Using data collected by wearables to improve the efficiency of the routine use of family cars

By Charles Elson

Master graduation thesis

By Charles Elson
Graduate student - MSc Design for Interaction

25th August 2022

Delft University of Technology,
Faculty of Industrial Design Engineering
Landbergstraat 15, 2628 CE Delft, The Netherlands
+31 (0)15 27 89 807

Milene Gonçalves | Chair
Fernando Del Caro Secomandi | Mentor

Ford Research and Innovation Center
Süsterfeldstraße 200, 52072 Aachen, Cuitsland
+49 241 94210

Nicole Eikelenberg | Company supervisor
Alexandra Holz | Company supervisor

PREFACE

First and foremost, thank you very much for being here and taking your time to read this. This has been 6 months of very hard work and essentially a culmination of the last 2 years of my life. I will use this space to express my gratitude towards everyone who has helped me throughout, and really made me feel at home during my time in the Netherlands.

As this project comes to a close, I am not only grateful to everyone who has been involved in this project this past semester, but also the three before that and making my time at TU Delft enjoyable and memorable. This project has really been the perfect way to conclude my study life, not necessarily due to the direction I am about to head in in my professional career, but rather the way it made me step out of my comfort zone and look at design. And because of that, I feel I have developed as a person.

I am generally not so good with things like this and although this may not be the best time to learn, I will try my best. I firstly want to say thank you to everyone who has been involved in this project one way or another. Whether that be weekly meetings with Nicole and Alexandra discussing all things data whilst I wrap my head around trying to link everything together, or just sat at the white tables of the Industrial Design faculty talking to anyone who is anyone about something related to graduation life.

I would like to initially thank my supervisory team of Milene and Fernando for really being available for me throughout the project, as well as reminding me that they are there when I'm in a world of my own. Without your direct feedback and open doors, the project would not be where it is today.

I would like to thank the Ford company supervisors, Nicole and Alexandra, for being so present throughout the project. From our weekly meetings, to putting me in touch with experts and creating a community amongst the students, you both provided a very motivating and welcoming environment.

I would like to thank all my friends who joined me at the white tables every now and then, either for a talk, user test or purely to say hi and bye. Being able to socialise with people is a real treat, now that it is allowed again.

I would like to thank Nika who has been my sponge of problems and stress and rants for the past months and for some reason, is still yet to complain. I look forward to hearing a bit more about what you have done the past 6 months once this project is finished.

Finally, I would like to thank everyone else who I have missed who has been involved in this project one way or another; whether that be through a user test, borrowing your car (both toy and real), or joining me at the Coffee Star at 11am every morning. Thank you all.

I suppose now all that is left is…happy readings!

ABSTRACT

The experience of using a car can be defined as a lot of things. How comfortable it is to drive in? Or just sit in? What entertainment features does the car have that can keep all passengers entertained for a car journey? Or even for the more extreme motor heads, how does the engine sound when going through a tunnel? All of these factors shape how a driver and the passengers would experience a car. However, when you take a step back, there is so much more to it. This project will be looking into the experience away from driving; the non-driving experience.

As part of a University Research Project set up between the Industrial Design Faculty at Technology University of Delft, and Ford Research and Innovation Center, this project will be going into detail about how data can be collected from wearables in order to enhance and improve the user's non-driving experience of cars. More specifically, how can the approach and leave scenarios of using a car be improved through this use of data.

The initial stages of the project were focussed on understanding where the problem lies. What context is best suited and has clear pain points, or potential moments of surprise and delight, to the problem? This was done through a number of research tasks including literature research, interviews, and workshops with a large variety of potential users.

The context of using your wearables to improve the routine of family cars was chosen to go into further detail and exploration. Families often have different routines that happen simultaneously at times, and it was interesting how a family car can be so flexible in adjusting to each members routine. Data was looked at throughout this project in order to get an understanding as to how it can be used in a way to create a relationship between car and driver.

Throughout the development phase of the project, 'Ford Experience' came to fruition, which did exactly that. It used data from the wearables of both the main driver, as well as family members and other passengers, in order to adapt and respond to a number of different inputs from individuals. Throughout this day-to-day use, the vehicle works with the user in order to provide the best possible, and most efficient experience possible.

CONTENTS

1.0 INTRODUCTION

This chapter will be an introduction to this project. It includes the background as to why this project exists and what the problem is that is going to be looked into throughout this report and beyond. It will introduce the problem as a whole, the research question that will be answered, the main stakeholders included in this university research project (URP) and finally the design process that will be adopted for the duration of graduation.

1.1 PROJECT INTRODUCTION

As smart cars are getting smarter, companies are constantly looking at ways to not only improve the functionality of the car but also the user's comfort and experience of driving the car itself. Automotive companies are looking for innovative ways in order to make that next step in regards to connecting the user to the car and it becomes an extension of oneself. Not only are they looking into this problem whilst the user is in the car, but also before and after their journey.

One of the steps currently taken is using data as an input. Car manufacturers have been using big data for a number of years in order to meet changing customer preferences and needs (Hastings, 2022). This data can be accumulated from a number of sources; the car, its driver, the surroundings and other special devices, making the cars safer and enriching the driver's experience (Cprime Studios, 2021). However, what other forms of data are there? Ford sees an opportunity for data from the driver to play a big part in improving the experience and making it more personal. This personal data can be collected by wearables. When using this data to improve the driver's experience, extensive research and development have gone into making the user's 'in-car' experience more fruitful. Auto-pilot, changing lanes, and automatic seat adjustment are some examples of how data extracted from the car is used to improve the driver's experience. However, there is a lack of research into the experience away from driving. How can this be improved with the data available from a more personal source such as wearables? (see figure 1)

There has been extensive research into the driving experience of cars and the user's perception of developments such as autonomous driving (Linehan et al., 2019), as well as what the next steps are for improving the experience of driving (Busch, 2020). However, throughout this previous research, there is little to

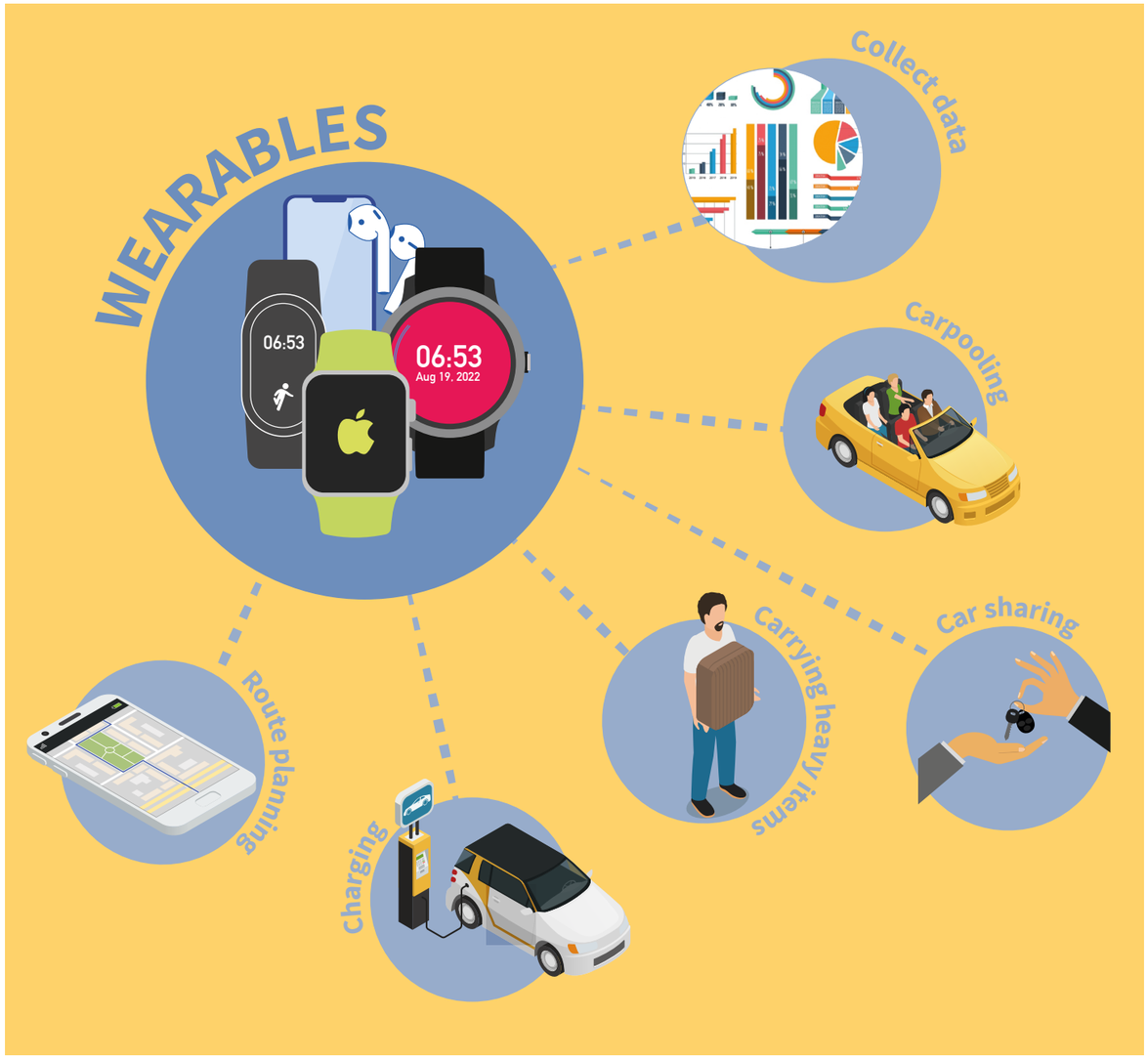


Figure 1: What are the potential use cases that wearables can be used for to improve the experience?

suggest that companies are looking into the non-driving as the next step in improving the user experience (UX) of the overall driving experience. This is an area that could provide value to Ford and their development of vehicles in the future. With the work that they are doing with data enabled design (DED), there is potential focus more on the UX of their vehicles, outside of the vehicles to get a step ahead of the competition.

The non-driving experience is an extremely broad subject and can differ from person to person in several different scenarios. Someone using their car to go shopping would encounter endlessly different experiences and interactions as compared to a delivery driver. Through interviews, observations and workshops (discussed throughout section 3.0), the goal is to find a solution in a context and user group that is of high value to Ford and has the potential for an innovative solution.

In previous Ford University Research Projects (URP), there has been research into how data can be used within the internal design process to enhance the creative process. Mellado Cruz (2021) and Spalburg (2021) both research how this can be done through their method of Explorative Inquiry and concrete toolkit respectively. They see data as an important driving factor behind the next step of development within their cars and improving the driver's experience in a unique sense. Van Wijnden (2021) took the first steps into this development within Ford with her research into a data-driven in-vehicle system. More specifically, using data to make Battery Electric Vehicle (BEV) trips more efficient. However, what Ford is looking at is the broader approach of a user's experience and that of the experience away from driving, namely the non-driving experience. This can be described as anything that is not physically driving the car itself. This project will be focused on the experiences of the approach and leave scenarios surrounding the use of a vehicle.

As part of the ongoing URP with Ford, this project will be focused on the use of data-enabled design and how it can be applied to improve the driver's non-driving experience of their vehicles. It will focus on the specific use case of family cars and the routine that surrounds them, as well as using data collected from wearables, namely smart watches, to improve and develop these experiences uniquely. It proceeds the research project carried out by Ford on how to use data to inspire and inform the whole creative process. This URP is in collaboration with the Ford Research and Innovation team that will be explained further on page X (section 1.4 - Stakeholder Analysis).

1.2 PROJECT GOAL

The main goal of this project is to investigate the journey that a driver has ***away*** from the car. Ford is interested in looking at the approach and leaving scenarios of the vehicle as based on previous research internally in Ford. They see this is an interesting moment in the use of a car where the experience can really be improved and therefore this will be an aspect that is looked into throughout this project. The aim is to pinpoint a specific scenario, or scenarios, within this non-driving journey to be improved (figure 2). Besides creating a solution for pain points, it could also be a surprise and delight moment that is created in the use of a car via the use of data that is collected from the driver by wearables.

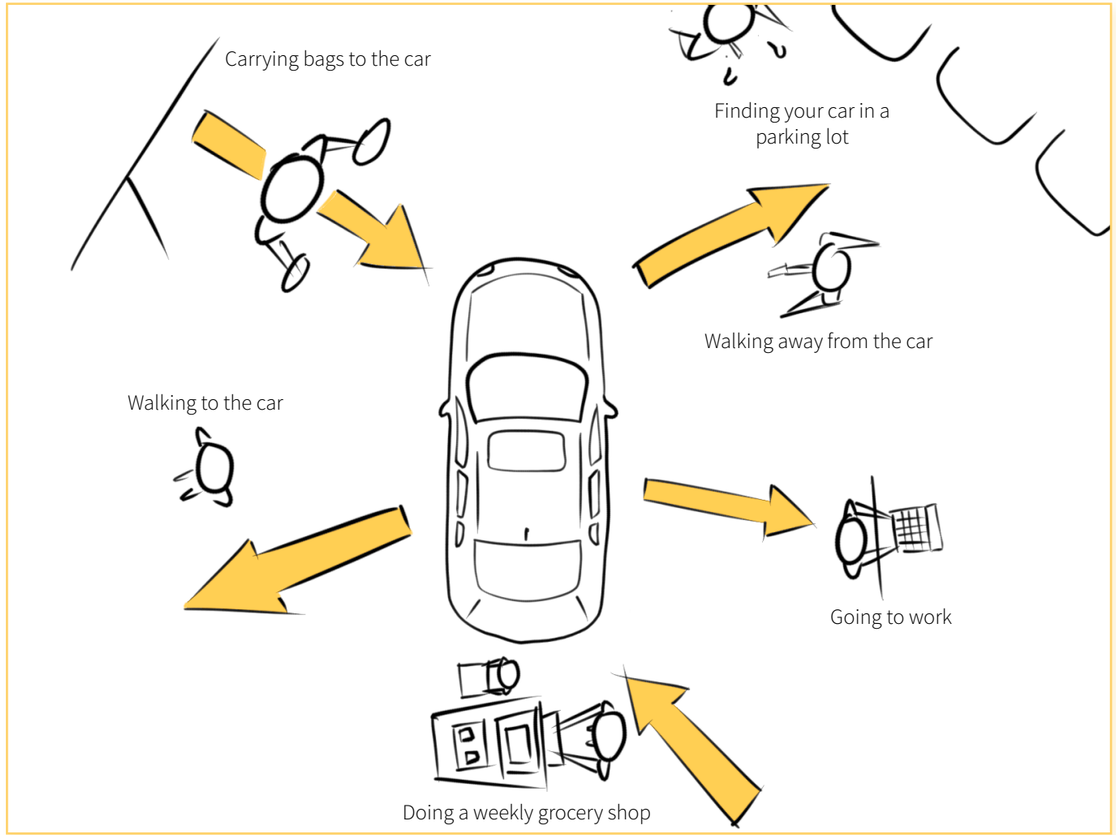


Figure 2: The approach and leaving scenarios from a vehicle

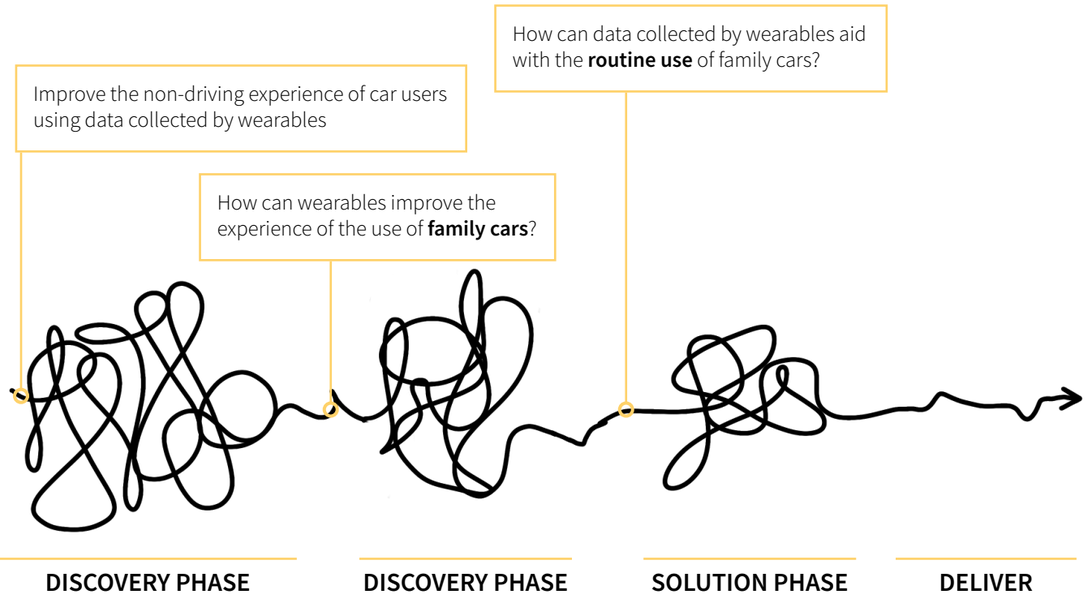


Figure 3: The development of the research focus throughout the project

1.3 RESEARCH QUESTION

The initial research question that was used as a starting point of this project was defined as:

> *How can the non-driving experience be improved or an experience created using data collected by wearables?**

*The research question changed several times throughout this project. The focus became more and more refined throughout both the research and solution phase (figure 3) and will also be described later on in the project.

1.4 STAKEHOLDER ANALYSIS

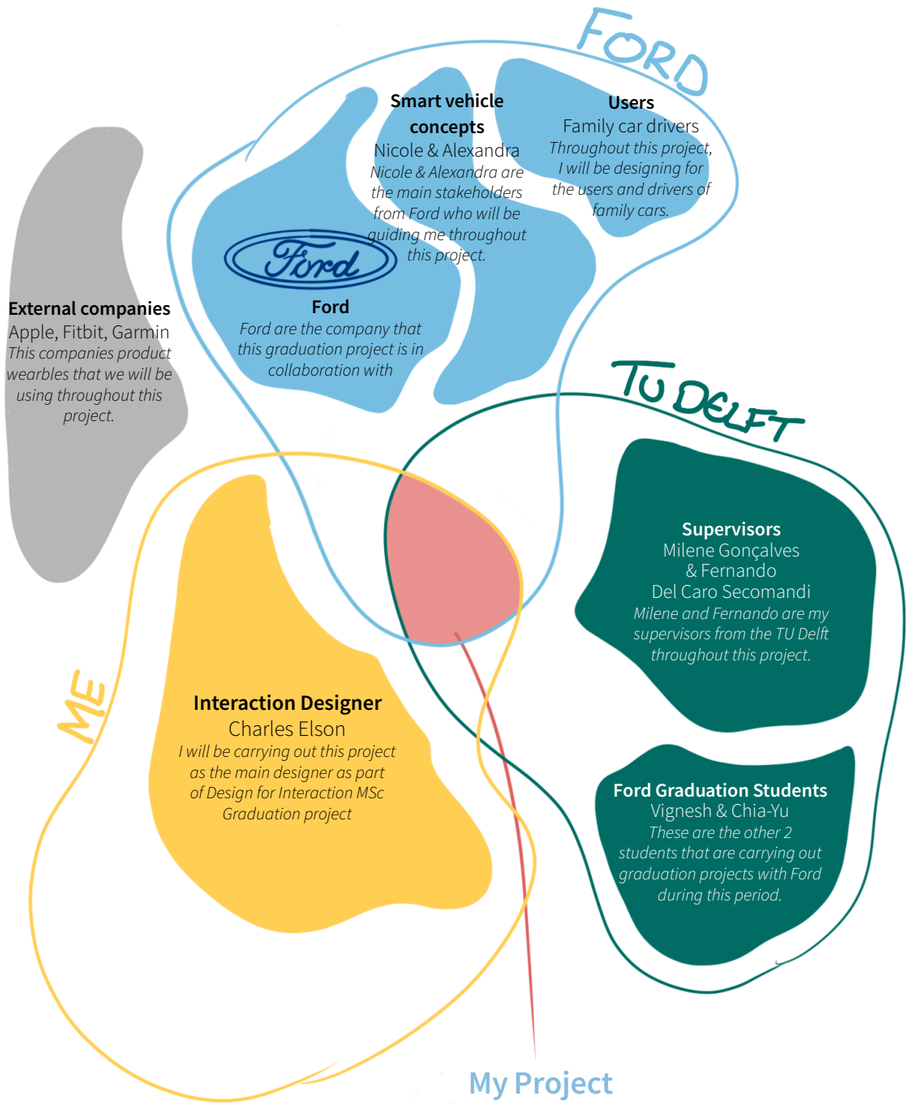


Figure 4: Stakeholder map

This project is part of the URP between the Industrial Design Faculty at Technology University of Delft (TU Delft) and the Ford Research and Innovation Center from Aachen. This URP was established to find new opportunities for developing a data-enabled design (DED) and the ever-developing user experience of Ford motor vehicles.

Ford | the company:
The role of Ford as a company within this project is as a client. This project proposal has been set by Ford RIC as part of an ongoing URP into the data-enabled design. The primary goal of this project is to continuously improve the product innovation process by taking DED to the next level and using it to improve the user experience of a vehicle.

Family car drivers | Users:
The target user of this project is the driver of family cars. This project is based on the routine use of family cars and how this can be made more efficient in their day-to-day life, therefore the solution should match the needs of the users.

Smartwatch companies (Apple, Fitbit, Garmin) | Technical support:
These companies are not directly involved in this project, however, the devices that are being used by the user throughout this project (smartwatches) are created by these companies. Therefore there is a direct effect on the outcome based on what is possible from said wearables.

Nicole Eikelenberg & Alexandra Holz | company coaches:
Nicole acts as a company coach throughout this project. She is part of the Smart Vehicles Concepts (SVC) department focused on developing innovative solutions to be implemented in the longer term.

Alexandra is also part of the SVC department at Ford and works on developing innovative concepts, technical solutions and business models for Ford passenger vehicles and Ford Smart Mobility by applying methods such as design thinking. Throughout this project, weekly meetings are held with both Nicole and Alexandra to keep up to date with work as well as meetings about recent in-company developments.

Milene Gonçalves & Fernando Del Caro Secomandi | TU Delft chair and mentor:
Both supervisors for this project have differing areas of expertise that complement each other well. Milene, who is an assistant professor of Creativity in Product and Service Design at the Faculty of Industrial Design Engineering (IDE) will be helping with the data-enabled design aspect as well as visual design and creativity. She is a specialist in this area along with creative problem solving, inspiration, design thinking and visual communication.

On the other hand, Fernando who is also an assistant professor at the IDE faculty, experts in social justice and the creation of AI-enabled interfaces for new services. This will therefore be usual throughout this project as the main goal is to create a new service and it is envisioned that interfaces will be used throughout as a form of communication to the user.

Charles Elson | Interaction Designer:
As the author of this thesis and carrying out this project, my role is to investigate the current role that wearables play in day-to-day life, what data they can collect and what is readily available from the user to create an improved experience for Ford drivers. As a student of Design for Interaction (DfI) MSc, I will be focussing on how the user interacts with various touch points throughout a journey to carry out this project, but will also maintain constant and close contact with all the stakeholders to ensure an optimal end product.

Ford graduation students:
Thanks to the fact that this is a URP, there are several other students carrying out and collaborating in slightly different directions with Ford. The role of these students is to have a community to interact and collaborate with.

1.5 DESIGN APPROACH

This project will follow a slightly altered double diamond design process, namely, a triple (and a half) diamond. It is divided into six phases; discover, define, discover, define, develop and deliver, with the emphasis on the diverging and converging as seen in figure 5.

The first phase of this project is focused on the 'first diamond', and also the first of the two problem spaces. This is where research tasks will be carried out such as observations, targeted user interviews as well as research into literature (discover). The aim of these research activities was to collect a variety of information about the current user journeys in a number of different contexts as well as to pinpoint some potential problem or opportunity areas. These research activities lead to a convergence of a context, and the first of the 2 define phases, is the context of using family cars. A triple diamond design process was used, as opposed to a double diamond as this project lent itself well to a number of convergence and divergence in order to research thoroughly, as well as iterate on this research where seen fit. Within the non-driving experience, there are a number of contact moments and contexts that can shape the project in certain directions. Once a particular direction was defined (family cars), there was scope to research even further and explore more areas within family cars, hence the second diamond, and second of the two problem spaces.

Throughout this phase of the process, more targeted research activities were carried out which included a sensitising booklet that revolved around the use of family cars, as well as wearables in order to spark participants into thinking about a relationship between the two. This was carried out in combination with a context mapping workshop in order to further define the project into a problem definition revolving around the **routine use of family cars.**

Once this problem was defined, there was a small, third discover phase, which revolved around the micro-use cases of the use of family cars and consisted of a use case workshop. This resulted in a customer journey map being created which would lead kindly into the final phase of the project.

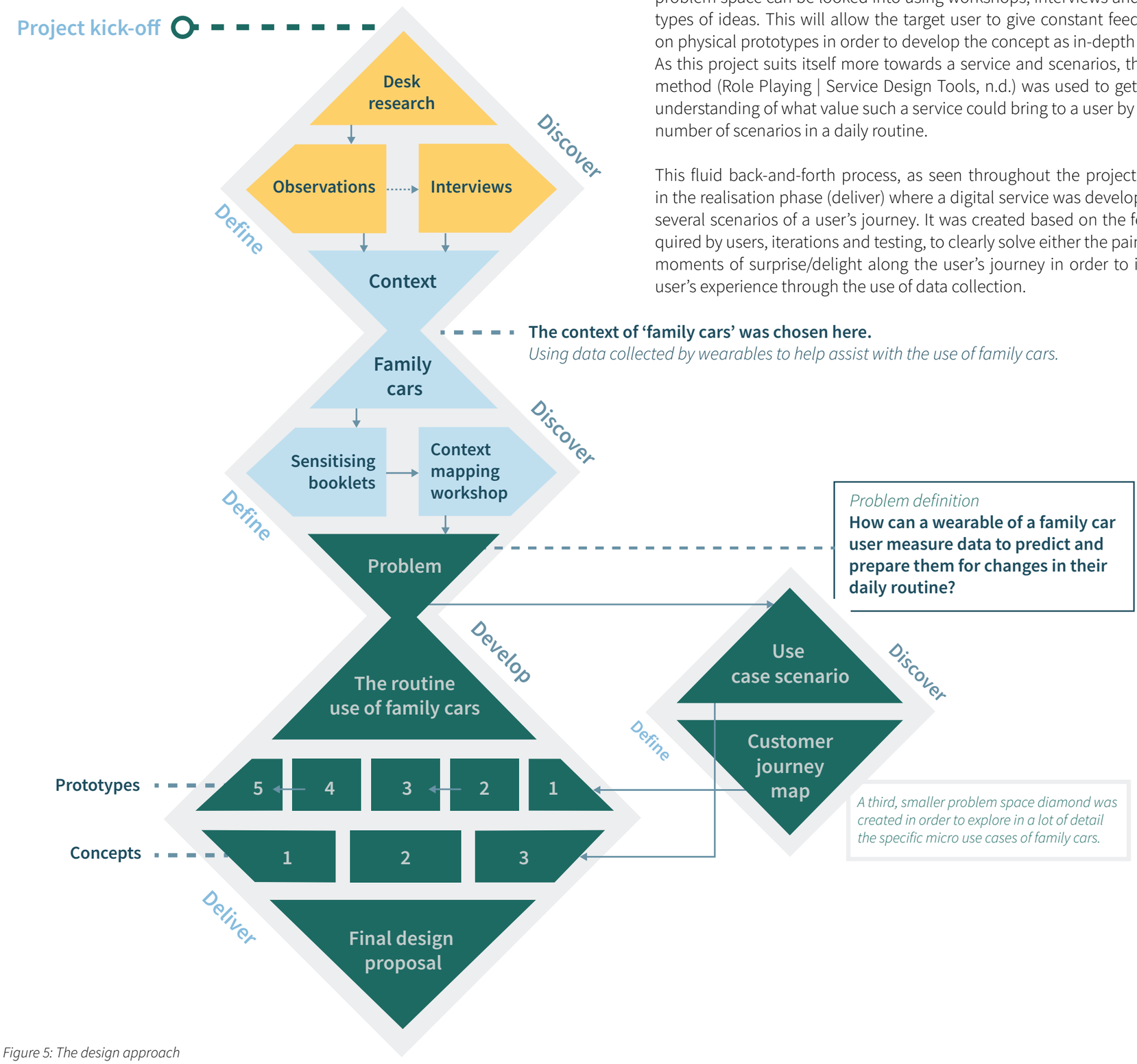
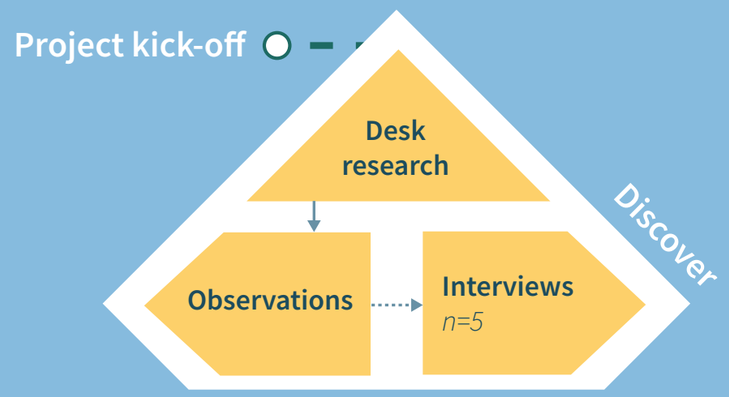


Figure 5: The design approach

The develop phase, the third diamond, is where a more in-depth analysis of the problem space can be looked into using workshops, interviews and also prototypes of ideas. This will allow the target user to give constant feedback based on physical prototypes in order to develop the concept as in-depth as possible. As this project suits itself more towards a service and scenarios, the Act it Out method (Role Playing | Service Design Tools, n.d.) was used to get more of an understanding of what value such a service could bring to a user by acting out a number of scenarios in a daily routine.

This fluid back-and-forth process, as seen throughout the project, concluded in the realisation phase (deliver) where a digital service was developed through several scenarios of a user's journey. It was created based on the feedback acquired by users, iterations and testing, to clearly solve either the pain points and moments of surprise/delight along the user's journey in order to improve the user's experience through the use of data collection.

2.0 DESK RESEARCH



Based on the research question and topic of this project, a literature review was carried out which was the first step of the research into what had been already done in this area. It also provides ideas as to where the gaps in the knowledge are in this area to delve into further throughout this project. It includes research about Ford as a company, what they have done in regards to data-enabled design and using it in the design process, as well as into car sharing amongst families and the overall experience of this.

2.1 FORD

This section gives background information into the company, describes their goals and where they want to be heading in the near future. It will also cover internal developments within the company and why this research is interesting for Ford themselves.

2.1.1 Ford - company background

Ford Motor Company (Ford) is an American automobile manufacturer founded by Henry Ford in 1903. It was a revolutionary time in the automotive industry when horse-drawn carriages made room for automobiles. In 1908, the highly successful Model T was produced and the demand for this car leads to new mass production methods and the world's first assembly line in 1913 to supply enough for the demand it had. Only a year later, the $5 a day pay was introduced, which at the time, was double the existing pay rate.

This came into action at the same time as reducing the working day from 9 hours to 8 hours, and lead to a 10,000-person strong queue at the employment office. This increased wage allowed many Ford employees to purchase the cars that were being produced, and along with increased leisure time of employees, and better mobility, lead to the American working class (Ford, n.d.).

By the time the Model T had stopped being produced in 1927 to retool factories for the production of the Model A, Ford had sold 15 million units and it had become the world's most recognisable automobile (Britannica, n.d.).

In several ways, Ford revolutionised the automotive industry. If creating the first automobile wasn't enough, they have kept up and responded with the trends and changes of recent times and created several innovative cars and products along the way. This way of thinking that Henry Ford instilled from the start is also one that has been at the forefront of design and innovation for several years.

In several ways, Ford revolutionised the automotive industry. If creating the first automobile wasn't enough, they have kept up and responded with the trends and changes of recent times and created several innovative cars and products along the way. This way of thinking that Henry Ford instilled from the start is also one that has been at the forefront of design and innovation for several years.

2.1.2 Ford and current solutions

MyKey is a feature that allows you to configure one or more of your Ford keys to control specific settings. It is physically car keys so that the car configures the driving settings based on which key is being used. The target for this is keeping a teenager safe or reinforcing driving habits for other family members. It can limit a vehicle's maximum speed, radio volume or seatbelt alerts. Along with these, the easily configurable settings include speed minders, no not disturb mode for mobile devices all with keeping the user safe and improving the personalisation of the driving experience (Ford Motor Company, 2009).

MyKey

MyKey is a feature that allows you to configure one or more of your Ford keys to control specific settings. It is physically car keys so that the car configures the driving settings based on which key is being used. The target for this is keeping a teenager safe or reinforcing driving habits for other family members. It can limit a vehicle's maximum

> ***"To do more for the world than the world does for you. That is success."***
>
> HENRY FORD

speed, radio volume or seatbelt alerts. Along with these, the easily configurable settings include speed minders, no not disturb mode for mobile devices all with keeping the user safe and improving the personalisation of the driving experience (Ford Motor Company, 2009).

FordPass

The FordPass app was created as part of Ford's development for battery electric vehicles (BEV). As vehicles are not becoming more connected with the introduction of an embedded modem, it allows users to communicate remotely with their vehicle. FordPass is Ford's answer for this development and acts and serves as the digital connection between the user and the car. The features that are available to the user of the app include:

- Lock and unlock your vehicle remotely
- Start your car automatically so that it is ready for when you arrive
- Securialert lets you know if you have locked your car or if the doors have been opened
- Vehicle location locates your vehicle when you can't find it
- Charging station finder
- Charging status
- It will optimise the charge of your vehicle based on your pre-determined leave time
- Breakdown assistance
- Instruction manuals

The FordPass app also has several features whilst in the car itself, and these include;

- Local hazard information
- Live traffic
- Monthly fuel reports to improve your environmental impact
- Journey log of all your past trips

In conclusion, FordPass is key to smart mobility within Ford. FordPass helps users to use their electric vehicles to their full potential and provides a seamless, connected experience (Ford Motor Company, n.d.).

2.2 WEARABLE TECHNOLOGY

Wearable technology (WT, or wearable computing) encapsulates a plethora of devices worn directly on or loosely attached to a person. Smartphones are often seen as the aid to assist the use of WT rather than being a wearable themselves primarily due to the rise of apps which have nurtured innovation. However, there is an ongoing debate around this topic (Smith, 2019).

WT can be divided into two categories; primary, which is those that operate independently and act as a connector for other devices (e.g. smart watch or smartphone), and secondary, those that capture specific actions (e.g. a heart rate monitor around the chest) and relay the information to a primary device (Godfrey et al., 2018).

The miniaturisation of electronic components in recent years has made it possible for wearables to carry out a huge number of functions. They are often used in sporting scenarios such as heart rate monitors and distance covered, health scenarios such as measuring sleep patterns and irregularities as well as technical measurements using pressure, speed and gyroscopic sensors.

Ford as a company has previous experience with using wearables to collect data. They are mostly used to working with Apple, Garmin and Android smartwatches as a form of data collection methods due to their ease of use and popularity with users. The data collected by wearables is almost infinite and is collected constantly as long as the user is wearing it. According to Armitage (2020), Stanford Medicine researchers say that wearables collect more than 250,000 measurements per day from wearables and using these frequent data points, can track and predict almost anything.
Some of the data sets that can be collected from wearables are:

- Steps
- Heart rate
- Location
- Bluetooth connection
- Acceleration
- Gravity
- Barometer
- Microphone
- Orientation
- Calendar data
- Stress levels
- Sleep quality
- Weight
- Distance covered
- Active calories
- Cardio fitness level
- Hard falls
- Step length

Predicting and reacting to users based on their heart rate, stress levels or even sleep quality can be used in the next step to further develop and improve the experience of products. There is extensive research into how this data can be used to improve health issues, as Armitage (2020) explains how it can predict COVID and Smuck et al. (2021) examine how wearables can be integrated into the Ochsner Health System and Kaiser Permanente for glucose and blood pressure monitoring. As seen during the COVID pandemic, scientists and governments have used data from phones and wearables as part of the track and trace ruling, which is used to alert a user if they have been in close proximity to someone with coronavirus.

Alongside physical health, there is research that smartwatches can measure and determine people's emotional health. Quiroz et al. (2018) concluded in their research that by using the heart rate monitor and smartwatch, they were able to determine changes in the participant's emotional state whilst on a 250m walk. This is one of several studies, but also products that have been researched to tap into the emotional side of wearables. Empatica's embrace uses sensors to track electrodermal activity with temperature and movement which shows when a user is actions, depressed or stressed. Moxo measures changes in skin conductance to determine frustration or boredom, and the 'Feel wristband' can detect electrodermal response (EDR), combined with movement, blood volume pressure and skin temperature to detect a large number of emotions (Sawh, 2019).

The predicted future of wearables is to tap more into the analysis of our neurotransmitters that influence our moods; dopamine, oxytocin, serotonin and endorphins (DOSE). Further research on this topic can unlock the potential for measuring human emotions and potentially improve the experience of smart products based on this. Apple has already said to be interested in using its technology to decipher human emotion (Devanur, 2019).

A lot of previous research into wearable technology focuses on detecting whole body activities such as walking, running or cycling. However, Laput and Harrison (2019) explore in their study how wearables can be used to detect micro hand movements. Based on machine learning and using participants using wearables for over 1000 hours, they were able to detect the difference in 25 different hand movements, such as cutting food, and brushing teeth and could even tell the difference between typing and playing the piano. Not only this, but Laput et al. (2015) exploit the unintentional electromagnetic (EM) noise that is emitted by everyday electrical and electromechanical objects such as computers and kitchen appliances in order to identify these devices. These signals are all slightly unique due to internal operations (eg, brushless motors or capacitive touchscreens) and can be identified using hardware small enough to go onto a wrist. This technology could very easily be implemented in wearables in the near future.

Overall, there are endless possibilities and data sets that wearables can measure from us and can be used to improve both our physical and mental health. In our daily lives with the most basic smartwatch it is possible to collect your location, how many steps you take, and on the more expensive end of the spectrum a sleep tracker, step length and even a barometer. The primary devices already have access to everything a phone would have (calendar, messages, contact) and therefore it is possible to access these data sets also via your wearable. Although these products are not as advanced in the emotional sense, it is already clear that some emotions can be measured and predicted by combining several data sets. This research gives an overview of what data can be collected by WT and how it can be used in different scenarios. It also shows the possibilities for how this technology can be used throughout this project and how such data can be used along a user's journey to improve their interaction with the vehicle, and therefore, overall experience.

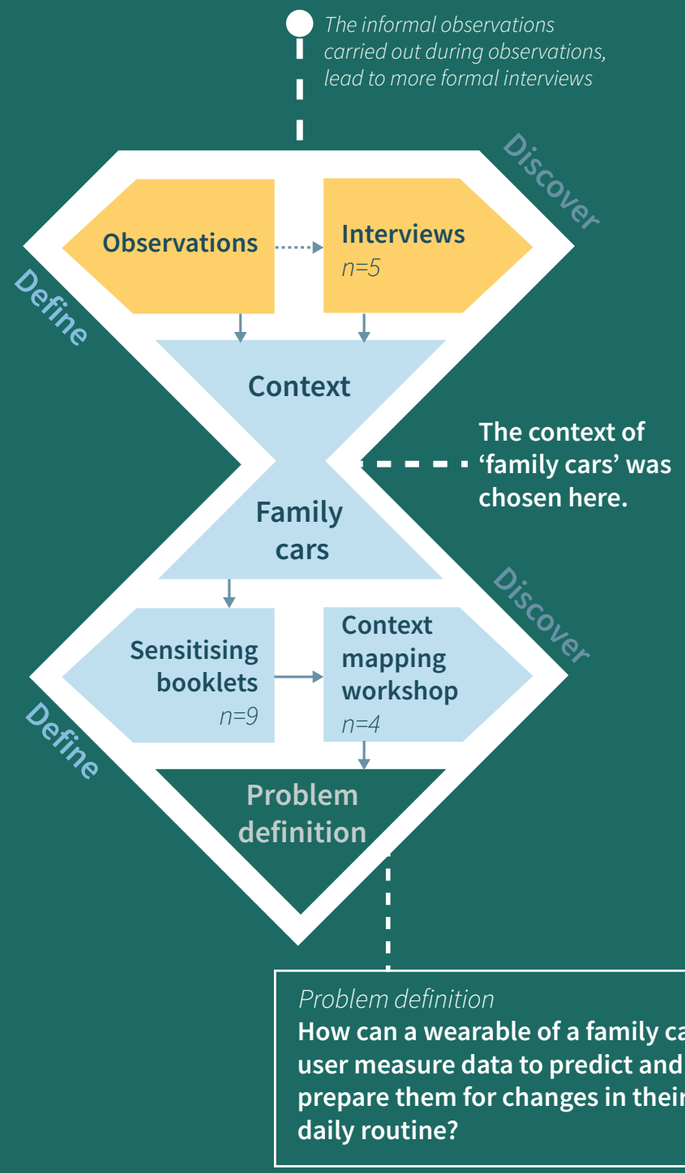
2.3 (NON) DRIVING EXPERIENCE

The driving experience of drivers has been exhausted in terms of research. Every car manufacturing company has been researching how they can take the next step in terms of innovation and improving the relationship between vehicles and users. When talking about innovation in the automotive industry, brands such as Tesla and Polestar are on the tips of tongues with features such as self-driving, personalisation and their in-car entertainment systems. However, there is a huge gap in the research on the out-of-car experience or the non-driving experience.

The non-driving experience, in terms of Ford, can be described as any activity related to vehicles that are not the act of driving. This can be described in more detail as all the activities involved in being the passenger of a vehicle, loading the car or even preparing a journey. Some examples of these activities are charging/filling your car, loading it with groceries, choosing music or walking your children from the car to daycare. Currently, Ford is looking into combining their previous work on using data within a design process in order to spark the creativity of a team (Spalburg, 2021 and Mellado Cruz, 2021), and the physical development of the vehicle and its features in it (van Wijnen, 2021) in a number of innovative ways to look outside of the box. They are looking at the overall driver's experience and this includes whilst outside of the car itself. Namely, the non-driving experience.

There has been limited development in this area in recent times, however, with the rise of user experience design there is more of a focus on how can the experience be improved away from driving. As previously mentioned, the rapid development of electric cars has been a driving factor in this area. An example of the non-driving experience of cars would be the application that comes with most cars nowadays. The Tesla app, FordPass to name a couple, however, allow the user to access a huge array of information and interact with the car in ways that would not have been thought of 20 years ago, such as opening and closing the boot, locking the car and winding up windows automatically. All of these are interesting ways in an attempt to improve the non-driving experience, however, outside of these interactions, the research is rather limited.

3.0 PRIMARY RESEARCH



Qualitative primary research was carried out in the form of interviews, observations and workshops to find out more information about the use of family cars, as well as the pain points that come with them. The research gives insight into what scenarios and use cases family cars are used for, both individually and as a family in order to find out what part of the journey could be added or developed to improve it. This leads to the routines of drivers of family cars and how they can be improved or predicted based on the data collected by wearables.

3.1 OBSERVATIONS

Initially, in order to gain insight into the general usage of cars, observations were carried out in a number of locations. These were combined with informal interviews where seen fit and focussed around why people use their cars, what they like about them and what could potentially be improved. The observations took place in three locations; the IKEA car park, a residential parking lot, and the TU Delft university parking lot (figure 6). These locations were chosen as they were seen to be the locations that are busiest amongst car users in a condensed area. At the beginning of the research phase, the aim was to get a large amount of data from several use cases. Each of these observation sessions lasted for one hour and was carried out at different times of the day to get a range of users.

A wide variety of use cases were discovered from this, across several areas. At IKEA's car park were a large number of adults that were getting furniture for their home, both alone and with children/partners, at the residential parking lot were mainly parents with younger children, but also employees from nearby companies, and at the university campus were students and professors attending lectures, lunches or graduation ceremonies.

Parents with children

It was noticed that parents who had children with them generally had a great deal of difficulty when leaving and approaching their car. This was due to taking care of their children at the time and having to keep one eye on them whilst loading their car or having more than one child to look after whilst also prepping or locking the car. In these situations, it also occurred several times that the parent had forgotten something from the car and had to run back and get it. When the child was older and didn't require as much 'looking after', there was less of an issue with leaving the car, and when approaching they would generally be helping with carrying heavy items and loading the car.

Especially at the IKEA car park, car owners were exiting the shop and walking to the car with food and drink in their hands. This added to the noticeable issue of trying to do too many things at once. This wasn't seen to be such a huge problem, but rather only added to the time it took to get going as they were in more of a relaxed mindset. It was tough to discover a trend when observing parents who had children with them as there was

Figure 6: Observations at the science museum

"It is a privilege rather than a necessity to own a car, and it is very easy to borrow a car from a friend if needed for trips like this [to IKEA]".

CAR OWNER

not much consistency in terms of if they were rushing, struggling or more relaxed, so informal interviews were carried out to find more about their routine and experience of car journeys. A few people seemed to not want to talk, however, it was unclear as to whether they didn't have time or if they just did not want to talk at that time, however, when able to grab a family's attention they mentioned that if they did not have kids, then they would not own a car. ***"It is a privilege rather than a necessity to own a car, and it is very easy to borrow a car from a friend if needed for trips like this [to IKEA]"***.

Car owners without children

At these locations, there were also car owners without children accompanying them. These owners were generally more relaxed and took more time to get to their car and find the best way to load everything in the car. One participant said that he likes the flexibility of having a car, however, doesn't need one. Another mentioned that without a car it would be impossible to do his work as he had a meeting in Delft and then another meeting in Leiden. In this situation, it is much easier to drive and also much quicker. "It not only allows me to have calls and a bit of me time in-between meetings but also stops me sweating on warm days on the train before important meetings."

In a residential area where observations took place, it was common that people were often coming and going to their cars frequently. Whether this was people unloading their car in multiple trips due to moving into a new room, or construction workers getting tools from their van numerous times, there was a similar interaction with the car. Most people alone were unsure if they should lock the doors each time, or if there was someone nearby, to ask them if they could keep an eye on their open boot whilst they were away for 5 minutes. There was always a pause as they unloaded the car, and a predictable struggle to find keys to lock the door whilst their hands were full with items.

In the more professional environment of the university campus, it was common for people to be alone, and in a rush to get to a meeting or lecture. They would almost always be on a call or listening to music and have no time to answer some quick questions. One user was in such a rush he hadn't switched off the car properly and had to come back to fix it, and another was borrowing the car and didn't know all the controls to control the car properly.and have no time to answer some quick questions. One user was in such a rush he hadn't switched off the car properly and had to come back to fix it, and another was borrowing the car and didn't know all the controls to control the car properly.

KEY INSIGHTS

These observations provided valuable insights into why people use their cars in several different scenarios, as well as what their pain points were both from my perspective, and theirs. It was useful to combine these observations with informal interviews because there was sometimes a lack of clarity as to why someone would do something in a certain way, however once talking to them it became clear and was often a reason that I otherwise would not have thought about. The main points I learned from these observations were:

- People with children are often more stressed and it takes them longer to fully pack or unpack the car at a certain location.
- Using a friend's or family member's car can prove troublesome in certain rushed scenarios, such as being late for a lecture or unpredictable weather conditions.
- Owning a car is seen as much more of a privilege than a necessity for most car owners, however, families find uses for their cars every day and it does make their daily lives much easier.

3.2 INTERVIEWS

As mentioned previously, these observations went hand in hand with some informal interviews. It was clear that there was a lot of value in speaking to people and therefore, a set of more structured and formal interviews were the next step to go further in the project.

These formal interviews (n=5) (see Appendix B for participant demographics) were carried out with target users, who were mainly adult car owners, however, some interviews were also carried out with other members of the family who use the car (figure 7). These participants were chosen through a mixture of parents of colleagues, and contacts via these participants. This allowed for a range of unbiased and interesting responses.

From these varying user groups, there was a huge amount of information that varied from user to user. The majority of car owners enjoyed the fact that they owned a car, they saw it as flexible and it allows you to do your own thing because you are in a sort of 'bubble' of your own. When asked ***'what is your favourite part about having and using a car'***, almost all car owners mentioned the flexibility around it. The fact they could do what they want and when they wanted without having to worry about other modes of transport was a benefit of owning a car. However, car owners rarely mentioned anything regarding the actual driving experience of owning a car. Out of the 5 people interviewed, only 1 mentioned that they enjoyed driving and it was relaxing. This goes to show that the experience both inside and outside of the car is not the most prominent thought when thinking about cars amongst users.

The interviews followed a semi-structured process where users were mainly asked to describe a recent journey of theirs, going into detail on the pre and post-journey experience (see Appendix C for full list of interview questions). Participants who did not own the car and shared family members or friends mentioned that going on a journey often took more planning than usual. Even the more spontaneous trips meant that they had to check if there was a vehicle they could use at the time, or if not when it was available to use.

This was a common theme throughout, and although throughout these interviews the majority of participants were not restricted by not being able to use the car at that time, they mentioned that it still required an extra message or planning for how long they can use it for and if the usage interferes with anyone else planning or routines. This was seen as a big problem amongst families with two working parents. Now that working back in an office is possible, it meant that it was not always possible for both partners to drive to work. On several occasions, the family car was being used for longer periods such as at a conference in a different part of the Netherlands, and therefore alternate arrangements had to be made not only to get to work but in many situations, to take the child to daycare/school.

"I was sat at home and had to call my sister to ask her to pick me up"

PARTICIPANT B1

Figure 7: Interviews carried out with a number of potential users.

Within this situation of parents taking their child to daycare/school, this generally happened before or on the way to work. It required extra planning either the evening before or the morning itself to have everything run smoothly because it was not always the case that the daycare was so near the parent's work. This was not seen as a huge pain point, however, this was down to the experience they have had with it. ***"At the beginning, it was almost impossible. I was always late and something always went wrong, however, now it goes like clockwork as I do it every day almost."***

There was a clear positive experience when the user had time to interact with other drivers. This was often a spontaneous interaction either at their child's school with other parents, or colleagues in the car park of their office, however regardless, participants mentioned this several times as being a positive moment along their journey. This goes to show that the out-of-car experience, either on the approach or leave, in a similar scenario of going to or from work and school is an interesting direction to look into for further surprise and delight moments. ***"The part of the journey I enjoy the most is the little interactions with other users, you slowly form a bond with them and it's a nice break from thinking about the day ahead."***

KEY INSIGHTS

These interviews went into a more detailed description of the journey of using a car from both an owner's standpoint and the young adult's standpoint who could be using the car. The detail that users went into was insightful and the semi-structured nature of the interview lead to not only informative answers but also extensive discussions throughout. The key takeaways from these interviews were:

- There are more issues surrounding the preparation aspect of the journey such as getting your child ready as well as yourself and needed preparations before the journey.
- Using the car of someone else takes more time and planning, even if that is just your parent or partner that needs to be asked to use it.
- Interacting with others along the journey is a positive experience that comes from driving.

Conclusion observations and interviews

From the main insights gained from observations and interviews, it could be concluded that family cars were not only popular amongst users, but had a large number of opportunities for value to both Ford and the user. This topic was mentioned through a number of use cases, such as going to work or taking the kids to school. There were numerous moments when parents or families were describing potential problems and moments where surprise interactions could lie.

3.3 FAMILY CARS

Based on this converging direction, additional literature research was carried out in order to delve deeper into past research into this topic of family cars.

In the Netherlands, 75% of all vehicles are passenger vehicles (CBS, 2022) and although the number of sales per year is slightly decreasing (Statista, 2020), it goes to show that families are still in need of cars as part of their day-to-day life.

Almost 70% of Dutch families own a car (Shaw, 2012), and of this 70%, over half of families only own one car. Although it is not necessarily a necessity to own a car in the Netherlands, this figure shows that the number of families who do own one is quite high, and they find a use for it. Car-owning families often have similar weekly routines. This could be driving to and from work, picking their children off at school or just doing the weekly shop in the car, there is a consistent routine carried out by the parents and children alike.

This routine is often carried out by a number of people within the household and is sometimes hard to adjust if there is a deviation from this routine. Zakaria et al. (2019) described in their study that a change or deviation from a daily routine can be a driving factor toward stress and potentially depression. Zakaria et al. (2019) detect changes in daily routines to prevent stress or prepare the user to be less stressed in certain situations. Travel is one of the times in the day when a family member can have time to themselves. It may not be long and it may not always be alone, but it is time to reflect on the day ahead or the day they have just had and is, therefore, one of the advantages of sticking to a routine, in order to have this time to yourself and time to look after your mental health.

Extending this experience to before and after the actual driving aspect can lead to a more structured day which gives the driver more time to think about the day ahead, as well as mentally prepare for their next activity, whether that be going to work, to home, or anywhere else. Being able to extend this experience before and after the journey itself is one that has not been explored as thoroughly as in the car experience, however, has the potential for a greatly improved experience.

3.4 SENSITISING BOOKLET

To get more detail about the day-to-day use of family cars, a sensitising booklet (Appendix E) was handed out to several target users. Rather than asking participants to think about their experience, both driving and non-driving, it was useful to get people to fill in a booklet over a period of time to get more accurate thoughts and feelings at that time. This booklet was also carried out in order to get a more detailed and accurate understanding of participants' feelings and thoughts at the time.

The responses from the interviews (section 3.2) lead to the questions and tasks for participants to carry out in these sensitising booklets and are targeted towards users' perceptions of wearables, driving and non-driving experiences, and concluding in mapping out and improving an aspect of one of their journeys. The sensitising booklet was carried out over a period of 3 days and completed by 10 participants of varying age groups (see Appendix B).

3.4.1 Results

The sensitising booklets (figure 8) were analysed combined with mapping out various use cases and opportunities at three phases of the journey; pre-departure, during the trip and once the driver has returned home. Each of the booklets was compared to the other and mapped out on a larger scale to easily see the relationship between the high and low points of each participant's journey. From the analysis, three main topics stood out.

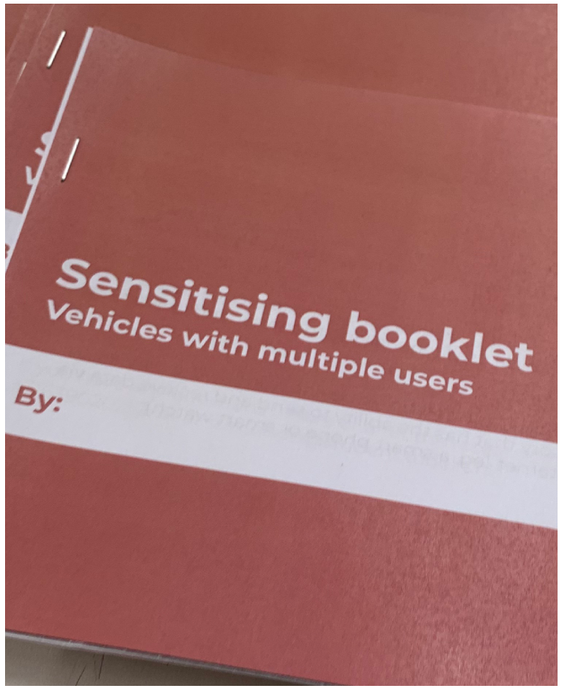


Figure 8: The sensitising booklets

Wearables

There was a common preconception about wearables amongst these participants, which was 'to collect data'. Although this was common knowledge, there was a lack of knowledge in specifically what data there is to collect and what one can do with the data. There was a split opinion on wearables with 5 people saying that they are 'useful' and 'fashionable' to have, with the other 5 mentioning that they were 'annoying' and making them 'lazy'. It was unclear as to whether this was down to specifically using them in a car, or whether they had this opinion after prolonged usage.

When delving into the types of data that users use from their phone or wearable, location and their agenda were at the top of the most frequent answers and there were the most useful pieces of data to collect based on a user's day. One user noted that different applications on her phone can be used to collect different pieces of data. Snapchat for example can be used to judge speed and location, whereas the general clock app can accurately judge the amount of sleep you have had. Overall, considering there is so much data that is collected from users by their wearables, it is still relatively unknown as to the extent of the data and what it is used for. There is a huge gap in knowledge in this area and one that can be used to improve an experience, with little to no input from the user. This 'silent data', such as stress levels, happiness and tiredness are areas that have the potential to be used in improving the experience of car owners subtly and effectively.

Driving and non-driving

When describing and thinking about past experiences of driving (Appendix E), there was a common description of **'easy to get to places', 'flexible' and 'practical'**, with 6/10 participants mentioning this. It was clear that owning a car was a luxury for car users and at times, a relatively useful thing to own, however, all these users said that the experience around owning a car (the non-driving experience), such as filling up with fuel, finding parking spots and the expense aspects was not such a luxury. These were mainly mentioned by participants as negative aspects. ***"There is not much reason, outside of practicality, as to why I would own a car, it is very annoying actually".***

The majority of the car uses amongst these 10 participants were related to doing groceries, travelling to and from work and going on trips with friends or family. The perceived annoyance of these journeys was not seen to be the driving aspect, but rather several use cases before and after the journey, such as packing and unloading the groceries in the boot, or clothes from a holiday, and planning the journey itself. Planning a journey is something that in essence is often seen to be the start of a journey, yet quickly becomes an extra burden to the user. Deciding on going somewhere itself was a relatively high point, however, what follows is what the majority of users find one of the worst parts of the journey.

Multi-user cars

Throughout this study, multi-user cars appeared to be quite popular, from both a social and effective standpoint. Within a family all the members generally use one, maximum two, cars to go about their daily lives. This means that there are constant compromises within the family. If one member is using it to go to work, then the other has to find another form of transport to travel. Doing the family grocery shop has to be adaptable and revolve around other family uses of the car, and sometimes a family car is being used for a whole weekend and therefore alternative travel plans have to be made. These were all participant's experiences with multi-use family cars, and although the majority of experiences were positive, these compromises are something that you wouldn't have with a single-user car.

Within various users' self-mapped journeys it was a theme that the high points of the journey included travelling with people. It made the journey more fun and meant that the trip started before they had arrived. Being with others, whether family or friends, was directly mentioned by 4 participants with the reasoning behind was that it was 'cosy' and you could have 'nice conversations'.

3.4.2 Conclusion

To conclude, the sensitising booklets led to a number of areas and opportunities for potential overlap, not only in the data collected but also in the interaction that a user would have with a car in these scenarios. There was a common theme of routines, big parts of the scenarios can not be changed so much by the driver, which has led to an important question: **'How can a family vehicle help and aid the daily or weekly routines of a user?**' An answer to this can be wearables, which can collect endless amounts of data, including data about your weekly routine. Which can be measured based on your location, agenda, heart rate, and exercise amount, and is an area that can be consistently monitored for change or alterations in this routine.

> ***"There is not much reason, outside of practicality, as to why I would own a car, it is quite annoying actually!"***
>
> PARTICIPANT D2

KEY INSIGHTS

After analysing these sensiting booklets, I saw that there was nice direction to converge on. Routines. In order to find out more about how you can measure and detect routines, as well as what research has currently been done in this area, I carried out some extra desk research.

3.5 ROUTINES

Routines are seen in our daily life. We wake up in the morning to go to work or school at around the same time every day. Families come home at similar times and generally, their evening activities are relatively similar day in day out. There are parts of the routine that change and alter, however, the general structure is something that stays fixed. Tsai (2022) describes the term family routine as the activities provided by parents in a structured, stable and organised form. This is not always the case within families and it can often be a challenge for families to make and stick to routines that can actually help them in their day-to-day life. In particular, couples whom have recently become parents often struggle in managing routines for a number of reasons (de Goede & Greeff, 2016). Temporal incongruence, unexpected derailments and intra-family factors were the main reasons behind the troubles families face in managing routines, and are mainly related to time constraints within multiple routines at once, or unexpected difficulties that disrupted said routine. In the early stages of parenthood, it takes some time to get used to an altered or changed routine as opposed to your usual individual routine, however, this new unfamiliar one is often one that suits the whole family best.

Solving such issues in routines can be done in a number of ways. Two of those are; people solving the problem themselves and making their routines more efficient through trial and error so to say, or secondly, through the use of artificial intelligence (AI). The use of AI is becoming more and more popular in our everyday lives for example the rise of smart home hubs such as Alexa and Google Home is something that can help families also. By focusing on user behaviour and patterns in routines, AI can learn and optimise these routines without extra effort from the user. ***"Well design technologies can offer high levels of human control and high levels of computer automation can increase human performance."*** (Shneiderman, 2020).

Car manufacturers are also using AI in order to improve and change the driving routines of users. Gish et al. (2017) wrote about how Advanced Vehicle Technologies (AVTs) can modify the routine and habitual driving-related tasks of users. This study was focused on 'safe driving' and by using these AVTs routines such as a head-check when changing lanes, and reverse parking were altered and made easier. It allowed participants to feel more comfortable in their car whilst driving and also optimised these standard driving routines. Participants also mentioned that they preferred the quality of the information communicated on the screen of the car rather than looking over their shoulders whilst parking/reversing, which shows that modern technologies can be used in a way that both improves the efficiency of a routine, but also user-friendliness. Interesting here is that the technologies used within this study could also have a similar effect on the user's non-driving experience (such as temperature control, and opening doors) as they do on the aforementioned driving experience.

Using AI in the routine use of vehicles is already being used in a number of ways by automotive companies in order to improve the user experience. Yi et al. (2019) research how driving assistance systems have been evolving towards personalisation and adaptation to different drivers. There is a lot of research within this area regarding the driving experience and how that can be personalised, by using individual historical driving data or even external conditions such as the road types and traffic on a specific route. However, what this research by Yi et al. (2019) also touches upon is using specific pieces of data from the driver (drowsiness, fatigue, distraction) to adjust certain preferences. This type of data is what can be used by companies to improve the non-driving experience of drivers. Collecting personal data from users is what can be used to predict and overcome difficulties in the routine of a driver in order to make their journey more efficient and safe.

A study by Patel et al. (2021) aimed at assisting drivers based on their daily routines and not only learning from them but also predicting the next destination based on pre-trip and en-route information. The outcome of this study was that routines were critical for predicting and improving the experience of drivers, with participants of this study also mentioning that the preparation of a journey such as setting the respective temperature, and defrosting windshields before the driver arrives at the car is something very attractive to them. A feature like this could only be possible with the AI learning the routine and preferences of the driver in certain conditions. Not only will this improve the experience in real-time, but also ease any sudden changes in routines along a user's journey.

As seen throughout literature, the topic of routines is one that is researched thoroughly. This includes not only the problems of routines but also the various solutions for how they can be helped and made more efficient. These solutions are an extremely interesting part of how a small part of a family's daily life, such as driving, can help in consolidating an effective and optimised routine. This knowledge can be further explored by looking at how data can be used to optimise routines outside of the driving experience and more on the surroundings of this. The approach and leave scenarios of your vehicle are also part of a routine and can be optimised by such a service by knowing where you are going and adjusting conditions accordingly in order to make the journey as smooth as possible.

3.6 CONTEXT MAPPING WORKSHOP

From the information found during the literature research about family routines, there was an opportunity to explore what routines families currently undertake outside of the car. Whilst still on the topic of approach and leave scenarios, a context mapping workshop was carried out to understand what other scenarios families encounter in a usual week, and from there continue into potential opportunities and scenarios. With this umbrella term of 'routine' in mind, a workshop was carried out with four participants (2 from the sensitising booklets, and 2 new participants) that focussed on mapping out the user journey based on four scenarios that fall under the terms; the transition between work and home, shopping (groceries, clothing, other), dropping off and picking up children from home, and getting used to a new car. These four specific use cases were the most common use cases that came from the interviews and sensitising booklets that had overlapping interests between participants. They are also the use cases that fall closest to a family's routine. Furthermore, these use cases also have the most interest and opportunity for an improved experience for family car owners. This workshop was structured in such

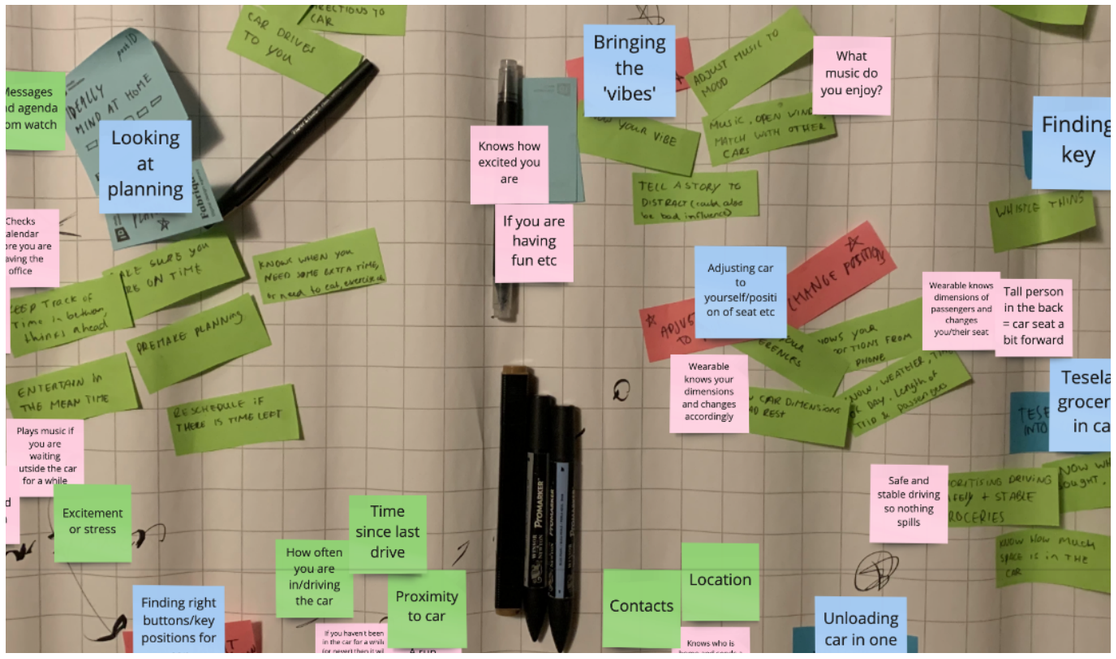


Figure 9: Analysis of the context mapping workshop

a way that it would introduce the participant slowly to the problem from both a wearable and data point of view, as well as from a car user point of view. The specific tasks can be found in Appendix F.

The goal of this workshop was to ideate potential areas and scenarios where data can improve the current experience. Together with target users, we started with getting more informed about the potential that wearables have in terms of collecting data. With this knowledge, we looked into how this can improve the current experience, or create a new surprise/delight moment at some point along the user's journey.

The workshop was created so that it could be done physically in order to get more of a natural conversation going between participants which leads to a more fruitful outcome. The first task of defining wearables and increasing the knowledge of what data can be collected and potentially used for was initially individual, and then the results were discussed amongst participants. This was similar to the second task where the participants were to note specific points before, during and after their journey based on the four scenarios above. Steps 3 and 4 were discussing as a group what the interesting points from each scenario were, and how they could be improved using data.

The outcome of this workshop (figure 9) revolved around several interesting points. The participants saw the most interesting experiences as getting used to the internal controls of a new car, tessellating items and unpacking the car, and looking at your planning before you go on a trip. These were areas where not only did the participants think were interesting but engaged in deep discussion about what opportunities and solutions there are. The opportunities to look into are not limited in terms of ambition and are not always related to data, nevertheless, upon further analysis can be associated with data sets collected from wearables.

A second round of analysis tasks was carried out where these scenarios were listed and the respective data point was also listed (see table 1). These data points were not single sets such as 'steps' or 'heartbeat', but rather a collection of data sets to create a larger more meaningful one, such as; 'if you are carrying a heavier item than you are used to' or 'did not sleep as well as usual. These pieces of data are a collection of multiple data sets combined to detect patterns and trends in data. This can be seen already in the Health app on the iPhone where it detects not only trends over a certain period of time, but also a change in trends and alert you when something is not right/out of the ordinary. It leads to the clear thought that instead of alerting a user's phone only, this is where the car can come in and create an environment to counteract or aid the change in trends.

A partial collection of the data points and related scenarios that came from this workshop can be seen below (table 1).

KEY POINT

This table below is by no means extensive, but rather a selection of interesting scenarios that come from detection of data that came about from the workshop and getting users involved in data.

Table 1: What can a wearable collect vs potential scenarios that come from it

What can the wearable detect?	Macro use-case	Scenario
If you are exercising	Doing sports	How much exercise you should do to make up for driving to the gym
What type of exercise you are doing	Doing sports	Can cool the car based on the intensity of the workout
Lifting something heavy	Doing the groceries	Can open the boot of the car automatically
		Can call your family to help out when you are arriving home
How much sleep you have had	Driving to and from work	Will change the internal conditions of the car in order to optimise performance
Whether you are with children	Driving kids to and from school	Set the entertainment system to the childrens preferences
Whether you are with colleagues	Driving colleagues home from work	Pre-set all the addresses of the colleagues in the system as they step into the car
What you buy from the supermarket	Doing the groceries	The car will move seats and open the boot based on how much you bought
What the weather is	Doing the groceries	The car can drive towards you if you have heavy bags and the weather is bad
Whether you have all your electronic items	Going to work	The car can remind you if you have forgotten an item that is needed for work
If you daily/weekly exercise trends are up or down	Going to work/doing sports	The system will suggest parking locations nearer or further away based on trends
Emotions	Driving to work	Will change playlist when you are on the way to work to mentally prepare you

3.6 PRIMARY RESEARCH CONCLUSION

There was a large amount of primary research done throughout this phase which resulted in converging and diverging twice. The initial divergence of this project was where the observations and interviews tasks were carried out which lead to interesting findings that steered the project in the current direction. The findings from the observations were the difference in interaction with the car when there are children present or the mixed opinions around the shared use of cars, whether that be with friends or family members. This was also backed up by the interviews where the main insight was the organisational issues around sharing a car with someone. These tasks allow the project to converge in the direction of the use of family cars. I saw that family cars were very common and they were used for a number of use cases amongst a family. The versatility was an area that I saw as an interesting context to go into.

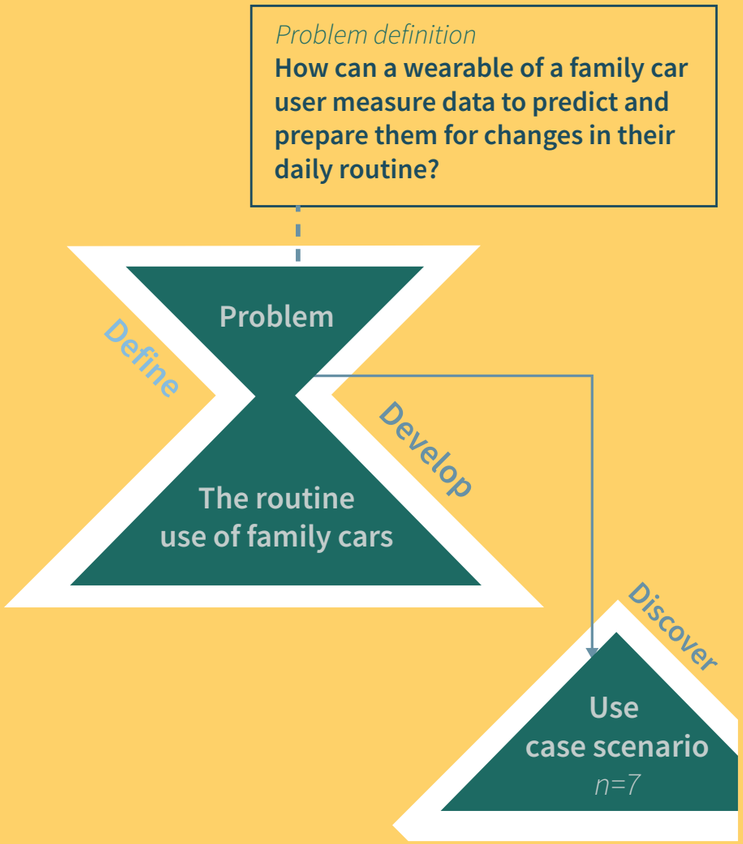
Within this area, there were also several scenarios and use cases that were seen to be both problems, but also surprise and delight points. For example, sharing a car with other members of the family was quite an annoyance, especially if both members need it at the same time. On the other hand, the spontaneous moments of meeting parents whilst dropping the kids at school, or meeting colleagues whilst walking from the car park to the office were seen as really nice delight moments around the use of the car.

From this convergence, there was an opportunity to diverge once more to explore in more detail this topic of family cars. This is where the sensitising booklet was used, in order to find out more about why people use their cars and what they like and dislike about specific moments along the journey. Throughout this task and the self-mapped journeys that each participant had to complete, there was a common theme of repetitiveness. The majority of the participants used their car for day-to-day tasks, such as going to work or doing the groceries, and even those who shared a car with a partner or children also had these similar use cases, however, required a bit more planning and organisation. Both the car and the drivers had to be flexible as to when and what they were using the car for in order to compromise. This term of repetitiveness of daily tasks is one that could be defined as routines.

The combination of insights from the primary research so far, can then be translated into a more well-defined research question, and thus the second convergence point in this design process:

> ***"How can a wearable of a family car user measure data to predict and prepare them for changes in their daily routine?"***

4.0 PROBLEM SPACE



From this definition of the context, it was possible to further define and look further into the problem and its definition of it. This chapter looks into that. It focuses on the activities carried out that are more defined towards a final problem and based a bit more around this context, as well as the outcome of the activities and how they lead the project in a specific direction. This was done using a workshop that focused on the primary use cases of family cars.

4.1 THE PROBLEM EVOLUTION

This large collection of data collection and analysis through a variety of means has led this project in several directions. Ford at the moment is moving into the electric vehicle market where a lot of research and development is being done into improving the experience of the driver in this area. Throughout this extensive research mentioned in the earlier chapters of this report, it is clear that family cars are not only common in the Netherlands, but provide a huge market for Ford. This is a problem space that evolved throughout the research and will be carried forward through to the next stages of the design process; family cars in the Netherlands.

Within this family car context, several areas were explored through interviews, sensitising booklets and workshops. There were many different takes and opinions on this topic and it varied massively between age groups, however amongst further analysis there seemed to be a common theme regardless of whether it was the parents or child using the vehicle, and that was of a routine. The weekly routine of a family is relatively similar week in and week out. There are some anomalies within this routine, however, what is interesting is how the car can benefit the user.

These routines, as well as changes in routines, can be recorded and predicted with data collected by wearables (see section 2.2). These wearables are constantly collecting data from you, whether that be your hours of sleep, daily step count, heart rate or even just how long you have sat down. These data sets can be combined to measure and predict more in-depth pieces of data such as how stressed you are (Garmin, nd-b) through heart rate variability, whether you have been sat down for too long based on movement and heart-rate monitors, as well as how tired you are by looking at your recent sleeping patterns. It is these data sets that Ford is interested in collecting from a weekly routine of a family and looking further at how the car can react to it (figure 10). This could be through preparing a car based on the weather and amount of sleep you have had, or hinting at going to do groceries before your next appointment if there is sufficient time.

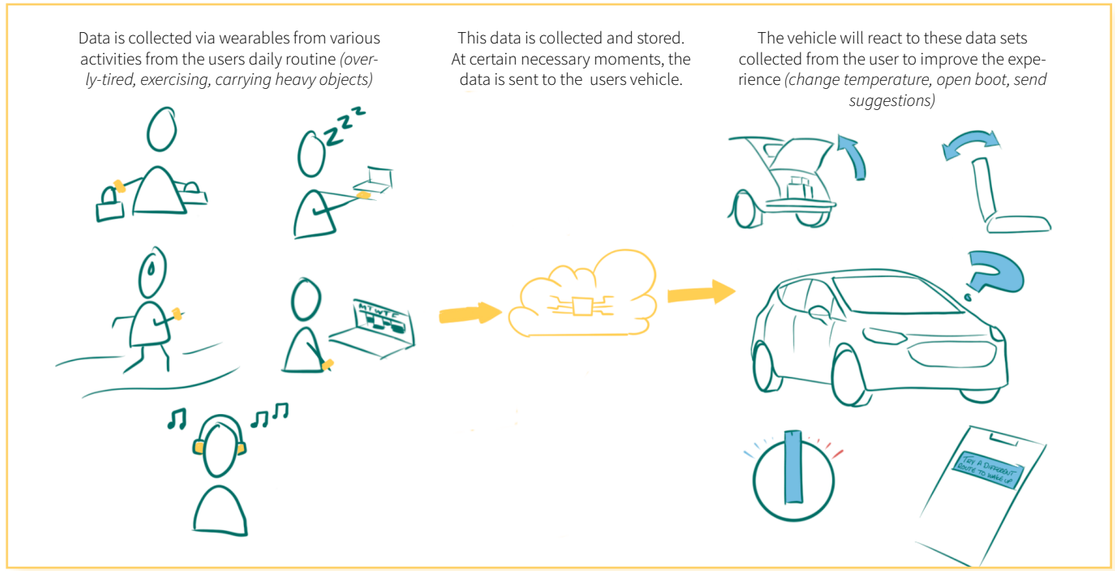


Figure 10: Potential scenarios within the problem space for the development phase of this project

Figure 11: The problem

4.2 THE PROBLEM DEFINITION

Based on the primary research in chapter 3, the problem definition could be defined as: ***'How can a wearable of a family car user measure data to predict and prepare them for changes in their daily routine'.***

Wearable	an electronic device that is worn as an accessory (such as a watch or phone), in this project the main focus is the Apple Watch, Garmin and Fitbit however can be used in collaboration with data collected by a phone.
Family car	a car that is owned and used by a family (with and without children)
Data	any piece of measurable information that can be collected via an external device, such as a wearable.
Routine	the daily or weekly activities that they consistently carry out.

4.3 USE CASE WORKSHOP

Within this context of the daily routines of family cars, there are several use cases. To go into detail about these specific use cases and reasons why families use their cars, a workshop was carried out. The goal of this workshop was to find not only the main use cases of family cars but also the micro use cases. For example, within the use case of groceries, there could be several micro use cases such as; doing the groceries alone, doing them with your child/partner, and doing groceries after work. This workshop was an opportunity to get details of users' micro use cases to create scenarios that have value to users.

The workshop was created in an online format and carried out by 8 individuals (see Appendix B for demographics). It was a semi-structured individual workshop, where participants were to use the template provided on Miro to either fill in or talk about the reasons why they use their family car. The first tasks were introductory questions such as '**What do you like and dislike about driving and owning a car?',** which led to participants' lists of the 6 main reasons why they use their cars (see Appendix I for the full list of tasks).

In the second set of tasks, the participants were tasked with choosing 3 of these 6, and going into detail about the micro use cases, as mentioned above. These micro use cases were specific touchpoints and action points from throughout the user's journey that was carried out, such as packing the car or choosing a playlist to play. From these, a journey was mapped out by the participant which paid close attention to the high points and low points, as well as thoughts and feelings along the journey.

Pilot test

A pilot test (figure 12) with two members of the Ford design team (see section 1.5: stakeholder analysis) was carried out in order to find points in the workshop that could be improved and adjusted in order to collect the most interesting and valuable results. The main changes that were made between the pilot (see Appendix H) and real tests were:

- Change the 'day' timeline (07:00 - 22:00) to a more broad timeline (before, during and after a journey) because users aren't using their cars the same way every day.
- Spread the tasks into different sections, so as not to overwhelm the participants
- Give participants a selection of emotions that they can choose from to avoid only the basic emotions (happy, sad, worried etc).

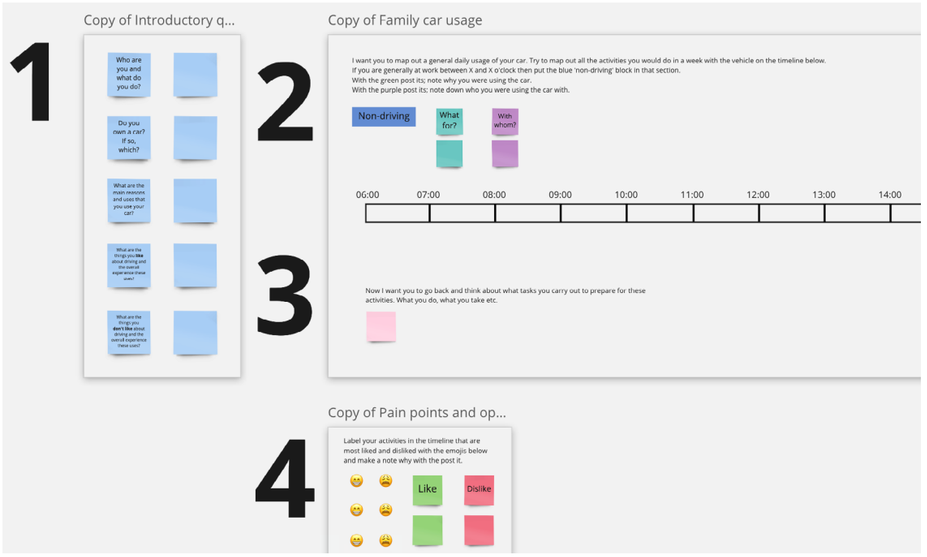


Figure 12: Pilot test set-up

Results

The results of this workshop lead to several detailed use cases from a variety of users. One participant, who was self-employed and therefore much more flexible with their timings, said that the main reason she used her car was for helping the kids out with extra-curricular activities. This could be taking them to see friends, helping out with school trips, or going to see sports matches of the children. Due to the fact this participant was so flexible, they also used the car a lot for short surfing holidays, both in and out of the Netherlands. They said that without their family car, it would be near impossible to spontaneously make these trips.

"Having the flexibility to go on these spontaneous trips with the kids led to a nice bonding time with them whilst they were growing up."

PARTICIPANT C1

Three participants mentioned that having a car was helpful when needed to do a weekly shop. The majority of the participants lived a drive away from the city centre, and this meant that when a large shop had to be done it was often with the car. One participant who also had a child said that they made a family day out of it on the weekend and combined it with some other fun activities, however, the fact children were present made the shopping experience more difficult with the loading, unloading and finding a parking spot not too far away from the centre. Two other participants said that having the car made it flexible to just drive past the shops on the way home from work if there was time to pick up last-minute groceries, however, it did require communication as they were leaving work to know what was needed from the shops. This was often via a list that was forgotten, or they forgot one of the items when they arrived home.

Six of the participants, all of whom were full-time employees, said that the number one reason they use their car is because of work. This varied between using the car to go to and from work and going on longer work conferences with several other people, however, the broad term of 'work' was the use case mentioned by the large majority of participants. When going into more detail about these general use cases, three participants said that they use the car to drop their child off at daycare on the way to work, as most of the time it was on the way. This journey provided a lot of interesting touch points and opportunities for the solution space, as there were negative feelings related to a rushed morning, but also the hassle around parking the car and getting out of the car just for the short trip in and out of daycare. There were also a number of positive emotions related to this, such as bonding time with the child, and meeting other parents along the journey who are also in similar situations.

There was overlap between participants going to work via daycare, and those going straight to work, as both groups of participants often had the day ahead of them on their minds. They all said that wondering about their day ahead and whether they will be in time for their first meeting was something that happened on the walk to the car. When participants first had to go to drop kids off, there was an external factor that could mean they were late, however, it was also the case that although not going via daycare, some participants had to make sure their child was ready for school before they could leave themselves. Depending on which situation the participant was in, it also determined which route they would take to work. This differed each day based on traffic and who was with them and was an extra task that had to be carried out before they were able to set off on their journey.

KEY INSIGHTS

These micro-use cases that were described throughout the use case workshop were very detailed and provided a lot of insighs. However there were a number of overlaps in the macro-use cases which allowed for variations fo the micro. These are documented in Appendix J. This also lead to the 3 focussed macro-use cases; taking kids to/from school, taking colleagues to/from work, and finally doing groceries.

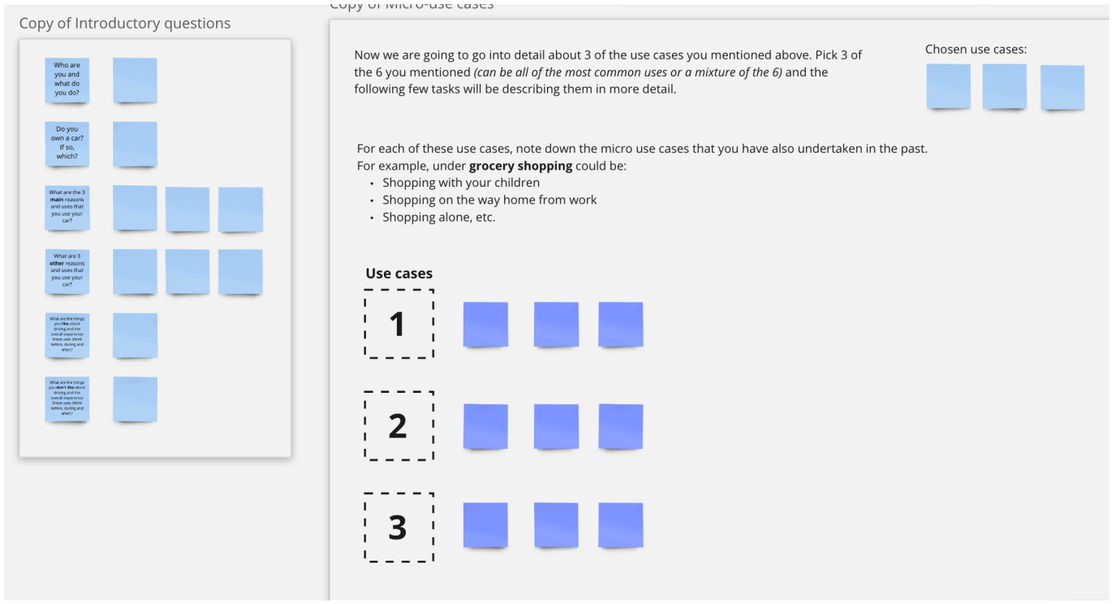


Figure 13: Use case workshop template, tasks 1 and 2

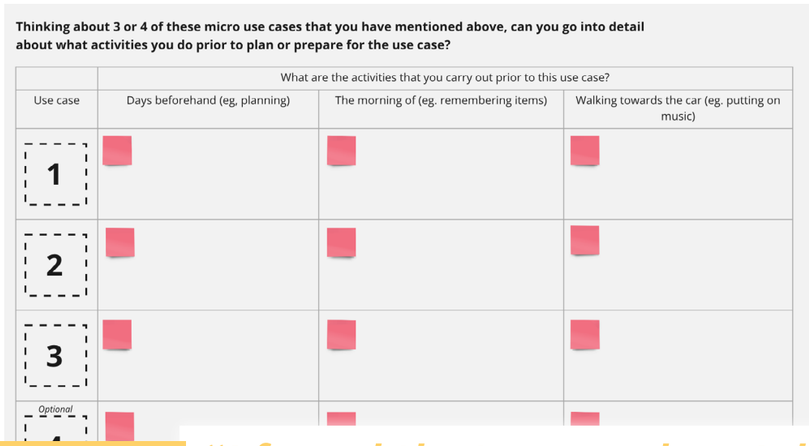


Figure 14: Use case workshop template, task 3

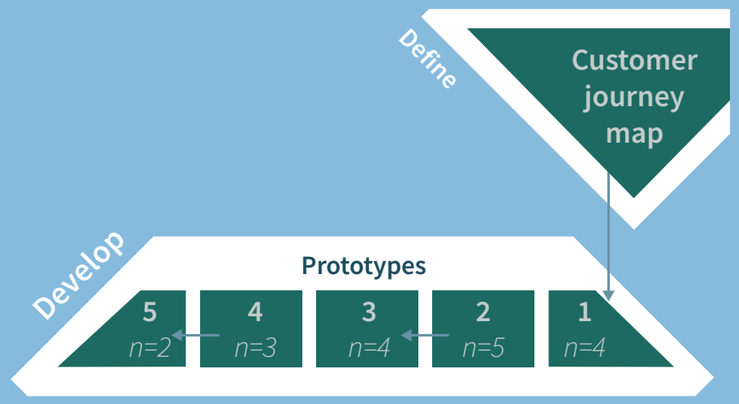
"I found that even when I didn't have to take my kids to daycare that day, I felt like I was missing something and my mind wasn't yet in the 'work mode'"

PARTICIPANT E5

4.4 CONCLUSION

The results of the Use Case Workshop meant there were a number of well-thought-out user flows on a number of different micro use cases. From this, it was possible to map these journeys against each other (Appendix J) in the form of day-in-the-life scenarios to see overlaps in data points and also potential opportunities or surprise/delight moments along the journey. It was clear that this transition between work and home was one of the main use cases and not only that, but it also contained several situations that were also visible in other use cases. For example, packing the children into the car can be seen when taking kids to daycare, and also when going on family trips. From this three **macro-use cases** came to light in order to give more of a focus on when venturing into the prototyping and developing phase of the project. These were; going to and from work, doing the groceries, and taking the kids to school. Knowing to look for a moment (micro-use case) along the various macro-use cases that fell under 'work' and 'trips' was useful for the next phase.

5.0 IDEATION



This chapter walks through the prototypes that were made throughout this project, the results that were gained from them, as well as how they helped with developing the project towards the final concepts. It will show the customer journey map that was created based on the journeys mentioned in the previous chapter (4.0) and which parts of the journey were points that either needed improving or if there was an opportunity to create a surprise and delight moment. These were then prototyped in various forms and tested with potential users.

5.1 CUSTOMER JOURNEY MAP

Based on the scenarios that came from the use case workshop (see section 4.3) it was clear that the transition between home and work was an interesting and opportunistic scenario to explore and map out further. A customer journey map (figure 15) was created, based on the three macro-use cases most related to the routine user; driving to and from work with colleagues, taking kids to and from school on your way to work, and doing groceries on the way home. There were several other use cases, both in and related to the transition between home and work, however, there was enough overlap in situations that any solution could be taken and put into the new scenario.

Figure 15: Customer journey map

	Preparing for the day			**Approaching the car**						**During the journey**		**Arriving at work/leaving car**		**Leaving work/approach to car**			**During journey home**			**Arrival at home/leaving car**	
Steps	**Ensuring kids are ready for school**	Packing bags	Packing lunch	Getting overview of day	Prepping route	Unlock car	**Put kids in car**	Pack car	Prepare for journey	**Take kids to daycare**	*Pick up colleagues*	Unpack car	Walk to office	Pack up work belongings	Check evening plans	Walk to car	Grocery shopping	**Collects kids form daycare**	*Drop colleagues at home*	Unload car	Unpack belongings
Key actions	**Packing lunch** **Checking after school activities** **Getting them dressed**	Packing laptop and all accessories	Checking what is in the fridge	Checking calendar for meetings Checking time for first meeting	*Asking colleagues if they need a ride* **Checking with other parents to pick other kids up** Checking route		**Open doors** **Put kids in seats** **Make sure they are comfortable**	Putting items in boot if there is a lot Quickly on the passenger seat if alone	**Entertainment for the children** Choose a playlist/radio station	Find parking space Lock car **Take kids inside** **Unpack kids belongings** Come back to car	*Message when arrived* Load car		Checking time *Talking to colleagues*	Close laptop Pack bags *Ask if anyone needs a lift home*		*Ask colleagues addresses* Sort out music and entertainment	Check shopping list Remember bags Pack the car with groceries Find parking spot	Find parking spot **Go into daycare** **Put kids into car** **Sort out entertainment**	*Open boot for their belongings*	**Get kids to carry bags**	
Thoughts	"I have so much to think about in the mornings" "Will be nice when they are more independent"	"What meetings and events do I have today?"	"We need more..."	"What time do I need to be there?" "What are the important meetings?"	"What is the best route?"		"I hope they stay still" "Make sure that the other child is sensible whilst I'm doing this"	"Do I need to save some space for other people?" "What needs to be near me and what can go in the boot?"	"What music do I feel like playing?" "What would be good for the kids as well?"	"Do I need to lock the car?" "I need to park as close as possible"			"Am I in time for my meeting?" "Did I lock the car properly?"	"Anyone need a lift home?"	"What do I need to do tonight?"	"What is the best route home?" "Which playlist should I play?"	"What do we need again?" "Do I have bags" "Is there enough space in the boot?" "Which supermarket is the best to go to/nearest?"	"Where can I park?" "Shall I go in or wait outside?" "How can I calm them down?"	"Which bags are theirs?" "What music does everyone like? If any?"	"Can I do this in one go?"	"Nice to be home relaxing"
Interaction points	Kids bags Phone/agenda	Electronics (laptop/tablet/charger)	Fridge and lunch items	Agenda Phone Physical calendar	Google maps Whatsapp groups Phone	Car keys Phone (if unlocking via app)	Children Doors Car seats	Car boot Bags Pavement Car	Maps Connecting phone to bluetooth Spotify	Kids bags Other parents Locking and unlocking car Making sure valuables are out	Phoning them to inform of arrival Bags in boot	Boot Bags	Lock car Checking phone Interaction with other colleagues	Laptop Phone Interacting with colleagues	Check agenda Message event stakeholders	Key to unlock Load car with bags Interact with colleagues	Bags List (on phone) (Coin for) Trolley Heavy bags	Parking payment Kids belongings Doors/boot Phone Music	Boot Google Maps Entertainment system	(Grocery) Bags Locking car Boot Checking for valuables	Laptop Tablet
Emotion																					
Pain point/opportunity point	Waiting for children to get ready Being rushed and tired	Remembering everything	Not having items in the fridge	Having a very busy day Not in the right mindset	Having to fill in a number of addresses Roadworks so will be late	Got to find keys	Make sure that both children (if there are 2) are being sensible whilst putting the other child in the car	Thinking about where to put stuff based on future passengers Packing in a rush	Knowing what type of music to put on Making everyone happy	Improving spontaneous interaction between parents Locking and unlocking car in quick succession	Having to wait Make interaction special and unique	Have a lot of bags	Dreading the day ahead	Reminder of the next day so know what you can leave and what you have to take	Have a busy evening Got to rush home	Can't find car in ca park Takes a while to get everyone in and ready	Forgotten what is needed The supermarket is far away Takes a long time Can buy something nice and spontaneous and	Nice interaction between parents Having to lock car and open for a short time Finding a parking spot	Finding the fastest route Not knowing music they like	Bags are heavy Checking everything is out Need help from other members of the family	

Prototype 3 *Prototype 2* *Prototype 1* *Prototype 4*

Legend:
General daily routine
Taking the kids to and from school
Taking colleagues to/from work
Doing the groceries

The key moments are marked on the map where there was an opportunity for either a surprise and delight moment or an interaction that could be improved based on the pain points of the users. These key moments were the inspiration behind the prototypes in this chapter. These prototypes were created to attempt to provide an enhanced experience at these moments.

5.2 PROTOTYPING

There were several prototypes produced throughout this phase, and they were focused on different stages along the journey. The prototypes vary between developments on each other, and a solution to different points along the user's journey. Each of these ideas was tested with several people, ranging from 2-5 who were selected based on availability and from interaction with this project prior.

Prototype 1

Prototype 1 (figure 16) is a digital idea that would be used when the user is leaving work and is due to do groceries for dinner. It focuses on the approach scenario to the car when leaving the office, as well as the leave scenario when walking away from the car and to the supermarket. The data collected from this flow range from messages on the phone, to activity data on the watch and the digital interface, which reacts accordingly.

As the user is leaving work they choose what they want to make based on the amount of activity they and their family have done during the day or are planning to do in the evening. These recipes are suggested to you based on this data and then based on the choice, the user is sent the list of what is needed from the grocery store as they are leaving the car and heading in.

The goal of such an idea would be to make life easier for parents going to do groceries after work. It also allows a family interaction and choice when choosing what to eat tonight, and automatically creates a shopping list when the user is entering the shop.

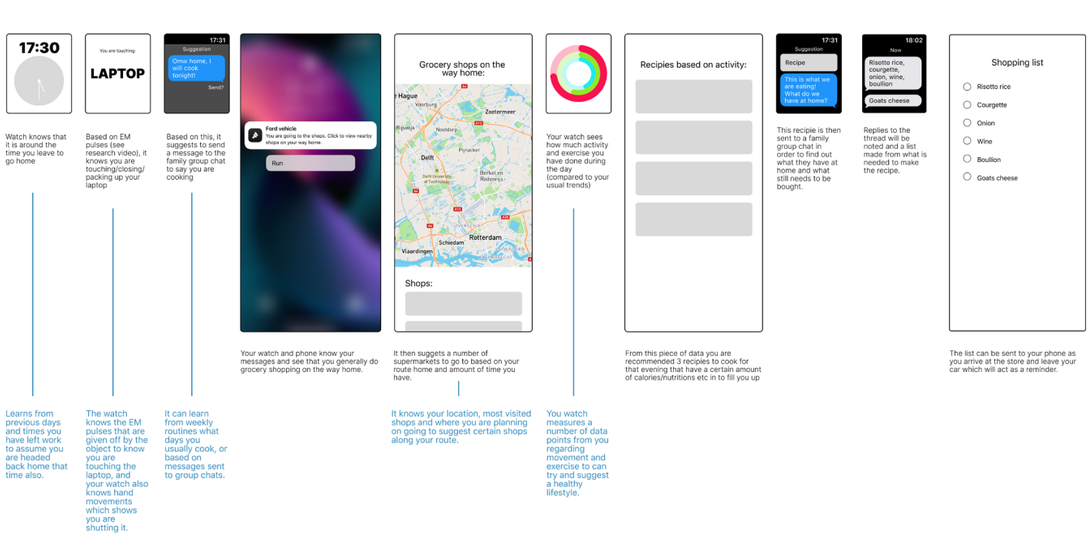


Figure 16: Prototype 1

Feedback 1 (n=4)

This idea has a lot of scopes. Some aspects are really useful to the user, such as suggesting the recipes as a family based on evening plans (going to the gym, just having a chilled evening etc), as well as looking at data from the children and what their plans are. This aspect was interesting and users thought could be a nice feature and **interaction at the end of a long day**. However, there was a common theme among participants that this had **no real connection with the car**, and could be its standalone application by any company.

Prototype 2

The second idea acts as a form of stress reliever and a way to take the user's mind off work on their way home (figure 17). The intended use is on the approach to the car when leaving the office, however, it has the versatility to be applied to several other scenarios.

Data is collected from the wearable throughout the day, such as heartbeat, calendar data and sweat, and based on this will suggest several activities to do before you get to your car. These activities are aimed at triggering interactions between the user and other surrounding objects. Simple tasks like 'take a photo of a blue car', or 'what are you most looking forward to this evening' is a mixture of physical and mental exercises that allow the user to rest by the time they get into the car and go home to their family.

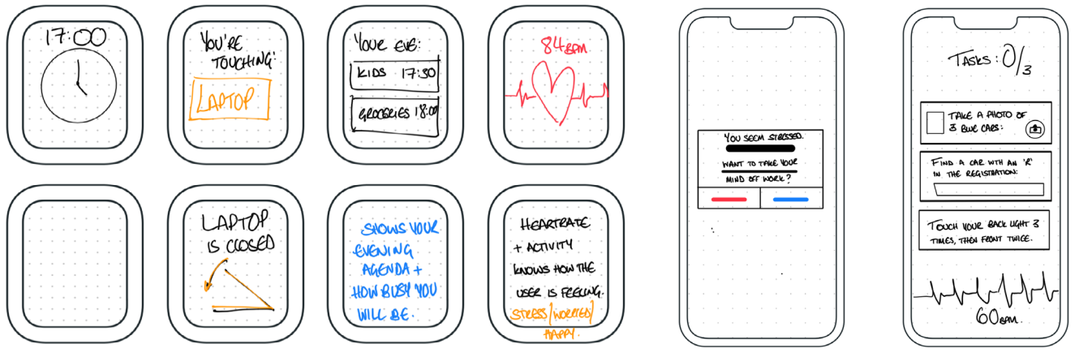


Figure 17: Prototype 2

Feedback 2 (n=5)

Participants were generally strongly against having to do extra activities after a long day of work. They saw this time as a time just to do nothing and be relaxed and not want to do any more unnecessary tasks. ***"It is annoying if you just want to get into your car and go home, and suddenly all these unwanted tasks are popping up"***. It is much nicer to take some time to look around rather than look at your phone all the time.

On the other hand, 2 participants mentioned that this idea could easily be used in different scenarios, such as with kids to get them ready for school or to calm them down after school. It could also be used as a nice time to have some interaction with your child after school and work.

Prototype 3

The third idea was the development of the previous prototype. Based on the feedback from the activities it was clear that this idea was not so well suited to an office setting, but rather could be used for children (figure 18). This idea aimed to encourage children to leave the house on time and get used to a routine. This could be used in the morning to get out of bed and to school on time, or in a more relaxed setting like preparing for a weekend trip.

The features are similar and it uses game-like tasks such as 'high five parent as you leave the door' or 'take a photo of your packed lunch' and gradually leads them towards getting into a consistent routine.

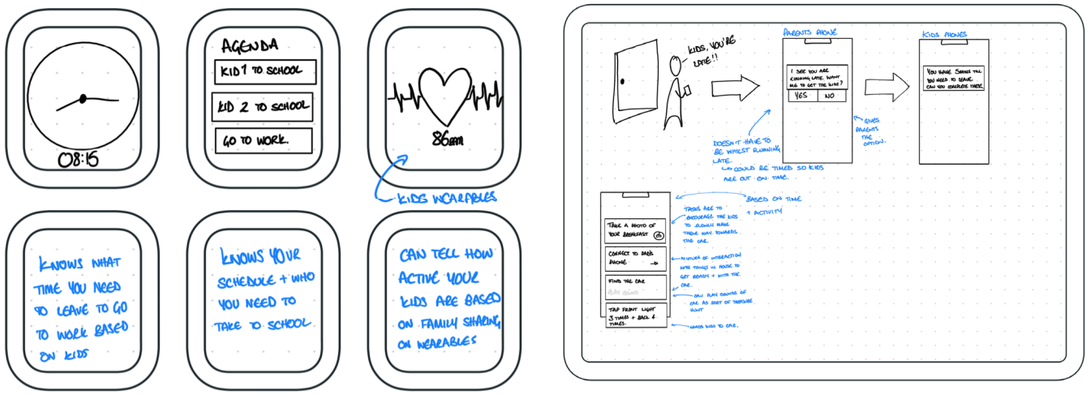


Figure 18: Prototype 3

Feedback 3 (n=4)

This idea was split amongst participants. On one hand, the idea of helping kids with their morning routine was extremely useful and is something that could be used in a real setting. It **elevated a lot of the stress** in the mornings that parents had which is something that is not touched upon currently. On the other hand, there was a big **worry** amongst participants that this would **encourage kids to be on their phones at all times**, and there is the **safety aspect of kids** running outside to try and complete the task without really thinking about where they are going. There were a lot of unanswered questions that came about from users using the prototype. The idea of **helping out the parents in what usually is a stressful morning was a common positive point** about this idea.

Prototype 4

As a direct response to this term of routines, this idea learns your daily and weekly routine from you the more you use it. The idea is a day-to-day app (figure 19) that the user would use for their calendar and emails, and as you go about your routine it adds suggestions to the calendar. For example, it seems that you are always leaving the house to go to drop the kids off at school at 8:30 am, and therefore it adds that event to your calendar, as well as the location and reacts if there are any changes. If the user is delayed for a reason, then it will trigger a reaction via the phone or the car as a response to this.

It would also connect with various family members and know when they also use the car, or when they accompany the main driver, and the car could change seat position, localised environment or even destination accordingly.

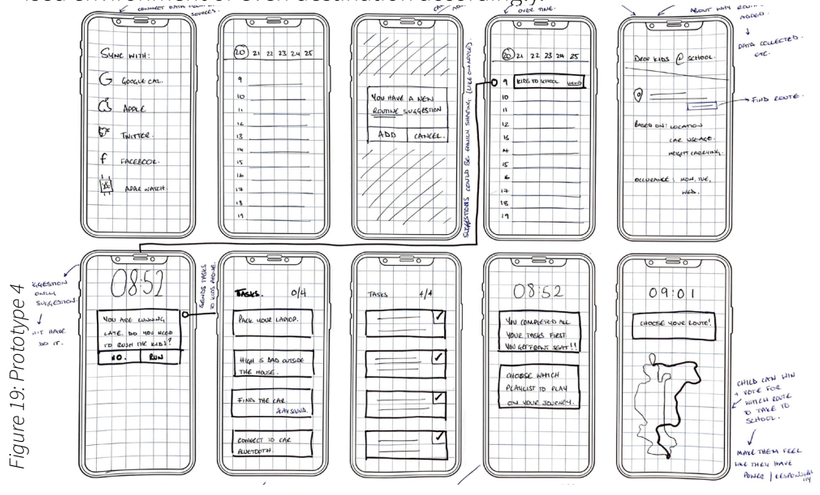


Figure 19: Prototype 4

Feedback 4 (n=3)

The **learning aspect of this idea** was one that all participants thought was **interesting**. During discussions prior, it often came up that the user could input data before they use the car (home location, work address, number of children), however with this learning from the wearable data, it is a **sleeker feel and more connected experience**.

The fact that it is a stand-alone application, was not as liked by 3 participants, however. ***"Why would I use another organisational app when there are so many already? I don't want to feel as if I can't use my car properly if I don't use this app."*** One participant said that they didn't per se need to see all the backend side of the workings, but rather would like the car to react regardless of what was in my schedule.

Prototype 5

This idea is a development of a feature of the previous prototype. It focuses on this change of mindset and preparing users for either heading to work, or heading home (figure 20). This feature organises the user's evening plans based on what they are and where they are going. It would give a broad overview of what the plan is and suggest an order to do it. This would be a suggestion and allow the user to play around with the order because the goal is to get the user into the mindset of their next activities.

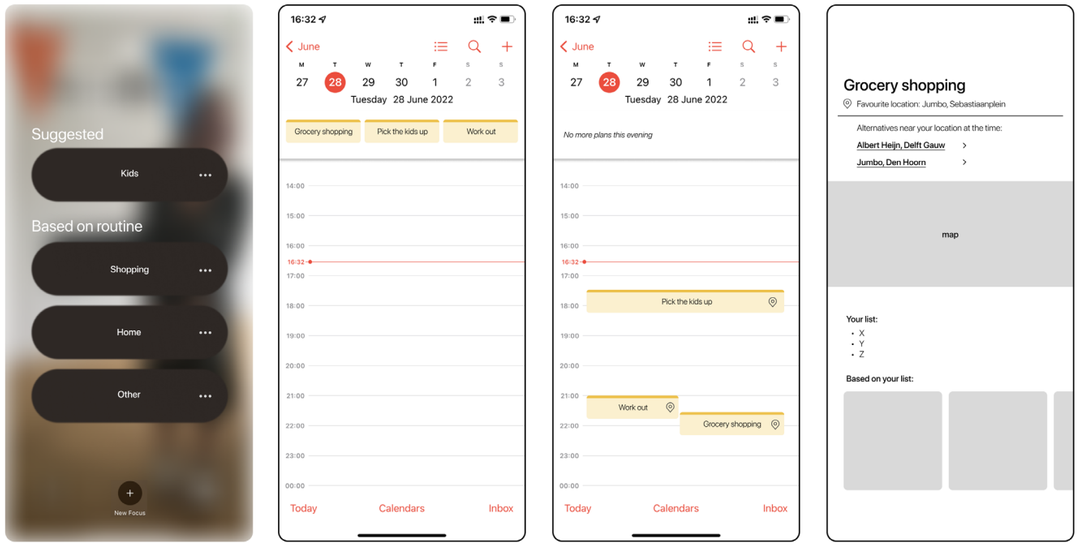


Figure 20: Prototype 5

Feedback 5 (n=2)

This idea was tested with 2 participants, and the main piece of feedback was that it was too confusing. Planning your evening in your agenda is already ***getting the user into the mindset*** of what they are doing in the evening. Having suggestions on where to go and potentially information about the route, along with reactions from the car, would be useful and make the evening run more smoothly. However, ***having the application change your agenda*** automatically based on these would be something that both participants would ***be against.***

5.3 CONCLUSION OF IDEATION

The iterative development and feedback of these ideas and testing of prototypes were insightful. There were moments along the journey where there was an opportunity for improved or new interaction which was what was developed in a number of these prototypes. It was clear throughout that participants felt that some of the ideas behind these were interesting. There is a much bigger picture than just one moment in this journey. Encouraging kids to get into more of a rhythm, setting the internal environment of the vehicle based on mood and getting your head out of the work mode are all interesting ideas, nevertheless, they should not be only used in one or two specific moments along a journey, but rather throughout it. Below you can see a list of requirements that is set up by rephrasing the insights from the ideation phase.

Ford experience

- The system should be connected to the car and the user in the right way
    - By being a silent encourager, so does not motivate the user to be more on a device
    - By interacting with the user when it is safe to interact (e.g. not whilst driving)
    - By using existing apps and collected data to know and learn the routine of the user

Decision making

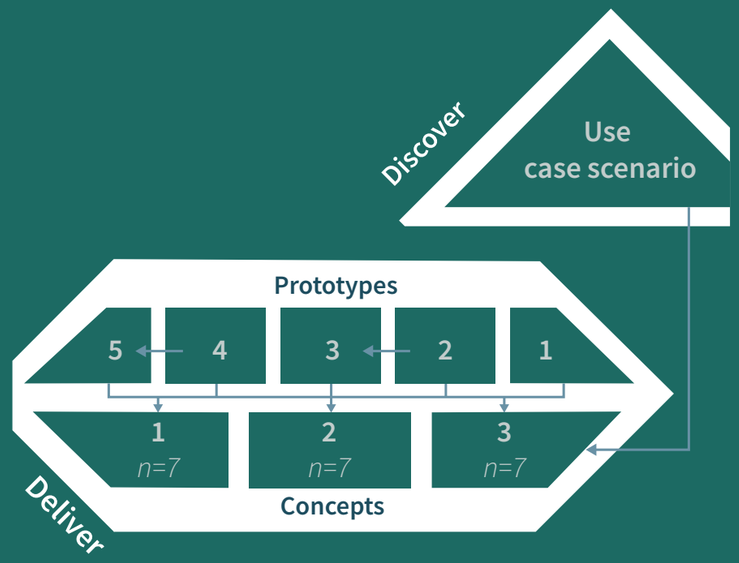
- The system can guide the user in making the right or better decision in different situations
    - By being able to recognise stress levels, temperature, location, people around, ...
    - By knowing what the current routine of the parent is and what changed (AI)

Suggestions

- The system can help the user go through their day
    - By being able to suggest useful and worthy tasks, tips or inspiration
    - By giving planning suggestions (note: the system can not decide for the user)
    - By helping with structuring kids before and after e.g. school or sports activities

These requirements can be taken into account in the conceptualisation phase. A service such as this can collect huge amounts of data from the user and use this to make the user journey more efficient from start to finish. ***"It feels as if the car could be my assistant and that someone is taking care of me"*** is a resonating quote, as the ideas behind each of the aforementioned prototypes could be used in a 'day in the life' scenario and help the user at each step. These insights that were gained from testing a number of prototypes led to the list of requirements. In order to converge toward a final scenario, some well-defined concepts had to be created to get feedback about the aiding aspect a car would have in the 'day in the life' of a user.

6.0 CONCEPTS



This chapter talks in detail about the three concepts that came about from the ‘day in the life’ journey that was mentioned in the previous chapter. Three concepts were produced that show different day-in-the-life scenarios of a user of a family car. The concepts stay true to the focus of the transition between home life and work life. Furthermore, they show how the vehicle would react to several different inputs and situations.

6.1 THE SCENARIOS

This chapter talks in detail about the three concepts that came about from the ‘day in the life’ journey that was mentioned in the previous chapter. Three concepts were produced that show different day-in-the-life scenarios of a user of a family car. The concepts stay true to the focus of the transition between home life and work life. Furthermore, they show how the vehicle would react to several different inputs and situations.

From the feedback gained from the Use Case Workshop mentioned in chapter 4.3, a number of user journeys were created (Appendix J) that touched on all the scenarios and use cases that a driver would encounter throughout the day. This started from waking up in the morning, all the way through to unpacking their bags once home in the evening. There were several different scenarios within this user flow such as dropping kids off and picking them up from school, doing groceries after work or just going straight home. This user flow contained all the ways in which the vehicle could help the driver on this journey and make it a more efficient journey, almost acting as their assistant.

As mentioned, this larger journey contained several scenarios. The most common of the ‘day in the life’ scenarios were chosen which included a large number of micro use cases and touch points with the vehicle. These three scenarios were then acted out, using the act it out method to allow potential users to get more of a sense of the scenario and give feedback on them.

Each of the three scenarios (macro-use cases) shows several micro-use cases where the vehicle reacts to the data from the user. They range from before the journey, whilst the driver is in the vehicle, to after the user has left. The three scenarios contain use cases that are specific to the scenario (opening the boot with heavy bags), some are more general and can be used over a number of different scenarios (playing a certain playlist when you step into the car).

6.1.1 Scenario 1 (figure 21)

The first scenario portrays the situation of going to work and, after work, spontaneously driving home with a work colleague. Throughout this scenario there are a number of interactions with the car, starting at the beginning of the day with the user leaving the house in the heat, as well as the car automatically showing the driver an overview of their day to get in the right mindset before work. Below is a user flow of the actions from the user, data collected by the wearable and the reaction from the car. The goal of this is to show potential users how the car would react to the user’s headspace, as well as other unforeseen circumstances.

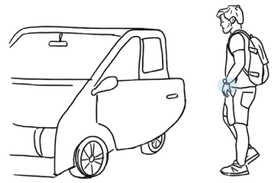
QR to scenario 1 video

Data collected

Outside and car temperature measured, as well as what time the user usually leaves.

Bluetooth connection and proximity to car

Emotions, exercise you have done, time until your first meeting



Reaction

Car automatically turns on heating/air con

Door opens when user is near for ease of entering

Internal conditions are adjusted based on mood and emotions (music, temperature), parking suggestions are made

Data collected

After work activities (agenda)

Location of car from office, next event on agenda

Reaction

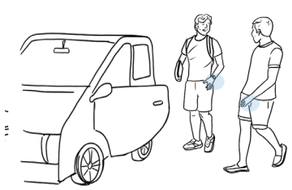
Reminder of after work activities to slowly trigger mental preparations

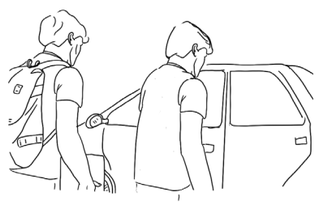
Suggests time when user should leave based on next event

Data collected

Bluetooth of two devices are linked, proximity to car, demographics of 'new' passenger

Home address of passenger, music preferences





Reaction

Suggests to the vehicle that there are two people using the car, and reacts by opening two doors (passenger and driver)

Inputs the address and route of passengers, and plays entertainment based on mutual preferences

Figure 21: Scenario 1

6.1.2 Scenario 2 (figure 22)

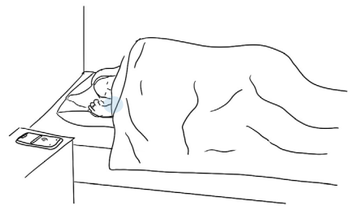
The second scenario shows the situation of doing groceries after work. Throughout the day there are reminders both for events during the day, as well as after work and at the grocery shop. It shows the car reacting in certain ways based on who approaches the car, as well as approaching the car carrying several items. The storyboard of the scenario, as well as the data collected to trigger a reaction, can be seen below.

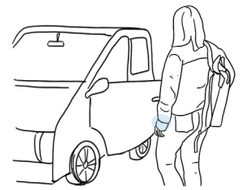
Data collected

Traffic on usual route, time driver usually leaves. sleep cycles

Outside temperature, car temperature, time driver usually leaves

Proximity to car, bluetooth connection, number of passengers





Reaction

Your alarm will automatically be altered based on severe traffic on your usual route

The air con or heating will turn on to make entering the car as comfortable as possible

The car doors will open based on number of passengers

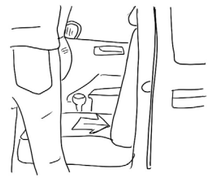
Data collected

Number of bags carring, number of passengers

Emotions, daily exercise, temperature

Evening activities, daily exercise

Shopping list, favourite supermarket, location, time, car battery



Reaction

Passenger seat will move back if alone, so it is easy to place bags on there.

Internal conditions (music, temperature) will adjust to suit the user, and route and parking spaces will be suggested

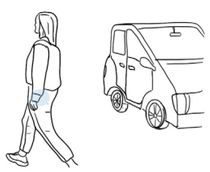
An evening overview will be sent to their phone in or to get their mindset prepared

Recommendations for supermarket locations will be sent to the car for the user to choose

Data collected

Proximity to car, location, direction of travel

Proximity to car, bag weight, sweat, heartrate



Reaction

Shopping list will be sent to drivers phone as a reminder as they walk to the shop.

The boot will open as your are arriving to the car in order to allow you to easily load your boot without dropping items

Figure 22: Scenario 2

QR to scenario 2 video

6.1.3 Scenario 3 (figure 23)

The final of the three scenarios is taking the child to and from school. As with the previous two, it starts in the morning and shows how the car reacts to a child being with the driver, goes through the day both on the way to daycare, and to work, and ends with picking the child up from school. The aim is to show how the car reacts to different members of the family, knowing who is in the car and how to make the journey of those users efficient also. The storyboard of the scenario, as well as the data collected to trigger a reaction, can be seen below.

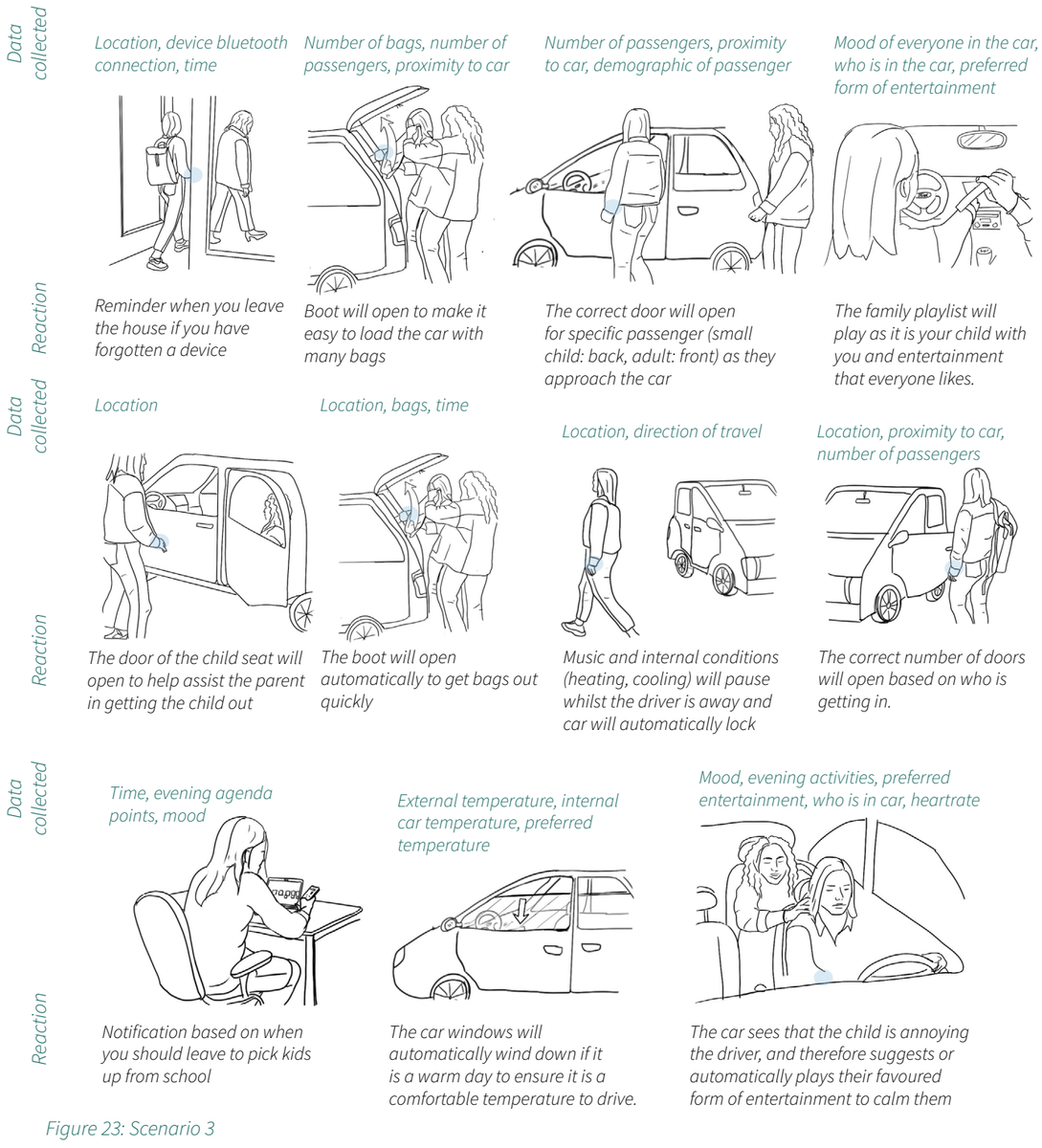


Figure 23: Scenario 3

QR to scenario 3 video

6.2 TESTING SET UP

These three scenarios were then acted out using the role-playing method (Role Playing | Service Design Tools, n.d.) and three small videos were created. To get feedback from potential users regarding these scenarios, a test was carried out with 7 participants from varying demographics by showing these videos. The goal of this test was to find the value that such a service would have on a user, as well as which situations and use cases were interesting and could be taken and developed into a final scenario.

The test followed the structure of introductions to the project, what the context is and why the test is being carried out. This was followed by showing the participants the three videos consecutively, allowing for time to ask questions in between each one if needed. Once all three videos had been seen by the participants, a semi-structured discussion took place which sparked a conversation rather than short answers to questions. Some questions were prepared in order to guide the user through the discussion. These were only asked when there was a lull in the discussion, and were designed to inspire the participants. These questions were;

1. What are your first impressions?
2. What would you expect to gain from such a service?
3. What did you like and dislike about the service?
4. What would you change or improve about this service?
5. Which of the three scenarios would you recommend for a friend or family member?

Throughout, particular emphasis was put on the participants to be as specific as possible in regards to the specific use cases of the scenarios, rather than the idea behind each scenario itself.

6.3 RESULTS

Upon analysis of the user tests, there were several interesting points both that participants saw as potential points for development, but also use cases to look at from a slightly different perspective. All participants said that the vehicle was **creating a relaxing feeling** by automatically carrying out tasks, for example, opening the doors or playing music automatically. One participant said that it “felt like the car was looking out for the driver, rather than the other way around”, and by two other participants, there was an **‘assistant’ feeling** that was enjoyable and also a **playful aspect** that would be something they would ‘show off’ to others about.

Creating a personalised environment for either the passenger or driver was a use case that was picked up on by 6 participants as being **unique**. This is where the benefit of wearables is as they can collect accurate data from the user from heartbeat, mood, and sleep patterns in order to create a comfortable environment within the car. The different music based on who is in the car and time of day was an example of how this could be used effectively in a way that users would find seamless with their day-to-day use. Recommendations for how this feature could be improved included **adjusting temperature locally to the passenger** (seat or surrounding temperature), **seat position and lighting**. All of these suggestions could potentially reflect the user’s mood at a particular moment in the day and improve the driver’s experience.

Although not directly related to an interaction with the vehicle itself, **reminders for kids’ school items as well as personal belongings** before your journey proved to be extremely popular amongst parents. Of the 4 parents who were spoken to, all 4 said that this would be a feature that they would use every day. It was often that they would get to daycare forgetting a piece of paperwork or important document that was needed. ***“It would be useful to have a moment just before setting off where I can pause to see if I have everything”***. In the current scenarios, there is a reminder on the phone, which was liked by users. Moreover, it was mentioned that although this has value to the user, it would not be as much value to Ford themselves.

Opening and closing doors/boot automatically had mixed reactions from the participants. Although everyone saw it as a nice novel aspect, parents with young kids found this more useful than participants without. Having to carry your child and also open the door, amongst other tasks, is seen as quite an annoyance and with automatic opening and closing, this challenge is counter-

acted. One participant spoke about being able to hold their child's hand in busy environments, and automatically opening the doors allows for this, as opposed to having to do it manually whilst also carrying other items. There was the worry nevertheless, of doors opening when they shouldn't and potentially putting children at risk. For example, if the door opens on a busy road and allows the child to leave without it being the parent's intention.

A participant without children was wondering about the value it brings to the car and the cost of implementation compared to the value it brings to the user. In a typical travelling to work situation, it is rare that the driver cannot open his or her door on their own, yet if, with a fault in the system, all four doors opened, the time it takes to walk around and close all of them would be much longer than opening them manually. This point was countered by another participant who said that such a feature may or may not be as valuable in certain situations. The ability for the car to react to different use cases and knowing when the right time to react is what is more valuable than the reaction itself.

"The unique point is that the car is versatile enough to transition between a grocery car when doing groceries, to a child transporter when with kids"

PARTICIPANT C4

Figure 24: Participant responses quesitons 1

6.4 DISCUSSION

As a result of these tests, a final concept scenario will be created that is a development of the three scenarios above. There are a number of factors that came up when talking to participants that they saw were interesting and in some cases, a necessity. Whilst also focussing on this surprise and delight moment, a list of requirements was created:

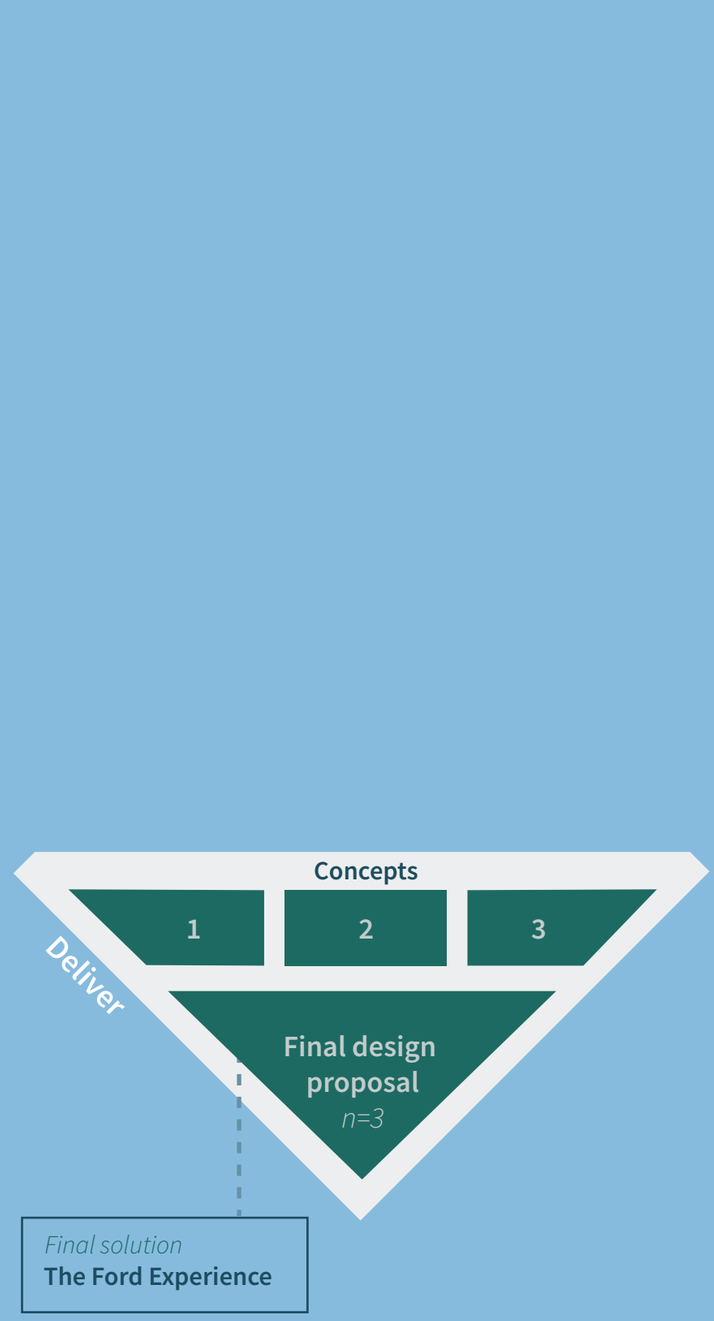
- Focus more on the personal data that is collected by wearables from the user, rather than the agenda and external conditions. These are also interesting, and should not be ignored in cases it improves the driver's experience. More personal data creates a more personal experience.
- Creating a car that is flexible to users in different scenarios is what makes this service unique, so knowing who is where and when is something to focus on in the final concept.

These tests brought up the aspect of routines and that the vehicle knows the driver's routines, however as mentioned by a participant "how does it work?". There is great detail into the useful features that it does, however, is not so much information on how it works.

There was the idea brought up of a 'learning period' where the vehicle over the first weeks of usage would not react in any particular way, but rather learn what the driver's routine is. Where they go, what time they go and whom they go with can easily be picked up based on location data, car usage and weight on seats. However, there is an opportunity to help the system learn by the user by communicating with it at times throughout the learning period, such as who is driving, who is the passenger, and confirmation of addresses, in order to provide the best possible experience once the learning period is over.

From this, the car can react based on changes in this routine, or changes in the driver's mood and passengers in the car itself in order to make the journey more efficient.

7.0 THE SOLUTION



This chapter will discuss and describe in detail the final design proposal that came from this project. It includes what the service is, how it works through the use of data, as well as the value it provides to the user. The format of the final design is a digital service, which includes an onboarding application for the driver, as well as a learning period before the main use. The experience of the service is of a similar format as the scenarios in the previous chapter (chapter 6: concepts) and would help improve the daily routine of the driver and passengers, as well as making it more efficient.

7.1 THE SOLUTION

The testing carried out with the previous three concepts led to valuable feedback. It was clear which aspects users found interesting and very unique, as well as which aspects they saw to answer some pain points that they currently had along their daily journey. Not only that but it also raised the question of how. There was not so much information in the previous scenarios as to how this service would work, as it was more focussed on what it does. As part of the final design, an application is used for the onboarding part of the experience.

7.2 THE FORD EXPERIENCE APPLICATION

In order for the service to be used to provide the most value to the user, an application was developed that served as the 'set-up' of the service. This application (figure 25) is a development of the testing and feedback of the prototypes described in chapter 5: ideation. This is what users would use when they first get their car, and in the first few weeks of the 'learning period' (see later in this chapter). Not only would the Ford Experience app be used at the beginning, but it would also be used throughout in order to make adjustments to the service.

Figure 25: The Ford Experience application

The Ford Experience service consists of 4 main features where moments of interaction with the car occur:

- **Opening doors:** this is the feature that triggers the vehicle the open the doors depending on who is walking towards the car for usage. The vehicle knows who is walking towards the car based on the time of day (and usual trip at this time), as well as Bluetooth connection with the user's wearable. Depending on who is set to be in the car, the correct door will open. For example, if alone, only the driver's door will open, however, if there are children present, then the back doors will open also. This is also the same for the boot, which opens depending on whether there are a lot of bags required to be put in.

- **Preparing vehicle:** This feature uses the personal data from each user in the car to pre-set the internal conditions to best suit them. It knows who is in the car based on a Bluetooth connection to the user's wearable and knows their favoured settings through the learning period. The internal conditions consist of the temperature, entertainment (playlist/radio station), as well as seat position. This is done as the user steps into the vehicle in order to make the journey efficient.

- **Parking**: the parking feature is used mainly in tight areas. The vehicle will automatically park for the user if there is a tight parking space to get in and out of. The user can exit the car when lined up, and the car will drive into the parking space. The opposite happens when the user is walking towards the car in order to leave, in that it will drive out of the parking space to provide easy access and no damage to doors. This will also occur when the boot of the car is too close to a wall, and the car will drive so that access to the boot is possible.

- **Suggestions:** Based on where the user is, where they are going and what items they have with them, the vehicle will send the driver a notification to alert them if they have everything they need for the day ahead. For some items, the vehicle can connect to Bluetooth, such as phones, tablets and laptops, however, for the items where this is not possible, this notification is used merely as a moment to pause and think.

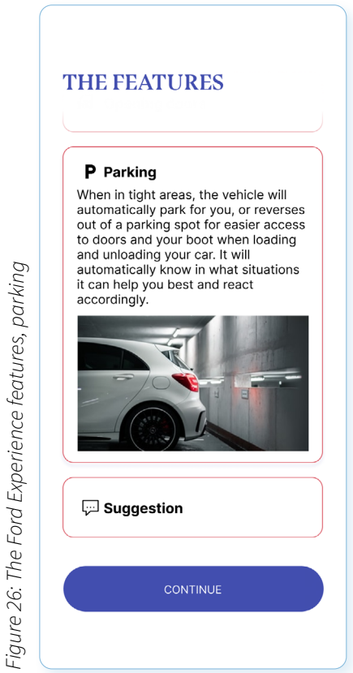


Figure 26: The Ford Experience features, parking

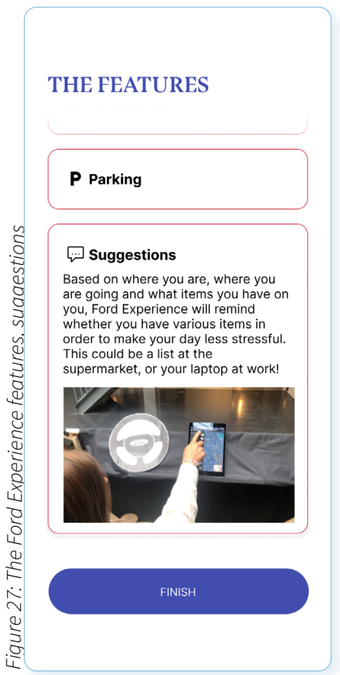


Figure 27: The Ford Experience features, suggestions

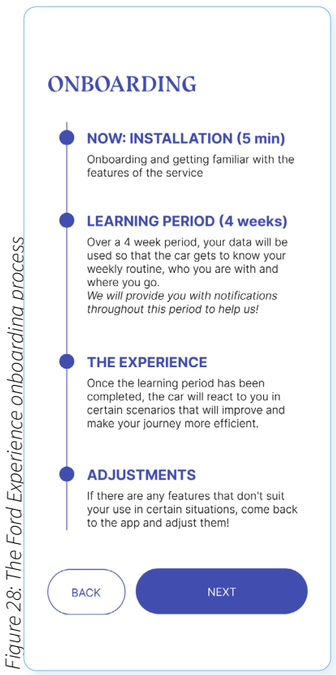


Figure 28: The Ford Experience onboarding process

The service is split into 4 phases of use; onboarding, learning period, the experience, and adjustment. Throughout the onboarding phase, the application walks the user through the 4 features as seen above, as well as showing examples of how these features would work in certain situations (figure 26 and 27). The application is also used to describe to the user these 4 phases and how long they would take (figure 28).

7.2.1 The learning period

The learning period is the part of the service that creates its personalisation and versatility of it. Throughout the first month of usage of the car, none of the aforementioned features will work for the user. This is where the car collects and learns the routine of the user to use for later in the experience. It learns where the driver goes, at what time and with whom. With this data, it creates agenda events **(figure X)** in order to build the reliability of the service and create an improved experience.

Not only does the service collect the above data sets, but also personal preferences such as seat position, body temperature, preferred car temperature and entertainment method on each of these journeys are set in the agenda. This data is collected not only from the driver but also from any passengers that are in the car for specific journeys. When the vehicle detects a new passenger on one of the journeys (via a wearable or smartphone), the main driver will receive a notification from the car after the journey asking who the passenger was (friend, family member, colleague) **(see figure X)** in order to collect who joins on which journeys.

The data from the passenger is dependent on what device they own, however basic data will always be collected such as seat position, internal temperature, music choice and which seat they sit in. This will be collected each time the same passenger is in the car and eventually at the end of the learning period, will be automatically set as the passenger steps into the car (see figure 32 for internal logic and figure 33 for the passenger logic).

This learning period is not only carried out in the first month but is constantly being carried out based on new passengers or changes in routines, however, it is in this first month where the majority of the data is collected.

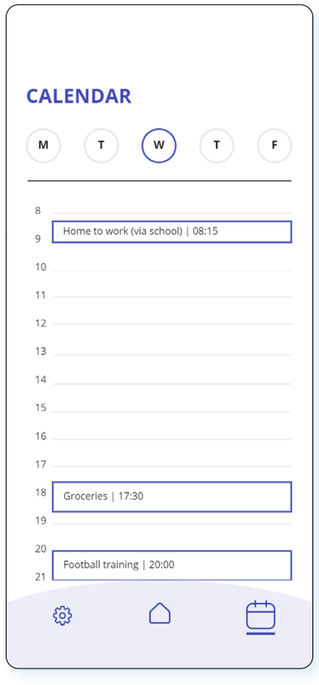


Figure 29: The agenda created through the learning period

Figure 30: New passenger notification

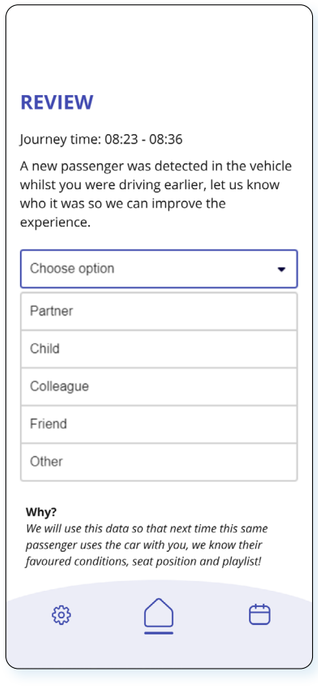


Figure 31: New passenger confirmation

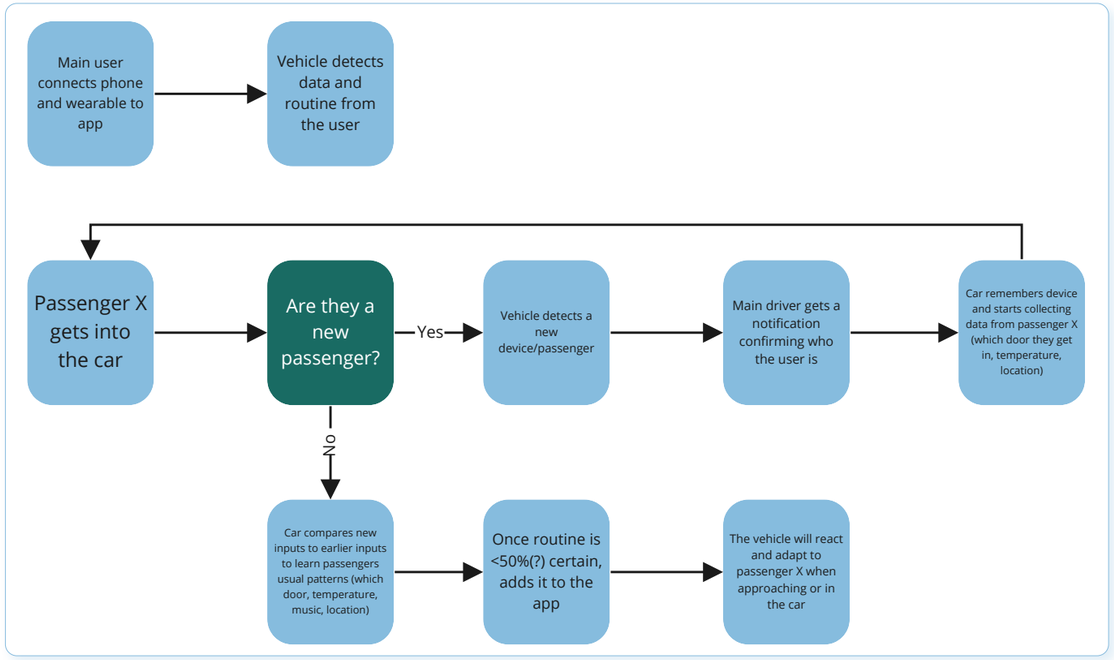


Figure 32: The learning internal logic

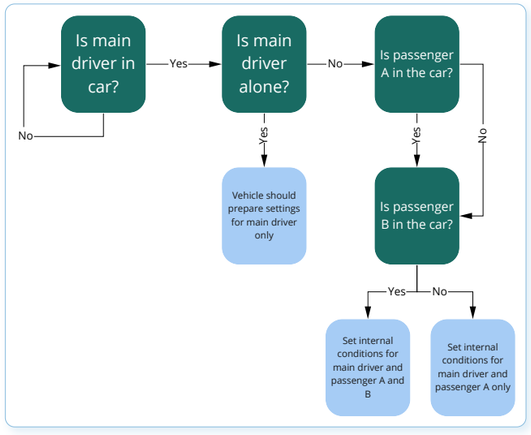


Figure 33: The passenger logic

7.3 THE FORD EXPERIENCE

The Ford Experience is where the main service can be seen. After the 4-week learning period, the vehicle begins to react to certain triggers from the user. As seen in the concepts in the previous chapter, the experience does not focus on one moment of the user's journey, but rather on numerous moments through the user's day. There is a significant emphasis throughout the service on the scenarios approaching and leaving the vehicle as mentioned throughout the design process, however, they are not limited to these, as the service focuses on improving the efficiency and experience of the user, which can be extended to before they leave home for example.

KEY INSIGHTS

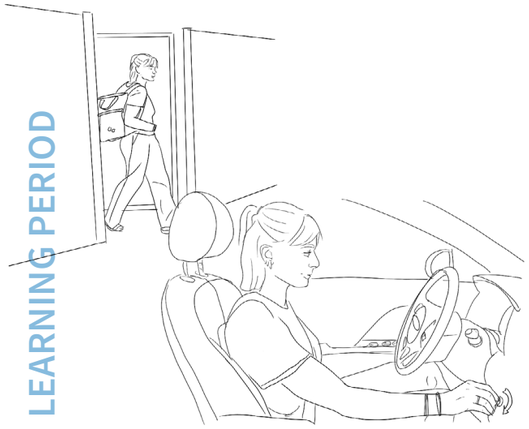
The final scenario is not in any way limited to what can be seen here. What is shown is a small example of the possibilities of how a vehicle can react to certain data inputs, with the inputs listed below (see table 2). The main focus of this is how the service would work, whilst also being able to show what it does through examples. I envision the future of such a service to be full of innovative interactions with the vehicle and triggers from the user.

A day-in-life scenario can be seen below which shows a selection of the main features of the vehicle to help the user in daily life:

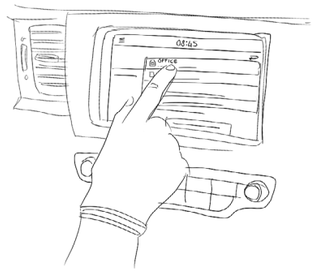
ONBOARDING

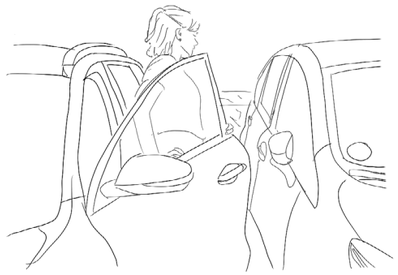
The user will download the Ford Experience app and run through the onboarding process which will explain each of the features of this service.

LEARNING PERIOD

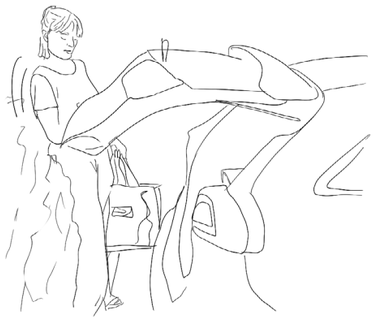


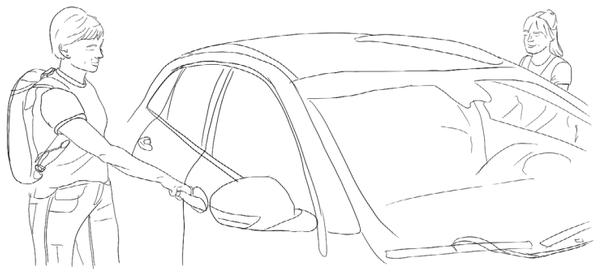
Once the onboarding process is over, the car will start learning the users routine through the use of data (location, time, car use, etc). It will learn things such as when you usually leave the house for activities, seating position, temperature and favourite playlists.





It will also learn how the driver interacts with the car in various situations, such as when grocery shopping or dropping kids at school. It will remember where kids sit in the car or where you usually put the grocery bags after a shop.



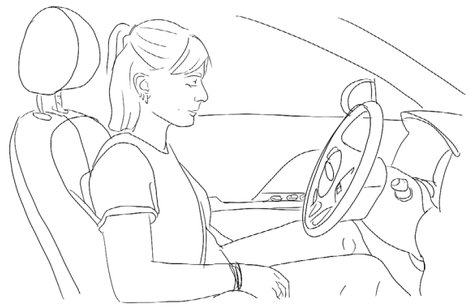


The system will also see how passengers (colleagues) interact with the vehicle. Where they enter, what temperature they set and what music they play when in the car.

When a new passenger has been in the car, the driver will get a notification asking who the passenger is, in order to keep learning the preferences of the passenger to enhance the experience.

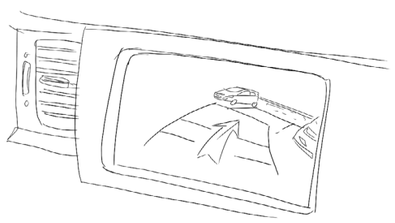
THE EXPERIENCE

After the learning period, the driver will start noticing the help the system provides. For example they will get a notification before they need to leave to ensure they leave on time.



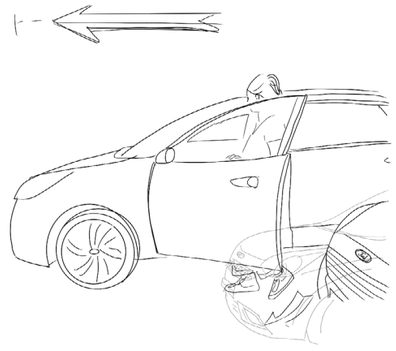
The system will remember the internal preferences of the driver from the learning period and prepare the car before they even step in to ensure an efficient journey.

The doors will open for both the driver and the passengers, and the internal conditions will be set so it is comfortable for all passengers.



The car will suggest parking spaces based on your daily activites, and suggest different locations if you need to do more exercise.

The vehicle will reverse away from any walls or cars in order to allow easy access to the boot when walking towards the car.



If in tight parking spaces, the car will drive out as the user is approaching the vehicle so that the driver and any passengers can enter easily.

Figure 34: Scenario of use

7.3.1 Datasets table

As the main part of this project, the data that is collected by wearables is what was looked into throughout. How can the data collected be used by the vehicle to create an enhanced experience for the users of the car? Above can be seen the scenario of how the car reacts to inputs from the user, however below (table X) can be found a table with the specific data points that are collected from the wearable and user in order to trigger the reactions seen above.

Action	Data point(s)		
In the morning			
Set air-con or heating in sufficient time before leaving the house	Measures outside temperature and users body temperature	Measures in-car temperature	Knows what time the user usually leaves the house
'You should leave in 5 minutes' notification	Knows the time the user usually leaves the house on that specific day	Expected travel time to destination	Road/traffic conditions
Reminder as you get to the car if you have everything (either for work, or for children)	Connects your device to the Bluetooth of the car	Knows your devices through the learning period	Knows what you need each day through the learning period
Automatically opens door(s) based on number of passengers	Bluetooth connection with the car	Bluetooth connection with other passengers devices based on learning period	Hand gesture of moving hand towards the door handle
Moves seat and passenger seat back	Seat preferences based on driver and passenger from learning period		
Suggests playlist/radio station	Preferred radio station based on learning period	Music playlist based on learning period and who the passengers are	What time of day these playlists are listened to
Internal conditions optimise for user(s)	Heating changes based on passenger	Door opens based on which passenger enters the car based on learning period and Bluetooth connection with the car	
Overview of the day	Vehicle knows your calendar and the important events of the day	Vehicle knows when you step into the vehicle	
Suggests parking spaces at the office/school	Knows your expected activity for the day	Knows the location of your work based on the learning period	Knows parking spaces nearby based on live parking sensors at location
Automatically turn down music when looking for a parking space/ stressed	Knows the location you need to park at	Knows that you are stressed/concentrating based on heart rate and sweat	Knows the right level to turn the volume to not be distracting based on usual volume
Open door if you are getting child out of the car at school	Knows your location and that you are at school	Knows if you are on a busy road based on surrounding sensors	Knows how many children are in the car and opens the respective doors if safe
Automatically close door when getting children out of the car	Knows your location and that you are at school	Knows when kids are out of the car based on weight on seats	Knows when you are walking away from the car
Reminder when leaving the car if they have everything	Knows that you are walking away from the car	Knows what devices you have on you based on Bluetooth connections	Knows what devices you need for the day
On the way home with colleagues			
Opens door(s) for passengers	Proximity to car via Bluetooth connection	Who you are with (through the Bluetooth connection and the learning period)	The vehicle knows who is 'meant' to be with you based on the learning period
Adds addresses to the sat nav based on who you are with	Knows the passengers usual locations based on the learning period	Knows the time of day and therefore the most likely destination for passengers	
Changes internal conditions to passengers preference	Know the internal conditions that the passenger set during the learning period	Knows the favoured playlist based on the inputs from the learning period	
Doing the groceries			
Automatically suggestions locations of nearby supermarkets	Knows how long you have before your next calendar event	Knows what you need from the shops based on your shopping list/supermarket app	Knows how much battery your car has
Sends you a list as you lock the car/walk towards the shops	Knows that you are walking away from the car	Knows the location is at the supermarket	
Knows how much you need to buy to moves seats/opens boot accordingly	Knows you are carrying heavy bags based on your wrist tensing	Knows your shopping list and exactly what you have bought (via the supermarket app/receipt)	Knows where you usually store the bags (based on the learning period)
Illuminates the car/flashes lights to help locate it	Knows your location compared to the car's location	Knows your emotional state based on your heart rate and seat (if you are scared/ worried etc)	
If the car is in a tight parking space, then it will reverse so the driver can get in or so the boot doesn't hit other cars when close to them	Proximity to other cars	How many people need to get into the car based on Bluetooth connection	The proximity of the boot to other items (the wall/cars)
Message your family if you need help with unloading bags	Whether your bags are heavy and you are struggling	Your location and estimated time of arrival	How many people you are with, and how many are at home
Picking kids up from school			
Opens the doors for the parents and children	Knows if you are on a busy road	Knows which doors to open based on Bluetooth connection and the learning period	
Plays entertainment for children	Knows if the driver is stressed based on heart rate and sweat produced	Knows if the children are active or not (if they have a wearable themselves)	Knows their favoured form of entertainment (based on their settings during the learning period)
Changes the internal conditions based on the physical condition of passengers (tired/stressed etc)	Knows the heart rate of the passengers		

Table 2: The collection of datasets that is collected in order to trigger an action from the vehicle

7.3.2 Adjustments

Not only is the Ford Experience application used for the onboarding, but it is also used throughout the various points in the lifetime of the car. Eventually people's routines will change or they will slightly differ. For example, they change jobs, a child moves out, or they want different internal conditions due to the differing seasons. These are factor that can be detected and re-learnt by the system, however there is also the option to manually adjust some of these settings in order to give the user more control. Figure 35 shows the settings feature of the digital application, which is separated in the four features in order to simplify the finding of the feature. Under each selection there is a list of the functions that the vehicle can do (figure 36) and from here, the user can toggle on or off the individual features to work automatically, as well as it being possible to manually schedule when such a feature should work (figure 37).

As mentioned, being able to change settings manually (just like in the agenda section of the learning period), gives the user more control over the service and builds on the trust between the user and the system.

To see all the screens of the final concept, see Appendix K).

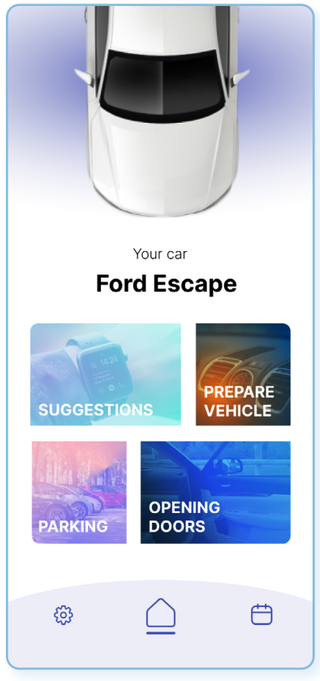


Figure 35: Home screen to access settings

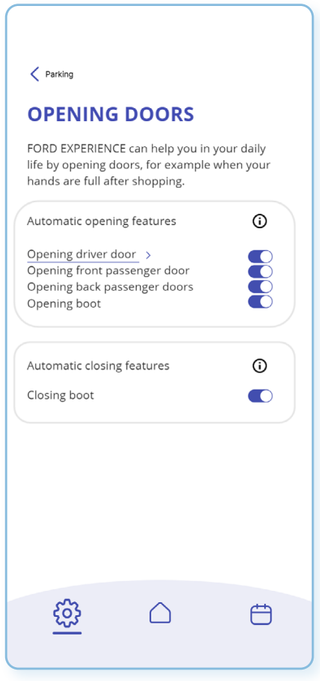


Figure 36: Opening doors settings screen

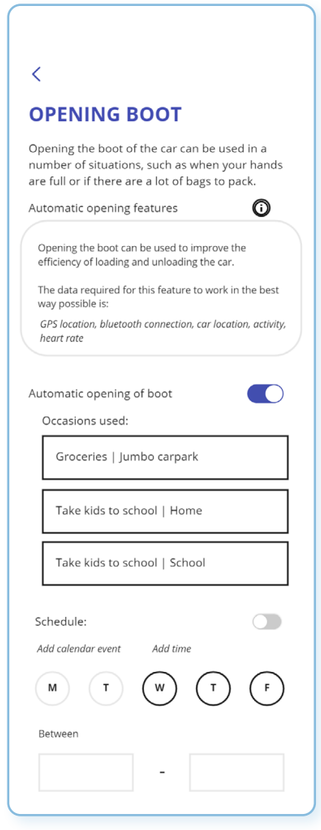


Figure 37: Opening boot settings screen, automatic/manual toggle

7.4 TESTING

7.4.1 Methodology

In order to evaluate and validate the final concept, user tests were carried out with three target users. These tests consisted of the user using the application throughout the onboarding phase, 'learning phase' as well as experiencing the experience themselves through interacting with the vehicle. Each of the tests were physical and followed the following process:

1. Introduction to the test and explanation of the service
2. Running through the onboarding and main features using the mobile application
3. Using their car as they would normally and experiencing the changes their car would make*
4. Questions were asked after each of the steps in the process (onboarding, learning phase, etc) in order to make sure that it was clear for the user
5. A number of questions were asked to the participant after the test in order to gain feedback of the concept. These questions included the opinions of each of the aspects of the concept (onboarding, learning, experience and adjustments), whether the amount of control over the service was sufficient and they experience with the data collection of the service (see appendix K for full list of questions).

*these changes made throughout the experience and users interaction with car were made through the Wizard of Oz technique, as these features are not working, nor implemented.

7.4.2 Results

The feedback of these tests were split into the onboarding aspect (digital application), and the physical service (the Experience).

Onboarding digital application

The onboarding aspect is where the user is informed about the features of this service. 2 of the participants mentioned that there was a lot of reading throughout this period of onboarding, which lead them to ask whether ***"the app was clear enough"*** after the onboarding phase. They asked why there was so much text at one time, and why they couldn't see what would be happening as they read. One participant mentioned that they would like to ***"physically see and interact with the vehicle to see the features work in person"*** throughout the onboarding process in order to get a real idea on how the car could react.

All participants said that the aesthetics of the application were very nice, and even though there was a lot of text, it was spread out over a number of different screens which made it easier. However, 1 participant was relatively confused about the navigation between screen. She found it tough to get onto the next page, as the 'continue' button was hidden at the bottom of the screen and the difference between aesthetics of the screen were quite similar.

Throughout this service, a lot of data is being collected from the user to use for different features. This side of the service was greeted with mixed responses. 2 participants said that they didn't really mind so much about the collection of data. ***"A lot of other apps I use collect data and it doesn't really bother me, I think such a service has a good reason to collect my data as opposed to other applications such as Facebook."*** A similar response was made from the other participant and they saw that the service provides better value to the user if data is collected from various sensors. The participant who was against the data aspect however, saw that it was a useful in this service, but would be worried about what else it is being used for.

When going into further detail about the data collected, this same participant also brought up the issue surrounding anomalies in data collects. For example when the car is changing the internal conditions based on your body temperature, this could be skewed based on menopause or illnesses that alter the bodies temperature. This data anomaly point was also made by a second participant when in reference to the learning aspect of the feature. As the car is used, it learns more about where you go and when, however this specific user said that he didn't have a ***"structured way of living"*** and no consistent day to day routine. He brought up the question of ***"how would the car learn my schedule in this four week learning period, if every week is different?"***

The Experience

The Experience feature of this service is the main feature where the interaction occurs and that the user can see how the service really works. The main features of the service were liked by all three participants and they liked that they were split into the separate features. Parking was verbally mentioned by 2 participants as being a really nice feature of this service, and the way it knows how to react based on different inputs was the key point. ***"I like how it knows when I am walking towards it with bags, and walking without so it knows how to react to in these different use cases"***. On the other hand, one participant did bring up the issue surrounding the automatic movement of the car, that being, ***"what if it crashes into something? Who's fault is it then?"***

Participant 3 said that the detail of the features was really nice and added to the versatility of the vehicle in different situations, however in some situations it might not be safe or effective to perform a function. They brought up the use case of automatically opening doors on a busy road in windy conditions and they they personally would not want the doors to open in such a situation. These situations, although very useful in stand alone scenarios, could lead to a negative experience and one participant that the learning phase of the service is extremely important in defining whether the experience will be positive, or also negative aspects as described above.

All three participants throughout this test mentioned how the car felt like your personal assistant and liked the fact that it worked with you throughout your day. ***"It is nice that the car works with you as opposed for you. The digital app also makes me feel more in control when needed"***. The versatility of the service, and therefore the car, was a real selling point of the service and mentioned by 2 participants throughout these tests.

As mentioned previously, having control as a user over the service was an important aspect in the overall experience of the service. One user mentioned it was ***"nice you can change these settings later"*** as they thought it would be nice to use the features and adjust them accordingly at a later date. Not only the adjustment of the specific features, but also throughout the learning period it is nice to see and adjust the calendar events if needed. This was also brought up by another user in saying ***"can you change these agenda points if needed?"*** This goes to show that having a sort of power and control over the service was important to the users and gave them peace of mind when giving the service control in certain feature and aspects of their journey.

7.5 CONCLUSION

Overall, the feedback from the testing was relatively positive. It provided not only aspects that the users liked about the service, but also areas to focus on and develop in future iterations of this service. The onboarding digital aspect was an area that users felt was lacking from the concepts in chapter 6 and therefore saw as a welcome addition that gave the users peace of mind, as well as a heightened sense of control over the service. Not only this, but it also provided some transparency behind the service and gave the users insights into what it can do, but also how it works. The learning process is an aspect that users said let them know how the service worked as well as allowing them to have some say in the routines and data collected. Not only this aspect of the application, but also the adjustment features, was also a point that was very useful. Being able to adjust certain feature when the user wanted throughout the use of the car was seen as imperative, as there were some features that some users would prefer to others, or prefer in different occasions.

The onboarding process as a whole was liked by users. They mentioned that there was a lot of text and felt like it dragged on for a while, however the fact it was on different screens made it much easier to read through and comprehend. Nevertheless, 2 users said that being able to interact with the car whilst also running through the learning period would be a nicer way to learn what it does as opposed to just watching your phone. ***"Why wait 4 weeks to experience what the car can do?"*** Users saw it as a useful development to be able to see what the car can do before the main 'experience' feature starts. This could also be done by inputting basic data (addresses and schedule) to experience the experience right away.

The learning phase, as mentioned, was very interesting to participants. All of them were interested in not only how the service learnt where they go, who with and when, but they were also interested in the interactions that the service had with user throughout this learning period. As opposed to leaving the service to 'do its thing', there were small interactions between the user and the service throughout which lead to a more trusting experience as well as a more accurate and enhanced result. However, some participants had some queries regarding the learning phase, and that mainly revolved around the reliability of the the learning. If there is a user with a very wild and non-consistent schedule, then ti would be relatively tough for the system to learn in a short 4-week period. This is indeed true, and for such a use case, 4-weeks would not be enough time, however the system would also be able to learn in this period user preferences, internal conditions, as well as the main addresses of where they travel to. The system would not stop learning after 4-weeks, but rather constantly be learning, and trying to find patterns in routines, in order to aid the user on future journeys.

8.0 EVALUATION

This chapter evaluates the final concept against the previous set list of requirements. This will give an overview of whether the solution has used the feedback of the various participants in the various tests in order to get where it is. Not only that, but here I will discuss my recommendations for the future development of this concept.

8.1 EVALUATION OF CONCEPT

Upon reflection of the results of not only the tests of the final design, but also the final design itself, I was able to evaluate these results against the list of requirements drawn up as a conclusion of the feedback from the prototypes (chapter 5.3). Below can found a table (table X) which evaluates the final design agains the list of requirements:

Concept requirement	Reasoning
Ford Experience	
The system should be connected to the user by being a silent encourager and therefore does not motivate the user to be more on the device.	The Ford Experience includes a digital aspect for the onboarding and adjustment of the service. This does require the user to be on their device, however during the onboarding and learning period, this is for a small amount of time and is used as and aid to the learning for how the car should react to certain passengers in the future. The notification and user flow can be seen in 'The learning period section' above. Throughout adjustment of the service, the app is also used, however this is purely to turn on or off features, and therefore is not seen as encouraging users to be on their device.
The system should interact with the user when it is safe to do so (eg, not whilst driving)	The interactions throughout the learning period are carried out only after a specific journey (once at the desired location) in order to inform the application who was in the car. The interactions with vehicle itself mainly occur on the approach and leave scenarios which are already in safe situations. However, the vehicle uses location data and learns when the correct time is to open doors and the boot, such as when children are there, or near busy roads.
The system should use existing apps and collected data to know and learn the routine of the user	The Ford Experience service uses certain apps (Health, Agenda and music services) in order to collect data from the user, as well as using the personal data collected from wearables. This data is used throughout the learning period to learn the routine and eventually to create a personal experience with the vehicle.
Decision making	
The system can guide the user into making the right or better decision by being able to recognise stress levels, temperature, location etc.	The service collects personal data such as stress levels, internal and external temperature, as well as location in order to make a more personal experience. The service is aimed at making the routine of the user more efficient and therefore this requirement point is met.
The system can guide the user into making the right or better decision by knowing what the current routine of the user is and what changed.	Throughout the learning period of the service, the routine of the user is learnt and tracked. This includes where the user goes, who they go with and at what time, as well as internal conditions of each passenger. From this period, the car can make certain decisions in certain situations and also react if there are any unplanned changes in the routine. This learning period that lasts four weeks, will actually be carried on throughout the entirety of the use of the vehicle in order to adjust on these changes.
Suggestions	
The system can help the user go through their day by being able to suggest useful and worth tasks, tips or inspiration.	As part of the Ford Experience, the user is supplied with tips and suggestions throughout their day in order to improve and make their routine more efficient. These suggestions include parking further away from the office one day in order to get more exercise in, reminders if an item has been left at home or in the car, as well as music suggestions based on who is in the car.
The system can help the user go through their day by giving suggestions as opposed to decisions.	The learning period learns the users preferred settings (seat position, music, route) and based on these will change automatically depending on which user is in the car. However any other decisions, such as parking locations or opening doors for new passengers will be suggestions to the driver. Using the digital app, the user has full control over the features and therefore can change specific features when it suits them.

The system can help the user go through their day by helping with structuring kids before and after school.	The Ford Experience will use notifications at the correct moments throughout the day in order to prepare the user for evening activities, which also includes after school activities for kids. The vehicle also reacts to the different passengers (eg. children) and will adjust temperature and entertainment in order to suit the passengers and therefore make the transition between activities smoother.

The final concept therefore, can be seen to have met partially, or fully, all the list of requirements that were set earlier in the project. This goes to show that the large amount of testing, prototyping and ideating resulted in requirements that were not only realistic, but also useful for the user throughout its use.

8.2 RECOMMENDATIONS

Based on the feedback from the tests, evaluation of the results as well as personal opinion on the features throughout the development of the project and concept, there are a number of areas that have scope and potential for development in future iterations of the project. Here is a section regarding what I think are the important parts of the service that should be the most important to develop in the future to improve and enhance the experience of the user. My recommendations, so to say.

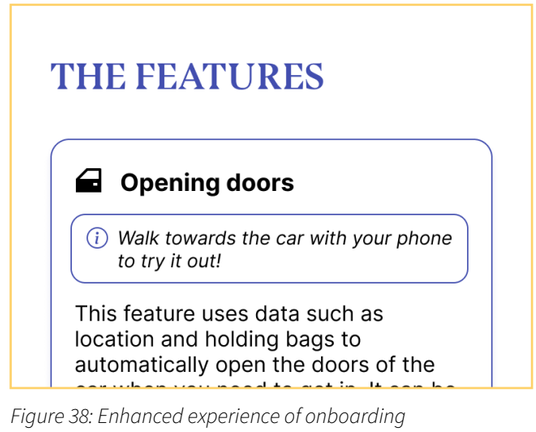


Figure 38: Enhanced experience of onboarding

As mentioned in the previous conclusion of the testing and final concept, the onboarding aspect and learning what the service can do is very text heavy. It is currently only reading from a phone screen and imagining what the service and car can do. However in order to improve the experience and extend the user's interaction with the service to before the 'experience' feature begins, physical examples of what the vehicle can do can be incorporated. As the user walks is reading through the list of features of the vehicle, a pop-up would be provided, hinting them to 'walk towards the car' or 'step into the car' (figure 38) in order to experience how the car could react to these inputs. The main goal of this would be to allow the user to experience right from the moment they have bought their car. It was a common point raised that users didn't want to wait for 4 weeks to experience find out what they bought. They want to experience it right away, so why not allow them to in the onboarding phase.

The learning phase of the service is where the majority of data is collected. It is where the system learns where you go, who with and when, and builds up its knowledge about your daily routine. However, it does not do this alone. Currently it uses notifications after journeys with 'new' passengers in order to learn who it is and adjust the internal conditions and settings accordingly. This notification is sent at the end of a journey and merely asks 'who was the passenger?'. This is an important part of the process as from this the system can learn about different passengers to improve not only the experience of the driver, but all users of the vehicle. Nevertheless, there is an opportunity to extend this notification and interaction with the driver to beyond only passenger confirmation. Throughout the learning period, the vehicle could start reacting to triggers from the driver such as turning on the heating, or opening a window. In order to learn whether the system is doing the right thing, notifications could be sent every now and then such as 'The window opened, was this correct?' (figure 39/40). this could hint the user to select a simple 'Yes' or 'No' via the app in order to help the system learn more personal preferences, quicker.

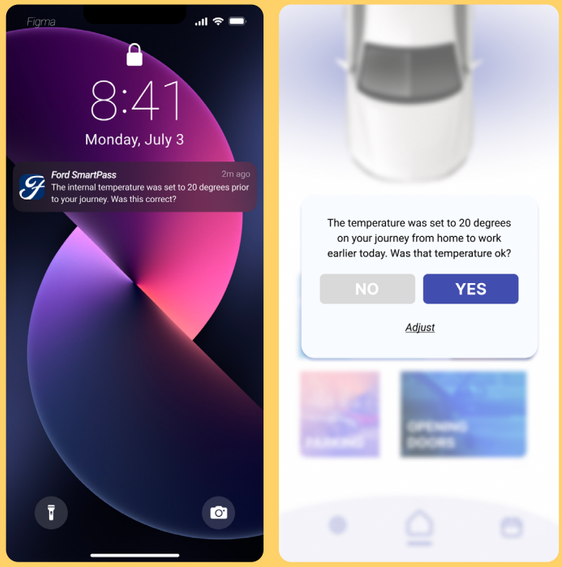


Figure 39 and 40: Improved interaction in learning period

For the next steps of this project, development of the application is also required. Although the application is not intended to be used daily, but rather sporadically when a feature needs adjusting, there should still be development in the accessibility of the digital aspect. The demographic of the intended user of the application is the main driver of a family car, however this could vary from anywhere between 30 and 60 years old. Throughout the testing phase of this concept, it was clear that some older users of the service had trouble reading and using the application, however for younger participants it was much easier. Future recommendation of this would be to improve the accessibility of the app (spacing, screens and wording of the onboarding) in order to cater for users of all ages.

In terms of the data collection of this system, there were varying responses not only throughout the testing of the final concept, but also throughout the project. This is an area that for a long time has been a grey area. What data can and should be collected in order for the system to work to its fullest, whilst also not raising ethical questions? This is not explored so much throughout this project, and although it was not the main question or focus, it is something that would have to be looked into in order to implement this service in the future. A more pressing matter of data, however, would be what can wearables measure in the future. I touched on what the potential wearables have in the future and what they would be able to detect, however not so much into how these future sensors and detections can be used to improve the experience. This project was relatively limited to the current features of the vehicle itself (doors opening/closing, internal condition, internal computer etc), however future cars will also incorporate more innovative features that can be used in conjunction with the data of the future to enhance this experience.

9.0 PERSONAL REFLECTION

This is a reflection of my process and the project as a whole. It will describe the highs and lows of the project, as well as what I would change if I were to do it again.

9.1 REFLECTION

This project, as with all projects, has had many an up and down. Personally, it was a project that took me quite a long time to really get me teeth into. The fuzzy front end felt very fuzzy and I couldn't quite see where I would come out the other side. I felt very in the deep end at the beginning of this project due to the fact that I was completely new to both of the aspects of the initial brief. Wearables, and cars. However what really helped, was doing design work. Prototyping, iterating and talking to people about anything I had jotted down on paper were methods that I used that really put me on the right track again. As seen throughout this project I carried out a number of tests with a number of people and tried to speak to anyone who had an opinion about a certain aspect of it.

The prototyping aspect at the time was a catalyst for the develop phase of the project. Although looking back, the prototypes were very narrow and tried to focus on one specific moment along the journey of a user, they did get my mind out of the exploration phase and into 'doing' phase. At times, the prototyping felt superficial and I did feel as if they were not leading towards and end result that I would be proud of, however, looking back, I see that some aspects of these prototypes can be seen throughout the final concept (in particularly the digital feature), as well as areas where I think could be incorporated into future developments of the service (the community aspect). If I were to go back and tell my 6-month younger self how to go about such a new and open project, I would tell him to start getting things down on paper and making decisions early.

Due to the prolonged explore phase of this project, I saw that the develop 'diamond' was not as thorough. The processes carried out in this diamond (act it out/role playing, concept generation and iterating) were carried out on a relatively tight time constraint as opposed to the tasks earlier in the project. On looking back at the project, the extensive research and activities carried out in the first phase lead for a smooth transition and very targeted concepts in the latter process. This is not per se how I would carry out a design task normally, however I felt comfortable doing extensive research and using this research to really define a solid problem definition and develop from there.

Hindsight is of course a wonderful thing, and I would say that if I were to do this project again I would know which tasks were more useful than others and which I would carry out right from the beginning, however this would not be the case in reality. All of the tasks that I carried out had a reason to be carried out. Whether that came from results of the previous task, or advice from the supervisory team based on previous experience, there was not a task that I would not have carried out.

The design process that I had said I would carry out at the beginning of this project, and the one I actually did carry out, are quite far apart. The initial double diamond process, with a typical 'discovery' diamond and 'solution' diamond was quickly seen to be much more iterative. As mentioned above, I felt that I was converging and diverging almost weekly, and this was not representative of a double diamond process. In reality, I carried out three 'discovery' phases, each resulting in a more defined context or problem statement that shaped the final design in the way it is now. The Frame Innovation aspect of this project was one that also

took a step back. I found it an interesting method to carry out in previous project, hence the inclusion of it. However, with the research tasks and way that the project was being shaped, I did not see a direct link with the Frame Innovation method and it was becoming more of an effort to stick to it than not. As an alternative, the 3 (and a half) diamonds that I carried out were accompanied by a number of activities that I did not predict to be carrying out. The act it out method was one that was used in the develop phase and shaped the solution of the service as good as brainstorming and sketching would for a product. It was a method that I would use more throughout the project should I do it again, and one that created the Ford Experience described throughout.

10.0 REFERENCE

Apple. (n.d.). Automatically collect data in Health on iPhone. Apple Support. Retrieved 25 March 2022, from https://support.apple.com/en-hk/guide/iphone/iphbb8259c61/ios

Armitage, H. (2020). Stanford Medicine Scientists Hope to Use Data From Wearable Devices to Predict Illness, Including COVID-19. Stanford Medicine Snyder Labs.

Autoverzekering.nl. (2019, November 12). Nederlanders vertrouwen eigen auto liever niet toe aan een ander. Retrieved 7 April 2022, from https://www.autoverzekering.nl/nieuws/nederlanders-vertrouwen-eigen-auto-liever-niet-toe-aan-een-ander/

Britannica. (n.d.). Ford Motor Company | History, Headquarters, & Facts. Encyclopedia Britannica. Retrieved 9 April 2022, from https://www.britannica.com/topic/Ford-Motor-Company

Busch, J. (2020, November 10). How UX Plays A Role In The Automotive Industry | TomTom Blog. TomTom. Retrieved 25 March 2022, from https://www.tomtom.com/blog/navigation/importance-of-user-experience-research/

CBS. (2020, March 12). Car fleet growing faster than population. Retrieved 9 July 2022, from https://www.cbs.nl/en-gb/news/2020/10/car-fleet-growing-faster-than-population

CBS. (2022, February 28). Motor vehicles; type, age class, 1 January. Statistics Netherlands. Retrieved 13 April 2022, from https://www.cbs.nl/en-gb/figures/detail/82044ENG

Cprime Studios. (2021, November 24). How big data can be used in automotive. Retrieved 24 February 2022, from https://cprimestudios.com/blog/how-big-data-can-be-used-automotive

de Goede, C., & Greeff, A. (2016). Challenges couples face in managing family routines after the transition to parenthood. Scielo. https://doi.org/10.15270/52-2-512

Devanur, G. (2019, January 2). What If Wearable Technologies Can Track Our Emotions? Forbes. Retrieved 9 July 2022, from https://www.forbes.com/sites/forbestechcouncil/2019/01/02/what-if-wearable-technologies-can-track-our-emotions/?sh=31d39984590c

Dorst, K. (2015). Frame Innovation. Amsterdam University Press.

Düking, P., Hotho, A., Holmberg, H. C., Fuss, F. K., & Sperlich, B. (2016). Comparison of Non-Invasive Individual Monitoring of the Training and Health of Athletes with Commercially Available Wearable Technologies. Frontiers in Physiology, 7. https://doi.org/10.3389/fphys.2016.00071

Fitbit Legal: Privacy. (n.d.). Garmin. Retrieved 25 March 2022, from https://www.fitbit.com/global/us/legal/privacy-summary#:%7E:text=When%20you%20use%20a%20Fitbit,you%20your%20stats%20and%20progress.

Ford. (n.d.). Ford: Company timeline. Ford.com. Retrieved 5 July 2022, from https://corporate.ford.com/about/history/company-timeline.html

Ford Motor Company. (2009). MyKey®. Ford.Com. Retrieved 30 March 2022, from https://www.ford.com/support/how-tos/keys-and-locks/mykey/mykey/

Garmin. (n.d.-a). Garmin Connect Privacy Policy. Retrieved 25 March 2022, from https://www.garmin.com/en-US/privacy/connect/

Garmin. (n.d.-b). What Is the Stress Level Feature on My Garmin Watch? | Garmin Customer Support. Retrieved 25 April 2022, from https://support.garmin.com/en-US/?faq=WT9BmhjacO4ZpxbCc0EKn9#:%7E:text=Stress%20level%20is%20a%20feature,the%20interval%20between%20each%20heartbeat.

Gish, J. A., Grenier, A., Vrkljan, B., & Miltenburg, B. V. (2017). Older People Driving a High-Tech Automobile: Emergent Driving Routines and New Relationships with Driving. Canadian Journal of Communication, 42(2), 235–252. https://doi.org/10.22230/cjc.2017v42n2a3125

Godfrey, A., Hetherington, V., Shum, H., Bonato, P., Lovell, N., & Stuart, S. (2018). From A to Z: Wearable technology explained. Maturitas, 113, 40–47. https://doi.org/10.1016/j.maturitas.2018.04.012

Gullstrand Edbring, E., Lehner, M., & Mont, O. (2016). Exploring consumer attitudes to alternative models of consumption: motivations and barriers. Elsevier, 123, 5–15. https://doi.org/10.1016/j.jclepro.2015.10.107

Hastings, R. (2022, January 3). How the Use of Data and AI Is Transforming the Automotive Industry. Emeritus - Online Certificate Courses | Diploma Programs. Retrieved 25 March 2022, from https://emeritus.org/blog/big-data-ai-in-the-automotive-industry/#:%7E:text=Big%20data%20analytics%20also%20allow,them%20viable%20to%20the%20customer.

Laput, G., & Harrison, C. (2019). Sensing Fine-Grained Hand Activity with Smartwatches. Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. https://doi.org/10.1145/3290605.3300568
Laput, G., Yang, C., Xiao, R., Sample, A., & Harrison, C. (2015). EM-Sense. Proceedings of the 28th Annual ACM Symposium on User Interface Software & Technology. https://doi.org/10.1145/2807442.2807481

Linehan, C., Murphy, G., Hicks, K., Gerling, K., & Morrissey, K. (2019). Handing over the Keys: A Qualitative Study of the Experience of Automation in Driving. International Journal of Human–Computer Interaction, 35(18), 1681–1692. https://doi.org/10.1080/10447318.2019.1565482

Liu, X., Chen, T., Qian, F., Guo, Z., Lin, F. X., Wang, X., & Chen, K. (2017). Characterizing Smartwatch Usage in the Wild. Proceedings of the 15th Annual International Conference on Mobile Systems, Applications, and Services. https://doi.org/10.1145/3081333.3081351

Nwanazia, C. (2021, May 10). Car sharing in the Netherlands is on the rise: here's why it should continue. DutchReview. Retrieved 24 March 2022, from https://dutchreview.com/expat/car-sharing-netherlands/#:%7E:text=In%202020%2C%20the%20Netherlands%20had,second)%20cars%20people%20will%20buy.

Patel, A. R., Ferreira, F., Monteiro, S., Silva, A. C., Erlhagen, W., & Bicho, E. (2021). Prediction of attitudes towards human-centred cognitive vehicles aware of their users' routines and preferences. 2021 IEEE 6th International Forum on Research and Technology for Society and Industry (RTSI). https://doi.org/10.1109/rtsi50628.2021.9597265

Quiroz, J. C., Geangu, E., & Yong, M. H. (2018). Emotion Recognition Using Smart Watch Sensor Data: Mixed-Design Study. JMIR Mental Health, 5(3), e10153. https://doi.org/10.2196/10153

Riggins, J. (2015, March 19). Why wearable tech for kids could mean instant peace of mind and safety. Blogthinkbig.com. Retrieved 18 May 2022, from https://blogthinkbig.com/kids-wearable

Role Playing | Service Design Tools. (n.d.). Service Design Tools. Retrieved 10 July 2022, from https://servicedesigntools.org/tools/role-playing

Sawh, M. (2019, August 13). Getting all emotional: Wearables that are trying to monitor how we feel. Wareable. Retrieved 9 July 2022, from https://www.wareable.com/wearable-tech/wearables-that-track-emotion-7278

Shaw, J. (2012, April 11). 30 percent of Dutch households do not own a car. IamExpat. Retrieved 12 April 2022, from https://www.iamexpat.nl/lifestyle/lifestyle-news/30-percent-dutch-households-do-not-own-car#:%7E:text=According%20to%20Statistics%20Netherlands%2C%20three,having%202%20or%20more%20cars.

Shneiderman, B. (2020). Human-Centered Artificial Intelligence: Reliable, Safe & Trustworthy. International Journal of Human–Computer Interaction, 36(6), 495–504. https://doi.org/10.1080/10447318.2020.1741118

Smith, C. (2019, August 17). What is wearable tech? Everything you need to know explained. Wareable. Retrieved 9 April 2022, from https://www.wareable.com/wearable-tech/what-is-wearable-tech-753

Smuck, M., Odonkor, C. A., Wilt, J. K., Schmidt, N., & Swiernik, M. A. (2021). The emerging clinical role of wearables: factors for successful implementation in healthcare. npj Digital Medicine, 4(1). https://doi.org/10.1038/s41746-021-00418-3

Staacks, S. (2016). Your smartphone is a mobile lab. Phyphox. Retrieved 8 March 2022, from https://phyphox.org/

Statista. (2020, January 13). Passenger car sales in the Netherlands 2010–2020. Retrieved 13 April 2022, from https://www.statista.com/statistics/423067/passenger-car-sales-in-the-netherlands/

Statista. (2021, January). New registered electric passenger cars in the Netherlands 2014–2020. Retrieved 13 April 2022, from https://www.statista.com/statistics/654531/number-of-new-registered-electric-passenger-cars-in-the-netherlands/

Tsai, P. (2022). The association between family routines and parents' different working hour schedules. Children & Society. https://doi.org/10.1111/chso.12565

Yi, D., Su, J., Hu, L., Liu, C., Quddus, M., Dianati, M., & Chen, W. H. (2020). Implicit Personalization in Driving Assistance: State-of-the-Art and Open Issues. IEEE Transactions on Intelligent Vehicles, 5(3), 397–413. https://doi.org/10.1109/tiv.2019.2960935

Zakaria, C., Balan, R., & Lee, Y. (2019). StressMon. Proceedings of the ACM on Human-Computer Interaction, 3(CSCW), 1–29. https://doi.org/10.1145/3359139

11.0 Appendices

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: Elson 5673
initials: C.A.R given name: Charles
student number: 4927923
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: Milene Guerreiro Gonçalves dept. / section: DOS/MOD
** mentor: Fernando Del Caro Secomandi dept. / section: DOS/MOD
2nd mentor: Nicole Eikelenberg
organisation: Ford
city: Delft country: Netherlands

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.

comments (optional): Although both Milene and Fernando are from the same department , each has an expertise in a different subject related to this project. Milene experts in creativity and data-enabled design, and Fernando in service design.

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

TU Delft

Procedural Checks - IDE Master Graduation

APPROVAL PROJECT BRIEF

To be filled in by the chair of the supervisory team.

chair Milene Guerreiro Gonçalves date 13 - 04 - 2022 signature Digitally signed by Milene Guerreiro Goncalves - IO Date: 2022.04.13 12:31:50 +02'00'

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: 41 EC
Of which, taking the conditional requirements into account, can be part of the exam programme 30 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:

C. van der Bunt Digitally signed by C. van der Bunt Date: 2022.04.20 11:40:44 +02'00'

name C. van der Bunt date 20 - 04 - 2022 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

- but the projectbrief has been submitted late

comments

name Monique von Morgen date 26 - 04 - 2022 signature

Using wearables to prepare family car users for changes in their routines — 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 21 - 02 - 2022 — 25 - 08 - 2022 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, ...).

As smart cars are getting smarter, companies are constantly looking at ways to not only improve the functionality of the car but also the user's comfort and experience of driving the car itself. Automotive companies are looking for innovative ways in order to make that next step in regards to connecting the user to the car and it becomes an extension of oneself. Not only are they looking into this problem whilst the user is in the car, but also before and after their journey.

One of the steps currently taken is using data as an input. Car manufacturers have been using big data for a number of years in order to meet changing customer preferences and needs (Hastings, 2022). This data can be accumulated from a number of sources; the car, its driver, the surroundings and other special devices, making the cars safer and enriching the driver's experience (Cprime Studios, 2021). However, what other forms of data are there? Ford sees an opportunity for data from the driver to play a big part in improving the experience and making it more personal. This personal data can be collected by wearables. When using this data to improve the driver's experience, extensive research and development have gone into making the user's 'in-car' experience more fruitful. Auto-pilot, changing lanes, and automatic seat adjustment are some examples of how data extracted from the car is used to improve the driver's experience. However, there is a lack of research into the experience away from driving. How can this be improved with the data available from a more personal source such as wearables? (see figure 1)

There has been extensive research into the driving experience of cars and the user's perception of developments such as autonomous driving (Linehan et al., 2019), as well as what the next steps are for improving the experience of driving (Busch, 2020). However, throughout this previous research, there is little to suggest that companies are looking into the non-driving as the next step in improving the user experience (UX) of the overall driving experience. This is an area that could provide value to Ford and their development of vehicles in the future. With the work that they are doing with data enabled design (DED), there is potential focus more on the UX of their vehicles, outside of the vehicles to get a step ahead of the competition.

The non-driving experience is an extremely broad subject and can differ from person to person in several different scenarios. Someone using their car to go shopping would encounter endlessly different experiences and interactions as compared to a delivery driver. Through interviews, observations and workshops (discussed in section X.X), the goal is to find a solution in a context and user group that is of high value to Ford and has the potential for an innovative solution.

In previous Ford University Research Projects (URP), there has been research into how data can be used within the internal design process to enhance the creative process. Mellado Cruz (2021) and Spalburg (2021) both research how this can be done through their method of Explorative Inquiry and concrete toolkit respectively. They see data as an important driving factor behind the next step of development within their cars and improving the driver's experience in a unique sense. Van Wijnden (2021) took the first steps into this development within Ford with her research into a data-driven in-vehicle system. More specifically, using data to make Battery Electric Vehicle (BEV) trips more efficient. However, what Ford is looking at is the broader approach of a user's experience and that of the experience away from driving, namely the non-driving experience. This can be described as anything that is not physically driving the car itself. This project will be focused on the experiences of the approach and leave scenarios surrounding the use of a vehicle.

space available for images / figures on next page

introduction (continued): space for images

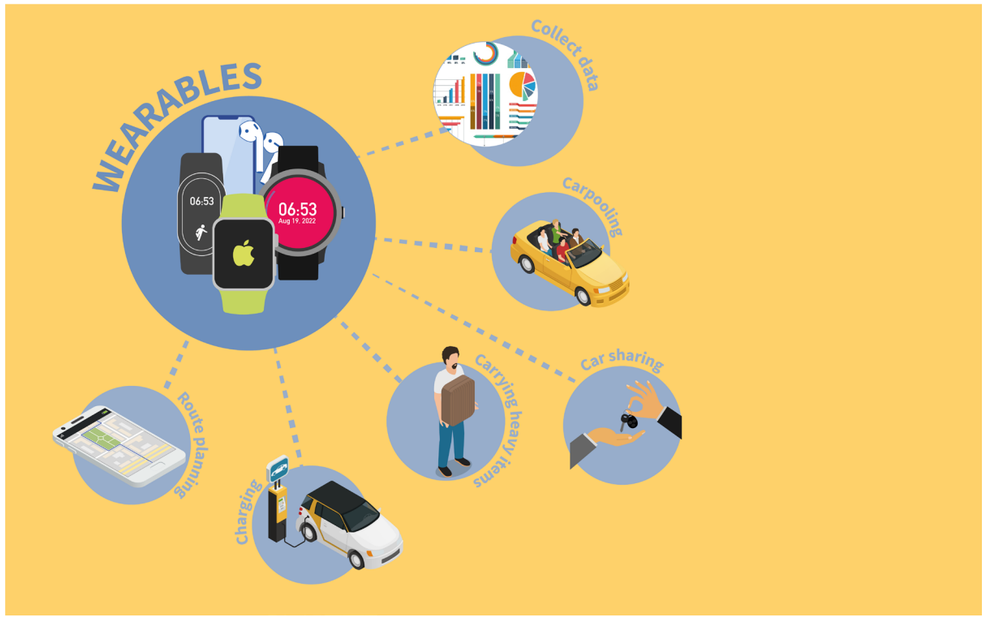


image / figure 1: What wearables am I focusing on, and how can they relate to the non-driving experience.

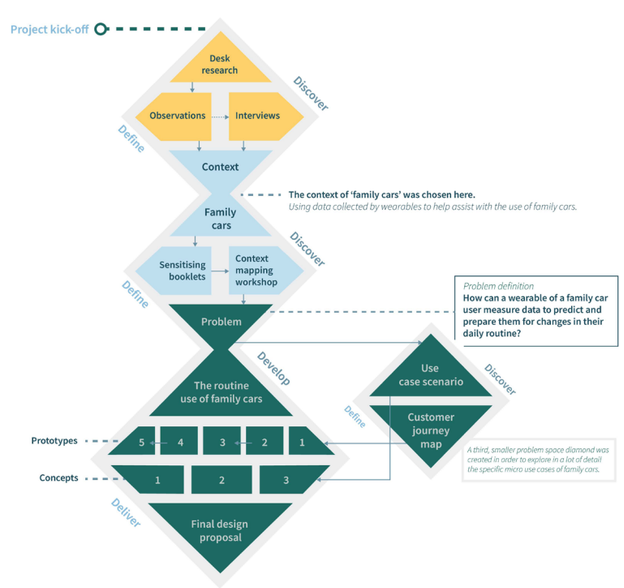


image / figure 2: The design process

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.

A driver's experience is not limited to the time they are in the vehicle, but rather starts long before, and ends after their destination is reached. I will be focusing on the routines that are made and carried out as a family using their car. This could be going to work or dropping the kids at a sports game. These are routines that families encounter almost daily and are routines that can be predicted through the use of data. Using a car as a family can mean that a different person uses it everyday, or one person uses it at the same time everyday, with a number of scenarios involved.

Looking at interactions outside of the vehicle is something that has the potential to unlock the next step of improving the experience of vehicles. What are users experiencing and interacting with in the build-up to sharing a car and the journey itself? What do they do before they arrive? What are the opportunities that Ford can provide through their use of data-enabled design (DED) for added value to the user?

The data currently collected through wearables such as iWatch, Garmin and Android smartwatches is extensive and ranges from GPS location and heart-rate monitor to how many hours of deep sleep you had and your cardio fitness (Apple, z.d., Garmin, z.d., *Fitbit Legal: Privacy*, z.d.). I will be looking at what data points can be used from these devices in order to improve the prior or post driving experience of the driver. In order to use DED for a specific use case along a driver's journey, I will first research what user data is available via wearables that can be used and translated back to the user to improve an aspect of the journey.

Throughout my graduation project, I will be focusing on a slightly different end-user as to previous Ford university research projects; the driver of the car itself. I will be looking into what data can be collected from the driver and how we can use this data to improve the non-driving experience of sharing cars. I will be focusing on the data collected via wearables of the driver.

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.

I will create a digital service that provides added value to the driver's non-driving experience of using a Ford automobile. The concept will use DED where data is gathered through wearables (smartwatches) and translated to the car in order to create an innovative experience for the user, away from driving.

I will create a digital solution or a service that provides added value to the driver's non-driving experience of using a Ford automobile. The concept will use DED where data is gathered through wearables (smartwatches) and translated to the car in order to create an innovative experience for the user, away from driving.

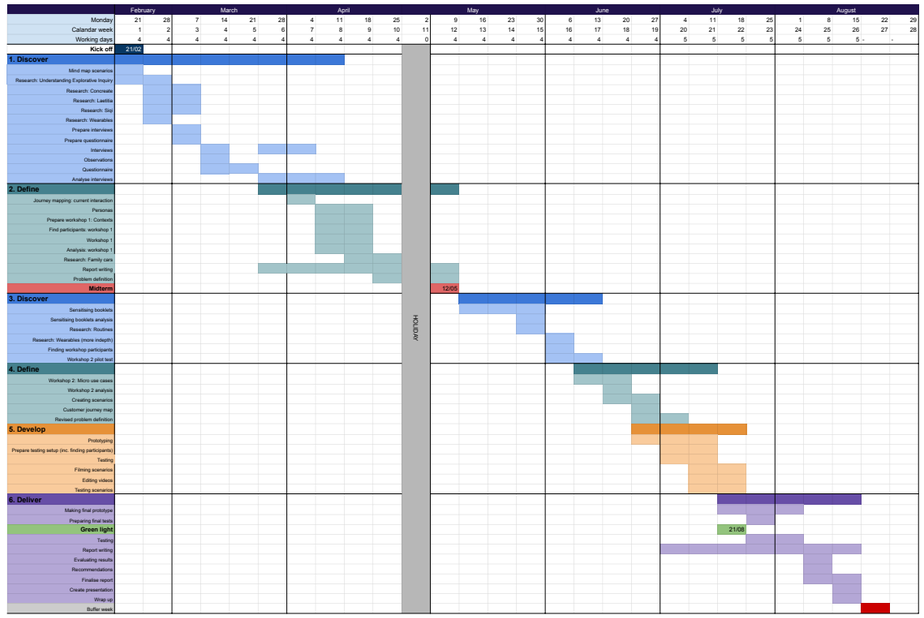
I have found the context through a series of interviews, questionnaires and observations which is sharing cars with family members. These interviews allowed me to speak first hand to people and the surveys gave me large amounts of data that I could use to map out the pain points of these drivers. Alongside exploring context, more specific research on research into the data collected by wearables was carried out through sensitizing booklets which resulted in how the data can be used in ways to improve the experience.

This resulted in a number of prototypes as well as using the Act it out method to create a number of scenarios, of which, the service could come from it. The service lends itself well to a digital on-boarding app which can be stand alone, or integrated into the current Ford app.

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 21 - 2 - 2022 25 - 8 - 2022 end date



This project will follow a slightly altered double diamond design process, namely, a triple diamond. It is divided into six phases; discover, define, discover, define, develop and deliver, with the emphasis on the diverging and converging as seen in figure 1.
The first phase of this project is focused on the 'first diamond', and also the first of the two problem spaces. This is where research tasks will be carried out such as observations, targeted user interviews as well as research into literature (discover). The aim of these were to collect a variety of information around the current user journeys in a number of different contexts as well as to pin-point some potential problem or opportunity areas.
A triple diamond design process was used, as opposed to a double diamond as this project leant itself well to a number of convergence and divergence in order to research thoroughly, as well as iterate on this research where seen fit. Within the non-driving experience there are a number of contact moments and contexts that can shape the project in certain directions. Once a particular direction was defined (family cars), there was scope to research even further and explore more areas within family cars, hence the the second diamond.
Throughout this phase of the process, more targeted research activities were carried out which included a sensitising booklet that revolved around the use of family cars and wearables. This was carried out in combination with a context mapping workshop in order to further define the project into a problem definition revolving around routine use of family cars.
The develop phase, third diamond, is where a more in-depth analysis of the problem space can be looked into using workshops, interviews and also prototypes of ideas. As this project suits itself more towards a service and scenarios, the Act it Out method (Role Playing | Service Design Tools, n.d.) was used to get more of an understanding of what value such a service could bring to a user by acting out a number of scenarios in a daily routine.
A buffer week was included in order to give myself time if any of the design activities overran.

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.

Throughout my MSc programme, I have grown an affinity towards user experience (UX) design. This started rather subconsciously through some early modules where we were redesigning a product-service system based on a number of topics in order to improve the UX and grew substantially throughout a number of internships in the area. User experience has a huge part to play in the future of not only design companies, but all companies, and I saw that there is an opportunity to create an innovative service as part of Ford smart vehicles using data-enabled design.

Data-enabled design is an area that I do not have a huge history with, however, when I have encountered it, it has sparked my interest. I think that being able to use DED throughout this project will be an exciting opportunity and a great challenge, especially within a context that is rather new to me; automotive. I also see that there is a huge market for the application of DED in the future, and this project is the perfect introduction to this area.

This project will also allow me to gain a further insight and understanding into service design as a topic. I will be able to go through a pre-defined process that will guide me in creating a service for a globally known brand. I want to create a project that I am not only proud of personally but could potentially be carried forward and become an innovative and useful solution to Ford's research team.

Such a project allows me to learn how to carry out an extensive, individual project, putting what I have learnt over the past years to practice. The collaboration with Ford provides structure and also opportunities that I would not have encountered alone such as travelling, testing with various departments and designing and developing a solution that could be put to practice.

FINAL COMMENTS

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

APPENDIX B: PARTICIPANT DEMOGRAPHICS

Key: The letter is related to the activity (A=observations, B=interviews...) and the number is for the participant number. If a participant has participated in a previo research task, they will have the same participant ID as they were assigned in the first tas

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
Observations	The goal of these observations was to get an insight into the interactions that a range of users have with their cars in differing contexts. I wanted to be immersed into a number of different contexts where I was able to see how different user groups acted in different situations. It was also useful to see initial pain points and opportunities that potentially could arise from these scenarios.	N/A					

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
Interviews	Based on the observations, I wanted to get more of a detailed insight into the journeys that certain target users went on in their car. These included the before, during and after a specific journey as well as the highs and lows of it.	5	B1	Student - Design	22	M	This participants recently passed their drivers exam and now shares a car with his sister. His sister lives in a difference city and therefore use of the car can be complicated and requires planning prior to the use.
			B2	Student - Design	23	F	This participant has her drivers licence for many years, and uses the car of her father mainly to travel to and from family members houses. Her father has his own car as well and therefore her car is not shared so much with other people (sometimes a friend).
			B3	Sales manager	54	M	This participant is the sole owner of a car. He has two children who can also drive, however they have a car that they share between them. He doesn't often use his car, however when he does it is mainly to work or family holidays.
			B4	Self employed	57	F	This participants uses the family car that is often shared with both of her children, as well as her husband at times (although he has a company car).

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
			B5	Full-time employed	25	M	This participant owns his own car, however due to the fact he lives in a busy city, it is not used so much as he used to use it. When used however, it is mainly to travel back and forth to family members on the other side of the country.
Activity	**Goal of activity**	**No. of participants**	**Participant ID**	**Occupation**	**Age**	**Gender**	**Extra info**
Sensitising booklets	Based on the results from teh interviews and observations, as the converging context of the use of family cars, the goal of these sensitising booklets was to gain a deeper understanding as to why people use their family cars. It was interesting to see the whole journey of a potential user, what the pain points were as well as the delight points along this journey.	9	C1	Child-care counsellor		F	She uses a family car (van) mainly for short and long trips. These include trips in the Netherlands, as well as longer family trips outside of the Netherlands. She shares the car with her husband.
			C2	Engineer		M	He owns a car and shares it when no one else. The main use of the car is to go to and from work.
			B2	Student - Design	23	F	This participant has her drivers licence for many years, and uses the car of her father mainly to travel to and from family members houses. Her father has his own car as well and therefore her car is not shared so much with other people (sometimes a friend).
			C3	Training co-ordinator		F	This participants has a car that she shares with all members of her family (5), although most of the time her children are away from home and therefore they do not use it often. When she uses her car it is to travel to and from work and also to carpool with colleagues.
			C4	Student - Design	24	M	He does not own a car, and the car that his family own is too far away to use it efficiently. Therefore when he does use a car, it is that of a friends and the main use is to go to and from events as public transport is unreliable.
			C5	Student - TPM	24	F	She uses the car of her family when she is not at uni (on weekends) and mainly to travel into town to meet friends, or to travel to sports training/matches with teammates.
			C6	HR	22	F	This participant mainly uses the car of her parents to travel to and from her university city and home town, as well as visiting friends and family members who live further away.

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
			C7	Student/ escape room host	22	F	She mainly uses the car of her parents to go and visit friends when she is home, or to go to sports training/matches with other teammates.
			C8	Beautician	54	F	She has a car that she solely owns. The main use of this car is to go to and from work when the weather is not nice, as well as driving to go large grocery shops. The car is sometimes borrowed by her daughter.
Activity	**Goal of activity**	**No. of participants**	**Participant ID**	**Occupation**	**Age**	**Gender**	**Extra info**
Context mapping workshop	As a results of the previous activities, a research question was created that related to the use of family cars. The main goal of this was to map out a large number of scenarios surrounding the non-driving experience of family cars, and how these can relate to data in a way that improves the experience. It was used as a co-creation session where participants worked together, along with myself to come up with wild scenarios, as well as a number of potential wild solutions.	4	C5	Student - Design	22	F	She uses the car of her family when she is not at uni (on weekends) and mainly to travel into town to meet friends, or to travel to sports training/matches with teammates.
			B2	Student - Design	23	F	This participant has her drivers licence for many years, and uses the car of her father mainly to travel to and from family members houses. Her father has his own car as well and therefore her car is not shared so much with other people (sometimes a friend).
			D1	Web developer	34	M	This participant is the sole owner of a car. He recently bought his first car and therefore uses it quite a lot with his partner. He mainly uses it to go to and from work as there are no trains that go there.
			D2	Self employed		M	This participant does not own a car anymore, however when his children were living at home, had a car that they shared between 4 of them. The main use was just extra-curricular activities such as visiting friends or going shopping.
Activity	**Goal of activity**	**No. of participants**	**Participant ID**	**Occupation**	**Age**	**Gender**	**Extra info**
Use case workshop	With the research question of routine use of family cars in mind, a workshop was carried out to find out more of the micro-use cases of family car routines. I wanted to see what	7 (2 pilot)	E1 (pilot)	Ford research centre		F	She owns two cars with her partner that she uses mainly for going to work and back, however when she has more time, will use it to take her car to visit her horse.
			E2 (pilot)	Engineer		F	She owns a car that she shares with her husband. The main use of the car is picking her child up from school, but also using it to transport her horse to and from the stables.

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
	the micro interactions were in a number of different uses of the family car, ranging from going to work alone, to going grocery shopping with your child.		C1	Child-care counsellor		F	She uses a family car (van) mainly for short and long trips. These include trips in the Netherlands, as well as longer family trips outside of the Netherlands. She shares the car with her husband.
			E3	Asset manager		M	He owns a car that he shares with his wife, and also has 2 young children (1yo and 4yo). The main uses of his car is to go to and from work in Amsterdam, however he also goes on family holidays and weekends to friends houses.
			E4	Online co-ordinator of LR		F	She owns a car that she shares with her husband, as well as a child of 2 years old. The main use of the car is to travel to and from work at the university (via child's daycare), as well as doing groceries on the weekend.
			E5	Professor of EWI		F	Shares a family car and has a child of 2 years old. The main uses of her car are to travel to work conferences with colleagues (carpooling), as well as collecting her child from day-care.
			E6	Assistant professor in design		F	She has a family car that she shares with her partner as well as 2 children (1yo and 3yo). She mainly uses her car to travel to and from work, as well as (grocery) shopping.

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
Prototype 1	Throughout the scenarios that came out of the use case workshops, a number of prototypes were made that were a solution to various pain points/ opportunities. These prototypes were tested with a number of potential users in order to develop the prototype, or iterate towards a potential solution.	4	C4	Student - Design	24	M	He does not own a car, and the car that his family own is too far away to use it efficiently. Therefore when he does use a car, it is that of a friends and the main use is to go to and from events as public transport is unreliable.
			B2	Student - Design	23	F	This participant has her drivers licence for many years, and uses the car of her father mainly to travel to and from family members houses. Her father has his own car as well and therefore her car is not shared so much with other people (sometimes a friend).
			B1	Student - Design	22	M	This participants recently passed their drivers exam and now shares a car with his sister. His sister lives in a difference city and therefore use of the car can be complicated and requires planning prior to the use.
			F1	Student - Engineering	26	F	This participant does not own a car, however does use the car of her parents when possible, mainly to travel on holidays with friends, or when her parents are on holiday themselves.
Prototype 2		5	C4	Student - Design	24	M	He does not own a car, and the car that his family own is too far away to use it efficiently. Therefore when he does use a car, it is that of a friends and the main use is to go to and from events as public transport is unreliable.
			B2	Student - Design	23	F	This participant has her drivers licence for many years, and uses the car of her father mainly to travel to and from family members houses. Her father has his own car as well and therefore her car is not shared so much with other people (sometimes a friend).
			B1	Student - Design	22	M	This participants recently passed their drivers exam and now shares a car with his sister. His sister lives in a difference city and therefore use of the car can be complicated and requires planning prior to the use.
			F1	Student - Engineering	26	F	This participant does not own a car, however does use the car of her parents when possible, mainly to travel on holidays with friends, or when her parents are on holiday themselves.
			F2	Professor of design	52	M	This participant owns his own car. He has 2 children and a partner (however she does not drive) and mainly uses their car to go to and from work.
Prototype 3		4	F1	Student - Engineering	26	F	This participant does not own a car, however does use the car of her parents when possible, mainly to travel on holidays with friends, or when her parents are on holiday themselves.
			F2	Professor of design	52	M	This participant owns his own car. He has 2 children and a partner (however she does not drive) and mainly uses their car to go to and from work.
			E1	Ford research centre		F	She owns two cars with her partner that she uses mainly for going to work and back, however when she has more time, will use it to take her car to visit her horse.

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
			C4	Student - Design	24	M	He does not own a car, and the car that his family own is too far away to use it efficiently. Therefore when he does use a car, it is that of a friends and the main use is to go to and from events as public transport is unreliable.
Prototype 4		3	F2	Professor of design	52	M	This participant owns his own car. He has 2 children and a partner (however she does not drive) and mainly uses their car to go to and from work.
			E1	Ford research centre		F	She owns two cars with her partner that she uses mainly for going to work and back, however when she has more time, will use it to take her car to visit her horse.
			C4	Student - Design	24	M	He does not own a car, and the car that his family own is too far away to use it efficiently. Therefore when he does use a car, it is that of a friends and the main use is to go to and from events as public transport is unreliable.
Prototype 5		2	F2	Professor of design	52	M	This participant owns his own car. He has 2 children and a partner (however she does not drive) and mainly uses their car to go to and from work.
			E1	Ford research centre		F	She owns two cars with her partner that she uses mainly for going to work and back, however when she has more time, will use it to take her car to visit her horse.

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
Scenario testing	Using the act it out method, I created 3 scenarios of how the service could react to certain inputs from the user and the data of the user. The goal was to find out the most interesting moments along the day in the life journey, as well as what parts are most interesting to the user and which parts could be improved to suit the user in certain situations.	7	B4	Self employed	57	F	This participants uses the family car that is often shared with both of her children, as well as her husband at times (although he has a company car).
			C8	Beautician	54	F	She has a car that she solely owns. The main use of this car is to go to and from work when the weather is not nice, as well as driving to go large grocery shops. The car is sometimes borrowed by her daughter.
			B3	Sales manager	54	M	This participant is the sole owner of a car. He has two children who can also drive, however they have a car that they share between them. He doesn't often use his car, however when he does it is mainly to work or family holidays.

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
			G1	Shop owner		M	This participant owns 2 cars as a family. One is the family car that he shares with his wife, and the other is the car used for the company. The family car is mainly used to travel to and from the child's school, as well as family trips to family members houses.
			C4	Student - Design	24	M	He does not own a car, and the car that his family own is too far away to use it efficiently. Therefore when he does use a car, it is that of a friends and the main use is to go to and from events as public transport is unreliable.
			G2	Professor of Design		M	This participant does not have any children, nor can he drive, however his partner owns a car that he rides in as a passenger.
			G3	Web developer	26	M	This participant owns his own car that he mainly uses to travel to and from his office, as well as the occasional holiday road trip.
			G4	Web developer	27	M	This participant owns 2 cars with his family, as well as having one child (1yo). He shares the cars often with his wife because one car is much nicer than the other so they have to find ways around that. The main use is for work and the child's day-care.

Activity	Goal of activity	No. of participants	Participant ID	Occupation	Age	Gender	Extra info
Final tests	From all the tasks and activities carried out throughout this project, they have resulted in this final concept. The goal of these tests is to find out whether the concept meets the list of requirements that was written earlier int he project, but also to find out what is liked and disliked about it, and where can improve for future recommendations.	3	C8	Beautician	54	F	She has a car that she solely owns. The main use of this car is to go to and from work when the weather is not nice, as well as driving to go large grocery shops. The car is sometimes borrowed by her daughter.
			E3	Asset manager		M	He owns a car that he shares with his wife, and also has 2 young children (1yo and 4yo). The main uses of his car is to go to and from work in Amsterdam, however he also goes on family holidays and weekends to friends houses.
			G1	Shop owner		M	This participant owns 2 cars as a family. One is the family car that he shares with his wife, and the other is the car used for the company. The family car is mainly used to travel to and from the child's school, as well as family trips to family members houses.

APPENDIX C: INTERVIEW QUESTIONS

First primary interview

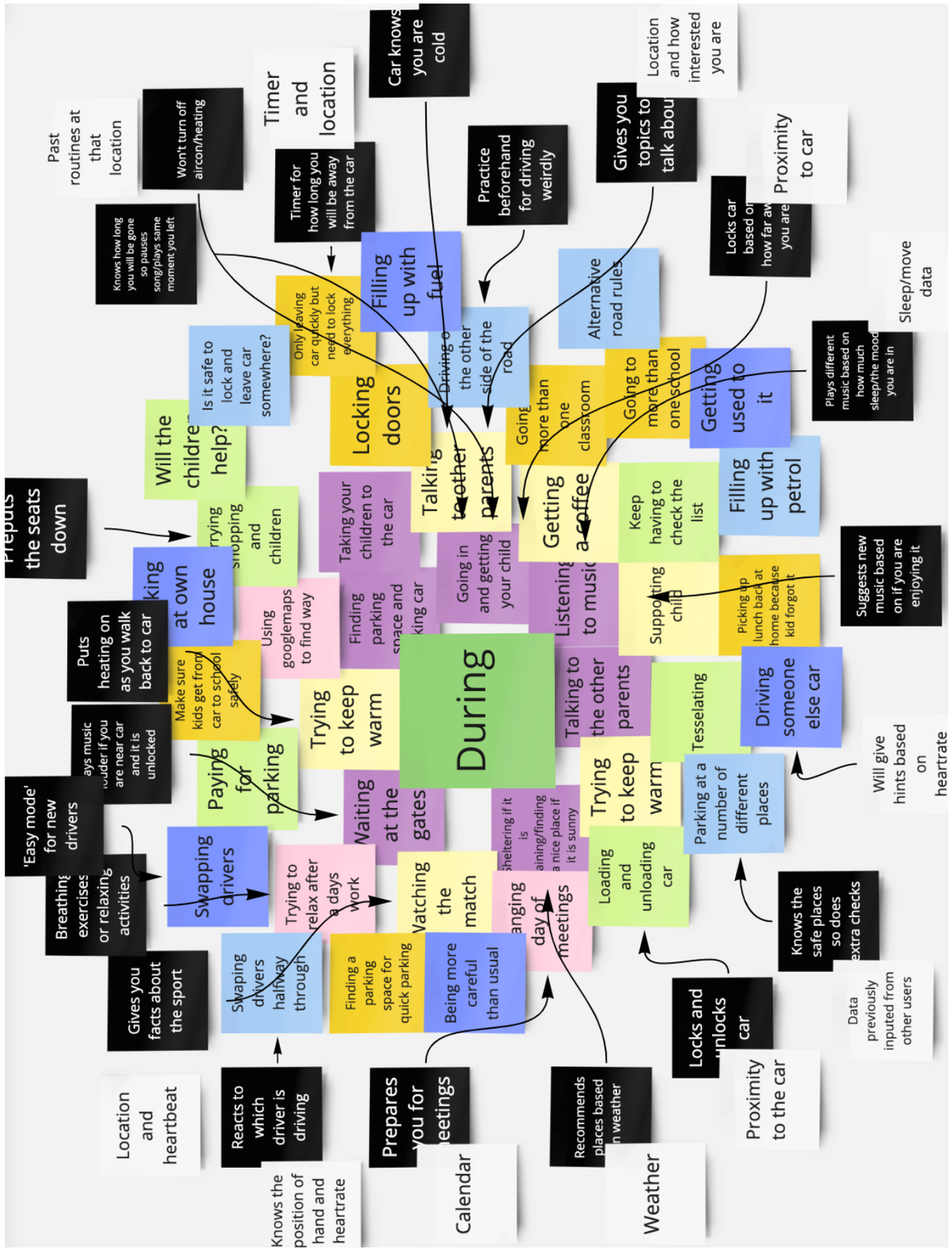
My goal: To get more an understanding of the journey of car drivers

1. Do you own a car?
   1. If not, go to question 2.
   2. If yes, go to question 3.
2. What is your main mode of transport?
3. What is your favourite part of this mode of transport?
4. Do you share the car with anyone else?
5. How often do you use your car?
6. What do you use your car for?
7. What do you use to plan your journey?
   a. Talk through in a bit of detail about how you plan it/what you use to plan it/how far in advance etc
8. What are the main things that you don't like on your journey (from planning the trip to when you have parked/car unloaded etc.

More defined interview questions

1. Do you own a car?
   a. If not, do you share a car with someone?
   b. If yes, do you share your car with anyone else?
2. Who do you share your car with?
3. How often do you use it and how often does the other person/people use it?
4. What happens when you want to use it but the other person has it? And visa versa
5. Can you recall a recent journey that you went on? Be specific (e.g., if you had to message someone beforehand, pick up the car from somewhere etc)
6. What was the most annoying thing about this journey?

APPENDIX D: INTERVIEW ANALYSIS


Past routines at that location
Won't turn off aircon/heating
Timer and location
Timer for how long you will be away from the car
Knows how long you will be gone so pauses song/plays same moment you left
Car knows you are cold
Location and how interested you are
Gives you topics to talk about
Practice beforehand for driving weirdly
Proximity to car
Locks car based on how far away you are
Sleep/move data
Plays different music based on how much sleep/the mood you are in
Filling up with fuel
Only leaving car quickly but need to lock everything
Is it safe to lock and leave car somewhere?
Alternative road rules
Driving on the other side of the road
Locking doors
Going more than one classroom
Going to more than one school
Getting used to it
Will the childre help?
Talking together parents
Filling up with petrol
Keep having to check the list
Getting a coffee
Taking your children to the car
Prepds the seats down
rrying shopping and children
Going in and getting your child
Listening to music
Suggests new music based on if you are enjoying it
Supporting child
Picking up lunch back at home because kid forgot it
Puts heating on as you walk back to car
at own house
Finding parking space and king car
Using googlemaps to find way
Make sure kids get from car to school safely
During
Talking to the other parents
Driving someone else car
Tesselating
Trying to keep warm
Paying for parking
Waiting at the gates
Parking at a number of different places
Will give hints based on heartrate
'Easy mode' for new drivers
ays music louder if you are near car and it is unlocked
Breathing exercises or relaxing activities
Swapping drivers
Trying to relax after a days work
Vatching the match
Loading and unloading car
Knows the safe places so does extra checks
Gives you facts about the sport
Swaping drivers halfway through
Finding a parking space for quick parking
Being more careful than usual
anging day of meetings
Locks and unlocks car
Data previously inputed from other users
Location and heartbeat
Reacts to which driver is driving
Prepares you for eetings
Recommends places based n weather
Proximity to the car
Knows the position of hand and heartrate
Calendar
Weather


Calendar and maps
Location and if you haven't gone into the car for a while
Location of you vs location of devices
Plan when you and your parents need the car next and organise best place to meet
Weight and tensing
Will automatically send a message to say thank you
Reminder to take your valuable items out
Knows you have sported
Will throw all your stuff out onto the street
Drop car back off at parents
Hoover the car
Leaves the windows open for a bit longer after you have parked to get rid of the smell
Knows you are struggling and messages others for help
Unpack car
Walk home
Wave goodbye
All electronics out
Clean sports kit
Ask other people to help unload
Automatic locking system
making sure ca is locke
Go to work
Holiday CDs out
Unloading car
Unloadir car
Don't drive over other kids
Spits out CDs if you forget to take them out
Sleep
Putting parking thing on
After
Putting in right position so tomorrow morn is easier
Putting stuff in fridge/cupboards
Heartbeat
Treat them to something nice
Putting key away
Take kids out
Put it in original position
Knows where you are going next so suggests parking position
Find out when and where next person needs it
Ski box off (or similar)
Check when you have to pick them up
Cook
Make sure they have everything
Take other kids home
Making sure you have all their kids
Clean car
Clean car
Don;t run over kids
Best route to drop everyone off
Google calendar?
Clean the car
Drop keys through letter box
Are all the seats sat on?
Did you walk to 3 classrooms?
Alert 5 mins before you need to leave
Car prepares itself
Message sent to groupchat automatically
Pressure points
Usual routine
Calendar
Location
Work intensity (more intense=more warning, less intense=less warning)

APPENDIX F: SENSITISING BOOKLET

Sensitising booklet
Vehicles with multiple users

By:

Definitions

Below are a list of definitions of the key words that I will be using throughout this booklet.

Multi-user vehicles	A vehicle that has more than one user that is related to the main owner (eg. a car that is used by multiple member of the same family).
Non-driving experience	The non-driving experience is any experience that is outside of the vehicle itself (eg. walking to the car and unloading the vehicle).
Wearable	A wearable is an electronic device worn by the user as an accessory that has the ability to send and recieve data via the internet (eg, a smart phone or smart watch).

Hi there!

You are being invited to participate in a research study carried out by Charles Elson from the TU Delft in collaboration with Ford Motor Company (Ford).

The purpose of this research study is to collect information on a drivers day to day use of a multi-user vehicle, as well as any non-driving experiences that they have, including pain points and potential opportunities to explore further. A multi-user vehicle is a car that has more than one defined user (eg, a family car, car with your partner or with a set group of friends). The data will be used for the research phase of a Design for Interaction Master's thesis. I will be asking you a number of tasks over a period of 3 days (around 15 minutes per day) to describe your experience that you have with travelling via a multi-user vehicle both before, during and after your journey through a set of questions and tasks.

If you have any questions before or after the research please contact Charles Elson at +31639020253, or at c.a.r.elson@student.tudelft.nl.

Day 1: About me

Use this page to fill in information about yourself including your name and your photo. Make this page your own and add whatever you want...or nothing at all.

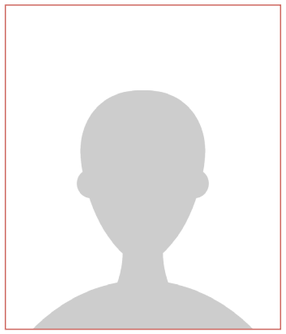
Name: _____

Occupation: _____

Interest field: _____

Fill in 3 words that best describe yourself:

Paste a photo or make a drawing of yourself



Day 1: Preparation

Use this page as a brain dump of all the things that are currently on your mind. It could a check list of what you need to do today, or a drawing of your favourite scene from a movie. Just empty your brain.

Day 1: Past experiences

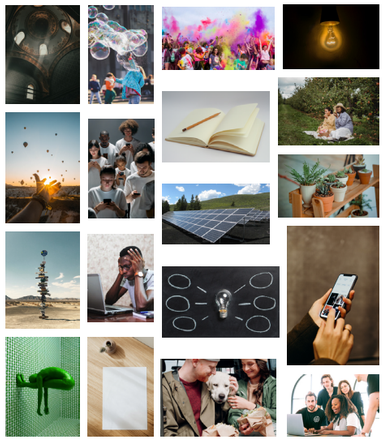
Here I will be asking you about your past experiences of driving in a multi-user vehicle, using wearables and driving in general.

1. Using a combinations of the words and photos on the next page as well as your own thoughts/words, fill in your personal definition and experience of what you think/feel about the following 3 words.

Driving | *Using wearables* | *Multi-user vehicles*

Exciting
Annoying
Mysterious
Fun
Irritating
Confusing
Brave
Brilliant
Luxurious
Practical
Sophisticated
Weathered
Lazy

Kind
Quick
Serious
Boring
Complicated
Embarrassing
Facinating
Relaxing
Unpleasant
Pleasant
Joyful
Excellent
Beautiful



Day 2: Wearables

Here I will be asking you more detailed questions about your use of wearables. What data you collect and how you **personally** use the data.

Data and wearables

What: _____
How: _____

What: _____
How: _____

What: _____
How: _____

What: _____
How: _____

What: _____
How: _____

Day 2: Wearables

Here I will be asking you more detailed questions about your use of wearables. What data you collect and what it can be used for.

1. In the red box, fill in all the types of data that you collect, or think your wearable collects from you. If you can think of one, fill in a scenario in the blue box which that data can be used for. Be as wild as you want.

Wearable data	*Scenarios*
Heart rate	See how in a rush you are to get to the car

Day 2: Using your car with others

This task will be based around your experience of using your car with other people within your family or close group. Whether you are the owner of the car, or share it with others, I am interested in both sides of the story.

☐ I am a car owner
☐ I use someone elses car

What is the main reason for using your car? What items do you take with you (people, pets, items etc)?

Reason: _____

Items: _____

Reason: _____

Items: _____

Place here a brain dump of all of your car sharing experiences, both in a family/friends car and from a car sharing service.

Day 3: Using your car with others

1. Recalling a recent journey of yours, think about how you would map out the journey, using the highs and lows of the journey as reference. Make a note of what the key parts along the journey are **focussing mainly on the activities outside of the car**.

High

Knowing you need to use/ borrow the car

In-car experience

Getting home

Low

Day 3: Using your car with others

2. Note below three high points and three pain points of the journey that you illustrated above. Also note why these were high and pain points.

😀

A. Journey point _____
Why _____

B. Journey point _____
Why _____

C. Journey point _____
Why _____

😩

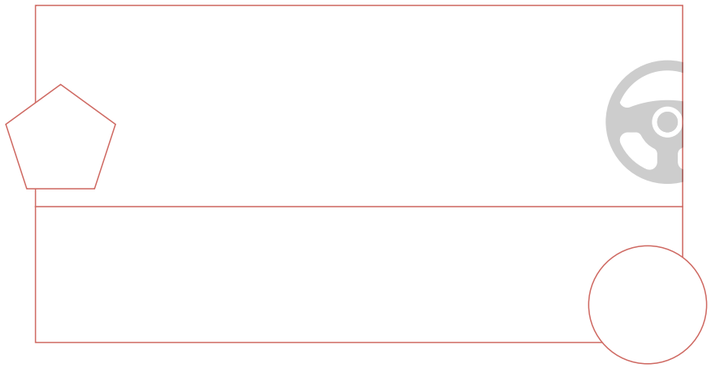
A. Journey point _____
Why _____

B. Journey point _____
Why _____

C. Journey point _____
Why _____

Day 3: Improving the journey

Thinking of the previous journey that you illustrated, **what** part of this journey would you improve? You can choose more than one aspect and more then one improvement if you wish to do so. Feel free to use words, drawings , cut outs or just descriptions to improve the journey.



Day 3: Improving the journey

Thinking of the previous journey that you illustrated, **how** would improve this part of the journey? You can choose more than one aspect and more then one improvement if you wish to do so. Feel free to use words, drawings , cut outs or just descriptions to improve the journey.

I would improve [*Insert aspect here*] by *[describe in the box below]*

Any other comments or suggestions?

Thank you for filling out this booklet!
Once you have filled it out, please get into contact with me via c.a.r.elson@student.tudelft.nl or +31639020253 so that I can recieve the booklet back to analyse the contents :)

TO VIEW THE RESULTS OF THE INDIVIDUAL SENSITISING BOOKLETS, VIEW THEM AT:
https://miro.com/app/board/uXjVODIoI8A=/?share_link_id=975951101682

APPENDIX F: CONTEXT MAPPING WORKSHOP SET-UP

The focus of this task is to understand a bit more the use cases around using a car as a family. This can be whilst living at home with family, or once you have already moved out. I want you to have a mixture of the 2 and try and think of a number of different scenarios about why you use a car.

From this I am interested in seeing what opportunities there are around how we can make one part of this journey easier.

Wearables

This task is to get a bit more used to having and owning wearables. I will be taking you through a couple of tasks that are related to what wearables you own and what you can do with them.

What is a wearble?

What can a wearable do?

What data can a wearable collect?

Before during and after the journey

Thinking of these use cases, I want to delve a bit deeper into the specific scenarios of each of these. Come up with as many specific actions that both you and your parent would do **before, during and after stepping foot into the car**

Transition from work to home (visa versa)

Shopping (groceries, clothes, other)

Dropping kids off/picking them up from school

Getting used to new car

Before

During

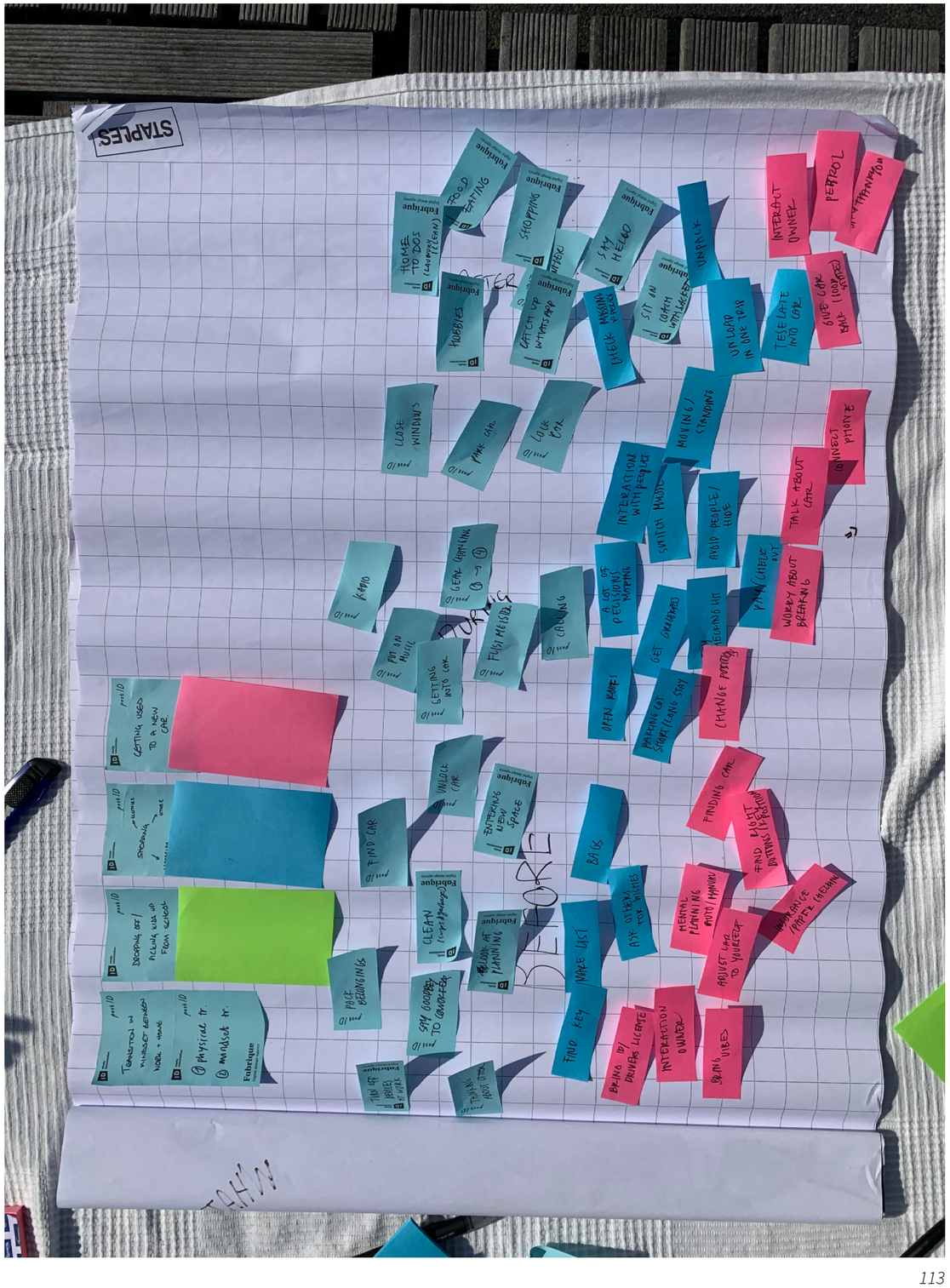
After

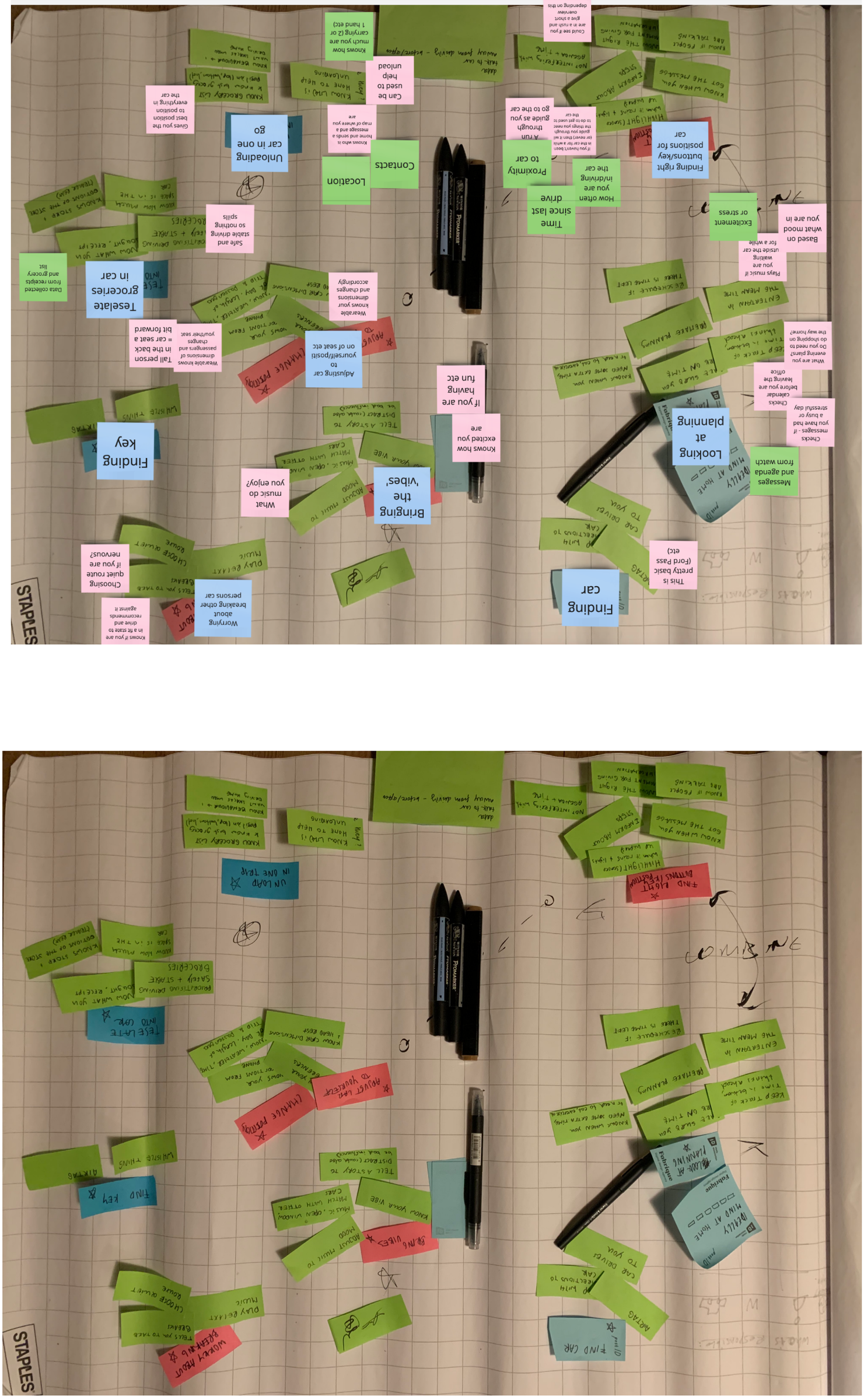
Potential oppotunities

Based on these scenarios, I want to see what potential opportunities lie in terms of how the car can react and how the experience can be improved.

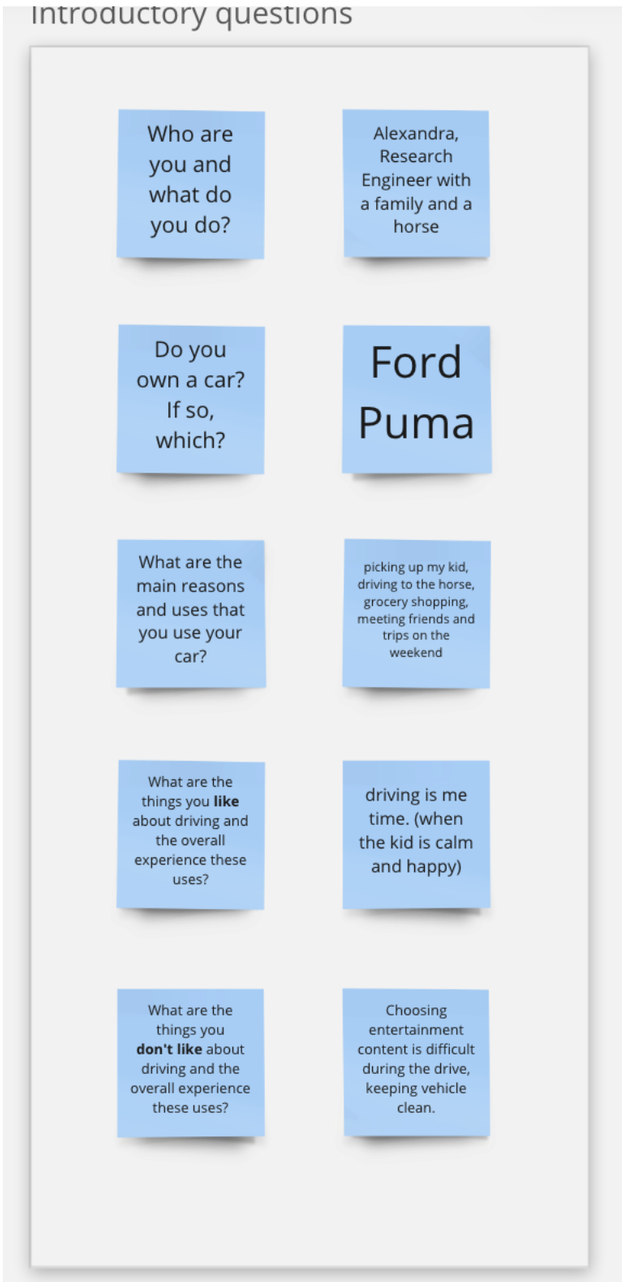
From these opportunities, I want you to add another post it that is related to the data that could be collected from the user in this situation.

APPENDIX H: CONTEXT MAPPING WORKSHOP RESULTS

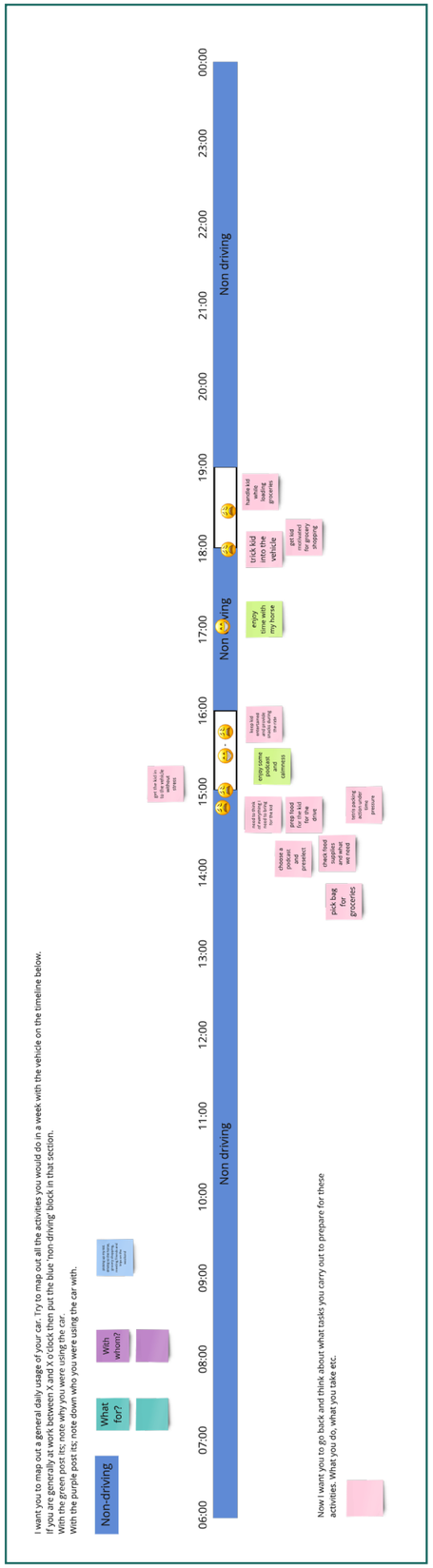



Finding car
This is pretty basic (Ford Pass etc)
Looking at planning
Checks messages - if you have had a busy or stressful day
Checks Calendar before you are leaving the office
What are you meeting plans? Do you need to do shopping on the way home?
Messages and agenda from watch
Bringing the 'vibes'
What music do you enjoy?
Finding key
Tall person in the back = car seat a bit forward
Wearable knows dimensions of passengers and changes you/their seat
Tesselate groceries in car
Data collected from receipts and grocery list
Wearable knows your dimensions and changes accordingly
Safe and stable driving so nothing spills
Unloading car in one go
Gives you the best position to position everything in the car
Knows how much you are carrying (2 or 1 hand etc)
Can be used to help unload
Knows who is home and sends a message and a map of where you are
Location
Contacts
Proximity to car
A run through guide as you go to the car
Time since last drive
How often you are in/driving the car
Finding right buttons/key positions for car
Exctement or stress
Based on what mood you are in
Plays music if you are waiting outside the car for a while
Knows if you are in a hr state to drive and recommends against it
Worrying about breaking other persons car
Choosing quiet route if you are nervous?

APPENDIX I: USE CASE WORKSHOP; PILOT



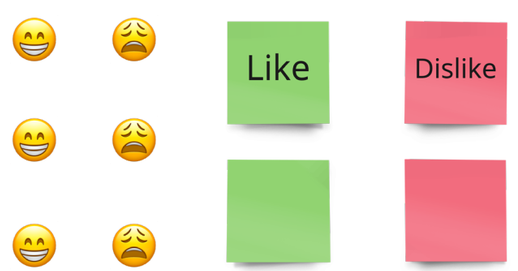
TASK 1



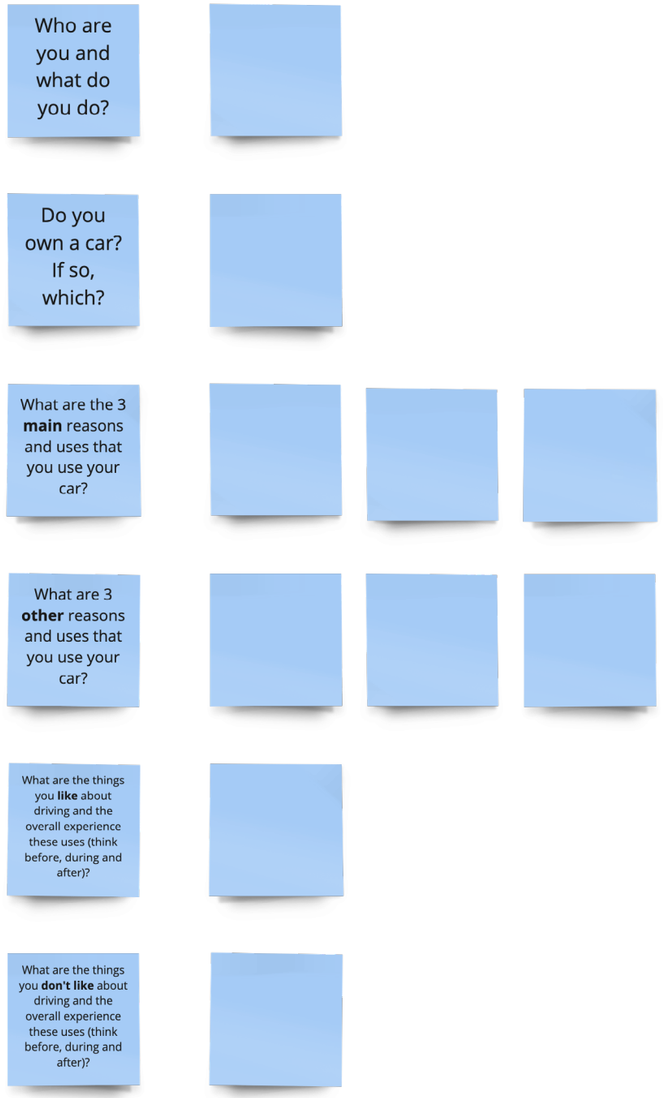
TASK 2 A ND 3

TASK 4

Label your activities in the timeline that are most liked and disliked with the emojis below and make a note why with the post it.



APPENDIX I: USE CASE WORKSHOP; TASKS



TASK 1

Now we are going to go into detail about 3 of the use cases you mentioned above. Pick 3 of the 6 you mentioned *(can be all of the most common uses or a mixture of the 6)* and the following few tasks will be describing them in more detail.

Chosen use cases:

For each of these use cases, note down the micro use cases that you have also undertaken in the past.
For example, under **grocery shopping** could be:

- Shopping with your children
- Shopping on the way home from work
- Shopping alone, etc.

Use cases

1

2

3

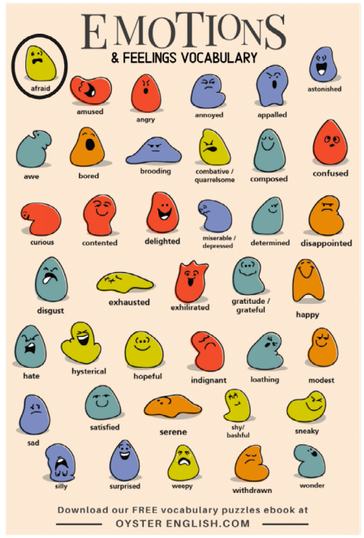
TASK 2

Thinking about 3 or 4 of these micro use cases that you have mentioned above, can you go into detail about what activities you do prior to plan or prepare for the use case?

	What are the activities that you carry out prior to this use case?		
Use case	Days beforehand (eg, planning)	The morning of (eg. remembering items)	Walking towards the car (eg. putting on music)
1			
2			
3			
Optional 4			

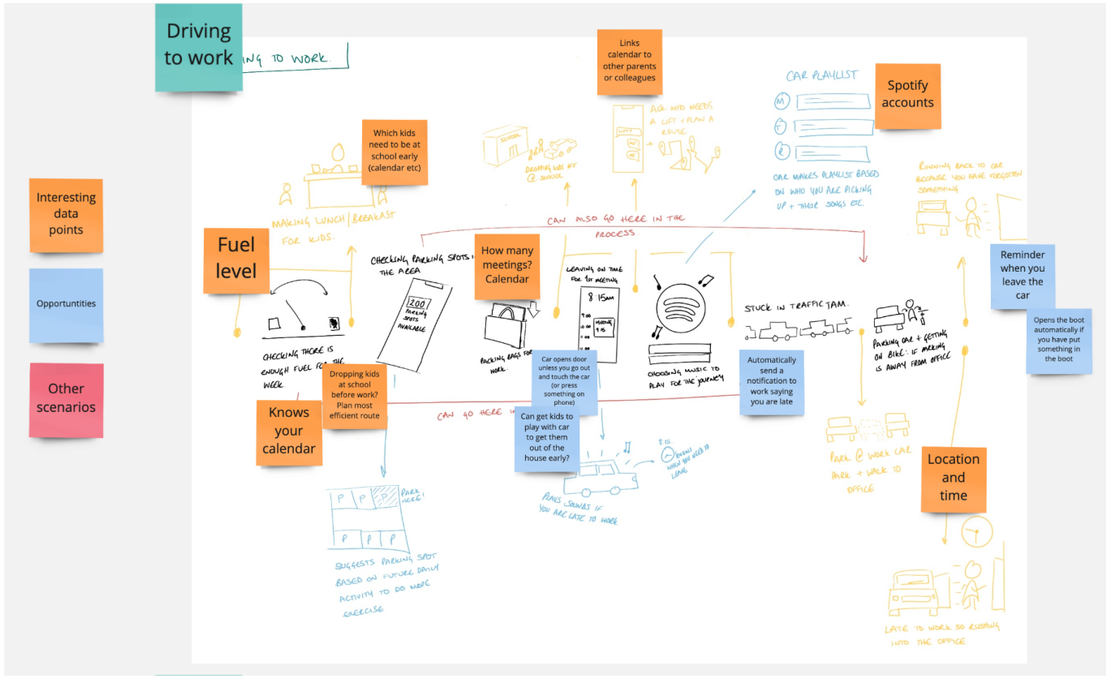
TASK 3

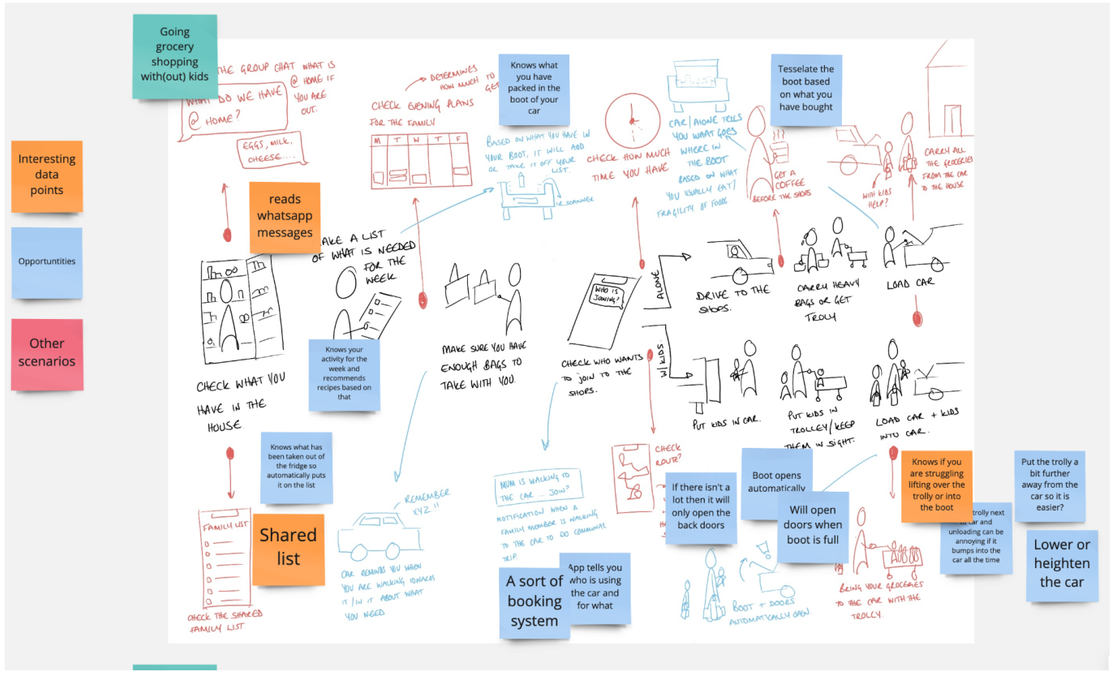
Looking at the below emotions, use the post its to mark your actions in the table above with how you feel about at that time.

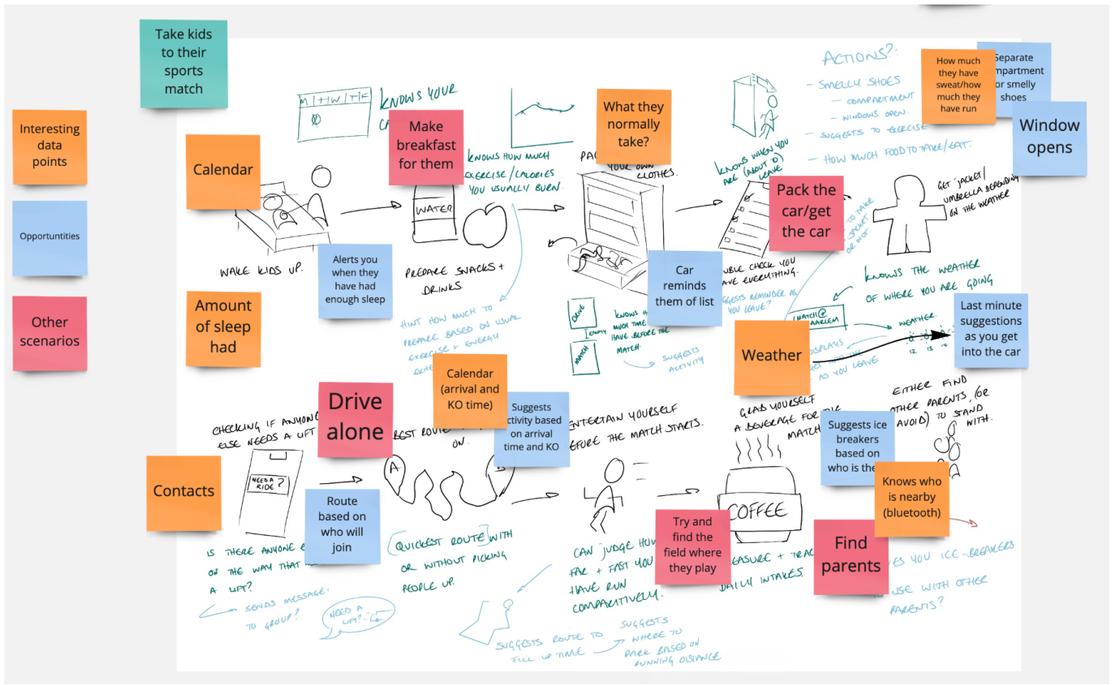


TASK 4

APPENDIX J: SCENARIO OF USE CASES

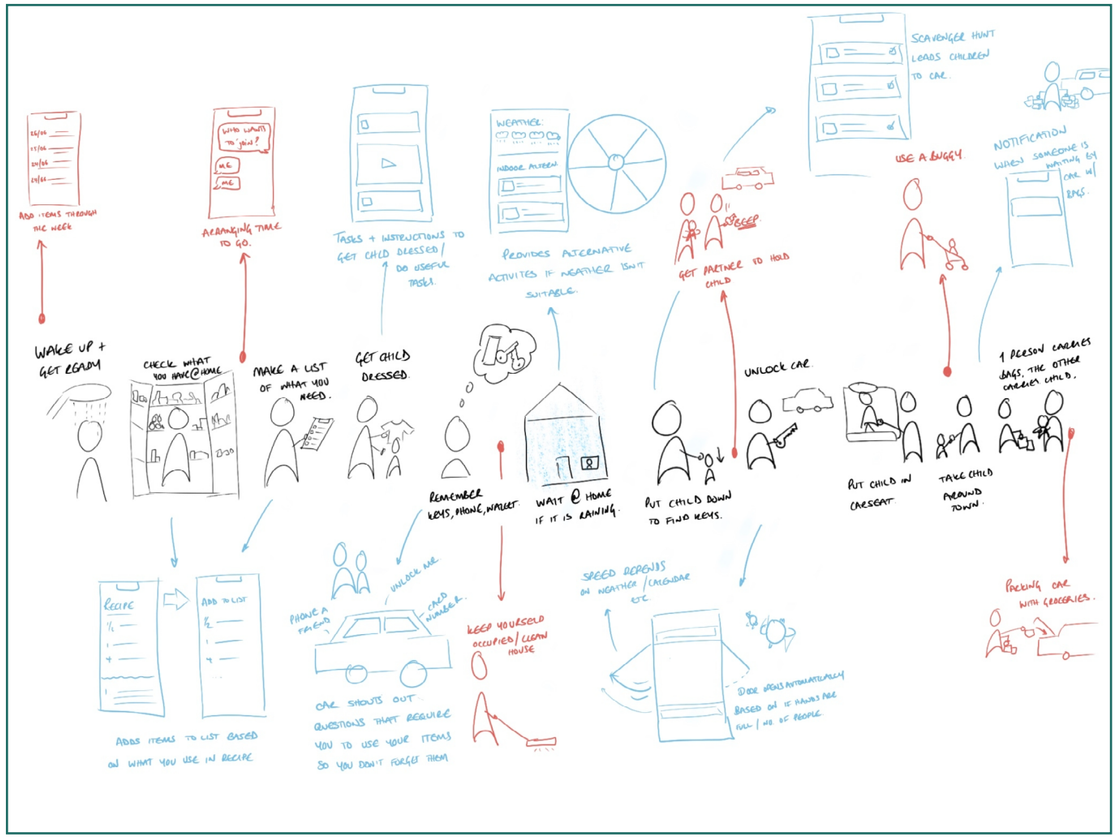


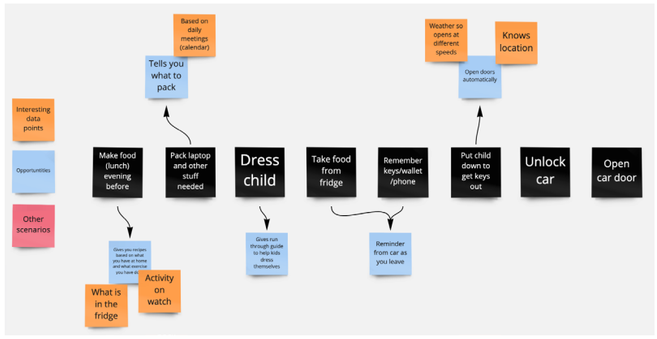

Going grocery shopping with(out) kids
Interesting data points
Opportunities
Other scenarios
reads whatsapp messages
CHECK WHAT YOU HAVE IN THE HOUSE
TAKE A LIST OF WHAT IS NEEDED FOR THE WEEK
Knows your activity for the week and recommends recipes based on that
MAKE SURE YOU HAVE ENOUGH BAGS TO TAKE WITH YOU.
Knows what has been taken out of the fridge so automatically puts it on the list
Shared list
CHECK THE SHARED FAMILY LIST
REMEMBER XYZ !!
OH, REMIND YOU WHEN YOU ARE NEARING TOWNS IN CASE IT'S ABOUT WHAT YOU NEED
CHECK WHO WANTS TO JOIN TO THE SHOPS.
ALONE
WITH KIDS
DRIVE TO THE SHOPS.
CHECK BOOT
PUT KIDS IN CAR.
PUT KIDS IN TROLLEY/KEEP THEM IN SIGHT.
CHECK EQUIP
A sort of booking system
App tells you who is using the car and for what
If there isn't a lot then it will only open the back doors
Boot opens automatically
Will open doors when boot is full
LOAD CAR + KIDS INTO CAR.
Knows if you are struggling lifting over the trolly or into the boot
Put the trolly a bit further away from the car so it is easier?
Lower or heighten the car
Tesselate the boot based on what you have bought
Knows what you have packed in the boot of your car
CHECK HOW MUCH TIME YOU HAVE
CHECK WHAT GOES WHERE IN THE BOOT BASED ON WHAT YOU USUALLY EAT/ FRAGILITY OF FOOD
GET A COFFEE BEFORE THE SHOPS
CHECK ALL THE GROCERIES FROM THE CAR TO THE HOUSE
CHECK HOW MUCH YOU HAVE IN YOUR BOOT, IT WILL ADD OR TAKE IT OFF YOUR LIST.
CHECK EVENING PLANS FOR THE FAMILY
OBSERVES HOW MUCH TO GET
LOAD CAR
CHECK HEAVY BAGS OR GET TROLLY
Trolly next to car and unloading can be annoying if it bumps into the car all the time
BRING YOUR GROCERIES TO THE CAR WITH THE TROLLY.

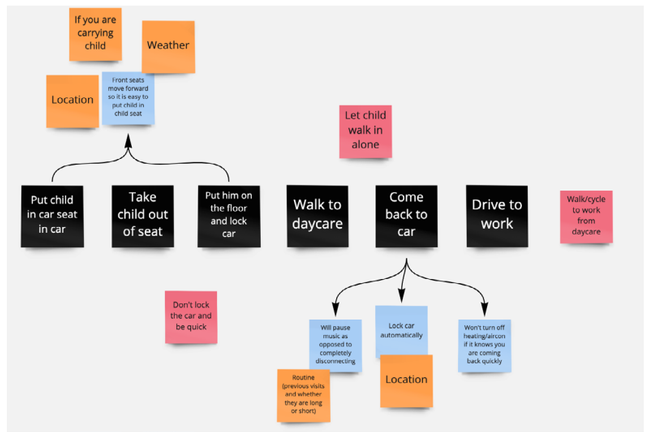

Take kids to their sports match
Interesting data points
Opportunities
Other scenarios
Calendar
Amount of sleep had
WAKE KIDS UP.
Alerts you when they have had enough sleep
Make breakfast for them
PREPARE SNACKS + DRINKS
What they normally take?
Car reminds them of list
Pack the car/get the car
ACTIONS?
- SMELLY SHOES
- COMPARTMENT
- WINDOWS OPEN.
- SUGGESTS TO EXERCISE
- HOW MUCH FOOD TO PACK/EAT.
How much they have sweat/how much they have run
Separate compartment for smelly shoes
Window opens
Weather
Last minute suggestions as you get into the car
Drive alone
Calendar (arrival and KO time)
Suggests activity based on arrival time and KO
Contacts
Route based on who will join
Try and find the field where they play
Suggests ice breakers based on who is the
Knows who is nearby (bluetooth)
Find parents

Short day trips within Holland (surfing)
Interesting data points
Opportunities
Other scenarios
Planning where to go
Car fuel / family calendars etc
Checking route
Go to the shops beforehand
Trends for activity/hunger last trip
Knows weight of skis/if they are in place
Doesn't have to be surfboard, but also normal clothes in boot/on roof
Release a step to help get to roof
Provides entertainment on route
Suggests the best places to surf/ski depending on weather/wind
Weather
Location
Body temperature
Turns heating on (depending on weather)
Keeps clothes warm whilst surfing
Separate section in the boot/roof for wet clothes
You are wet heading back to the car. How can it react?
Push seat back to help you get ndressed
Blacks out car windows whilst getting dressed
How long is the journey, how much food do you generally need?

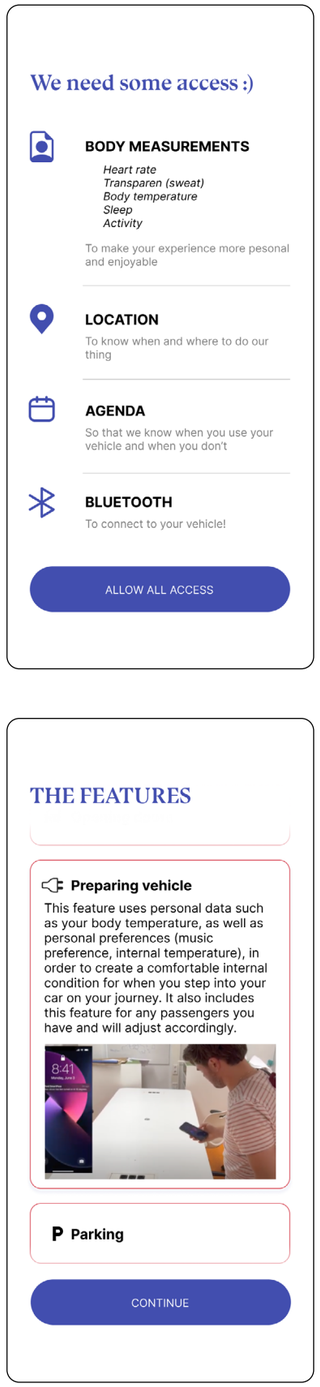
Going on a weekend trip to family
Interesting data points
Opportunities
Other scenarios
Automatic planning of packing in your calendar
Based how long it usually takes you or others
Based on how long and where you are travelling to
Knows how much petrol you have
How far/long is the journey
Buy a present for family
Suggests suitable locations to switch drivers
ASsigning doors for children
Based on weight and height and location
Opens boot automatically when stationary and at destination
Automatically send message to family telling them you are on your way
Parking suggestions
Amount of bags and people in the car to help
Suggests suitable locations to stop for gas
Based on fuel prices and tank
Knows how much it costs you fo
Make packing list for you based on previous journies
Or on other peoples journies?
An app with a community????

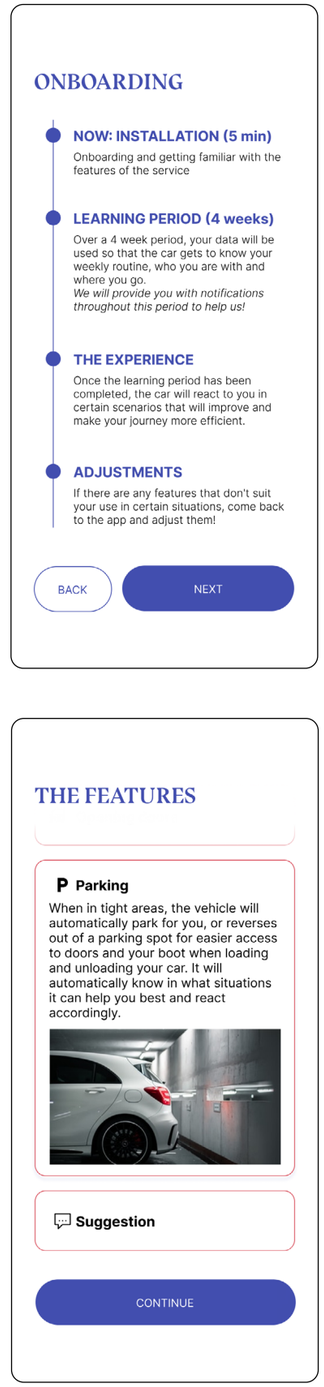


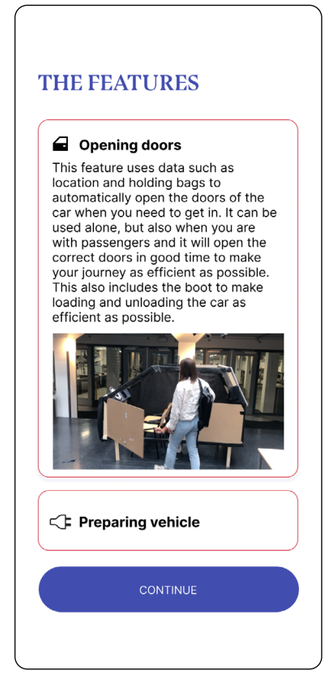


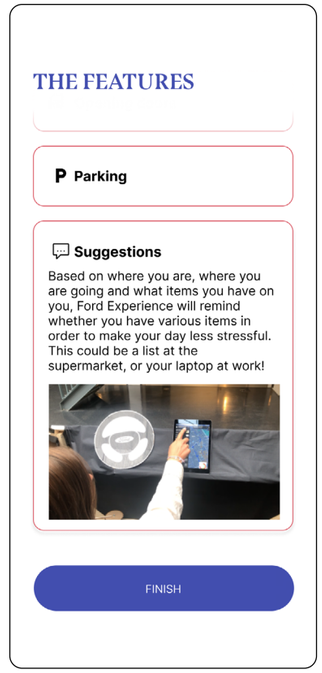


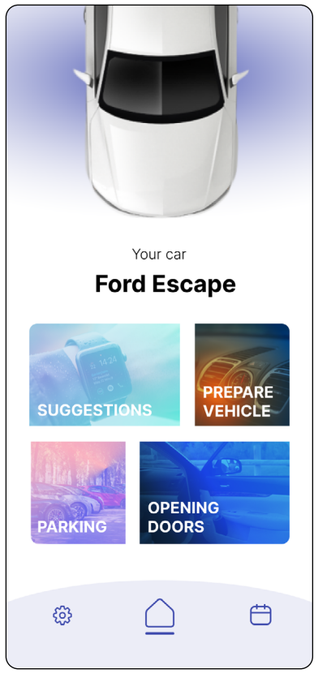
APPENDIX K: FINAL CONCEPT APP SCREENS

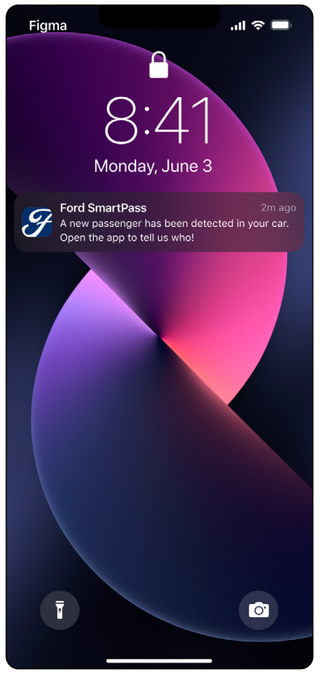


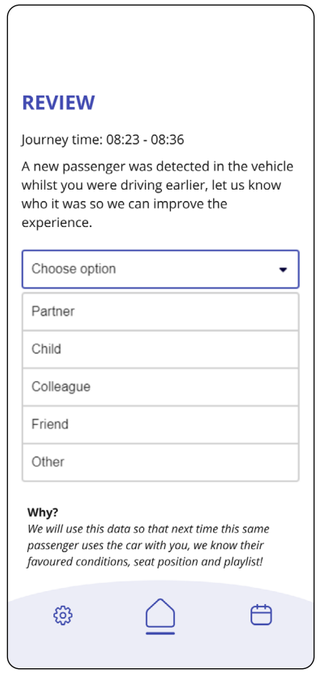


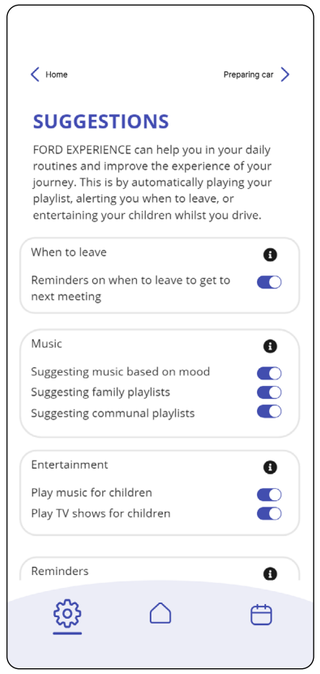


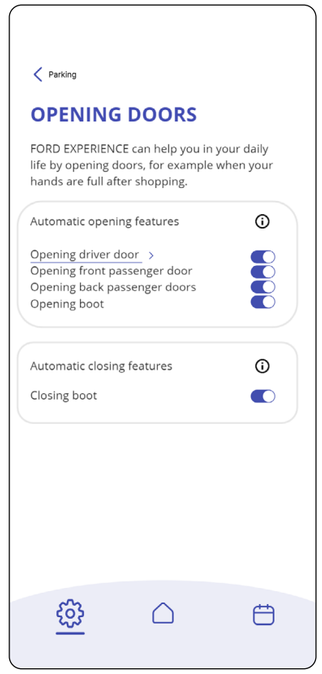


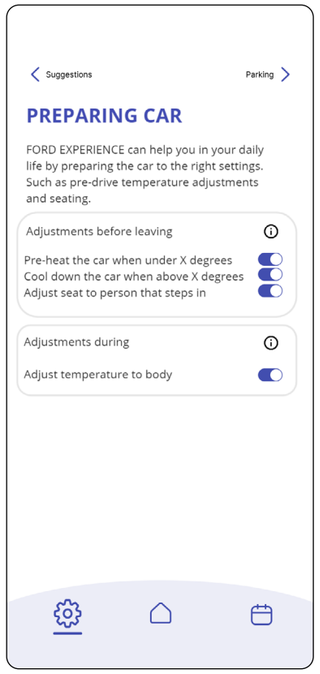

Your car
Ford Escape
SUGGESTIONS
PREPARE VEHICLE
PARKING
OPENING DOORS

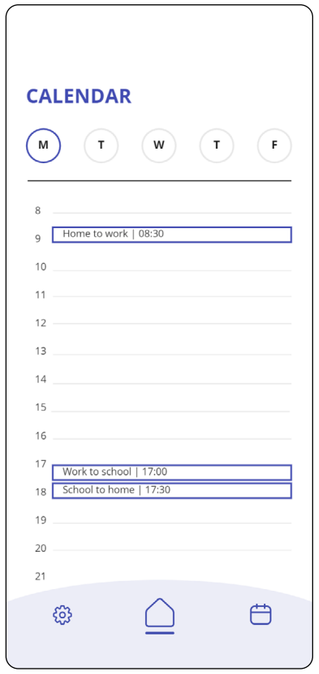

Figma
8:41
Monday, June 3
Ford SmartPass
2m ago
A new passenger has been detected in your car. Open the app to tell us who!

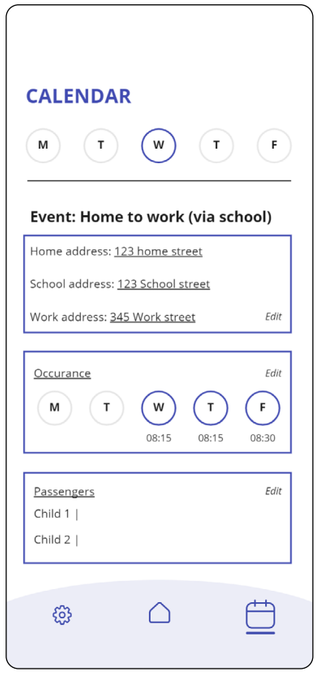

REVIEW
Journey time: 08:23 - 08:36
A new passenger was detected in the vehicle whilst you were driving earlier, let us know who it was so we can improve the experience.
Choose option
Partner
Child
Colleague
Friend
Other
Why?
We will use this data so that next time this same passenger uses the car with you, we know their favoured conditions, seat position and playlist!

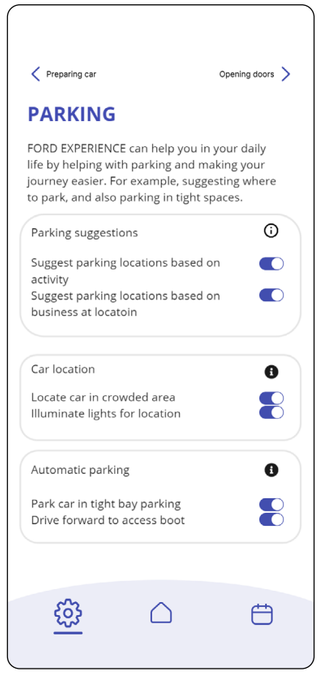

Home
Preparing car
SUGGESTIONS
FORD EXPERIENCE can help you in your daily routines and improve the experience of your journey. This is by automatically playing your playlist, alerting you when to leave, or entertaining your children whilst you drive.
When to leave
Reminders on when to leave to get to next meeting
Music
Suggesting music based on mood
Suggesting family playlists
Suggesting communal playlists
Entertainment
Play music for children
Play TV shows for children
Reminders

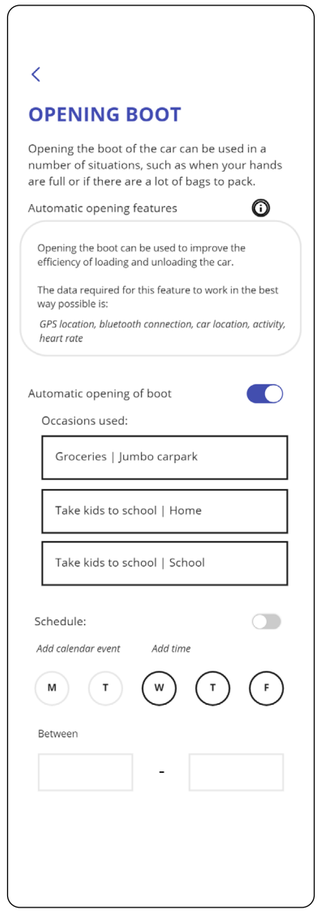

Parking
OPENING DOORS
FORD EXPERIENCE can help you in your daily life by opening doors, for example when your hands are full after shopping.
Automatic opening features
Opening driver door
Opening front passenger door
Opening back passenger doors
Opening boot
Automatic closing features
Closing boot


Suggestions
Parking
PREPARING CAR
FORD EXPERIENCE can help you in your daily life by preparing the car to the right settings. Such as pre-drive temperature adjustments and seating.
Adjustments before leaving
Pre-heat the car when under X degrees
Cool down the car when above X degrees
Adjust seat to person that steps in
Adjustments during
Adjust temperature to body


CALENDAR
M
T
W
T
F
8
9
Home to work | 08:30
10
11
12
13
14
15
16
17
Work to school | 17:00
18
School to home | 17:30
19
20
21


CALENDAR
M
T
W
T
F
Event: Home to work (via school)
Home address: 123 home street
School address: 123 School street
Work address: 345 Work street
Edit
Occurance
Edit
M
T
W
T
F
08:15
08:15
08:30
Passengers
Edit
Child 1 |
Child 2 |


Preparing car
Opening doors
PARKING
FORD EXPERIENCE can help you in your daily life by helping with parking and making your journey easier. For example, suggesting where to park, and also parking in tight spaces.
Parking suggestions
Suggest parking locations based on activity
Suggest parking locations based on business at locatoin
Car location
Locate car in crowded area
Illuminate lights for location
Automatic parking
Park car in tight bay parking
Drive forward to access boot


OPENING BOOT
Opening the boot of the car can be used in a number of situations, such as when your hands are full or if there are a lot of bags to pack.
Automatic opening features
Opening the boot can be used to improve the efficiency of loading and unloading the car.
The data required for this feature to work in the best way possible is:
GPS location, bluetooth connection, car location, activity, heart rate
Automatic opening of boot
Occasions used:
Groceries | Jumbo carpark
Take kids to school | Home
Take kids to school | School
Schedule:
Add calendar event
Add time
M
T
W
T
F
Between
-

APPENDIX L: FINAL TEST QUESTIONS

1. What are your first impressions?
2. Did you understand the several steps of the experience?
   a. Onboarding
   b. Learning steps
   c. Adjusting settings
3. Was the app clear? Was something missing?
4. Would you know how to change settings for for example opening doors?
5. How would you feel regarding the learning aspect (4 weeks normal use) of this service?
6. Which part of the app was or wasn't clear?
7. Would you have liked to have more control over some of the features? Or were there some features missing?
8. Did you have any thoughts about the collection of your data at the time of using?