

APPENDIX

Mediating between Human Driver and Automation through Human-Machine Interface for Highly Automated Vehicles

Student: Benedetta Grazian

Design for Interaction


October 28th, 2020




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APPENDIX 1. Project Brief





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 to 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 !

<p>family name <u>Grazian</u></p> <p>initials <u>B</u> given name <u>Benedetta</u></p> <p>student number <u>4941454</u></p> <p>street & no. _____</p> <p>zipcode & city _____</p> <p>country _____</p> <p>phone _____</p> <p>email _____</p>	<p>Your master programme (only select the options that apply to you):</p> <p>IDE master(s): <input type="radio"/> IPD <input checked="" type="radio"/> Dfl <input type="radio"/> SPD</p> <p>2nd non-IDE master: _____</p> <p>individual programme: _____ (give date of approval)</p> <p>honours programme: <input type="radio"/> Honours Programme Master</p> <p>specialisation / annotation: <input type="radio"/> Medisign</p> <p><input type="radio"/> Tech. in Sustainable Design</p> <p><input type="radio"/> Entrepreneurship</p>
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SUPERVISORY TEAM **

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

** chair	<u>Grondelle, E.D. van</u>	dept. / section:	<u>DA</u>
** mentor	<u>Pont, S.C.</u>	dept. / section:	<u>HICD</u>
2 nd mentor	<u>Diane Cleij</u>	organisation:	<u>SWOV</u>
	city: <u>Den Haag</u>	country:	<u>Netherlands</u>

comments (optional)

- !** Chair should request the IDE Board of Examiners for approval of a non-IDE mentor, including a motivation letter and c.v.
- !** Second mentor only applies in case the assignment is hosted by an external organisation.
- !** Ensure a heterogeneous team. In case you wish to include two team members from the same section, please explain why.

APPROVAL PROJECT BRIEF

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

chair Grondelle, E.D. van date ____ - ____ - ____ signature _____

CHECK STUDY PROGRESS

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

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

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

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

YES all 1st year master courses passed

NO missing 1st year master courses are:

name _____ date ____ - ____ - ____ signature _____

FORMAL APPROVAL GRADUATION PROJECT

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

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

Content: APPROVED NOT APPROVED

Procedure: APPROVED NOT APPROVED

comments

name _____ date ____ - ____ - ____ signature _____

Human-Machine Interface design for highly automated vehicles 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 28 - 04 - 2020 end date 02 - 10 - 2020

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, ...).

Over the years, the development of automated transportation is increasing rapidly, and consequentially, the safety potential has been changing as well. The Society of Automotive Engineers (SAE) defines the responsibilities between the human driver and an automated driving system with six automation levels, ranging from no-automation (Level 0), where the driver has full control of the vehicle, to full automation (Level 5), where the user is not expected to respond to a request to intervene. However, the transition to Level 5 automation brings new risks such as mode confusion, overreliance, reduced situational awareness and misuse. Moreover, the driver's tasks will change to a more supervisory role, where the communication with the (partially) automated system will happen through the Human Machine Interface (HMI) (Christoph, M., et al., 2019).

With the aim of developing a mediating system for drivers in semi-automated and highly automated vehicles, a 4-years project called MEDIATOR has been founded, and is now at the end of the first year of studies. This project is led by SWOV, the national institute for road safety research, and it also connects a strong network of partners and universities, including TU Delft. Therefore, another graduate student, T.Mallon, will begin his Master thesis within Mediator, analysing and designing a different use case of the same scenario.

This Master graduation project, in collaboration with SWOV, will focus on the HMI of an automated vehicle. The HMI is defined as the set of all interfaces that allows the user of a vehicle to interact with the vehicle and/or devices connected to it. It is a crucial aspect to ensure that the driver and the automated vehicle have a safe and acceptable exchange of roles.

Generally, the HMI should take into consideration several demands that need to be evaluated and balanced: driver needs, available technology, applicable regulations, and the costs. Related challenges include trust, mode awareness, fatigue and distraction, information load, user acceptance, industry acceptance, as well as learning and unlearning. Between all these challenges that Mediator project aims to address, this graduation project will mainly focus on overreliance and mode confusion within the driving mode. In this specific scenario, some level of transparency is needed for user acceptance and trust in the system, as well as to develop mental models to anticipate automation functioning and create appropriate reliance. Too much information, however, can cause confusion and information overload. How to achieve an optimal balance between this transparency and information load is where this graduation project will contribute to Mediator. The main research questions, coming from these considerations, are "What information should be communicated? When should this information be communicated? And, how should this information be communicated?" Some research on the quality of the HMI communication with the driver has already been conducted on preferred multimodal signals in relation to level of situations' urgency (Bazilinskyy, P., et al., 2018). The research, the concept exploration and the user tests' outcomes will investigate modalities and define patterns among people behaviour to answer the research questions and propose useful design directions for SWOV and Mediator.

In conclusion, the objective of the project is to design the HMI of automated vehicles in order to guarantee trust, comfort and transparency within the driving mode.

References: 1. Bazilinskyy, P., et al., (2018). Take-over requests in highly automated driving: A crowdsourcing survey on auditory, vibrotactile, and visual displays. Transportation Research Part F: traffic psychology and behaviour, 56, 82-98.
2. Christoph, ...Van Nes, C.N (2019). Mediating between human driver and automation: state-of-the art and knowledge gaps. D1.1 of the H2020 project MEDIATOR.

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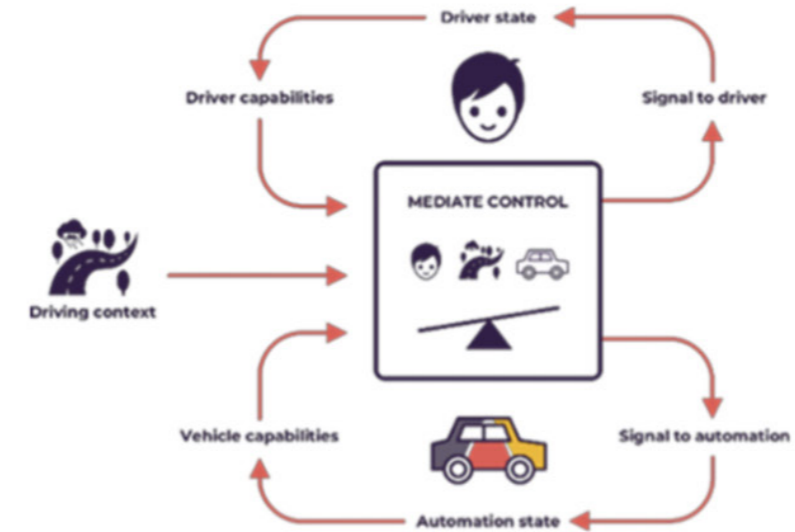


image / figure 1: The MEDIATOR system constantly weigh driving context, driver state, and vehicle automation status.



image / figure 2: The graduation project's focus: Autonomous Vehicle and Driver's communication through the HMI

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.

While manual driving allows the driver to adapt and interpret situations related to external context (Horswill, & McKenna, 2004), automated vehicles will not have the same ability to interpret those signals as humans do. The HMI will have the role, indeed, to communicate those interpretation easily, avoiding surprise effects (Christoph, M., et al., 2019). In addition, other studies have shown that drivers cannot easily distinguish between driving modes and understand their responsibilities. This mode confusion problem is closely related to the overreliance one (Feldhutter, et al., 2019). The main research questions to be answered are "What information should be communicated? When should this information be communicated? And, how should this information be communicated?" to ensure transparency on the driving mode and avoid overreliance. To be more specific, the issues that need to be investigated are:

- When does overreliance and mode confusion happen? When is communication needed? (Define scenarios)
- What are the current contents of communication? For the current contents, what are comprehensible, clear and what are misleading? What are the information that users find needed but currently missing? (Define the content of the communication)
- How can the HMI communicate this information in order to ensure trust, comfort and transparency with the driver? (Define HMI channels and means of communication)

References: 1. Christoph, ...Van Nes, C.N (2019). Mediating between human driver and automation: state-of-the art and knowledge gaps. D1.1 of the H2020 project MEDIATOR.
 2. Horswill, M.S., & McKenna, F.P. (2004). Drivers' hazard perception ability: Situation awareness on the road. p. 155-175.
 3. Feldhütter, A., et al., (2019). Effect on Mode Awareness When Changing from Conditionally to Partially Automated Driving. Aerospace Human Factors and Ergonomics.

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.

The end result will contribute to knowledge about overreliance and mode confusion for Mediator.
 The contribution will consist of concepts' generation and the development of one final design proposal for the HMI focused on trust, comfort and transparency optimization for the Mediator HMI pilot tests.

The assignment consists of a complete design process, from literature to interviews (mainly with experts) to draw the analysis of the current state, then the ideation phase, conceptualization, and implementations of promising designs will be tested in a driving simulator environment, and finally evaluated to assess their effectiveness.

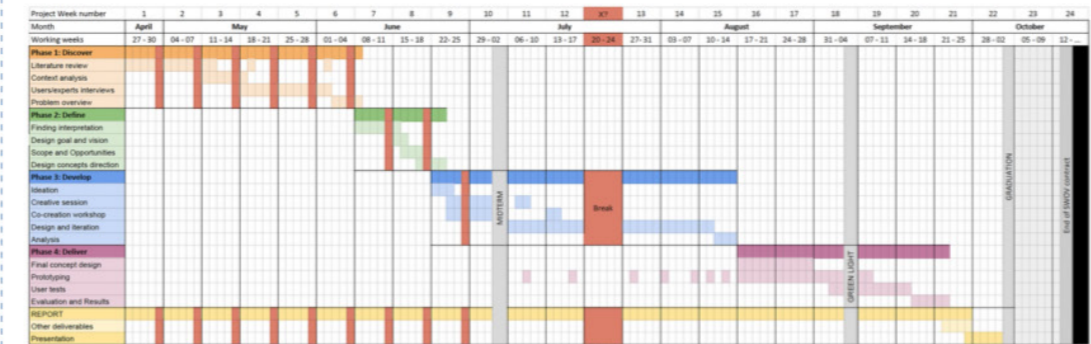
Working for SWOV will also mean getting the help of experts from the Mediator project, or from other company's employees. Moreover, other experts in the field could be my Graduation Team itself (Elmar van Grondelle and Sylvia Pont) but also other professors of the faculty (for instance Peter Vink, speaking of comfort).

Another crucial moment will be the user tests with the final prototype. First, I will build the prototype as more HIFI as possible within the time, to also learn new prototyping techniques/programs. Second, the tests will be prepared to avoid unreliability, simulating the environment and the context at the best.

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 28 - 4 - 2020 2 - 10 - 2020 end date



The project will take 100 working days, starting from the week of April 27th, 2020. Until the mid-term meeting the I will work only 4 days a week, because every Friday I attend an Oral Presentation course, to improve my soft skills. After the mid-term meeting I will work on the project 5 days a week. In July I will take one week of break, to relax and regenerate. The graduation day will be on the first week of October (after 100 working days). The 100 days are divided in 4 phases:

- 1 - Discover: in this phase, literature review, context analysis and interviews will be conducted to have a better understanding of the context of reliance and communication between driver and HMI of autonomous vehicles. The research will start analysing the general knowledge on HMI of autonomous cars with the aim of understanding principles and requirements. The study will then focus on driver's perception of information communicated by HMI, current problems, such as mode confusion and overreliance, in order to define design direction to explore.
- 2 - Define: Insights and finding from the phase 1 are then interpreted and used to formulate a design goal, scope and opportunities for the graduation project.
- 3 - Develop: ideas and concepts will be generated in this phase. The concepts will also be prototyped and tested following an iterative design process. I would also like to plan and facilitate a creative session to have more ideas before coming up with concepts. The research group will consist of drivers and experts.
- 4 - Deliver: After the iteration cycles, I will analyze the data and choose a way to converge all the insights in one, final design that will be build, possibly an hi-fi prototype (digital or physical depending on the test modality). The prototype will be tested by users and evaluated based on the outcomes.

Before the graduation day, I will take around one week to finish the deliverables and presentation, but the report will be started already since phase 1

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.

First of all, giving my contribution to a European project makes me feel really proud and conscious of studies and initiatives that take place at TU Delft, at SWOV and generally in the Netherlands.
I am very enthusiastic to zoom into those initiatives and to have a better understanding of the research structure and how I feel about working in such a context.

This graduation project has many aspects that I feel connected to and interested in but that I also want to deepen during my final project. Digital design and User Interface Design is a topic that I have worked with during my internship. I enjoyed it, but for the future, I also wanted to be able to combine technology and digital transformation with physical products or environments. And this graduation project offers exactly both.

Since in the past I have worked with blind people for a project, I gained some experience with feedback and alternative channels of communication. I really got passionate about the topic and I think I can learn even more on this topic. I am really curious how those channels can guide or communicate information with people.

I am not really familiar with HIFI prototyping. It is something I would like to do and gain experience, for instance, with Arduino or MAX MSP or programs for prototyping and testing different channels of communications.

I have attended the elective course Creative Facilitation, which I really liked but unfortunately I could not execute the final external creative session with people out of IDE, because of the imminent COVID-19 situation. In this graduation project I would like to fulfill this lack, even just with an online session, if the situation does not change.

In addition, I want to learn more methodology about User Tests and especially Analysis on tests data, but also learn to deal with professionals from different backgrounds - presenting ideas, workshops, facilitating sessions, etc. - and I think by working at SWOV this will be already possible.

FINAL COMMENTS

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

The covid-19 situation, can affect the project in terms of user test outcomes reliability. Some research and meetings will be conducted to prevent results to be untrusted and not relevant for Mediator. Moreover, I will decide, together with my Graduation Team, how to proceed with the prototype realization more in advance compared to a normal situation scenario.

APPENDIX 2. Technology Trend Research

The transformation of the driving experience from manual driving to automated driving and its consequential change in terms of interactions and HMI, need to guarantee that the technologies and features implemented into the new vehicles can be understood and operated in terms of usability by future and current drivers. The situation is constantly evolving, but some trends and patterns started to appear in new concept vehicles and launches from several car industries. For this reason, below a Trend Research about technologies is proposed to zoom in some of the shifts in technology which are expected to occur approximately for the next 3-10 years in the automotive field. Trend research could be a rich source of inspiration and determine risks involved when introducing new products. This method is a key process to understand the whats and the whys of past, current and future users' behaviour (Becerra, 2017).

Screens and displays

In any vehicle, the occupants can manipulate the audio system's output by pressing a button on the screen to change radio stations, select input devices, explore navigation instructions, and more. Some systems like Fiat Chrysler Automotive's Uconnect 12.0 infotainment system, as well as Tesla's 15-inch portrait-oriented touchscreen, incorporate heating, ventilation, and air conditioning (HVAC) controls into the screen also. Fully customizable, fully digital instrument cluster displays are also a great example of HMI in screens as steering wheel controls let you manipulate information on the cluster. The industry is going towards an increasingly screen-based interior, Ford's 15.5-

inch screen in the mass-market Mach E electric SUV and the 48-inch pillar to pillar display fitted to the forthcoming Byton M-Byte, are some examples. The M-Byte certainly represents another step towards autonomy, with a large front screen supplemented by separate smaller screens for each passenger. Allowing both communal and personal enjoyment covers both private and shared ridership. Supplier Yanfeng is one of many already working on bringing HMI functionality to just about any surface in the car. Especially useful once a car doesn't need to be driven, and interiors can be reconfigured

Augmented Reality and Virtual Reality

The recent spread of AR and VR for many applications bring a new innovative wave also in automotive. It is expected that augmented reality (AR) and virtual reality (VR) automotive applications will increase road safety, bring intuitive activities to driving, and finally enhance driving experience, especially during the transition to fully automated cars (Riener et al., 2018). AR head-up-displays (HUDs) may soon overlay 3D navigation instructions onto road geometry and moving obstacles like vulnerable road users (pedestrians, bikers, wheel-chair users) and other vehicles may be highlighted to calm down the driver-passenger and enhance trust in their vehicle's automated operation as the vehicle proves its awareness of its surroundings. VR windshields may allow for dynamic reconfiguration of multi-lane roads based on demand and will, in the long term, remove road signs, traffic lights, road paintings, etc. from the streets.

Vehicle sharing

One of the current trends that will certainly spread even more with the raise of autonomous and electric vehicles will be sharing the vehicles with other users. Tesla, as well as other car manufacturers, already envisioned autonomous car that can be shared when users don't require them.

Face recognition and eye-tracking

Face recognition is finding its way into the new generations of cars to increase safety and convenience. From car ignition to theft prevention – there are countless possibilities of using facial recognition in cars (Visage technologies, 2019). Face recognition works on a simple and non-obtrusive principle. After a driver enrolls into the system, the system “remembers” them. Each time they enter the vehicle again, the system “recognizes” them and gives them access to predefined functionalities such as the permission to start the car. Face recognition can be combined with face and eye tracking to provide the complete picture of the driver's states and moods. By tracking driver's face, gaze and emotions, the system can detect inattentiveness, drowsiness, road rage and other potential safety issues. Consequently, the system can send corrective messages to recall the user back in the loop or adopt automation measures automatically.

Voice Commands

An increasing technology in automotive applications is voice control. It has been predicted that by 2022, voice controls will be integrated in 80 percent of in-vehicle HMIs. Today, most HMIs use voice commands for convenience factors like controlling audio systems and placing and receiving phone calls. As voice recognition technology advances,

so do the applications. In the future, it is not difficult to imagine that voice commands will be able to perform more complex functions, from adjusting follow distance in adaptive cruise control to communicate trip's destination. (<https://www.mes-insights.com/5-human-machine-interface-trends-in-cars-today-a-910615/> check reference)

Mercedes' MBUX system is a front-runner in this regard, including an AI-powered voice control for the infotainment system. However, control of all vehicle functions – including destination and style of driving are likely to be key parts of future HMI.

Virtual Assistants

Virtual assistants differ from Voice Commands even if those could apparently overlap, they serve different purposes in automotive. Rather than performing vehicle functions, virtual assistants act as a secretary and advisor for the driver through voice command and powered by Artificial Intelligence (AI). Virtual assistants, as a secretary, can immediately connect with the service department and schedule a maintenance appointment, for instance, and add a reminder to your online calendar. Virtual assistants' functionalities will probably extend for company conversation while driving is autonomous, answer users' questions (on the system for example), or suggest music based on your emotional and physical behaviour. When communicating with a machine, few people expect more than an easy-efficient way to get a fast answer to a simple question. But expectations are changing as some companies look to combine a virtual agent's efficiency with the problem-solving capabilities and emotional connections that a human agent can provide. Increasingly, these companies are investing in sophisticated

virtual support platforms that incorporate intelligent systems with affective computing—what some call “cognitive agents.”(<https://www2.deloitte.com/us/en/insights/focus/tech-trends/2020/human-experience-platforms.html>) check reference IPsoft says, “What's valuable about a cognitive agent is that it can help build trust,” which encourages humans to use it for increasingly complex issues. The company sees three steps that cognitive agents need to perform effectively to establish trust: demonstrate understanding, classify the issue, and select appropriate next steps.

Machine Learning

Besides Voice control and Virtual assistance, technology is going in the direction of offering the possibility to create a relationship with the vehicle. Machine learning will be able to detect driver's preferences and developing a learning system able to respond differently according to different users, behaviours, emotional state and moods. For instance, a possible scenario could be to offer personalized messages to each seat of a ride sharing service.

Everything connected and accessible

The introduction of Virtual Assistance to the driving experience will also include the opportunity for users to connect devices and services that are not related to the road context and driving tasks. Booking appointments via virtual assistants will also mean that the users could link existing smart devices and connect their account and apps such as Calendars, Maps, Clouds, etc. Moreover, some services as Netflix and YouTube, for example, are already been announced by Tesla to be implemented in high automated vehicles where users are entertained with Non-Driving-Related Activities (NDRA). This will also open new opportunities

for HMI touchscreens. Therefore, it is not difficult to think of vehicles' touchscreens like tablets where the user can browse the internet, work, do shopping, download apps and video games or simply get some sort of entertainment.

Haptic interfaces

As discussed before, touchscreens and displays are commonly used in terms of users' input control in cars. Although those are easy to use and learn for users, they also require visual demand in order to use them properly, distracting drivers' eyes from the road context. An interesting approach could be a haptic interface that doesn't demand visual effort but can detect hands' movements and interpret human intents through hand gestures. This approach that allow people to control things without looking has been already developed by Google's Soli Project and implemented in diverse fields from automotive. In terms of user acceptance and usability, this will overturn the conventional interaction methods currently used in vehicles but provides an alternative opportunity that could enhance safety.

APPENDIX 3. Experts Interviews Outline

Introduction (15 min)

- Introduce myself and graduation project

Hello! First, I would like to thank you for giving me the opportunity to interview you. I am Benedetta, graduate student at SWOV for Mediator project about mediating system between driver and autonomous vehicles. I am a student from DFI (IDE faculty) and for my graduation project, I am working with Professors Elmer van Grondelle and Sylvia Pont. My graduation project focuses on the design of the HMI in order to improve the information communication to user during high automation driving.

- Why I decided to interview that person and goals of the interview

- Getting knowledge about driving modes, especially during level 3 and 4 automation (technical aspects and driver's experience)
- Getting knowledge about shift level 4 to level 3 (technical aspects and driver's experience)
- Collect opinions about future scenarios on user experience, perception of responsibilities, tasks, NDRA, ... and define sweet spots during the driving modes (level 3 and 4)

- Brief agenda of the interview

1. Use cases explanation and scenario in high automated driving context
2. Discussion and question
3. Information priority – automation level scenario: filling the table
4. Essential information during NDRA
5. Ideas for implementation

1. Use cases explanation (CM, SB, LOotL) (5 min)

Human driver
 Continuous mediation (CM)
 Stand-by (SB)
 Long Out of the Loop (LOotL)
 (How to make users in these 2 levels to understand their responsibilities, which info they need to have to be HIP users and avoid LIP users!
 Which is the difference in responsibilities and info to communicate?
 How would describe the user qualities in these two levels? For instance, need to be careful, trustworthy, ...)

2. Discussion and Questions (20 min)

Technical aspects:
 - How often is an AV supposed to change driving modality during a long trip?
 - Who or what can set/change the driving mode?
 - When is the mode change expected to occur? In which circumstances?
 - In which circumstances the user will be able to perform NDRAs?
 - In which circumstances the user will be able to sleep?
 - When does the system realise that a mode change is necessary (only from 3 to 4 or 4 to 3)? And, How soon?
 - How variable can level 3 be?
 - What would driving in level 3 mean for user?
 - Can the automation make a time estimate of take over request? --> is it probably needed in the next 5/10/20 min?

User's perspective and HMI:

- Can you describe me drivers' responsibilities in a driving context where the user can go to LOotL?
- Let's focus on level 3 which are the driver's expected activities? Different activities level 3 and 4?
- During those activities, which relation should be with the driving context?
- Which information is absolutely necessary for a safe driving experience in SB?
- Which information is absolutely necessary for a safe driving experience in LOotL?
- Which is instead driver's preference?
- And what do you think the HMI should NOT do?
- Which information should be available during SB/LOotL? (NSI=next task related info, SAI= situation awareness related info, BAI=behaviour awareness related info)
- Do you have any idea on how to communicate when driver is immersed in NDRAs? Which modalities are more effective? Non intrusive but effective to enhance SA?
- What can be a worst-case scenario in HMI communication in high automation driving?
- What should the driver aware of, during SB?
- What should the driver aware of, during LOotL?

3. HMI info communication – automation level hierarchy (15 min)

Depending on the automation level, the HMI needs to communicate different information, and in different modalities. Indicate with numbers from 1 to 5 (ascending order of importance), the relevance of information reception during driving in different automation levels.

	Automation Decision on the Trip	Automation Behaviour on Road Context	Automation Availability for the complete Trip	User Driving Opportunities (levels available)	Driver Responsibilities	Driver Next level Responsibilities	NDRA Opportunities	Time Estimated on Current Level	Time before Change of Level	Next Level Availability
Long Out of the Loop	2	1	2	4	4	3	4	5	5	5
Standby	3	2	3	4	4	3	3	3	3	4
Continuous Mediation	5	4	5	4	4	3	2	2	2	3

4. Essential information during NDRA

Finally, think about driver is immersed in his/her NDRA, mark 2 of this info that absolutely need to be communicated to driver.

- Automation decisions on the journey
- Automation behaviour on the road context
- User driving opportunities (levels available)
- Driver responsibilities
- NDRA opportunities
- Time estimated on current level
- Time before change of level

Do you think by communicating only this information is enough? (while driver is in NDRA)

5. Ideas for implementation

How do you think should the info be communicated to a driver in SB scenario?
 How do you think should the info be communicated to a driver immersed in NDRA?
 How do you think should the info be communicated to a driver in LOotL scenario?

APPENDIX 4. Users Questionnaire Outline

Before spreading the questionnaire on forums and Facebook groups online, the questions were verified with the SWOV Ethical Committee. The participants were also informed about privacy and data protection in advance, since the questions might lead to illegal activities answers. Below are all the questions posed to the participants.

Partially automated driving options Questionnaire (10 min)

I am Benedetta Grazian, a graduate student at TU Delft in Industrial Design. For my thesis in collaboration with Mediator Project on Autonomous Driving, I am investigating people's experience with the automation system and the interaction with human drivers, in order to improve the communication between vehicles and humans.

***Required**

1. The answers and sensitive data collected with this questionnaire are anonymous. The study has no links with authorities and consequently, you are free to answer honestly to the following questions. The data will be then analyzed in its entirety (without taking individual examples) for the aim of future implementations of Automated Vehicles' systems. *

Tick all that apply.

- I have read and understood the written information about the study.
- I know that I can contact the researcher for any questions via benedetta.grazian@swov.nl.
- I understand that I can terminate my participation in the study at any time without giving any adverse consequences for me.
- I understand that my data and research results will be treated confidentially and will be anonymized.
- I agree to participate voluntarily in the above study.

Online Questionnaire, part 1

This survey (divided into 3 parts) is investigating people's experience with cars and different levels of automation, in order to understand drivers' behavior and needs. Let's start with some simple questions:

2. Your age: *

Mark only one oval.

- 18-25
- 26-35
- 36-50
- 51-65
- 65+

3. How long have you been driving cars? *

Mark only one oval.

- less than 1 year
- 1-5 years
- 6-10 years
- 11-15 years
- more than 15 years

4. What car(s) are you driving at the moment? *

5. How much do you drive on average? (km/month) *

Mark only one oval.

- less than 200 km/month
- 200-700 km/month
- 700-1200 km/month
- 1200-1700 km/month
- more than 1700 km/month

6. How often do you drive? (before coronavirus emergency) *

Mark only one oval.

- Everyday
- 4-6 days/week
- 1-3 days/week
- Few times a month
- Few times a year

7. Do you have any experience with cars having Partially Automated Driving options? (such as Autopilot / Pilot Assist system / Traffic Jam Assistant / Active Steering Assist / Active Distance Assist Distronic) *

Mark only one oval.

- Yes
- No
- Other: _____

8. How often do you use Partially Automated Driving options? *

Mark only one oval.

- Only used once or few times
- Sometimes
- Often
- Every time possible
- Other: _____

9. In which circumstances do you normally use Partially Automated Driving option? *

10. How do you feel during Partially Automated Driving mode? *

11. How did you feel the first times you tried Partially Automated Driving options? *

12. How would you describe yourself as a driver? *

13. While the Partially Automated Driving option is active, have you ever performed activities non-related to driving? *

Mark only one oval.

- Never
- Sometimes
- Often
- Always

14. Which activities non-related to driving do you normally perform during Partially Automated Driving mode? *

15. What kind of information would you like to have from the car, when you perform those activities non-related to driving? *

16. Have you ever had a bad experience related to the Partially Automated Driving option? Describe it here. *

Online
Questionnaire,
part 3

With Partially Automated Driving the driver is supposed to monitor the road to check what the car is doing. The next step of technology will be that driver will not need to monitor anymore, with High Automated Driving, drivers will be able to "disconnect" themselves from the road context.

17. With High Automated Driving, drivers will be able to "disconnect" themselves from the driving context. How long should at least this feature last to be useful for you? *

Mark only one oval.

- For at least 1 minute
- For at least 5 minutes
- For at least 10 minutes
- For at least 20 minutes
- For at least more than 20 minutes
- Other: _____

18. In the future scenario of High Automated Driving (described before), WHICH ACTIVITIES would you perform if you could "disconnect" for 1-5 minutes? *

19. In the future scenario of High Automated Driving (described before), WHICH ACTIVITIES would you perform if you can "disconnect" for more than 30 minutes? *

20. In the future scenario of High Automated Driving (described before), WHICH information would you like to receive from the car if you can "disconnect" for 1-5 minutes? *

21. In the future scenario of High Automated Driving (described before), WHICH information would you like to receive from the car if you can "disconnect" for more than 30 minutes? *

22. In the future scenario of High Automated Driving (described before), HOW would you like to receive this information from the car if you can "disconnect" for 1-5 minutes? (think as if your car can have advanced technologies like "superpowers", innovative installations/modalities) *

23. In the future scenario of High Automated Driving (described before), HOW would you like to receive this information from the car if you can "disconnect" for more than 30 minutes? (think as if your car can have advanced technologies like "superpowers", innovative installations/modalities) *

Thanks for participating in this questionnaire!

Your personal experience and opinion will remain anonymous from now on to protect your privacy. All the collected material from participants will be downloaded and deleted from Google Drive immediately after a large enough sample will have answered. The data will be then analyzed in its entirety, without taking individual examples.

24. If you have more questions on the topic, you are curious about results/master thesis/eventual publications or you would like to be contacted for further experiments on this project, please leave a comment below or contact me: benedetta.grazian@swov.nl

APPENDIX 5. Thematic Analysis

Link to the thematic analysis of the open-ended questions of Users Questionnaire:

<https://docs.google.com/spreadsheets/d/1qanQd1w-Rm76PyFUeBASHKWpv-PSDpcl-DzTyx87B5A0/edit?usp=sharing>

APPENDIX 6. Word Clouds Analysis

9. In which circumstances do you normally use Partially Automated Driving option?



Figure 1. WordCloud Question 9

10. How do you feel during Partially Automated Driving mode?



Figure 2. WordCloud Question 10

11. How did you feel the first times you tried Partially Automated Driving options?

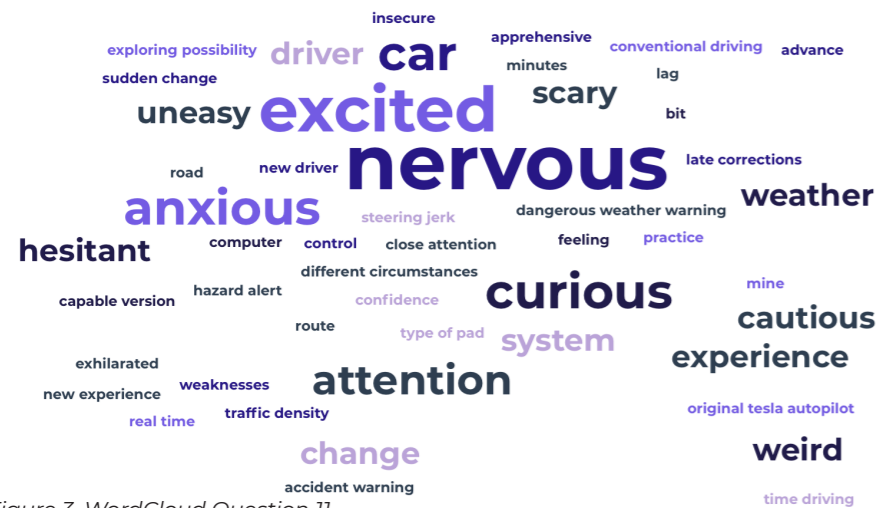


Figure 3. WordCloud Question 11

12. How would you describe yourself as a driver?



Figure 4. WordCloud Question 12

14. Which activities non-related to driving do you normally perform during Partially Automated Driving mode?



Figure 5. WordCloud Question 14

15. What kind of information would you like to have from the car, when you perform those activities non-related to driving?



Figure 6. WordCloud Question 15

16. Have you ever had a bad experience related to the Partially Automated Driving option? Describe it here.



Figure 7. WordCloud Question 16

18. In the future scenario of High Automated Driving (described before), WHICH ACTIVITIES would you perform if you could "disconnect" for 1-5 minutes?



Figure 8. WordCloud Question 18

APPENDIX 7. Generative Sessions Outline

Session Plan

- 0. Sensitizing booklet (DO)
- 1. Introduction + goals explanation + agenda - 20 min
- 2. Workbook page 6 sharing your journey (SAY) - 15 min
- 3. Collage making about emotions in situations like this that happened to you, generative tools (MAKE) - 15/20 min
- 4. Discussion Collage one by one (SAY) start talking about future - 20 min
- 5. Smart environment qualities ---> codesign 'how could the ambient help you?' (free collage from google images) (MAKE)- 15/20 min
- 6. Discussion while purging (DO)- 15 min
- 7. Conclusions - 5 min

0. Sensitizing workbook

Send a booklet to introduce participants to the topic.

1. Introduction

Welcome everyone to this generative research session.

First I will ask you to sign the consent form for me to record this session so I will be able to look back of the sessions and comment and to do an analysis of the insights.

I don't want to anticipate too much about my graduation because today is all about you guys and your experiences with the situations where you faced two different interactions at the same time. This will be particularly helpful for my graduation's user experience research to investigate people's perceptions on this kind of contexts so please feel free to voice out your opinion and add comments whenever you have!

This kind of session are incredible because from my point of view will be inspirational and will guide me in the design process. So, please, during the session try not to ask yourself "why am I doing this" but just focus on the topic and share your opinions, experience and memories as much as you can! Remember during the session there is never right or wrong comments or answers but only your personal experiences and needs! Try to postpone judgement

But before starting I want to show you a small agenda for today and hopefully we will be done in about 1 hour and half:

Workbook "Me and my attention"

Emotional toolkit

Discussion

Brainstorming

Discussion

Wrap-up!

Do you have questions?

Today we will use a platform called Miro, it's an interactive tool that allow us to work on the same whiteboard as if we are in the same room, playing around with postits, images and words. I have sent you an invitation to join the board. Please check and join the invitation.

MIRO: explanation

2. Workbook reflections

Let's start with the workbook that you have completed in these last few days. Was it hard to complete?

Ok, so, now I would like you to take a screenshot of the page 6 of your workbook, timebar, and upload here in miro. Can you explain your situation and journey? Who wants to start?

Supervising something without getting distracted from the activity you are doing
Remember to ask them: "how do you feel about it?" and "What does it mean for you?"

...
Improvisation following the layout on MIRO

Session 1

Workbook reflection

Maira	
Francesco	
Lisa	

Emotional toolkit

Supervising something without getting distracted from the activity you are doing

Maira			
Francesco			
Lisa			

Figure 14. Outcomes Generative session 1

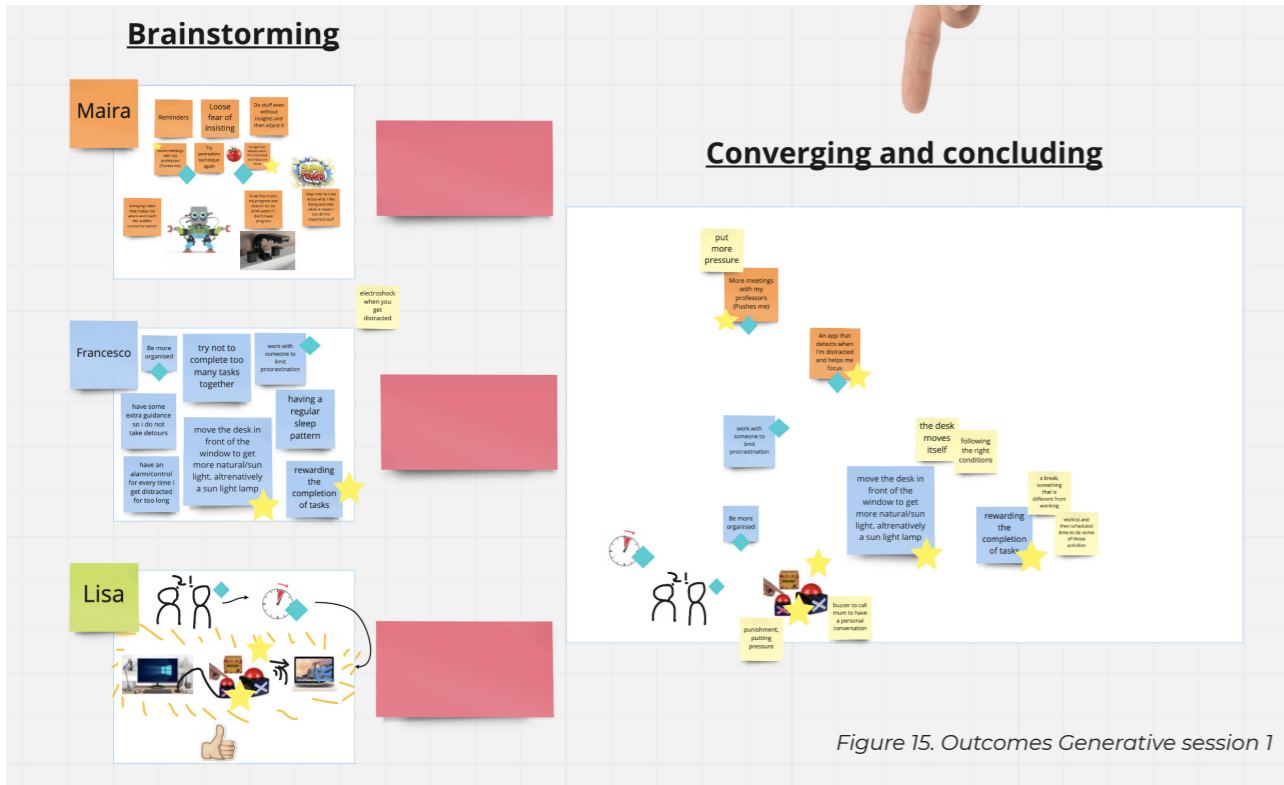


Figure 15. Outcomes Generative session 1

Session 2

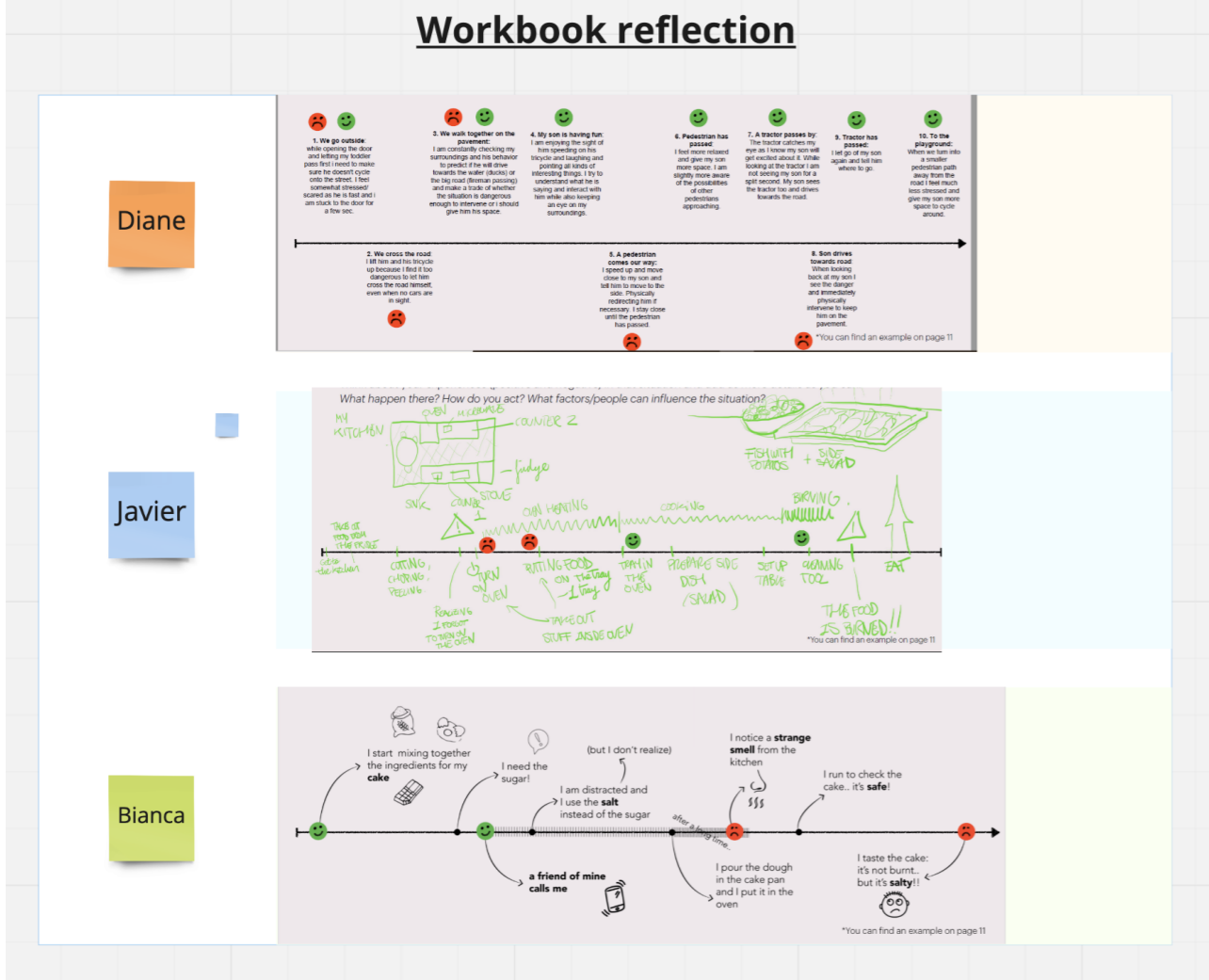


Figure 16. Outcomes Generative session 2

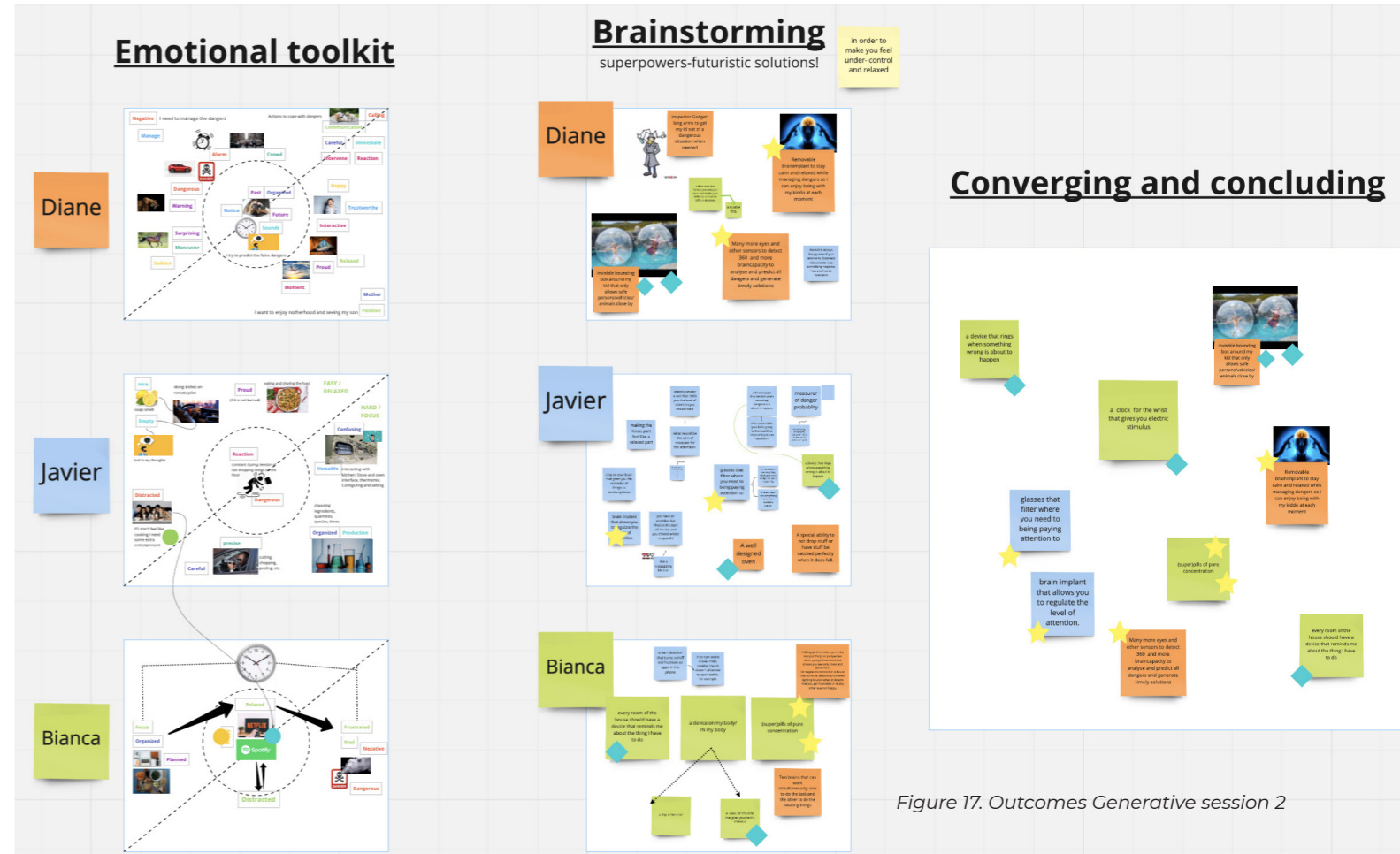


Figure 17. Outcomes Generative session 2

Session 3

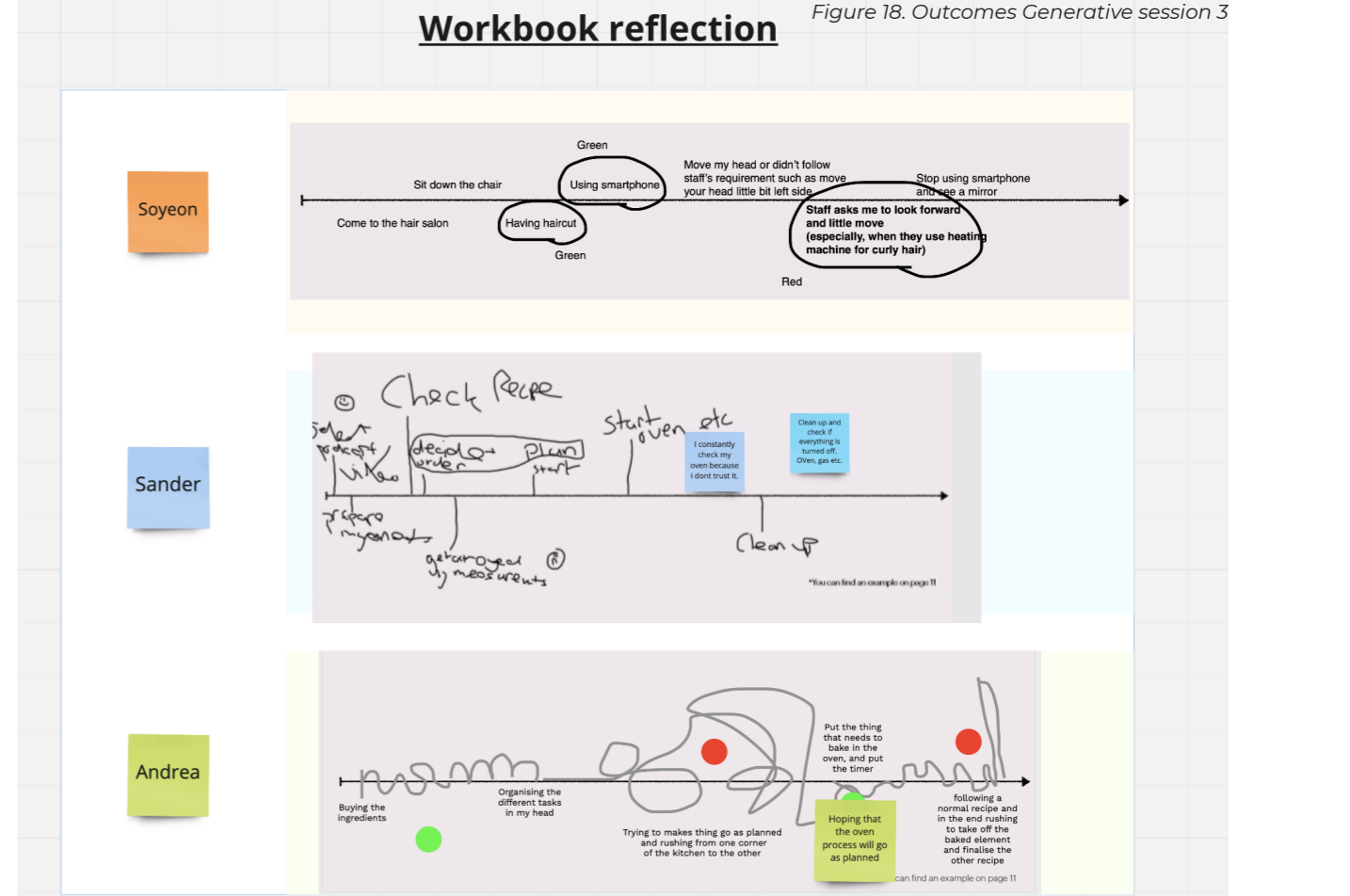


Figure 18. Outcomes Generative session 3

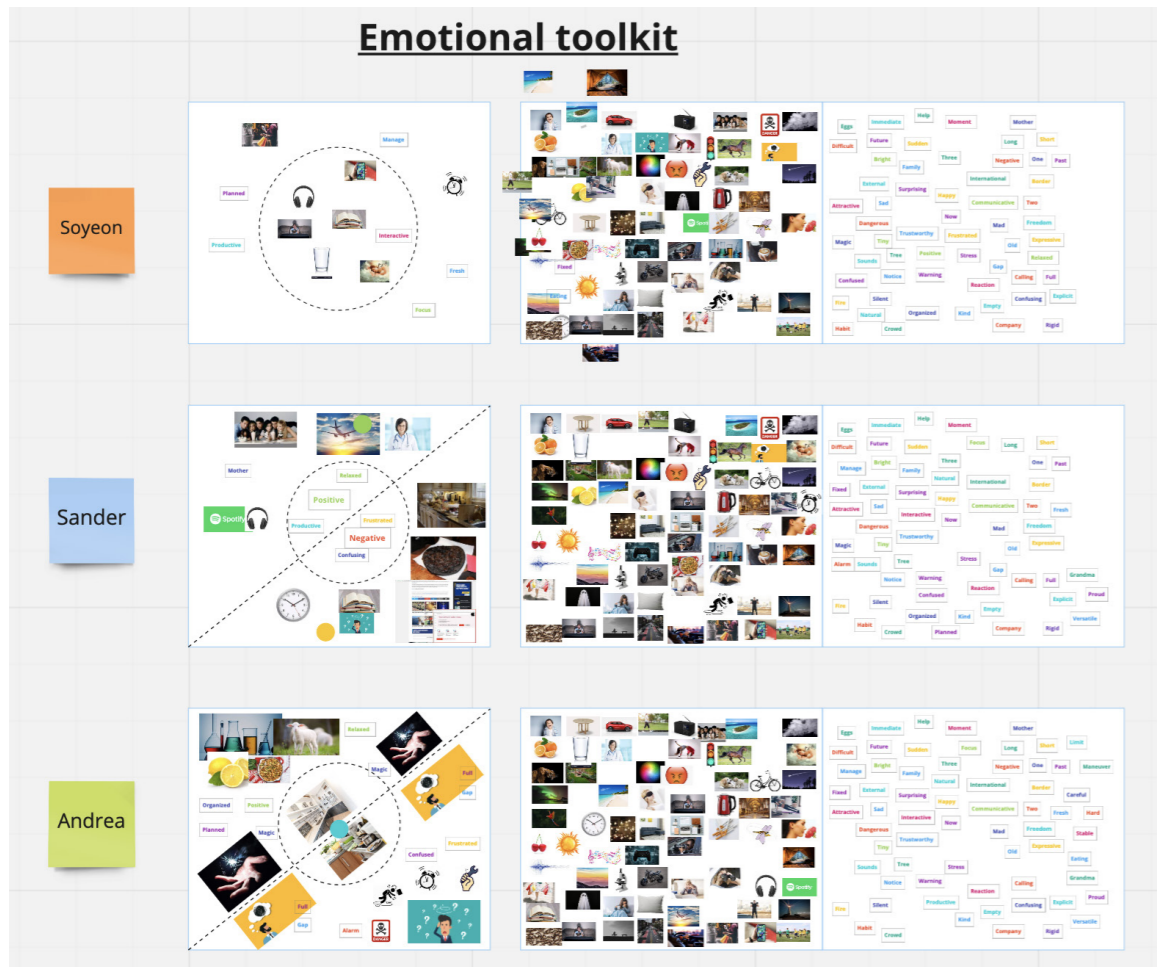


Figure 19. Outcomes Generative session 3

The Storyboard in below (figure 20), shows Pain points in red, Gain points in lilac and design qualities for each step during the Highly Automation Driving Mode. This tool helps reflecting on the intended interactions for a design project at an initial stage. In this project Storyboard is used as a way to reflect on design qualities and users' emotion for a product that do not exist yet. This tool helped the author of this project reflecting from a user's point of view, understanding which positive or negative emotions the HMI might provoke. The storyboard put some basis for the elaboration of Functional requirements.

APPENDIX 8. Storyboard

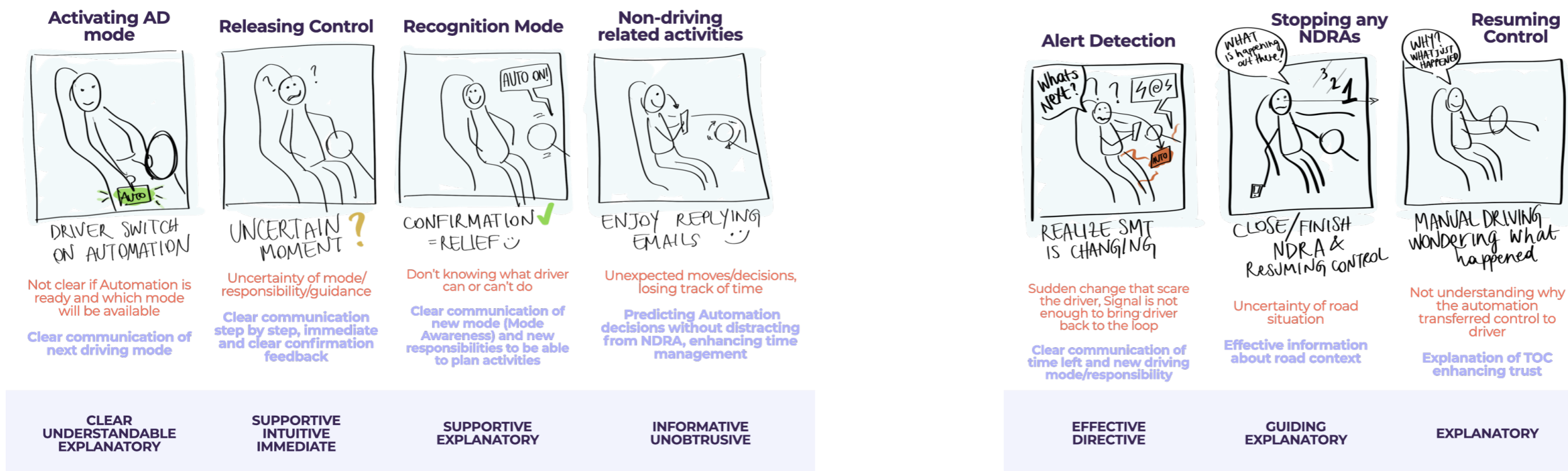


Figure 20. Storyboard

APPENDIX 9. Creative Session Plan

Script for the session

Introduction
 Welcome everyone to this creative session, I am really happy to see all of you here, and grateful you agreed on doing the session physically, besides the hard times of social distancing. For this reason, I have to ask you to please keep a certain distance between each other, I provided you masks and hand sanitized, so anytime, feel free to use it!

Ok, what are we doing here today?

For my graduation I am entering into the ideation phase now, and with my supervisors we thought it was an amazing idea to have a creative session, since the individual projects are very limiting, and since there could be so many ways a same project can be approached. For this reason, I reunited students from IPD and DFI to have a balanced mix of product and interaction together.

In a creative session we usually start with a challenge and then, through exercises and technique I will propose you, you will be stimulated to have opinions and ideas on the topic.

Explain agenda and toolbox

Icebreaking
 Now before starting with the challenge, I want you to introduce yourself in an alternative way ---> Icebreaker! Introduce your self using an adjective that defines your driving style :)



Figure 21. Creative Session ideation

Session Approach

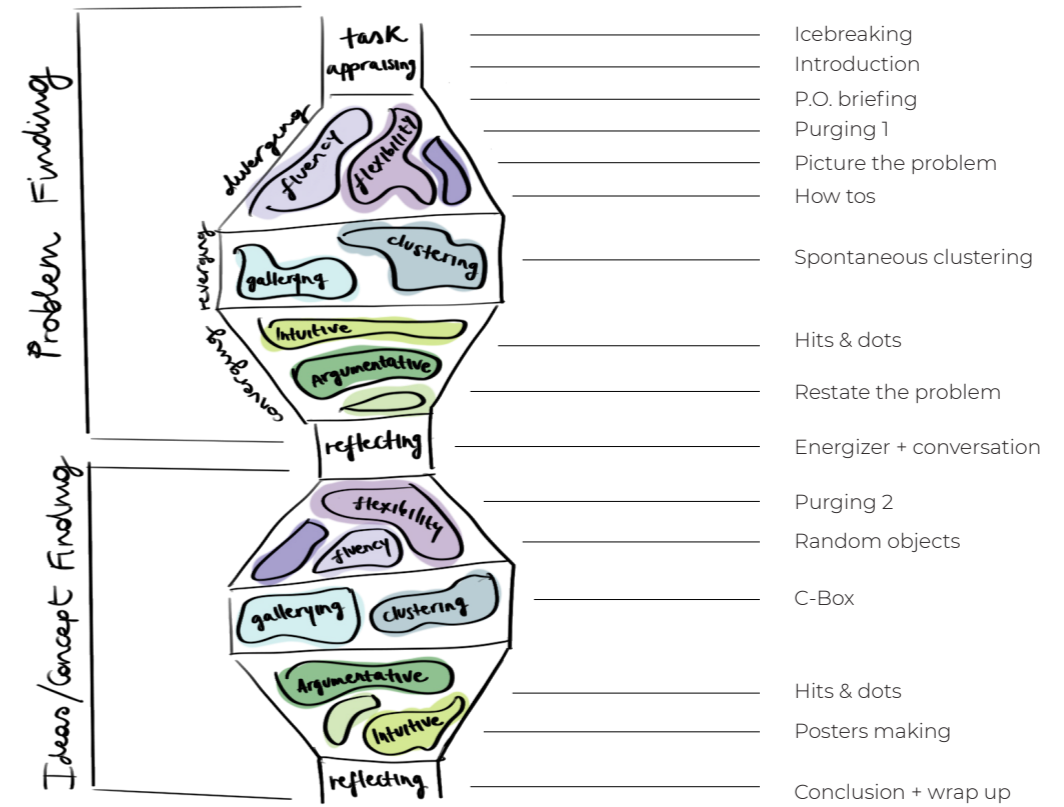


Figure 22. Creative Session approach

Session Plan

Problem Statement: How to make users of autonomous cars feel aware of the current mode and their responsibilities during full automation mode?									
	Time	min	What	Aim	Material	Note	Content	Duties!	
1									
2	16.00	5	Welcome, Agenda & Introduction		Show poster templates		Agree on code of conduct	Welcome and Introduction	
3	16.05	5	Icebreaking	Introduce the RG to play with names		Telling each other name + quality as driver + mimic + small explanation	Make the RG play with their names.	Icebreaker	
4	16.10	10	P.O. Briefing + Q&A	Me explaining the case	Pitching the case with slides		Explain the group that Priyanka is curious about the process and she will stay in the room to observe	PO briefing	
5	16.20	5	Purge 1	Purge on the PaG	posters, post its, markers	Ideas, solutions on PaG		Purge	
6	16.25	10	Picture the Problem	Explore the context of AD (diverging)	markers, A3	in couples			
7	16.35	5	H2s	Generate variation of PaG	post its, markers, posters	now write down your understanding of the PaG in "How to..." statements			
8	16.40	5	Reflection + Hits and Dots	Decide PaP direction (converging)	dots	I also put 3 dots	Give 4 stickers each, 2 per every posters' rooms		
9	16.45	10	Restating the problem	Make the PaP sparking (if it is not yet!) (converging)	Posters, markers		Engage the RG one for all, discussion on camera.	Spark PaP	
10	16.50	10	Energizer - Telephone Pictionary	Transition between Problem Finding and Idea Finding	decks of big post its	Explain the energizer and give an example of the sentence		Energizer	
11	17.00	10	Purge 2	Purge on the PaP (diverging)	posters, postits, markers			Purge	
12	17.05	10	Random Objects	Go beyond obvious, OUT OF THE BOX IDEAS	big post-its, markers, posters, objects	Select random objects	Detailed explanation of the technique		
13	17.25	10	Guided Fantasy	Provide fluency (diverging)	posters, postits, markers		Remember them to hitchhike		
14		10	NOW-WOW-HOW	Provide fluency (diverging)	posters, postits, markers		Remember them to hitchhike		
15	17.40	10	Hits and Dots	Choosing best 3/5 ideas (Reverging+converging)	Dots	With P.O.	Give two each		
16	17.50	5	3 cards per group	Ideas development for presentation	posters	In groups			
17	17.55	5	Wrap up	Conclusion, Thank RG, Agree on presentation				Wrap-up	
18	18.00		Done						

Figure 23. Creative Session plan

Figure 24. Creative Session setup



Figure 25. Creative Session setup

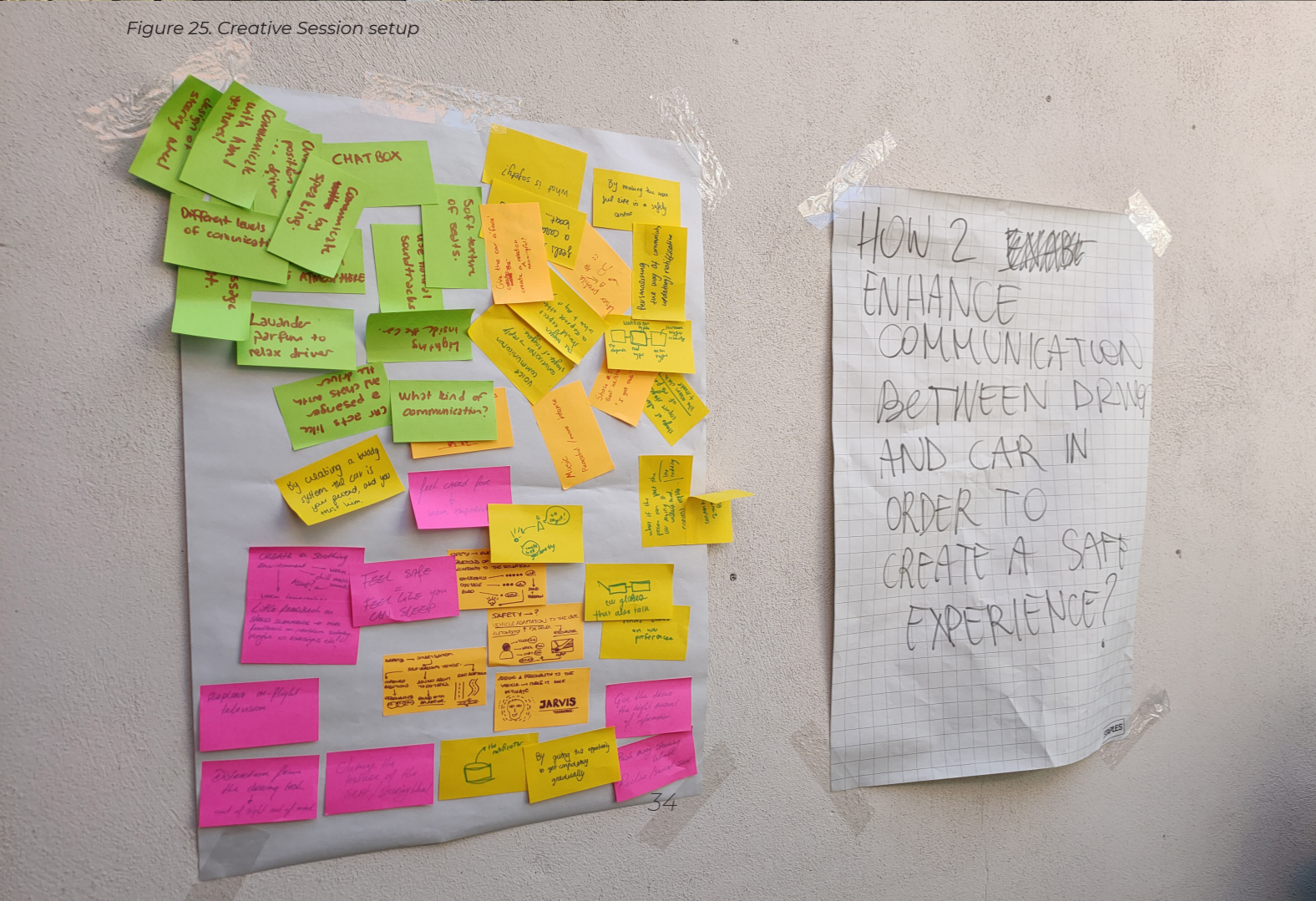


Figure 26. Creative Session participants and outcomes

APPENDIX 10. Concept phase 1 Analysis tools

Analysis

The analysis of this concept phase consisted in creating a PrEmo visual for every concept, summarizing the emotions provoked by participants. Then the surveys were visualized as in figures 28, 31, and 34 where every dot's color corresponds to a participant, and finally, the audio were listened again to analyse the opinions on every concept's component, summarized in figures 29, 32 and 35, where every dot's number is a participant red means they did not like the element, dark green means they voluntarily expressed approval for the element and light green means they mentioned they liked the element after being asked so.

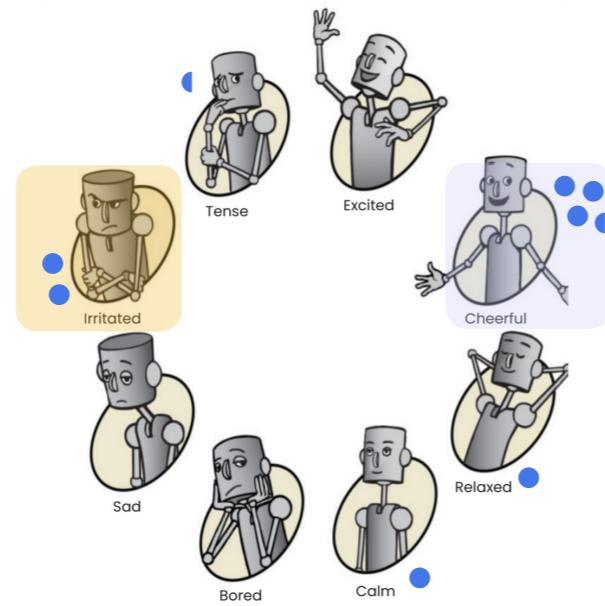


Figure 27. PrEmo Copilot Concept

A - Copilot

Questionnaire

This concept would help me feeling:

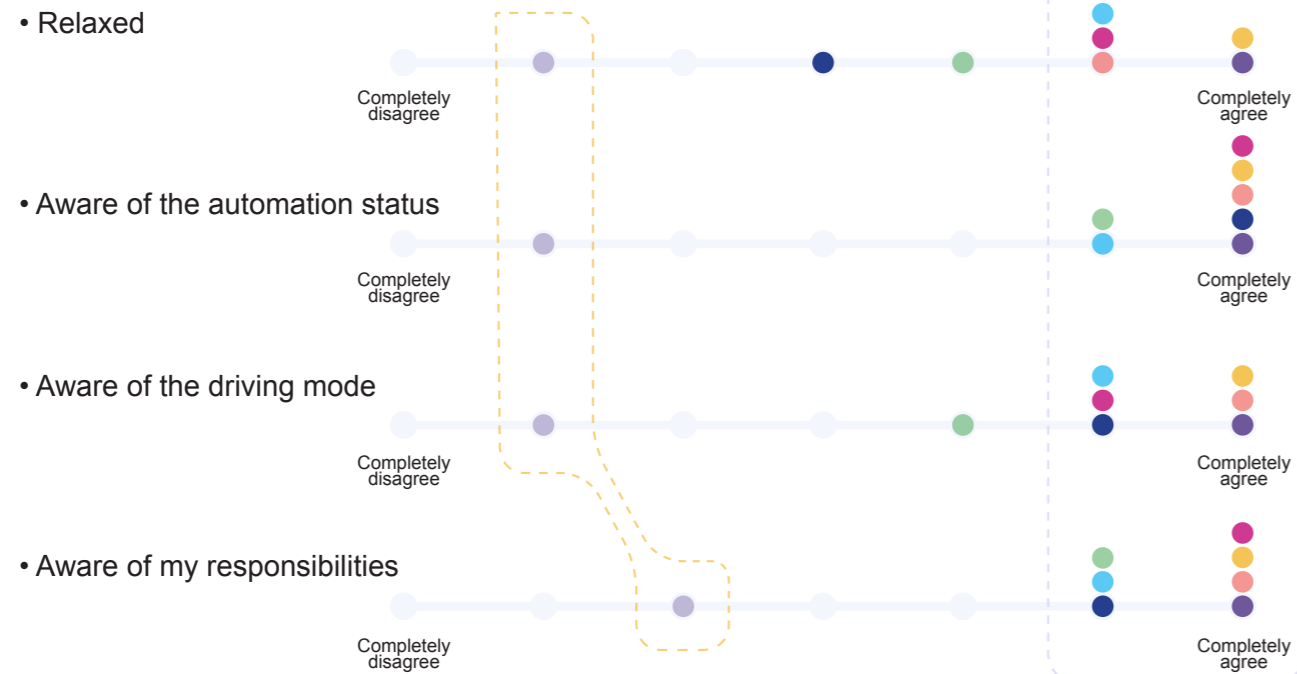


Figure 28. Survey outcomes Copilot concept

Insights per concept's component

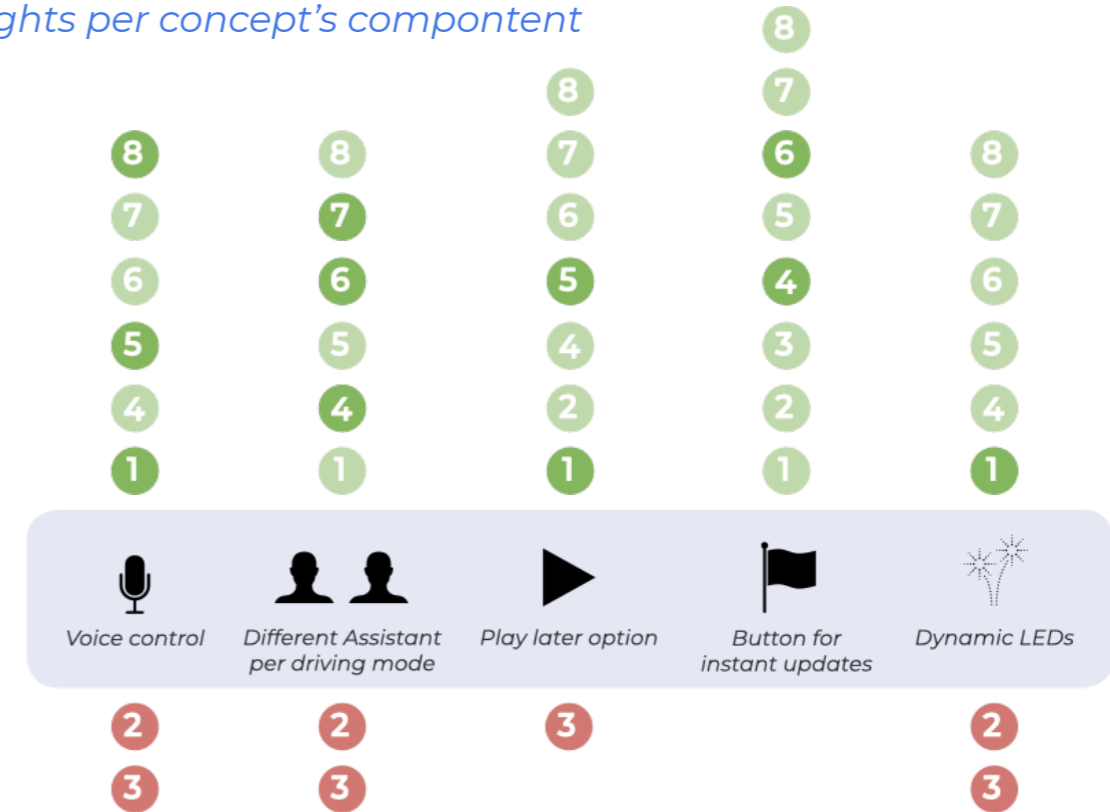


Figure 29. Copilot Concept elements evaluation

B - Subliminal Awareness

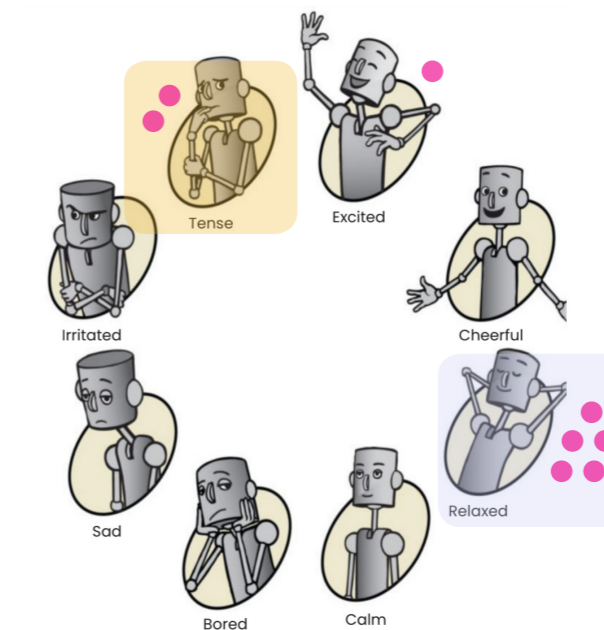


Figure 30. PrEmo Subliminal Awareness Concept

Questionnaire

This concept would help me feeling:

- Relaxed

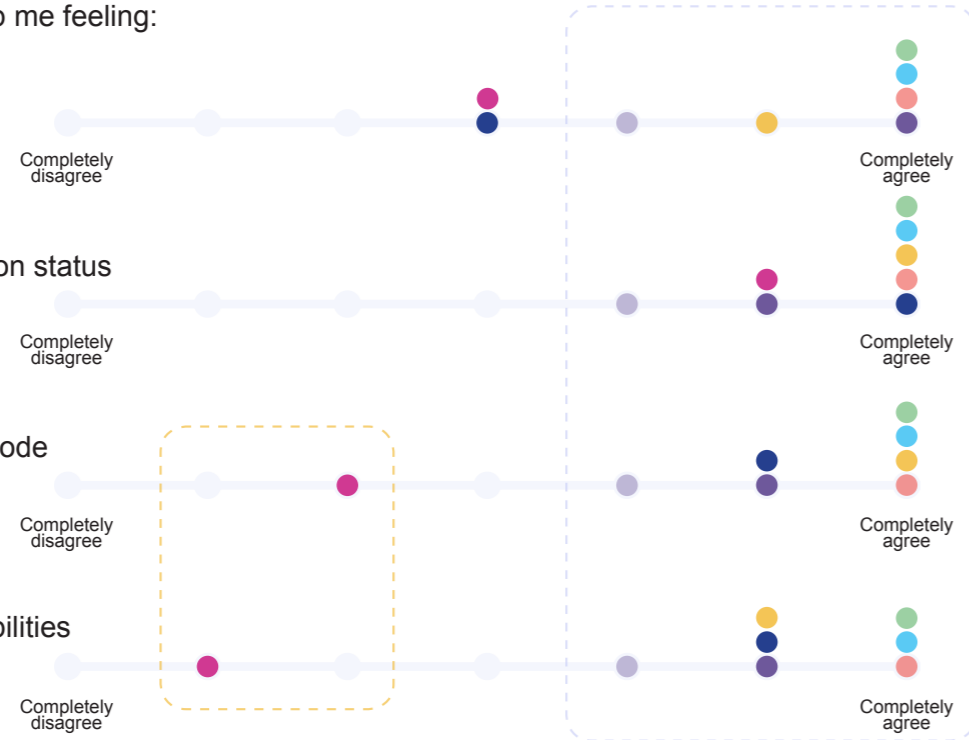


Figure 31. Survey outcomes Subliminal Awareness concept

Insights per concept's component

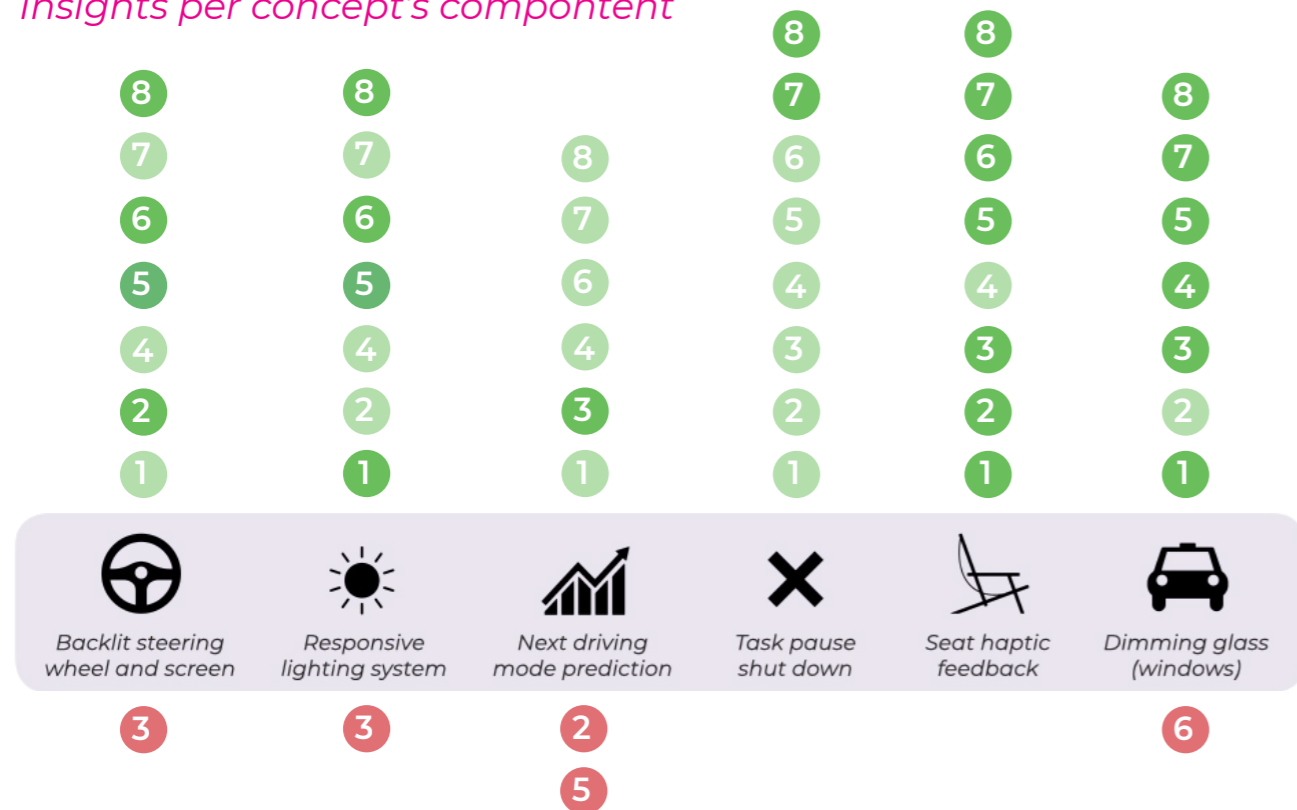


Figure 32. Subliminal Awareness Concept elements evaluation

C - Tailored Journey

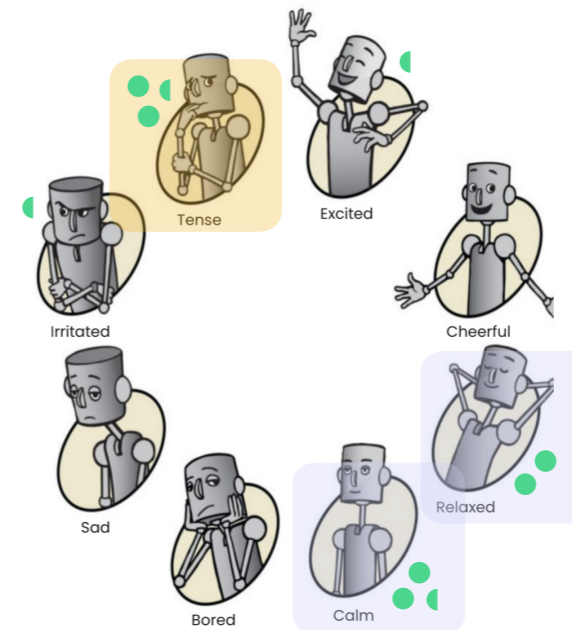


Figure 33. PrEmo Tailored Journey Concept

Questionnaire

This concept would help me feeling:

- Relaxed

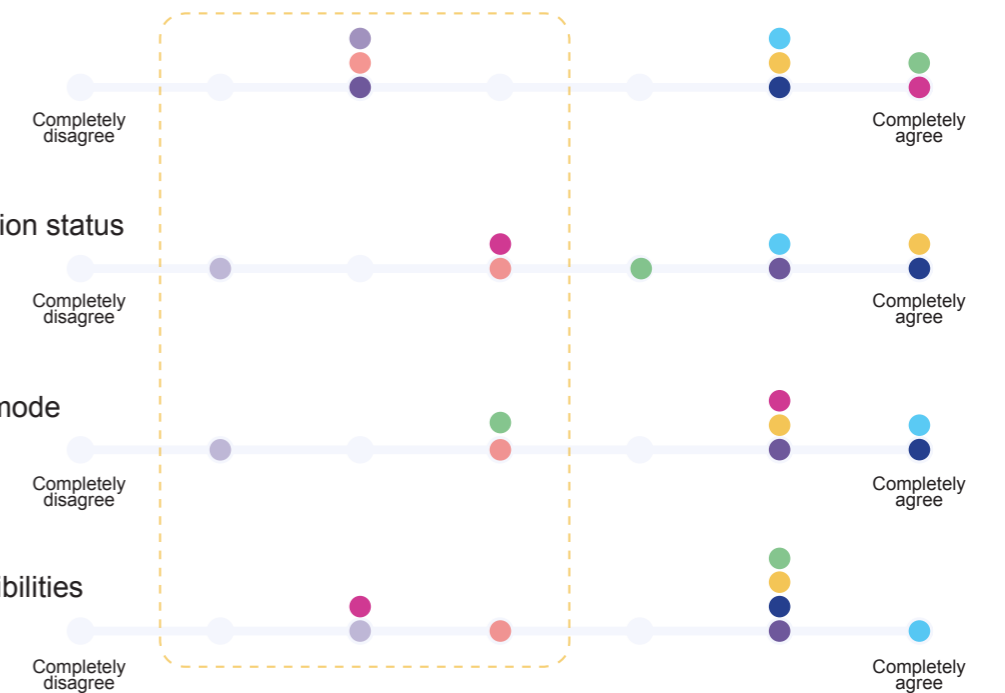


Figure 34. Survey outcomes Tailored Journey concept

Insights per concept's component

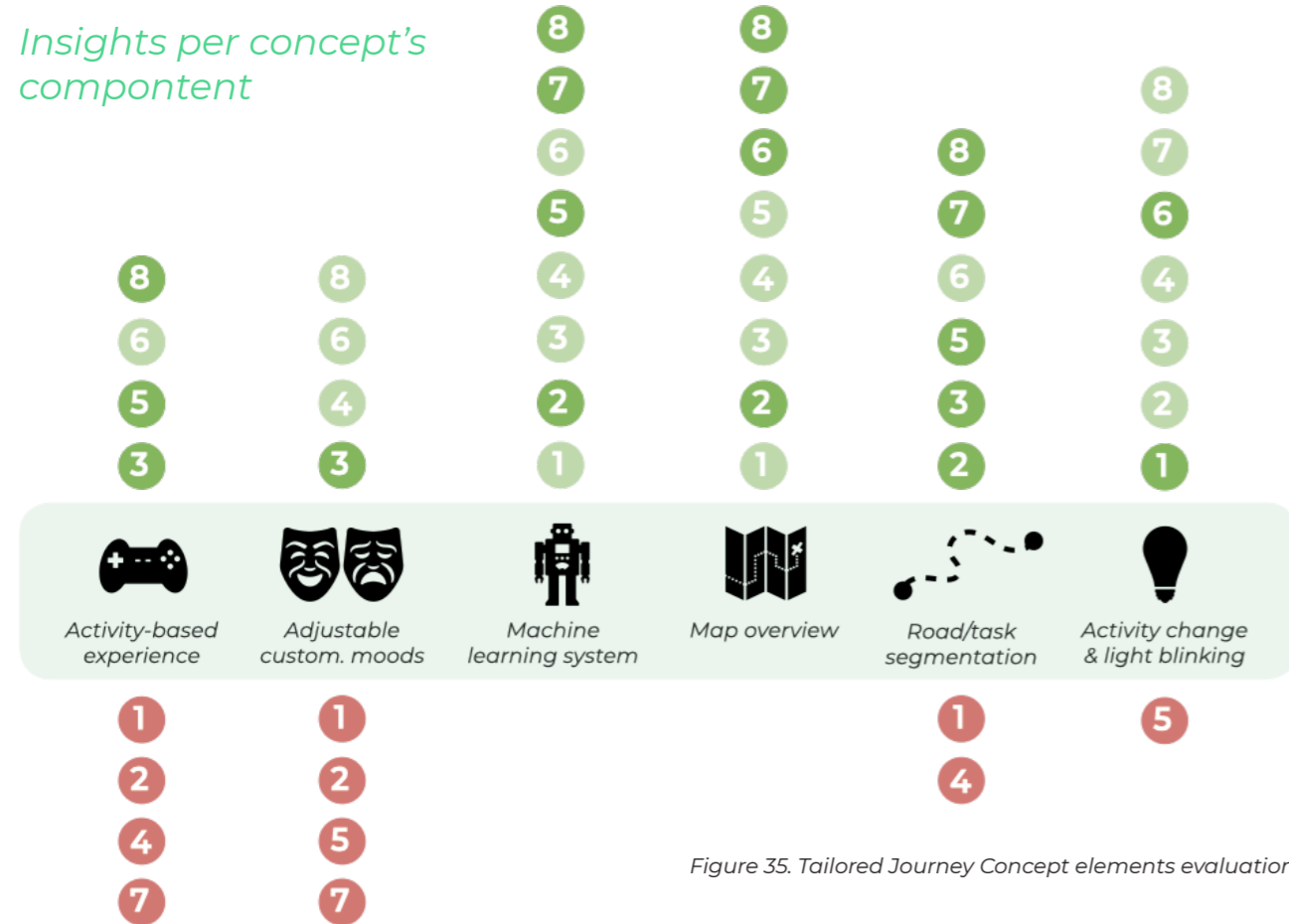


Figure 35. Tailored Journey Concept elements evaluation

APPENDIX 11. Concept phase 2 - Survey Outline

Ambiance Autonomous Driving Concepts

Welcome to this fast round of concept testing!

I sent you 3 videos named C1, C2, C3, keep them around, and follow this survey to complete this test and provide your precious opinion about these 3 initial concepts.

Today we are talking about autonomous driving (expected in around 10/15 years).

I am interested to see what do you imagine this experience to be in terms of ambiance/atmosphere when your car could drive for you, and you could even perform other tasks non-related to driving.

***Required**

Concept 1 (C1.mp4)

WATCH VIDEO C1.mp4, then answer the questions of this section

1. What do you think about this concept? *

2. What do you like about this concept? Why?

3. What don't you like about this concept? Why?

4. This ambiance is: *

Mark only one oval.

	1	2	3	4	5	6	7	
Intrusive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Unobtrusive

5. This ambiance is: *

Mark only one oval.

	1	2	3	4	5	6	7	
Stressful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Relaxing

6. This ambiance is: *

Mark only one oval.

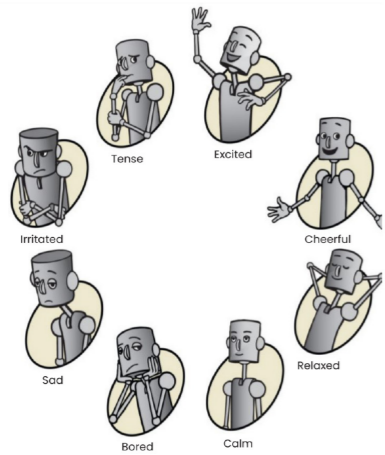
	1	2	3	4	5	6	7	
Annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Pleasant

7. This ambiance is: *

Mark only one oval.

	1	2	3	4	5	6	7	
Meaningless	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Informing

How would you feel to be in such a vehicle (referred to this concept)?



8. *

Tick all that apply.

- Excited
- Cheerful
- Relaxed
- Calm
- Bored
- Sad
- Irritated
- Tense

Other: _____

9. Additional comments on this concept

Concept 2 (C2.mp4) WATCH VIDEO C2.mp4, then answer the questions of this section

10. What do you think about this concept? *

11. What do you like about this concept? Why?

12. What don't you like about this concept? Why?

13. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

Intrusive Unobtrusive

14. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

Stressful Relaxing

15. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

Annoying Pleasant

16. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

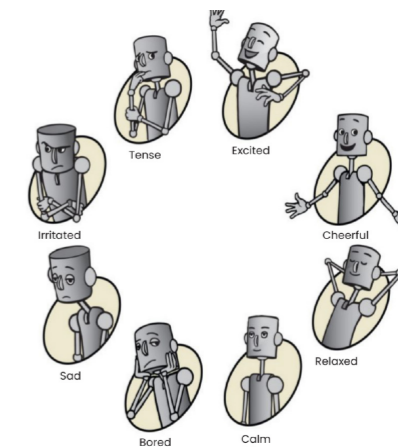
Meaningless Informing

17. *

Tick all that apply.

- Excited
- Cheerful
- Relaxed
- Calm
- Bored
- Sad
- Irritated
- Tense

Other: _____



18. Additional comments on this concept

Concept 3 (C3.mp4)

WATCH VIDEO C3.mp4, then answer the questions of this section

19. What do you think about this concept? *

20. What do you like about this concept? Why?

21. What don't you like about this concept? Why?

22. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

Intrusive Unobtrusive

23. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

Stressful Relaxing

24. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

Annoying Pleasant

25. This ambiance is: *

Mark only one oval.

1 2 3 4 5 6 7

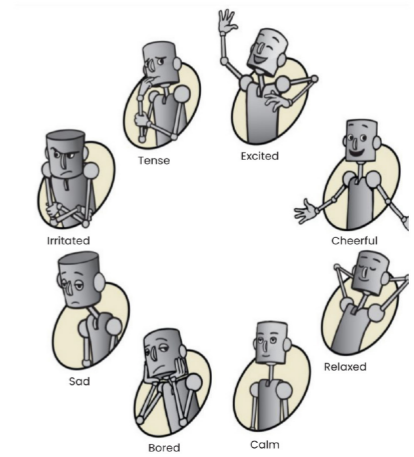
Meaningless Informing

26. *

Tick all that apply.

- Excited
- Cheerful
- Relaxed
- Calm
- Bored
- Sad
- Irritated
- Tense

Other: _____



27. Additional comments on this concept

APPENDIX 12. User Test Outline

User test

Before starting, remember:

1. You can ask any question anytime during the test.
2. The videos you are going to watch represent design concepts for autonomous vehicles level 4, in which the vehicle can handle the road context completely, but the driver needs to be ready to take control when this is required by the system.
3. Focus on the ambience/atmosphere of the car as well as the display of the vehicle in order to understand what the driver is recommended to do and the status of the automation.
4. After each video, please answer all the questions of the survey in order to give your opinion on what you have just watched.
5. Please, during the survey think aloud and speak for your thoughts :)

Thanks in advance for your time and good luck!

***Required**

1. LET'S START WITH SOME PERSONAL INFORMATION. Your age: *

Mark only one oval.

- 18-25
 26-35
 36-50
 51-65
 65+

2. Your gender: *

Mark only one oval.

- Male
 Female
 Prefer not to say
 Other: _____

3. Your nationality: *

4. Your driving skills:

	1	2	3	4	5	
Zero experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Advanced

5. Which of the following technologies do you use frequently? *

Tick all that apply.

- Smartphone / Tablet / Ipad
 Desktop / Laptop
 Home assistant / Smart Assistant
 Driving assistance tools (Autopilot / Pilot Assist system / Traffic Jam Assistant / Active Steering Assist ...)

Other: _____

Watch video 1 and then answer the questions below

6. Understanding the status of the automation would be:

	1	2	3	4	5	
Difficult	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Easy

7. Understanding the driver's tasks and responsibilities would be:

	1	2	3	4	5	
Difficult	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Easy

8. Understanding the road context would be:

	1	2	3	4	5	
Difficult	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Easy

9. Understanding the road context while performing non-driving related activities would be:

	1	2	3	4	5	
Difficult	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Easy

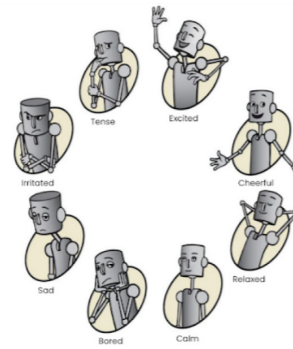
10. Understanding the road context while performing non-driving related activities would be:

Mark only one oval.

	1	2	3	4	5	
Annoying	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Pleasant

11. Mark only one oval.

- Excited
- Cheerful
- Relaxed
- Calm
- Bored
- Sad
- Irritated
- Tense
- Other: _____



12. I think that I would like to use this system frequently

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

13. I found the system unnecessarily complex

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

14. I thought the system was easy to use

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

15. I think that I would need the support of a technical person to be able to use this system

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

16. I found the various functions in this system were well integrated

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

17. I thought there was too much inconsistency in this system

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

18. I would imagine that most people would learn to use this system very quickly

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

19. I found the system very awkward to use

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

20. I felt very confident using the system

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

21. I needed to learn a lot of things before I could get going with this system

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

Watch video 2 and then answer the questions below

22. Understanding the status of the automation would be:

Mark only one oval.

1 2 3 4 5

Difficult Easy

23. Understanding the driver's tasks and responsibilities would be:

Mark only one oval.

1 2 3 4 5

Difficult Easy

24. Understanding the road context would be:

Mark only one oval.

1 2 3 4 5

Difficult Easy

25. Understanding the road context while performing non-driving related activities would be:

Mark only one oval.

1 2 3 4 5

Difficult Easy

26. Understanding the road context while performing non-driving related activities would be:

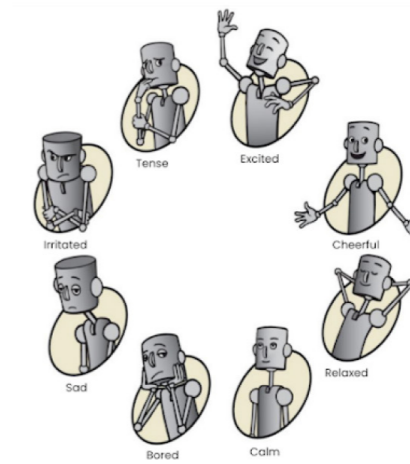
Mark only one oval.

1 2 3 4 5

Annoying Pleasant

27. Mark only one oval.

- Excited
- Cheerful
- Relaxed
- Calm
- Bored
- Sad
- Irritated
- Tense
- Other: _____



28. I think that I would like to use this system frequently

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

29. I found the system unnecessarily complex

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

30. I thought the system was easy to use

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

31. I think that I would need the support of a technical person to be able to use this system

Mark only one oval.

1 2 3 4 5

strongly disagree strongly agree

32. I found the various functions in this system were well integrated

Mark only one oval.

1 2 3 4 5
strongly disagree strongly agree

33. I thought there was too much inconsistency in this system

Mark only one oval.

1 2 3 4 5
strongly disagree strongly agree

34. I would imagine that most people would learn to use this system very quickly

Mark only one oval.

1 2 3 4 5
strongly disagree strongly agree

35. I found the system very awkward to use

Mark only one oval.

1 2 3 4 5
strongly disagree strongly agree

36. I felt very confident using the system

Mark only one oval.

1 2 3 4 5
strongly disagree strongly agree

37. I needed to learn a lot of things before I could get going with this system

Mark only one oval.

1 2 3 4 5
strongly disagree strongly agree