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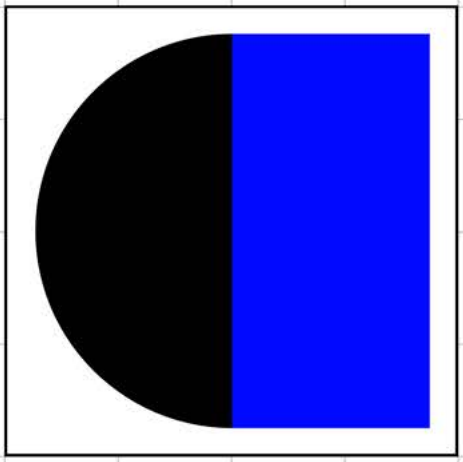
Building a collaborative relationship with a travel buddy for multimodal journey planning



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Master Thesis

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Cities of Things is a Delft design lab that focuses on the role that Things, enabled by artificial intelligent combined with Internet of Things, will play in our future cities “as citizens”, moving past the idea of the smart city and smart products as a dashboard and tools for easy living. In the Cities of Things Delft Design lab is shaping the future of our cities with intelligent things.

Building a collaborative relationship with a travel buddy for multimodal journey planning

Acknowledgment

This project is a result of the collaboration and contribution of many people. Conducting a project that requires a profound understanding of the way humans interact with their surroundings during COVID lockdown wasn't an easy path. I couldn't be more grateful for the kind heart of others.

I would like to express my sincere gratitude to my supervisory team at the Delft University of Technology for supporting and guiding me throughout this journey. Professor Eui Young Kim, thank you for providing your constructive and critical feedback and guiding me when I was lost not knowing where I am heading to. Because of your guidance, I was able to be more concise with my thoughts. Iskander, I am grateful for your effort to set a direction that fits my field of knowledge and interest and your support in many ways. Conversations with you fueled me with inspiration and creativity. With both of your help, I was able to apply what I have learned while studying here and become a better designer with a balanced perspective.

Thank you to everyone who has participated in my research. As this thesis was a self-initiated project, I randomly reached out to experts who are working in the mobility industry. Without your help and knowledge, I would have never managed to understand the complex mobility landscape and the decisions you made to make changes.

To many fellow students and friends who have shared their thoughts and insights, thank you for giving me opportunities to think outside of my own box and to gain a deep understanding of users. You were always there when I needed help and inspired me with courage when I was dealing with uncertainties.

To James, who has supported me in both emotional and professional ways. With little knowledge and interest in technology, I was like a kid who had just got hold of a new toy in my hands. Many discussions we had about opportunities and threats that technology can bring to our lives shaped my thoughts on the issue as a designer.

Lastly to my parents and family, who have always believed in me and supported every decision I made in my life. Thank you for giving me the opportunity to experience the world outside.

Yours Sincerely,
Yeonju Jeon

Executive Summary

Life is a series of choices. From a small decision such as choosing what to have for dinner to a major decision that will change the course of life ahead, decisions have consequences. Now we can make decisions faster with the help of an automation system with minimal human intervention. However, the problems themselves became more complex involving excessive information to process coming from different suppliers.

This project was assembled with my interest in mobility infrastructure in the Netherlands. As a graduate of a bachelor's degree in spatial design, it fascinated me how well-planned urban space can enhance the quality of residents' lives. There are more than 25 million bicycles in the Netherlands with 36% of Dutch people listing the bicycle as their most frequent way of moving around. Cycling is fun, healthy and a great alternative to cars when combined with public transportation. As Dutch government, municipality, and mobility service providers are putting emphasis on the role of digital systems to tackle mobility challenges, intelligent agents are taking a role in interacting closely with travelers connecting them with their surroundings.

This thesis is a result of the endeavor to address the interaction between a travel buddy and a multimodal traveler in the near future. The research started by defining the travel behavior of multimodal travelers, fundamental needs, and attitudes that compose their decisions. Meanwhile, a literature review was conducted to understand the interaction between human and artificial beings. The main finding of this chapter is that the biggest distinction between humans and machines is that humans are affective beings that pursue physical and psychological well-being.

With this basic understanding of the project context and challenge, several research activities were conducted. With a Mind Mapping technique, current travel experience involving a combination of mobile applications to support their journey is described followed by their future vision for a travel buddy. It appears that abilities to "understand" and "learn" users are key. However, frustration with existing digital solutions creates a separation between human and machine decision-making, which is likely to result in detachment with a travel buddy as well as decisions of their own.

On the other hand, the approach of decision-makers who develop digital solutions is analyzed in the following chapter. For them, enabling easy and intuitive use for users is a priority as well as delivering accurate and essential information to support users to choose a route that accompanies integrating diffuse application programming interfaces (APIs) from different suppliers in a consistent form. Although there is a tendency to give users access to parameters that are used to optimize routes, it is still provided in predefined travel scenarios that hinder users' full customization.

Based on these findings, the design goal and subgoals for designing a prototype were defined as described in chapter 5. Desired interaction with a travel buddy is defined as a collaborative one by enhancing the autonomy of users and engagement to shape future urban mobility with each other. Three ideas to provide route recommendations were generated and evaluated with a user survey. Based on the feedback, the Experience prototype that depicts a story in which a travel buddy actively learns, and asks for participation, and defines a travel type of a user to optimize the journey was developed and used for the final experiment.

The result shows that it was effective to apply different values that users have in their minds when they plan a journey and choose a route. Moreover, the idea of having a conversation with a travel buddy evoked curiosity and interest. A defined travel type can be used as a tool that users can observe and reflect on their travel behavior. The impact of defining a travel type can change travel behavior when it's well treated.

The thesis concludes with a manifesto for a travel buddy to share considerations for use with decision-makers who are envisioning the future with an intelligent being that assists and promotes multimodal journeys. Chapter 9 presents 9 considerations that will help stakeholders to address the intention, motive, and view of a travel buddy. This manifesto talks about the relationship between a user and a travel buddy, the role of a travel buddy, the attitude with which to approach users, contextual considerations, and more.

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Chapter 01

Introduction

Chapter overview

This chapter gives an introduction to the project. A design fiction envisioning the urban travel experience in the future is introduced as a starting point followed by the present mobility landscape in the Netherlands and emerging trends. The chapter concludes with an initial project brief that introduces an initial research question, approach, and the desired outcome.

1.1 Preliminary research

Speculating future travel experience

With the rise of AI (artificial intelligence) combined with IoT (internet of things), “things” that are embedded with sensors, software, and other technologies for connecting and exchanging data with other devices and systems process information, perform tasks, and even make some decisions on behalf of us. In the previous semester, as a part of an elective course, I delved into this subject in the context of urban mobility. I looked into the impact of things on urban travel experience in the future to address the issues we might encounter when things are more competent and capable of interacting with humans more naturally. To meet the goal, design fiction was used as a medium to explore and criticize possible futures.

Based on literature reviews and interviews with experts, the requirements for a personal intelligent assistant for multimodal travelers were defined. First, it will be given a role that bridges the digital and physical worlds. Second, it has to adopt travelers’ preferences and adapt itself to them. Third, the decision-making will become a collaborative performance between a user and a travel buddy. Fourth, it has to help travelers switching from one transport mode to another. Last, it will be equipped with better predictability.

The story depicts the future where work is blended into one’s life and the user closely interacts with a personal intelligent assistant to efficiently manage work and travel schedules. In the story, the main character called Thomas interacts with his smart assistant who takes care of every aspect of his life and makes a journey more engaging and streamlined. Smart assistants play a role that bridges the digital and physical world, adapting the service based on the preference of a person. As we delegate more authority to a smart assistant, it becomes a companion that makes a journey together in a collaborative way.

With this story as a starting point, the role of an AI assistant that guides us throughout our journey and the impact of it will be explored in the following chapters

** The full story can be found in appendix 2*

1.2 Project Context

1.2.1 Transport in the Netherlands

The Netherlands is known as one of the most bicycle-friendly countries in the world where 25% of all trips on the road are made by cycling followed by 20% walking and 5% public transport. In Amsterdam specifically, 38% of all journeys in the city are made by bicycle, and it has exemplary cycling infrastructure(van der Waard and others, 2012).

Although it has a very dense and modern mobility infrastructure, as the population in urban areas is increasing, mobility infrastructure is burdened and faced with challenges to tackle. Rather than investing in developing new infrastructure, the Dutch government and experts in the field are trying to find a better and smarter way to deploy existing mobility resources.

The government is striving to encourage more sustainable mobility behavior by discouraging car usage and encouraging the use of public transportation and shared micro-mobility to make the city more liveable and walkable. Experts are envisioning that intelligent systems and smart assistants will play a bigger role to fill the gap of the speed of change between infrastructure and service and rethinking the relationship between the traveler and the mobility system asking by who is in the lead. On the other hand, the social role of mobility will increase due to the value shift from efficiency to sustainability while shedding light on mobility-happiness. According to the report of INFO (2020), real change will take place in the software of our lives and society with appropriate social intentions.

1.2.2 Trends in mobility

> "Urbanization and condensationn, work-life integration, connectivity, climate change and sustainability, customization, shared mobility, smart assistance, ethical awareness are 8 trends that drive the future of mobility."
> - *INFO, Iskander Smit*

With the rise of new modes of transport and transport services, involved stakeholders are seeking innovative transport solutions to make going from A to B as seamless as possible. Integrated travel solutions via apps are being used to increase travelers' experience with public transport and active modes such as bikes. To manage diverse transport services and streamline the mobility network, mobility hubs that combine various activities to realize the more efficient movement of people and accessibility of urban environments are developing.

With evolving technology, the connectivity of mobility resources is increasing. Therefore, new ways of collecting and integrating data from various sources with different scales, times, and levels of granularity are being found to find new patterns, connections, and proof for mobility solutions. As analyzing and predicting the

capability of technology is improving, extensive studies to understand the mobility behavior of travelers and combine data to create efficient and pleasing experiences are being done.

1.2.3 Journey assisting tools

Journey planning apps have become essential to urban travelers (see figure 1.1). Beyond being more competent and smart to guide a user throughout a journey in terms of accuracy and predictability, journey planning apps are aiming to become a travel buddy that is adaptive and personal by providing tailored service. It aims to add value to multimodal journeys and enrich the experience on the road by learning users and adopting their preferences and travel behavior. In the automotive domain, on the other hand, personal voice assistants in cars are becoming human-like multiplayer. Multiple voice technologies are merged into one system integrating work, life, shopping, entertainment, and so on. This trend is related to the need of users who prefer familiar voice assistants, like the ones they use in their homes. This is being combined with different modalities to initiate the interaction and integrating user state detection to make user interfaces appear more human.

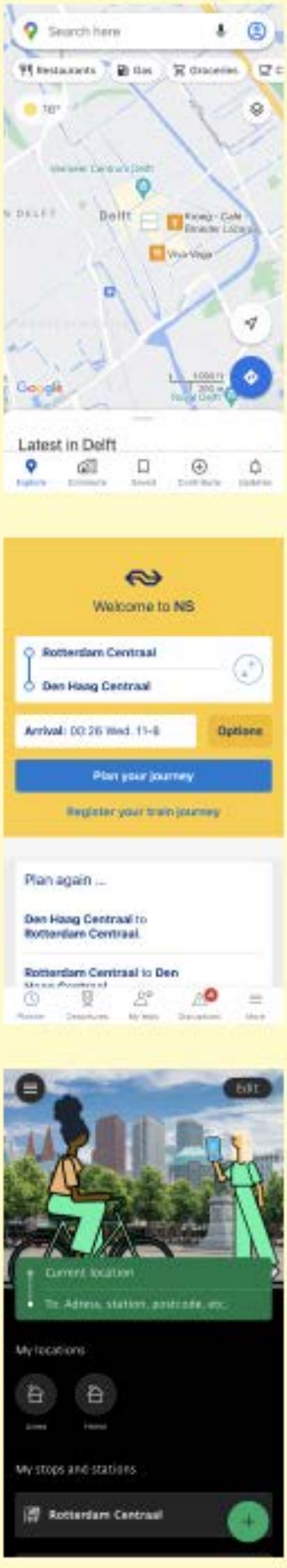


Figure. 1.1 Most used journey planning apps in the Netherlands

1.3 Project Brief

1.3.1 Problem definition

The main challenge of this project is to rethink and define a relationship between a traveler and a travel assistant for multimodal journeys that is likely to evolve in the future. The travel assistant that is equipped with predictive and adaptive capability mainly made to cater to the needs of multimodal travelers will be called Travel buddy in this document. The term Travel buddy implies that it is capable of interacting with a user in more human-like and natural ways. While current research and developments of multimodal journey assisting apps are focusing heavily on enhancing accuracy, predictability, and personalization of service, the real challenge of considering the emotions of users while interacting with a travel buddy and making decisions are not fully discussed in this domain of research.

Multimodal trips that involve more than one transport mode that isn't owned by a traveler can be less engaging and less empowering compared to the ones for car drivers. And there is an opportunity to improve and enrich this travel experience by considering that a human is not always rational but an emotional being. Travel assistants will play a more active role in this relationship, determining the quality of a journey. A well-designed relationship between a traveler and a travel buddy can be mutually beneficial, helping each other and learning from each other (Breazeal, 2004b).

1.3.2 Initial research questions

To enrich the multimodal travel experience by enhancing interaction between a multimodal traveler and a travel buddy in an affective and engaging way, the initial research questions were defined as follows:

- What are the fundamental needs and requirements of multimodal travellers?
- How will the role of a travel buddy evolve in the future?
- How would people interact with a travel buddy in the future?
- What kind of empathic features or behaviour will be desired from a user?

1.3.3 Approach

The project will follow the double diamond design process as decribed in figure 1.2, consists of 4 main phases. In the discovery phase, a literature review, as well as three research activities, will be done to collect insights. These research activities will be a consecutive step incorporating insights found in the previous steps. The findings of each research activity will be synthesized to form a design goal that describes the desired relationship between a user and a travel buddy as well as criteria to evaluate the prototype. The third phase will focus on developing a prototype that describes the future interaction with a travel buddy. The prototype will act as a tool for a design experiment. The result will be evaluated with defined criteria and a design guide will be created as a conclusion.

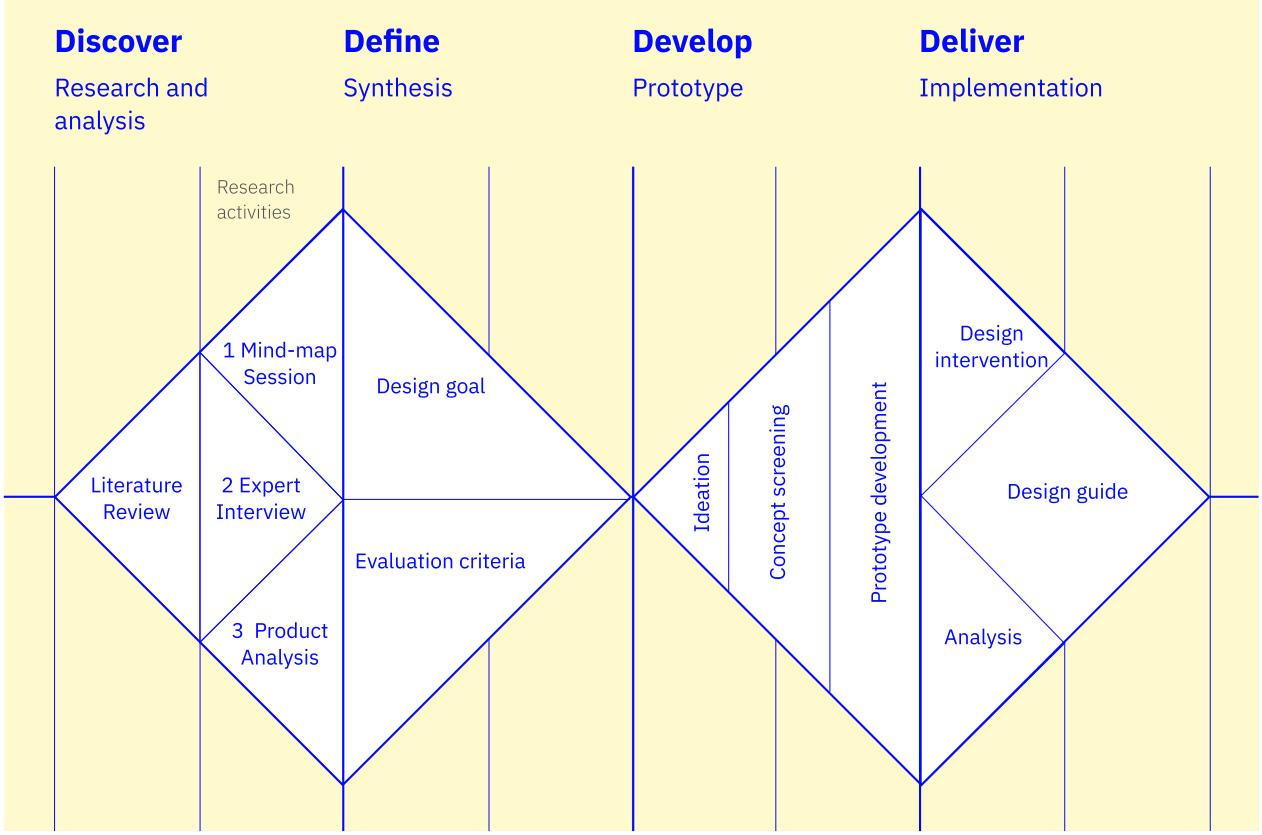


Figure 1.2 Overview of the research process

1.3.4 Desired outcome

This project aims to develop a provocative prototype that depicts a future relationship between a traveler and a travel buddy to test with users. The prototype will be used to create a set of guidelines — a manifesto that is built upon findings gained from several research activities for decision-makers including developers and designers who are starting to develop a travel assistant. The reason for choosing this form as an outcome of this project is that I want the findings to be used as a tool that makes room for discussion and to think about the impact before we decide to adopt a technology-enabled tool for multimodal journey planning.

Chapter 02

Literature Review

Chapter overview

This chapter is the first attempt to answer the initial research questions from the users, technology, and design perspectives. It first investigates the behavior and needs of multimodal travelers, especially in the Netherlands. Then, ongoing discussion in design and technology industries regarding mobility experience follows.

2.1 Understanding multimodal travel-ers

2.1.1 Multimodal travel groups and attitudes in the Netherlands.

As the focus of mobility is shifting toward promoting sustainable travel behavior involving public transport and active modes while reducing car travel, understanding travel behavior is important to introduce an impactful policy that can be easily adopted by citizens. Molin and others (2016) identify five clusters of multimodal travel groups in the Netherlands based on the use of four transport modes — car, bicycle, train, and bus. They suggest a direction for policy-makers with respect to each travel group.

The least sustainable group is the Car Mostly group (17%). This group used cars most often and bicycles the least. This group is the most favorable towards cars among other groups and least favorable towards both bicycle and PT.

The second-least sustainable group is the Car multi-modal group, which has a share of 27%, used cars most often with bicycles. Since this group has a positive attitude towards cars, a negative attitude towards bicycling, and an approximately average attitude towards PT, its attitudes are congruent with its travel behavior.

A third group is a bike+car group (18%). Although bicycle use of this group is high as in the previous group, its car use rate is also relatively high. Concurred with their travel behavior, this group has average car attitudes, positive attitudes towards bicycles, and negative towards PT.

The next group is labeled PT Multi-modal which has a share of 14%. This group uses public transport most often of all groups and also uses bicycles comparatively often. Notably, this group has about average attitudes towards all transport modes, which suggests that its travel behavior is not congruent with its attitude. The most sustainable group is the Bike multi-modal group. It takes up 24% of the whole proportion. This group uses bicycles most often and the use of PT is comparatively high whilst the car use is low. This group has a negative attitude towards cars in terms of pleasure, convenience, and environmental impact and perceives cycling as pleasant. This group is also a group that scored PT usage most positive.

A challenge for developing sustainable transport policies is to look into the congruence of attitudes and travel behavior of each group. It is less likely for groups that score negative attitudes towards bicycle and PT to adopt the mentioned modes. For them, promoting less polluting cars may work the most. For groups that already adopt sustainable modes and multimodal travel behavior, providing seamless experience switching between different modes and finding a better way to increase convenience with active mode are suggested.

At last, for the group in which attitude and travel behavior are congruent, the main policy challenge is to prevent the group to switch to a more car-oriented travel behavior style once they can access it.

2.1.2 Determinants for transport mode choice

One key determinant that influences travel mode choice is instrumental determinants, such as time efficiency, flexibility in terms of time and place of departure (Jensen, 1999), and monetary cost (Gardner and Abraham (2007). However, lower costs of public transport do not directly affect car users switching to public transport (Beião and Sarsfield Cabral, 2007).

Affective determinants which refer to autonomy, freedom, pleasure, stresslessness, privacy, and comfort (e.g., Guiver, 2007; Hagman, 2003) are inherently linked to individual preference. Affective determinants are associated with feelings evoked by traveling with specific travel modes (Anable and Gatersleben, 2005).

Another cluster is symbolic determinants of travel mode choice. This describes a social expression and social identity process associated with ownership (Lois and López-Sáez, 2009). However, symbolic determinants can be less relevant to urban travelers due to increasing travel time and cost (Firnkorn and Müller, 2012).

Clauss & Döppe (2016) bring individuality as a new determinant. This new dimension is related to the urban traveler's requirement to customize and mix travel modes. The advantage of multimodal travel options that allow situational and personal adaptability for urban travelers can open up new opportunity space (Susilo and Cats, 2014).

2.1.3 Characteristics and needs of multimodal travellers

Characteristics of multimodal travellers

According to Beuhler and Hamre (2015), multimodal travel is associated with young people with high education, small households, and car availability. People with innovativeness, tech-savviness, multimodal mindset, and the need for travel information and freedom of choice are highly likely to be early adopters of MaaS (Mobility as a Service). Based on these indicators, KiM, Netherlands institute for transport policy analysis further identifies the characteristics of early adopters. According to Zijlstra and others (2020), early adopters are likely to be highly mobile, have a high socio-economic status, high level of education, and high personal incomes. The identified characteristics overlap with those of innovative mobility service users and with those of early adopters of new ideas and technology.

Typical tasks to assist multimodal travellers for each phase of a multimodal trip

Pre-trip: Key parameters such as travel purpose, the time frame of a trip, travel budget, and preferred or available means of transport are often already defined before starting a trip. People use a journey planning service on their smart device to-

get information to plan how to travel from point A to point B. When the user enters the destination and decides when to depart or arrive, the journey planner calculates routes and uses parameters such as time, number of transfers, prices, and preferred transport means. The app prints out the route recommendation result with relevant information including the overview of transport means, number of transfers, public transport timetable, map visualisation of the route, prices and more. The advantage of multimodal journey planners is that it has a possibility to compare different routes and alternatives from the user's side (Infopolis 2 Consortium, 1999).

On-trip: Since multimodal journeys involve more than one transport mode, providing information for a seamless door-to-door assistant is necessary. Providing information about where to transfer to the next transport mode and navigating travellers to the final destination can be challenging for travellers to accomplish.

Use of travel information

The type of travel purpose and familiarity with a trip has a strong influence on the need for travel information. People mainly require travel information when they are uncertain about the journey or when they have doubts. Travelers look for travel information prior to a trip when they are going to new or less familiar destinations. According to research conducted by Rijkswaterstaat (RWS, 2018), people will search for the route when they drive to a relatively unknown or completely new route four times more than a route they take daily (see figure 2.1). The motive of a journey also has an influence. Travelers most often look for information priority to the trip (56%) for social and recreational journneys such as for leisure purposes or visiting friends and family (see figure 2.2). On the contrary, only 12.5% of people look up for travel information before going grocery shopping and 23% for commuting. In a frequent and recurring journey, travelers prefer to be informed about travel conditions in the early stage, rather than seeking information on their own initiative (Chorus et al., 2007). They would seek information about disruptions to predict travel conditions such as road construction, inclement weather, or canceled trains. In general, 20% of people seek information prior to the trip for daily trips or known routes (RWS, 2018). A journey that involves arriving at the destination strictly on time also entails a greater need for travel information (Schapp et al., 2017). For business appointments, people look up travel information twice as much (RWS, 2018) compared to recreational trips.

The type of transport mode the traveler uses influences the use of travel information. Journeys where travelers have to transfer, are known to have a need for travel information (Tang et al., 2020) and this can be explained by the insecurity that transfers cause. For active modes such as cycling and walking that most people use for the first-mile and last-mile journey, the need for travel information is less. However, cyclers need a different type of information to increase convenience while cycling.

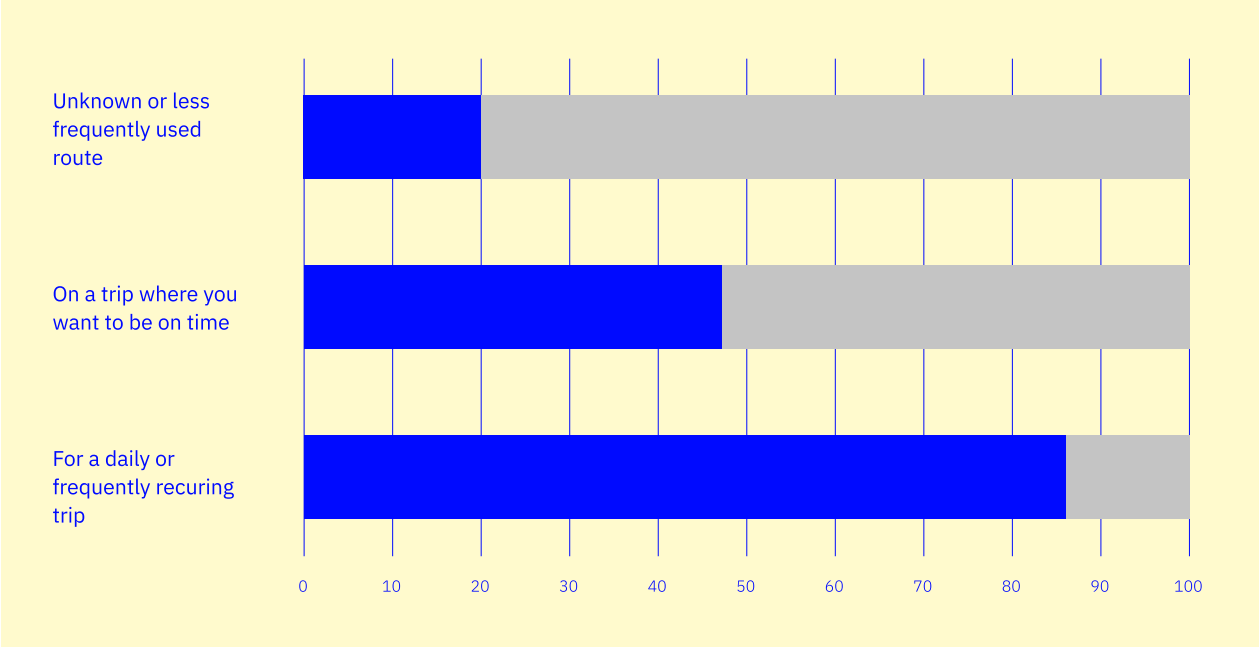


Figure 2.1 Share of people looking up travel information prior to a trip, by type of trip. Source: RWS (2018). Reprint from "Kansrijke verplaatsingen met MaaS" by Zijlstra et al., 2020

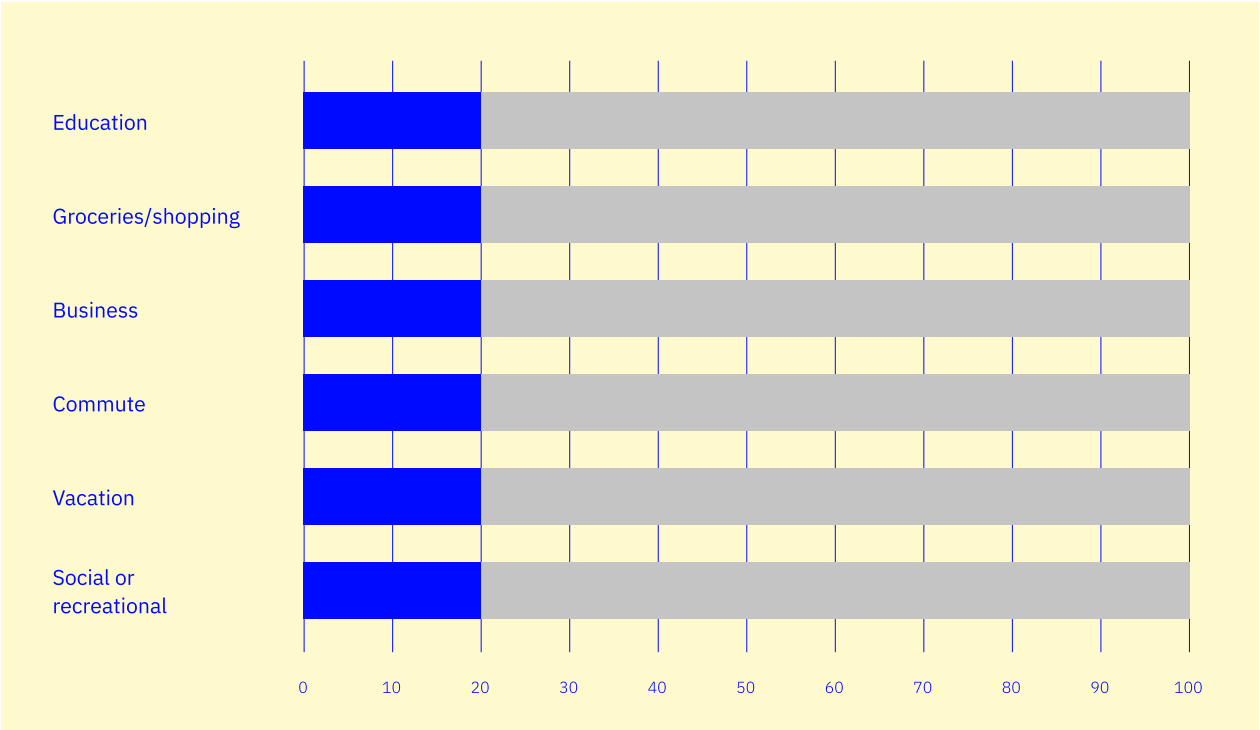


Figure 2.2 Share of people looking up travel information prior to a trip, by travel motive. Source: RWS (2018). Reprint from "Kansrijke verplaatsingen met MaaS" by Zijlstra et al., 2020

2.1.4 Motivations for multitasking during a commute

Emotion and Activities during commuting

Patrick (2019) found an interesting association between the mode of transport and the type of activity travelers perform. For people who use operating modes such as bicycles and cars, passive activities such as listening to music, looking out at the scenery, or thinking were observed because of the required mental and physical resources to cycle or drive. However, these passive activities can be found also in commuters of all modes. Several activities attempt to make productive use of travel time. Associations with the number of days/hours worked or travel time could indicate that commuters running out of time will be willing to spend their traveling time usefully by doing other things (Jain & Lyons, 2008). However, a closer look at other activities suggests that most activities are not considered traditionally productive activities. It is rather time constraints forcing people to schedule certain activities during the commute. Alternatively, some results suggested that some activities are done more for fun rather than to be productive. Finally, there are some activities that are done to pass the time and to cope with the boredom and burden caused by commuting. It is found that most in-travel activities are either (a) correlated with travel time but not related to indicators of time pressure (b) associated with perceptions about being dissatisfied with travel time or experience itself. The study implies that commuters are perhaps killing time on electronic devices as they can't make desirable changes that would increase their travel satisfaction.

Promoting sustainable transportation mode

Most walk/bicycle commuters perceive their commuting time as exercise since they value time efficiency. Therefore, promoting active mode usage is not only related to health but also has productivity benefits. Many ICT activities are strongly associated with transit use which suggests that technological developments in digital communication and internet-connected devices have transformed the transit user experience and have the potential benefit of facilitating more productive uses of travel time. However, enhancing the attractiveness of transit with technological breakthroughs should be taken cautiously considering the previous finding that the reason many transit riders are using smartphones may be associated with coping with an unsatisfactorily long or unpleasant commute.

2.2 What can design and technology offer to multimodal travelers?

2.2.1 Emergence of positive technology

We depend on digital devices and services more and more. Technology has become our companion in our daily lives and we consider technology as a solution to solve our everyday issues. Meanwhile, the question of if technology is making us any happier arises. While technology designers are gradually aware of the impact of their personal perspective on the artifact they create, Riva and colleagues (Botella et al., 2012; Riva et al., 2012) suggested that it is possible to combine the goals of positive psychology with technology design by using the "positive technology" approach that uses technology for improving the quality of our personal experience. This goal has three separate but consequential steps:

1. By structuring personal experience using a goal, rules, and a feedback system.
2. By augmenting personal experience to achieve multimodal and mixed experience.
3. By replacing personal experience with a synthetic one.

Designers are gradually embracing terms related to well-being such as "pleasure" and "fun" into their design briefs. Yet, they are generally not looking beyond short-lived emotions when considering the hedonic aspect of a digital experience. From the engineer's perspective, they generally take sensible things like productivity, speed, performance, and safety into account. Therefore, concerns have been raised within the computer-human- interaction community that designers and engineers need to be more conscious about the productivity mentality that is tracking, comparing, and measuring everything from us (Calvo and peters, 2014, 2015). Riva and colleagues (Riva, 2012; Riva et al., 2012) created a framework (see figure 2.3) to introduce well-being into design and technology and classified the technologies according to their effects on the features of personal experience defined by Botella and colleagues (2012).

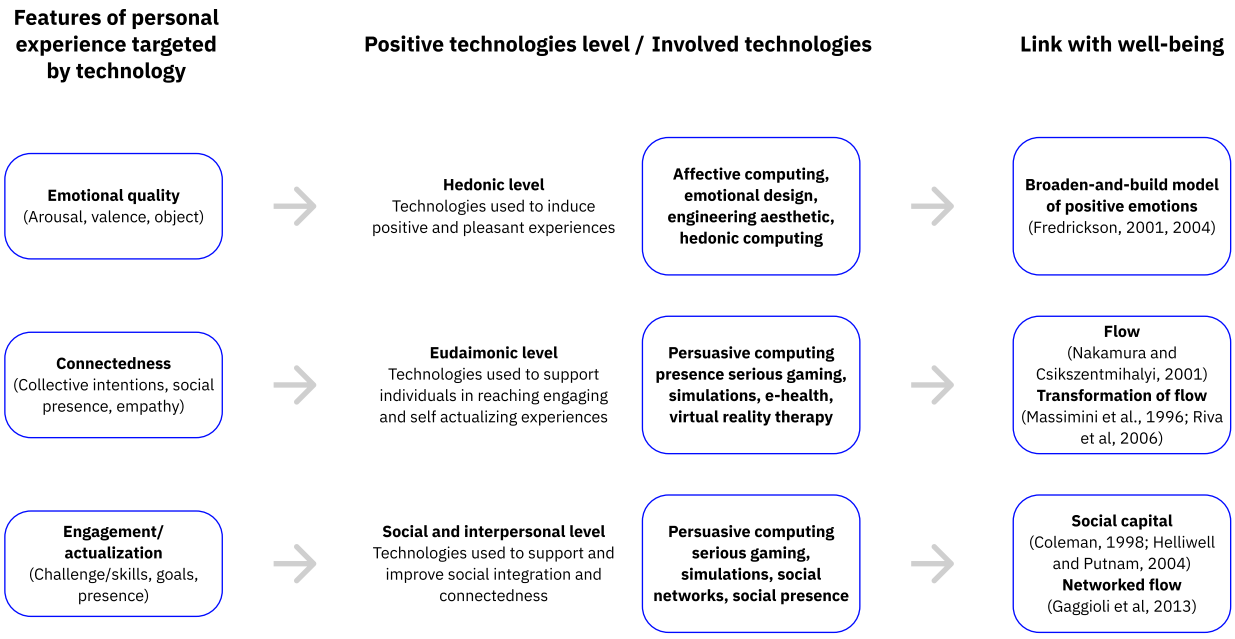


Figure 2.3 Positive technology levels. Reprint from "Positive technology, computing and design" by Gaggioli et al., 2017

2.2.2 Design and Emotion

Designers have been trying to incorporate emotion and even the success of the design is being evaluated with emotional aspects. Some academic fields are leaning toward making products and systems enjoyable in addition to safe and efficient. hHuman-computer interaction (HCI) and interaction design fields, in particular, emphasize the cognitive and affective human factors over usability. This evolution led to the possibility of developing intelligent agents that can engage in social interaction by responding to human emotion. Three common application areas are companionship, education, and aging. The adoption of emotions in HCI implies that user experience and acceptance towards the system can be improved by adapting the user's affective state, personality, and/or situation.

2.2.3 Psychological human factors

Mood effects on cognition

Affective states, or moods, may influence the way people process social and even practical information. The influence of emotions on cognition on the content and process of thinking has an important role for everyday interpersonal behavior in general, and for human-computer interactions (HCI) in particular considering the fact that human beings aren't always rational but moody. The way that positive and negative moods can influence the content of cognition has been explained through theories of affect congruence. Mood can influence the way we think, process, and remember information and form inferences and social judgement, as well as interpersonal behaviors.

People are better at retrieving memories when they have a prevailing mood in congruence (Bower, 1981). Positive moods increase and negative moods decrease salience effects on the impression which in turn influence people when making a judgment about the behavior of others (Forgas, 2015; Gilbert and Malone, 1995). People decide whether to trust and accept or distrust and reject social information in everyday life and negative moods tend to promote skepticism, which is associated with an externally-focused and detail-oriented thinking style (Forgas and East, 2008a,b).

States and traits

Interindividual and intraindividual factoInterindividual and intraindividual factors should be addressed separately to change human behavior. An information system should be designed by taking into account both permanent traits and temporary states (Braun, 2019).

User traits or interindividual differences refer to permanent behavioral patterns of individuals. These traits are fairly stable and only change over long time spans. They are not influenced by situational or interactional stimulation. Digital systems can observe users over a longer period of time to learn personal traits and adapt their behavior accordingly. Demographics explain the behaviors or needs of users. The demographics influence how users expect an intelligent assistant to behave and have an impact on functional requirements. Prior experience and resulting preferences can be used to understand the long-term behavior of users. This information can be acquired through usage statistics data and the preference can be collected during setup. Individual personality related to disposition to trust can also affect social behaviors and influence the user's preference of assistant personality for example.

User state, or intraindividual factors, on the other hand, is situational and/or interactional which changes rapidly and depends on a lot of situational and environmental factors. User states accompany physical responses that can be measured by heart rate, blood pressure, body temperature, breathing rate, and galvanic skin response. However, cognitive load theory explains that resources that can be used are limited so that too much stimulation can lead to unsafe behavior. Human emotion can also be detected from various signals such as facial expression which indicates satisfaction with a system. Whilst moods are defined as conditions that last longer, emotion is defined as short affective states which influence user action and last for a short time (Davidson and Ekman, 1994). Emotions can also be distinguished by basic emotions and continuous emotions such as arousal and valence.

2.3.4 Affective interaction with intelligent agents

The potential for embodied agents (screen-based anthropomorphic entities) to enhance human-computer interaction have been examined. One of the ultimate goals for researchers is to make agents capable of having natural interaction with users to produce desirable or beneficial outcomes. A recent study conducted by Yee et al. (2007) found that the use of an embodied agent in an interface leads to positive social interactions, however, there are conflicting opinions about whether the use of such agents is beneficial (e.g. enhances engagement with a system) or distracting to complete tasks. The experiments affective agents are being done in different fields from health, education, companionship, video games, and commerce.

Application in the auto industry

As the use of AI-powered personal assistants such as Google Assistant, Alexa, and Siri on mobile devices or on smart speakers becomes more natural in everyday life, changing the way people perform tasks, the auto industry is investing in developing voice-enabled assistants in cars. It enables users to control the information system in the cars more efficiently and provides services that aren't directly related to driving or a car itself to enhance passenger experience in general. While establishing partnerships with tech companies that develop smart assistants to provide a wide range of services from shopping to completing work-related tasks, researchers involved in this development are seeing opportunities of improving driver emotions with affective strategies. Research conducted by Michael et al. (2019) suggests that reacting upon a dangerous state of the user can enhance safety. Micheal also conducted user research with colleagues (2017) to evaluate the value of affective user interfaces (UIs) and found out that users do prefer affective approaches to enhance pragmatic features and proactive interaction. The study implies that the acceptance of the affective system can be improved by leaving room for a personal choice instead of automatic adaptation.

Chapter 03

Research Activity 1:

Mind-Mapping Session

Chapter overview

After the launch of personal smartphones, how we check travel information beforehand and planning a journey changed drastically. Looking into the present, which exists as an extension of the past, will bring us an opportunity to investigate the future. The mind-mapping technique has been selected as a medium to look into people's struggles and desires. This chapter reports on the result of user research conducted with the aim of understanding the evolving interaction and relationship between a user and a travel assisting tool from the user perspective.

3.1 Introduction

Nowadays, urban residents' journeys are often made by a combination of private-active modes of transportation such as cycling and walking or driving and public transport. In contrast to the flexibility that private modes have, public transport operates according to published schedules only departing at specific places and times. As the number of multimodal journeys that involve more than one transport mode increases, urban travelers use a so-called journey planner or route planner with any smart devices such as a personal computer or a smartphone to find an optimal means and time of traveling from point A to B. However, when we look back to the time when we didn't have personal smartphones, the way we look up travel information and plan for a journey has drastically changed.

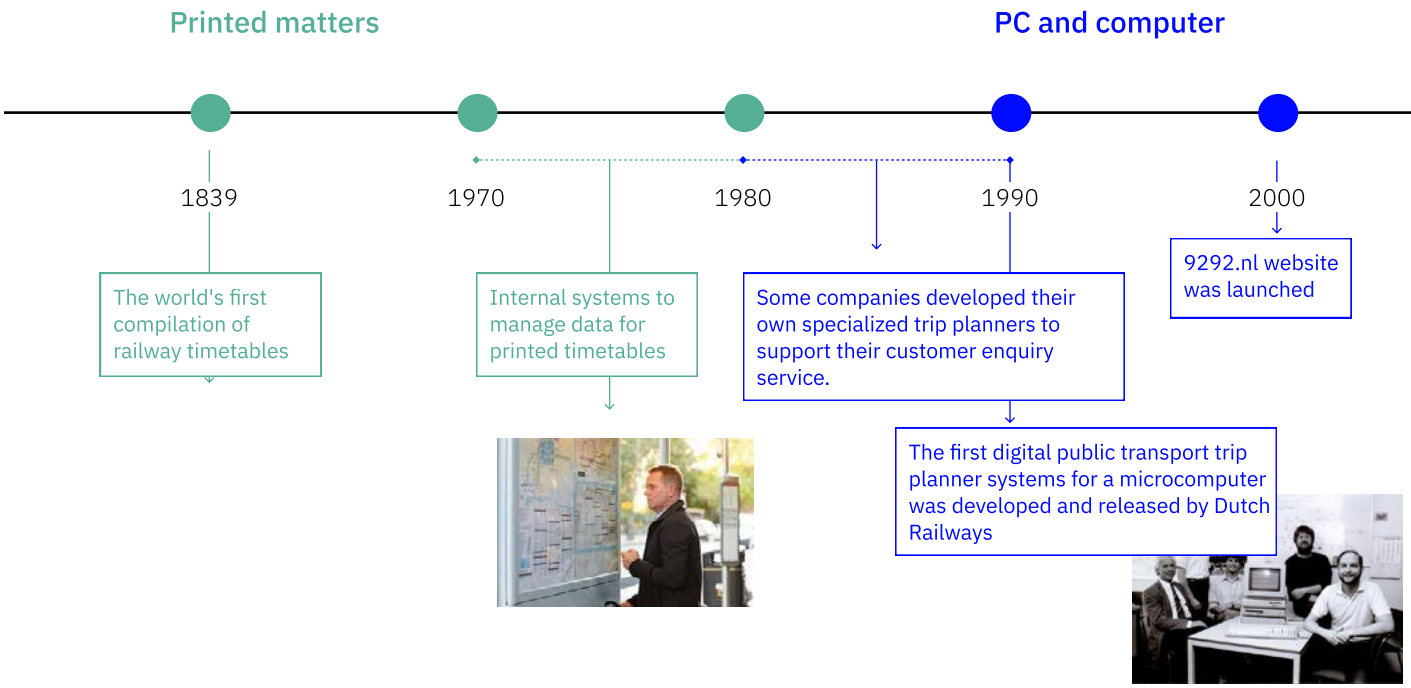
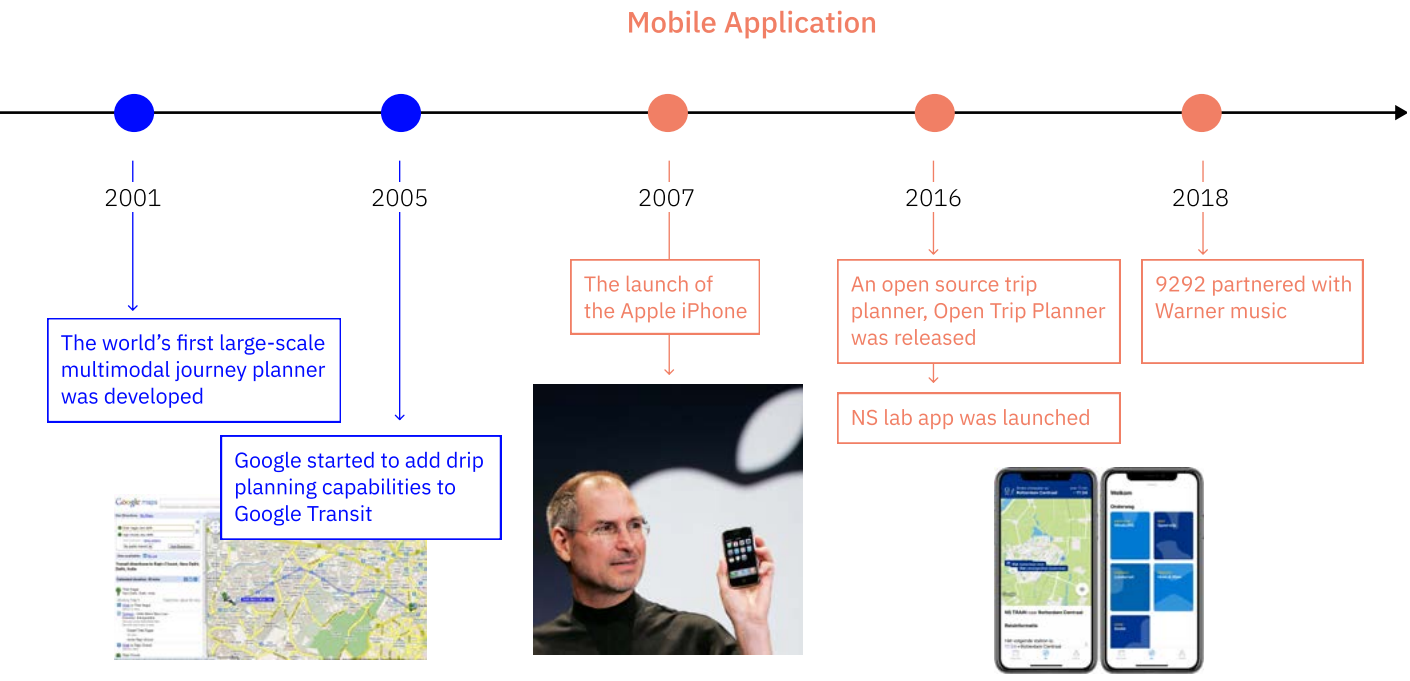


Figure 3.1 History of a journey planner, based on Wikipedia, journey planner

3.1.1 History of the evolution of a journey planner

Internal systems were first developed in the 1970s and 1980s to manage data for printed timetables and to support operations. In the late 1980s and early 1990s, some national railway operating companies and major metropolitan transit authorities developed specialized trip planners particularly designed to support their customer services. Systems that could be installed and operate on minicomputers and personal computers were developed with the advent of personal computers with sufficient specification in the 1990s. The first digital public transport trip planner system for a microcomputer was developed and released by Dutch Railways in 1990 and this soon expanded to include all public transport in the Netherlands. 2001 was when the world's first large-scale multimodal trip planner was developed and Google also jumped into this market by adding trip planning capabilities to Google Transit in 2005. After the Apple iPhone launched in 2007, people no longer had to stick around their computer or a printed timetable in a station or at a bus stop to look for the next available train or bus.

(see figure 3.1)



3.1.2 Recent development in journey planning apps

More recently, journey planning app development is trying to enhance the seamless door-to-door experience to satisfy their customers. To do so, they are expanding the range of transport modes they provide by including micro-mobility operators in their network. Also, real-time information is incorporated to increase accuracy and predictability. As mobility infrastructure is digitalized, they are looking for a smarter way to deploy data (1) to provide a personalized experience, (2) to manage the operation of transportation modes more efficiently, and (3) to utilize existing mobility resources and infrastructures more efficiently for the sake of sustainability. Lastly, attempts to enrich the journey by taking other activities such as work, entertainment, and tourism into account can be found from current development.

The means of providing travel information and assistance have a strong impact on the way people plan and make journeys. We can access travel information at any time, anywhere and many travel-related tasks have been automated by computational calculation. In this chapter, the perception that users have on evolving interaction with a journey planning tool will be explored in order to incorporate what users are envisioning and requiring for a future travel buddy that has more authority in our lives.

3.2 Research Setup

3.2.1 Approach and research questions

The purpose of this user research activity is to reflect on the change we have gone through and look at the use case, pain points, and interaction with journey planning apps in order to look forward to our future mobility experience with an intelligent travel buddy.

The main research questions for this chapter are twofold. One is to look into the present by asking (1) how users interact with their journey planning app and move forward to the future by asking (2) how the relationship with an intelligent travel buddy will evolve in the future. Sub-questions for each question are as follows:

Present

1. How do the users travel with journey planning apps?
2. What do the users think about using technology to plan their journeys?
3. What are the things that they like and dislike?
4. What kind of equipment and devices do the users use?

Future

1. What will the role of a travel assistant be in the future?
2. How the relationship between a user and a travel buddy will evolve?
3. How the users envision future urban mobility experience with it?
4. How will the users interact with a travel buddy?

3.2.2 Method

The session was conducted online via Zoom in a group and lasted for about 80 minutes. The session consisted of two main mind mapping activities and two introduction sessions about the context in between.

The mind-mapping technique was selected to create room for creative discussion about the future. It supports users to freely associate, structure, and visualize thoughts by branching out with associations from the given image (Buzan & Buzan, 1994). The advantage of mind-mapping is that the outcome users make results in more structured stories (Stappers & Sanders, 2003).

3.2.3 Procedure

The session followed the procedure described as in figure 3.2. The session started with an icebreaker activity followed by a brief introduction of the session and an explanation of the history of a journey planner. Then, the first mind mapping activity about the current interaction was done for 15 minutes. Before starting the second mind mapping activity about the future interaction, a short introduction on future mobility and future users who grow up with smartphones and AI speakers was provided. The second session was held for a long time and time for discussion was assigned at the end.

For the second mind-mapping session, images of an analogy to envision future relationships with a travel buddy were provided to the participants (see figure 3.2). People were allowed to select one from the provided images or to bring their own image to describe their versions of a future travel buddy.

Figure 3.2 Provided images to envision the future relationship with a travel buddy

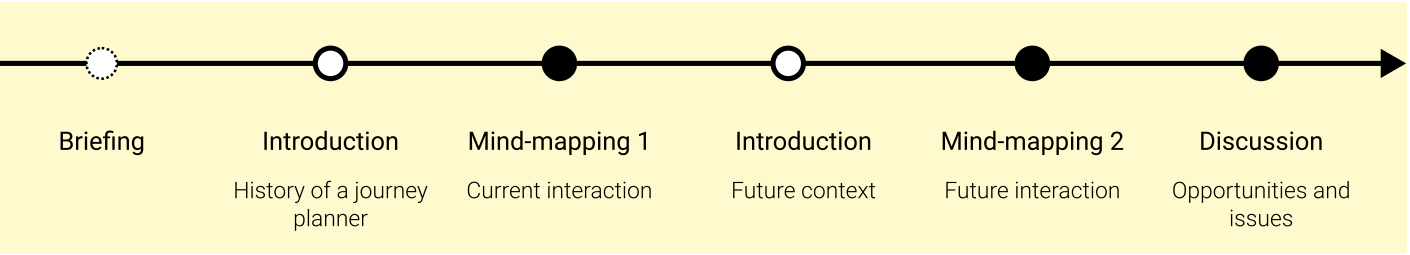


Figure 3.3 Procedure of the mind mapping session

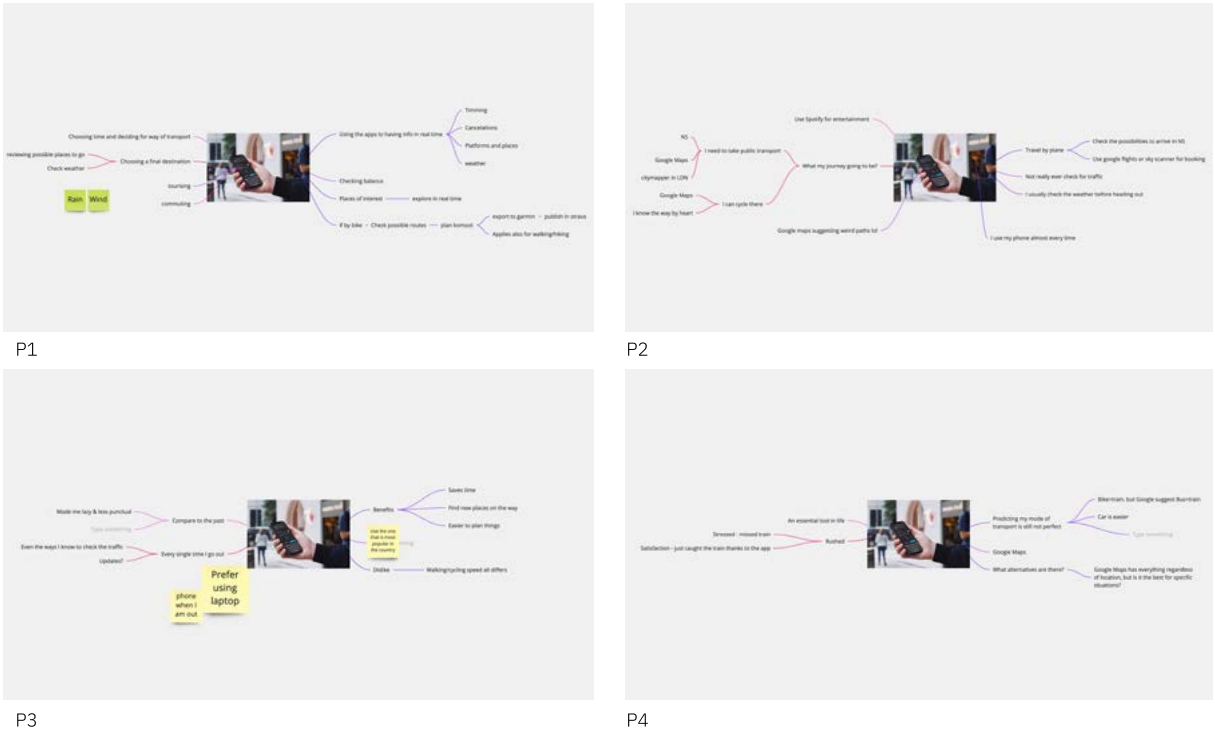
3.2.4 Participants

Five participants were recruited through personal contact. They were asked to rate their innovativeness and tech-savviness at the beginning of the session. (See table 3.1)

	Gender	Nationality	Field of expertise	Innovativeness	Tech-savviness
P1	Male	Colombia	Strategic design, mobility	4/5	4/5
P2	Male	Spain	Interaction design, haptic	4/5	4/5
P3	Female	South Korea	Strategic product design	4/5	4/5
P4	Male	US	International relations	2/5	4/5

Table 3.1 Overview of participants

3.3 Result



P1 P2

P3 P4

Figure 3.4 Mind maps created by participants. The number refers to each participant.

The session lasted approximately 80 minutes. All of the participants made two different Mind Maps (see figure 3.4, 3.5) by following instructions. The keywords and phrases used by participants while they were presenting their Mind Maps and during the discussion after making Mind Maps contained excessive information on use cases of different apps, their preference, way of making decisions, and their thoughts about technology being more persuasive in our lives. These are analyzed in table 3.2 (current) and table 3.3 (future).

3.3.1 Current Interaction

People tend to pick a journey planning app that is well-known in a located area and they tend to mix use of different apps in different situations. Participant 1 prefers to cycle anywhere because it is healthy and it allows him to explore. So he first calculates a route with Google Maps, exports the route to Komoot to find a cycling-specific route, and exports it to Strava to track exercise. Participant 2, on the other hand, uses 9292 to check train arrivals for familiar routes and uses Google Maps on the computer screen for unfamiliar routes to find new places to visit and see the entire route. Participant 4 is always in a hurry when using an app and his slow phone annoys him.

Participants mentioned that sometimes suggested routes don't consider how travelers actually travel. It suggests taking a bus and transferring to a train whilst bikes are commonly used to get to a station in the Netherlands. One participant raised an interesting point, *"Google Maps has everything regardless of location, but is it the best for specific situations?"*. Journey planning apps are certainly useful and essential tools to save time and plan a schedule. However, it also makes them *"lazy"* as they think everything is planned out and predictable. Even when they know that the next train will come in a few minutes, they often forget about the exact interval and feel they have *"failed a mission"*.

Topics touched and conclusion of each topic can be found in table 3.2)

Table 3.2 Topics discussed in terms of the current interaction with mobile applications

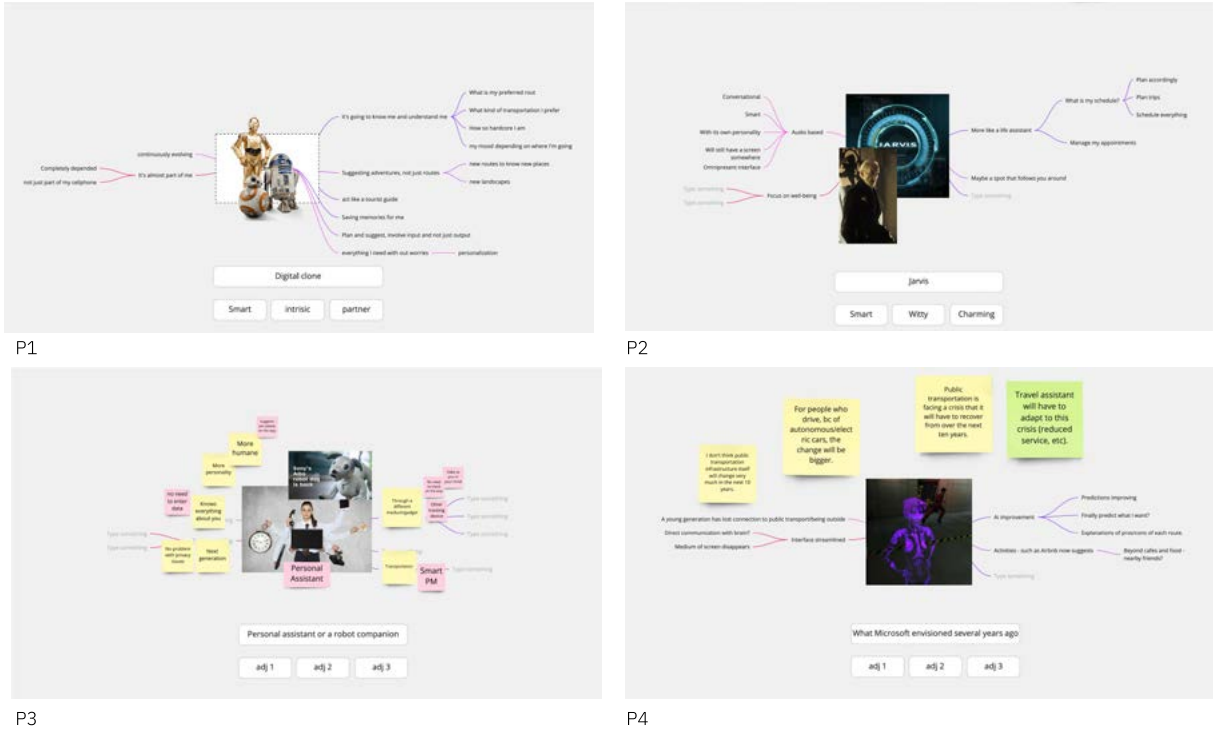
Main topics	General aspects	Conclusions on the topic
Apps in use	• For route planning: 9292/NS (local, journey planner), Google Maps (global, web mapping product) • For cycling: Komoot • For health tracking: Strava • For entertainment: Spotify	They customize their experience by using different apps for different purposes to meet diverse travel needs that aren't met with a single solution. The quality of the device or equipment that they use to access the service has an influence on satisfaction with the service. As foreign students, they used to use different apps back in their country besides Google Maps. Therefore, working location is a key determinant for choosing an app.
Purpose of use	• Pre-trip: check the timetable, check disturbance, check the entire route, confirm the journey before leaving home, browse places to go, browse places to visit • On-trip: check exercise, check the current location, check platform to transit, check the detailed route to get to the destination	Different types of support are required based on familiarity with the destination area. They usually determine which mode to use before they plan a journey and weather is an important determinant for choosing a transport mode. The local apps hold more reliability for checking real-time travel information. Products that provide information about the places such as Google Maps support people to find a place to visit and explore the neighbourhood they are already familiar with. It's not always about efficiency that matters. The value of travelling with micro-mobility and public transportation is that travellers have the flexibility to, for example, take a detour to drop in at a favourite cafe or extend their trip to meet a quota for daily exercise.
Issue	• Lack of assistance for active mode: Prediction is not very accurate yet with active modes (estimated time, congestion, route) compared to cars. • Lack of personal adaptivity: it doesn't fully incorporate personal differences such as speed of walking and cycling. • Lack of context-awareness: It doesn't seem to know contextual factors or situational factors much. (e.g., everyone cycles in the Netherlands)	Existing apps do their job perfectly in terms of providing a timetable for public transportation. However, they don't seem like they know and correspond to the actual travel pattern of users' demands depending on the situation. Although participants consider the issue addressed above as a primary pain point, they don't expect that machine to know personal, situational and contextual factors that make every journey have different goals. They would rather want other users to be involved in reporting disruptions to improve route recommendations.
Perception	• Technology dependency: thinking less and becoming more technology-independent, feels naked and outdated when not using the app • Autonomy: losing the holistic viewpoint of how the system works by only intaking partial information processed by an app.	In general, being helped by technology is associated with negative emotions. However, there is an opportunity to mitigate it by, for example, allowing users to be more involved in a process, giving sufficient information to compare different options, and allowing access to the rule applied to operate public transportation.

3.3.2 Future interaction

For future interaction Mind Map, participants were asked to freely use one of the provided images or bring their own analogy. They all used their own images to describe their own version of stories with rich narratives. Participants 1, 2, and 4 borrowed characters from movies or games. Participant 1 brought robot characters from Star Wars describing that a travel buddy will follow wherever users go and automatically know everything about users. Participant 2 brought Jarvis from Iron Man. He envisions that a travel buddy will be omnipresent and well-rounded managing the overall life of users. Participant 4 brought Cortana which is a fictional artificially intelligent character that Microsoft envisioned several years ago. He was focusing on the technology that will reduce the barrier between humans and machines. Participant 3, on the other hand, focused on describing the relationship that a traveler and a travel buddy will have in the future.

Participant 2 brought an interesting point into a discussion that the focus is *"not on efficiency anymore but being more positive"* and *"on the well-being"* of users. Participant 4defined the role of a travel buddy as connecting people with people and their surroundings. This role description implies that an intelligent assistant can't replace people and the importance of human involvement. The quote, *"AI is not necessarily working for us all the time yet. And we still want to rely on the sort of community things"*, from participant 4 implies that there is a misalignment between what humans want and do with what AI provides. Therefore, there is a need for *"a platform where people share updates. People coming together and creating this community intelligence."*

Topics touched and conclusion of each topic can be found in table 3.3)



P1 P2

P3 P4

Figure 3.5 Mind maps (future) created by participants.

Table 3.3 Topics discussed about the current interaction with a travel buddy

Main topics	General aspects	Conclusions on the topic
Characteristics	• Omnipresent: present everywhere along with a traveller. • Personality: have a personality or even more than one. • Smart and adaptive: know everything about the user and adapt itself to the user.	Images of analogy that participants brought themselves show that they think of a travel buddy as an embodied virtual being that either follows them everywhere they go or is always present so that they can reach out to them whenever they need. They expect a travel buddy to be smart by naturally learn and understand users. Knowing and predicting what a user wants is an important aspect of a travel buddy.
Interaction	• Reduced barrier: technology such as machine learning, natural language processing and brain reading will reduce the barrier to communicate with smart assistants • Natural communication: communicating with a travel buddy will be easier and more convenient • Supported by different digital devices: visual support will be enhanced or even the interface won't have a physical form.	Participants are envisioning that the development of technology will improve and change the way users interact with a travel buddy. The interaction will evolve to be one like with another human being and more natural. The user will interact with a system in a multimodal way with different equipment and interfaces.
Future travel experience	• Same old transport modes: transportation modes thelselves won't drastically change. • Life-work integration: every aspect of life will be integrated into one • Multitasking: squeeze in different activities in between trips to make more efficient use of time • Community-driven mobility: envisions a platform where people come together and share information to build community intelligence.	In the past, people thought they will be travelling by a flying car or by teleportation in the future. However, the transportation modes we are using these days haven't changed that much although the speed or the quality of those has been enhanced. Likewise, participants are envisioning that the way we travel will not change that drastically. However, how people perceive travelling can change since human activities are integrating into one and digital assistants or systems make that more manageable. They also mentioned that travelling is not only about moving from one point to another. People tend to make the best use of their time and place value on mental and physical well being as well as efficiency. Participants also envision a future mobility platform that is driven by community. They lack trust in AI because they think AI is not necessarily working for people yet. Therefore, there is a need for humans to be involved more in reporting disturbances or sharing updates.
The role of a travel buddy	• Life assistant: that manages schedule and plans a journey based on it. Provide overall life suggestions to a user. • Connect with surrounding/people: role as a mediator that connects a user with surrounding and people	As the focus of individuals and societies is shifting towards well being, a travel buddy will focus on making the experience positive when they provide service to users while undertaking certain tasks on behalf of a user. A travel buddy, according to participants will become a mediator that connects a user with surroundings and other people. Exploring the surroundings is a prime activity that associates positive emotions and a travel buddy can take an important role in this aspect. Technology is used to connect people using users' location data. One participant mentioned that the way of hanging out with friends is changing compared to the past where people could easily bump into each other and a travel buddy might be able to restore the connection between people.

3.4 Main findings

Capable of customizing the experience to cater for their own needs

The need of multimodal travellers can be observed from a set of different apps they use to serve their own needs. There is a tendency of choosing a journey planning app that makes them feel most comfortable and that they are familiar with. They don't expect that a journey planning app can be perfect. It requires an adjustment on the routing recommendation and they don't always adopt what the app suggests.

Incongruence of what apps provide with what users want

"I think predicting and knowing what transport mode the user prefers and uses are not there yet."

They feel that route recommendations don't correspond to the way they plan a journey and make a decision. For example, they think apps are giving suggestions based on efficiency the most whilst people consider contextual factors such as weather and they are also influenced by mood. They would gladly take a detour when they feel like it.

Require to take an active part in planning a journey

"You know, a platform where people share updates. People coming together and creating this community intelligence."

They acknowledge that technology won't be able to know everything that happens in the physical world. Assistance for active mode isn't satisfactory yet so they want human involvement in improving route optimization. They also want other users to be involved in reporting on disruption and the condition of the road.

Discovering new places is what multimodal travellers appreciate

"It will give more suggestions about life, like Airbnb suggests travel-related service."

The positive side of multimodal journey is that it drags out the adventurous side of them. They want to explore and discover more whether they are in a familiar neighbourhood in a new neighbourhood. Whenever they visit an unfamiliar neighbourhood.

They are not comfortable with depending on technology

"it can bring positive/negative emotion based on whether I actually succeed in my mission"

The downside of getting help from a technology is that it accompanies negative emotion, especially when they fail to follow the guidance. And not getting the whole structure of information but only a portion of it is also perceived as problematic.

Require for tailored service

"It will autoatically learn users and give recommendations based on their personalities, current moods, and the way they process information."

They envision that the travel companion in the future will have a better understanding of users. The product will automatically accumulate data of users and learn the way the user makes decisions. It accompanies data privacy issue, however, future users who grew up with technology and havea more positive experience with technology likely to be more opened to share their personal information.

Still need human touch

"The challenge is to bring back young people who have lost their connection to transportation and engage people get back in this world of moving around."

Although technology is becoming more advanced and they are expecting that the interaction with technology will be more natural and less frustrating, it won't replace the interaction with humans. It will rather have a role to connect people and bond them together.

Chapter 04

Research Activity 2:

Product analysis and expert interview

Chapter overview

Trust is multi-faceted and has many definitions. We trust something or someone because of its competence, when we feel secure or when we think we're on the same side. Most of all, trust is directly linked to the adoption and acceptance of something. This chapter looks into the term trust from different angles. Product analysis combined with expert interviews of selected journey planning apps were conducted and this chapter will report on the result.

4.1 Introduction

According to the findings of the previous user research, the main feature of a journey planning app that is frequently used by users and perceived useful is giving route recommendations. While expecting the journey planning app to expand its range of services from giving route recommendations to life suggestions, the currentproblem that participants are having is that the recommended routes from apps don't reflect or incorporate what users consider important. This often results in not adopting the recommended routes and moreover, the app. People acknowledge to some extent that apps can't practically know every detail of themselves and there is a fundamental difference in what the algorithm that operates the app and humans take into account when making a decision. This misalignment between what the app suggests and what users need can be a major obstacle for a journey planning app to become a travel companion that involves deeply in users lives. Therefore, this chapter examines the factors that relate to trust at the product level and defines themes to be explored to enhance cognitive and affective trust.

The selected subjects are MaaS apps that are built to assist multimodal travellers. The most distinctive feature of MaaS apps from previous journey planning apps is that MasS integrates the process from browsing to paying for each modality of a multimodal journey. However, the focus of this research will be on the route suggestion. Therefore, the printed routes on the app and underlying backend system and algorithm will be mainly discussed in this chapter.

This chapter follows three consecutive steps: (1) Theoretical research on trust. This step discovers the elements that construct trust between the user and artificial intelligence and the process of forming a trust. (2) Then, I take this common understanding as a basis to uncover the backstage action of the existing products. Selected products are examined at the user interface level and delved deeper into the backend system level including the recommendation algorithm that optimises and suggests routes through interviews with experts who are involved in MaaS platform development. (3) Finally, the results of the interviews and product comparison analysis will be shared.

4.2 Theoretical background

4.2.1 What is trust and how is it established?

Conceptualising trust is challenging since the term is defined in multiple ways. One reason is that this large term has been defined from various intellectual disciplines and the second reason is that it is multifaceted containing different meanings in even one definition (McKnight, 2001). McKnight reveals the underlying elements in the term trust by using the story of Franklin Roosevelt and Joseph Stalin:

During World War II, Franklin D. Roosevelt and Joseph Stalin had to trust or rely on each other for mutual support and cooperation (**show cooperative effort**) against a common foe (**a shared goal**), while at the same time distrusting each other's actions because each knew that the other had his own interests to serve. Even though they were guided by different ideologies (**derived by different motivation**), each believed the other would display enough integrity to fulfil agreements they made to conduct the war in certain agreed-upon ways(**in a certain situation**). They were therefore willing to depend on each other(**trust-related intention**) and actually depended on each other (**trust-related behaviour**), even though they were aware of potential problems in their relationship (Risk acknowledgement).

These constructs come more vividly if we put the term in a specific context. Lee and See (2004) define trust as the attitude that an agent will help achieve an individual's goals in a situation characterised by uncertainty and vulnerability. In this definition, an agent can be either automation or another person that interacts with the surroundings on behalf of the person. The definition identifies vulnerability as a crucial element of trust and the description of McKnight distinguishes the intention from behaviour. There are two crucial elements that define the basis of trust: (1) the focus of trust and (2) the type of information that explains the entity to be trusted. This latter element guides expectations by describing the ability of the trustee to achieve the trustor's goals. Based on these two core elements, the basis of trust constructs has been defined from different perspectives.

4.2.2 Dimension of trust in different contexts

Many researchers in different academic fields have defined the factors that lead to trust as is presented in table 4.1.

Trust does not establish in a vacuum but evolves in a complex individual, cultural, and institutional context. The interdisciplinary conceptualization of trust (McKnight Mayer et al, 1995) identifies that the competence of the trustee is important and the motivation and intent between the trustee and trustor should be aligned. The purpose of the trustor should be acceptable and the trustor expects consistent performance in a given situation. Built upon the general, interdisciplinary trust model, different elements have been defined in specific contexts.

In the e-commerce context, the general experience with other trustees in the same context affects trust formation and the trustee requires to calculate the costs and benefits of different options. Similar to the e-commerce context, it requires cognitive-based factors such as the categorization process to get cognitive cues to build trust in information systems. Contrastingly, in the interaction between human and machine/artificial intelligence, the trustee examines the quality of the artefact in three different layers: performance, process and purpose.

Antecedents	Trust	Source
• Competence: skill, competence and characteristic that enable the trustee to influence the domain • Benevolence: The extent to which the motivation and intent of the trustee are aligned with those of the trustor • Integrity: the degree to which the trustee adheres to a set of principles that the trustor finds acceptable • Predictability: consistency of the performance in a given situation	Trust in general (interdisciplinary)	McKnight Mayer et al. (1995)
• Disposition to trust: consistent tendency to be willing to depend on others • Institution-based trust: sense of security one feels about a situation due to impersonal structures • Knowledge-based trust: trust based on first-hand knowledge • Calculative-based trust: includes the calculation of pros and cons/costs and benefits	Trust in e-commerce	McKnight (2002) Gefen et al. (2003)
• Personality base: faith in humanity and trusting stance • Cognitive base: cognitive cues, including categorization process • Calculative base: calculation of pros and cons/costs and benefits • Institutional base: sense of security one feels about a situation due to institutional structures (e.g., regulations and guarantees	Trust in information systems	Li et al. (2008)
• Performance (i.e., operational safety, data security, privacy protection) • Process (i.e., cognitive compatibility, usability, trialability) • Purpose (i.e., context, design)	Trust in applied artificial intelligence	Hengstler et al. (2016)

Table 4.1 Elements that lead to trust defined in different contexts

4.2.3 An interdisciplinary model of trust

The interaction between the multimodal travel assistant and the user shares some commonalities with trust in information systems and trust in applied artificial intelligence. The users give permission to the personal travel assistant to access personal information while acknowledging the potential threat of privacy invasion. The personal travel assistant processes the entered data, destination of the travel within the internal system to give route recommendations while displaying information that will guide users to choose an option.

Figure 4.1 integrates McKnight's integrative trust model (1998) with factors shown in the context of trust in information systems and applied artificial intelligence (Li et al, 2008, Hengstler et al, 2016). This model consists of four levels of constructs: (1) five trusting base factors which form trusting beliefs, (2) trusting beliefs, (3) trusting intention, and (4) trusting behaviour. Trusting bases, which are trusting intentions. Intuition based trust, disposition trust, knowledge-based trust, cognitive-based trust and calculative-based trust are used as the determinants of trusting beliefs that form trust-related attitudes together with trust-related intentions. Trust-related attitude can be presented as trust-related behaviour, which is adopted in this case. With technology, the trust-related attitude is influenced by how the user perceives the quality of technology. These three pillars will be used for initial product analysis for the expert interview.

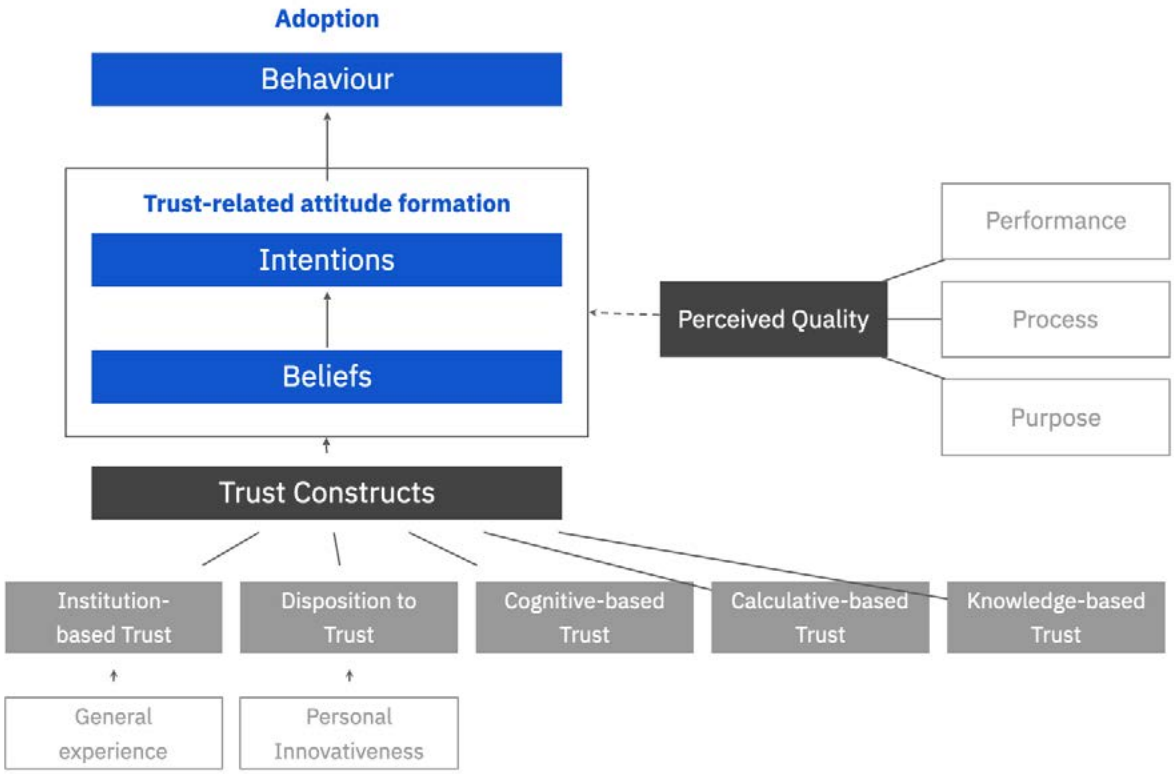


Figure 4.1 Integrated trust model (McKnight, 1998; Li et al, 2008; Hengstler et al, 2016)

4.3 Research Setup

4.3.1 Product selection and Interviewee recruitment

There are many MaaS products that were developed to test the impact of MaaS at a regional level before implementing at a larger scale. Among 9 MaaS products from countries including Netherlands, Germany, Finland, Singapore and Sweden, 4 MaaS products were selected for analysis. The most crucial requirement for product selection was that it has to be part of the ongoing regional/national pilot. The products that were part of a pilot that was over screened out. For interview participants, the requirement was that the person should have been involved in product development and equipped with an adequate amount of knowledge of the routing system and understanding of how their target users are experiencing their products.

4.3.2 Procedure

Research

Before conducting the interview, general information on the selected products was gathered to gain a basic understanding before the interview. The main focus of this preliminary research was twofold: (1) the information about the pilot that a product is a part of. Each pilot has a specific target group and purpose within a region. Therefore, the decision-makers of each app study and reflect the travel behaviour of the target group. Depending on the purpose and goal of the pilot, the strategy that the product adopted to achieve the goal can be observed in the user interface. For examining the product experience, selected 4 MaaS apps were downloaded on a mobile phone. The home page, route suggestion page, and the user profile setup page was mainly looked into to understand the interaction between the user and the app.

Expert Interview

The interviews were conducted online via Zoom video meeting for 30 minutes. The interview with one participant has been done via email. After explaining the topic and focus of the research, the participants were asked to briefly introduce their role in MaaS app development. The interview questions were built under three pillars: purpose, process and performance which are determinants of trust in the technology (Hengstler, 2016), as explained in table 4.2.

Purpose describes why the product was developed. Explaining the context of technology is critical for avoiding generalization and to easily understand the message that technology is conveying. Therefore, the context that the product is placed into and the goal of both pilot and product was asked to interviewees. Hengstler posits design as an additional factor that encourages the purpose dimension. The attempt to achieve the goal is engraved in design, which communicates directly with the users. Therefore, the questions about the goal at the user interface and user experience level have been touched and some design features related to explain the system operation and user involvement have been mentioned during the interview.

Process information describes how the system operates and refers to its understandability (Lee and See, 2004). Users tend to trust automation if the algorithms

are understandable and guide them towards achieving their goals. For multimodal travellers specifically, the routing system was mainly looked at. The personal/contextual/institutional factors that the route optimising system considers and the way of optimising the route were asked. Additionally, the backend system that gathers and integrates data from different APIs was discussed.

Performance information describes what the system does. Operational safety and data security are crucial determinants of performance trust. Therefore, how the product deals with personal data and communicates its data usage to the users were asked.

Theme	Purpose	Description
Purpose	To gain information on the basis that the product is built upon.	• Context: The purpose to be achieved with the app and other contextual factors that influenced the decision-making behind the scene. • Design: General remarks on design features and the design goal that was applied to initiate the intended user experience.
Process	To understand the backend system and route recommendation algorithm	• Backend system: Data the backend system gathers and the way of integrating and processing data from different mobility operators. • Route optimisation: the rule of route optimisation and factors that the algorithm considers for route recommendation. • Route suggestion algorithm: The operative process of route suggestion algorithm. Factors that the algorithm considered.
Performance	To understand how the product is dealing with personal data	• Data Usage and data security: collecting data, purpose of use, the way of communicating data usage and the way of handling personal data

Table 4.2 Structure of the expert interview

4.4 Analysis

4.4.1 Product Comparison Analysis

After the interview, the result of the expert interview and preliminary research has been analyzed based on the criteria explained in table 4.3 The criteria was built considering the aspect of MaaS apps giving route recommendation to multimodal travelers. Therefore, if the route recommendation is suitable for multimodal travelers, if the route optimization algorithm is adaptive, and if it gives relevant feedback to users were the main topics to look into.

The result of the product analysis was fitted in the form of a spider chart. This method was selected to compare the attributes of different products in one glance and find an opportunity space that hasn't been explored yet.

Theme	Purpose	Description
MaaS Schikofsky et al, 2020	**Usability (Ease of Use)**	Easy access to mobility services; easy operation of the MaaS platform/app, simplify the steps for a user to take an action
	HabitSchema Congruence	Mental transfer from associated habits (in other consumption domains); typical usage patterns; abstract familiarity
	Hedonic Motivation	Anticipated enjoyment associated with the use of MaaS; emotional benefit; fun; pleasure
Adaptive agent Glass et al, 2008	**Context-awareness**	Considering contextual and circumstantial factors when suggesting routes, being more accurate with real-time travel information such as disruption and cancelled train/bus, real-time availability of micro-mobility
	Transparency	Being transparent of what data does the app use and how it is going to be used.
	Explainability	Providing comprehensive information and feedback about what the app is doing, explaining the underlying computational reasoning when actions were taken by the system
	User-adaptivity	Actively involving users to customise their journey and respond to users after they provide the system with personal preference and personal information
Recommender system Hu et al, 2008	**Relevance Feedback**	Attempts to collect both implicit and explicit feedback within the app

Table 4.3 A matrix for product analysis

4.5 Result

4.5.1 Route recommendation process

Figure 4.2 explains a typical process that journey planning apps take. When the user enters a destination on the screen, the app automatically sets the current location and current time as a starting point and departing time respectively. Then, the back-end system calculates possible routes from point A to B. The system integrates data from different transport operators into a common form and optimizes routes based on their defined use cases. To increase the efficiency of routing optimization, the number of transfers, total travel time, and other parameters are restricted. Some circumstantial factors are considered, however, personal factors aren't being used at all due to data security. The additional system filters out some routes by recalculating data and checking availability. At last, the system checks real-time information such as disruption and prints out the suggestion displaying travel information. There are some configurable parameters that users customize the route suggestion to some extent. By adjusting the options, users can be provided with routes that match their travel cases.

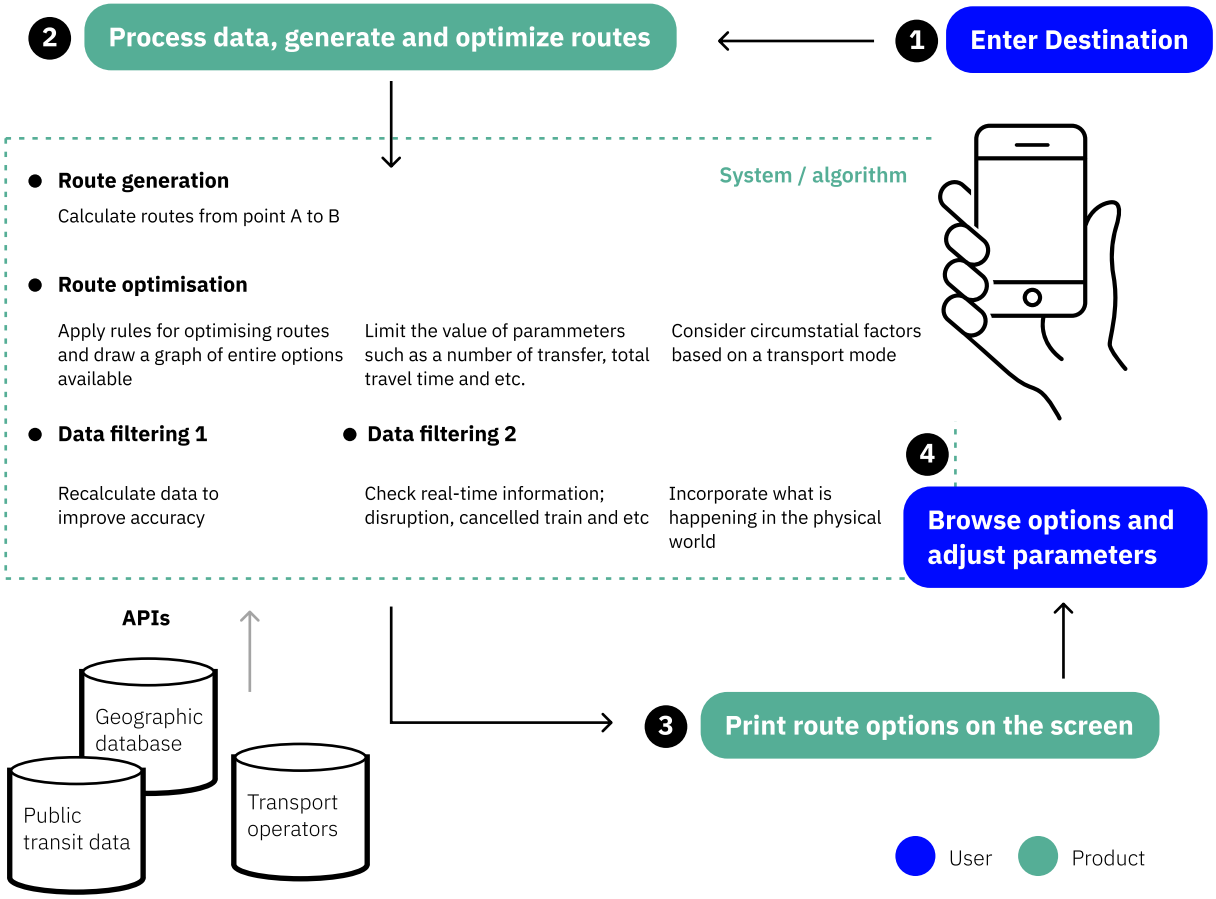


Figure 4.2 Process of a journey planning apps providing route recommendation
* order and details may differ

4.5.2 Interview response

Topic	Keywords	Product 1	Product 2
Purpose	**Context**	Car ownership and use in the region is high while the share of public transport and bicycles are relatively low. It might lead to a reduction in the quality of life.	Accessibility issue of Rott airport, to evaluate if Maa 4 social goals: traffic effic efficiency, environmental efficiency
	Pilot goal	To discourage car ownership and use while promoting alternative transport modes targeting residents who are open to a multimodal mobility offer.	To enable a seamless and door-to-door journey, imp accessibility for different
	Product goal	Being simple and straightforward as possible to cater to predefined travel cases of target users	To provide flawless, conv logical service without re while not overloading use information or options
Process	**Route optimisation**	Calculate routes in predefined clusters that reflect the way people travel in the context	The system puts public tr main transport mode and determine which mode to last mile. The travel advic depends on what transpo chooses.
	Route classification	Car, Park + Ride, Public transportation, Bike-train-bike, bike, walk	N.A
	Flexibility	There is no configurable parameter available but the order of suggested routes can be customised by the user	Users can eliminate unwa modes, set walking distar wheelchair-accessible op transfer time. Users can decide up to th information to display wit routes (total travel time, a transfers, price, crowd ex
Performance	**Data usage and security**	Doesn't save user-linked data as much as possible and collect product interaction data for improving the product.	The app shows full transp will be collected and why collected. The users can g each data usage.

Table 4.4 Topics touched during interviewing with experts

	Product 3	Product 4
terdam-The Hague aS can contribute to ciency, space efficiency and social	To find a smarter way to deploy existing mobility infrastructure to ease the burden on public transportation	The municipality has been trying to make the city more liveable and walkable, and to promote space and environmentally efficient transport modes.
d smooth prove the mobility types of travellers	To make business travellers and commuters opt for a sustainable mode of transport	Ease the complexity of browsing and choosing diverse options and enhance the accessibility of those modes by making them visible.
enient, easy and quiring extra effort ers with massive	leaning towards allowing users flexibility in order to learn and adapt the underlying factors and motivations that lead the user to make a certain choice	Simplify the complex operating mechanism of the backend system at the user interface level to make the user experience easy and intuitive.
ransportation as the lets the users o use for the first and ce the system gives ort mode the user	The system puts public transportation as the main transport mode and combines it with a walk and/or bike.	Suggest route per transport mode combined with walking and show mixed-mode route putting the selected transport mode as the main modality.
	least transfers, eco-friendliest, cheapest, fastest	PT, personal bike, electric scooter, car sharing, walk, e-moped, ride-sharing, taxi
anted transport nce, select a tion, and limit ree options of travel th the suggested a number of pectation)	Users can select preferred modalities, set walking speed and apply wheelchair accessibility options.	N.A
parency of what data it is going to be give permission to	Follow the basic privacy protection law	Collect anonymised data on what route was clicked but those aren't linked to the specific user.

4.5.3 Product analysis

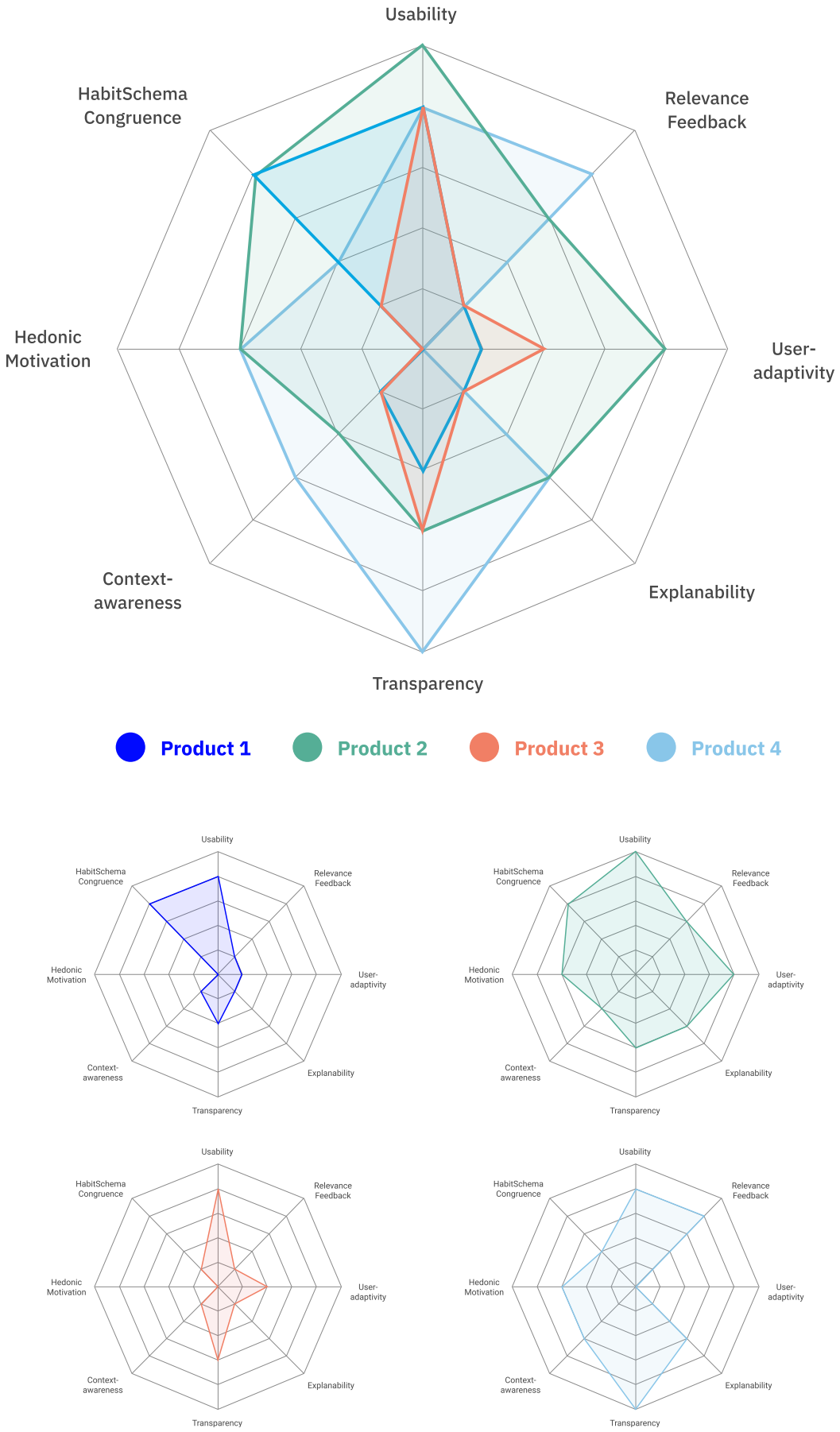


Figure 4.3 The result of product analysis based on evaluation criteria

Usability

Every interview participant answered that their goal of the product at the user interface level is to be simple and easy and doesn't cause any confusion or trouble using the product. Making the user experience flawless and intuitive is an important aspect of the user interface. All products don't require any unnecessary steps to plan a journey and even simplify steps by using a saved location function. Current location and current time, respectively, are set as a starting point of a journey and leaving time automatically which simplifies the steps to achieve the goal with a product. Product 2 has a customizable home page that shows a widget of saved locations, station and bus stops and routes in order to let users plan their frequently recurring travel quickly.

HabitSchema Congruence

This matrix sees if the routing system reflects how the travellers actually plan and make a journey. Each product has different target groups and attempts to serve their needs. The routing system of product 1 incorporates the actual use case of target users, who have high car ownership when optimising the route. Therefore, the product classifies the routes as follows: car, park and ride, public transport, bike-train-bike, etc. The user interface of product 2 reflects how travellers in the Netherlands travel by incorporating a button that allows users to select a connecting transport mode. According to KiM(2020), multimodal travellers often decide which transport mode to use before checking the route due to preference and accessibility towards certain transport modes. Product 3 and 4 consider that people walk or cycle to access public transportation.

Hedonic Motivation

There are some MaaS apps that give financial benefit to users who purchase subscriptions to promote people to use the app and travel in a multimodal way. Product 2 has a playlist generating function based on the total travel time and music taste of the user, which is receiving positive feedback from the users. However, hedonic motivation hasn't been explored explicitly yet although there are some attempts to incorporate hedonic-related features. Product 4 is at a testing stage of incorporating gamification of experience to promote sustainable movement.

Context-awareness

All selected products at least take real-time information such as disruption, train cancellation etc into account when suggesting routes. Product 2 and 4 give different travel advice based on the transport mode that the user chose. For example, the app doesn't navigate the user to cobblestone covered roads if the user chooses a bike as a connecting mode. Product 2 and 3 take contextual factors into account by letting the users adjust some contextual parameters such as determining the walking distance and selecting a wheelchair accessible option. Some contextual factors are crucial determinants for travellers when it comes to choosing a transport mode.

Interviewees of product 1 and 4 mentioned that the product was once used to show weather information on the app but this feature is now gone since weather prediction is often inaccurate which might, in turn, lead to decreased trust towards the suggestion and moreover, the product.

Transparency

All products are at least following the basic privacy law and interviewees have mentioned that they think twice before collecting data from users if it is necessary to collect the specific data. The use of GPS data is required to know the current location of a user. With product 2, the users can access a page that explains which data is being collected for what purpose. There, the users can give permission to each item. Product 4 informs about legal requirements and data usage in user onboarding.

Explainability

One major challenge of product designers is to simplify the complex operating mechanism of the backend system on the user interface and only speaks necessities. The explicit and comprehensive explanation of what happens behind the scenes is often neglected for the sake of usability. Product 2 and 4 give some cues on what the system can do or can't do via messages. Product 2 communicates what the user can adjust when there is no available route and explains that the users can decide which information to be displayed with route suggestions. Product 4 informs when the suggested routes are outdated which in turn increase the validity of suggested routes. Labelling and classification of routes also give hints on how the app optimises the route. Giving cues on how the routing system operates allows users to compare different options to make a decision.

User-adaptivity

This matrix evaluates the extent of user involvement of a product by allowing users to customize their routes by adjusting configurable parameters and responsiveness to user input. Product 2 has the most numerous configurable parameters that are accessible by users. Product 3 allows the users to adjust walking speed and they are planning to incorporate more parameters that affect the accuracy of prediction. However, personal factors can't be collected due to privacy issues when recommending routes.

Relevance Feedback

Product interaction data is usually collected to enhance user adaptivity. Product 4 is the only product that incorporates the function that receives explicit user feedback on the app. The interviewee of product 4 said that getting feedback on whether the suggestion was useful or not helps a lot to improve the routing system. On the other hand, product 2 has the focus group that they work with closely and in the beta app, they test new features before incorporating them into the main app. The interviewee of product 2 said that the quality of feedback matters.

4.6 Discussion

4.6.1 Product Comparison Analysis

Efforts to maintain the simplicity of the user interface conflict with other themes such as context-awareness, transparency, explainability and user-adaptivity. Most existing journey planning apps provide the users with predetermined decision options through simplified user interfaces and dashboards. However, the resulting simplicity may have negative effects when algorithms neglect contextual factors (Marabelli et al., 2018) which are important determinants in human decision making. Negative consequences such as reduced information due to oversimplification (Orlikowski and Scott, 2014), inaccuracy (McFarland and McFarland, 2015), a loss of fairness (Zarsky, 2016) and other ethical issues can be raised. Therefore, balancing between maintaining usability and allowing flexibility to invite users more into the recommendation process can be one major challenge.

Classification of routes that apps defined gives a hint on their understanding of target users' travel behaviour that is a result of massive user research. To provide valid options that suit the way users actually plan and travel selected products are largely depending on implicit feedback that can be collected through product interaction data. There is an attempt to allow customization by providing configurable parameters. However, the determinants that actually affect human decision making are related to emotion and personal state that changes rapidly and depending on a lot of circumstantial factors (Braun, 2019) that can't easily be quantified with parameters. Therefore, some decisions are solely left for users to make.

In conclusion, most existing products are mainly focusing on instrumental and pragmatic aspects to enhance trust and acceptance. Optimising the divergent provider landscape is a key challenge because each transport operator has its own rules to play. For example, there are different policies for reservation, return, requirements for activating the account, pricing and more. Moreover, as the app suggests routes based on data that comes from external API, the accountability and validity of recommendations largely rely on the quality of API data. Therefore, the backend system has an additional system that processes and recalculates these data. At the user interface level, the biggest challenge is figuring out how to represent data and information in an intended way.

4.7 Conclusion

There is a gap between human and algorithmic decision-making processes. To make a better alignment between the two, the focus will be on being more transparent than being opaque at the user interface level. However, interacting with a digital product should be easy and intuitive involving less effort. Less-explored areas such as hedonic motivation, explainability, context-awareness and user-adaptivity will be explored in the later chapter of this project.

Chapter 05

Synthesis

Chapter overview

This chapter synthesizes the findings and insights from the previous research activities aiming at defining a design goal and design criteria to tackle the addressed challenge in order to adopt a travel companion powered by adaptive intelligence that assists multimodal travelers to shape our future mobility together with users.
Under the design goal, four themes of design were defined and translated into four sets of design criteria accompanied by specific requirements to design and evaluate the final prototype that depicts the suggested way of interacting with a travel buddy by the author.

5.1 Synthesis

The opportunity that a multimodal journey can bring to users is that it can provide personal and situational adaptivity. While service is evolving fast, the speed of change in infrastructure falls behind. Intelligent systems and smart assistants will play an important role in filling the gap between infrastructure and service development guiding users to switch between different transport modes. Experts and users are envisioning that digital systems will be equipped with better capabilities of communication, prediction and user-adaptivity in the near future. As digital systems are gaining more power in our daily lives, more attention is being paid to the question of how digital service can be used as a tool to solve social issues and improve the well-being of individuals and groups.

From users perspective

While users are envisioning that future travel companions will be almost like a part of the users knowing everything about the user and provide service based on their previous activities and preference, the lack of reliability that users are perceiving with the existing journey planning apps is one challenge to overcome. While MaaS apps are dealing with general competence in terms of predictability, accuracy and perceived usefulness of technology, users require a profound understanding of how the system operates and be involved more in decision-making to be able to be in control of their own decision. Although future users would likely be less reluctant to share their personal information if they can be provided with personalised service and know that their personal information is in good hands, negative emotions of being dependent on technology should be tackled. Then how can we shape our future into a more positive one, together with smart agents which take over some authorities of users?

From experts perspective

From product analysis, two different strategies when it comes to facilitating interaction between an app and a user were identified. One strategy is to involve users more by being transparent with data usage, giving hints on how the backend system operates and allowing users to adjust options of routing systems. Secondly, some products rather maintain simplicity and are opaque, catering to needs for predefined use cases. However, reduced information can lead to detaching humans from decision making which in turn results in humans' losing control of their performance. On the other hand, it is found that selected apps are moving towards embracing more user-friendliness by expanding configurability and allowing users to micro-adjust their routes. Moreover, there is also an attempt to bring emotional benefits to a product. As products are leaning towards reducing barriers between human beings and intelligent things, it is worthwhile to look into the role of a touchpoint that mediates an assemblage of human and intelligent agents for making a multimodal journey.

5.2 Design goal

To design a travel buddy that empowers multimodal travellers to be more in control of their decisions and enhances engagement with each other to make joint efforts to shape future urban mobility experiences.

The interaction made through the screen should be interpretable to understand the user's needs.

The ultimate goal of a travel buddy is to build a collaborative relationship with users. Figure 5.1 illustrates the consequential steps to achieve this goal. The design goal is generated to tackle the two main challenges identified in assisting multimodal travellers from the previous research activities (literature review, research activities 1 and 2). Autonomy and engagement to facilitate collaborative interaction between a user and a travel buddy will be focused on. The sub-goal is to improve implicit human-computer interaction data to be more interpretable to understand the latent need of multimodal travellers. These two statements are broken into four goals and will be explained in the next section followed by criteria to design and evaluate a solution.

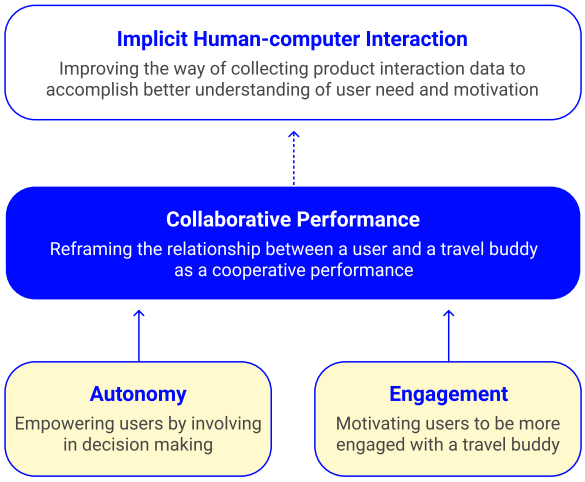


Figure 5.1 Elements that consist of the design goal

5.2.1 Collaborative performance

A travel buddy should mediate a collaborative relationship by inviting both users and itself to the process of planning and making a trip.

To facilitate a collaborative performance between a user and a travel buddy, the travel buddy and users have to have a fair amount of understanding of each other. The user interface has an important role as a medium that connects users with the system behind to make users feel that the system is adapting to their actions so that users can be more willing to share their information. Most of all, it should make the users that the travel buddy is operating under the same goal.

5.2.2 Autonomy

Reconnecting the users to their decision-making is the main challenge to facilitate the collaborative relationship. As journey planning apps are evolving to have a more complicated backend system to provide more personalised and intelligent service, many information and processes are getting simplified for the sake of usability. This results in detaching users from their decision-making and losing a holistic understanding of the information of the mobility system. The design should invite users more into the process of planning a journey and this requires the travel buddy to be more understandable from the user perspective. Sufficient information about the operation process of a travel buddy should be provided to users so that the barrier between the automated decision and users decision can be reduced.

5.2.3 Engagement

Engagement describes the attribute that encourages the users to have an engaging experience while interacting with a travel buddy. To make users adopt a product, they should feel that it is useful. This goal is adopted to explore the opportunity that cognitive and hedonic attributes can bring to the table. The focuses are on the congruence between what the user needs and what the travel buddy offers, motivating users to build a constant relationship with a travel buddy and providing emotional benefit to users.

5.2.4 Implicit Human-computer Interaction

From the expert perspective, investigating users' needs while not invading their privacy is a challenge. Therefore, the general way of learning users is to analyse the product interaction data to reveal latent needs. The goal is to make the interaction more direct and interpretable. It implies that the interaction through the digital touchpoint should allow a travel buddy to understand the way users plan a journey and the factors that influence decision-making in real life.

5.3 Criteria and requirements

01 Autonomy

Travel buddy should allow users to feel that they are in control of their decisions.

Sub-goal	Requirement
1.1 Explainability	It should provide comprehensive information on a product intention and underlying computational reasoning when actions are taken.
1.2 Customizability	It should allow users to customise their journey and be more flexible with situational change.
1.3 Transparency	It should transparently communicate the process, competence and the source used to provide information and route recommendation.

02 Engagemennt

Travel buddy should motive users to be engaged with it .

Sub-goal	Requirement
2.1 Congruence	It should make users feel that the guidance and information that a travel buddy provides correspond to their travel behaviour and needs.
2.2 Motivation	It should motivate users to engage with a travel buddy for the long term.
2.3 Emotional benefit	It should provide users emotional benefit and pleasure while interacting with a product.

03 Co-performance

The relationship between a user and a travel buddy should be collaborative.

Sub-goal	Requirement
3.1 Adaptivity	The user should be able to feel that a travel buddy is adopting users' data and input.
3.2 Coalition	It should make users feel that a travel buddy and themselves are driven to achieve the same goal.
3.3 Personal information	The users should be able to feel that sharing personal information would bring additional value

04 Implicit HCI

The user interface should help a travel buddy understand underlying reasons to users decisions

Sub-goal	Requirement
4.1 User understanding	The design should allow the travel buddy to have sufficient understanding (need, motivation and goal) of a user through interaction data.
4.2 Process	The design should allow a travel buddy to understand what happens in the physical world which users in while they are travelling.
4.3 Configurability	The design feature should allow users to access and adjust parameters that they consider important to cater their own need

Chapter 06

Conceptualization

Chapter overview

This chapter reports on the process of developing a prototype and the outcome. The prototype has been developed with the aim to provoke real action and behavior that will happen in the future based on the design goal to make an interaction between a travel buddy and a user a collaborative one. Three initial concepts were generated focusing on finding a better way to represent travel information to help users make decisions. These concepts were evaluated with a user survey. Based on the result, the final user flow has been defined and a prototype has been developed to deliver the user

6.1 Ideation

The integrated creative problem solving (iCPS) approach suggested by Delft University of Technology was adopted for this activity. iCPS basic module is built upon the traditional two-step creative diamond that consists of diverging, getting as many options as possible and converging, selecting the most promising options out of the many options (Guilford, 1950). The reverging step has been developed to fill the gap between two steps and get an overview of options generated in the first step. The ideation process of this thesis followed the three steps suggested.

In the diverging stage, the design goal was broken into two main themes: autonomy and engagement. Brainwriting technique was used for each theme to incorporate the ideas emerged in previous research stages. After the diverging stage, ideas were categorised by using the spontaneous clustering technique (see figure 6.1). Clustering helps to gain an overview of all options generated. Before converging ideas into a solution, ideas that don't fit the remaining two design goals, coalition and implicit HCI were eliminated. Ideas were combined considering the balance of autonomy and engagement into three concepts and improved to distinguish the characteristics of each concept.

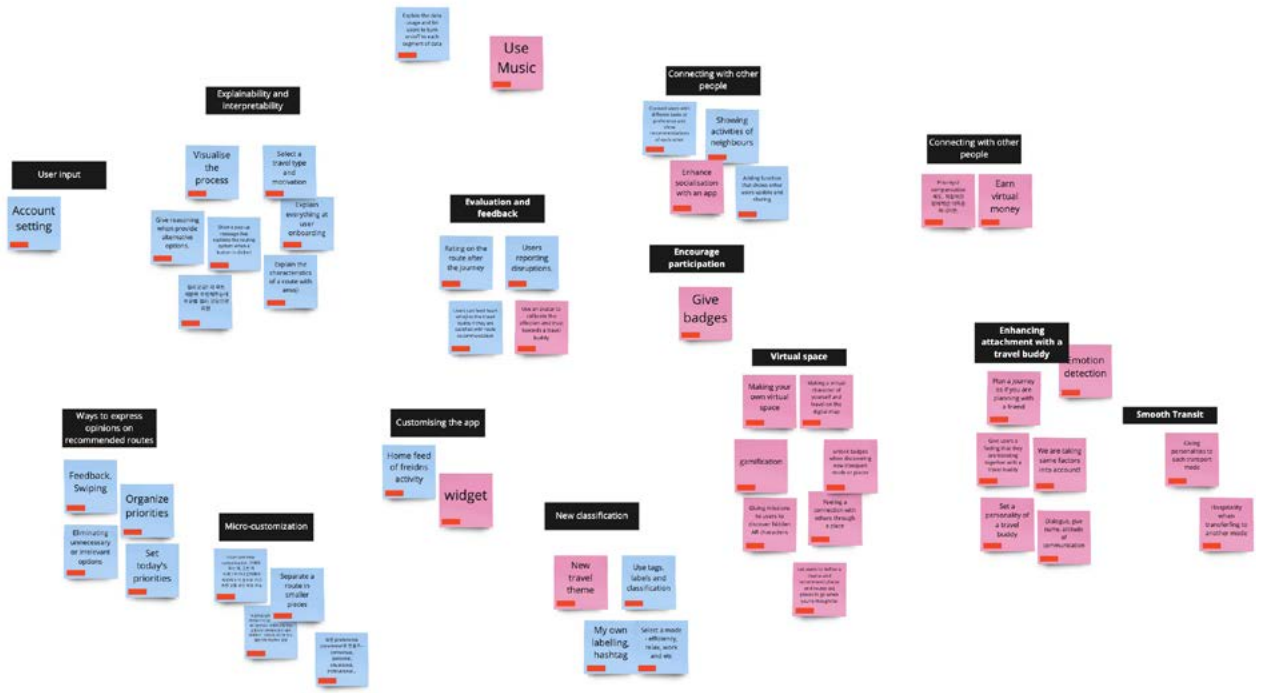


Figure 6.1 Generated ideas and clusters during brainstorming

6.2 Three Initial concepts

Based on generated ideas, three concepts were built that allows users to customise their routes more freely and gain an understanding of how the backend system operates. From the expert interviews, I found out that route recommendation algorithms in existing apps operate by limiting and predefining the value of parameters. The common thread that runs through these initial concepts is to allow users to access these parameters and adjust as they want.

Concept 1: Configurable parameters

The first concept, Configurable Parameters, gives the users full access to numerous parameters to adjust the route recommendation. After entering the destination, the app will show route options with a panel that allows users to adjust options and select transport mode for each mile of their journeys. If the user clicks the option button, they will enter a page that contains more configurable parameters that quantifies factors that they consider important to customise their journey to cater their own personalised needs.

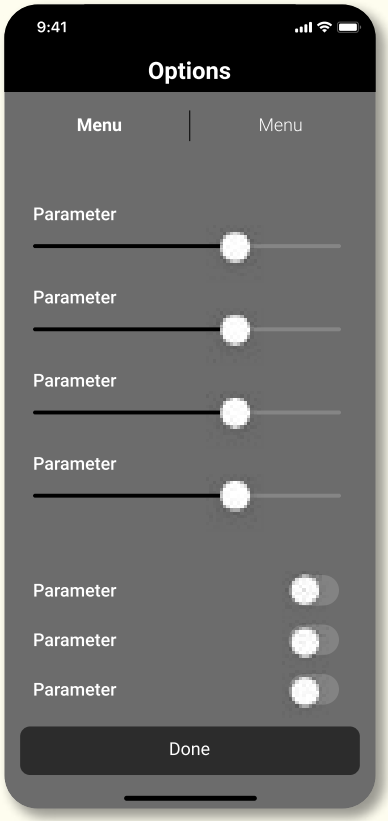
Concept 2: Label your route

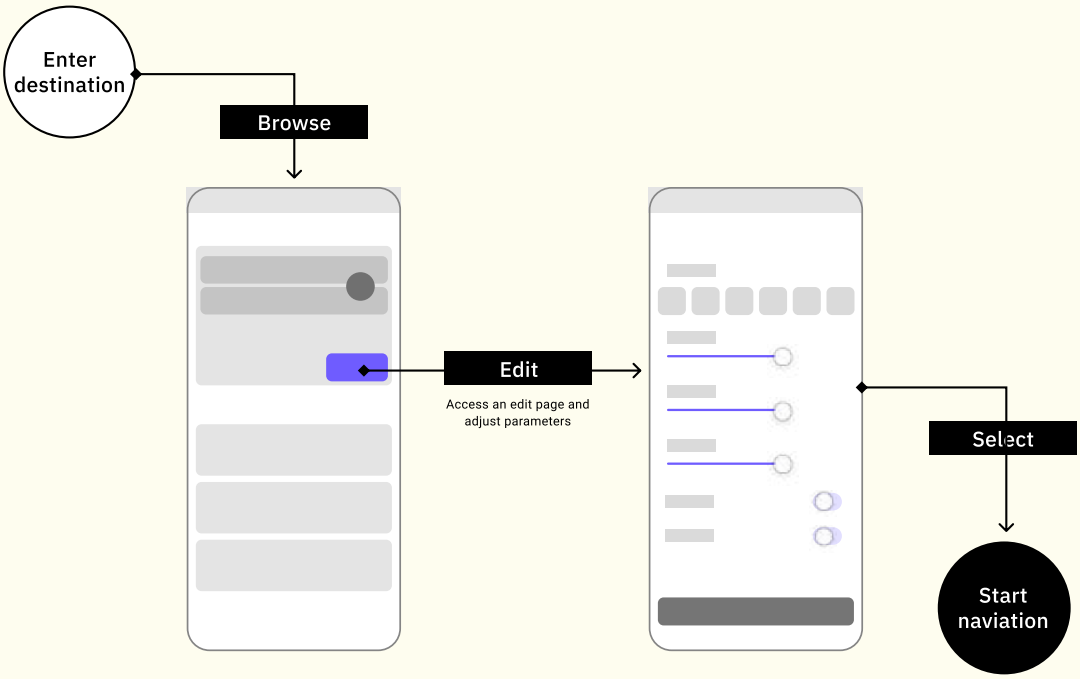
The second concept incorporates how the backend system of the existing MaaS apps generates routes for their customers. They predefine parameters and limit the quantity such as the number of transfers, walking distance and travel time to enhance speed and accuracy of their route suggestions. And they apply a sorting algorithm to categorise and label routes to help users to make decisions. The idea is to directly provide parameters that determine the routes to users and allow them to adjust the levels to create their own way of route optimisation. This way, not only customising their sorting algorithm, the users will be able to change the order and prioritise the classification in different travel situations.

Concept 3: Micro-customization

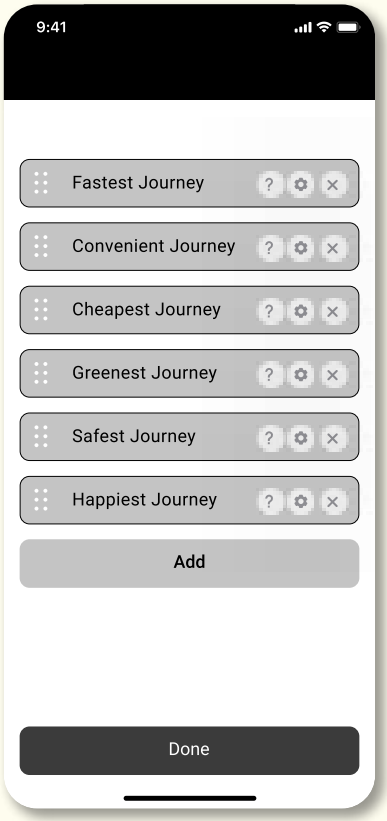
This idea came from one quote from the participant of the mind-mapping session. “I prefer to use my laptop to find routes because then I can see the whole overview of my routes with a map.” This quote implies that maps can help users to navigate the surroundings not only when they are on their way but in the earlier stage where they plan their journeys. For multimodal travel, the experience of each mile composes the experience of the whole journey. This concept allows users to have an overview of their journey more clearly and micro-customise their first and last mile of their journey by selecting a mode and adding stops. The main mile (the journey in between the first and last mile that usually takes up the longest distance) can be determined based on the first and last mile that are made by users.

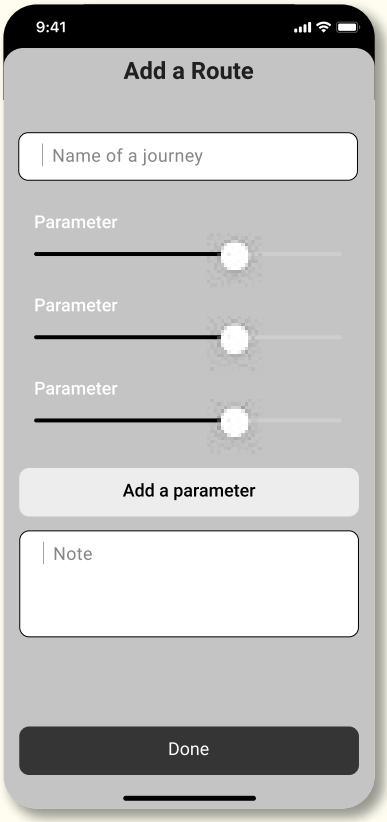
Concept 1: Configurable parameters

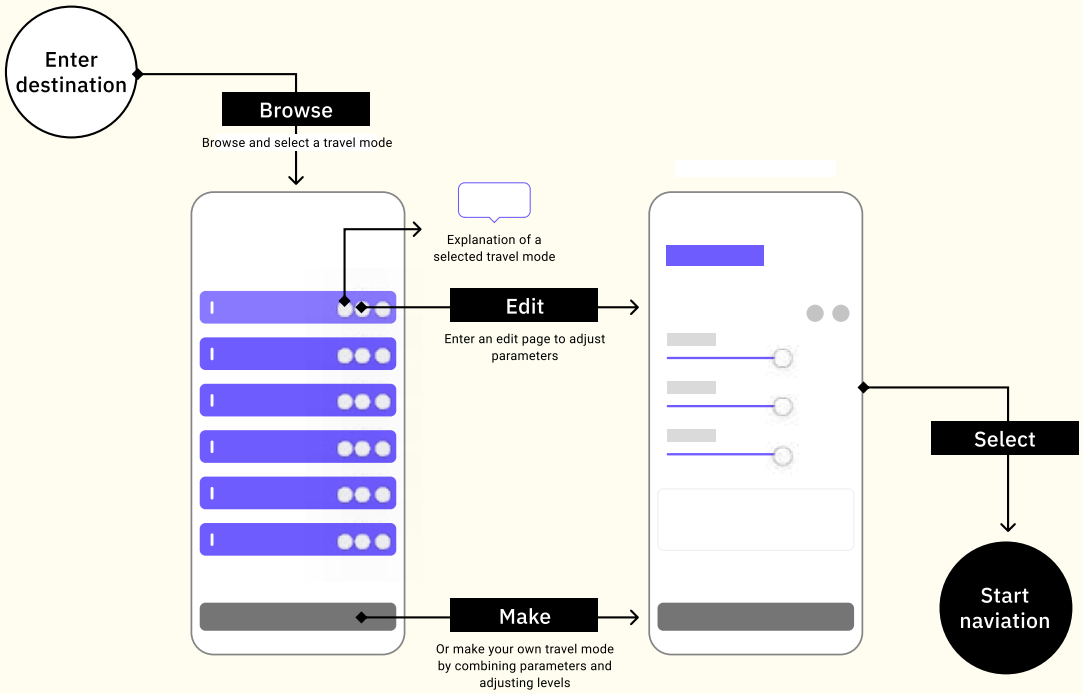




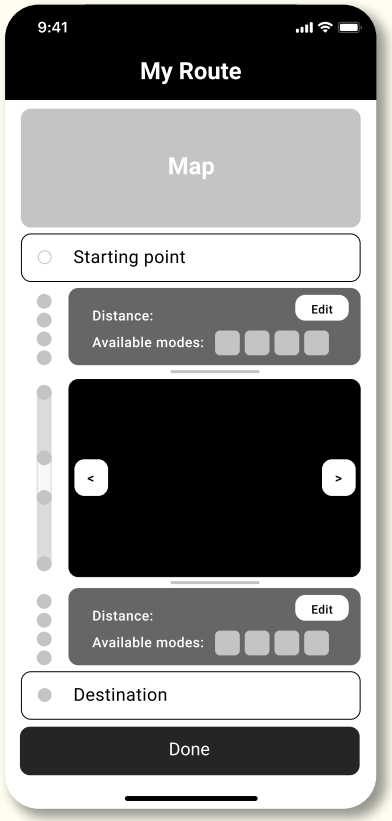
Concept 2: Label your route

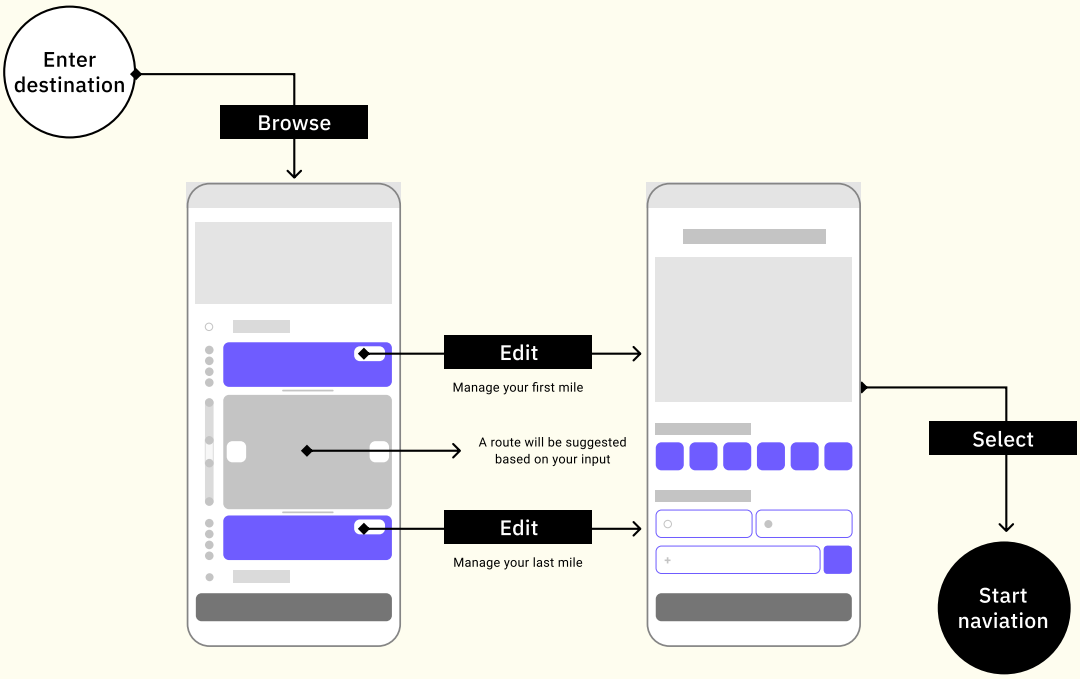






Concept 3: Micro-customization





6.3 Concept evaluation Setup

With the three initial concepts presented above, the survey was constructed to see which concept will be the most preferable and associates with autonomy, congruence with their travel journey and convenience. The survey was published online and made to take about 10 minutes to complete.

6.3.1 Structure

The survey consists of five sections. It starts with asking general demographic information and their level of multimodality was specifically asked. After that, the questions about their attitudes and tendency of making decisions were asked. Next, three concepts were presented and participants were asked to select a concept that is most relevant to the question regarding preference, perceived autonomy level, congruence with their travel behaviour and convenience of use.

6.3.2 Participants

12 people responded in total. Most of them are master students in the Netherlands and some are working in the mobility industry. (see figure 6.5)

6.4 Result

6.4.1 Personal dispositions in decision-making

More than half of participants responded that others' opinions and reviews influence them when they make a decision and they are rational and calculative rather than emotional and intuitive. The influence of their personal deposition to trust to the preference of the user interface couldn't be found. However, it is found that regardless of their attitude on decision-making, almost all except one person chose to have more detailed information rather than being recommended automatically by an algorithm.

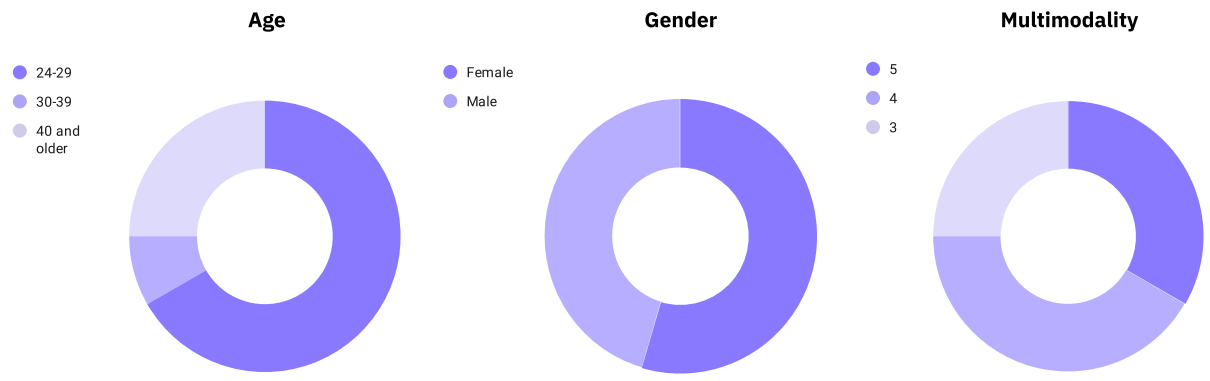


Figure 6.5 Overview of participants

6.4.2 Three concepts

The most preferred concept was the second concept. People responded that it is the easiest to use and understand compared to other two options. They appreciated that they can still find information they look for.

"These labels kind of correspond with how I choose / plan in real life without an app."

The ambiguity of the route label evokes the feeling that it might land them to a new place. This concept associates with fun and adventure. One respondent mentioned that this concept incorporates the fact that every travel has different goals and characters. And one other respondent said that this concept corresponds with how the user chooses and plans a journey in real life without an app.

"When I'm trying to find a route, I am usually in a hurry. I just want my jobs to be done, I won't have time to adjust small details for my route."

The first concept gained half of the remaining votes. Both respondents mentioned the convenience of this concept. Some participants agonized between the first and third concept and voted for the first one because of its ease of use.

"Although I know the recommendation is great, I would like to have more control."

The third concept also gained same votes. One respondent appreciated the amount of control he will have. Another respondent appreciated the customizability of the first and last mile. However, it is found that the amount of control is more needed when the user is travelling to an unfamiliar region.

The third concept was the most selected concept in terms of autonomy. In terms of congruence with the actual travel behaviour, there wasn't a big difference between votes that the three concepts gained. In terms of convenience, concept 2 won most of the votes and remaining votes went to the first concept.

The survey result can be found in figure 6.6 and appendix 3.

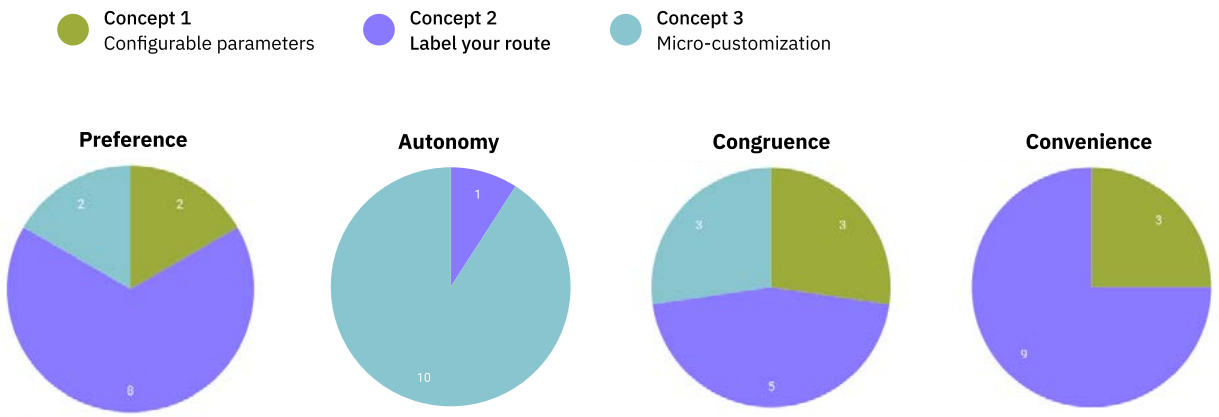


Figure 6.6 Result of the concept survey in terms of preference, autonomy, congruence and convenience

6.4.3 General findings

Simplicity and convenience is what users appreciate

Based on the result, convenience and consistency with the travel behaviour seem to be the most important determinants that lead to preference. According to comments from participants, they are mostly in a hurry and don't feel the need to micromanage their route. However, this could also mean that people don't expect an app to represent how they plan and choose a route in the real world.

Most people choose the concept they chose for preference also for convenience and consistency. Although participants mentioned that losing autonomy is a major concern of using technology (Chapter 3), it didn't directly lead to acceptance.

Too much control reduces spontaneity

"For me sometimes it's better to get lost to have a variety of experiences."

This quote from one participant explains what people like about travelling with public transport and active modes since it allows you to get lost and explore narrow streets. Although having a certain amount of control and predicting a trip in advance are important aspects to increase satisfaction of travellers, finding the right balance of intervention is important.

Labeling a route: intuitive representation of what travellers look for

"I like that with one word I can see what I look for: fastest, easiest, greenest etc. so I can just choose and go"

Multimodal travellers have to know various information to make a decision which route to select. To help this process, journey planning apps display precalculated information such as travel time, cost, number of transfers and et cetera. Putting a label that is defined based on preset parameters can be an intuitive, easy and interesting way to plan and choose a route.

Different goals and characteristics of each trip should be considered

"it's never only about one thing, e.g. only price. I want a combination of reasonable price, convenient timings and green."

"For a trip across Europe I like to be able to customize on a micro-level. If I travel across the Netherlands, then I'm fine with less control."

Every trip has a different goal and character. For example, what people want for commuting is different from when they are hanging out with friends or family. And the familiarity of the destination also matters. There are different goals that have to be achieved in one journey. Knowing these contextual factors and taking into account when guiding users could increase adaptivity of a travel buddy.

6.5 Final concept

Current interaction between a user and a travel assisting tool is rather one-way than two-way. Users have a limited access and understanding to parameters that are used to generate route recommendations which makes a travel buddy incomprehensible and distant.

This section suggests a collaborative relationship between a user and a future travel buddy by applying the following steps.

6.5.1 User flow

Introduction

A travel buddy introduces itself and asks to have access to certain data while explaining what it will going to do with it with examples. Users can either approve access, require more information for data usage, or decline access. Users build awareness and gain understanding of a travel buddy's performance and intention.

Journey planning

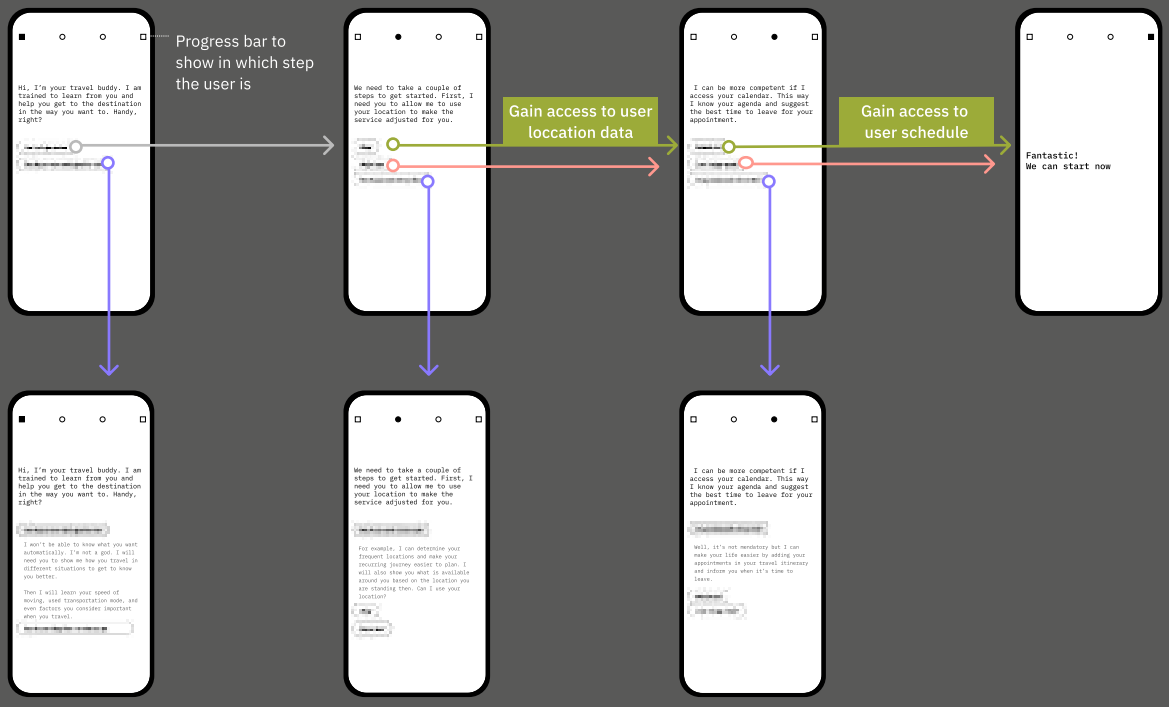
In the early stage of use, a travel buddy asks to travel together. When a user select a route and agrees a travel buddy to join, it will start tracking location data. Based on this data, the travel buddy will be able to know the actual transport mode you used, your moving speed if you're walking or on a bike, visited places and so on.

The user and travel buddy will get to know each other better over time. Then, many tasks can be automated and the process of planning a journey will be simplified by using saved travel modes. This way, users will be able to select *a travel mode* in different travel situations. Furthermore, the travel buddy auto-generates a travel mode based on the preference, previous travel behaviour of the user, and the mood.

Learning

A travel buddy analyzes a journey after the journey is over. First, the travel buddy gives an overview of a journey based on data that can be directly interpreted. It shows, for example, the actual travel time in total, used transportation modes and average speed of active modes (e.g., walking and cycling). Then, it compares the actual route with the planned route, suggested by the travel buddy. It pinpoints the difference and asks a question to understand what has changed the user's mind to take an alternative route. Then, the travel buddy further investigates the context and the motive of a journey so that the saved travel mode can be used in the similar travel situation. At the end, the travel buddy sums up the user's travel type by defining it with a name. The result is saved as a travel mode to apply saved parameters for the later use.

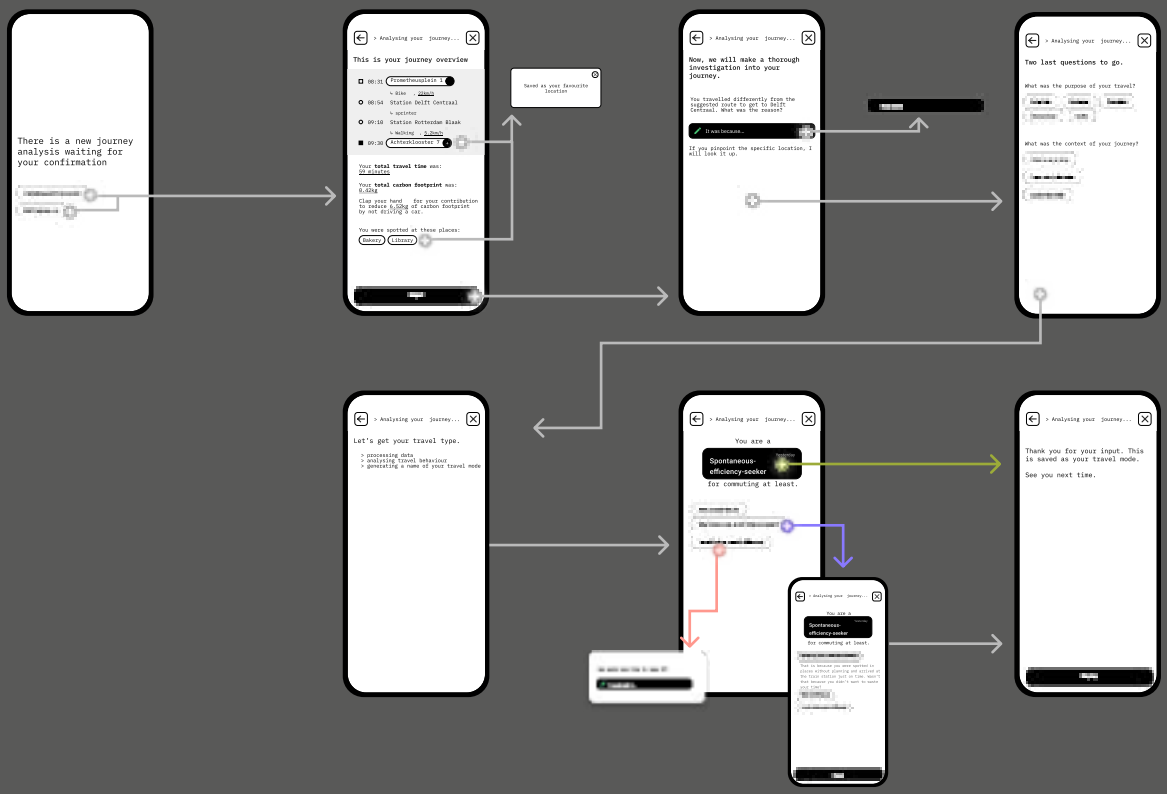
Flow 1. User onboarding



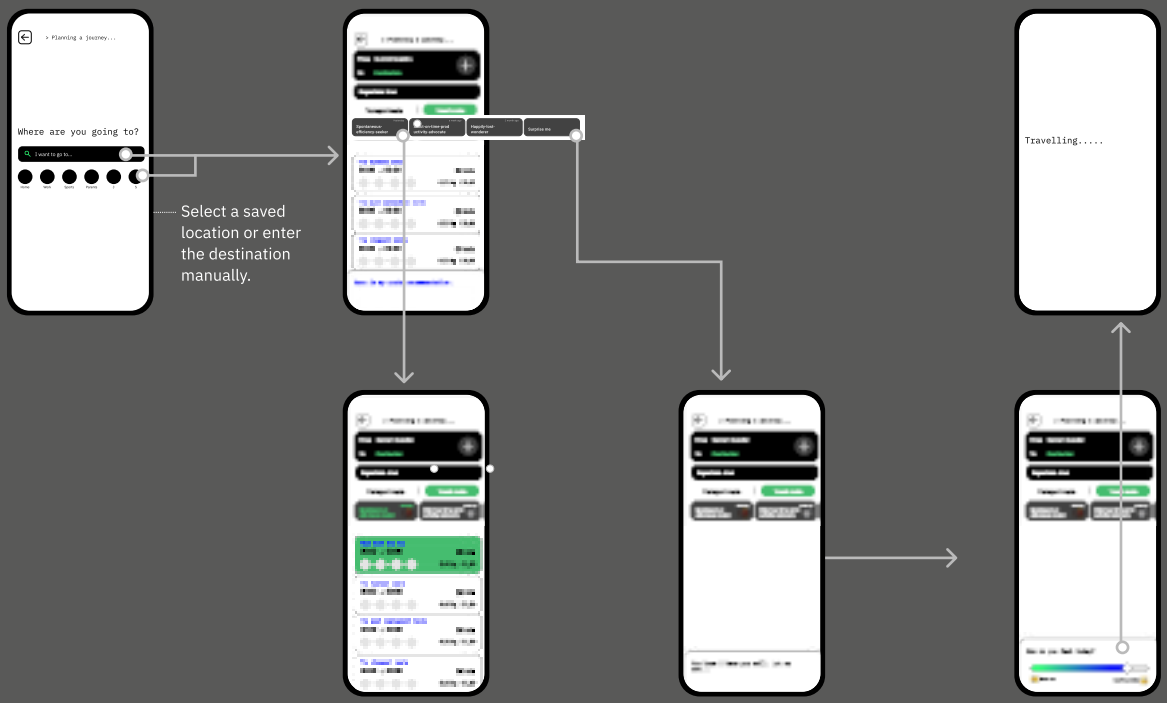
1. Continue
2. Approval/Agreement
3. Disapproval/Disagreement
4. Inquiry for explanation

Flow 2. Journey planning (First)

Flow 3. Journey analysis



Flow 4. Journey planning (Prolonged)



Chapter 07

Experience proto-type

Chapter overview

This chapter reports on the set-up, process, and result of the research conducted with an experience prototype. Experience prototype is a representation that is designed to explore and communicate existing or future conditions through engagement with prototypes (Buchenau & Suri, 2000a). Participants interacted with a prototype in two situations, after installation and prolonged use. The result was evaluated with a questionnaire developed based on the design goal defined in chapter 5, through observation and by a follow-up interview. The chapter concludes with the impact of a travel buddy that might influence the travel behavior of users.

7.1 Study Design

7.1.1 Research objectives

The goal of this research is to explore the impact of the suggested relationship between a user and a travel buddy in the context of multimodal travel in the near future. On the one hand an evaluation of Travel buddy as a medium for assisting multimodal journey planning. On the other hand, this study aims to explore the effects of such an assistant on the urban resident's travel behaviour.

These effects were explored by finding out the impact of defining a travel behaviour in different travel situations by inquiring deeper into the context of each journey and analysing the behaviour. Subordinate research questions are defined to measure the impact as follows:

1) How would people interpret the defined travel behaviour?

2) How would people define their travel mode themselves in different situations and what are implied in the statement?

3) What impact does it have in changing the way of travelling?

Travel buddy was expected to make the journey planning process more collaborative by assuring autonomy and enhancing engagement as described in chapter 5.

7.1.2 Method

This research employs an interactive prototype made with figma, a collaborative interface design tool. The prototype was developed to put participants in a story where they interact with a travel buddy in a suggested way. Experience prototyping is a form of prototyping that enables people to gain first-hand appreciation of existing or future conditions through actively engaging with prototypes (Buchenau and Suri, 2000). Thus, the prototype is a representation of an experience suggested for the future that is made to provoke real world actions and explore what it might be likely to engage with the travel buddy rather than to evaluate usability and user interface.

The prototype consists of two main flows that represent first user experience with a travel buddy and a prolonged user experience including user onboarding, planning, and analysis.

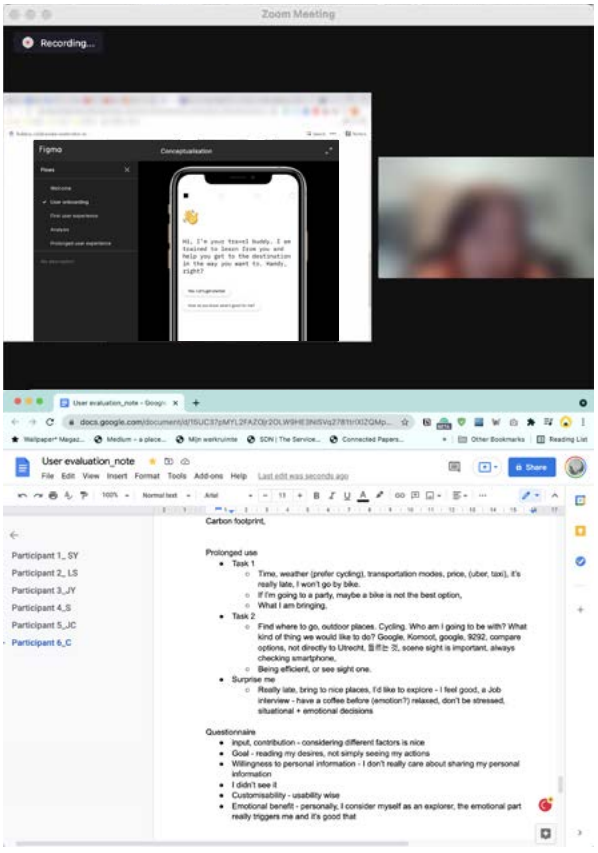


Figure 7.1 Research setup using Zoom and a prototype embedded in Notion page

7.1.3 Participants

6 participants were recruited through personal contact. The requirement for participants was to live in an urban area in the Netherlands and to be equipped with a multimodal mindset.

Participants	Gender	Multimodal mindset
A	Female	3
B	Male	5
C	Female	4
D	Female	4
E	Male	5
F	Male	5

Table 7.1 Overview of participants

7.1.4 Procedure

Every session was conducted online using Zoom combined with a Notion page embedded with the prototype (see figure 7.1). The session took approximately 40 minutes for each. It started by explaining the purpose of a session and the goal of a prototype. Then, participants were asked to imagine that they just installed and launched the travel buddy on their smart devices and to plan their commute for the first time. After getting their journey analysis, they were asked about their emotions. After that, they were given two tasks to plan their commute and weekend, imagining that they have been using the travel buddy for a while. In this phase, questions were asked about what they expect by using a travel mode they selected and how would they define their travel type in the given situation. After completing the tasks, they were asked about their emotion again and asked to fill out the questionnaire that is made based on design criteria defined in chapter 5. Participants explained the reasons for their responses. Lastly, the session concluded with a follow-up interview. General remarks on the experience were made and what they think about the impact of a travel buddy on changing the way of plan-

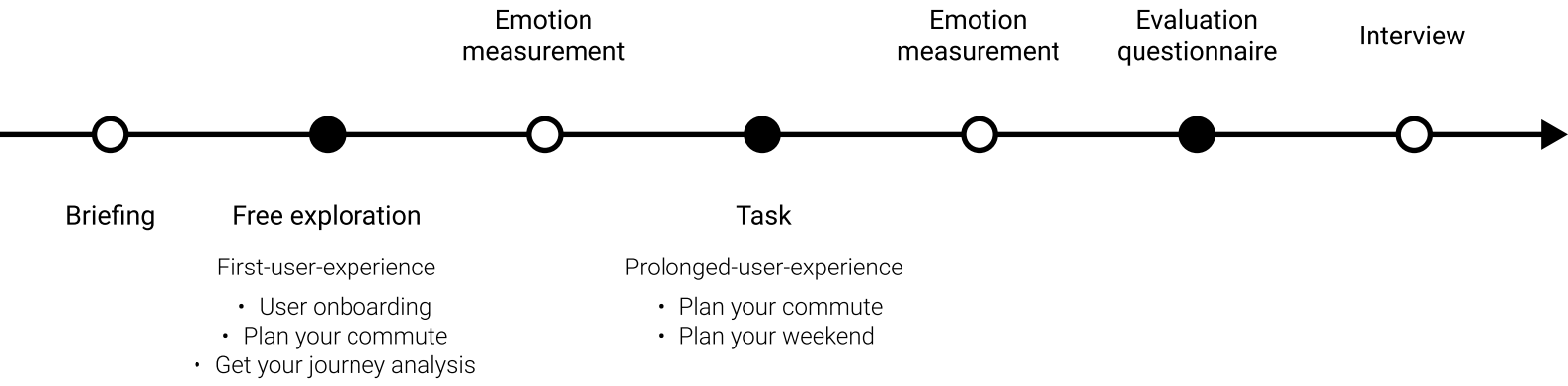


Figure 7.2 Timeline of a research with an experience prototype

7.2 Evaluation methods

The evaluation was done in three ways. First, a participant was asked about his/her emotion after each main flow. Premo, an emotion measurement instrument, was used as a discussion tool to help participants elaborate their emotions (Desmet and Laurans, 2017). Fourteen different emotions described with a cartoon character were shown to participants without showing what emotion each illustration describes and asked to choose one drawing and explain why. After exploring the prototype, an evaluation questionnaire form, which is made based on design criteria, was given (seee figure 7.3). Each article was paraphrased in the statement of a user and participants were asked to rate with the score from 1 to 5. More qualitative aspects were investigated with interviews. Remarks on clicks and responses were made. Lastly, the main question about the impact of a travel buddy on urban travellers behaviour was asked.

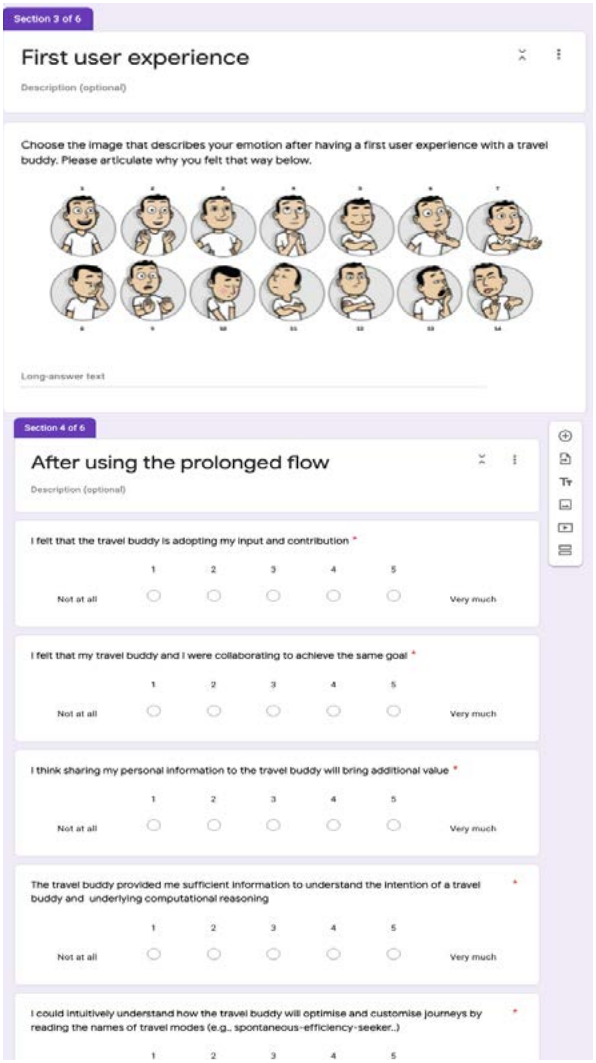


Figure 7.3 a screenshot of Google form provided to participants for evaluation

7.3 Result

7.3.1 Emotion measurement

After the first-user-experience flow, every participant felt curiosity wondering what will come next and what value it will bring to them. After the prolonged user-experience flow, reactions varied. Most participants understood what a travel buddy does, however, they wanted to see more about what it can do. They wanted to see the competence and capability of a travel buddy that will benefit them in long term. (see table 7.2).

First User-experience			
Participant	**Emotion**		**Quote**
A		Curiosity	I don't exactly know what it will bring to me, but the idea or the approach of it seems useful.
B		Curiosity	Nice UI. Draws me a curiosity. It's an interesting experience.
C		Intrigued	I just installed it and it's kind of a new thing to me. But the idea of defining me is fun
D		Wondering	Small design components makes me wonder and makes me want to click on it.
E		Curiosity	I've never used anything like this before
F		Thoughtful	Okay, what is going on?
Prolonged User-experience			
Participant	**Emotion**		**Quote**
A		Aha!	It seems to reduce my struggles with existing solutions. It won't be necessary to adjust settings every time.
B		Intrigued	I'm intrigued and makes me want to explore it more. I got familiar very quickly.
C		Aroused	What are you gonna give to me?
D		-	No emotion in particular. I would like to see the competence of it and get a satisfactory result with my contribution.
E		Curiosity	I am still curious.
F		-	Hey, this is really nice. What will come next?

Table 7.2 Overview of emotions participants felt after experiencing each flow

7.3.2 Questionnaire

Autonnomy

According to one participant, *"a travel buddy provided information to understand its computer reasoning and intention more than most computer travel systems"*. Some participants appreciated the examples that a travel buddy gave in the user onboarding phase. However, interacting with a travel buddy in a dialogue form didn't efficiently deliver every information it provided. One participant, an interaction designer, suggested *"to use design components such as icons or images to communicate information more successfully"*.

The travel buddy gave sufficient flexibility to solve pain points that some participants were struggling with existing journey planning apps. One participant said, *"it feels like this buddy will give what I want".* The aspect that the travel buddy is considering different factors that travelers usually keep in mind when planning a journey was appreciated. On the other hand, customizability was related to usability for some participants.

Based on observation, most participants didn't click a button to get more information on how this travel buddy uses their data and what it does. When they were asked why they answered that they usually don't have time to read all information that apps give and they think they can't do anything about it even if they know about it. However, participants thought travel buddy was being honest with data usage and it allowed them to be aware of the process they are in.

Engagement

Participants consider different factors in different situations. For example, one participant always cycles to his work, therefore he would only use an app to find an alternative to get to the office on time when it rains. When he plans his weekend, he browses a day trip and plans a journey the day before and prefers to take a route with a good view. Participants responded that this way of journey planning will allow them to apply different values and get an accurate time estimation. The correspondence to their actual travel behavior led to increased motivation. One participant, who also participated in the mind-mapping session uses several apps to meet his goal. He said, *"I would have a better tool that actually suits the way I travel".* One participant mentioned that *"direct feedback"* to their action will motivate him to use a travel buddy in long term.

"The idea of having a conversation with a travel buddy" makes participants be more engaged with a travel buddy and have emotional benefits.

Co-performance

Giving permission to access personal data doesn't necessarily mean that they trust a system. With previous experience with other mobile applications, they are aware that they have no other option but to hand over essential data to receive a full service that a product can provide. Therefore, a travel buddy has a mission to show its competence and capability within a few uses. The effort of a travel buddy to really understand the underlying needs of users was appreciated and made them feel that it is trying to adopt a goal of travelers. One participant mentioned, *"whether my own travel personality is the same as what a travel buddy says or not, it is likely to become similar as the travel buddy presents goals to achieve"*.

Adaptivity of a travel buddy gained a high score from most participants. A remark was made by one participant that showing examples of how a travel buddy adopts his input will be helpful to feel that the travel buddy is adapting itself to suit users' needs.

Interpretability and spontaneity

When participants were asked to guess what kind of routes will be generated when they select a particular travel mode, the interpretation of travel modes was considered accurate. Although every participant responded that the given travel type after experiencing the analysis flow represents how they travel, they weren't certain if their interpretation of travel modes is accurate. Some participants mentioned, *"although I can make good guesses, names can be more clear and specific"*. Moreover, one participant asked what other travel types there are. The conclusion on this topic is that giving access to parameters that were used to define a travel mode can be helpful in reducing uncertainty.

There were very different perspectives on how to interpret spontaneity, which was paraphrased with the word adventure in the questionnaire. For most participants, adventure is closely linked to place recommendation. Recommending places to visit or day trips will enhance the spontaneity aspect of the travel buddy. Although it wasn't explicitly communicated that a travel buddy will randomly add places to visit based on users' previous activities, one participant mentioned that *"being able to apply different values than efficiency makes him believe that he will discover new places"*. Another participant, on the other hand, said, *"it's not an app that can bring an adventure but I have to make make it myself".*

7.4 The impact of a travel buddy

Travel type and behaviour definition, a tool to reflect on one's travel behaviour

"It reminds me of MBTI, a personality test."

Knowing a type of yourself helps individuals understand their own preferences and the way of making decisions. Defining a travel type could act as a tool to reflect on and observe their own travel behaviour. On the other hand, it can also work the other way around. Users could also travel differently from what they used to do to fit that type.

The matter of who is adopting whom?

"It's more like presenting a goal to me rather than adopting my goal."

A travel buddy can only work within a predefined algorithm and may not represent the actual goal of a user. A travel buddy might learn and adjust service according to the user's input, however, it is likely that a user will adopt a goal that is presented by a travel buddy rather than pursuing his/her own goal.

It will allow users to apply different and various values than efficiency

"If it was the efficiency that existing journey planning tools prioritised, it seems applying different values and goals that I had only in my mind in route optimisation will be possible."

Journey planning apps optimise a route by applying their own set of values based on predefined travel cases. If users can access the parameters that represent those goals, people would be able to calculate an accurate time to travel in their desired ways.

7.5 Limitation

The research of this chapter as well as previous research were conducted during the COVID pandemic. Due to protocols and measures that the government imposed, people were remarkably traveling less studying and working from home. Thus, concerns and needs of people changed from the past and it resulted in difficulties immersed with the topic. The circumstance also influenced the quality of observation. Fortunately, the characteristic of this project that focuses on an interaction of a user with an artificial and digital being didn't hinder capturing what is going on on a screen, however, the impression and moods of users couldn't be detected.

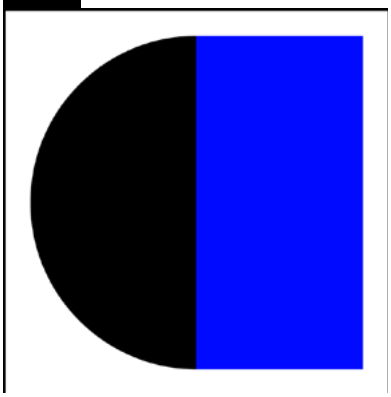
There are also limitations regarding the prototype. First, the prototype didn't have a learning capability. The travel type and modes used in the prototype were given as an example to participants. Secondly, individuals' personal disposition wasn't considered in participant recruitment or in the prototype. Thus, the experience prototype can't be evaluated with quantitative data such as scores. Lastly, the prototype lacks flexibility and configurability. Participants were only able to access limited functions. Due to these reasons, the competence of a travel buddy couldn't be measured and affected the result of the evaluation. Also, the prolonged user experience couldn't be evaluated due to the length of research sessions.

Chapter 08

Manifesto for a travel buddy

This chapter presents a manifesto for a travel buddy that is developed based on the findings I gained throughout generative research. A travel buddy is a cooperative being that actively learns from users, clarifies the needs of users by defining their travel type, and adapts itself to help users meet their goals. This guideline aims to share principles to facilitate a collaborative relationship between a travel buddy and users to decision-makers, including developers and designers who are starting their journey to find a better way to assist multimodal travelers.

1



Aim to establish a relationship that is valuable for both sides.

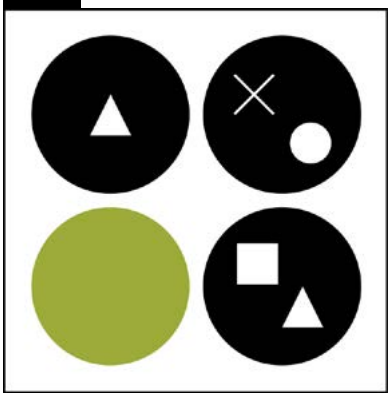
Defining a travel type can act as a tool for self-exploration and self-reflection. Addressing the factors that users take into account when planning a journey can clarify what users want but it can also be a goal addressed to users to follow. The travel buddy will change itself according to the user's need but it is likely to change the user as well ultimately.

2

Be aware of users' different personal dispositions when determining the attitude to approach users.

Some might expect the travel buddy to make decisions on their behalf, while others like to make decisions on their own by comparing options. Some decisions are triggered by emotions while others are based on efficiency and practicality. Different propensities toward decision-making and dependency on technology should be taken into account.

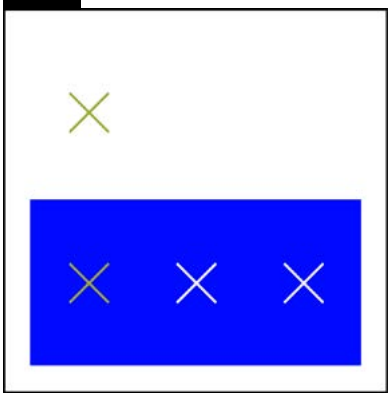
3



The different motives and contexts of each trip should be considered when giving travel guidance.

The motive of a trip, the familiarity with the destination, and the goal of a trip influence the type of assistance from a travel buddy. For a frequently recurring journey, such as a commute, checking public transportation schedules easily and quickly could be the prime goal, while being guided through a scenic route could be required from a user for recreational purposes.

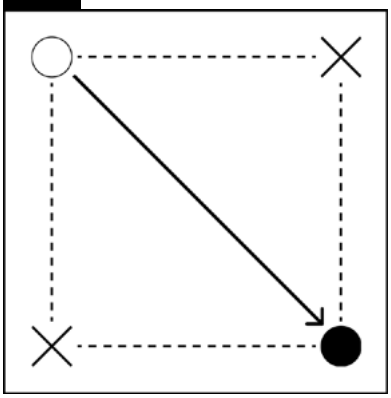
4



Show the value of collaborating with a travel buddy.

After all, traveling with a buddy is a collaborative action. It needs user participation in order to read people's underlying needs. People would only spend their time if it's worth their time. Give direct and immediate responses to make users feel that the travel buddy is adapting to their input. Show what will be different as a result of their contribution by providing examples.

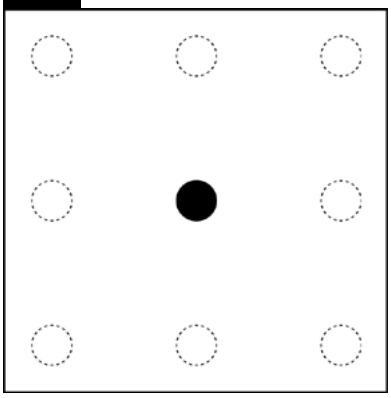
5



Use positive experiences that multimodal travelers appreciate

The most positive experience that travelers associate with multimodal journeys is exploring and discovering new places. Place and trip recommendations will be a prominent feature that users will expect from a travel buddy. Solving pain points is important, but look at the opportunity and enhance positive experiences with the travel buddy.

6



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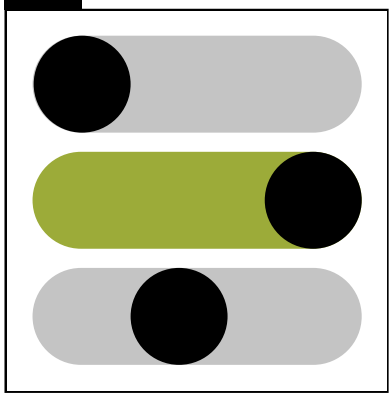
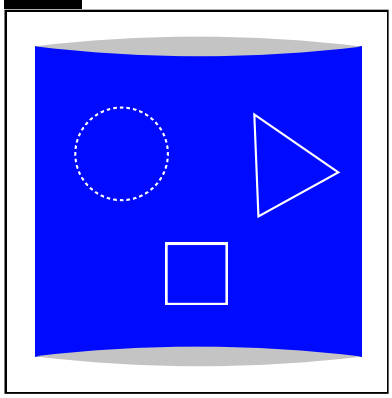


Let users be in control of their journeys

Involve users in the process so that they can feel that they are in control of the relationship with their travel buddy. Leave space for users to make their own decisions by providing travel-related information and giving access to parameters to support decision-making. Uncertainty is also what makes users insecure. Support users to react to changes and estimate time precisely.

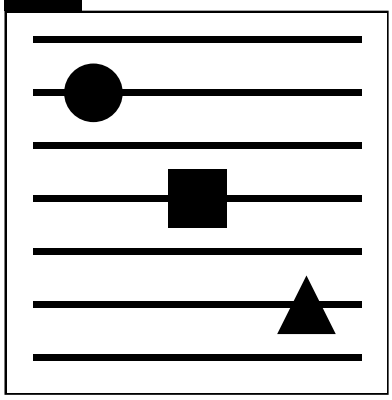
8



Would you commit to someone who is not honest?

Being transparent is two-fold. First, be transparent and ethical with data collection. Provide comprehensible information on what it does with what and why it does so using examples. Allow users to understand the mechanism behind the output. Give users access to parameters that the travel buddy uses for route optimization so that people understand the reasoning behind the decision-making of a travel buddy.

9



Use cognitive cues to linger longer in users' heads

People communicate with facial expressions and hand gestures. Objects and scents trigger memories. Visual cues can be used to process excess travel information efficiently and recall their previous trips. For example, icons and pictograms are effective tools for enhancing cognition when processing information and inviting users to participate more actively.

Chapter 09

General Discussion

Chapter overview

In this final chapter, the result of this graduation project will be addressed by answering the initial research questions. I will start by describing the characteristics of multimodal travelers, their needs, and the determinants that influence a decision. Then, the role of a travel buddy will be defined and some considerations on how to deploy this buddy to assist multimodal travelers. Project contribution in terms of the project context and approach will be discussed followed by directions for future research.

9.1 Addressing the Research Question

The aim of this project was to enhance interaction between a traveler and a travel buddy to enrich multimodal trips. Travel buddy is an ai-enabled assistant that will help out users to manage their travel and provides a seamless experience in the near future. To answer the main research question, I started by looking into the current experience of travelers to capture fundamental understandings to move forward to envisioning a future interaction with a travel buddy. In the following section, 4 research questions raised in the beginning are addressed.

1) The fundamental needs and requirements of multimodal travelers.

Multimodal travelers have a comparatively favorable attitude towards public transportation and bikes. They also consider the environmental impact of their actions. However, there are also a group of people who opt for multimodal journeys because there is no other option to choose. People choose a route by comparing options. One key determinant that influences a choice is instrumental determinant that includes time efficiency, flexibility in terms of time and place of departure, cost and et cetera. Situational factors such as hours (whether it is day or night), weather, and mood also matter to multimodal travelers. A country's mobility infrastructure should be considered as well. In the Netherlands, for example, cycling accounts for a large proportion for the first and last mile. Therefore, assisting journeys that involve active modes is required. Travelers require different types of assistance depending on the characteristics of a journey whether they have to be on time, have a concrete destination or not, a route or a destination is familiar or not, and motives of a trip.

According to multimodal travelers, the biggest obstacle to overcome for a journey assisting app to become a travel buddy is that route recommendations often don't correspond to their actual travel pattern in terms of transport modes. Moreover, situational and contextual needs are often neglected in route optimization.

2) The role of a travel buddy in the future.

Based on a conducted user research explained in chapter 3, people envision a travel buddy in the future to be aware of their preference and latent needs. They want a travel buddy to know everything about themselves and adapt the service accordingly. As the focus is shifting towards the well-being of individuals, they want a travel buddy to foster a positive experience with a multimodal journey. One major aspect that they appreciate from multimodal journeys is that it allows them to explore the known/unknown neighborhood and travel through scenic routes. Therefore, travelers want a travel buddy to act as a mediator that connects people with their surroundings.

3) The interaction with a travel buddy in the future

Users of existing journey planning apps are expecting that a barrier that hinders natural and efficient interaction to be reduced with advanced technology. They acknowledge that the fundamental operation of a human brain and AI system is different. Human beings value efficiency and productivity, however, their decisions are also influenced by their moods in contrast to machine decisions. To overcome this difference, people require human involvement, whether themselves or other people in the process of optimizing and recommending routes. Meanwhile, they envision that a travel buddy will be more capable of dealing with the affective and cognitive needs of users which means that a travel buddy will be able to change its personality based on a user's personal disposition.

As AI assistants and automation systems are processing information and managing more and more tasks on behalf of humans, researchers in the relevant academic fields (human-computer interaction, mainly) are suggesting that we have to aim for establishing a collaborative relationship that benefits both. Operation systems of intelligent agents have to be more transparent and their computational decisions should be explained so that users can restore their authority with their own decisions.

4) The performance of a travel buddy in the future

At the beginning of this project, the focus was on defining empathic and affective features for assisting multimodal travelers. However, while working on the project, it allowed me to start from scratch and rethink what a travel buddy should do for travelers. Therefore, the focus shifted towards the capability of learning users, and a prototype of a travel buddy that learns and defines travel behavior was developed. The main feature of this prototype is to analyze, present and allow users to access needs concerning the characteristics of a journey. It was appreciated that it gives users an opportunity to apply their own set of values to route optimization that has been done only in their heads. It has an implication that it will act as a tool to observe and reflect on their own travel behavior which will result in changing users as well as a travel buddy. The project concludes with a manifesto for a travel buddy to communicate findings gained throughout the research.

9.2 Project contributions

Assisting multimodal travelers with an intelligent thing

Everyone crafts their journey in their own ways. Individuals' personal disposition, way of planning and preparing for a schedule, the level of tech-savviness, preference to certain transport modes, physical and mental condition, mobility infrastructure and resources available in an area, and everything influence decision-making. In this research, I looked into the behaviour and decisions of travelers then moved forward to the product to find opportunities for product development. A user interface is a representation that contains decision-makers' strategies and reasoning to meet the goal and mediates the interaction between the product system and users. Comparing and analyzing two different approaches allowed me to realize the role of an interaction designer to mediate between technological matters, strategic decisions, and users' needs. Understanding this combination of different needs is a complex challenge especially when those change in different situations. It is difficult because it is often difficult to define latent needs in words and quantify them. However, from this research, it appears that involving users in the process has possibilities to fill this gap between what users want and what is provided to users. Transparency has always been considered important to enhance trust for users. However, at the product level, it is often neglected for the sake of usability. Usability is a key determinant for users to adopt a product, however, explaining a product's intention and computational reasoning behind the screen should be taken seriously to encourage users to be actively engaged with an intelligent agent. To build a collaborative relationship between a user and a travel buddy, we should give users an opportunity to understand a travel buddy better.

Research through design

This project involved diverse generative research activities driven by design. Design techniques such as mind mapping, experience prototype, and design intervention were used throughout the research to quest the fundamental understanding of multimodal travelers' behavior and accompanied decision making. The approach I took to answer the initial research question was to Research through Design. I aimed to gain and communicate findings rather than presenting the end product that is likely to be adopted by stakeholders in the industry. The prototype was developed with the goal to immerse users in a story that depicts interaction with a travel buddy. To demonstrate the possibility of collaborative interaction with a travel buddy to people who are involved in the mobility industry, I concluded the research with a set of considerations for use of a travel buddy as an additional transparent layer to spread upon a product vision and blueprint.

9.3 Direction for Future Research

This research aimed to rethink the relationship with a travel buddy that has an impact on multimodal travelers' behavior. Three directions for future research for whom interested in adopting a travel buddy are as follows:

1) Explore and define relevant factors and parameters that can describe and present the needs of multimodal travelers.

There are already some parameters such as "walking distance" that are quantified and presented to users to adjust. On the one hand, this can be used to define the travel behavior of users and on the other hand, it can allow users to customize a route according to their needs.

2) Explore and design user interface components that better deliver information and invite users to contribute.

A UI design system is a set of standards for design and backend system (code) along with components that unify these practices that are already being used as a language that triggers certain user behavior on a screen. As a type of information that a travel buddy tried to deliver and a way of interaction evolves into dialogue, there is a need to define a new design language to facilitate seamless communication.

3) Explore the impact of defining a travel type to change behavior.

The reason why the new generation (z) is so obsessed with defining themselves with a personality type is to understand themselves better as well as let other people understand them better. It acts as a tool to reflect or to fit oneself round a defined personality. It should be handled with caution.

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Appendices

Appendix 1

Approved Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

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

- The student defines the team, what he/she is going to do/deliver and how that will come about.
- SSC E&SA (Shared Service Center, Education & Student Affairs) reports on the student's registration and study progress.
- IDE's Board of Examiners confirms if the student is allowed to start the Graduation Project.

USE ADOBE ACROBAT READER TO OPEN, EDIT AND SAVE THIS DOCUMENT
Download again and reopen in case you tried other software, such as Preview (Mac) or a webbrowser.

STUDENT DATA & MASTER PROGRAMME
Save this form according the format "IDE Master Graduation Project Brief_familyname_firstname_studentnumber_dd-mm-yyyy".
Complete all blue parts of the form and include the approved Project Brief in your Graduation Report as Appendix 1 !

family name: Jeon
initials: Y.J given name: Yeonju
student number: 5036232
street & no.:
zipcode & city:
country:
phone:
email:

Your master programme (only select the options that apply to you):
IDE master(s): ( ) IPD (★) DfI ( ) SPD
2nd non-IDE master:
individual programme: - - (give date of approval)
honours programme: ( ) Honours Programme Master
specialisation / annotation: ( ) Medisign ( ) Tech. in Sustainable Design ( ) Entrepeneurship

SUPERVISORY TEAM **
Fill in the required data for the supervisory team members. Please check the instructions on the right !

** chair: Eui Young Kim dept. / section: MCR
** mentor: Iskander Smit dept. / section: HICD
2nd mentor:
organisation:
city: country:

comments (optional)

Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v..

Second mentor only applies in case the assignment is hosted by an external organisation.

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

Procedural Checks - IDE Master Graduation

TU Delft

APPROVAL PROJECT BRIEF
To be filled in by the chair of the supervisory team.

chair Eui Young Kim date 11 - 3 - 2021 signature

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

Master electives no. of EC accumulated in total: _____ EC

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

List of electives obtained before the third semester without approval of the BoE

YES all 1st year master courses passed

NO missing 1st year master courses are:

name date - - signature

FORMAL APPROVAL GRADUATION PROJECT
To be filled in by the Board of Examiners of IDE TU Delft. Please check the supervisory team and study the parts of the brief marked **.
Next, please assess, (dis)approve and sign this Project Brief, by using the criteria below.

- Does the project fit within the (MSc)-programme of the student (taking into account, if described, the activities done next to the obligatory MSc specific courses)?
- Is the level of the project challenging enough for a MSc IDE graduating student?
- Is the project expected to be doable within 100 working days/20 weeks ?
- Does the composition of the supervisory team comply with the regulations and fit the assignment ?

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name date - - signature

Personal Project Brief - IDE Master Graduation

TU Delft

Enhancing affective interaction with a multimodal travel companion

project title

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

start date 09 - 03 - 2021 20 - 08 - 2021 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

The Netherlands is known as one of the most bicycle-friendly countries in the world where 25% of all trips on the road are made by cycling followed by 20% by walking and 5% by public transport. In Amsterdam specifically, 38% of all journeys in the city are made by bicycle with exemplary cycling infrastructure developed[1]. The government is striving to encourage more sustainable mobility behaviour by discouraging car usage and encouraging the use of public transportation and shared micro-mobility [2].

To assist this multimodal trips, Journey planning apps are also evolving to become a travel buddy that can do beyond providing information. It's becoming an adaptive system that learns from accumulated data to provide tailord service, integrating and optimising the service to provide a seamless experience. From the interviews that I had during my research elective, it is revealed that stakeholders in this sector are trying to add the value to multimodal journey by enriching the experience on the road.

In automotive domain, on the other hand, the trend towards the usage of personal voice assistants in cars are becoming humanlike multiplayer. Multiple voice technologies are merged into one system integrating work, life, shopping, entertainment and so on. This trend is related to the need of users who prefer familiar voice assistants, like the ones they use in their homes [3]. It is being combined with different modalities to initiate the interaction and integrating user state detection to make user interfaces appear more human.

In regard to human-computer interaction, recent advances in technologies have spawned a trend to enhance interaction with empathic futures [4] considering user traits, a permanent behavioral patterns and states, a situational and/or interactional component that changes rapidly [5]. It is proven that emotion-awareness improves established features in a system from many researches [4].

Given the context, I would like to argue that affective interaction with a personal assistant will contribute to enrich the overall multimodal travel experience and ultimately make multimodal journey more acceptable and make people be more fond of their travel buddy. This thesis will explore the ideal interaction with a personal travel assistant in certain travel situations.

References:
[1] van der Waard, J., Jorritsma, P. and Immers, B., 2013. New drivers in mobility; what moves the Dutch in 2012?. Transport Reviews, 33(3), pp.343-359.
[2] "Amsterdam Fietst" (in Dutch). Archived from the original on 2007-03-06. Retrieved 2007-04-19.
[3] Future of In-Vehicle AI Powered Voice-Controlled Personal Assistant https://www.futurebridge.com/industry/perspectives-mobility/future-of-in-vehicle-ai-powered-voice-controlled-personal-assistant/
[4] Braun, M., Li, J., Weber, F., Pfleging, B., Butz, A. and Alt, F., 2020, October. What If Your Car Would Care? Exploring Use Cases For Affective Automotive User Interfaces. In 22nd International Conference on Human-Computer Interaction with Mobile Devices and Services (pp. 1-12).
[5] Braun, M. and Alt, F., 2019, May. Affective assistants: a matter of states and traits. In Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems (pp. 1-6).

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introduction (continued): space for images

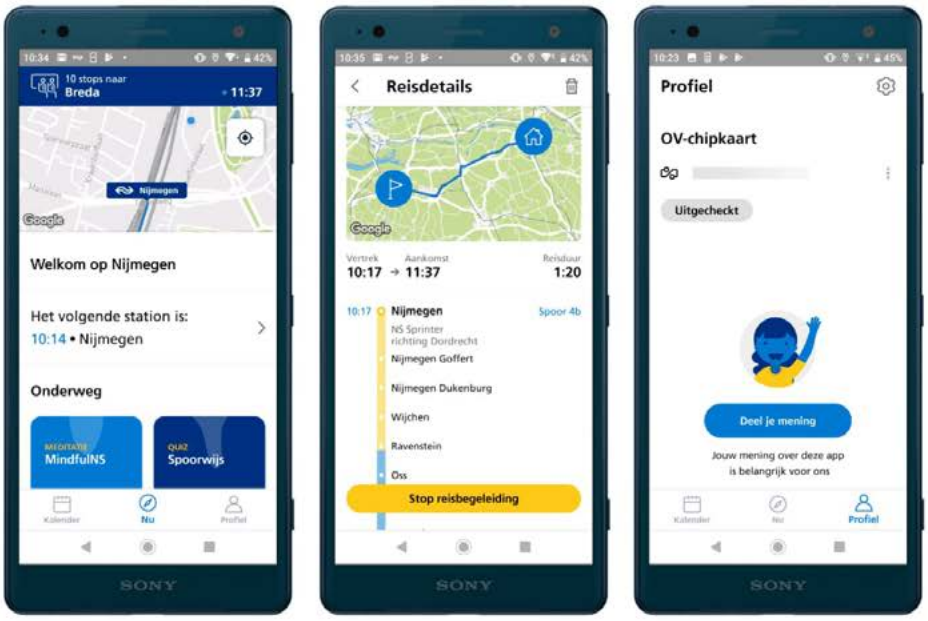


image / figure 1: Journey planning app becoming more personalised providing extra contents to satisfy travellers

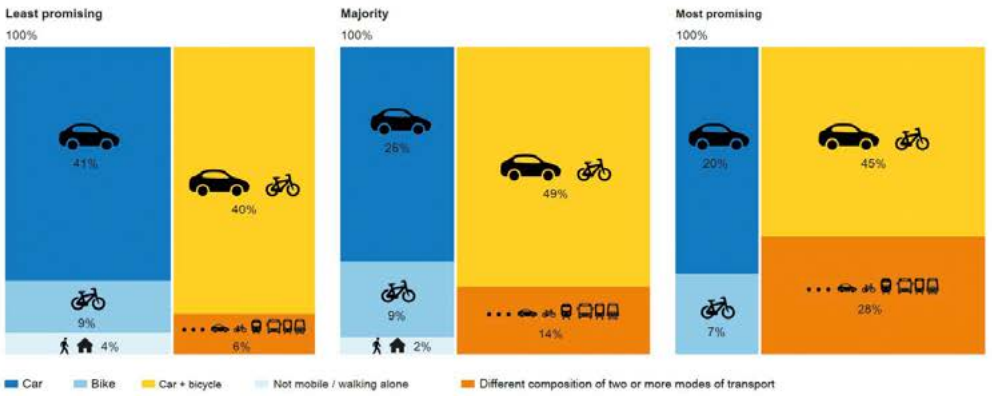


Figure 4.7 Use of modes of transport on a weekly basis by the 3 groups (N = 1,547). As the share of a category is less than 2%, it is included in 'Multimodal other'.

image / figure 2: The most promising group of MaaS use more than 2 modes in their journeys

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

The challenge of this project is to rethink the relationship between a traveller and a travel assistant for multimodal journey that will evolve in the future.

Current researches and developments of multimodal travellers assisting apps are mostly focusing on personalising the service and assisting seamless experience by deploying accumulated data and providing real-time information. However, the emotion-related interaction are not fully being discussed in multimodal mobility domain. Researchers in HCI and HRI domains are focusing on emotion because they believe that help drive behaviour and actions of people making the interaction more productive and engaging. [1].

Multimodal trips can be less engaging and less empowering compared to the ones with, for example, cars and there is an opportunity to improve multimodal travel experience by enhancing affective interaction of a travel buddy that accompanies travellers along their journeys. Travel assistants will play a more active role in this relationship determining the quality of a journey and well designed relationship between a traveller and a travel buddy can be mutually beneficial helping each other and learning from each other [2].

[1] Beale, R. and Creed, C., 2009. Affective interaction: How emotional agents affect users. International journal of human-computer studies, 67(9), pp.755-776.
[2] Breazeal, C., 2004. Social interactions in HRI: the robot view. IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews), 34(2), pp.181-186.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

This project aims to develop a provocative concept of a personal intelligent multimodal travel assistant of that the focus is on the affective interaction that will enrich the journeys . The future-oriented user scenario will be developed focusing on the context of Amsterdam and be served as a future use case.

The main research question is how affective interaction with a personal intelligent travel assistant can enrich the multimodal journey. More specific design goals will be established at the end of the research stage.

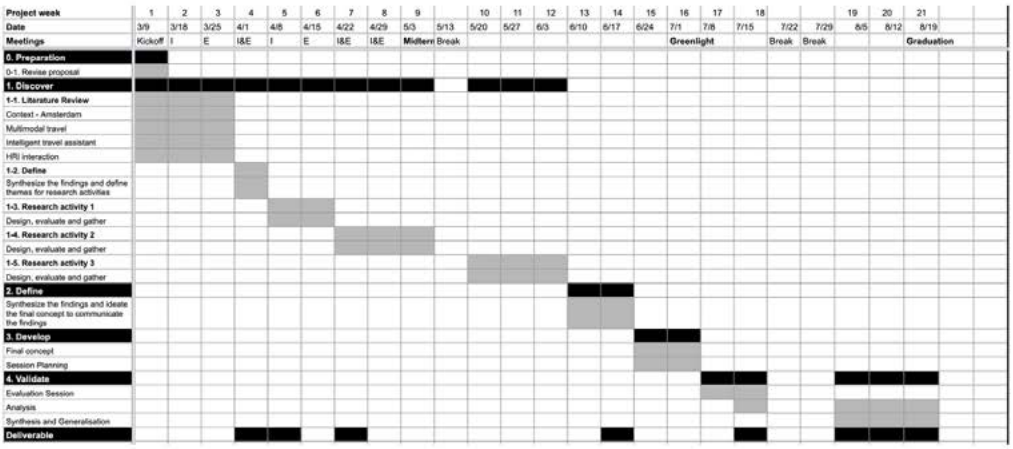
And the following sub-questions will be answered in the research stage.
(1) What are the needs and requirements for a personal travel assistant to assist multimodal travel?
(2) What type of gesture, posture, communication behaviour will be used to interact with a travel assistant supported by emerging technology?
(3) What kind of empathic features/behaviour will make a travel assistant into a travel buddy that makes a journey together?
(4) In which situation people will want this support in the future?

I will develop a prototype of a concept that has empathic features/behaviour and do user tests to define requirements for affective multimodal travel buddy and assess the impact of affective interaction.

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 9 - 3 - 2021 20 - 8 - 2021 end date



The project will be structured in 4 main cycles of project development plus one reporting period in the end to finalize the thesis' deliverables.

The first discovery phase is an iterative process that involves literature review and three research activities with a prototype. The themes and goals for each activity will defined after the literature review in a sub-define step. The overall purpose of this phase is to collect insights about affective interaction in the context. Affective interaction will be translated into certain features or behaviour of a travel assistant and used as a tool to collect insights from the users.

After research activities are conducted, final concept will be developed by incorporating all the findings from the previous phase which will be a visual representation of my findings from the process.

In the last phase, the final concept will be evaluated with experts through a evaluation session. This thesis project will be concluded with a report that contains a suggestion for future research defining the attributes of the chosen context, Amsterdam.

Personal Project Brief - IDE Master Graduation

TU Delft

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

As I studied spatial design for my bachelor back in my home country, I've always had a strong passion for spatial composition in a city that fosters interaction that a citizen has with the city. As the theme of mobility is very interconnected with the spatial element of a city and the interaction between a traveller and both the physical and digital world, this project will allow me to create a link between the knowledge I gained in my bachelor and during my MSc program.

I particularly enjoyed the Interactive Technology Design course especially using a future-oriented approach to develop an ai assistant for a vehicle that is not fully in use yet. Interacting with a digital world was very different from one with a physical world and I learned a lot during the course. And I would like to apply what I learned in my graduation project as I pursue to be a future-oriented interaction designer who is equipped with a holistic and systemic perspective.

These are my learning goals:
- To gain a deeper understanding of HCI interaction and develop insight into a plausible concept.
- To be able to evolve as a designer who can combine academic research skill with practical and creative concept developing skill.
- Communicating the insights and knowledge in a logical and convincing way.

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Appendix 2

A Speculative Story

Persona and background story

Thomas is 34. He is living in Amsterdam with his girlfriend Alicia at her place. He works flexibly switching between his home and at the office. He spends most of his time having a meeting with clients or colleagues working behind his laptop. He has been using a smart assistant for 8 years to manage his schedule and control electric appliances. Now that he is sharing space, Alicia is also added to this service.

 # The start of a day

It's 7:30 am in the morning. An alarm goes off. Thomas wakes up and says "I'm awake, Sara" to dismiss the alarm. "Good morning, Thomas and Alicia. Today is Friday, 13th of May, 2050. It's 15 degrees outside with a partly sunny sky. It will be windy in the afternoon and there is a chance of some rain. Before you start your busy day, how about a cup of coffee and nice morning music?" The kettle is on and music starts off. Thomas and Alicia crawl out of his bed and make coffee. After having a shower, Thomas sits at his desk and calls out. "Check my schedule, Sara." The screen shows his schedule. "Ok. Let's see. You have one meeting with James at 11:50 am online and the 2nd meeting with your client team at 1 pm at their Utrecht office. You have 3 new emails. Want me to read those for you?" He says "No thanks. I'll do some work here before I leave for the 1 pm meeting. Enable notification business email only until 11 am. " He reads his email on his laptop and sends some files on request.

 # Journey planning

"Thomas, it's 11 am. I think you should get going soon." "Oh yeah, I lost track of time. Plan my trip to the Utrecht office." Without hesitation, Sara lists the options Thomas would prefer. "Your neighbor Smit is looking for 2 more people for ridesharing to Utrecht at 12 pm. Then it will take 28 minutes by car and you can book an e-bike to get to the office." "Hmm. Could you send me options on my phone?" "Sure." The screen on his phone shows various options he can choose with combinations of different modes.

Option 1: Ridesharing with Smit 28min + e-bike 5min. 33min. 5 euro. Co2 0.4kg.

Option 2: Cycle + train + bus. 52min. 13 euro. Co2 0.3kg.

Option 3: Walk + metro + train 28min + e-bike 5min . 40min. 9 euro. Co2 n/a

Option3: Car. 38min. 18 euro. 1.2kg.

And so on...

"Sara, I'll ride share. Then I can leave after the meeting with James." "Alright. Perfect. I'll book an e-bike at the nearest transit hub. How about the return trip? Congestion charges will be applied on the way back home so I would suggest taking a train." "Okay. I can cycle back with my e-bike back to the station. Could you book a bike from the Amsterdam station?" "Alright. Payment has been completed."

#Before leaving

Right after the meeting with James, Sara informs him that he should be ready soon. “Thomas, Smit is on his way. You should leave in 3 minutes.” While Thomas is in a hurry, Alicia stops him. “Thomas, can you pick up groceries when you come back?” “Sure honey. Just put what you need in our shopping list and let me know.” He plugs his earbuds in and walks out the door.

 # On the way to the station

He walks to the spot where he will meet Smit looking at his phone. He sees Smit’s car and waves his hand. When he gets in the car, Smit’s personal assistant Ray welcomes him. “Hey, what’s up Thomas?” Thomas also sees three other people including Smit in the car and talks with them. He turns his earbuds into transparency mode.

On the other hand, Alicia is filling a grocery list looking inside a refrigerator. “Sara, we’re out of milk. Could you add that in the list?” “It’s already in! You guys always finish milk in a week. What is your plan for dinner?” Sara asks. “I haven’t decided yet. But I have beef, tomatoes, butter and stuff.” “What about trying this? I’ll send it to your phone.” Alicia checks the recipe on her phone. “Looks nice.” “Cool. Then I’ll put things you need in the list and complete the shopping.”

Back in the car, Thomas receives a notification from Sara. “Alicia sent a grocery list.” Thomas skims what’s in there and a bottle of wine and some snacks and proceeds to pay.

 # On the way to the office

Thomas goes to the pick-up station and stands in front of a Kiosk machine. There a lot of different vehicles are waiting for someone to ride on. There are several pick-up points throughout the cities. As he checks in with his phone, the system asks if it can access his earbuds and provides navigational assistance. He confirms. “Welcome, Thomas. My name is NexS.” A different voice coming from his earbuds. He sees a light blinking on one bike and he unlocks a bike with his smartwatch. He takes his smart glasses and rides on a bike. “How are you feeling today?” “Umm. Good. Thanks.” ‘I haven’t gotten used to a robot asking about my feelings. It’s still weird.’ “Is your first time cycling in this area, isn’t it?” “I’ve been here a couple of times before but I’m not familiar with this neighborhood yet.” “Alright. You have to cross here to cycle on a bike lane.” His smart glasses show the way. A few minutes later, he asks. “Hey NexS, should I keep going straight or turn right soon?” “You can turn right. It’s 1 minute faster.” However, after turning right and cycling for a few minutes, he sees construction going on. ‘Jesus. I should have just listened to my gut feeling.’ Then the alarm beeps. “Thomas, you’re not going in the right direction. What is the problem?” “There is a construction going on.” “Ok. I’ll update the information. Thank you.” Another voice intervenes. “Thomas, your meeting will start in 10 minutes. You are 5 minutes away from the location.” He feels a bit exhausted by non-stop conversation and changes the assistance mode to information-only mode.

 # After the meeting

The meeting was successful. He got a new contract and scheduled a meeting with a Belgium branch in two weeks. He notices that his phone is almost dead. “Umm. Can I charge my phone here before I leave?” “Sure.” While he was waiting, he got a notification on his smartwatch that the train he registered to take will be crowded. ‘I guess everyone is going to take a train to avoid congestion charges.’ And then a message comes from Alicia. [Hey, I saw that your meeting is over from the calendar app. How did it go?] They share a couple of messages.

He plugs his earbuds and seats on a bike. “Changing to transparent mode while you are cycling.” “Are you ready to go? I have a podcast recommendation,” says NexS. Thomas turns off navigation mode and listens to music. He returns his bike at the Utrecht station and holds his smartphone against the reader to enter the gate. A notification pops up: Welcome, you checked in at Utrecht station. Go to platform 8.” The train was busy as he expected.

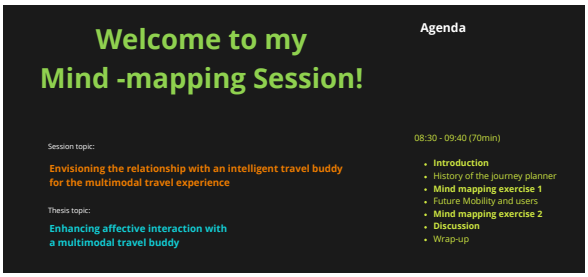
 # Back in Amsterdam

As he checks out, a notification message pops up. Today, you traveled 90km with sustainable transports. You earned 90 credits. Allow us to access your contacts to check how many credits your friends have earned today. He dismisses the message. He goes to the pick-up station and uses his smartwatch to unlock a bike he reserved. “beep”. ‘I like that this bike is not that talkative.’ He goes to the nearest Albert Heijn from his house. At the entrance, he scans his phone to collect the groceries he purchased. Next to the pick-up point, he sees a shelf for pre-ordered collectors. The products change every day and today he sees some sweets. ‘I need some sugar.’ He impulsively picks up a box of chocolate and pays. After collecting groceries, he returns the bike at a nearby metro station at his house. “be-beep.”

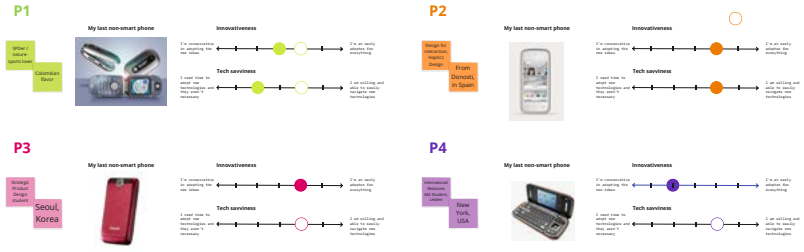
 # Saturday Morning

Another day has dawned. The alarm rings. He snoozes the alarm several times. At the fifth time, they decide to wake up. “Good morning, Thomas and Alicia. The weather is perfect today. What are you planning for today?” “Honey, do you want to go somewhere?” Thomas asks Alicia. “Of course. I don’t want to miss the perfect weather.” “Hey Sara, could you recommend some places to go today?” “Sure. It’s the opening day of the Sanne Sannes exhibition in Amsterdam. You visited another exhibition of him 3 months ago.” “What do you think, Alicia?” “Actually I want to go somewhere outside of Amsterdam.” “That’s a good idea. Sara, recommend us someplace to go outside Amsterdam”. ‘’Based on your current search history, I would suggest visiting Friesland. You can book a private guide to know more about the region.” “Alright. That sounds perfect.”

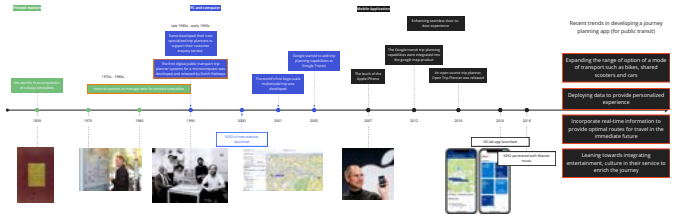
Mind Map Session Facilitation Material



1 Session Briefing



2 Icebreaking activity



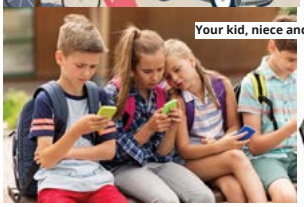
3 History of journey planner

4 Mind Map: Current Interaction

How will we move from place to place on a daily basis?

Future mobility will be:

- **Smart**
- **Sustainable**
- **Autonomous**



Your kid, niece and nephew

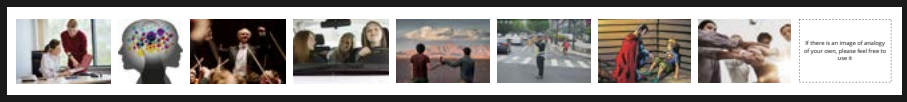
5 Future context

What the relationship with an intelligent travel companion will be like?

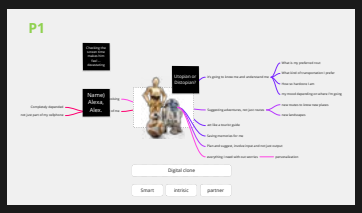
Jot down anything that pops in your head
There is no right or wrong
Anything is possible
Use your creativity!

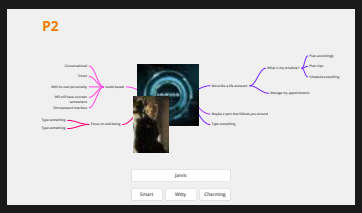
Place this robot on your sheet when you're done mind-mapping

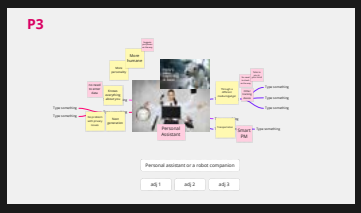
What is missing in your current journey?
How would next-generation perceive technologies?
In which situation will you use it?
What role will it have?
What new mode of transport will appear?
What new technology will emerge?
How the way we communicate with AI will evolve?
What kind of equipment will be required?



If there is an image of analogy of your own, please feel free to use it







6 Mind Map: Future Interaction

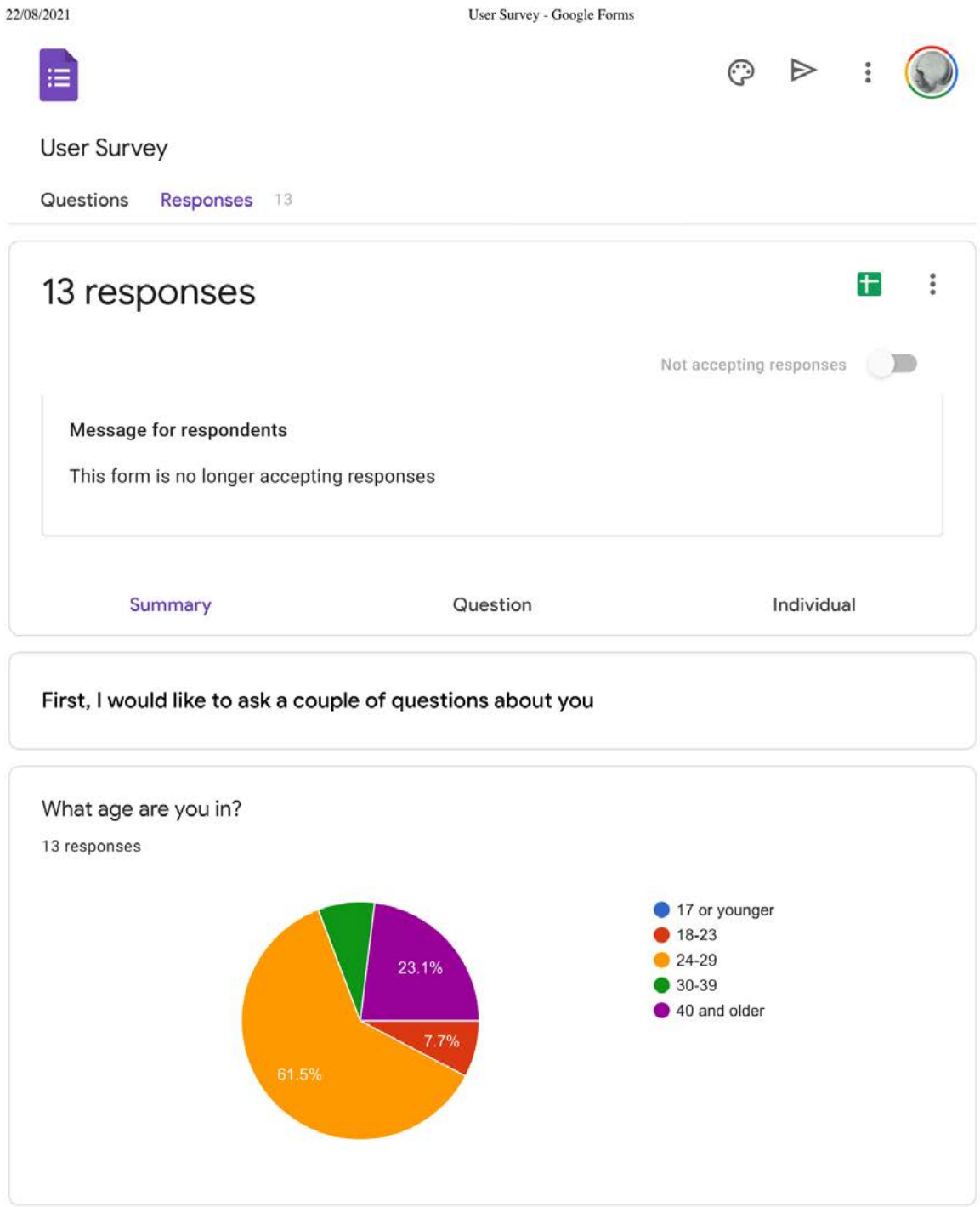
7 Discussion

What potential challenges do you see?

What opportunities do you see?

Appendix 4

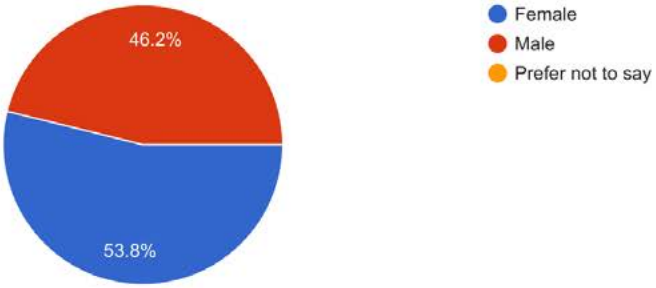
Result: Initial Concept Evaluation



https://docs.google.com/forms/d/1UPn5f_Zpv4pSV3FfeXPuJIfna8iucFEzCX3kR3Tgq_Q/edit#responses 1/9

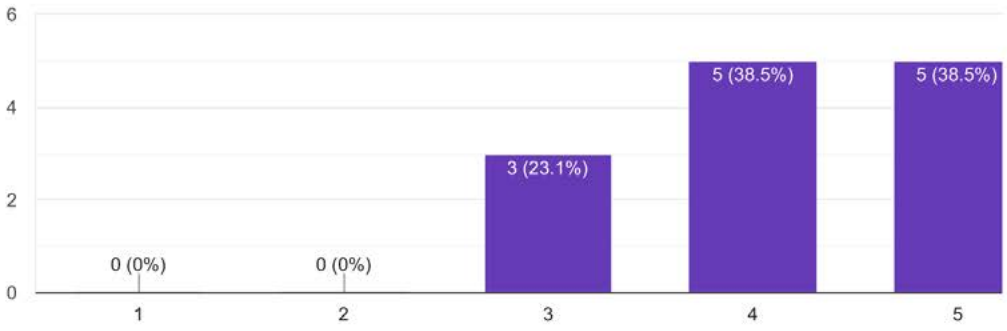
What is your gender?

13 responses



How multimodal are you?

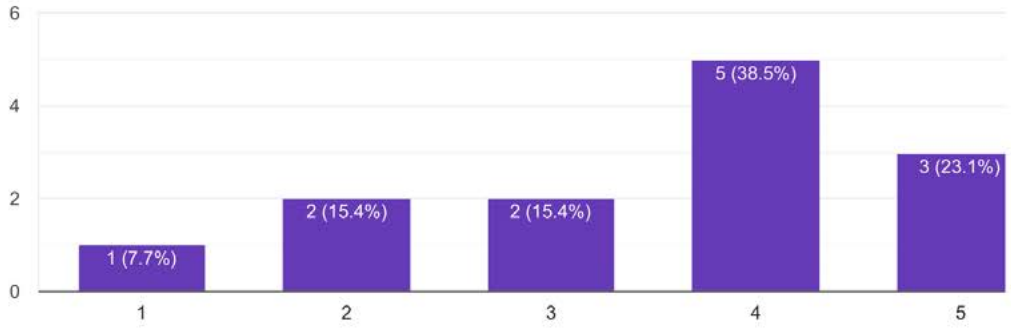
13 responses



Next, please answer the following questions about how you make your decisions.

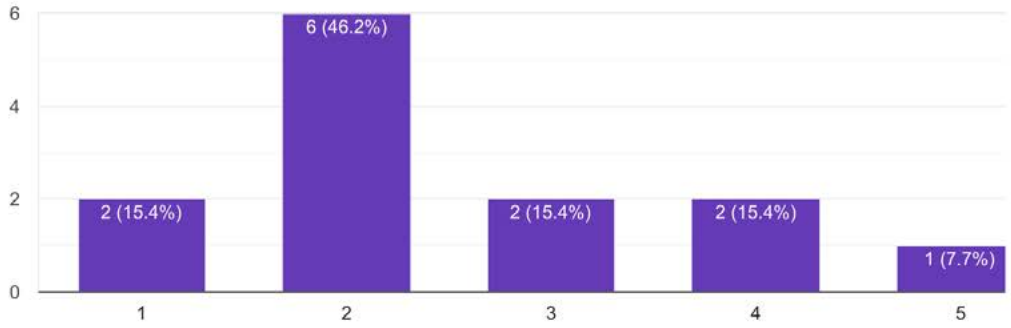
Do you easily get influenced by others opinion and reviews when you make a decision?

13 responses



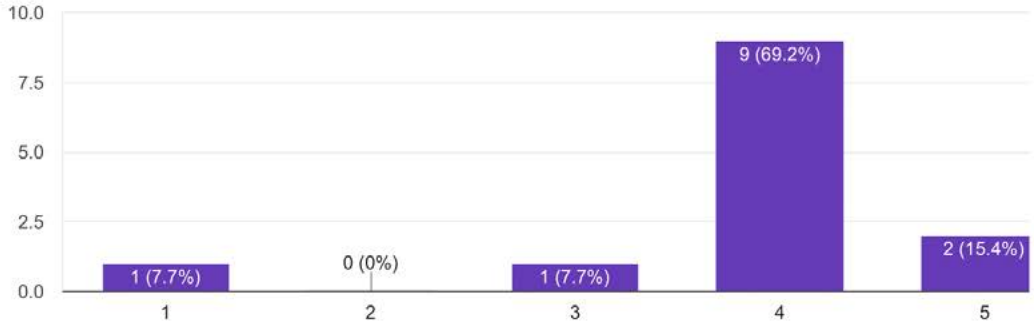
Are you an emotional and intuitive decision maker rather than a rational and calculative one?

13 responses



Do you want an assistant that gives you detailed information than an automated suggestion when you make a decision?

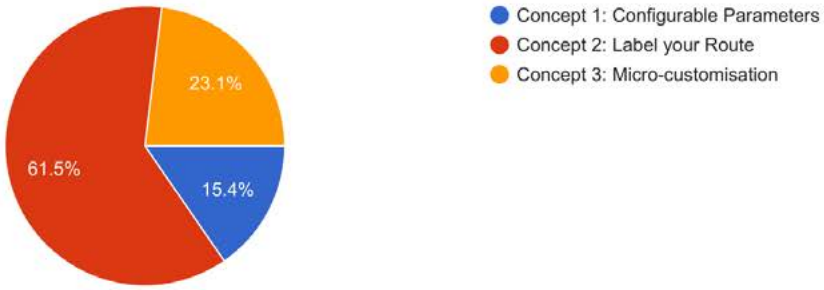
13 responses



Now we'd like to get your opinion on what would you like to see on an app

Which concept do you prefer the most at first look?

13 responses



Why did you choose that concept? Which part did you like it and what extra value do you see from that concept?

13 responses

Because I can't really think of the trip that I had to micromanage my trip. For me sometimes it's better to get lost to have a variety of experiences - so just handful of the 'accurate' and 'core' information would be enough.

To be honest it was difficult to understand the difference between 1 and 3. I think in number 1 I can only control the full trip and not the different parts. On the basis of that, I chose number 3. However, I do have to say that it depends for me on what kind of trip I'm making. For a trip across Europe I like to be able to customize on micro-level. If I travel across the Netherlands, then I'm fine with less control. Number 2 I do not like, because for me it's never only about one thing, e.g. only price. I want a combi of reasonable price, convenient timings and green.

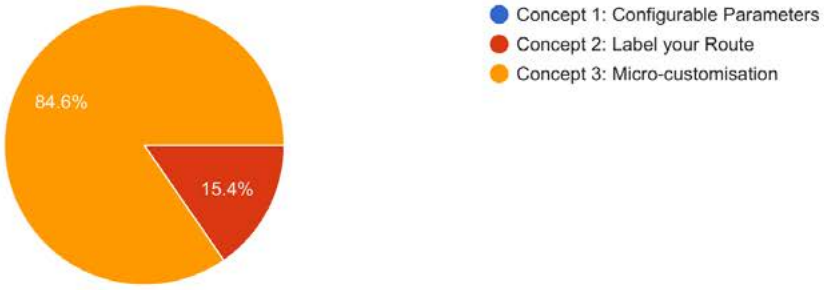
Although I know the recommendation is great, I would like to have more control.

When I'm trying to find a route, I am usually on a hurry. I just want my jobs to be done, I won't have time to adjust small details for my route.

I want to have various options for my journey, but too much configuration for one journey seems like too much hassle, and think that should be figured out from the app's side as that's the reason why I use the travel app. I like the option 2 since it already suggests pre-calculated routes and let me pick

Which concept gives you autonomy and makes you to be in control of your choice the most?

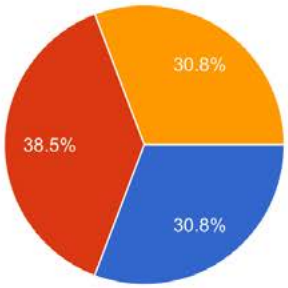
13 responses



Participant	Preference	Why did you choose that concept? Which part did you like it and what extra v	Autonomy	Congruence	Convenience
1	2	I think it seems fun, and the other ones are a little more difficult to grasp. The parameters and detail could be confusing.	3	1	2
2	1	Because I can't really think of the trip that I had to micromanage my trip. For me sometimes it's better to get lost to have a variety of experiences - so just handful of the 'accurate' and 'core' information would be enough.	3	1	1
3	2	seems like the easiest and has everything I would need, last mile first mile and other details are not really crucial. I like that with one word I can see what I look for: fastest, easiest, greenest etc. so I can just choose and go :D	3	2	2
4	2	it looks easiest to use. tbh, i don't like make a very complex plan for trips.	2	3	2
5	2	Since I prefer to choose the destination I've never been before, concept 2 will be very helpful for me to comprehensive the outline of the destination	2	2	2
6	2	I want to have various options for my journey, but too much configuration for one journey seems like too much hassle, and think that should be figured out from the app's side as that's the reason why I use the travel app. I like the option 2 since it already suggests pre-calculated routes and let me pick among them, then make me adjust the options afterwards.	3	2	2
7	2	I thought it could be tiring to adjust the detailed figures during the journey, whereas I expected the label one provided intuitive sense of what it is.	3	2	2
8	2	I like the idea that not all travel has the same goal and character. I liked by the way the distinction between parts of the routes of concept 3 but it is a bit too complex maybe.	3	1	2
9	3	Although I know the recommendation is great, I would like to have more control.	3	3	2
10	1	When I'm trying to find a route, I am usually on a hurry. I just want my jobs to be done, I won't have time to adjust small details for my route.	3	1	1
11	3	To be honest it was difficult to understand the difference between 1 and 3. I think in number 1 I can only control the full trip and not the different parts. On the basis of that, I chose number 3. However, I do have to say that it depends for me on what kind of trip I'm making. For a trip across Europe I like to be able to customize on micro-level. If I travel across the Netherlands, then I'm fine with less control. Number 2 I do not like, because for me it's never only about one thing, e.g. only price. I want a combi of reasonable price, convenient timings and green.	3	3	2
12	2	these labels kind of correspond with how I choose / plan in real life (without an app)	3	2	1

Which concept is consistent with your travel behaviour the most?

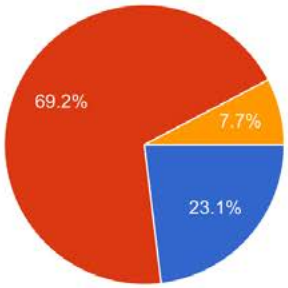
13 responses



Concept 1: Configurable Parameters
Concept 2: Label your Route
Concept 3: Micro-customisation

Which concept seems to be most convenient to use?

13 responses

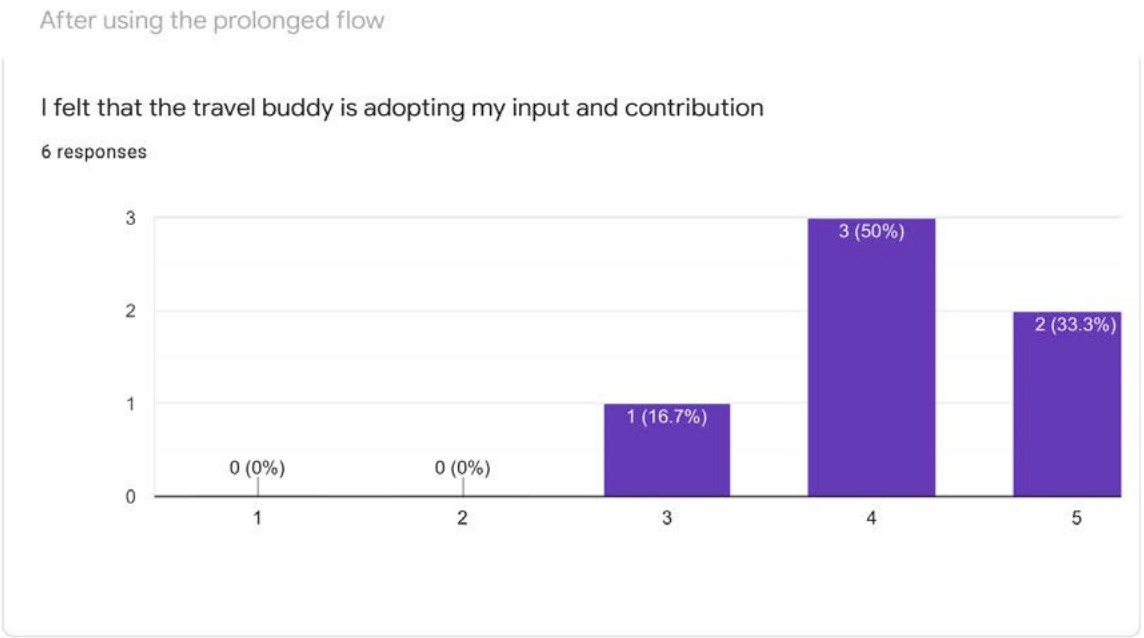


Concept 1: Configurable Parameters
Concept 2: Label your Route
Concept 3: Micro-customisation

Great. Let's move on to the next section.

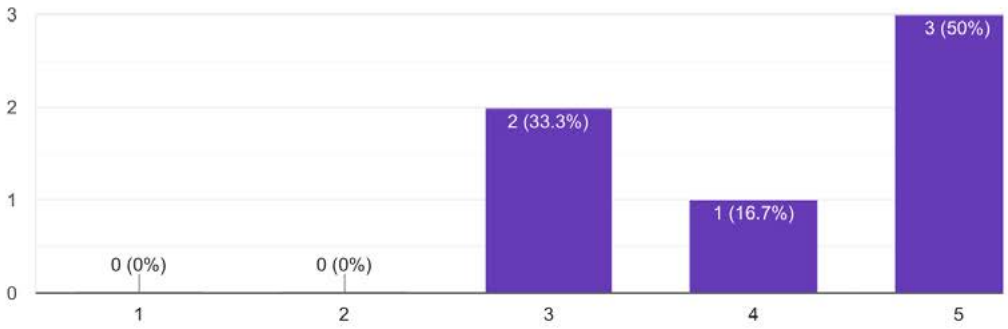
Appendix 5

Result: Final Evaluation with an Experience Prototype



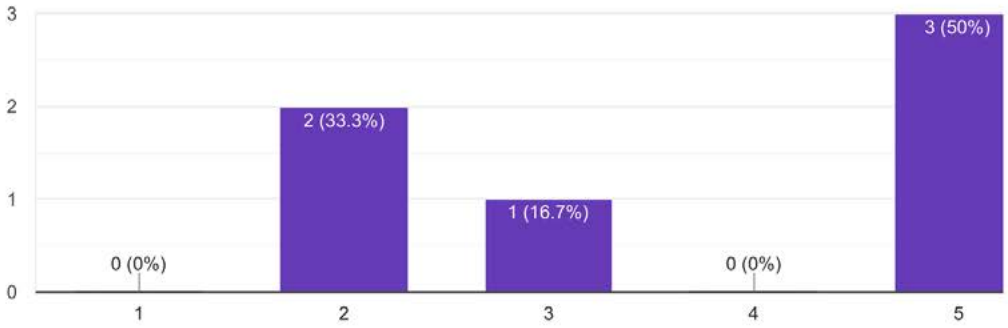
I felt that my travel buddy and I were collaborating to achieve the same goal

6 responses



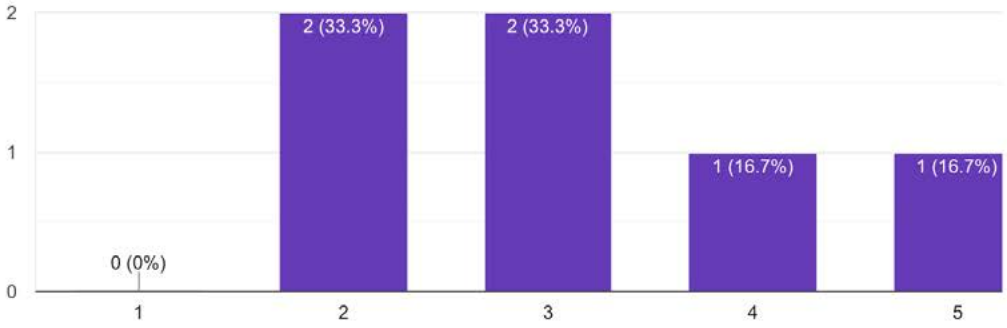
I think sharing my personal information to the travel buddy will bring additional value

6 responses



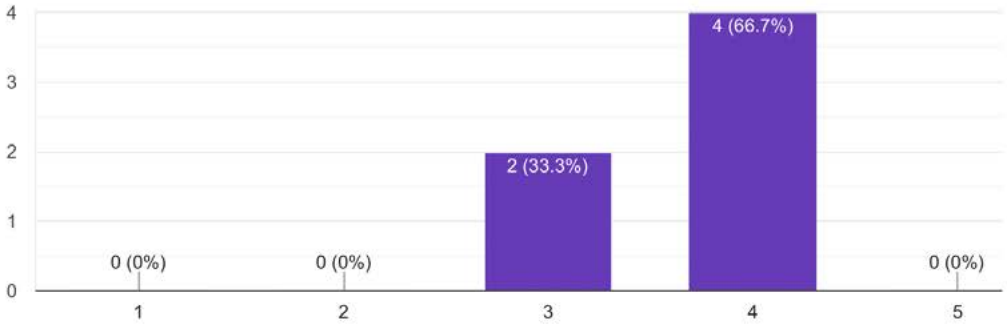
The travel buddy provided me sufficient information to understand the intention of a travel buddy and underlying computational reasoning

6 responses



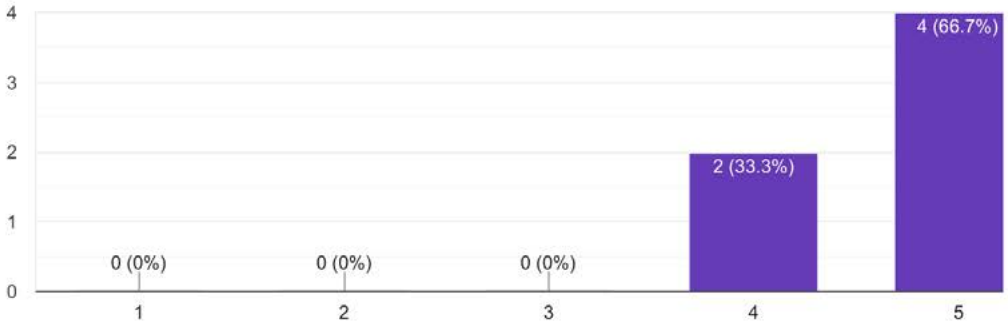
I could intuitively understand how the travel buddy will optimise and customise journeys by reading the names of travel modes (e.g., spontaneous-efficiency-seeker..)

6 responses



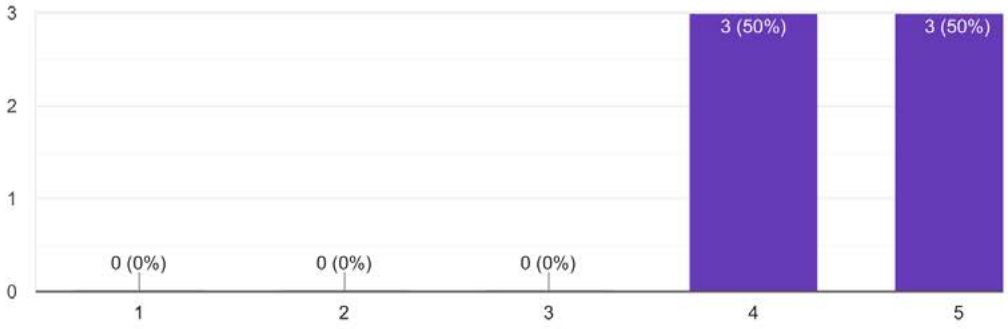
I had a flexibility to customise a journey to correspond to my ever-changing, situational needs

6 responses



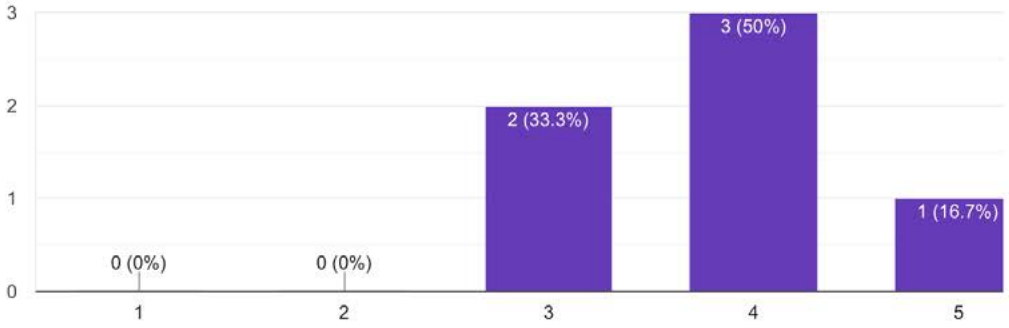
I think the design helped to understand the process

6 responses



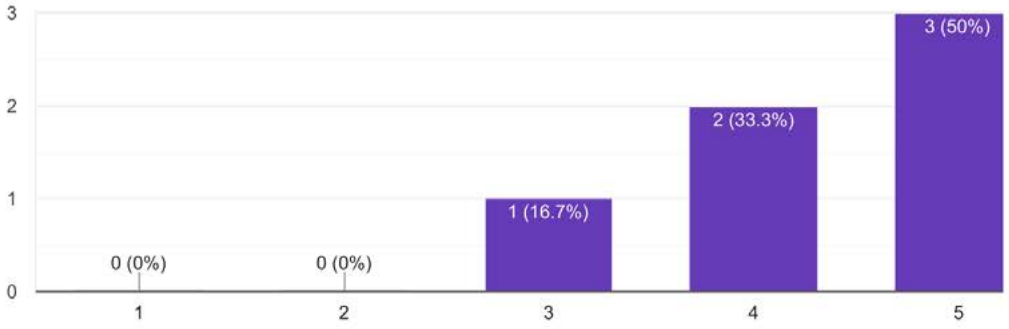
I felt the guidance and information of a travel buddy corresponds to my travel behaviour and needs.

6 responses



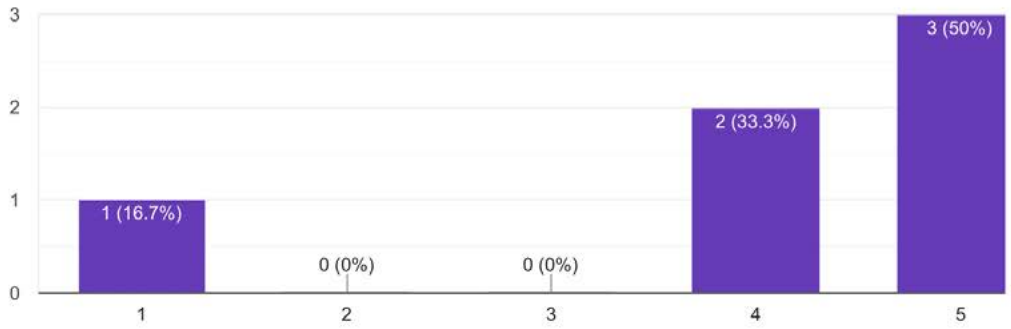
The interaction with the travel buddy motivated me to engage with it for the long term

6 responses



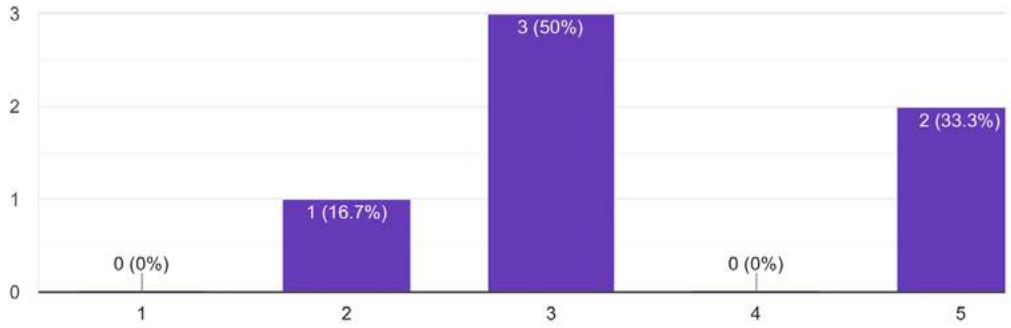
I felt emotional benefit while interacting with a travel buddy

6 responses



I feel that this buddy will bring adventures to my life

6 responses



Prolonged user experience

Building a collaborative relationship with a travel buddy for multimodal journey planning