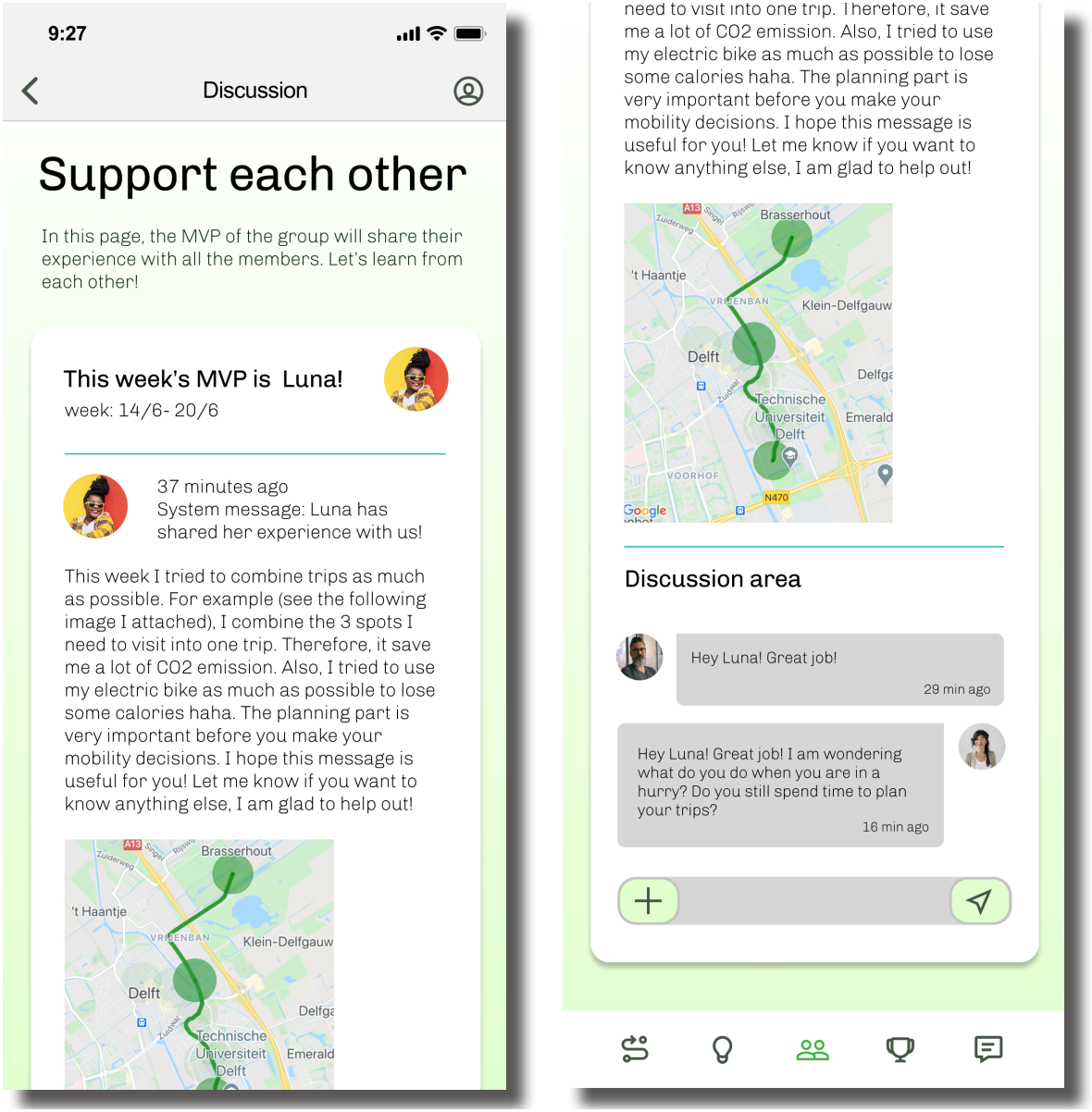

Figure 4.3.3-1 (part 1) & 4.3.3-2 (part 2) An example of the idea: Support system

These three questions were asked to understand how the participants perceive the support system (one of the ideas that developed during the process of concepts prototyping) and what do they think about certain elements in the support system. Furthermore, the third question was from the company mentor, he would like to understand if the participants would prefer to take the discussion elsewhere, for instance, to another platform or social media.

P1, P3, and P7 answered the above questions in the following days. The details of the conversation can be found in Appendix D. Below is the summary of the answers.

Question 1

P1 and P7 both answered that they would feel inspired and supported by reading other member's experiences. P3 answered that he would surely read other member's posts out of curiosity. However, P3 and P7 also mentioned that they might not spend time and effort to write a post of their sustainable travel experience.

Question 2

P1, P3, and P7 all reacted positively to the idea of the discussion area. P1 answered that it is nice to know what other members think, and she could imagine an interesting discussion to be created; P3 answered that a discussion area is a nice option. He was intrigued into knowing the reply from the sample conversation in figure 4.3.3-2; P7 answered that she would feel supported if other members respond positively to her contribution. Also, she liked that the discussion was presented with comments. She considered it is an interesting interaction within mobility tracking applications.

Question 3

P1 and P3 answered that they saw other people who would share their travel route on another platform (for example, Whatsapp) and discuss it with others. Therefore, they can imagine this interaction. However, P3 also mentioned that he would not make the effort to share his travel route to another platform. Furthermore, P1 and P7 answered that they prefer to have the discussion in the same application.

Interpretation

Through the insights from the online discussion group, some crucial qualities were revealed. First, the users might not spend much effort creating a post within the application. Therefore, it is important to increase willingness and reduce the burden of sharing travel experiences. Second, the discussion area was prefered by the participants. This resonates with the finding from design cycle 1, the online group session. Third, participants prefer to have the discussion function within the same application.

4.4 Conclusion

This chapter aims to produce the final design direction through an iterative process. Therefore, the conclusion of this chapter would focus on presenting the final design direction.

4.4.1 Final design direction

The final design direction has been refined through the re-analysis of the early design directions and the insights from the online discussion group.

The design should provide a better understanding of ourselves, others, and our surroundings in the sustainable mobility aspect.

To understand ourselves

To understand ourselves, insights about users' travel behaviour should be provided. Moreover, these insights should be as relevant as possible according to previous research. Additionally, the personalized advice and challenges in concept A can help the users to reflect on their travel behaviour and support them toward sustainable mobility decisions.

To understand others

To understand others, insights into other people's travel behaviour should be provided. Without a doubt, the privacy issue of sharing travel data in a group will always be taken into account. Furthermore, the design should enable the users to discuss, reflect, and learn from each other. The idea of providing group challenges in concept B and the idea of a discussion area within the application are prefered. However, increasing willingness and reducing the burden of sharing travel experiences need to be considered.

To understand others

To understand the surroundings, the design should provide knowledge about sustainable mobility and health that is related to the users. For instance, how much impact they create while travelling, how much positive impact they might create by travelling sustainably, and how they can improve their health by travelling more sustainably.

Next steps

To turn all the above design directions into one design, a brainstorming [6] process was conducted. Brainstorming is one of the best-known techniques available for creative problem-solving. It is the process of free-thinking and generating ideas without being bound by restraints [7]. Through brainstorming, the idea of selecting the community function as the main features of the design and connecting the group challenges and the personal (individual) challenges stood out. More details of connecting the group challenges and the individual challenges can be found in the next chapter (see chapter 5).

4.5 Reference

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Chapter 5
Final Design

In this chapter, the final design and its features were introduced. The final design is a mobility tracking application that enables users to explore how sustainable mobility can improve their health.

5.1 Overview of the Final Design

Connected with the final design direction: "to provide a better understanding of users themselves, other users, and the surroundings", four crucial features were developed. These four features are "personalized advice & indicating restrictions", "community", "challenges", and "informed infographic". More detailed information regarding the four features can be found in chapter 5.3. Later on, these four features were formulated into the final design.

The final design is a **mobility tracker that enables users to explore how sustainable mobility can improve their health**. In this design, users can form **communities**, create different **challenges**, receive advice and **alternative route options** from the application, and gain insights into their travel behaviour through the **informed infographic** provided by the design.

The structure of the final design and the corresponding features can be found in figure 5.1-1. More detailed information can be found in chapter 5.2 and 5.3.

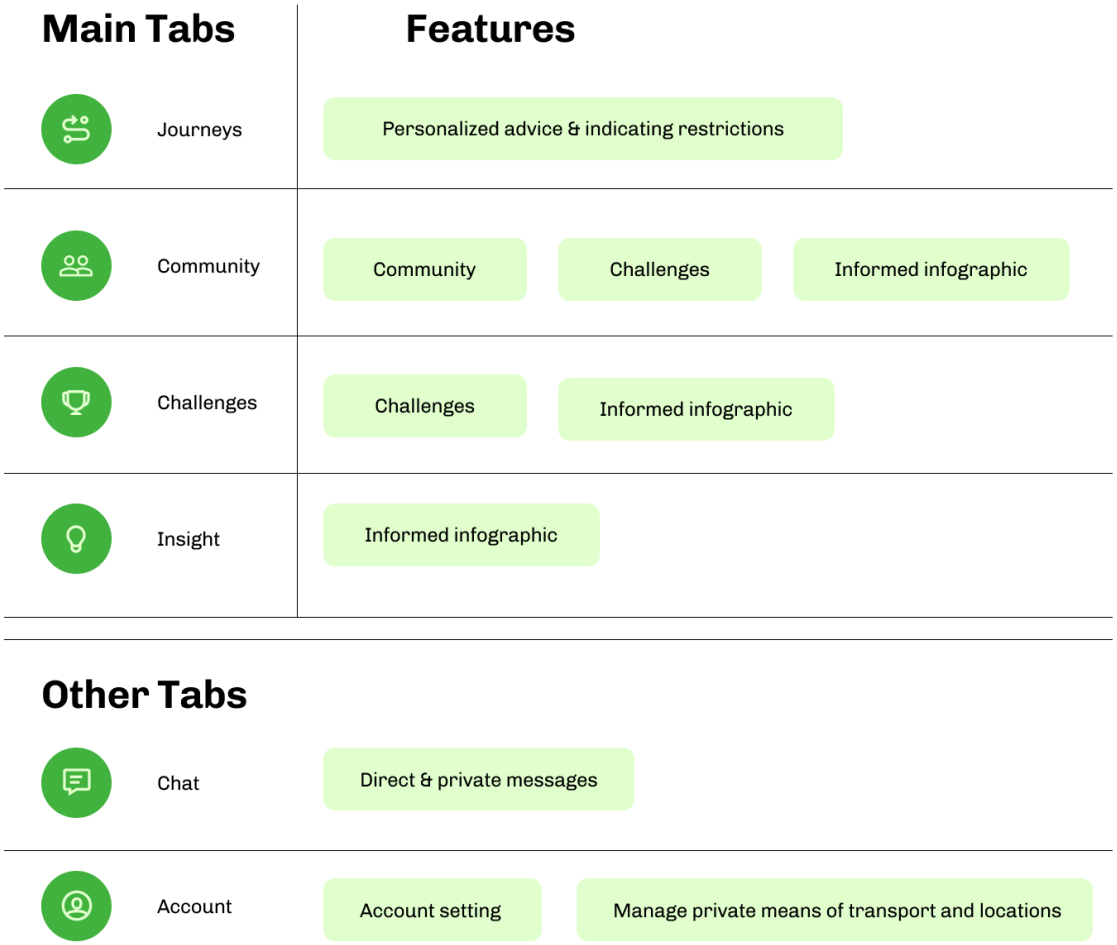


Figure 5.1-1 Structure of the final design and the corresponding features

Note

A prototype was made to illustrate the concept of the final design. The prototype can be seen as one way to illustrate the concept of the final design. Therefore, one thing that needs to be specially noted is that this thesis report only introduced one way of visualizing the final design concept, but in fact, it can be visualized and presented in multiple ways. For example, in the insight tab, there is an infographic that presents the overview of the kilometre, CO2, and calories by different means of transport (see figure 5.1-2). However, in this figure, the prototype only presents 5 means of transport with 5 different shades of blue. Once the means of transportation increase, the different shades of blue would not be able to distinguish them. Therefore, a redesign will be required in the near future. Furthermore, the figure of CO2 and calories in the prototype were estimated numbers. Therefore, they are incorrect.

In this thesis report, the term "prototype" or "design prototype" will be used to describe the prototype that was made to visualize the concept of the final design. When reading this thesis report, please take all the figures of the prototype as one way to illustrate the final design concept.

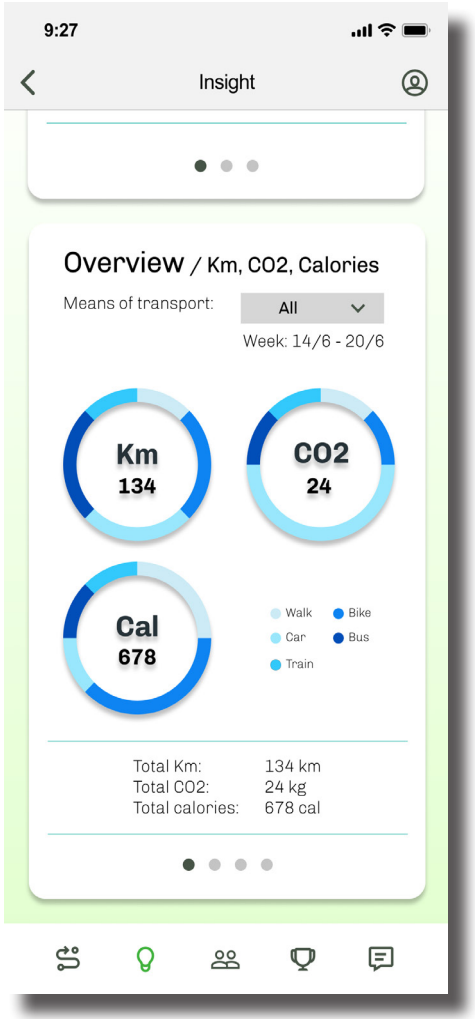


Figure 5.1-2 Infographic that presents the overview of the kilometre, CO2, and calories by different means of transport

5.2 Structure of the Final Design

5.2.1 Journeys

In Journeys, the application keeps a list of records of the user's travel activities. The relevant information about the journey is presented on the list. Including the date, time, private or business journey, means of transport, kilometre, and the types of journeys (See chapter 5.3.4 for detailed information about the types of journeys). Furthermore, the function of exporting the kilometre for travel reimbursement purposes is also clearly placed in the journeys tab (see figure 5.2.1-1).

Figure 5.2.1-2 illustrates an example when users click on one of the journeys they conducted. On this page, more relevant information about this journey is presented. Including the location, CO2 emission, calories burned.

There are two highlights in the Journeys tab. One is that the users can view advice regarding the trip they conducted. The other is that users can indicate the reason behind an unsustainable journey. Detailed information about these highlights will be introduced in 5.3.1.

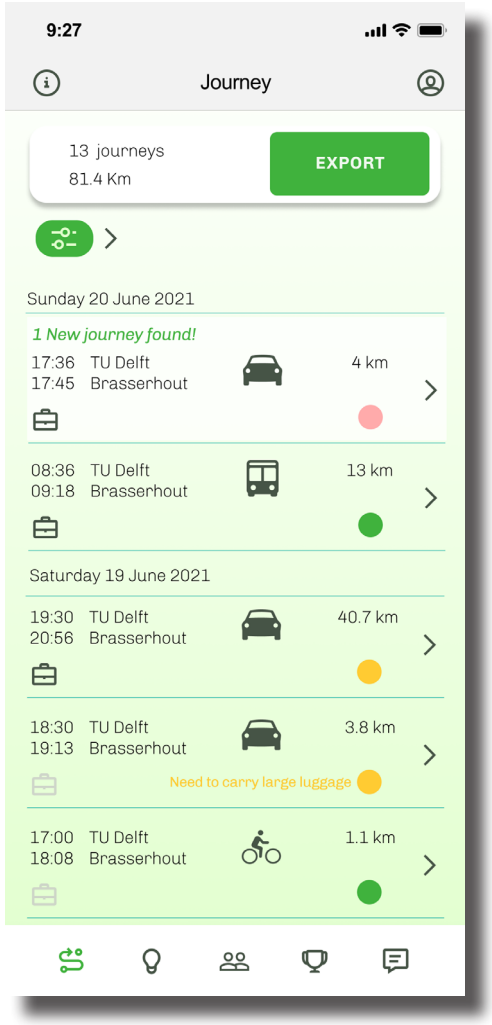


Figure 5.2.1-1 The main page of the journey tab (including the list of journeys and the export function)

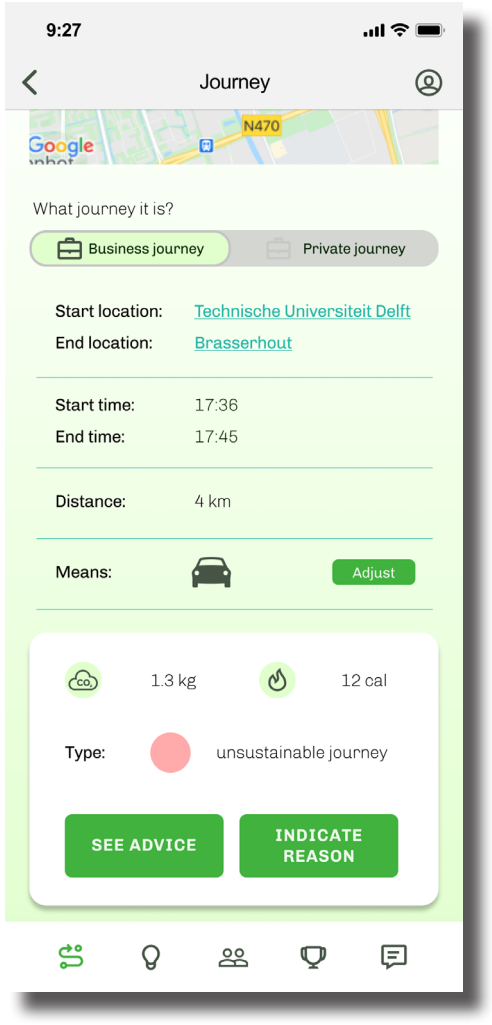


Figure 5.2.1-2 Detailed information of one journey

5.2.2 Community

Community is one of the core features of the final design. Therefore, the overview of the groups is set as the home page. On this page, users can quickly scan through all the groups they joined, and know how the group is doing with the group challenges by the visualized progress graph (see figure 5.2.2-1).

Once a group is formed, a group challenge needs to be created. Within a group, the first thing users would notice would be the group challenge and its progress. Below would be the discussion area which contains three default topics: “divide goals”, “adjust goals”, and “support each other”. (see figure 5.2.2-2 and 5.2.2-3). The details of the discussion area are introduced in 5.3.2.

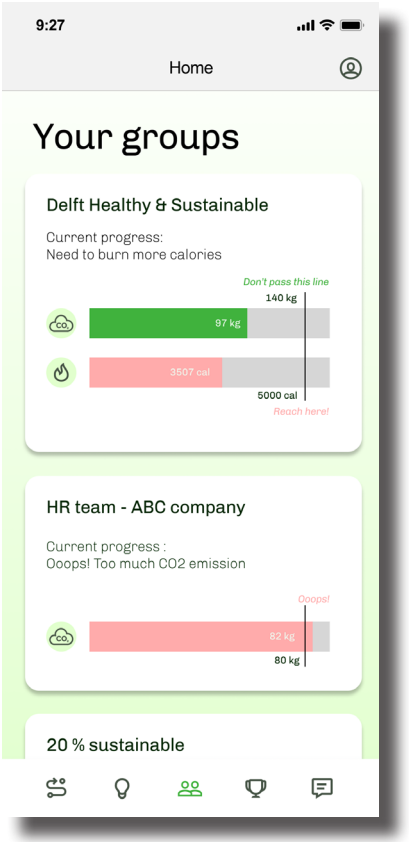


Figure 5.2.2-1 Home page: Overview of the groups user joined

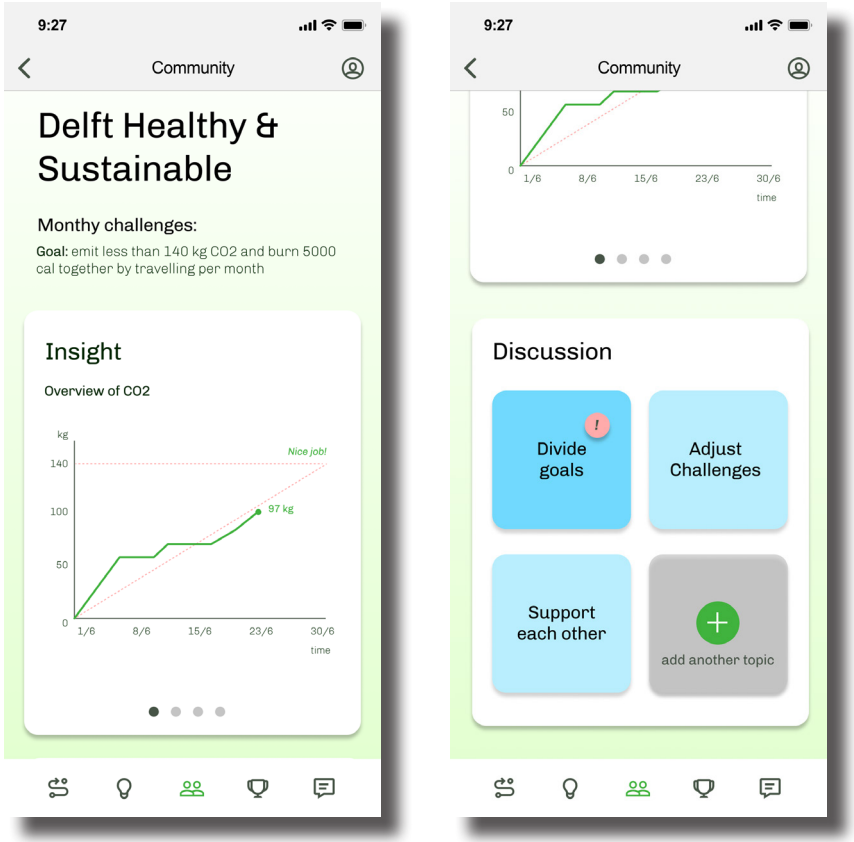


Figure 5.2.2-2 and 5.2.2-3 Functions within a group

5.2.3 Challenges

Challenges connected the whole design. In the challenges tab (see figure 5.2.3-1 and 5.2.3-2), the user would first notice the divided goals from their group challenges (their part of the group challenges). Below would be their individual goals. On this page, users can easily view the current progress of all their challenges, and navigate to the history of their challenges or create future individual challenges. The details of the challenges users can create are introduced in chapter 5.3.3.

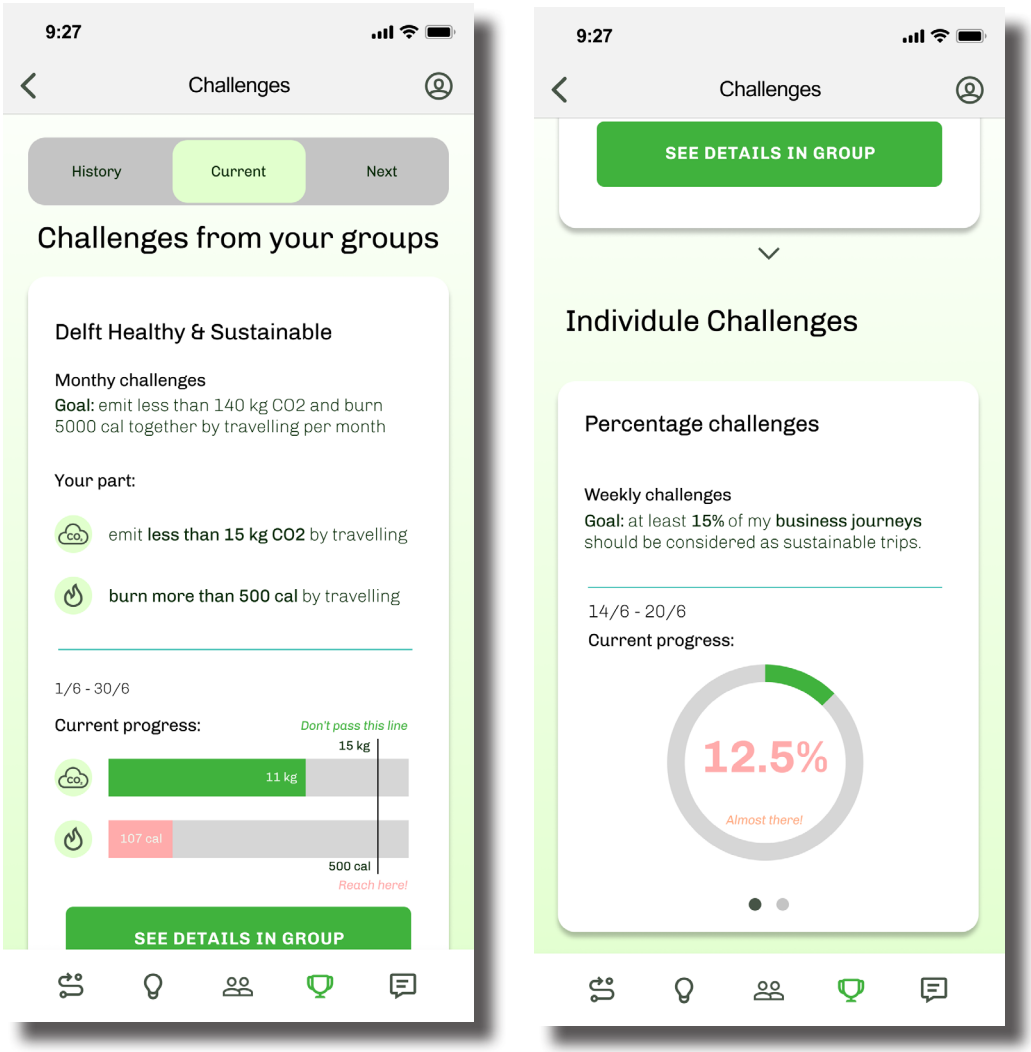


Figure 5.2.3-1 and 5.2.3-2 Challenge tab (Current challenges which include the divided goals from the group challenges and the individual challenges)

5.2.4 Insight

On the insight page, there are two major infographics. One is the overview of the three types of journeys (see figure 5.2.4-1), and the other is the overview of the kilometres & CO2 & calories (see figure 5.2.4-2). Both overviews can be swiped to the left, and more detailed information about the overview would be presented. The detailed information about these two types of infographics can be found in chapter 5.3.4. The users can easily select the time period and what types of journeys they would like to investigate by the filter on top (see the top of figure 5.2.4-1). Additionally, under the two major infographics, the information about what it means to emit a certain amount of CO2 are presented (see figure 5.2.4-3). This would help the users to understand the meaning behind the CO2 figures.

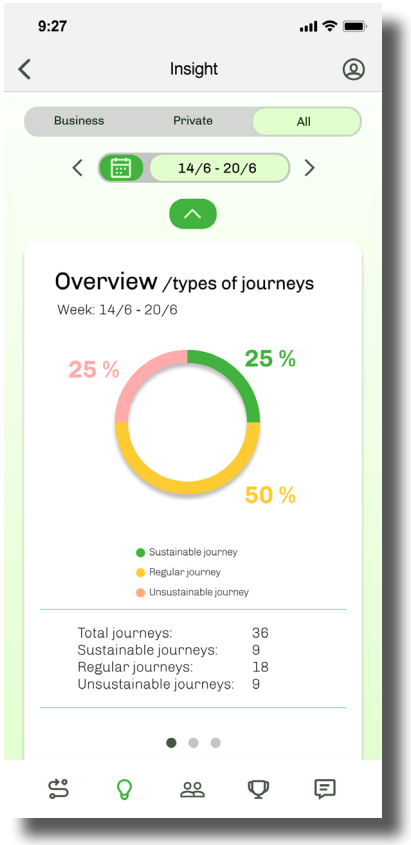


Figure 5.2.4-1 The overview of the three types of journeys

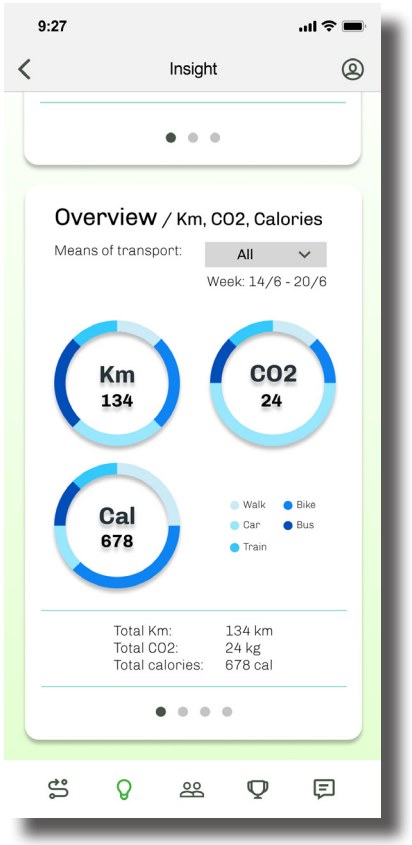


Figure 5.2.4-2 The overview of the kilometres & CO2 & calories

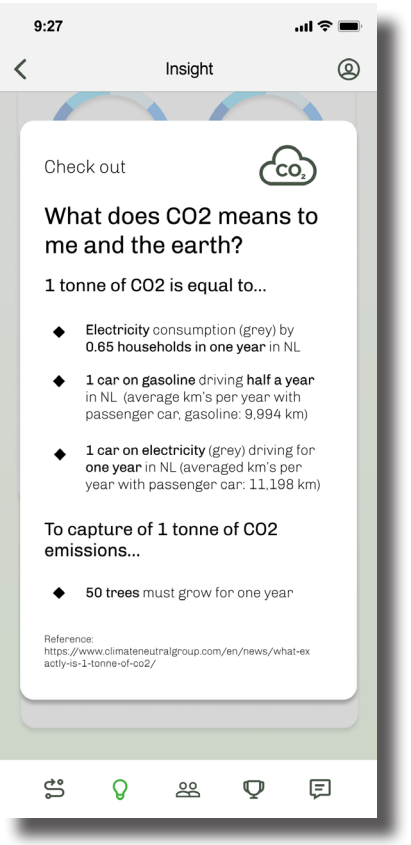


Figure 5.2.4-3 Information about the meaning behind the CO2 emission

5.2.5 Chat

The chat tab is there to enable users to send direct messages to each other. Since one of the core features of the final design is the community, the design would like to enable the direct messages function in case the user would not like to discuss some personal issue within the group. Figure 5.2.5 is the layout of the chat page.

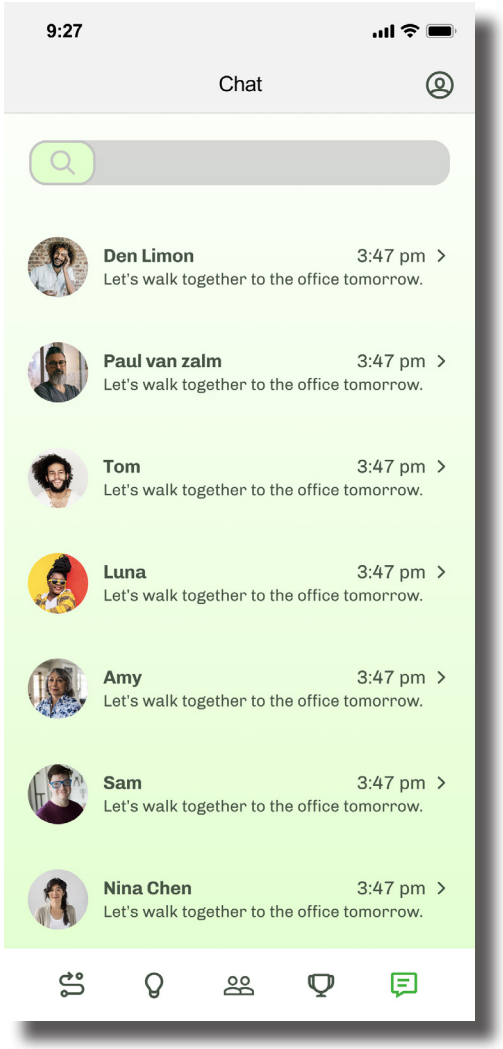


Figure 5.2.5 Layout of the chat page

5.2.6 Account

The layout of the account page and different options which users can modify can be seen in figure 5.2.6-1. Users can add and delete their private means of transport in the “means of transport” option. In “my location”, users can edit their home address and the address of their office. In the “privacy statement” users can view what data is being collected and select what data they would or would not like to share. In “my documents”, a list of the exported journeys can be found. The users can download it for travel reimbursement purposes (see figure 5.2.6-2). Furthermore, In the “setting”, users can edit the notification, password, their subscription, and the mode of distance calculation (see figure 5.2.6-3).

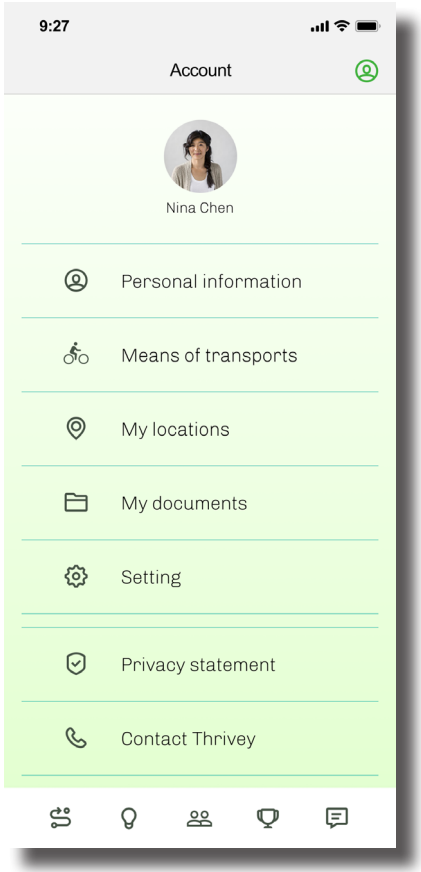


Figure 5.2.6-1 Layout of the account page

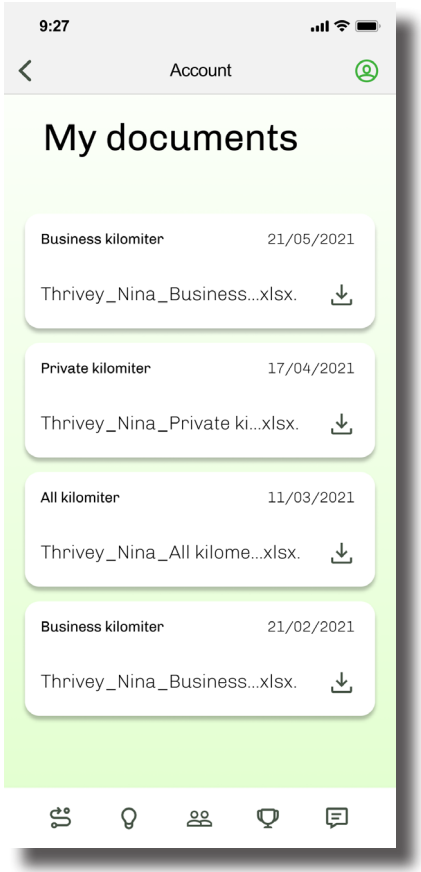


Figure 5.2.6-2 My documents: where users can find a list of the exported journeys

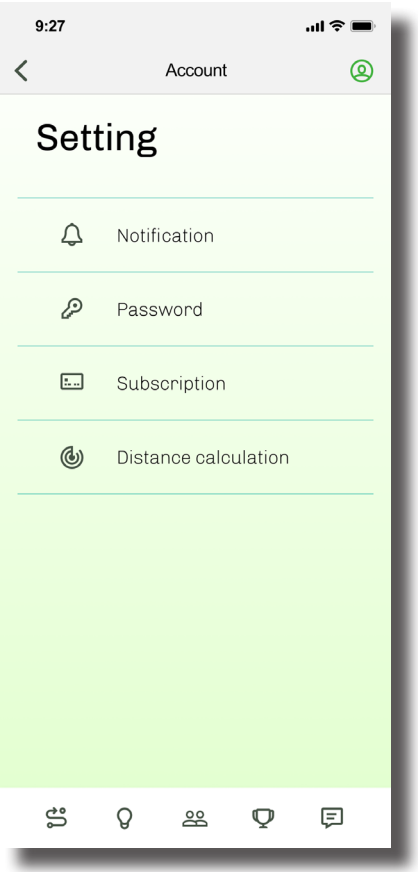


Figure 5.2.6-3 Setting: where users can edit the notification, password, their subscription, and the mode of distance calculation

5.3 Main Features and Values

The final design direction is to provide a better understanding of users themselves, other users, and the surroundings. As a result, Four crucial features were developed. These four features are “personalized advice & indicating restrictions”, “community”, “challenges”, and “informed infographic”.

5.3.1 Personalized advice & indicating restrictions

This feature is embedded in the Journeys tab (see chapter 5.2.1). There are two highlights in the Journeys tab. One is that the users can view advice regarding the trip they conducted. they can select the type of advice they would like to receive. For example, advice from the sustainability or healthy aspect. Through the advice, the comparison of the impact of different ways of travelling is presented (see figure 5.3.1-1). The second is that users can indicate the reason behind an unsustainable journey. Through the research, the complexity of travelling is comprehended. Therefore, by this design a channel to express this complexity and the restrictions users are facing is provided. Furthermore, an infographic in the insight tab is presented to inform users of the frequency of the restrictions they are facing (see figure 5.3.1-2). This is aiming to provide them with a perspective into why they cannot conduct more sustainable journeys.

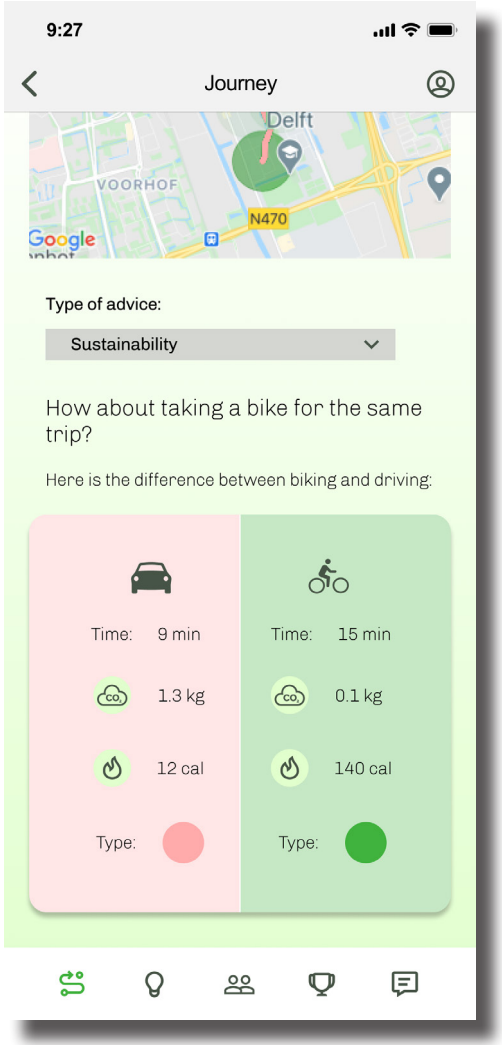


Figure 5.3.1-1 Personalized advice

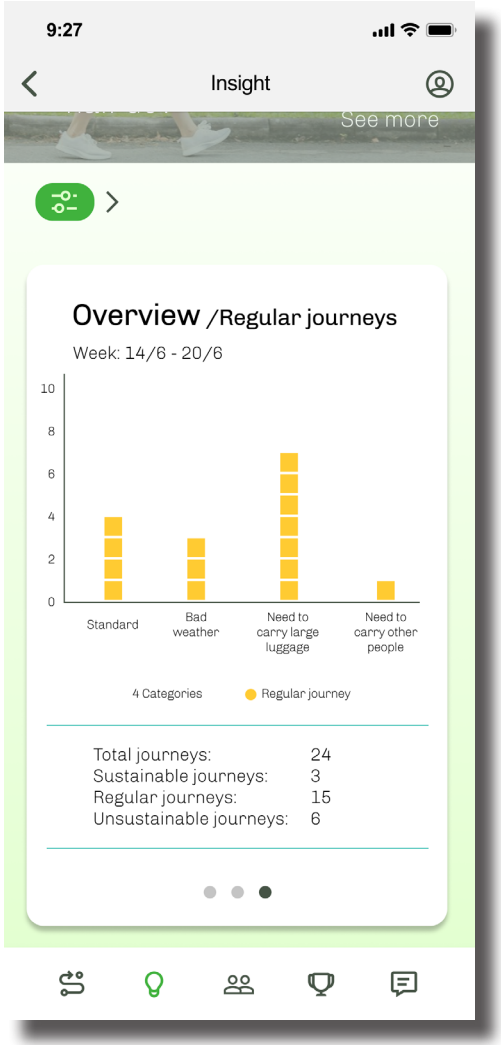


Figure 5.3.1-2 Infographic about the frequency of the restrictions

5.3.2 Community

The community feature is closely related to the challenges feature since once a group is formed, a group challenge needs to be created. All members in a group gather due to the group challenges. Furthermore, based on the previous research (see 3.3.2), a maximum number of members can be set by the group admin to keep the group manageable and effective.

Two highlights of the community feature are the informed infographic about the progress of the group challenges and the discussion area. Detailed information on the informed infographic can be found in 5.3.4.

The discussion area includes three default topics: “divide goals”, “adjust goals”, and “support each other”. (see figure 5.2.2-3). Under the “divide goals” topic, users can discuss and separate the work of the group challenges (see figures 5.3.2-1 and 5.3.2-2). Under the “adjust goals” topic, the group admin can adjust the group challenges and the group members can send suggestions to the group admin. Last but not least, under the “support each other” topic, connected with the insights gained from chapter 4.3.3, the application will send an invitation to the member who performs best on the group challenge and invite this member to share his or her experience. To reduce the effort of sharing experience, the application will select a few most sustainable journeys for this member to reflect on. Therefore, this member can recall the memory of these journeys. Under the shared experience, there will be an area for comments. Members of this group can send reactions, ask questions, and learn from each other (see figure 4.3.3-1 & 4.3.3-2).

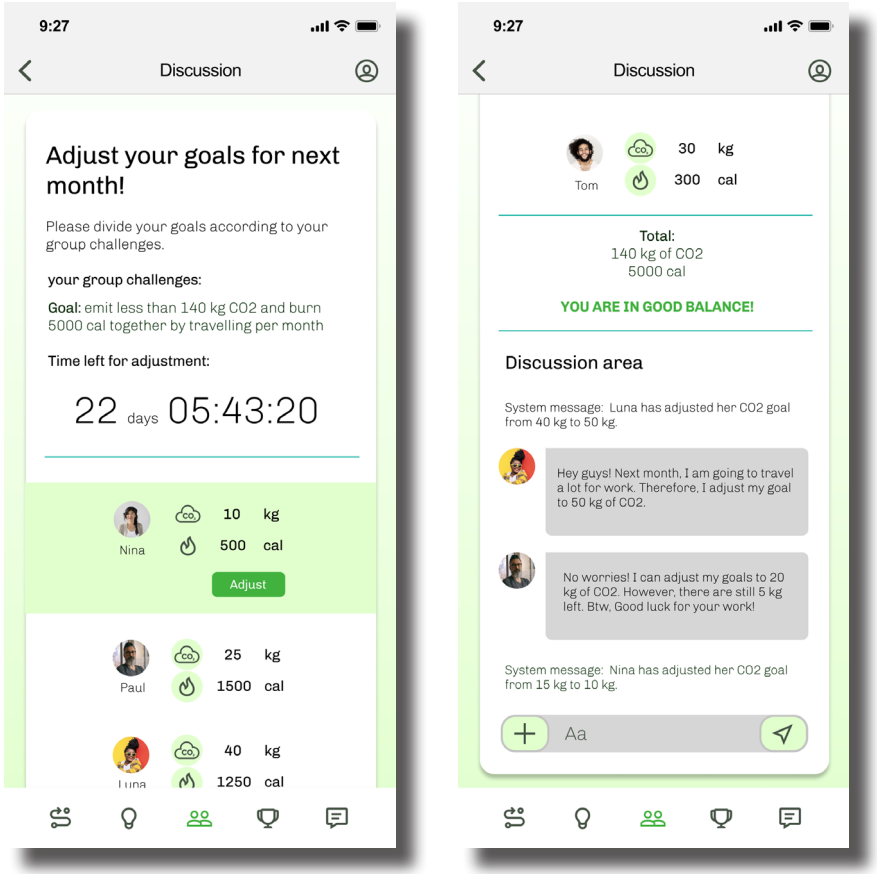


Figure 5.3.2-1 and 5.3.2-2 The divide goal function (users can discuss and adjust their parts of the goal)

5.3.3 Challenges

Providing personalized challenges is also one of the core features of this design. The challenges can be separated into two types: The group challenges and the individual challenges. Although there are two types of challenges, these two types of challenges are closely related to each other.

Group challenges

The group challenges are set by the group administrators and can be modified through discussion within the group. Once the group challenge is set, the member in the group can divide the work according to this challenge. The divided work will become member's individual challenges (see figure 5.3.3-1). Therefore, when the members are achieving their individual goals, they are also contributing to the group goals. Furthermore, this "divide goals (work)" function provides flexibility to all members. Members can divide the work (goals) based on their situation. For instance, if one member knows that next week one will be travelling a lot due to work reasons. This member can adjust one's goal according to it.

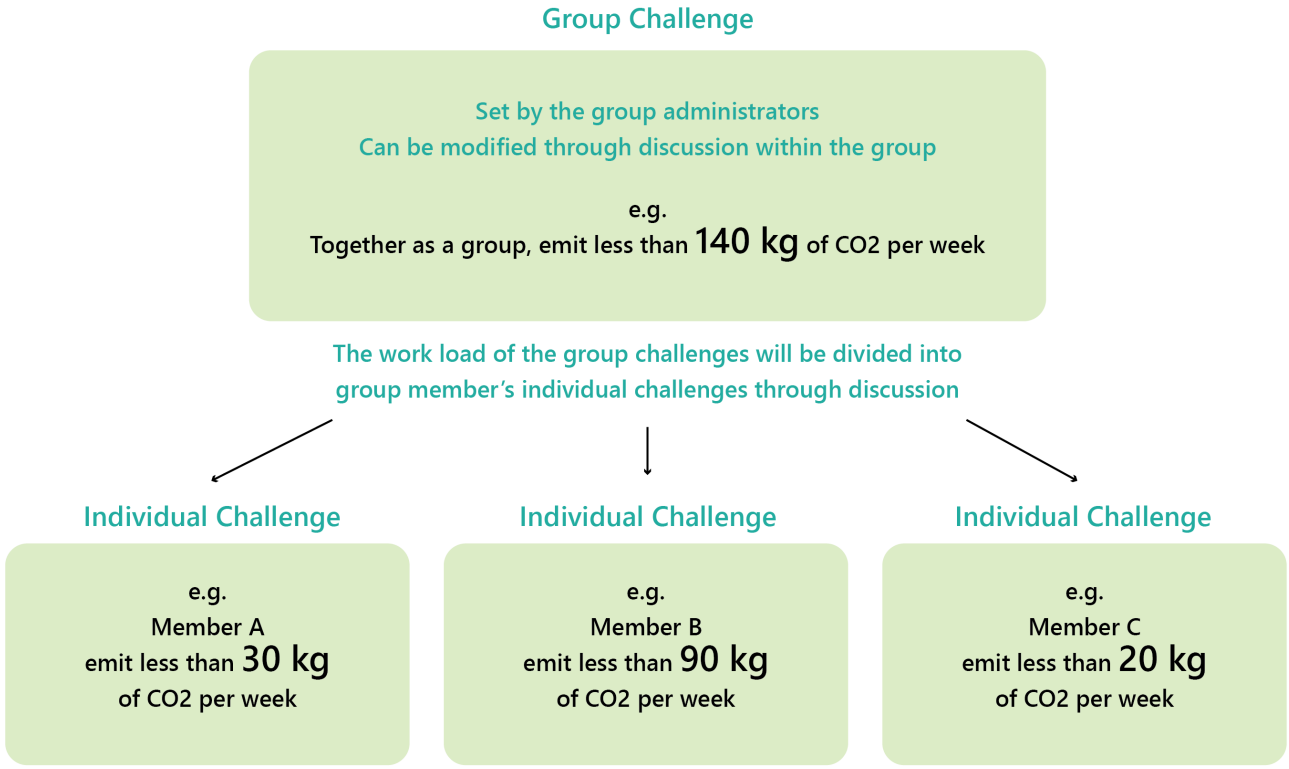


Figure 5.3.3-1 How does the group challenges be divided into individual challenges

Individual challenges

If the users or members want to set more challenges for themselves, joining another group and adding individual challenges are possible. There are four types of individual challenges, one is “self-improvement”, another is “percentage challenge”, the other is “Slide-it!”, and the last one is customized challenges. In this design concept, the application will suggest challenges based on users’ travel routines (see figure 5.3.3-2). The “self-improvement” challenge provides users with information about their past travel routine and suggests relevant challenges that can improve their travel impact little by little (see figure 5.3.3-3). The “percentage challenge” does not compare with the user’s past travel routine. However, it enables users to have a certain amount of journeys sustainable. For example, the users can set that they want to have 15% of their journeys sustainable. Therefore, the application will help the users to keep track of their progress (see figure 5.3.3-4). The “slide-it!” challenge provides users with a slide in which they can personalize their individual calories challenges by sliding it. The calories challenge is to burn calories via travel activities. Furthermore, the application will also inform the users of how much CO2 impact they would save by completing this challenge (see figure 5.3.3-5). The last one is the customized challenges, where the users can personalize their challenges. For example, to have five more journeys by bike than driving a car, etc.

Figure 5.3.3-2 Users’ travel routine which would form as the base for the Thrivey application to suggest challenges for the users

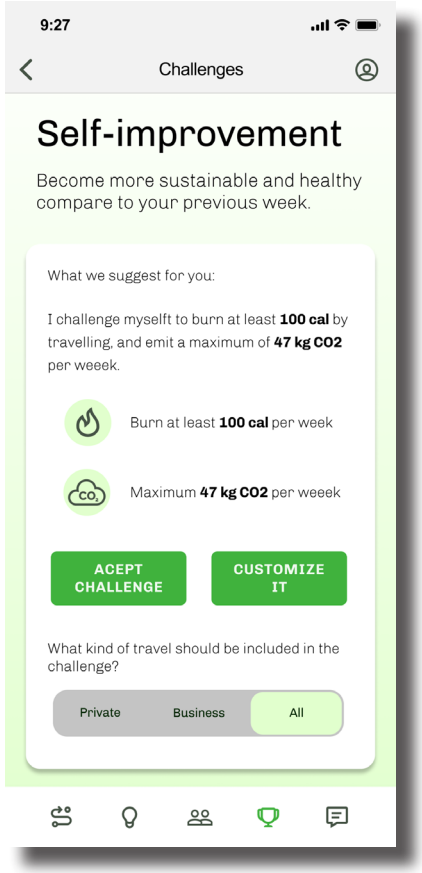


Figure 5.3.3-3 Challenges type: self-improvement

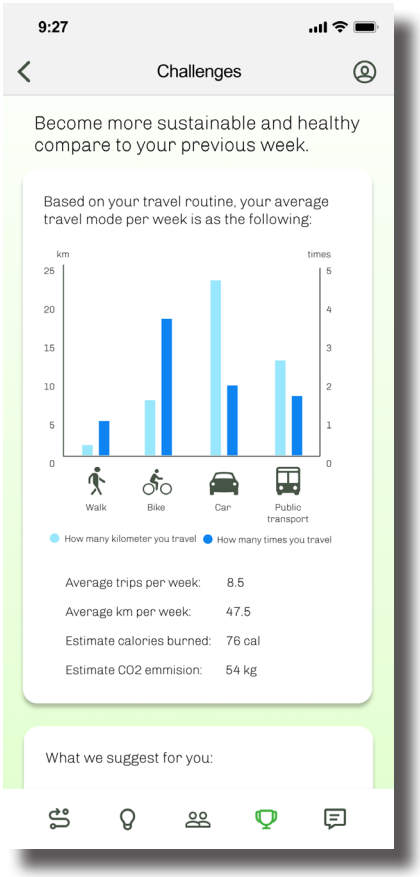


Figure 5.3.3-4 Challenges type: percentage challenge

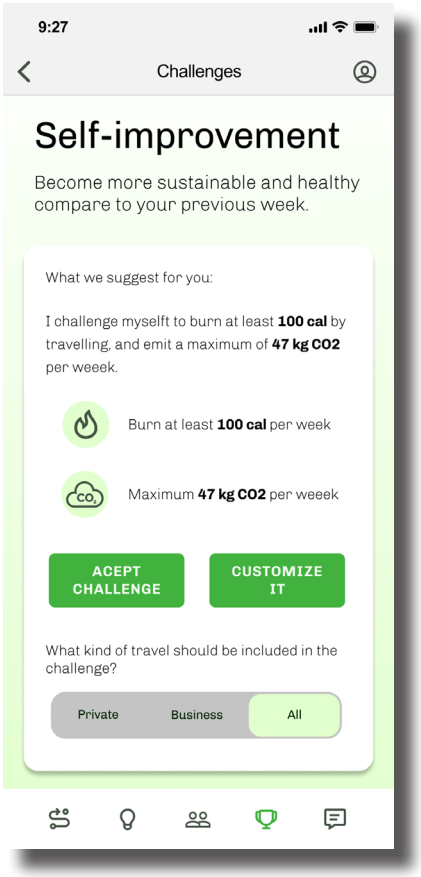


Figure 5.3.3-5 Challenges type: slide-it!

5.3.4 Informed infographic

Based on the design direction, to provide users with a better understanding of themselves, other users, and the surroundings, informed infographics were needed. This feature was implemented throughout the final design. Within the final design, the informed infographic can be divided into two major types: the overview of all the journeys conducted and the progress of the challenges.

Overview of all the journeys conducted

The overview of all the journeys conducted can be found in the insight tab (see 5.2.4) and divided into two categories. One is the overview of the kilometres & CO2 & calories, and the other is the overview of the three types of journeys: sustainable journeys, regular journeys, and unsustainable journeys. The types of journeys in this thesis report and the prototype are defined based on the Carbon footprint of travel per kilometre, 2018 (see figure 5.3.4), by Hannah Ritchie, Our world in

data [1]. The sources of data were published by UK Department for Business, Energy & Industrial Strategy (BEIS).

The journeys that emit less than 53 grams of carbon footprint per kilometre would be defined as sustainable journeys; The journeys emit between 53 grams and 105 grams of carbon footprint per kilometre would be defined as regular journeys; The journeys emit more than 105 grams of carbon footprint per kilometre would be defined as unsustainable journeys. One thing to note is that, in this thesis report, one way to define the three types of journeys was presented. However, this is only an example to defined the journeys and there is still room for debating.

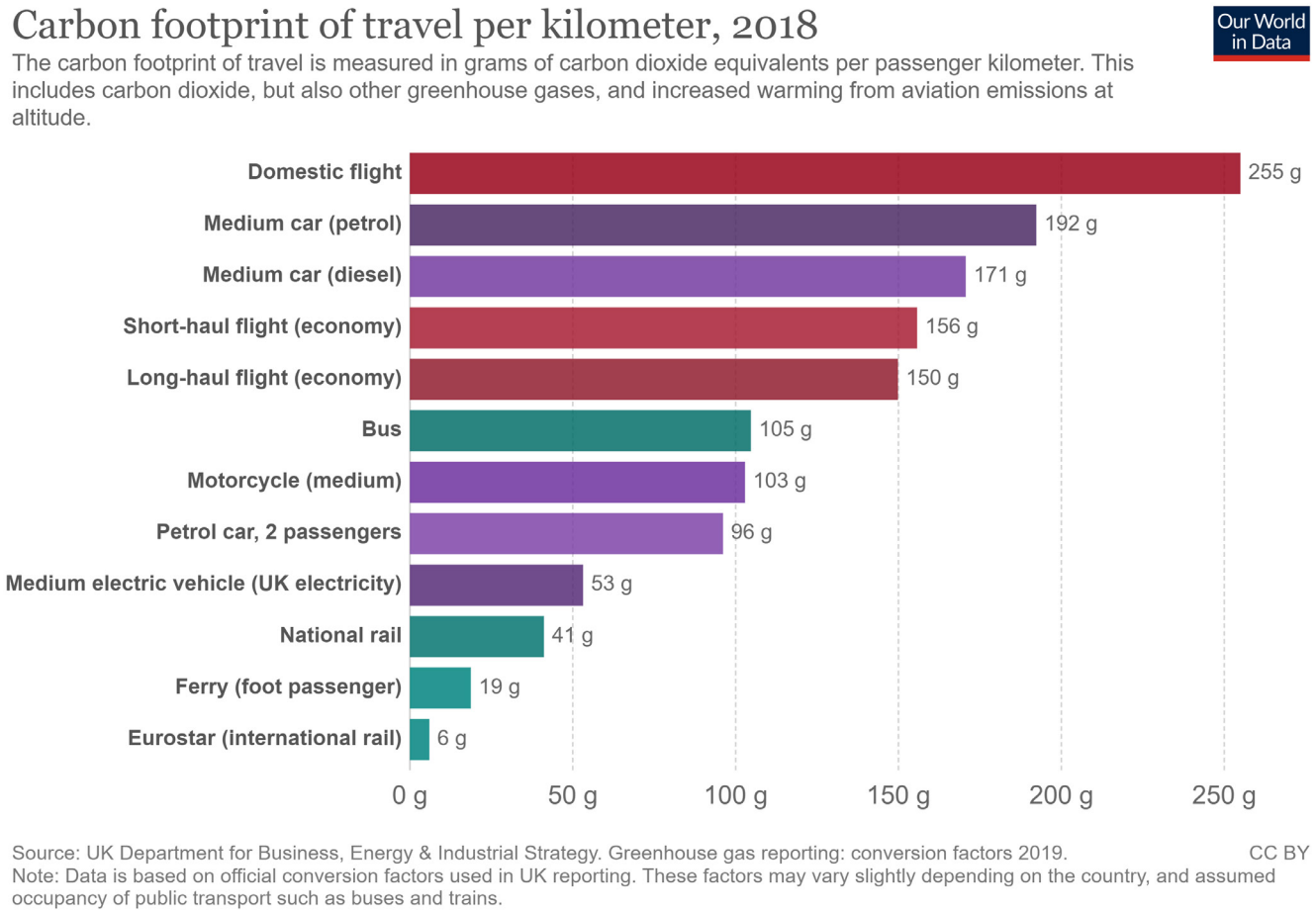


Figure 5.3.4 Carbon footprint of travel per kilometer, 2018, by Hannah Ritchie, Our world in data [1]

1. Hannah Ritchie, 2020, *Which form of transport has the smallest carbon footprint?*, Our World in Data, accessed 2 August 2021, <https://ourworldindata.org/travel-carbon-footprint>.

Figure 5.3.4-1 is an example of the **overview of the kilometres & CO2 & calories**. In figure 5.3.4-1 (left 1), the user can know how many kilometres one travelled, how much CO2 one emitted, and how many calories one burned through different means of transport. The pie chart makes it easier for the users to compare the impact of different means of transport. Additionally, when users click on the graph, the detailed figure and percentage will be presented (see figure 5.3.4-2). Once the users swipe left, they can view the details of kilometres (figure 5.3.4-1, left 2), CO2 (figure 5.3.4-1, right 2), and calories (figure 5.3.4-1, right 1) within the selected period. Moreover, the users can also select different means of transport they want to investigate.

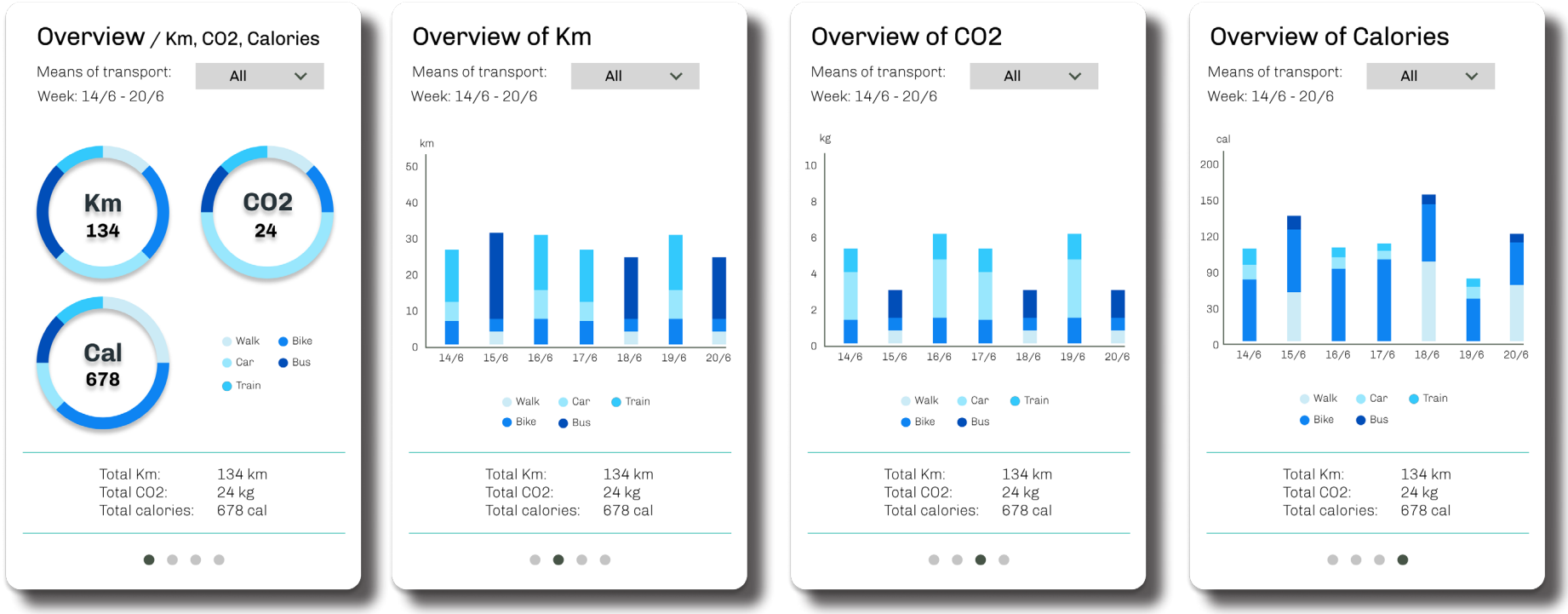


Figure 5.3.4-1 Infographic: an example of the overview of the kilometres & CO2 & calories

Figure 5.3.4-3 is an example of the **overview of the three types of journeys**. In this figure (left 1), users can view the percentage of different types of journeys they conducted in the selected time. Once they swipe left (see figure 5.3.4-3, middle), they can view the details of it with the time aspect included.

Another swipe (see figure 5.3.4-3, right), different categories of the regular journeys and how many journeys in each category can be found.

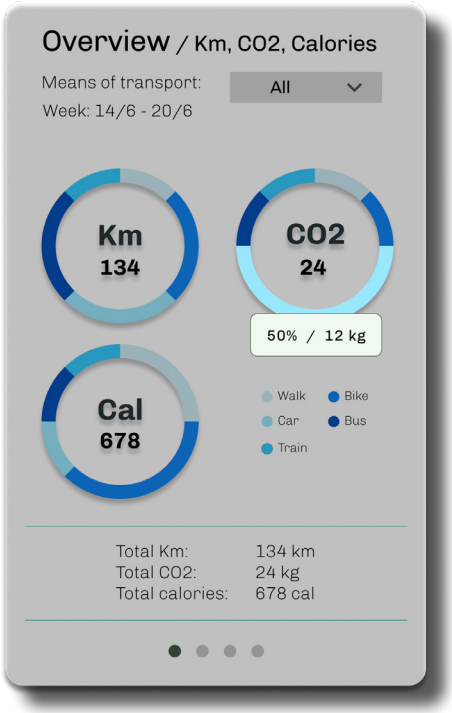
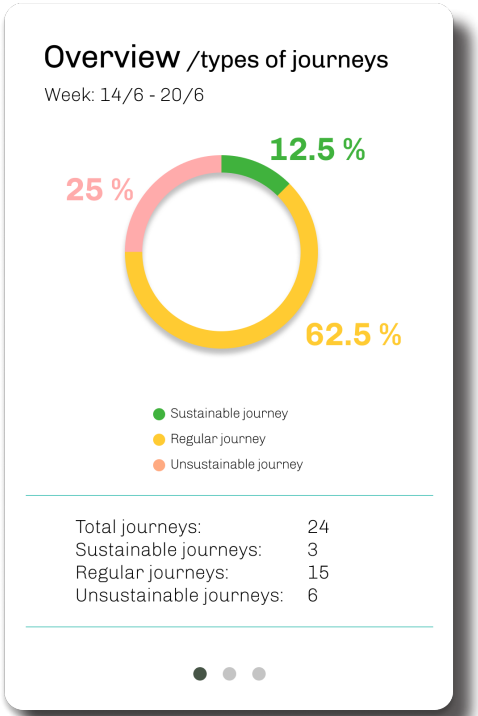
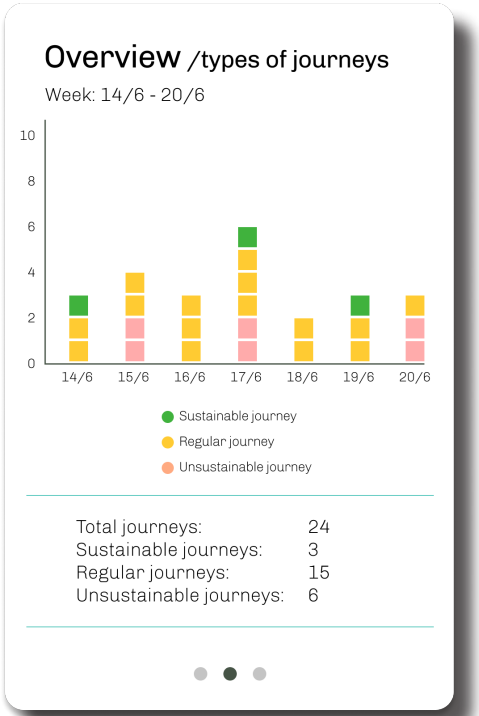


Figure 5.3.4-2 Detailed figure and percentage of the infographic





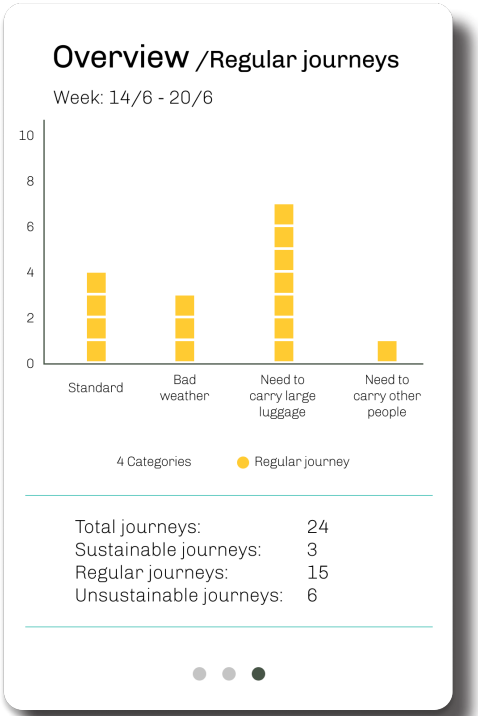


Figure 5.3.4-3 Infographic: an example of the overview of the three types of journeys

Progress of the challenges

There are two types of challenges in the final design. One is the group challenges, the other one is the individual challenges (more information about this can be found in 5.3.3). Therefore, the infographic for the process of challenges can also be divided into these two categories.

An example of the infographic for **the progress of the group challenges** can be seen in figure 5.3.4-4. In this figure (left) is the overview of the group challenge progress. This enables the users to quickly grasp the current situation of the group challenges. With a left swipe, the users can view the details of the group challenges progress (see figure 5.3.4-4, right). In this graph, the individual parts of the group challenges are presented. Users can understand the amount of work (divided goals) assigned to each person and whether they have completed it.

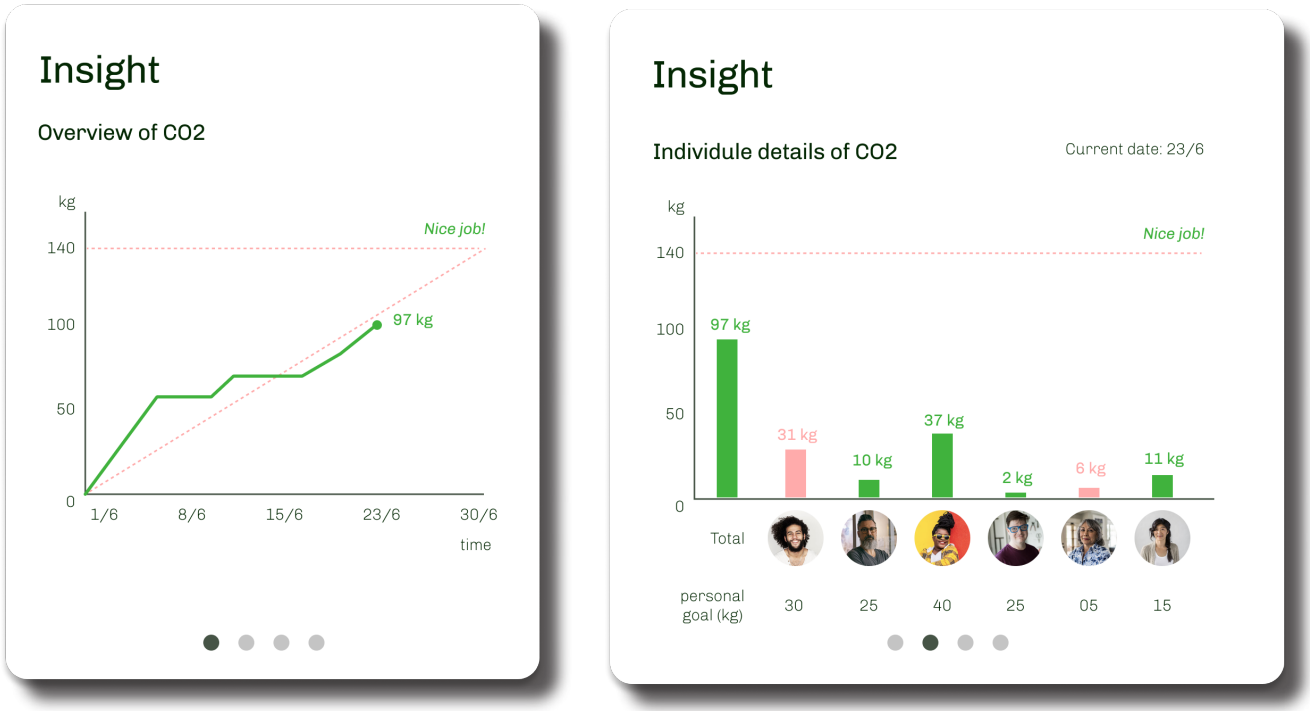


Figure 5.3.4-4 Infographic: an example of the progress of the group challenges

An example of the infographic for **the progress of the individual challenges** can be seen in figure 5.3.4-5. In this figure, the percentage challenge is presented. With this graph, users can easily understand the current progress of their individual challenges and see more detailed information when swipe left or use the button to navigate to the insight tab.

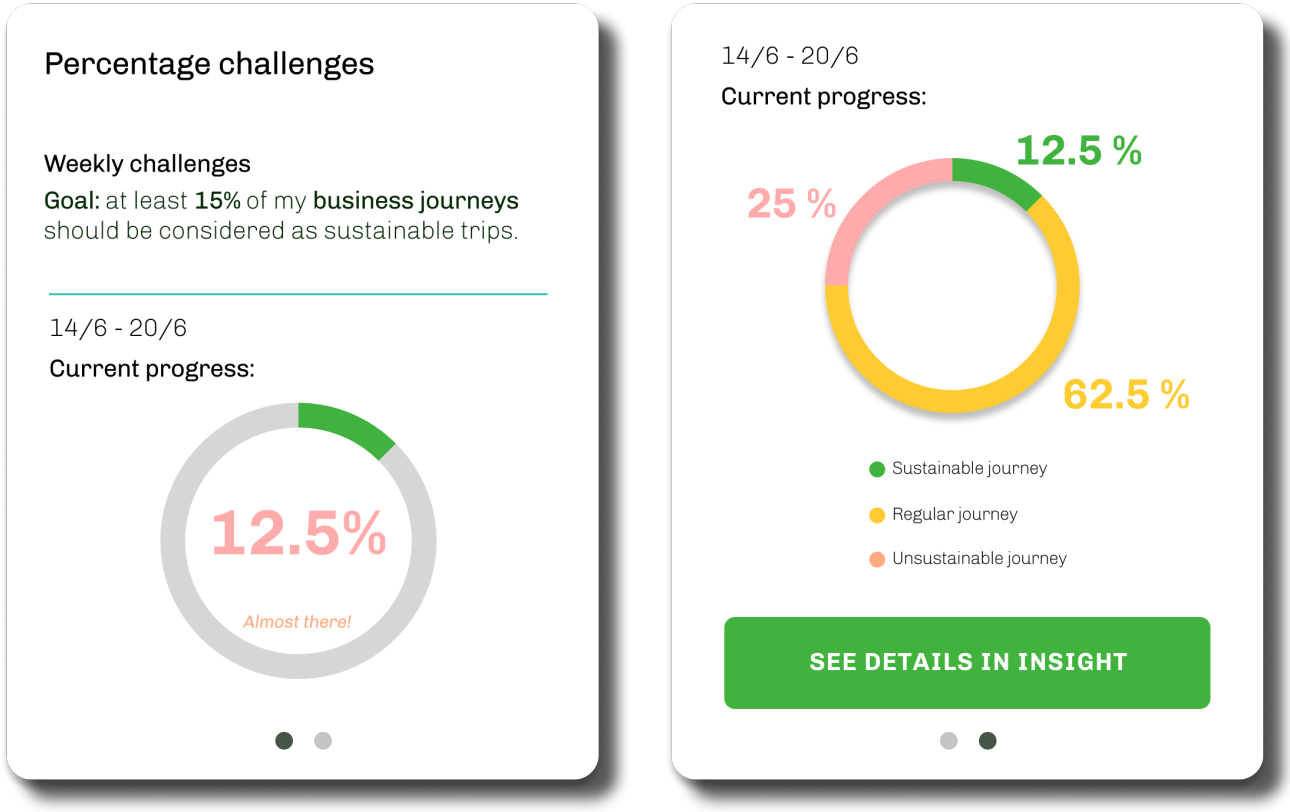


Figure 5.3.4-4 Infographic: an example of the progress of the group challenges

Chapter 6
Final Design Evaluation

The final design was evaluated through 6 online evaluation sessions. The evaluation validates if the design meets the project goals and desire effect, and provides knowledge on how the final design can be modified and improved.

6.1 Objectives & Research Questions

The final design evaluation aims to understand how the design prototype performs, how the design can support users toward sustainable mobility decisions, how users perceive the design, and if there are any usability issues of the design prototype. Therefore, research questions are formulated before setting up the final design evaluation:

- To what extent does the design and its core features (community/ informed infographic/ challenges/ personalized advice & indicating restrictions) support users toward sustainable mobility decisions? Why and why not?
- To what extent does the design activate the user's curiosity toward the connection between sustainable mobility and health? Why and why not?
- To what extent does the user feel they have a better understanding of themselves, other people, and the surroundings through the design? Why and why not?
- How do users feel after experiencing the design (in the following three aspects: relevant, motivation, and curiosity)?
- How do users feel about the design (in the following two aspects: novel and likeable)?
- To what extent do the users understand the design? Are there any usability issues?

6.2 Final Design Evaluation Setup

A graph (see figure 6.2) is made to illustrate the procedure of the final design evaluation session. The final design evaluation session was conducted six times with six different participants. All the sessions were conducted via the online meeting tools due to the COVID-19 pandemic.

6.2.1 Three tasks

The objectives of these three tasks were to understand how users interact with the design prototype and whether there are any usability issues. The three tasks were made based on three different scenarios according to the objectives. These tasks covered the four main features in the design (see chapter 5.3). The first task (see figure 6.2.1, top) focused on the journeys tab; The second task(see figure 6.2.1, middle) focused on the understanding of the informed infographic and the challenges; The third task (see figure 6.2.1, below) focused on the community and the group challenges.

6.2.2 Participants

Six participants (3 males, 3 females) joined the final design evaluation sessions. In the results (Chapter 6.4), the participants would be quoted as P1 to P6. The number of participants was reorganized again. Therefore, the P1 in the final design evaluation (chapter 6) might not be the same in other chapters. Same as the previous user-involved sessions, all six participants had signed the consent form before the session took place.

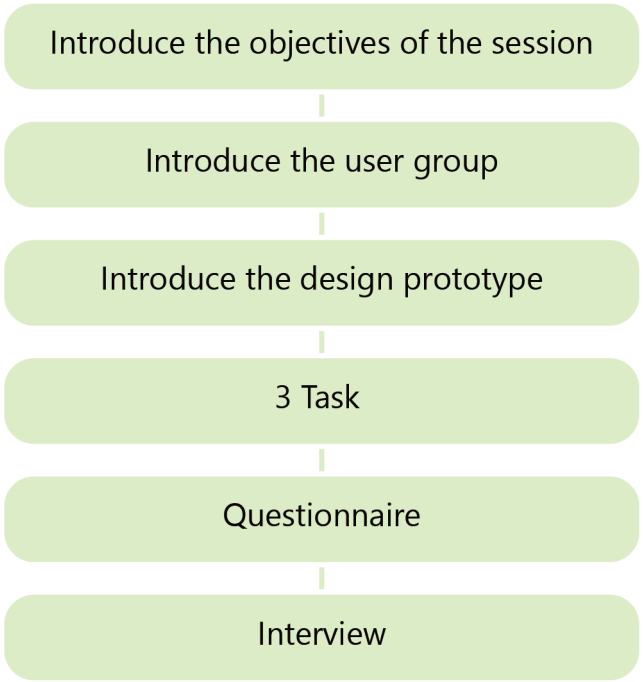


Figure 6.2 The procedure of the final design evaluation session

Task 1

Today (Sunday 20 June 2021) you made a **new journey**. You went by car for 4 km because you **need to carry large luggage**. You check the Thrivey app and found out it has been classified as an "**unsustainable journey**" and you want to **let Thrivey know your reason for it**. What would you do?

Task 2

You are having an **"individual percentage challenge: to have at least 15% sustainable journeys this week (14/6 - 20/6) for your business journeys"**. You check on your progress, however, it seems that you only have 12.5 % of your business journeys sustainable. Therefore, you want to **check the "overview of your business journey"** and see what happen.

Task 3

You have joined the group **"Delft Healthy & Sustainable"**.
Today, you want to **check on the progress of your individual and group challenge**. Also, you noticed the "divide work" for the group challenge is not in balance now. Therefore, you want to adjust your part of the group challenge from "**15 kg of CO2" to "10 kg of CO2"** because you know you are going to work from home **next month** and you will be travelling less.

Figure 6.2.1 The description of the three tasks

6.2.3 Data collection

The data collection methods included questionnaires, interviews, and observations. The questionnaires are modified AttrakDiff scale [1] (ranging from -3 to 3); The interview questions were formed based on the research questions in chapter 6.1; The observation was conducted during the three tasks. The participants were invited to share their screens (via the screen sharing function in the online meeting tool, zoom) while they were interacting with the prototype.

6.3 Results

The results of the final design evaluation sessions could be separated into three sectors. One is the observation, another is the questionnaires, and the other is the interviews. The results would be documented in black text and the green text is the interpretation by the researcher, Min.

6.3.1 Observation

The observations were conducted when the participants were interacting with the prototype. Table 6.3.1 showed the results of the observations, including whether the participants completed the tasks and what issues they faced during the tasks.

All the participants completed the three tasks. Moreover, an interesting fact to report was, during task 2, P1 was viewing the graph in the insight tab (see figure 6.3.1-1) and she mentioned that “Maybe I should take more sustainable journeys when it is in bad weather. If this can help me to reach my goals.”

This showed that the graph with the categories of reasons provides users with a new perspective into her travel behaviour which motivated her to conduct more sustainable mobility decisions to reach her goals.

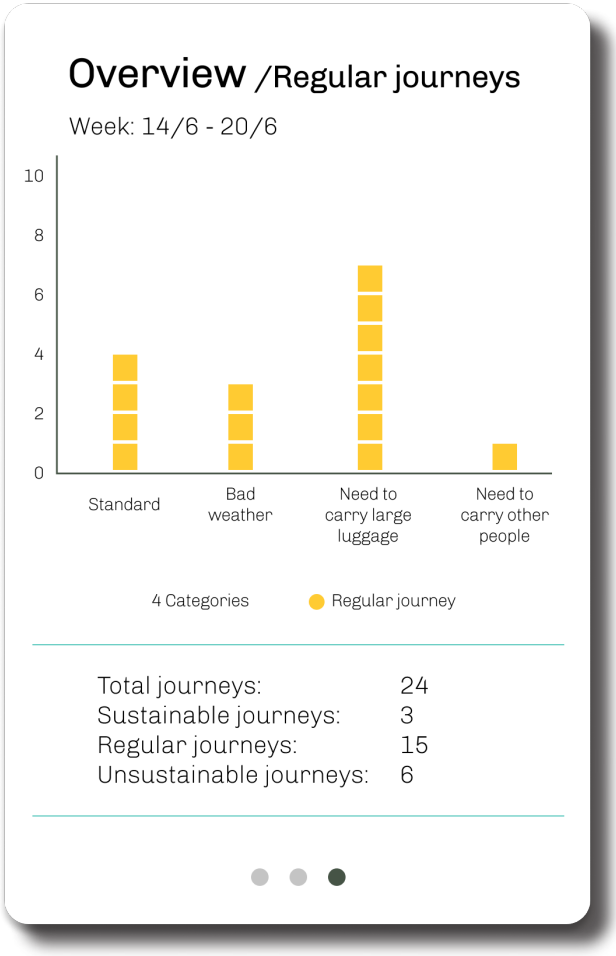


Figure 6.3.1-1 Infographic: the numbers and of the different categories of the regular journeys

	P1	P2	P3	P4	P5	P6
Task 1	✓	✓	✓	✓ P4 felt weird that after she indicated the reason for an unsustainable journey, that journey turned into a regular journey.	✓	✓
Task 2	✓	✓	✓ P3 completed task 2. However, he doesn't know if Task 2 is completed or not.	✓	✓ P5 wanted to find the overview of the journey. However, he went to the journey tab instead of the insight tab.	✓
Task 3	✓	✓	✓	✓	✓ P5 was stuck in the challenges tab because he wants to adjust his part of the group challenge in the challenges tab.	✓ P6 was confused by the "adjust challenge" button and the "divide goal" button.

Task completed: ✓ Task not completed: ✗ If the task is completed without any issue then it would only be marked with a ✓

Table 6.3.1 Results of the observations, including whether the participants completed the tasks and what issues they faced during the tasks

Nevertheless, some participants faced some issues during the tasks. When P3 completed task 2, he doesn't know if Task 2 is completed or not. He found the overview of the business journeys for 14/6-20/6. However, the overview did not show if this is the business journeys or private journeys (see figure 6.3.1-2). Therefore, he was confused.

The graph in figure 6.3.1-2 is the overview of the business journeys. Therefore, it should include the information of the type of journeys (business, private, or all) on the graph.

During task 1, P4 felt weird that after she indicated the reason for an unsustainable journey, that journey turned into a regular journey. She stated that an unsustainable journey would remain unsustainable, it should not turn into a regular journey due to indicating the reason.

The idea above was agreed upon by the researcher. It would feel like cheating if users can turn an unsustainable journey into a regular journey. Therefore, a way to improve it is to separate the journey with reasons and other journeys.

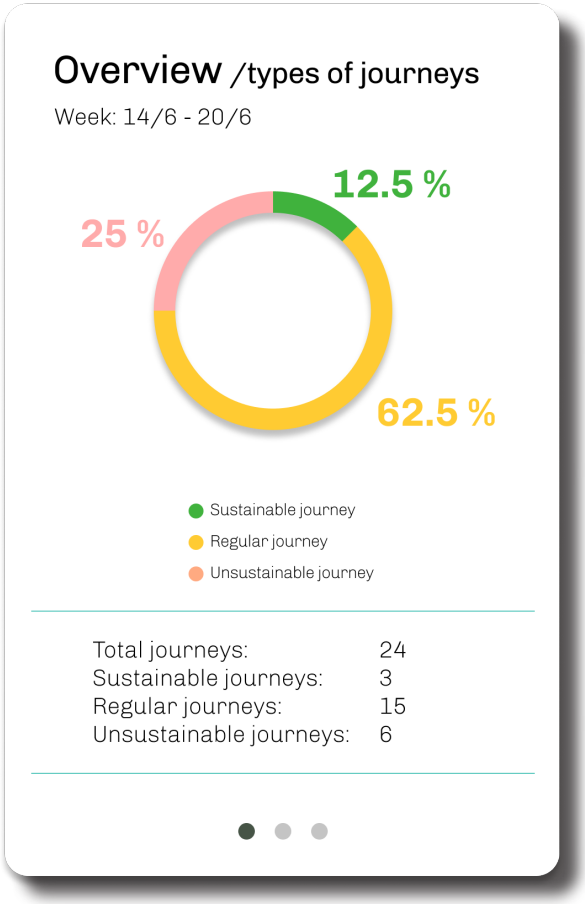


Figure 6.3.1-2 Infographic: the overview of the types of journeys for the business journeys

During task 2, P5 wanted to find the overview of the journey. However, he went to the journey tab instead of the insight tab (the overview of the journey is under the insight tab).

This showed that users might not feel intuitive to check the overview of the journeys in the insight tab. A possible reason could be, in the task description of task 2, it said "check the overview of your business journeys". With the word "journey", P5 might immediately think of the previous task (task 1) which was all about the journey tab. Therefore, the description of task 2 can be altered and a link that navigates users from the journey tab to the insight tab could be added.

During task 3, the task was about adjusting a part of the group challenges. The group challenges could be adjusted in the community tab. However, P5 wants to adjust his part of the group challenge in the challenges tab.

This showed that the design is not intuitive enough. The users should be able to adjust the challenge both in the community tab and in the challenge tab since the group challenges are related to both of the tabs.

Last but not least, during task 3, P6 was confused by the "adjust challenge" button and the "divide goal" button (see figure 6.3.1-3). He clicked into the “adjust challenge” button and found out it was not the function he was looking for, and then he clicked into the “divide goal” button and completed the task.

This indicated that the buttons "adjust challenge" and “divide goal” would make the user confused since they shared similar interpretations. Therefore, these buttons need to be redesigned in the future.

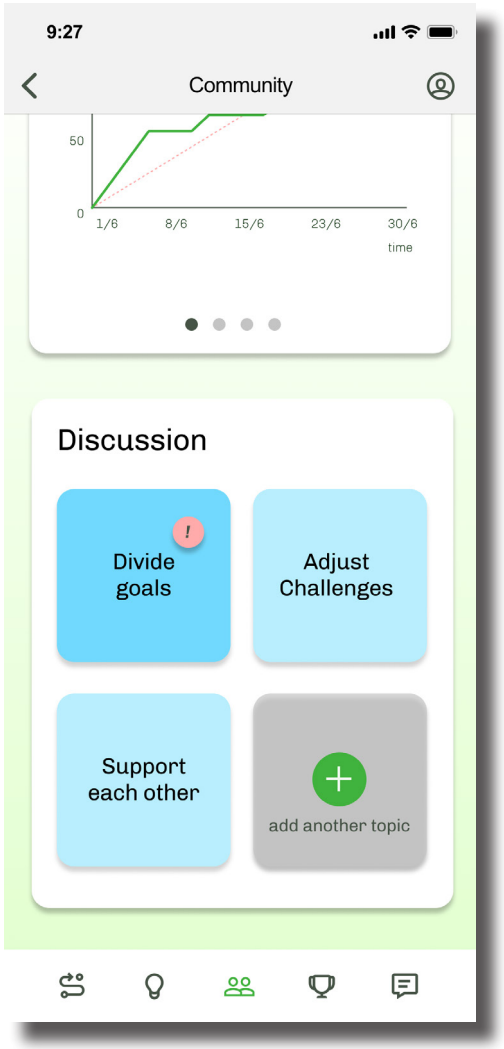


Figure 6.3.1-3 The "adjust challenge" button and the "divide goal" button in the community tab

6.3.2 Questionnaires

The results of the questionnaires can be separated into two parts. One is the evaluation regarding the design prototype. The other is, in what stages (the five stages of behaviour change by Prochaska's and Velicer's [2]) the participants are after participating in this project for over 3 months.

Evaluation regarding the design prototype

Figure 6.3.2-1 showed the results of the averaged scores by the 6 participants.

All the scores are above zero which indicated that the prototype provided the expected effect that the project aims to achieve. Nevertheless, this qualitative evaluation with six participants cannot guarantee an absolutely effective solution. However, the results showed that the design outcome is a potential direction to evoke users' motivation toward sustainable mobility decisions and support them toward the process. This can

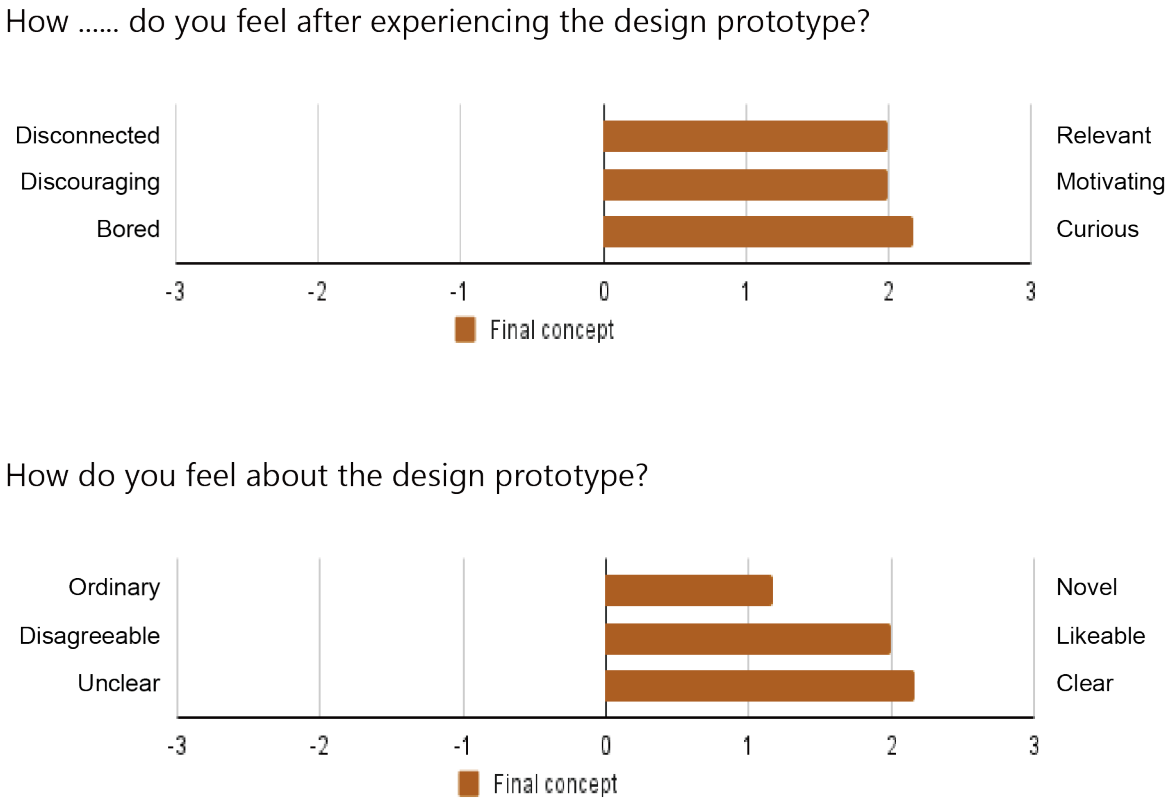


Figure 6.3.2-1 Results of the averaged scores by 6 participants

form a starting point for future research in the sustainable mobility sector.

Based on the results of the questionnaire, the participants felt relevant (connected to the design prototype), motivating (toward sustainable mobility decisions), and curious (want to know more about what the design can provide) after trying out the design prototype.

Furthermore, the design prototype was considered novel, likeable, and clear to the participants. However, the average score for "novel" is approximately 1.17, which is the lowest score compared to all other indexes. This indicates that the novelty of the design prototype can be improved.

Furthermore, a comparison of the averaged score of the final concept and the three concepts in design cycle 1 (see chapter 3.2) was presented in figure 6.3.2-2.

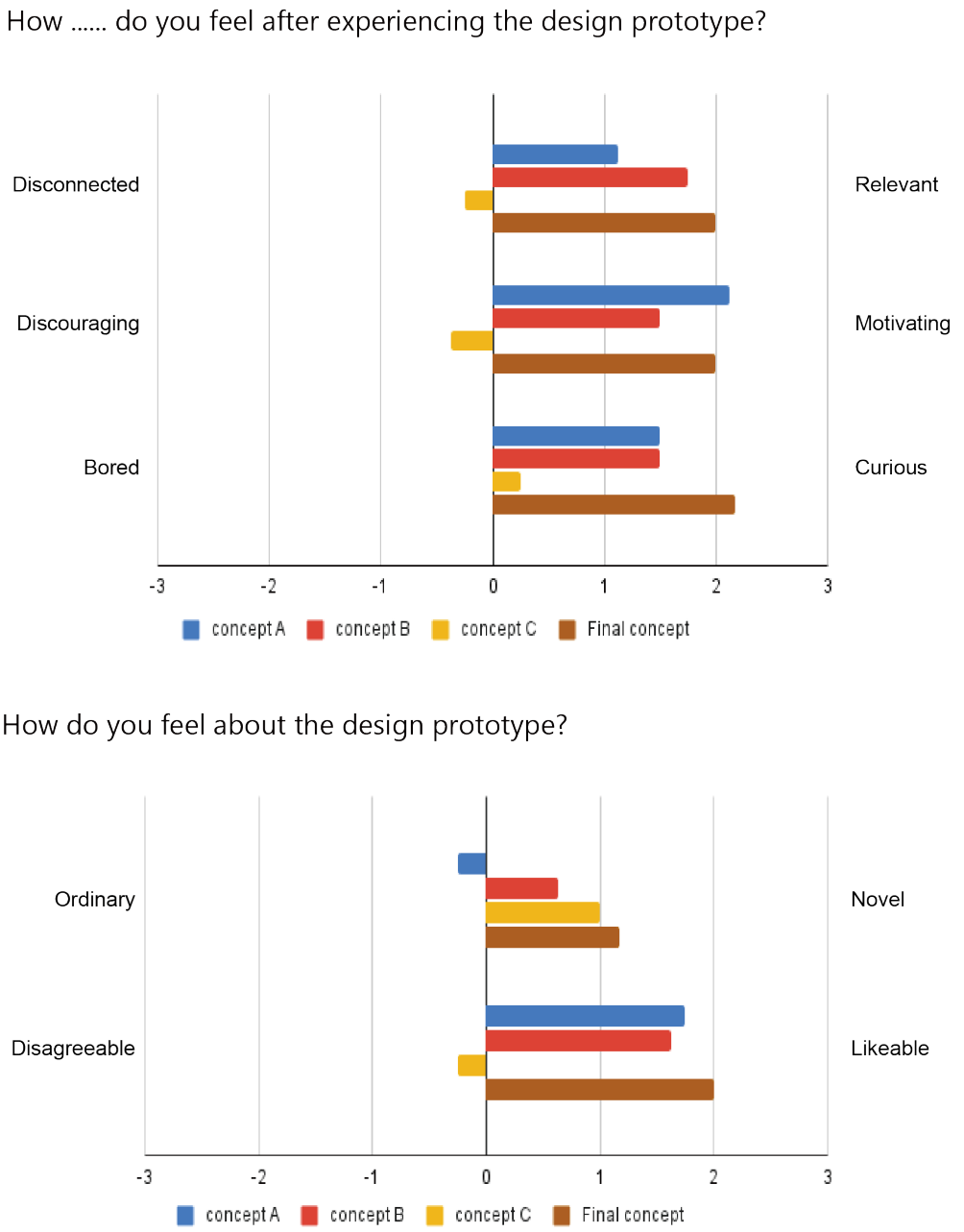


Figure 6.3.2-2 Comparison of the averaged score of the final concept and the three concepts in design cycle 1

Based on the results in figure 6.3.2-2, the final concept (illustrated as the design prototype to the participants) has the highest scores in the following indexes: relevant, curious, novel, and likeable. However, in the index of "motivating" (which indicates "how motivating the participants felt after experiencing the concepts? ") concept A in design cycle 1 (see chapter 3.2.2) had a slightly higher score than the final concept.

Overall the comparison of the results of the questionnaires showed that the final concept is an improved version of the previous three concepts. An interesting point to discover is that, although the final concept included most of the features in concept A, based on the questionnaires, concept A had a slightly better effect on motivating users towards sustainable mobility decisions. This indicated that users felt most motivated by the "personalized advice" since it is the core feature of concept A.

Five stages of behaviour change

A questionnaire was filled in by all the participants, except P6, at the beginning of the project. The questionnaire aims to understand which stages (the five stages of behaviour change by Prochaska's and Velicer's [2]) the participants were in at the beginning of the project. The same questions were asked again in the questionnaire of the final design evaluation sessions. Figure 6.3.2-3 showed the comparison of what stages the participants were in at the beginning of the project and the end of the project. However, P6 did not fill in the first questionnaire. Therefore, for P6, only the stage at the end of the project was presented.

Pre-contemplation refers to having no plan to travel more sustainably; Contemplation refers to have not started to travel more sustainably but intending to start soon; Preparation refers to trying to travel more sustainably but not yet being regularly active; Action refers to being regularly active to travel more sustainably but for a period less than six months; Finally, maintenance refers to being regularly active to travel more sustainably for the last six months or more [2, 3].

Based on figure 6.3.2-3, P1 and P3 had changed their behaviour stages toward travelling more sustainably. However, P4 and P5 had changed in an opposite direction. Furthermore, P2 did not feel that she had changed through the project.

The result showed that participating in this project, using the Thrivey application (the released version in March to July 2021), and experiencing the three concepts and the final design prototype influenced P1 and P3 to travel more sustainably. However, for P4 and P5, they returned to the preparation stage and action stage. As for P2, participating in the project does not influence her to change her stage.

Nevertheless, there are doubts about these results because the participants might have a new understanding of their travel behaviour and what sustainable mobility is through the project. Therefore, they might have a different understanding of the behaviour change stages at the end of the project. For example, participants might have felt they were doing sustainable mobility for over six months, however, through the project, they understood they were not. Therefore, this might lead to the results in figure 6.3.2-3. The same could apply oppositely.

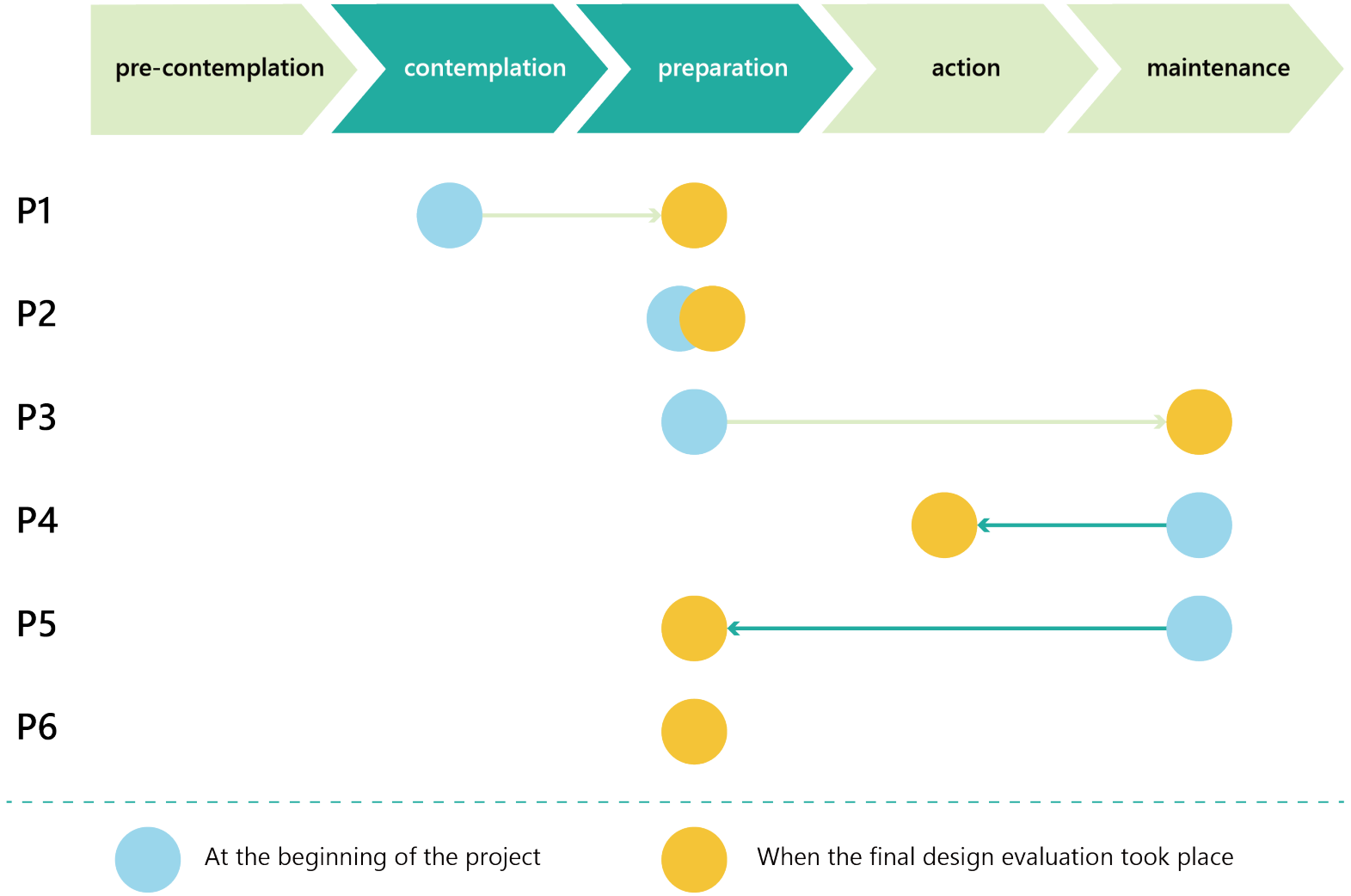


Figure 6.3.2-3 Comparison of what stages the participants were in at the beginning of the project and the end of the project

6.3.3 Interviews

The interview results can be separated into the following 7 sectors according to the research questions in chapter 6.1.

The details of the interview questions and the interview results can be found in Appendix E.

Support toward sustainable mobility decisions

The main goal of this project is to understand how self-tracking travel data can support people toward sustainable mobility decisions. Therefore, one of the research questions in the final design evaluation aimed to understand what features in the final design make users feel support toward sustainable mobility decisions.

For P1, the community and the group and the individual challenges support her the most. She mentioned "I think the main few features that would support me are the community and the group and the individual challenges. Because I think those were very clear in how I can compare to the rest (other people) or how I can compare to my own ambitions. So from those, I could get useful insights into what I should do to improve." However, for P3, the community does not support him much, but the individual challenges do. He stated "I'm a self-motivated person, and I'm not part of any group. So at the moment, I'm most interested in my individual challenges. The app can help me keep track of my routes and help me to reach those goals."

As for P2 and P5, the personalized advice made them feel most supported. For instance, P2 mentioned "Well, I think it's nice that you compare, for example, the car and the bicycle, and you have information about how many kilograms of CO2 you're meeting or not, and how many calories you're burning or not. So I think the last one (personalized advice), I think it really supports me towards (sustainable mobility decisions). It's also easy to understand, like, right away." Furthermore, P5 stated that it would be nice to see the traffic conditions for different means of transport.

Furthermore, P2, P4, and P6 considered the informed infographics support them toward sustainable mobility decisions. For example, P6 mentioned that "It's good to see how your weekly results are and what you have to do in the last week or days of the month to reach your goal. And it's with the whole group (the progress graph of the group challenges), I think it will motivate a lot."

Through the evaluation, all four features of the design showed that they could make users feel supported toward sustainable mobility decisions. However, different participants feel supported by different features.
Some participants preferred the feeling of "togetherness", however some participants focused more on self-achievement. Therefore, they have different preferences. Furthermore, the informed infographics were considered supportive by three participants. This showed that the visualized information is indeed crucial when it comes to designing a mobility tracker.

Activate Curiosity

The design goal (see chapter 3.1) of this project is to activate user's curiosity about how sustainable mobility decisions can influence their health condition when interacting with the Thrivey application. Therefore, one of the research questions in the final design evaluation aimed to understand how the design activates the user's curiosity toward the connection between sustainable mobility and health.

For P1, P2, P3 and P6, they felt that the calorie information provided in the "personalized advice" was interesting and would motivate them toward sustainable mobility decisions. For instance, P3 mentioned that "Yes, of course (whether the participant feels curious to know how much calories they can burn by different ways of travelling). I want to stay healthy and this is part of it. I don't want to gain "COVID kilos" (add weight during the COVID-19 pandemic), that's one of the reasons I started walking." However, P2 and P4 stated that, for them, the CO2 information is more important than the calories information since their objective to use the mobility trackers are to become more sustainable in travelling.

For P5, he did not care about the calories. However, he considered other people would care about it. Furthermore. he considered that it is weird knowing that people also burn calories while driving a car.

Through the evaluation, the "personalized advice" in the journey tab was considered the most effective feature to active users' curiosity. Four participants felt that it is useful and interesting to know the calories you can burn by different ways of travelling. However, two participants who care more about the sustainability aspect stated that they care more about the CO2 information; one participant felt that it is weird to know that people also burn calories while driving a car. In fact, people burn calories even when they are just breathing. Therefore, whether to present the little number of calories burned by driving a car still needs to be discussed with the company, Thrivey.

A better understanding of oneself

The final design direction (see chapter 4.4) of this project is to provide a better understanding of ourselves, others, and our surroundings in the sustainable mobility aspect. Therefore, one of the research questions in the final design evaluation aimed to understand whether users feel they have a better understanding of themselves through the design, and why or why not they feel so.

For P1, P2, P3, P4, and P6, they considered that the "informed infographics" in the design helps them to have a better understanding of their travel behaviour. P3 stated that "Of course it does (help you to have a better understanding of yourself). Because it gives you insight into what you are doing. And you could see where you could improve." Also, P6 mentioned that "It was a nice surprise about the overview where you can see the reasons why you use the car. So when you have a look at one trip, it's okay to use the car. But when you have an overview, and you see what you have done in a month. And you see that you had 50 trips and you use just one time the bicycle. And you see what the reasons are, like the weather or go with other people with a car. And I think you realized: okay, I did something

wrong. Because I have my goals to take more bicycles, then go by car. So I think it helps. I think you're more straight to yourself because of this."

However, there is room for improvement for the informed infographic in the design prototype. P5 considered the design offensive since all the journeys would be classified by colours (the colours represent unsustainable, sustainable or regular journeys). P5 mentioned, "Let me judge for myself because I'm the only one who can judge why I did what I did." On the other hand, however, P4 showed her appreciation for the classification of the journeys. She mentioned "I personally like the graph that shows the proposition of sustainable versus unsustainable as well as regular journeys. And that's a very basic general overview of how I am doing."

Furthermore, three aspects that can be improved in the design prototype were pointed out by the participants. First, P1 said it would be useful to add a graph that shows the "time spent for each means of transport." Second, P3 considered the bar chart would be easier to read if the bars are not stacked on each other, but are sticked slightly next to each other. An image is made to illustrate how the above idea looks like (see figure 6.3.3-1). Third, P5 suggested that the infographic should show the comparison of users' current and previous travel behaviour.

Through the evaluation, the "informed infographic" was considered the most effective feature to provide users with a better understanding of their travel behaviour. Through P6's statement, it showed that the informed infographic can reveal and present the real situation of users' travelling activities which they are not aware of. This can provide users with a new perspective on their travel behaviour. Furthermore, it is crucial to consider users' feelings when designing the classification of the journeys. Although only one of the participants felt offensive with an "unsustainable label" on the journeys. This showed that the way to present and communicate users' behaviour can be improved. Last but not least, 3 aspects that can be improved in the design prototype were pointed out by the participants. These three aspects were considered useful in terms of providing a better understanding of users' travel behaviour. Therefore, they would be added to the final recommendation of this thesis report.

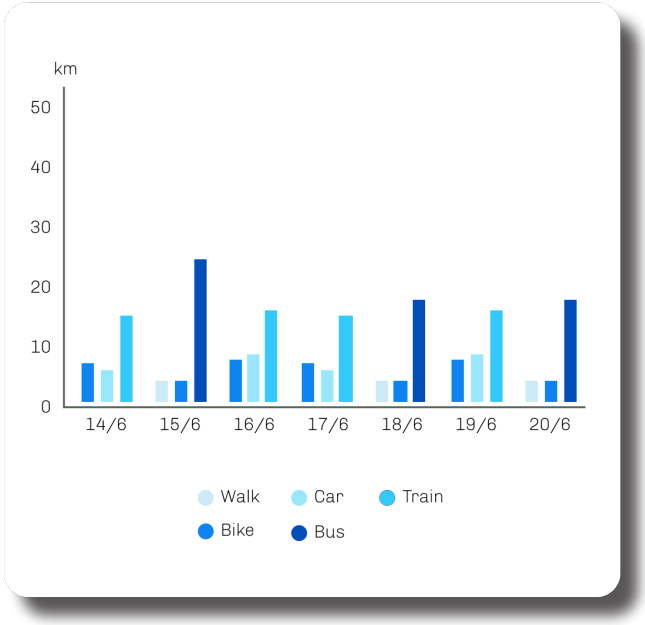


Figure 6.3.3-1 An example of the bar chart that sticked slightly next to each other

A better understanding of others

The final design direction (see chapter 4.4) of this project is to provide a better understanding of ourselves, others, and our surroundings in the sustainable mobility aspect. Therefore, one of the research questions in the final design evaluation aimed to understand whether users feel they have a better understanding of others through the design, and why they feel so.

For all participants, they considered that the "community" feature can provide them with a better understanding of others and motivates them toward sustainable mobility decisions. P2 stated that "It will definitely give you a better understanding of other people's behaviour, also, like, which kind of behaviour they take and what matters to them. I think it's a great feature for that." and P1 mentioned that "I like the graph (see figure 6.3.3-2) where you saw everyone's goal, and then if they were reaching it or not. And then, it was fun to me that there was this gay (Sam, third from the right) who has a goal of 25 (kg of CO2) and he had only an emit 2 (kg of CO2). That would be a reason for me to get in touch with him and ask him to adjust his goal." Furthermore, during the interview, P3 mentioned that "If I see that the other people are also doing their best to reach these goals, I will be a stimulus to do the same. And in the task you gave (task 3), Nina adjusted her goal and did more for the group to reach the group goal. And this is good."

However, there were some drawbacks to the community feature. P3 and P6 considered it would take time for the users to understand how the functions in the community feature work. For example, P6 mentioned that "But I think it takes more time, you have to use it a few days to know what it means. And it takes a little time to know how it works and what it means. But just a little." Additionally, P5 considered the group challenges too complex and this resonated with P3 and P6.

The evaluation showed that the community feature enables the users to have a better understanding of others. Furthermore, users felt more motivated to make sustainable mobility decisions with the community feature since they would notice other users are also contributing towards sustainable mobility. Additionally, based on P1's statement, it showed that the design has a possibility to increase the interaction between users. This would also lead to active engagement with the mobility tracker. However, the complexity of the community feature and the group challenges need to be reduced. It should be designed in a way that is easy to understand by the users.

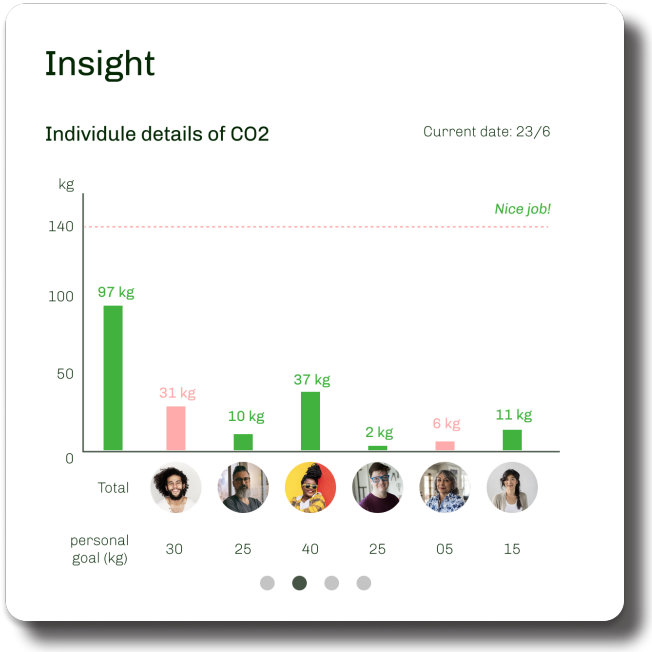


Figure 6.3.3-2 The infographic that made P1 want to get in touch with other members

A better understanding of the surroundings

The final design direction (see chapter 4.4) of this project is to provide a better understanding of ourselves, others, and our surroundings in the sustainable mobility aspect. Therefore, one of the research questions in the final design evaluation aimed to understand whether users feel they have a better understanding of the surroundings through the design, and why they feel so.

For P1, P2, and P4, They consider the "news area" in the insight tab can trigger their curiosity to click in and gain more information about sustainability or health. For instance, P2 said "I think it's very interesting to have it and I will definitely click on it. Maybe, it depends on the information that is displayed. And sometimes you just want to open the app to see what news comes out, you know, it just triggers you to use the app more. Yeah, like, you know, when I have these long train trips, and instead of scrolling social media, I would just use this and get informed. I will do it personally, I will open the app to see what news is there."

Furthermore, P1 appreciated the visual style of the news area. She mentioned "I liked the fact that you see this news thing (news area) but it's not very into your face. So if you came to the insight tab, just to check your own travelling, you can scroll by it very easily. It (the news area) doesn't bother you."

However, P1, P3, and P6 considered the example news in the news area (see figure 6.3.3-3), was not relevant to them. P1 mentioned that the news needs to be tailored to keep her interested. Additionally, P5 considered most news that related to sustainability were sad and negative. He prefered to have more positive news. for example, news that showed what sustainable milestones people achieved. He mentioned that "If it's (the news in the news area) about sustainability, or about people not moving anymore (walking or biking less). It's just sad. But we all know it's true. Yeah, so what did we achieve? I would like that more than these negative messages (sustainable news)."

The evaluation showed that the "news area" enables the users to have a better understanding of the surrounding. It can provide users with additional information that is related to sustainability or health issues. Nevertheless, as the literature review concludes, the relevance of the information to the users is crucial. Although the example news in the prototype is related to sustainable mobility. However, it was not relevant enough to the participants. Therefore, designing a "tailored news area" for each user would be prefered. However, this required advanced data collecting and information delivery technology for the current Thrivey application. Last but not least, selecting positive news instead of negative news is prefered by the participant. Therefore, these criteria (to select positive news) needed to be taken into consideration.

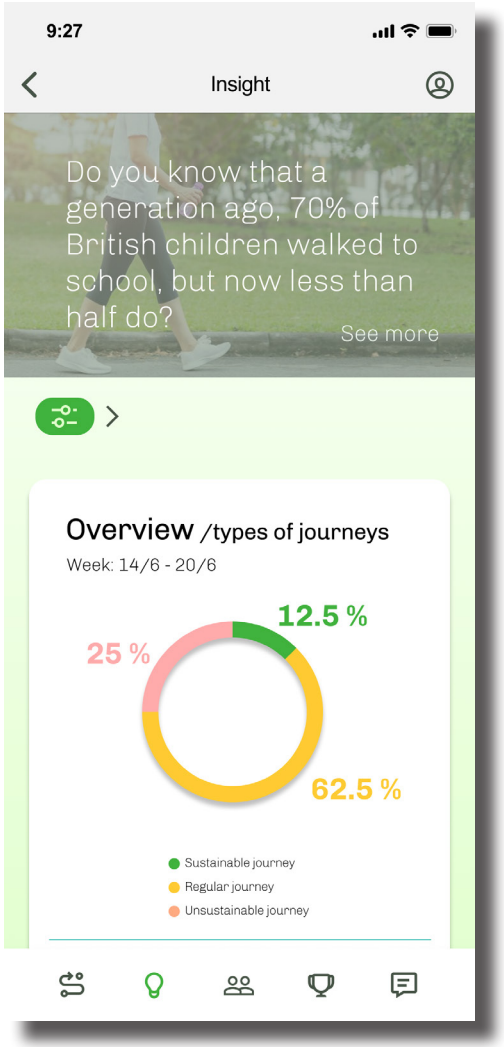


Figure 6.3.3-3 News area in the insight tab (the top part: "Do you know that a generation ago, 70% of British children walked to school, but now less than half do?")

Usability issues

For a mobility tracking application, usability and ease of use are important. Therefore, one of the research questions is to understand if the design prototype can be easily understood by the users and whether there are any usability issues within the prototype.

All six participants considered the design prototype to be "clear" and they all completed the three tasks which were given in the final design evaluation sessions, although some of them faced some issues during the tasks (see table 6.3.1). Through the three tasks, it was observed that participants would know where to find the information they need after a few times of try-outs. Nevertheless, some aspects can be improved. For instance, P1 considered apart from the personalized advice, there should be more suggestions that can help the users to achieve their goals. She mentioned "If the app would give me more suggestions on how to improve, that would help me. But other than that, I don't think I faced that many obstacles. Just quite clear, and everything I needed is there."

Furthermore, P3 and P4 both mentioned that if there is a scrollable bar next to the screen, it would help them to know if there is more information below. Additionally, P5 considered some of the infographics or graphs in the prototype were confusing and misleading. For example, he mentioned that "You should stay below that line (the line on the graph, see figure 6.3.3-4), I think, although it makes me think that I should reach that line. But I think I should stay under the line."

Through the evaluation, the design prototype was perceived as "clear" by the participants. This showed that the prototype can communicate itself to the users. However, participants pointed out three points that can be improved. The first was to add more suggestions to help the users to reach their goals. This showed that apart from the personalized advice, some users would like to have more support and guidance in their travel behaviour. How to provide enough support and guidance, at the same time, leave space for the user to judge themselves would be a potential direction for Thrivey. Second, the scrollable bar on the side of the screen would indeed improve the usability of the design prototype since many screens in the prototype are long and contain a lot of information.

Third, some misleading infographics need to be improved. For example, if the graph indicates that the users should not emit more than 140 kg of CO2, it might be clearer to start with a bar that represents 140 kg of CO2, and gradually lower the bar according to the CO2 that is emitted by the users.

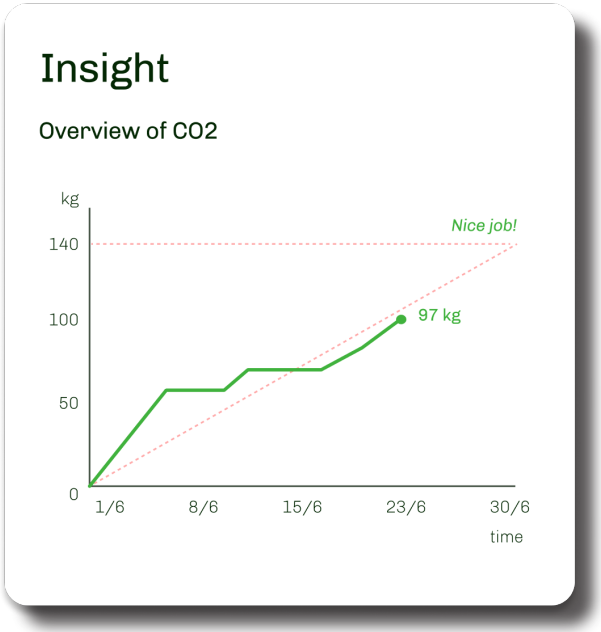


Figure 6.3.3-4 The infographic that made P5 confuse

User Experience

One major objective of the final design evaluation session was to understand how users perceive the design and how they feel after experiencing the design prototype.

Connected with the previous outcomes, overall, all the participants considered the design prototype was “clear”. The clear prototype made the participants feel calm and no stress, as P1 mentioned “I think I feel calm. Because I don't feel stressed. Everything in the design was really clear. So I don't feel stressed or frustrated. So that's good. I felt that my use of the app was enjoyable. And I think it was because the prototype was really clear, I knew where I could click. And I wasn't afraid to just click on stuff and see what happens because I wasn't afraid that something would go really wrong. And then when I would open certain depths, everything that was in there would make sense for it to be there. And then some of the graphs, of course, I had to look a bit more into depth to see what they would mean. But overall, it made sense of what was in all the different subsections. So I feel happy. I think it's really clear. And I know what to do. And it looks very nice. I enjoyed how it looked visually.”

Moreover, participants considered the visual style of the design prototype enjoyable, nice, interactive, and modern. P2 and P4 mentioned that they like the design prototype and if it is released on the market they would like to use it. As P4 mentioned "The testing (final design evaluation session) was very interactive. The prototyping process was very clear. And then in general, I think it was quite fun to use the app. And I did feel motivated after testing. And I wanted to use this app. This new release version of the app. To be honest, I wasn't really using the current Thrivey app. But the new design just looks nice and with nice usability. And the charts provide lots of insights."

Furthermore, P2 mentioned that “It's (the design prototype) very connected, it tells you your progress and what you can do next. It's about being sustainable while travelling, so it's very interesting. I feel like being guided through my new behaviour. Because you keep track of what you're doing. So you have control of the situation. And then you are also inspired to do more to improve (one's travel behaviour).” This indicated that the design prototype can motivate, inspire, and support

users to reach their sustainable mobility goals. It can form as a guide for the users, nevertheless, the users still have control of the situation.

Overall, the design prototype was considered an improved version of the current application. For example, P5 stated that "I like the design, it's an improvement to what it was, or what it is." However, three issues were pointed out by the participants. First, the prototype and the tasks provided were focused on the comparison of the car and the bike. P3 considered the design prototype lacking the comparison of public transport. Second, the description on the activation screen (see figure 6.3.3-5) emphasized the connection between sustainable mobility and users' health. However, lacking the emphasis on the health of the earth (mentioned by P3). Third, P5 considered the main focus of the Thrivey application is kilometre reimbursement, and the part of promoting sustainable mobility should intertwine with it. As P5 mentioned "From my perspective, the main goal is to track your kilometres. And the sustainable part should intertwine with it. Because I think that one of the unique selling points of this product is sustainability. But it's not the main goal of your end-user."

Through the evaluation, the design prototype was perceived as a "clear design". It enables users to feel calm and have no stress when interacting with the application. Additionally, participants enjoyed and appreciated the visual style of the prototype, they considered this is an improvement of the current application. With clear visuals and design, the prototype can provide users with insights into their travel behaviour which, as a result, support, motivate and inspire them to make sustainable mobility decisions.

Regarding the three issues mentioned: first, the prototype was built based on the three tasks that were given in the evaluation sessions. Therefore, it was focused on the comparison between driving a car and riding a bike. However, in the actual design, public transport will indeed be added in. Second, the objective of the description on the activation screen was to introduce the design to the users. As a result, the current description does fit. However, to mention that sustainable mobility can also improve the health of the earth is agreeable. Therefore, the description can also be altered into "Thrivey, an easy way for kilometre reimbursement. Plus, a community for you to explore how sustainable mobility can improve your health and the health of the earth." Third, the idea of intertwining the kilometre reimbursement feature with sustainable mobility is agreed upon by the researcher. However, it would depend on each user when it comes to the main objective of this mobility tracker. For example, P2 and P4 used the application mainly as a tool to help them toward more sustainable travel behaviour.

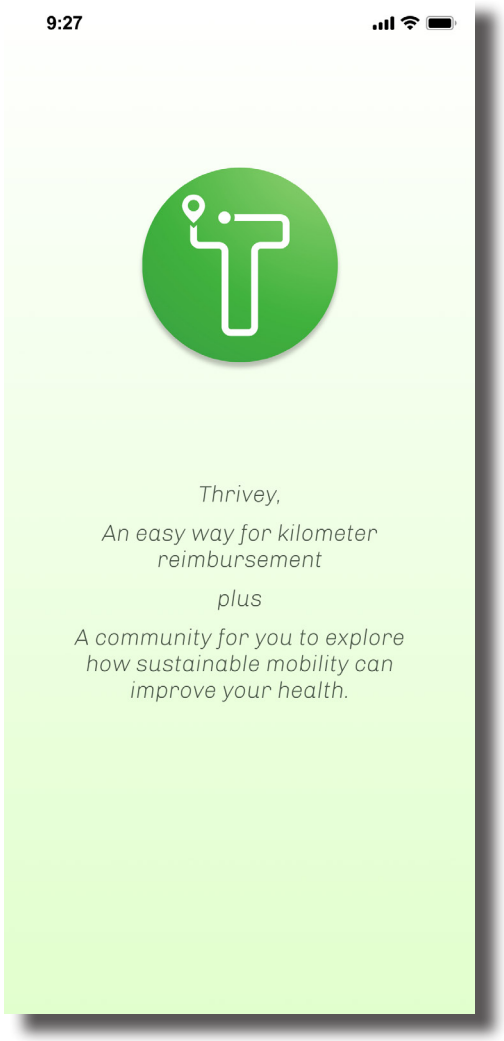


Figure 6.3.3-5 The activation screen and the description on it

6.4 Conclusion

This chapter aims to evaluate the final concept via the design prototype and the final design evaluation sessions. All the research questions in chapter 6.1 had been answered. Below is the main takeaway of this chapter:

The final concept has shown its ability to support users making sustainable mobility decisions. However, there are many aspects regarding the usability of the design prototype that needed to be improved.

The detailed takeaway of this chapter can be divided into three parts: meeting the project objectives, usability issues and user experience (UX) issues

6.4.1 Meeting the project objectives

- Based on the questionnaire, the prototype provided the expected effect that the project aims to achieve. Nevertheless, this qualitative evaluation with six participants cannot guarantee an absolutely effective solution. However, the results showed that the design outcome is a potential direction to evoke users' motivation toward sustainable mobility decisions and support them toward the process.
- Based on the questionnaire, the participants felt relevant (connected to the design prototype), motivating (toward sustainable mobility decisions), and curious (want to know more about what the design can provide) after trying out the design prototype.
- The design prototype was considered novel, likeable, and clear to the participants. However, the novelty of the design prototype can be improved.
- Based on the questionnaires, the final concept is an improved version of the previous three concepts.
- Through the observation, the graph with the categories of reasons provides users with a new perspective into her travel behaviour which motivated her to conduct more sustainable mobility decisions to reach her goals.
- All four features of the design (see chapter 5.3.1 to 5.3.4) showed that they could make users feel supported toward sustainable mobility decisions. However, different participants feel supported by different features.
- The "personalized advice" in the journey tab was considered the most effective feature to activate users' curiosity and motivate users toward sustainable mobility decisions.
- The "informed infographic" was considered the most effective feature to provide users with a better understanding of their travel behaviour.
- The community feature enables the users to have a better understanding of others. Furthermore, users felt more motivated to make sustainable mobility decisions with the community feature since they would notice other users are also contributing towards sustainable mobility.

- The “news area” enables the users to have a better understanding of the surrounding. It can provide users with additional information that is related to sustainability or health issues.
- The prototype can provide users with insights into their travel behaviour which, as a result, support, motivate and inspire them to make sustainable mobility decisions.

6.4.2 Usability issues

- All participants completed 3 tasks in the final evaluation sessions. This indicated that the design prototype is usable to the participants.
- The design prototype was perceived as “clear” by the participants. This showed that the prototype can communicate itself to the users.

However, several usability issues were identified by the participants:

- The users should be able to adjust the challenge both in the community tab and in the challenge tab since the group challenges are related to both of the tabs.
- The buttons "adjust challenge" and “divide goal” would make the user confused since they shared similar interpretations.
- P1 would like to receive the information of the “time spent for each means of transport.”
- P3 considered the bar chart would be easier to read if the bars are not stacked on each other, but are sticked slightly next to each other.
- The infographic should show the comparison of users’ current and previous travel behaviour.
- The complexity of the community feature and the group challenges need to be reduced.
- Apart from the personalized advice, some users would like to have more support and guidance in their travel behaviour.
- The scrollable bar on the side of the screen would indeed improve the usability of the design prototype since many screens in the prototype are long and contain a lot of information.
- Some misleading infographics need to be improved.

6.4.3 User experience issues

- The design prototype was perceived as a “clear design”. It enables users to feel calm and have no stress when interacting with the application.
- Participants enjoyed and appreciated the visual style of the prototype.
- It would feel like cheating if users can turn an unsustainable journey into a regular journey. Therefore, a way to improve it is to separate the journey with reasons and other journeys.
- One of the participants felt offended by an “unsustainable label” on the journeys.
- The example in the “news area” was not relevant enough to the participants.
- P5 prefered to see positive news instead of negative news.
- The design needs to intertwine the kilometre reimbursement feature with the sustainable mobility vision.

6.5 Reference

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Chapter 7
Conclusion & Recommendations

In this chapter, the conclusion of this project and the recommendations for future study or design development are presented.

7.1 Conclusions

7.1.1 Meeting the project goal

The project aims to understand how self-tracking travel data provided by the mobility trackers can support the user toward more sustainable mobility decisions.

The final design concept has shown its ability to support users making sustainable mobility decisions. However, there are many aspects regarding the usability of the design prototype needed to be improved.

Based on the final design evaluation, the prototype can provide users with insights into their travel behaviour which, as a result, support, motivate and inspire them to make sustainable mobility decisions. In other words, the prototype provided the expected effect that the project aims to achieve. Nevertheless, this qualitative evaluation with six participants cannot guarantee an absolutely effective solution. However, the results showed that the design outcome is a potential direction to evoke users' motivation toward sustainable mobility decisions and support them toward the process.

7.1.2 Meeting the design goal

The design goal in this project is to activate user's curiosity about how sustainable mobility decisions can influence their health condition when interacting with the Thrivey application.

Most of the participants in this project stated that they felt more connected to the topic of sustainable mobility because the design connects and presents users' health-related data (for example, the calories data in the prototype) according to their travel behaviour. This made users feel curious about how their travel behaviour can lead to different results of their health condition.

7.1.3 Limitation

Under the global pandemic of COVID-19, all the user-involved sessions were conducted online. This caused some difficulties when it comes to interacting with the prototype. For example, during the final design evaluation, the participants interacted with the prototype via their mobile device (mostly laptop or computer) because they were invited to share their screen in order for the researchers to observe their interaction with the prototype. However, the design is a mobility tracking application that aims to be used on a smartphone. Therefore, participants had mentioned that they felt unintuitive to use a mouse to interact with it.

Moreover, due to practical issues, the prototype in the final design evaluation sessions could only present the preset data. This might cause some difficulties for the participants to relate themselves with the design prototype, although there were scenarios (the three tasks and the introduction of the user group) to support participants to immerse themselves in the situation. However, based on the results of the final design evaluation, most of the participants felt relevant and connected with the design prototype.

7.1.4 Contribution

The final design in this project introduced a way to present users' self-tracking travel data in a way that would provide users with insights about their travel behaviour they usually do not aware of. By showing how much restriction the users were facing and what keeps them from travelling more sustainably, users were given a new perspective into their travel behaviour. As a result, this supports, motivates and inspires them to make sustainable mobility decisions.

Through the research, the community feature was found out to be the most motivating feature that can keep the users engaged with the mobility tracking application and hold on to their sustainable mobility goals. Moreover, personalized advice was found out to be the most supportive feature that enables users to travel more sustainably.

Furthermore, this project provides new knowledge into people's travel behaviour under three contexts: before the COVID-19 pandemic, within the COVID-19 pandemic, and after the COVID-19 pandemic; Also, the research revealed the complexity of real-world travelling, users need and concerns regarding mobility trackers, and people's values and views toward sustainable mobility and what factors can influence these values and views.

Last but not least, the project provides the company, Thrivey, insights into their future development, and provides an example for future remote research.

7.2 Recommendations

7.2.1 Design improvement

Clear and intuitive infographic

Some of the infographics in the prototype were considered misleading for some participants. This leaves room for a future redesign of the infographic.

Definition of the type of journeys

There are three types of journeys in the final design. One is the sustainable journey, another is the regular journeys, the other is the unsustainable journeys. One way to define the three types of journeys was presented. However, this is only an example to defined the journeys and there is still room for debating. Furthermore, one participant felt offence by the label of "unsustainable journeys". Therefore, this leaves room for discussion in the future.

Changing the type of journeys

Some participants felt weird to change the label "unsustainable journey" into a "regular journey" when they indicate a reason for that journey. Therefore, a way to improve it is to separate the journey with reasons and other journeys.

Comparison of the travel data

During the final design evaluation sessions, P5 suggested that the infographic should show the comparison of users' current and previous travel behaviour. This idea was considered highly agreeable since it can provide users with more direct insight into their travel behaviour.

Usability issues

The naming of the term used in the prototype needs to be redesigned. Some participants pointed out that the term "divide goals" is easily confused with "adjust challenges". Next, the community feature was considered too complex by P5. Therefore, how to simplify the community feature need to be discussed. Furthermore, a scrollable bar next to the screen may be needed in order to let the users know how much information is contained on one page.

Relevant information

The example news in the "news area" in the insight tab was considered less relevant to the participants. Therefore, designing a "tailored news area" for each user would be prefered. However, this required advanced data collecting and information delivery technology for the current Thrivey application.

Connect with the kilometre reimbursement function

The design needs to intertwine the kilometre reimbursement feature with the sustainable mobility vision.

7.2.2 Possible future research direction

Provide new perspectives using the self-tracking technology

The next step of this research could deep dive into what else information the self-tracking data can provide to uncover the unknown travel behaviour of the users. This would provide users with new insights and perspectives that might support them to undergo behaviour changing process.

Data privacy

The privacy of the uses' data should be treated carefully. Consent might be needed before the application starts collecting users' travel data. Furthermore, users should always be informed about what data they share. Although the focus of this project is not on data privacy, it is still important to understand the boundary between human privacy and technology.

Presenting self-data

The final design presented one way to illustrate users travel behaviour. However, there is room to be improved. How to present the self-data in a way that can be easily interpreted by the users without hitches, and how to present the self-data in a way that will not make users feel offended (since self-data is highly connected with the users) would be the next question.

Appendix

Appendix A: Original Project Brief

Introduction

Mobility is a necessity. Nowadays, people move from one location to another by various means of transportation. Such as train, vehicle, bike, and the increasingly popular options: e-vehicle, e-bike, e-scooter, and shared mobility. Each means of transportation result in different levels of environmental impact and create different values for one's physical health condition. How to make people aware of the environmental impact they have created, and motivate them to consider these impacts and their own health status when making their mobility decisions is an essential question for designers to look into.

In this project, I will collaborate with TU Delft and Thrivey. Natalia from TU Delft will be my chair, Abhigyan Singh will be my mentor, and Maarten from Thrivey will be my company mentor.

Thrivey is a hybrid tracking solution/ application that can automatically track the movement of the user when they carry their smartphone with them. It can track the geographical route that people travel and recognize the type of transport and location names automatically. Currently, the system is targeted to self-employed people and company's which requires tracking the mobility costs during work hours, for the purposes of taxes and reimbursement. It makes the task of tracking mobility cost more efficient and accurate.

In the next phase of development, Thrivey is planning to take advantage of their tracking system to stimulate a positive (sustainable) impact on people's mobility decisions. It creates an opportunity for this graduation project to investigate how can self-tracking commute data provide information that can enable people's decisions towards a more sustainable behavior.

Problem Definition

According to the current regulation in the Netherlands, when workers travel by private transportation (car, motorcycle, bicycle, by foot, etc.) it is common to receive a travel allowance per km. However, there are people who did not take the advantage of it or simply unaware of it. With Thrivey, an convenient and efficient way is introduced to the users for keeping track of their self-commute data and use it for reimbursement. Furthermore, with the vision of promoting a sustainable commute behavior, Thrivey would like to invite more user to take advantage of the reimbursement system and reflect on their own commute activities.

In this project, the user group will be the workers (especially self-employed and freelancer) who need to travel at least 5 km per working day, have a choice on their mobility means, and are potentially care about the sustainable issue. (Workers with a company car, and workers who always travel by train or one type of mobility means are excluded.) With the above user group in focus, the application/design is also open to people who would like to track their mobility data and understand the sustainability meaning behind it.

The current Thrivey app has the functionalities, however, it requires a stronger usability and user experience (UX) strategy that can invite user to join, embed the underlying sustainable issue behind the commute activities, and meet the emotional and functional needs of the users. To achieve this, research need to be done in order to understand how our user group perceive the self-commute data and

what does these data means to them. This lead to our project aim, inviting user to understand and be involved with their commute data, and providing personal commute/travel data and the sustainable meanings behind these data in an understandable and informed way that can enable them to make their future mobility decision. Thus, how to present self-tracking data in a way that can support user's mobility decision will be the key question.

Assignment

The expected intervention will be an application design that enables the user to understand and be aware of the sustainability impact they create with their commute/travel activities. Furthermore, the design should be able to inform and support users to make their next sustainable mobility decision.

In this project, research will be done and data ethnography methods will be applied to gather contextual information of how the user group make their mobility decisions, in what condition will the user change their mobility behavior, and how they interact with the Thrivey application. With the data ethnography methods, different types of contextual data will be gathered, discussed, and analyzed, which will become the foundation of the further research and design.
Through the analysis, we can uncover how self-tracking commute data can influence the user group's behavior, which might contribute to the future research which related to this topic. Moreover, experimental prototypes will be developed to understand what is the optimal way to apply self-tracking data that enable user stay informed of their own mobility activities and manage their next mobility decision according to it.

Planning and Approach

Here is the link of the agenda/planning:
https://docs.google.com/spreadsheets/d/14is2A6DFA3ZTjN2KJpTMEhcwQXw1l0tGeeIUoetaGh0/edit?usp=sharing

This graduation project will be full-time work (8 hours a day), starting form the 16th of February until the 27th of July. (In the end, it ends on 9th of August) During this period, there will be several public holidays and 9 days of vacation (buffer).

Motivation and personal ambitions

Data-related digital product design

I am always interested in this design domain and I would like to take a project related to this domain as my graduation thesis. I believe that mankind has entered the data era, and data plays an important role in all aspects of our life. Through digital product design, for example, software, application, website, and product interface, people have a gateway to interact with data. I would like to be the person that designing this gateway to enable people to understand and interact with data. In a nutshell, this project gives me the opportunity to research how to present data in a way that can inform and influence people's decisions, which is very valuable for me.

Management skill

Through this graduation project, I would like to strengthen my management skill. I had been leading several group projects throughout my study life. I love to make plans and execute them. However, doing a project for five months on my own is a challenge I had never faced. I would like to prove that I am self-driven and capable to manage a project of this scale.

Usability and User experience

I consider my strength lies in usability and user experience. Through this project, I would like to present my ability on enhancing the usability and user experience of the application.

Positive and meaningful values

To me, Design is to seek for the optimized interaction between the user and the product and bring out meaningful values to both users and project owners. In this project, the concept of health and sustainability is introduced to people's mobility decisions. I consider this is a positive and meaningful step to take, and the trend of sustainability and taking care of one's health will continue.

Appendix B: First Interview Questions & Results

First interview questions

Travel context & needs and concerns while travelling

- Are you currently employed, or you are an employer?
- How often do you need to travel for your work?
- Can you describe your travel routine? (current/ past / post-pandemic(imagine))
- Can you describe the travel you would make other than your travel routine?
- How often do you travel to work/family/ friends/supermarket/other locations?
- What means of transportation would you use for travel?
- What aspects are important to you when making your mobility decision?
- (For people in contemplation stage) What keeps you from starting to act toward sustainable travel behaviuor?
- (For people in preparation stage) What keeps you from taking regular actions toward sustainable travel behaviour?

View on sustainable mobility

- What does sustainability mean to you?
- What does sustainable mobility mean to you?
- What motivate you to become more sustainable in the mobility aspect?
- Humans are collective species, we are part of our family, part of our society, part of the earth. How does this feeling of collectiveness influence your mobility decision?
- Does the feeling of collectiveness make you want to do good/contribute to this this bigger whole? Why and why not?
- What If you need to travel from A to B, and someone introduce you with a trial trip (for example: a sustainable way of traveling from A to B), would you be interested in it? Would you try it? Why? And why not?

Interaction between users and the mobility trackers

Do you have experience on using trackers (for example, applications, smart watch, etc.) to track your travel data (for example, time, duration, location, km, environmental impact, means of transportations etc.)?

If Yes:

- What is it? How was the experience? What kind of information you can get from the travel data?
- What is your motivation to start using this tracker?
- What is your expectation for this tracker? What insights or tips you would like to get from the tracker? What do you intend to see in your travel data?
- What do you do with these data?
- How would you like to share these travel data? Why and why not?
- How does knowing your own these data (travel data) influence your travel decisions?
- What if this tracker can provide you with the environmental impact (for example, CO2 emissions) of your trip, what do you think about it? Will it influence your next mobility decisions? Why and why not?

If No:

- Have you use NS app, google map, 9292, or other mobility applications?
- How was the experience? What kind of information you can get from it?
- What is your expectation for this application? What insights or tips you would like to get from it?
- What if the NS/google map/ 9292 can provide you with the environmental impact (for example, CO2 emissions) of your trip, how do you think about it? Will it influence your next mobility decisions? Why and why not?

First interview results

The interview results were divided into different themes according to the research questions in chapter 2.3. The guideline to help readers to understand the following interview results is shown in figure 8.1.

The grammar in the "quotes from the participants" might be incorrect because these quotes are expressed in a colloquial way.

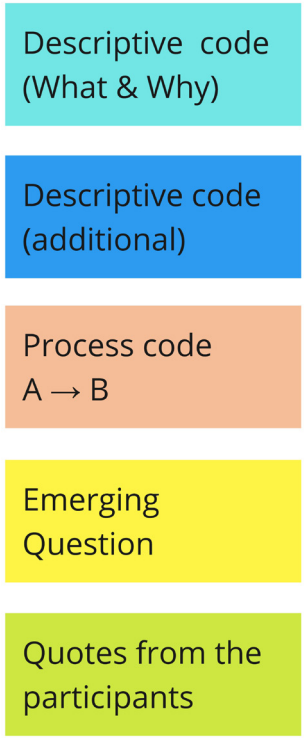


Figure 8.1 The guideline to help readers to understand the interview results

Theme	Descriptions	Examples
Past travel context	More usage of flights before the pandemic happened because people sometimes travel during vacations. Also, there were no flight restrictions at that time.	"I used to travel around Europe and the means of transportation that I used to take were mostly flights." (P1)
	fast pace of travelling → Pandemic → slow pace of travelling Past travel contexts were faster pace, goal oriented, and care less about the healthy aspect because people live in a faster pace lives.	"Travel (under the pandemic) can be a little bit more extended and a little bit more purposeful. It doesn't have to be so fast paced (pre-pandemic)." (P6) "I think then I wouldn't walk to a lot of places. I would go by bike every everywhere here and in Delft." (P7)
	More public transports usage before the pandemic happened because at that time people are not worried to stay in a enclosed place with others.	"I do a lot of volunteer work in some foundations and I also work one or two days a week in Rotterdam. So normally I would go there by form Zoetemeer to Rotterdam with a bus and then the metro. So when we have to go far, we take the train. And everything changes since COVID so we go to the museum by car now." (P5)
	Before the pandemic happened, people had more outdoor life and were more active on mobility, because they can travel to work, travel for vacations and visiting friends, etc.	"I lived in Budapest before the pandemic happened. At there I have no private means of transportation and Budapest is not really bike friendly to me. Therefore, I used public transportation, mainly the subway, tram and bus. And then I would also take public transportation to go to friends houses to go out for dinner for drinks for dancing museums. Obviously, much more active, outdoor life." (P6) "Before the pandemic, I was like out every day almost every day. But mostly that all travel was with my bike. On Saturdays and Sundays I would go to Hague and Rotterdam, but that was all with Tram." (P3) "Before the pandemic, I used to work four days a week. So I do travel, I used to live in The Hague. So I travelled from The Hague to my office, which is in Amsterdam. Also, I think, I don't really go to nature quite often. I'm more city person." (P2) "Sometimes we make it (trip for walk) into weekends. So we we booked a hotel room for two nights." (P5)

Theme	Descriptions	Examples
Current travel context	Face pace (less time to think of the health, or purpose of the trip) → flexible & purposeful (think about the purpose of the trip, and whether it is necessary.)	"I created the daily habit that's my COVID walk. Now, of course, you have to stay healthy in both body and mind and walking is something very beneficial for both your physical and your mental health. So I tried to walk at least 10,000 steps a day on average." (P5)
	Develop new walking or biking habit in order to stay active and have more exercise	"Because normally, if I would do groceries, I would just take my bike there. But now I'm at home all day. So I take the opportunity just to just walk from my home to the supermarket, instead of taking my bike, because the supermarket is also only five minutes away. To have a bit more of exercise of and also I go on walks with my friends now because I don't see them at university. So I will meet up with them and go for a walk. Because I noticed that I'm more sitting down and I used to so I tried to compensate for that." (P7)
	How to support users to think of the health, sustainability, and the purpose of the trip?	"Short of I go for to get a coffee in the city center now, but I wasn't really doing that before. But I also go there. I walked there. So I guess maybe I would have gone by bike before. Yeah, that's just completely a new activity for me." (P7)
	Less active under pandemic → walk and bike more during pandemic (sometimes setting goals)	"During pandemic I just constantly watch screens just always in the room and confined in the space and then I just feel like want to freshen up and then I just decided to go out and take a walk." (P9)
		"After corona, my travel behavior changed, I took more bike." (P1)
		"I use the bike as most as possible. " (P8)
		"I would say it's mostly bicycle based." (P6)
	Increase traveling to the locations which are opened (eg. parks & supermarkets)	"I go to the supermarket everyday, since it is the only place open now. And for outside places mostly is parks, a lot parks." (P1)
		"Quite often, almost every day, I do go for a walk around my neighbourhood, like parks or supermarkets. And I do groceries shopping two to three times a week, because I want to take a walk." (P2)
	Traveling less due to the pandemic	"During the pandemic, I haven't gone to any like big trip or something. " (P3)
		"After the pandemic, I work from home all the time. And for going outdoor, it's usually for doing groceries, most of the time I walk to the supermarket nearby. And also, I think once a week or twice I bike to the market in the city center for groceries as well." (P2)

Theme	Descriptions	Examples
Current travel context	More usage of public transport → Less usage of public transport	"I don't use public transport since COVID started. The current travel routine is that I seldom travel by car. And when I travel, I mainly travel on my e-bike. Because all venues are closed now." (P5)
	More usage of private means of transports and less usage of public transportations due to the worries of the pandemic (virus).	"Now because I have a car, I rather go by car, so I don't see a lot of people. And if I go somewhere close, for example the University, then I go by bike." (P4)
		"Yeah, a lot less public transportation." (P9)
		"Yeah, but due to the corona measure. I don't take the public transport." (P8)
Future travel context	More flexibility and purposeful travelling because during the pandemic people noticed that it is not necessary to travel to all those places that they used to travel to (eg. office / workplace).	"Because of the ability to be so much more flexible with work in school schedules, that travel can be a little bit more extended and a little bit more purposeful. It doesn't have to be so fast paced. More flexibility of schedule and flexibility of place, that you don't necessarily have to be in the place where you're working. And that that can make your like where you want to be in the world a little bit more purposeful. So with family with loved ones with someplace warm, sunny, whatever it might be, but that you kind of have a little bit more option in that." (P6)
		"But I think that I might go less to clients than I was used to. Because a lot of clients like it that we don't visit in person. But I have a lot of clients who want to meet in person. So I'm not sure what's going to happen. If it's up to me, it's a bit less (than pre-pandemic), but more than it is today (under pandemic)." (P8)
	Future mobility will be more or less the same as before the pandemic and people will undergo a transition stage before getting back to pre-pandemic's routine.	"After the pandemic end, my travel routine will be more or less the same as before the pandemic." (P2)
		"Take more time to settle down late to get back to regular traveling routine." (P3)
	How to support users within the transition stage of the travel routine?	

Theme	Descriptions	Examples
Future travel context	Walk and bike more during the pandemic (this gives the users a positive feeling) → keep walking and biking after the pandemic ended	"I'll probably use my bike more to go to people and places and just be outside more." (P4)
	Stick to the walking or cycling habit that developed during the pandemic because the habit is already developed.	"When the pandemic ends, I think we will use public transport more. Now we use either our bikes or we go by car. And when COVID ends I don't think I will go with public transport to my museum volunteer job because now my habit change I went out when I go by bike, and I don't see me if weather conditions are really not too bad, I will continue to use my bike to go to Rotterdam." (P5)
	How to support users to keep using their bike (or waking) to other locations after the pandemic end?	"I think I will keep on walking more than I used to before the pandemic. Besides that, maybe after I graduate and you move somewhere it is sort of normal to buy a car and maybe I would just postpone that as long as possible. But other than that, yeah, I was mostly using the train for long distance anyway, I think I will keep doing that." (P7)
		"I might keep on walking a bit more frequent than before (pandemic) but overall, I think it's going to be similar (pre-pandemic)." (P9)
	Private and sharing means of mobility might become more popular due to the worries of staying in an enclosed space with others.	"I think I'll be traveling less, I think I'll be more purposeful with my travel. I guess the whole hassle of it makes me not want to do it (travelling) at all. I see post pandemic travel to be actually much more reliant on private transportation rather than public, I think you're gonna see a lot of, I think you're gonna see a big bump in bicycles and maybe even some, like public sharing system like scooters sharing, or bike sharing systems where people can I get around without being kind of in an enclosed space, per se. That's my ideal image of the of transportation post pandemic." (P6)
	Gradually increase the usage of public transport when the pandemic is over.	"Once Corona is done I will use it (Public transportation) again." (P8)

Theme	Descriptions	Examples
Needs and concerns	Cost and time. Other relevant examples: 1) paying a subscription for OV-chipkaart, therefore, would like to travel more during weekend. 2) Not settling long in one place, therefore, would not like to invest on a private means of transport.	"I select the cheapest one of course and also the faster one and I tried not to take the one that has like changes in between because otherwise it's too long." (P1)
	Influential aspects, needs and concerns in people's mobility decisions.	"During pandemic, I realized I might had been spending a lot on travelling. The pandemic saves me a lot money as well. That might also influence my decisions." (P3)
		"I only take public transport, if it doesn't take longer time (than car)." (P8)
		"On weekends, I take the train to other places in the Netherlands, because I have an NS flex subscription, the one with free trips on weekends. Therefore, I want to take advantages of it." (P1)
		"I did not settle in one place very long, which I think makes it hard to kind of invest in private, which makes it easier to kind of rely on public transportation over private." (P6)
	People have the needs to compare options before making their decisions.	"I always have a notebook next to my computer so I can make some notes and compare different prices or different flights to see which one is more convenient, for example, I need to take the arrival time into considerations." (P1)
	Influential aspects, needs and concerns in people's mobility decisions: **Convenient**, which is a combination of time and effort.	"When I'm alone, I will prefer the convenience and then I will see the cost. If it's cheap enough, and if it is convenient to the place. It's only convenience or cost." (P3)
	How to support users within the "knowing options" and "comparing and analyzing" phase?	"We go by car because it is either you go by plane and then you have to rent or do you have to rent a car or you go by train but you train a connection to that place is not so very handy." (P5)
	Knowing the options → comparing and analyzing (where needs and concerns come in) → make decisions	"I don't really know if driving would be a more convenient way of travelling. I think the NS network is quite accessible to whatever places." (P2)
		"I don't prefer to take the train because the train cancels so much here (the Netherlands)." (P9)
	Parking availability	"It actually depends on where it is. If it's far away, then I'll use my car. And I also look if there's parking availability there. So one time there wasn't really a parking spot. It was like in the city of Amsterdam. Yeah. So you pay a lot. So that time I parked at a P+R thing. It's this place where you can park your car and then for very cheap, you can use public transport to go to the place where you have to go." (P4)
		"Because you it's difficult to park in Rotterdam Central and when you park it is expensive. The bus has a free bus lane. So it is also timewise." (P5)

Theme	Descriptions	Examples
Needs and concerns	Distance	"Distance is a very important factor. The distance is a physical restriction. For example, it's not possible for me to walk from Rotterdam to Amsterdam. " (P2)
		"Before pandemic, after every quarter. I would go to some country. Depends on the distance, I went to some places by flight. And for places like the closer ones. I went by bus, flix bus. " (P3)
		"Proximity is also a big I think a big one as well. I guess if I'm just around learned the city, the little town I live in, it's always I'm always going to take my bike. But if I'm going somewhere larger than it's going to be a combination of train and bike." (P6)
	Infrastructure. Whether the infrastructure is reachable.	"In Netherlands, many people do cycling, also, the infrastructure for the cycling road is well designed, this makes me want to cycle more." (P1)
		"Scooter is a very convenient and popular way to travel in Taiwan. Also, how the city is designed in Taiwan makes scooter the easiest way to travel around. I think the resistance to not using a scooter is much larger in this context. Not that I don't care about the environment, but it's very difficult to be more sustainable when I was in Taiwan. For example, in Tainan, it's so hot outside and it's torture to wait under the sun for a bus that is so slow." (P2)
		"I perfer to take the tram. Because the tram station is just in front of my house." (P3)
		" I used to travel by bus when it was raining. But they changed the bus stop, and it isn't close to my home anymore. So that's why I actually stopped going by bus." (P4)
	Luggage / weight load	"So normally, I would go by bike to the university. But sometimes if I have to bring something like large a perfect thing I made, then I would go by bus, or by car." (P4)
		"I think about what I'm going to be carrying, like, if I'm going to get groceries, or if I have my musical instrument with me." (P6)
	Whom you travel with	"I cannot ask all my family members to cycle me, to me, even if it is a short distance, that time I need to do some taxi or stuff. So that is still influencing my decisions." (P3)
		"I use the car when I have to drive my kids to for instance, my parents and daycare. So then I'll take the car to bring them and I drive to the office." (P8)
		"I tried to use to walk if it's nearby, especially with the kids because they can run a lot. But when it's raining I take the car even for small distances when I have two kids with me." (P8)

Theme	Descriptions	Examples
Needs and concerns	Weather / Daylight	"When it was snowing, I did not take my bike out, tram was a better option for that." (P3)
		" I'm doubting with this weather (with the rain) if I want to go by bike or take the bus." (P7)
		"Three, four times a week, depending on the weather. I would say every day if it's nice weather, but if it's bad weather, then not that often." (P6)
		"I think about the weather. And I think about the lightness, how light it is outside, like if I'm going somewhere very late? Am I going to bring my bike? And if I'm bringing my bike, do I have my bike lights? And if and if I want flexibility to be able to leave a place later at night? like should I have my bike? Or should I be reliant on public transportation? So I think we are whether weight load and daylight." (P6)
	The sub-goals of travel (eg. working during transit, looks fresh when showing up at the office, enjoy the experience of the trip, exercise during the trip, marketing reason: show client that you care about the environment).	"I'm a sporty person, so I enjoy doing sports. For me, biking it's a combo that I can go to the place that I want to go to and plus doing exercise. If I have time, of course. I don't really mind biking for an hour or even longer time." (P2)
		"I have an electric bike now. And that's actually not so good because I don't go to the gym anymore. And I'm also using electric bicycle. So that's not really good for my health. So I think I should take my regular bike more often." (P8)
		"Decision is based on how can I work as efficient as possible and how can I be as green as possible, it's one of our marketing items, actually. So we try to convince our clients that we are doing everything we can for a better environment. Something that we actually get some contracts because of the that." (P8)
		"If you could work in the train, then it's better to use to train." (P8)
		"If I have to be some at some meeting or someplace like 15 meters away, I won't go by bike because I don't want myself to be exhausted." (P3)
		"It's also kind of adventure and interesting to go by bike and ferry. And because I've been a sailor for six years, almost six years, it's also nice to do that." (P5)
	Mood	"Whether I am tired at the moment and if I am in that mood of relaxing way of transport. " (P2)

Theme	Descriptions	Examples
Needs and concerns	When people are in a hurry, time will become the most important factors of their mobility decisions.	"if I am in a hurry, I will take the fastest decision option. I don't mind walking a lot as long as I am not in a hurry and the weather is nice. " (P1) "If I have to go somewhere for business or I have to be at a meeting, I will see the one the road which is taking me there in the least time like just saving my time, in that case, I won't see the cost I will see the time. " (P3) "I get busier in life. So I have to go from a place to another within a shorter time or I have to rush sometimes. So scooter is a faster choice." (P2)
	If it doesn't require too much time and effort, and if the weather allows, for people to change their travel behavior toward more sustainable way, people are mostly willing to do so due to the increase awareness on the environmental issue.	"So if I can and if the travel time isn't much longer than with public transport, I will try to go with my bike or walking. But when the travel time is really long, compared to public transport, I will take public transport or when like the weather is really bad." (P7) "The outcome of the (mobility) decision process is dependent on a lot of other things. For instance, the train was more expensive, and it took longer than the plane, however, it is more sustainable, we might decide to do that. But when the differences are too big, we might decide otherwise." (P5) "That's said within 1000 kilometers train or other means of transport might be a good alternative for a plane." (P5)
	The needs and concerns of the mobility decisions are possible to conflict with each other. Therefore, the mobility decisions are depended on different situations and different priority of needs and concerns.	"Time is an important aspect and so does ease, whether it is it easy to reach. Also, the environmental footprint is important, but sometimes that's in conflict." (P5)
	Safety & Social. Due to the pandemic, safety and social become the emerging needs and concerns of people's mobility decisions. These two aspects are interrelated. 1) Safety: people prefer more private means of transport. 2) Social: people has the desire to meet with their important ones, and to be safety together, an emerging way to meet up is to have a walk together.	"Because I have a car, I rather go by car, so I don't see a lot of people. But after the pandemic, there will probably be a lot of traffic jams. So then the train is probably better." (P4) "If I want to be a bit social with my friends or someone else, I would like to take a walk to together, because on the bike it's hard to talk to each other" (P9)

Theme	Descriptions		Examples
Motivation to change travel behaviour	How to present the consequences in a effective and understandable way?	Awareness	"I had a research course, and it was about flight shaming. Therefore, I want to change my behaviour. I want to take more trains instead of flights when it's when it is possible." (P1)
	Knowing or seeing the consequences → motivated to change travel behaviour	When people are more educated on the environmental issue in the mobility aspect, people are more likely to be motivate to change their travel behaviour.	"When you study environmental science, you learn about these kind of really big emitting industries, and you know, transportation and food production are two of the highest pollutions. " (P6)
	How to let the users know other people are putting effort to behaving more sustainably?	Other people taking a conscious effort to be more sustainable in mobility → also be move along with them	"Influenced by this kind of environmental change (moving from one place to another). And you see the people around are behaving good, makes you also want to behave good." (P1)
		People's travel behaviour are possible to be influenced by the people around them.	"I think people around me, motivate me. And I think the health part motivates me. To get a better condition and to to get back in shape again." (P8)
	How to connect the cute animal/creatures to sustainable mobility?	People's thoughts toward contributing to the environment might be influenced by the nature surrounding (seeing the creatures in the nature or parks).	"When I went to the park or the nature, I started to think that these animals are like, we are also animals. So we should sort of having a more equal way of, they should have also an ecosystem that they could live on. Rather than human just, you know, kept on exploiting everything due to our own interest." (P2)
			"What suggested me or encouraged me to make better mobility decisions is something that more tangible or more effective, like animals, maybe that could be very motivating to me." (P9)
	How to support people to come up with personal commitment toward sustainable mobility?	Personal commitment might motivate people to change their travel behavior.	"I got more aware of our flighting so much. So I promised myself that after corona finished, I don't want to take that many flights anymore." (P1)
			"I kind of have committed myself to other parts of a more sustainable lifestyle, and that transportation is a very important part of that, in terms of what I can do for my personal ambitions." (P6)

Theme	Descriptions	Examples
Motivation to change travel behaviour	Awareness	"When you actually see what are the consequences or what your behaviour like has to do with sustainability, you want to act more positively." (P1)
	Seeing the consequences of not being sustainable enough (eg. climate change or global warming) might encourage people to change toward sustainable travel behavior.	"There's global warming. And I think it's true that it's because of all the people that live on the planet. So if everyone's price a little to be good for the environment, I think it will really help in the long run." (P4)
		"I want to limit my impact on the world, like the climate change." (P7)
	The sense of responsibility might motivate people toward more sustainable travel behavior.	"The more you educate on the topic the more you are more aware of how your behaviour can impact the environment you take the responsibility yourself to act more positively." (P1)
		"Because it is our responsibility. I am a reposible citizen. You and me are part of the earth and the earth is part of us." (P5)
View on Sustainability	How to define how much you can get from the earth? How to let users know what benchmark they should set?	"It means taking care of the resources that we've been given by the earth and the world. And managing them in a, in such a way that we don't take substantially more from the world than we sort of give back. So that there's more of a balance between us and our lives, and the amount of resources that the world can create." (P7)
	How much you provide to the earth should = how much you get from the earth.	"It's important that we try to work in such a way that you are healthy yourself. So that's one thing that's important to me, and what's healthy for the environment at the same time." (P8)
	Sustainability is the balance between one's need & health and the health of the earth.	
	Before people taking a more sustainable action, they need to be able to trust the action they are taking is truly more sustainable.	"Even though we say that this particular process is sustainable, over the long run, or if you see the zoomed-out perspective, it is actually not sustainable. It might look sustainable for the time being, but it might have another bigger impact." (P3)

Theme	Descriptions		Examples
View on Sustainability		More and more people take sustainability as a new normal.	"Sustainability is a new normal, you have to do as much as you can, it's like something that you have to do to cope with all the things that are going on. I was already sustainable certain options and I am trying to integrate this aspect in the in travelling as well." (P1)
			"Isn't that thing that we do every day? " (P2)
			"If we're talking about sustainability, I think we're, like all contributing to it. So yeah, we are part of a group because we all live on this planet. So I feel like if you can be more sustainable, you should do it. Because it's will help everyone" (P4)
		People are willing to take a more sustainable action when there are no restrictions and it is affordable.	"The places where I think I can be sustainable is making better decisions. Like many times I prefer costs because of my own financial status. But I know that in many places I can be more focusing, like prioritizing sustainability above cost. But then the problem comes when I cannot trust what is sustainable and what is not." (P3)
			"Well, I think that the way I travel is all the least polluted way. And that is by choice. And also by some financial restrictions. So I don't have a car and just in my opinion that these ways are the most sustainable ways to travel." (P2)
			"I think everyone is doing his or her best in making choices, sometimes you are, unfortunately, not allowed to make a greener or more sustainable choice. But if it's an affordable choice and I know this choice is more sustainable or less impact, I don't see why not go for that option." (P2)
		Sustainable mobility is less carbon based, less pollutions, more renewable, more sharing and more human powered.	"From a perspective of environmental impacts, I think it covers, for instance, to make less co2 emissions when I travel, and also less other substance, for example, SO2, NO2. " (P2)
			"It needs to be less carbon based. It needs to be more renewable, or it needs to be more human powered, and kind of creating less mobility, I think is the key to sustainable mobility." (P6)
			"I feel like it could be more more of a hassle. It's more of manual job. I imagined it to be more manual things." (P9)
			"Sharing is more important, first of all, try to not use any transport. And if it's not possible, try to share stuff like public transports are already sustainable for me compared to other people who are using their own cars." (P3)
	What are smarter and better way to travel in sustainable mobility?	Sustainable travelling is not travelling in a certain way, but travelling in a smarter and better way.	"I think sustainable mobility means traveling smarter and better. Understanding that we live in a very globalized world and understanding that we need to fly sometimes, but also knowing that we don't necessarily need private cars in our everyday lives, and that there's some trade offs that need to be made in order to kind of promote a carbon-neutral or, you know, negative carbon kind of footprint in that regard." (P6)

Theme	Descriptions	Examples
View on Collectiveness	Other people behaving good → motivated to change travel behaviour	"People behaving good, people giving a good example. The sense of trust and the sense of community. So for example, it really influenced you to act in a better way. And if you follow these good rules, you feel part of a community. " (P1)
	People's actions toward sustainable mobility are influence by other people who are around them.	"If I would see that everyone is taking a conscious effort to be more sustainable in mobility, then I guess I would also be move along with them. And it probably also work the other way that if I see a lot of people not caring about the planet, in their mobility decisions, then maybe I would also not try to do the same as them, but be happy with creating less impact than other people. " (P7)
		"Because other people like it that you are trying to use more public transport, that really helps. And it really helps that people dislike it if you take your car. So, yeah, I think it really helps if you have some positive reinforcement from your surroundings from the people around you. " (P8)
	Feeling connected when present in the context.	"When I go for a walk every day in the park, or when I sometimes go to the forest, I see a lot of, you know, birds, and lots of trees, flowers, the sort of things, I do have a feeling that I am a part of this eco-system." (P2)
	Participating or surrounding by the nature can prompt a feeling of being a part of the eco-system.	
	How to let users feel like they are connected to each other/ connected to the sustainable mobility context?	"Yeah, of course. If I feel like a part of that community, then definitely I would love that community to become better and contribute to that communities. And I think it is the obvious thing to do. " (P2)
	When people feel belong to a community, people have a higher chance to contribution to the community.	"I try to make decisions much better decisions to the best of my knowledge. " (P3)
	Because sustainability is all people's responsibility therefore, it might have a significant bystander effect.	"I think it's challenging to want to make better mobility decisions when you see the rest of the world not responding. So I would say it could have a bystander effect where you think that you don't have to and you can kind of just go along with the masses and do what's easiest. But I found that kind of being part of a collective that being part of the human race that doesn't necessarily like being part of a larger group of people who don't necessarily understand the impacts makes me want to work harder at it and make me what makes me kind of want to be a leader by example, in terms of my mobility, I'm very fortunate to like be studying with people and around people right now who have similar values to me. So it's not as if I'm, in this kind of smaller community, I'm definitely not alone. And I would say perhaps I have some of the more, I mean, I have friends who just like it, who haven't gone on public transportation and you know, who go on it significantly less than I do, but I know that that we exist in kind of a very small bubble of the world. So I think that being part of that collective is good, because it encourages me to be better. And that was when I kind of rejoined the real world, if you will, apart from my environmental sciences bubble that I can the collective will make me want to lead by example." (P6)
		"For society collective level that perhaps, and for Earth level, to be honest, I've never thought about it for my mobility choices." (P9)

Theme	Descriptions	Examples
Trial behaviour	Restrictions	"Yes, if without time restriction I will definitely go for that one." (P1)
	People are willing to try out a more sustainable trial trip when there are no other restrictions (eg. not in a hurry).	"If I don't have to go for business purposes, then I will prefer his way. But if it is something where time is important for me that situation, then I would not go for that sustainable option." (P3)
	How to inform the user when there are no restriction for them to take a more sustainable mobility decisions?	"I think I would ask more information about it. But I would like to try it. Yes. So if it does, if it doesn't take too much more time, then I would be interested in it. If it's from one hour to two hours, then probably not. But if it normally would take me 15 minutes, and then it would take me 30 then I would consider it." (P4)
		"I would consider it based on the context I have for example, how much time do I have and how much energy do I have?" (P9)
	Trust	"I would be curious how more sustainable it could be? Because sometimes, you know, you'll see products or commercial saying they are sustainable, but in fact, they are not. " (P2)
	People are willing to try out a more sustainable trial trip when they can trust that this trial trip is truly more sustainable.	"First of all, I would not directly trust what he say, not because I don't trust the guy, maybe I trust that guy, he's my good friend or something. But I do not know the source of his information." (P3)

Theme	Descriptions	Examples
motivation for using trackers (PI tools)	People would like to use mobility tracker when they want to record their mobility data, for staying healthy and achieving their personal goals. seeking information: distance, goals achivement staying healthy What more insights people need? having a positive feeling or sense of achievement through feedback, seeking information: speed, distance, insights achieving their personal goals Confirmation by tracker → Having a positive feeling or sense of achievement Confirmation by tracker → Having a positive feeling or sense of achievement → keep doing the same action How to stimulate a positive feeling though the use of PI tools? FB like buttons / colleges knows what you do → Having a positive feeling or sense of achievement → keep doing the same action positive quality: being accurate/ remember location for the users. Recording for memory	"Because of corona, I want to check if I did the kilometer I want to do per day. yeah, it's mainly for health reason. " (P1) "I wanted to know my speed, I wanted to know the distance that I covered. And I wanted more insights in what I was doing. " (P8) "I liked it because it was showing me that, oh, I walked some maybe I walked 10,000 kilometres or 10,000 steps or something or it's kind of an achievement like it the application shows it as kind of an achievement which kind of gives me a positive boost." (P3) "And I had a strange hobby that I like cycling a lot. And I needed a goal to cycle because my trips were always the same. And that's why I cycled to every municipality in the south Holland. So I went to the city hall, each on separate locations. I tracked it to make sure that I could keep up with this stupid goal. I posted it on Facebook, because some people would hit the like button. And then when you're you came to the office, people would say hi, you did that. And then it was like ,yeah, I have another reason to go on. So again, if the people around you tried to stimulate you and say, Oh, that's cool. I noticed that you did this, then it makes sense to do it. Because sometimes you just need an extra push. " (P8) "I liked to record where I have been, and this app can help me with it. Using screenshot so I can look back at it another time. And it's like, really accurate for being so that's really nice." (P4) "I guess it's less about my own mobility and more about just for my own memory of knowing where things are, so that when I save each item, I can put a little note like, this is my friend Julian's house, kind of thing. And that that's how I know how to get there every time." (P6)

Theme	Descriptions	Examples
Concerns for using trackers (PI tools)	Privacy concern: • Being tracked unwillingly • Let others know the living place	"One time, I check the history function of the Google location tracker, and I found out it is very precise, it recorded the location and the means of transport I used. This make me feel scary. " (P2)
	People feel scary about the privacy issue behind the mobility trackers.	
	Ensure their living place is unknown by the system.	"I never share my cycling route with others because it will include my living place." (P5)
	negative quality: being accurate	
	Some people care less about the privacy issue behind the personal travel data since they know they are being track all the time by multiples app on their phone.	"I already know I give too much. My privacy settings are really bad. I know I like the the internet knows everything about me where I am, what I'm thinking, whatever. So I've kind of succumbed to the fact that every time I go onto the internet, it's not a private thing." (P6)
		"I know, I'm being tracked all the time. And that actually changed my opinion on being tracked. Because I know that I'm being tracked all the time by every app on my phone, but also by the government, because they can actually see my traveling data form my phone company. And I decided not to care that much anymore." (P8)
	Important quality: Consistent	"I just stopped using that because it was inconsistent. I actually disabled it. " (P3)
	Inconsistent information will decrease the users' trust and users will cease to use it.	
	How to make the user feel that the presented data is in consistence?	
	To many notifications is considered annoying by the user. Weekly basis notifications is more appropriate.	"I didn't really care too much about it (smart watch). And then it would like vibrate when I was sitting still for too long. And that was useful to see how long you sometimes sit still for. But in some ways it's also a bit annoying because then, when you're working on something and then your watches vibrating until you stand up and walk" (P7)
		"It should not disturb me with a lot of notifications. If I know that notification is going to come, then it would not disturb me too much. And it would be nice if the app only shows me the notifications on weekend, or on a weekly basis." (P3)

Theme	Descriptions	Examples
Needs & Expectation for using trackers (PI tools)	Provide automatically insights and the mobility data which users are not aware of will fit with users' expectation to the tracker.	"I think it's nice to see how much you've circled in one day." (P4)
		"I think it was nice to get insight in things that you're not really aware of. So maybe you feel good about yourself or walking but then if you look at the data, you're actually not working that much." (P7)
	How to let the users be aware of the information that they might not aware of or overlook? / Important quality: New (novel) and relevant data.	"It would be interesting to know the calorie from the app, because the health app doesn't does that, I have to manually calculate it myself." (P1)
		"You can have instructions on your training. So if you want to you can have it say whether you have to go faster or you have to go slow. work, or you have to keep a certain speed. It's kind of I advise you in this one." (P8)
	Provide the information in a visualized way and provide relevant information that fit with what user need.	"The location, time, distance between locations. Yeah, and I think it would be really nice to see the total distance I traveled in one day. And I want to see it on a map (visualize instead of data or figures)." (P4)
		"I'd actually like to see less information on Google Maps. Oddly enough. I have like, sometimes there's just too much on there. So I don't necessarily need the reviews, or the phone number, or the like, for places I've already been to, there's just like, a lot of extra information where versus I just, like, want to know how to get there from where I am. I think it's weird that you have so many different options to like satellite versus regular, whatever, I Just need a map." (P6)
	Precise information is more important than providing many options.	"I prefer precise over options like I don't want more options I want more precision over the available options. " (P3)

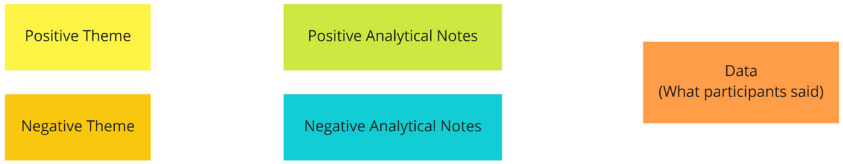
Theme	Descriptions	Examples
Acting according to the data on the trackers (PI tools)	For some participants, seeing their own travelling data does not influence their travel decisions. The travel data act like a reference to them.	"I will just take the data into consideration. for example, if I know I walk a lot today, maybe 20 kilometres, perhaps I will get a pizza. The data is just information or reference for me. " (P1) "It doesn't influence my mobility decision. It just something to show me how much I walk and it makes me feel good if I know I did enough exercise." (P3) "Not really, seeing what I have done (step counter) doesn't really influence my future mobility decisions." (P5)
	For P3, what helps him with the mobility decisions is the Google map because its route planning functions are reliable.	"What helps me with mobility is the google map." (P3)
	Novel information by tracker → Provide new perspectives to the users How to provide a perspective that would help users to travel more sustainably? Mobility data might help people to reflect on what they have done through their mobility activities and provide new perspectives.	"Oh, and there's one thing that I find very interesting, because I would also wear it when I would go to a party or something like that. And then in a few hours I danced and achieved my goal of the steps for that day. So in two hours, I would dance enough to achieve like 5000 steps or 10,000. I don't know how much my goal was then. So that was really interesting to me. This would make me feel less bad about going out and having a party." (P7)
	When people set goals toward their mobility activities, the mobility tracker become handy to help them record, compare their results with their goals and keep them motivated. How to support users to set the goals that can keep motivate them to travel more sustainably? Set goals → did not reach it→ motivate you to reach it Good results → don't want to break it	"I think a little like if you notice that you walk only a few steps every day. And you don't even reach some kind of minimum, I think it would motivate me to go on more walks to get the minimum amount of steps." (P7) "I think if you have like good results over time. And you'll see that nicely in a graph. You don't want to break your record. So you keep sort of showing good behavior, because you feel bad if you break it." (P7) "I actually analyze it a lot. I want to see what happened, for instance, if you had a really bad time on your bicycle, for a certain period of time, during your cycle, you'll see what happened there. It's like taking pictures, but done with numbers. For the cycling part, then I want to have certain averages for speed. Or I want a longer distance, or I want to take a new route. So that that's goals that you take for your mobility decisions. But when traveling from one place to the other, I don't really care." (P8) "Sometimes if my step count was too low, then I sometimes that thought, Oh yeah, maybe I should walk more." (P9)

Theme	Descriptions	Examples
Sharing travel data	When it comes to sharing the travel data, there are different level of privacy concerns. Ranging from do not mind sharing at all, only share with close friends to consider it as too private to share.	"I don't really mind sharing my data, because it just "travel" data." (P1) "I always share with close friend, unless I want it to be share in open." (P3) "Maybe just showing it to friends and comparing it with them if they also counted their steps, but I wouldn't like put it on Facebook or anything like that." (P7) "I never thought of sharing my travel data, I think it is scary to let another person know that where and when I am." (P2)
	It might be useful and inspiring to have a community feeling when people have similar goals.	"I think it would be nice to have a community like you can say you want to do 10 kilometres today or you want to take a walk today. Yeah, in that case, I would like to share my travel data, I think it is useful and inspiring. For example, sharing a photo of a pizza because I walk a lot on that day, etcetera." (P1)
	What kind of overview/results from the tracker are consider cool and won't cause privacy concern at the same time? Sometimes users share the overview of their travel data in order to look cool or get stimulations to do the mobility activities again. Good results / overview from the tracker looks cool → share it to have a positive feeling	"And then you use run-keeper, just to track the route that you covered, and to share it with other people to get more stimulation to do it again." (P8) "The running overview. Yeah, everybody shares that." (P9) "Maybe a screenshot of like the overview, but not in detail. Because it looks cool." (P4)

Theme	Descriptions	Examples
Presenting environmental impact on PI tools	Goals setting and new information which is helpful and interesting to the user can help them stay motivative to the tracker.	"I think it is interesting to see the environmental impact I create. And it would be nice to be able to set goal, yeah, this will keep me more motivated. " (P1)
	Important quality: Provide guidance.	"I think it (CO2) might be nice in the first few weeks, however, after a few weeks my mind will be trained to be able to estimate the CO2 I consume. Then, I would like to have new information. Yeah, new information is nice, like, other information about sustainability." (P3)
	What kind of guidance do the user want? What kind of guidance will support the users to travel more sustainably?	Being informed with sustainable alternative options before the mobility decisions are made can help user to make more sustainable decisions.
		"it would be nice if you can ask the tracker (Thrivey) what is the most environmental friendly way to travel before you take the action instead of seeing what you have done already. " (P5)
	Seeing the consequences → motivate to travel more sustainably	If the user are informed with the considerable difference between the intended options and sustainable alternative options, it might motivate them to make more sustainable decisions.
		"If I see that going by plane is really bad for the environment. Maybe the next time I will think, oh, I'll go by car or train or something else." (P4)
	How users would like to see the consequences? How to present the consequences in a way that can resonate with the users?	"I think if it would show me that, for example, walking somewhere, would provide a large benefit compared to going somewhere by train or car, when it's feasible, I guess it would really motivate me to go there more sustainably. So I guess it depends on how much you would lower your impact compared to how much effort it would take you to change your travel means. So I guess if the difference is huge, it would really motivate me to to change my behavior." (P7)
	Users would like to have guidance and understand the sustainable alternative ways in a transparent and objective way.	"If I have a guide on how I can be more sustainable in my mobility activities, that would be nice." (P3)
		"If it is transparent and it allows me to compare which route has less impact, then I think with a nice incentive and intuitive indicators, it would be very nice." (P2)
	How to present the data in a transparent and objective which can support the user to make mobility decisions?	Trackers provide information → allow user to compare and make decisions
		"If I make a decision to take my car and I see there is really an alternative now that was better or that might have been better. It can tell me objectively, like well, the other options were like this, this would be great." (P8)
		"Information to help me make the decision, for example, there is a platform to let you know how much environmental impact you create with that trip." (P1)

Appendix C: Results of the Group Discussions

The reading guide for the group sessions results:



Topic : Which concept makes you feel support to make sustainable mobility decisions? why and why not?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
What makes users feel supported in concept A	Goals setting and alternative options give users a feeling of support toward sustainable mobility.	Concept A: yes, By giving sustainable options; yes, by setting your goals.; Yes, the walking app stimulates me.
What makes users feel supported in concept B	Doing, reflecting and comparing and gaining knowledge together support users toward sustainable mobility.	Concept B: Because it is shared, we gain knowledge together; Yes, it is more competitive; Reflection with other people, adds to the understanding
Concept C does not make users feel supported	Stories do not really support users toward sustainable mobility.	Concept C: Concept C, not really; I can motivate myself, I don;t need a story to motivate me

Topic : Which concept make you feel curious about your health data and its relationship with sustainable mobility? why and why not?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
Mobility plays only one part in users' health	Users health condition is not fully related to mobility. They can also go to the gym to exercise and burn calories.	It is related and not related. Travel from one point to the same point, is not traveling.
Connect health with sustainable mobility	Users enjoyed relating health to sustainable mobility, this makes them feel more personal.	Yes, relating makes the matter more personal instead of societal or moral; Practically: people care more about their health than the environment
Main focus: sustainable mobility	Reminder: the main goal of this app is to support users toward sustainability, health is a tool.	I value the sustainable part more. The health aspect I can guess myself.

Topic : What do you like about in concept A?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
Relevant, clear, simple visualization	Visualization that fit with the realities (need to be clear and simple)	I would like a graph; Like to see the map; Visualisation is clear and simpel
Personalized	Personal goal setting, and adjusting the goal based on their status.	Improve on your goals; Set and meet your own points, your own private goals
Humanness	Humanness of the design. To let the system what the reason is that this journey was not that sustainable	Like to let the system what the reason is that this journey was not that sustainable
Alternative	Alternative options, because people wants to know more and understand more.	Alternative options to be more sustainable; Like to see the different types of alternatives; Like to see the alternatives
On point	People like it because it focus on the insight (health > sustainability) that they are interested in. They feel it is "on point".	On point; It focusses on the insight I'm curious about my mobility data; Insight in transportation

Topic : What do you dislike about in concept A?

Not novel	Ordinary, not novel, how to keep user motivated?	Bit gamified, collect goals. How do I stick to this app.; Kind of ordinary, where is the spice (new things)
Privacy: Need assurance.	Worries about the privacy issues	Scary, because I don't want to feel precisely tracked (privacy).

Topic : What do you think is a nice goal to set?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
Personalized percentage challenges	The goal should also closely related to the user. Eg. percentage of his/her behaviour can be improved.	A percentage of my travel will be sustainable. Travel time / traveled km.; Produce 15% less CO2
Goals that the results can compare with others	Fixed goals that compare with the average of others behaviour.	Predefined goals are great.; 10 minutes of walk every day.; In this amount of weeks, an ultimate goal like emission free; Average of a person is this amount of co2. Let's be better.; Amount of times means of transportation used.; Showing number of km traveled by bike.

Topic : Do you like to receive advice of your trips? What do you think about the advice in concept A?

The alternative option need to be realistic	People like the advice of the trip and they like that it is human. The alternative options should be realistic.	I like that the app gives me advice. Plus that the application also understands the practicalities.; Should be realistic (In time / not 40km walking) For example 10% more time.; Like to see the different types of alternatives
Transparent Present the data in an understandable way	People want to understand the data, how to present the meaning behind the data?	A measure that is understandable.; I don't know what an amount of co2 means.; Help the user understand what it means.; Provide translations of what co2 or calories means

Topic : What do you like about in concept B?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
Close friends	Participants would like to use it with people they knew	Making my commutity with regular friends, trying to compete Fancy this interaction with the people I know.
Collective feelings	Motivating to work together. The collective feeling, working together, celebrating together.	Group / community is more motivating Motivational / societal groups. I like Different challenges in multiple groups Celebrate as a group
Competition and cooperation	Gaming, comparing and reaching for the same goals at the same time.	Add another goal (the group goal) Like to set goals together By competing you also reach the primary goal of the group Would be fun to see how other people are doing. In a group I relate too. Like comparing that with other people Love gaming with colleagues
Fun and at ease	It's not a big deal to lose the group challenges	It is not a big deal if I loose

Topic : What do you dislike about in concept B?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
Qualities to make the group works	Prefer small group with closed friends and people who have the same motivation and behave more or less the same.	You need people of the same level and grow together If the group is too large, I would not feel motivated to reach the goal Depends on how serious the group is
Also need individual challenges	Users prefer concept B to have both personal goals and group goals.	Also include personal goal

Topic : Do you feel comfortable to share your CO2 footprint and the calories you burn via travelling?

Different levels of privacy concerns	People have different level of concerns about privacy issue. Prefer to let them choose which data is shared. Only shared with closed friends.	I don't mind I do mind Like to share with friends. Sharing with every body is unfortable There can be an issue sharing my data Let the user select which data is shared Privacy issue, because of health data

Topic : What do you like about in concept C?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
instant knowledge	Get a quick bite of knowledge that related to your health and sustainability.	Providing cool facts about health or the environment I like to get extra information Browse information in my commute Get more knowledge. Related to the goal small information would be nice on point very short. max one flip
Novel	Novel concept	Novel

Topic : What do you dislike about in concept C?

People need efficiency, don't like it because it is too slow	Too slow, people want to get quick information/knowledge.	Easier if it is immediately after reaching a goal For me... It is to slow. I dont like the big story line
Story: annoying, feel like being educated by a teacher	Less motivated and sometimes annoying by a story.	Don't like the type of game. Don't need a game to motivate me. Not sure how motivating it is. People might get annoyed by the game. hard to fill a month, to keep everybody interesting Children's app. Be little me. Try to educate me. I would not be convinced

Topic : What kind of story would you like to see through the application?
What do you want to gain from the story?

Theme (in keywords)	Analytical Notes (Interpretation)	Data (What participants said)
need more on point infographics	Participants felt that there are lack of on point infographics	More on point infographics
scientific information	Participants prefer to gain more scientific information.	I would like scientific information If I learn something new every time I unlock the story
Change or upgrade the avatar	Participants would like to change or upgrade the avatar.	Upgrading the avatar Boy scout earning badges
How to present the information	Participants would like to receive audio story or podcast by celebrity.	Unlock audio stories podcast Providing by celebraty

Appendix D: Feedback/Answers from the Online Discussion Group

The Log of the Online Discussion Group

Date	Participant	Description	Message	Replies from the researcher (Min)
03-06-2021	P3	Feedback about Thrivey's possibility P3 considered it would be nice if Thrivey app can provide suggestion for weather, location, and sustainable options.	Hey Min, I recently travelled to the north and this thought came up like before travelling anywhere in NL, I use 2 or 3 apps 1. To check weather 2. Google maps to check the location and all 3. 9292 To plan with the public transport What if Thrivey does all this for me with the suggestion of the sustainable option? Would be nice I think. I don't know how much this helps but thought of sharing with you.	Hi P3, Yes, indeed it helps! Thank you for sharing! I am curious, since you can plan the public transport in google map, why do you want to use 9292? Is the planning function more convenient for you in 9292?
03-06-2021	P3	Reply about the usage of 9292 (A route planning application) P3 stated that 9292 has better information about the real situation on the road, and he appreciates this feature.	Google map doesn't always have the status updates. For example, there is construction work so this route of tram is changed, and 9292 has those warnings.	I see! I agree with it! 9292 has better information about the real situation on the road. About the idea of combining weather and route planning function in Thrivey is awesome! I had discussed this with Maarten (comapny mentor & the owner of Thrivey), however, it is not feasible for Thrivey now, because currently Thrivey wants to go for the direction of a mobility tracker, instead of a route planning app. Thank you very much!
23-06-2021	P3	Answering the question in chapter 4.3.3 P3 considered writing a post may cost too much effort. However, he is interested in reading other's posts and discussing with other members. P3 considered sharing and discussing the travel activities in other application (other than Thrivey) would cost too much effort. However, he saw other people doing it. Therefore, he considered it might work.	1) I don't see myself putting efforts and writing a post of my sustainable travel choice But yes I would surely read someone's post out of curiosity 2) Yes a discussion area is a nice option. I am already intrigued into knowing the reply from Luna for the question asked in the sample image 3) I again don't see myself taking those efforts but yes I know many of my friends that share such things on social media and I can see that happening in this case as well.	Hi P3, Thank you very much for your reply! It is very valuable for me! It is nice to know your view on this topic, thank you!

The Log of the Online Discussion Group

Date	Participant	Description	Message	Replies from the researcher (Min)
23-06-2021	**P1**	Answering the question in chapter 4.3.3 P1 considered the "support system" is useful. P1 considered it would be better to have the discussion within the Thrivey app. However, he saw other people sharing and discussing similar topic in other platforms as well. Therefore, she considered it might work.	1) Yes I would feel supported and inspired by reading other member's experience, I think it's a nice and useful option! 2) I think the discussion area is a good idea. It's nice to know what other people think and interesting discussions may be created 3) Personally I would prefer to leave the discussion in the same app, but I see other people sharing the experience in other platforms as well. So I think it could work!	Hi P1, Thank you very much for your feedback! It is very valuable for me! It is nice to know your view on this topic, thank you!
25-06-2021	**P7**	Answering the question in chapter 4.3.3 P7 considered reading others' posts would make her feel supported and inspired. However, she considered writing a post may cost too much effort. Also, she would feel supported if other members positively to her contribution. P7 preferred to have the discussion within the Thrivey app.	1) Yes I would feel supported and inspired by the messages of others. I wouldn't be sure if I would take the time to write post often. 2) I think so, mostly if people respond positively to my contribution. I also like the discussion going on the comments. Interesting interaction! 3) I would not be tempted to take the discussion elsewhere. I would like to be able to discuss in the app directly! Hope my answers are useful! If you have any additional questions please let me know.	Hi P7, Thank you very much for your answers! It is of course useful for me! Good to know that you and P3 has the similar thoughts on the effort of writing a post.

Appendix E:
(Final design evaluation) Interview Questions & Results

Interview questions for the final design evaluation

- Overall, how do you feel after experiencing the design?
- The main features of this design are the community, the group and individual challenges, the informed infographics, and the personalized advice. What features make you feel support toward making a sustainable mobility decision? Why and why not?
- Do you feel curious about how many calories you can burn by different means of travelling (walk, bike, driving, taking public transport, etc.)? Why and why not?
- If you see this (the "news area" in the insight tab), would you click on it to see more information? What do you feel about this "news area"?
- How do you feel about the infographics in the insight tab? Do these infographics provide you with a better understanding of your travel behaviour? Why and why not?
- How do you feel about the community feature (including the group challenges, divide goals' function, the "support each other" function, and the discussion area)?
- Does the community feature provide you with a better understanding of other people's travel behaviour? Why and why not?
- What obstacle did you face when interacting with the design prototype?
- Any final thoughts you would like to share?

Interview results of the final design evaluation

The interview results were divided into different themes according to the research questions in chapter 6.1.

The grammar in the "quotes from the participants" might be incorrect because these quotes are expressed in a colloquial way.

Theme	Descriptions	Examples
Provide Support	Participants felt supported by different features in the final design: 1) P1 feels supported by the community feature, and group & individual challenges. 2) P2 feels supported by the personalized advice and the infographic. 3) P3 feels supported by the individual challenges. 4) P4 feels supported by the progress of the group challenges, seeing what other member are doing. 5) P5 feels supported by the personalized advice. 6) P6 feels supported by knowing the progress of the group challenges.	"I think the main few features that would support me are the community and the group and the individual challenges. Because I think those were very clear in how I can compare to the rest or how I can compare to my own ambitions. So from those I could get useful insights in what I should do to improve. And then the informed infographics were useful, but I just had to look at them a bi t longer to understand what they were saying. And I would like it if they would give me direct advice on how I could improve." (P1) "For the personal advice, I think it's really nice, if it makes sense." (P1) "For example, if some trips happen more often. Then, the design can give advice and those trips would be very useful. For example, in the case of the heavy luggage, if the design can suggest me with another option in which I can carry the heavy luggage, that would be nice." (P1) "For me, the overview of the co2 and the type of advice. Well, I think it's nice that you compare, for example, the car and the bicycle, and you have information about how kilograms of CO2 you're meeting or not, and how many calories you're burning or not. So I think the last one (personalized advice), I think it really supports me towards that (sustainable mobility decisions). It's also easy to understand, like, right away." (P2) "I'm self motivated, and I'm not part of any group. So at the moment, I'm most interested in my individual challenges. The app can help me keep track of my routes and help me to reach those goals." (P3) "During corona time (COVID-19 pandemic) I made an individual challenge to walk at least 10,000 steps a day. And that's about 8 kilometers. And I have a meter on my telephone so I can see how many steps I did. And then, I found out that (10,000 steps / 8 km) is quite easy to to do. So I I improved my challenge from 10,000 steps to at least 10 kilometers a day. Those are the insights the application gave me and drove me to increase the challenge. I think that could be the same for the Thrivey." (P3) "I like this particular image (the progress of the group challenges) where you have a lot of bar charts of each individual member in the group and how they are doing in terms of their progress. I think that was the most interesting graph that I found and also very motivated and fun to see how we are all doing in terms of the group goals. And doing it was like playing a game together towards a sustainable goal." (P4) "The thing on the right side with a green background (the personalized advice), like seeing what it was by car and seeing what it was by bike, I think that's one of the most important one. That would help me make sustainable decisions. What I would even like to see is, for example, the traffic." (P5) "It's good to see how your weekly results are and what you have to do in the last week or days of the month to to reach your goal. and oh it's with the whole group, I think it will motivate a lot." (P6)

Theme	Descriptions	Examples
Activate Curiosity	Personalized advice: 1) It can trigger users' curiosity. 2) The calories information makes users feel motivated. 3) It can help users to make mobility decisions. 4) Some users care more about the sustainable aspect than the personal health aspect.	"Yeah, it was interesting to me that you burn 12 calories when you're sitting in car (while driving), that's fun. But then, if you go by bike it's (the calories) way, way more. It's like, more than 10 times. And, and the difference between the CO2 is also large. I would be more motivated by the calories because that's more clear to me what they mean." (P1)
		"Yes, I would be curious, because it's (the information of the calories) like an extra motivation to choose one way or another to travel. But I think the CO2 emission is more important. Because it's (for P2 to use the app) not really about the calories. It's more about how sustainable I'm traveling." (P2)
		"Yes, of course. I want to stay healthy and this is part of it. I don't want to gain "COVID kilos" (add weight during the COVID-19 pandemic), that's one of the reasons I started walking." (P3)
		"I'm very curious. Because I, I have too much kilos. So it's good, it's good to know what what the difference is. (the difference calories that can be burned by difference means of transport)" (P6)
		"You see the calories and it helps motivate me to choose the way of transport. I think we don't realize it. (the difference calories that can be burned by difference means of transport) So, this will help." (P6)
	Personalized advice: 1) P5 considered it is weird to have calories burned while driving. 2) The application should enable users to understand the meaning of the CO2 and the calories.	"yeah, that would be quite good, because, well, keep in mind the discussion we had earlier on about calories you burn in a car." (P5)
		"I don't feel so relevant to me because seeing like 12 calories of 140 calories, I don't really feel related to the number itself. I think my preference on mobility would be more on other factors then the calories burned. And I don't really know ,like, what 40 calorie means." (P4)

Theme	Descriptions	Examples
The understanding of oneself	Informed infographic: 1) Clear, nice 2) First time user might need to take more time. However, they will gain insight from it over time. 3) Help users to have a better understanding of themselves 4) the overview of the categories is a nice surprised. It helps users to know their travel behaviour better and support them to make next mobility decisions	"The one (infographic) with the green, yellow, and pink is very clear. So that helps to understand what the graphs are saying. And then for the blue one (infographic), the difference between the colors of blue is less clear. But still, it's clear enough. Also, I would like to see the amount of time used on different means of transports." (P1) "In the beginning is hard to read. But over time, I would get more information out of these graphs, because I can compare them and I have more knowledge on how to read them." (P1) "I think for me, they're clear. So yeah, it's I think it's nice. It enable you to know how you behave in the last period, and you're, like, it's okay, I just have to, you know, correct my behavior." (P2) "I think the overviews are clear." (P3) "Yeah, it was nice surprised about the overview where you can see the reasons why you use the car. So when you have a look at at one travel, it's okay to use the car. But when you have an overview, and you see what you have done in a month. And you see that you had 50 travels and you use just one time the bicycle. And you see what what the reasons are, like the weather or go with other people with a car. And I think you realized: okay, I do something wrong. Because I have my my goals to take more bicycle, then go by car. So I think it helps. I think you're more straight to yourself because of this." (P6) "Overview helps to see what your behavior is and what your travels are. And help you to make it in a decision." (P6) "Yeah, of course, it does (help you to have a better understanding of yourself). Because it gives you insight on what you are doing. And you could you can see where you could improve." (P3) "I personally like the graph that shows the proposition of sustainable versus unsustainable as well as regular journeys. And that's a very basic general overview of how I am doing. Perhaps if the graph would be in a scale of months, it would be more useful for me. Because I was not so interested in my progress per day, but for a longer period, and I would check once in a while. " (P4)
	Informed infographic: 1) Present the information without the judging. 2) Should compare the data with user's previous travel behaviour. 3) The "unsustainable journeys" label make P5 feel offended. 4) Visual suggestion: the bar chart can present the bars next to each other, not stack on each other.	"I think it would be more interesting to see how many times you took, for instance, suitable traffic or a suitable travelling method. And then without the judging." (P5) "I think it's really important to compare it (the infographics) to other weeks. And let me judge if it's okay, or not. In those same way of the screen time. So when I get a message, like, you have a 30% increase in using car for the same rides that you made for a different period. If I get that message, it's like yeah, yeah, I should not do that I should take my bike more." (P5) "let me judge for myself, because I'm the only one who can judge why I did what I did." (P5) "I think it would be would be easier for me to understand if for they are next to each other or stick slightly next to each other." (P3)

Theme	Descriptions	Examples
The understanding of others	Community feature: 1) motivated users to become more sustainable in the mobility aspect. Because they can seeing other member are also doing their best. 2) It provide a better understanding of other people travel behavior. 3) It is considered interesting / attractive / fun (like playing a game)	" I liked the fact that in the divide goals function, people could say, like, I need more challenges next week or next month, can we arrange something? And, it's like a shared effort. If you do it together, you can sort of balance out. It motivates you more because you're doing it together." (P1)
		" I like the graph where you saw everyone's goal, and then if they were reaching it or not. And then, it was fun to me that there was this gay (Sam) who has a goal of 25 (kg of CO2) and he had only an emit 2 (kg of CO2). That would be a reason for me to get in touch with him and ask him to adjust his goal." (P1)
		"It will definitely give you a better understanding of other people behavior, also, like, which kind of behavior they take and what the matters to them. I think it's a great feature for that." (P2)
		"I think indeed, it it's very interesting and attractive feature of this app. In my opinion, it's very fun. I can imagine that doing this with a group of friends, and achieving a goal together, defined goal together, this will be very fun. Also, learning and seeing how others are doing. It's also just interesting. Like playing a game together." (P4)
		"If I see that the other people are also doing their best to reach these goals, I will be a stimulus to do the same. And in the task you gave (task 3). Nina adjust her goal and do more for the group to reach the group goal. And this is good." (P3)
	Community feature: 1) too complex 2) Less competitive 3) Need to take time to understand it	"Maybe you can add something to let the individual members of this compete to each other. Maybe you can add something like "the most contributing member" or somebody who in percentage contributes the most to the to the group challenge" (P3)
		"Yeah, I do like these monthly challenges and weekly challenges. I think that it needs a lot of designing still. Well, I got lost in the wireframe. So that was clear. But also like, I think it's too complex right now. Simply because I think this is a rather easy feature from a user perspective. I actually think it's the function that's too complex." (P5)
		"But I think it takes more time, you had to use it a few days to know what it means. I think it's all the possibilities are in there. And it takes a little time to, to know how it works what it mean. But just a little." (P6)
		"I think it will take time within this group to let that (divide goals function) work. Because you have to be able to forecast your own travel for a certain periods. And to be able to know what this means in your co2 footprint. So I think, this would work better if maybe you are in this group for half a year or something." (P3)

Theme	Descriptions	Examples
The understanding of the surrounding	News area: 1) It can trigger users' curiosity. 2) The burry visual is considered appropriate. 3) It can increase the user engagement. 4) It is considered interesting to the users.	"The sentence that stayed there (on the design prototype) is already interesting to me, like why did a generation ago more children walk to school? I want to know why. Why is this happening? It makes me curious to check what's behind it?" (P1) "I liked the fact that you see this news thing (news area) but it's not very in to your face. So if you came to the insight tab, just to check your own traveling, you can scroll by it very easily. It doesn't bother you. " (P1) "I think it's very interesting to have it and I will definitely click on it. Maybe depends on the information that is displayed. And sometimes you just want to open the app to see what news comes out, you know, it just triggers you to use the app more. Yeah, like, you know, when I have this long train trips, and instead of scrolling social media, I would just use this and get informed. I will do it personally, I would open the app to see what's news is there." (P2) "I wasn't really aware of this feature. But now that you are introducing it, it looks very interesting. I will definitely break into to see a read more about it." (P4)
	News area: 1) News need to be novel 2) P5 considered most news related to sustainability are sad, and he prefers positive news. 3) News need to be tailored to the users. 4) The news should be free to the users.	"it's hard to find good facts that aren't actually already out there. Because reading this one made me think like, nah, sad. and nothing more. Yeah, it's more blah, blah, that are already heard. So I'm not really the the audience for this one." (P5) "If it's (the news in the news area) about sustainability, or about people not moving anymore (walking or biking less). It's just sad. But we all know it's true." (P5) "Yeah, so what did we achieve? I would like that more. Than these negative messages (sustainable news), because, you know, they're all around and we know it's a problem, and we should do something about it. And we don't (do something about it)." (P5) "Not on this particular example (the example news in the news area). Because that is, for me, that is common knowledge that nowadays people bring their children by car to school, and they don't work anymore. So this is not a good example." (P3) "Yeah, normally it makes me curious when I see a news line. Well, it depends on what the news is. It is better to connect to travel, to calories, to CO2, to health." (P6) "British children's are interesting. And if it's from me, it was tailored to like Dutch children or European children would even be more interesting." (P1) "And I would hope that the article or the information was for free. If it was free, I would like click every time I see an interesting sentence. " (P1)

Theme	Descriptions	Examples
Usability	P1, P2, P5 considered the design prototype is "clear". Also, P1 prefers to have more suggestion on how to improve her travel behaviour.	" If the app would give me more suggestions on how to improve, that would help me. But other than that, I don't think I faced that many obstacles. Just quite clear, and everything I needed is there ." (P1)
		"Don't feel challenges. It's pretty clear. Overall, I know where to click." (P2)
		"I think it's quite clear." (P5)
	Issues: 1) Need a scrollable bar next to the screen. 2) Some infographics are confusing to the users. 3) Some texts are too small.	"Add a scrollable progress bar on the right side would help." (P3)
		"the scroll bar thing. It would help because many of the pages are very long, and if there's no scroll bar present, then I might have missed some of the contents." (P4)
		"You should stay below that line (the line on the graph), I think, although it makes me think that I should reach that line. But I think I should stay under the line." (P5)
		"Because not some people have a very large screen and some people have a smaller screen. So it's good when you design the application to make it readable for everyone." (P6)

Theme	Descriptions	Examples
User Experience	The design prototype was perceived as a “clear design”. It enables users to feel calm and have no stress when interacting with the application. Additionally, participants enjoyed and appreciated the visual style of the prototype, they considered this is an improvement of the current application. With the clear visuals and design the prototype is able to provide users with insights into their travel behaviour which, as a result, support, motivate and inspire them to make sustainable mobility decisions. P4 even said she would like to use this new version (the design prototype).	"I think I feel calm. Because I don't feel stressed. Everything in design was really clear. So I don't feel stress or frustration. So that's good. I felt that my use of the app was enjoyable. And I think it was due to the fact that the prototype was really clear, I knew where I could click. And I wasn't afraid to just click on stuff and see what happens because I wasn't afraid that something would go really wrong. And then when I would open certain depths, everything that was in there would make sense for it to be there. And then some of the graphs, of course, I had to look a bit more into depth to see what they would mean. But overall, it made sense of what was in all the different subsections. So I feel happy. I think it's really clear. And I know what to do. And it looks very nice. I enjoyed how it looked visually." (P1) "It's very connected, it tells you your progress and what can you do next. It's about like being sustainable while traveling, so it's very interesting. I feel like being guided through my new behavior. Because it you keep track of what you're doing. So you have control of the situation. And then you are also inspired to do more to improve (one's travel behaviour)." (P2) "I think it's a nice app. It's like, I never saw something like that before. I mean, it's saw like a lot of apps that tracks your performance on other contexts. But this about the sustainable behavior. I think it's very interesting. And oh, I will use it actually." (P2) "I think it's a nice modern design and way to track my movements and to maybe to help me to reach this goal. if you want to say you want to be 10% more sustainable, then it is a way to track that." (P3) "The testing (final design evaluation session) was very interactive. The prototyping process was very clear. And then in general, I think it was quite fun to use the app. And I did feel motivated after testing. And I wanted to use this app. This new release version of the app. To be honest, I wasn't really using the current Thrivey app. But the new design just looks nice and with nice usability. And the charts provide lots of things." (P4) "Not that I can think of at the moment, I think this prototype, you've done a great job. Very nice." (P4) "Yeah, I like the design, it's an improvement to what it was, or what it is. " (P5) "Yeah, it's it's a great design because it's it's easy to use. Most things are good on the screen so you can swipe down or left right and find your way. And it's green. It's of course a good color for sustainable journeys." (P6)
	P5 considered the main goal of Thrivey app is to help users with kilometre reimbursement. Therefore, he suggest to intertwine the sustainability aspect with the kilometre reimbursement. P3 considered the design prototype only focused on cars and bikes. More information about the public transport is required. P3 considered the app should not only focused on improving the health of the users, but also the health of the earth.	"From my perspective, the main goal is to track your kilometers. And the sustainable part should intertwine with it. Because I think that one of the unique selling points of this product is the sustainability. But it's not the main goal of your end user." (P5) "The prototype was about cars and bikes and it was not about public transport." (P3) "There are two things you can be more sustainable, one is for the better health of the earth and second is for a better health of yourself. And I would like to have more emphasis on the first parts." (P3)