# Tools to stimulate interaction amongst passengers of the Seabubble

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Master Thesis
Design for Interaction, TU Delft

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This master thesis is part of a graduation project of the Design for Interaction (DfI) Master's programme at the faculty of Industrial Design Engineering at the Delft University of Technology in the Netherlands.

Delft, April 2020


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# Tools to stimulate interaction amongst passengers of the Seabubble

TU Delft

SEABUBBLES

ADVIER MOBILISEERT

# Preface

This thesis is part of a graduation project for the Master's programme Design for Interaction. It explains a design process in which a list of requirements (tools) is composed out of research and testing in the domain of socially shared travelling. The list is put into practice by a design for stimulating interaction amongst passengers of the hydrofoil Seabubble. The thesis is written in the period of 17th September 2019 till 23rd April 2020.

The thesis concludes the prolonged chapter of studying. A chapter in which I realised that designing in the context of future mobility is the path I had to take. Therefore it was an obvious choice to close this chapter, and obtain my master's degree, with a project in this same field.
It was the perfect project to apply the VIP-method; a method that emphasizes the importance of the conceptual level of designing and so creating the possibility to focus on constructing an inspiring vision and a suitable (future-oriented) context. My strength within designing lies in the conceptual level and so I realised that the VIP-method suits my way of designing very well.

First of all, I want to thank my supervisory team, Bregje and Iskander. You guided me through the process in a very pleasant and empathetic way. You were always available to help, listen, advice and check my grammar. Your constructive feedback contributed to this nice result.

Secondly, I want to thank all of the employees of Advier, particularly Minze. Next to the fact that you were always available to help and give (personal) advice, you made graduating a very pleasant experience. Together with Aliene you made me feel very welcome at Advier by providing a very pleasant and energetic work environment. But most of all, you both reminded me that there are other things to life than work.

Thank you Geert, for giving wholehearted support and listening at every hour of the day. You provided a test location, assisted throughout this whole project and gave me a very comfortable workplace to finish up my project in times of Covid-19.

Thank you Matt, for using your expertise and mother tongue to check the structure and grammar of my thesis while you were already so busy yourself.

Furthermore I would like to thank all my friends and family for encouraging me, listening to worries and providing me with welcome diversion.

Delft, 23rd April 2020

# Abstract

This project is focussed on a design for **stimulating interaction amongst passengers in the Seabubble.** The Seabubble is an autonomous hydrofoil that is able to fly above water. The Seabubble can transport 4 to 5 passengers on inland waterways. The hydrofoil-technology creates a whole new travel-experience because it provides very stable and silent travel conditions.

Haven-Stad is used as a case-study. This water-rich area in het Westelijk Havengebied of Amsterdam will be transformed into a mix of residential- and workplaces (figure 1). The Seabubble can make community sharing possible within neighbourhoods of this area.
The ViP-method (Vision in Product design) served as the main research & design method to create a future-oriented context for the design. Additionally a creative session and Minimal Viable Products (MVP) supported the designing phase. The VIP-method requires a construction of a future context in which the design is implemented. This context is created by means of literature-research, a survey and interviews. This resulted in a context in which the challenge of the design lies in connecting 2 divergent type of individual-oriented passengers: the passengers differ in their preference regarding (continuous) technical development, like autonomous vehicles.

Additionally a detailed description of the desired interaction is required. The easiest interaction for individual type of passengers is a spontaneous interaction. This spontaneous interaction is described by an analogy (called an interaction vision): **The interplay of confidence and doubt during improvisation**.

The creative session (figure 2) led to the first ideas of how to exploit the journey by Seabubble as a social stimulus between neighbours of Haven-Stad, in a spontaneous way. This session resulted in several design directions. These directions are used for MVP-testing in which low-fidelity prototypes in test set-ups were used to explore if the ideas would give the desired effect in practice (figure 3). The obtained insights are translated into a list of requirements that both function as a guideline for a design for the Seabubble as that it functions as tools for stakeholders in the field of shared autonomous vehicles. For this last reason, all the insights are bundled into a guide in a generic state (figure 4).

MVP-testing showed that a certain amount of (cooperative) control provides a motivation for undertaking interaction. This insight was used, together with the list of requirements, to design a control-system for the Seabubble: *the SpeedBubble*. It facilitates interaction by requiring passengers to cooperate in order to have a sense of control on the sailing speed.

The *SpeedBubble* is a projection that indicates the speed of the Seabubble. The passenger can choose to interfere with the control of the autonomous Seabubble by means of the *SpeedBubble;* they can collect 'bubbles' by moving their hands or feet (figure 5). The amount of control depends on the amount of collaboration since the *SpeedBubble* can only be controlled when the passengers act in successive order (regarding their seating position).

The evaluation of the *SpeedBubble* concept was conducted amongst neighbours in a test set-up (figure 6). The test showed that the concept stimulates interaction in a spontaneous way. Both divergent type of passengers were actively involved.

The *SpeedBubble* concept could be offered as a customization-option for parties that would want to implement Seabubbles in community sharing contexts.

FIGURE 1 | Visual of development of Haven-Stad (Programmabureau Haven-Stad, 2017)


FIGURE 2 | Creative session (Brainstorming)

FIGURE 3 | Test with low-fidelity prototype (MVP-testing)


FIGURE 4 | A guide for stimulating interaction amongst passenger in autonomous vehicles

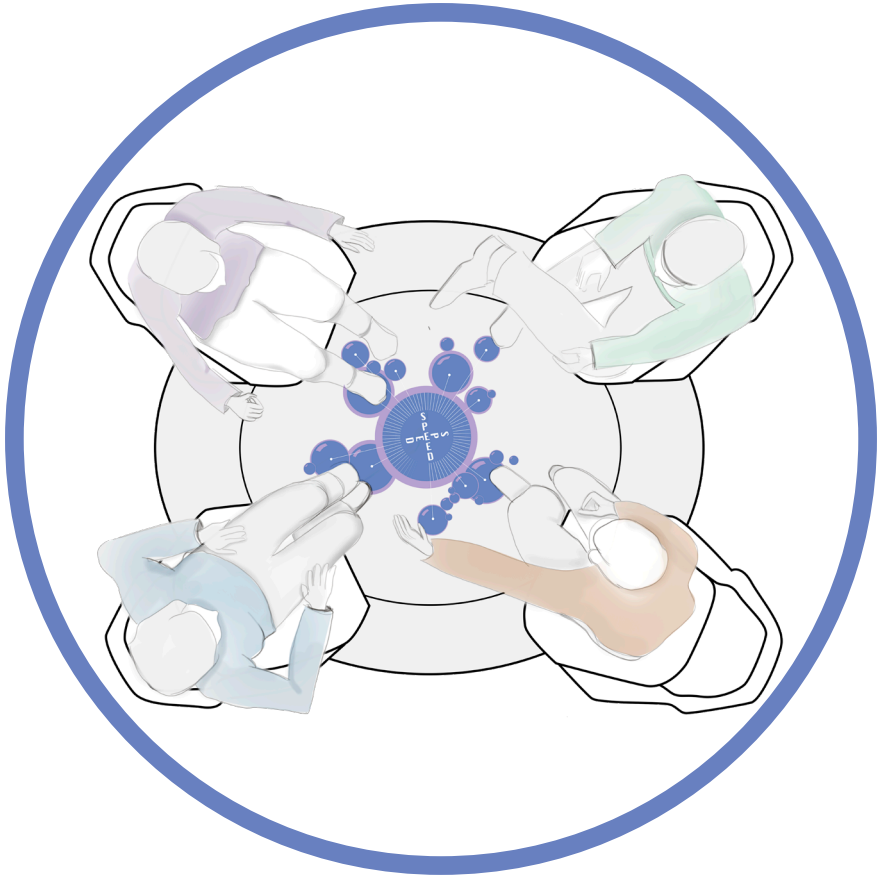


FIGURE 5 | The *SpeedBubble* concept

FIGURE 6 | Evaluation of the concept

# Glossary

### Advier
An advisory company in the mobility sector. Advier is the Dutch representative of Seabubbles.

### Seabubbles
An autonomous hydrofoil vehicle that can fly above water owned by the company Seabubbles.

### TU Delft
Delft University of Technology

### DfI
Design for Interaction

### VIP
Vision in Product design

### MVP
Minimal viable product

### Community sharing
Sharing products and/or services within a group of people that have a particular characteristic in common.

### Shared transport
Transport that is used by multiple people at the same time who are not always familiar with one another.

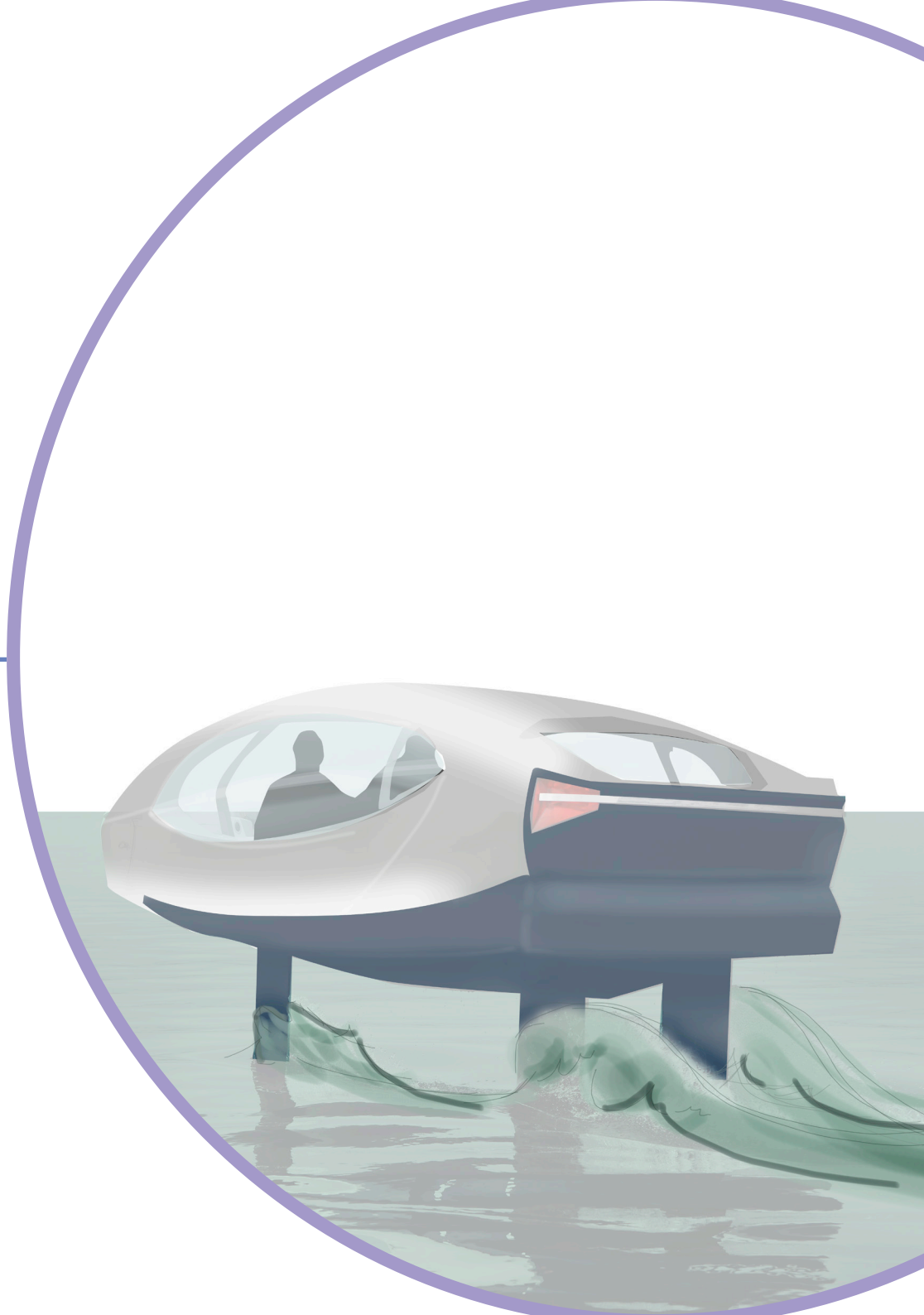
### People mover
Automated small vehicles that are used for intern transport (like car-parks, airports or business campuses)

### Creative session
A group-thinking session in which several brainstorming-techniques are used to create ideas.

### Haven-Stad
A part of the harbour of Amsterdam (het Westelijk Havengebied) that will be transformed into a mix of residential- and work places.

# The contents

# 1. Project



# 1.1 Introduction

### The Seabubble

To anticipate on the growing amount of cars (with as a result, global gridlock and pollution) Alain Thebault and Anders Bringdal invented the Hydroptère in 2016: a boat flying on water.

Alain and Anders believe that waterways have been underrated for many years although the future mobility lies on the water ("Seabubbles", 2019).

The Hydroptère is called Seabubble and it is meant for daily transport of 2-5 people on inland waterways.

The Seabubble contains a hydrofoil-system: a propulsion system attached to a foil which is powered by an electric motor. The hydrofoil-system makes it possible to lift the Seabubble above the water.

Besides the fact that Seabubbles are an eco-friendly solution to global gridlock and pollution, they provide a comfortable journey; they do not create waves or noise when moving in the flying mode (figure 7).

Currently a pilot is still needed to control the Seabubble, but the Seabubble will perform autonomously in the future.

### Design opportunities

This future scenario in which Seabubbles perform autonomously, is the scenario in which design opportunities arise: suddenly everyone has their hands free. Furthermore the fact that the hydrofoil-system prevents vibrations and noise, passengers are not distracted or restrained by these factors. The possibilities of the Seabubble were recognized by the company of Advier and therefore they offered the possibility to design for the interaction amongst passengers in the Seabubble.

### Focus area

People in big cities who travel by public transport from public places may never see each other again, so there is a low motivation to put effort into an interaction. A bigger chance of people being motivated to interact, is when passengers might run into each other quite often. A good example of such a situation would be a neighbourhood in which people use the Seabubble for the first and last miles of their journey.

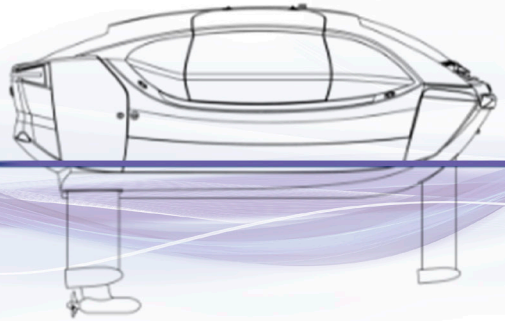
Such a neighbourhood (abounding in water) is being realised in the Westelijk Havengebied in Amsterdam. It will be called Haven-Stad and between 2029-2040 it will be a mix of residential- and workplaces. This area will serve an exemplary role in terms of how the Seabubble will be deployed.

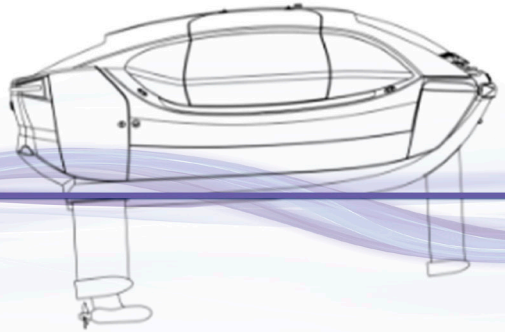
### Scenario

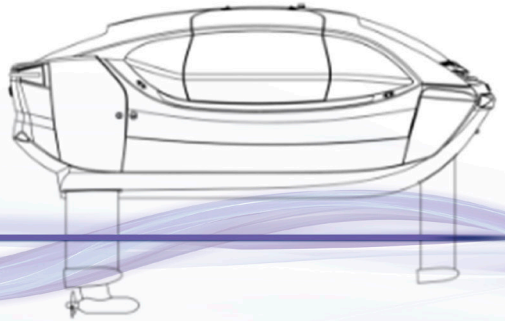
Figure 7 illustrates a scenario in which people would use the Seabubble in their neighbourhood. The Seabubbles will lie in the water (Archimedean mode) at several boarding points. At these points neighbours can gather and enter the Seabubble. Thereafter the Seabubble takes off (at set times) by lifting itself 66 cm above water. Subsequently the Seabubble will be in Flying mode in which it almost imperceptibly moves forward.

The neighbours will get into the small space of the Seabubble for a short time-frame(3-15 minutes) with just a few seats facing each other. Because of the hydrofoil-system, they will not notice noise or vibrations; the journey will be smooth and quiet. This makes some sort of interaction amongst passengers almost inevitable.

Some neighbours might know each other quite well, others not at all. Some might be very willing to interact, others prefer to have a moment for themselves. The challenge lies at stimulating interaction amongst these passengers with divergent preferences in a spontaneous way.



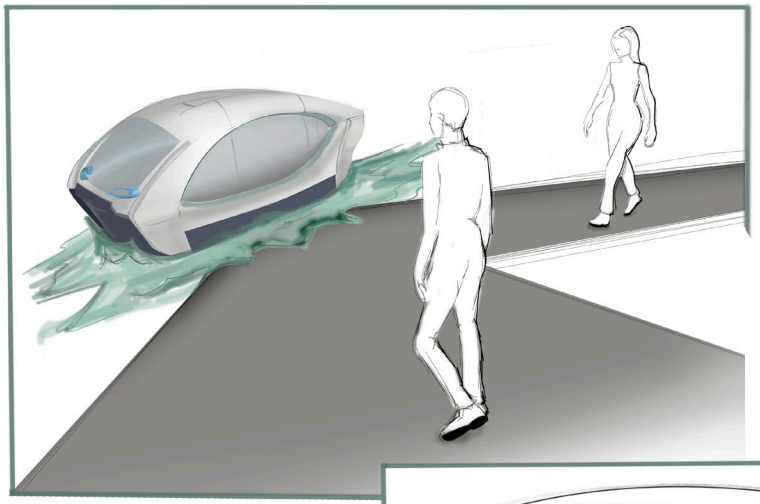


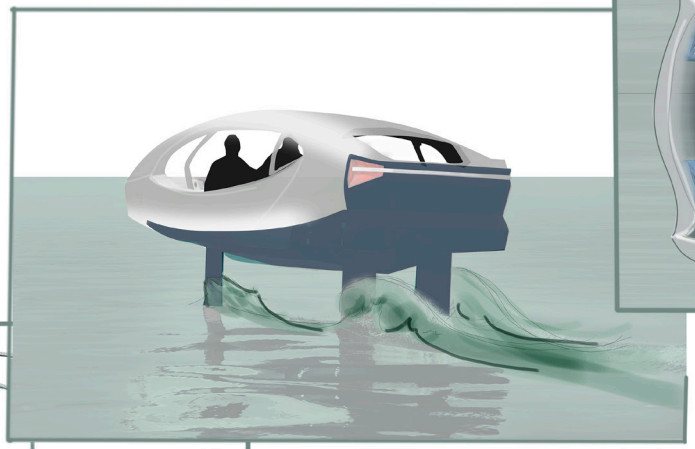


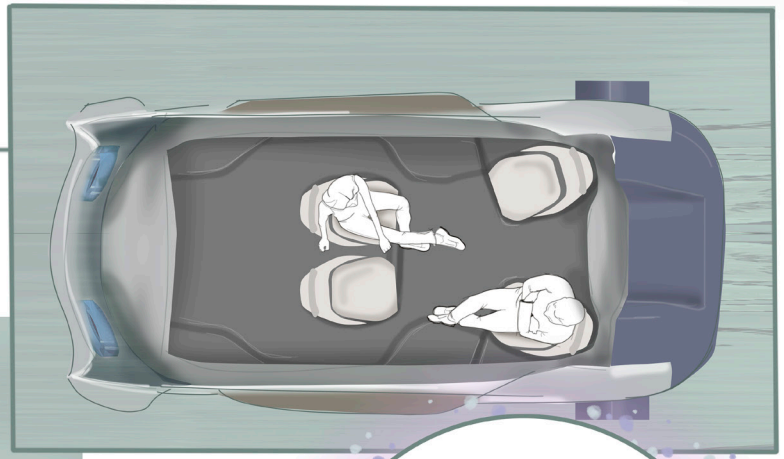
**Archimedean mode**
**Entering & getting seated**

**Take off**

**Flying mode**
**Moment of interaction**







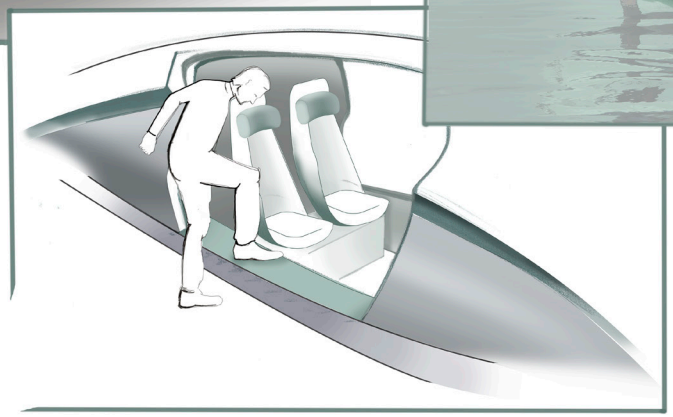


FIGURE 7 | Scenario displaying the possible usage of a Seabubble

# 1.2 Process & Structure

### Intro

A slightly modified structure of the VIP-method (Hekkert & van Dijk, 2011) is used during the design process (this modified version is shown in figure 8). VIP stands for Vision in Product Design and is frequently used for future-oriented design processes.

The first part of the VIP-process is analysing the current context of usage. This is mainly focussed on the interaction with the product and its users with the main goal of exploring design possibilities and desired interactions. Secondly a future context with its probable features is formulated by gathering factors. These factors can either be based on stable patterns and trends, but personal principles and beliefs are substantial elements for factors as well. The collection of factors enables a design space with a future context.

The VIP-method is characterised by the fact that the form of the end results is not the main focus during the biggest part of the process. The main focus lies at the ability of the design in terms of what it needs to be able to accomplish.

The shift of focus from design itself towards what the design should accomplish, distinguishes the VIP-method from many other design-methods. Since this is such an essential part of the VIP-method, it is being highlighted in a visual as an addition of the general overview of the method (figure 9). The general overview displays the entire process, where the additional visual is specifically focussed on the cycles of the designing phase.

## 1.2.1. Overview & adjustments

The VIP-method consists of two phases: the deconstruction- and designing-phase (Refer to appendix A for the original structure). The division of these two phases remained the same (figure 8).

#### The Deconstruction phase

The VIP-method's first phase is called the deconstruction phase in which a clear distinction between analysing in product-, interaction -and context level is made. Similar products, interactions and contexts should be analysed, but since the Seabubble fits an entire new product-category, there are no similar products that matches its function. Therefore, solely similar interactions and contexts are explored.

#### The Designing phase

After obtaining a deeper understanding of the product itself (and similar interactions and contexts), it is time for the second phase of the VIP-method: the designing phase. During this phase it is of importance to focus on what the design should accomplish instead of what form the design eventually might take. This is the main focus until the Design Foundation is set. Thereafter there can be focussed on the design itself. This part is kicked-off with a creative session followed up by testing and iterating triggers for interactions. All the findings are presented as requirements which are implemented into a design for the Seabubble and presented in a more generic form. This form is a booklet meant to inspire and inform stakeholders of the field of autonomous transport.

The essential shift of focus from ability of the design towards the design itself is not particularly emphasized in the method-overview, therefore an additional visual is provided in which the cycles clearly display this shift. This is thoroughly explained in chapter 1.2.2.

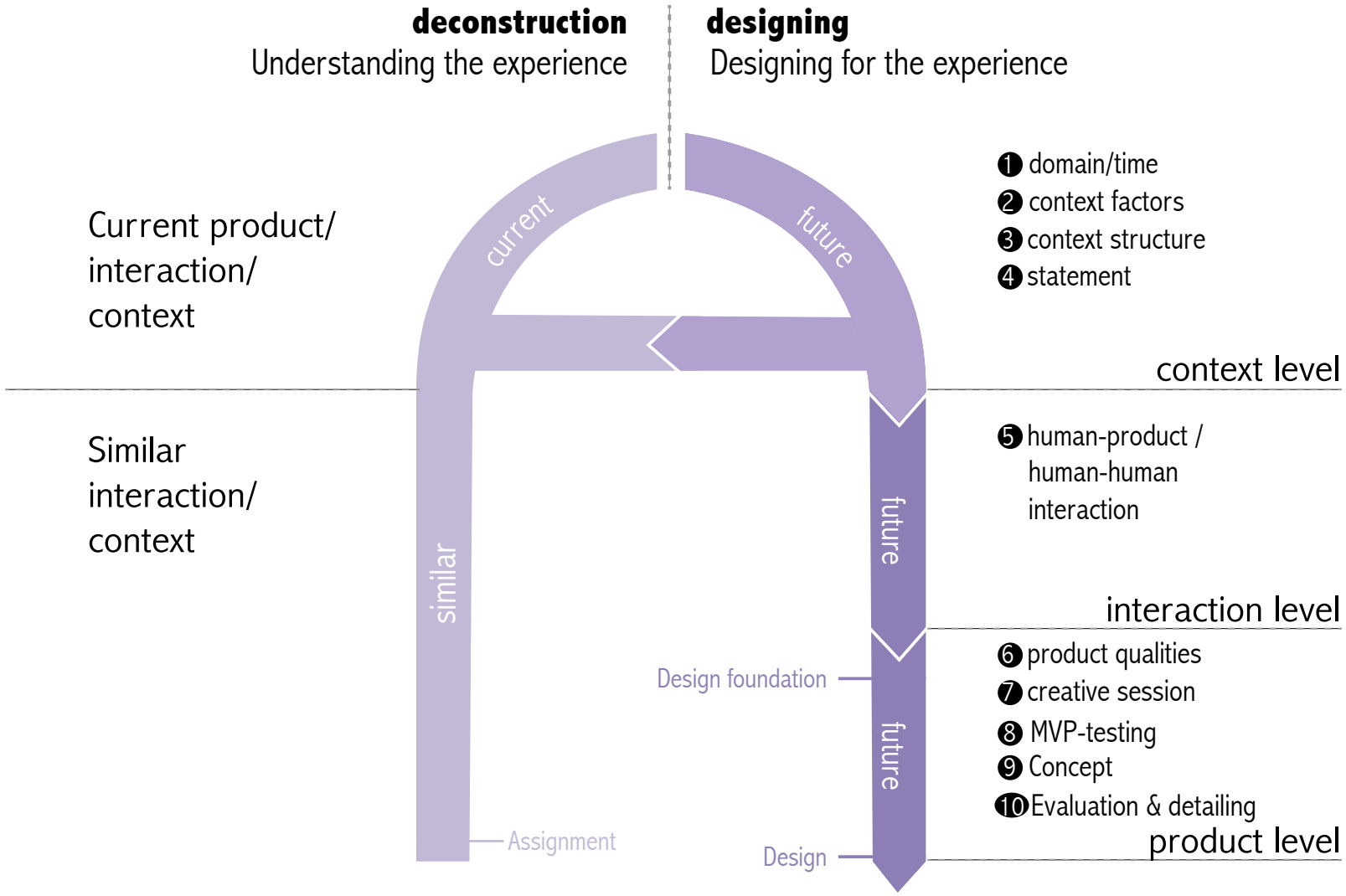



FIGURE 8 | Modified VIP-method structure

## 1.2.2. The Designing phase

The designing phase can be divided into 2 cycles (figure 9). During cycle 1 the focus solely lies on what the design should be able to accomplish. The assignment is formulated into a broader theme which is converged into more specified goals. This foundation is the base for cycle 2, in which the focus lies on the design itself. The 3 pillars (assignment, design foundation and the design) are discussed below. The 2 cycles will be discussed separately in chapter 1.2.3.

### The assignment

The technology used in the Seabubble is not applied very often yet, which is why it is quite unknown how people experience this fluent and soundless way of travelling. There are some design opportunities hidden in this experience which led to the assignment: *"Design for the experience of travelling by Seabubble"*. This assignment, together with the exploration of the deconstruction phase, is the starting point of cycle 1.

### The design foundation

The assignment is re-framed into a domain: "Socially shared travelling". The domain widens up the context to be able to explore interesting possibilities for the design and its interaction. When reaching the end of cycle 1, relevant information is processed and will lead to the design goals. This makes the design foundation; a steady base to elaborate on.

### The design

The design is the result of (repeatedly) going through cycle 1 and 2. Insights gathered until step 7 that might have the potential of fulfilling (part of) the statement and interaction vision, are tested during step 8 and 9. The results lead to a more concrete and validated design.

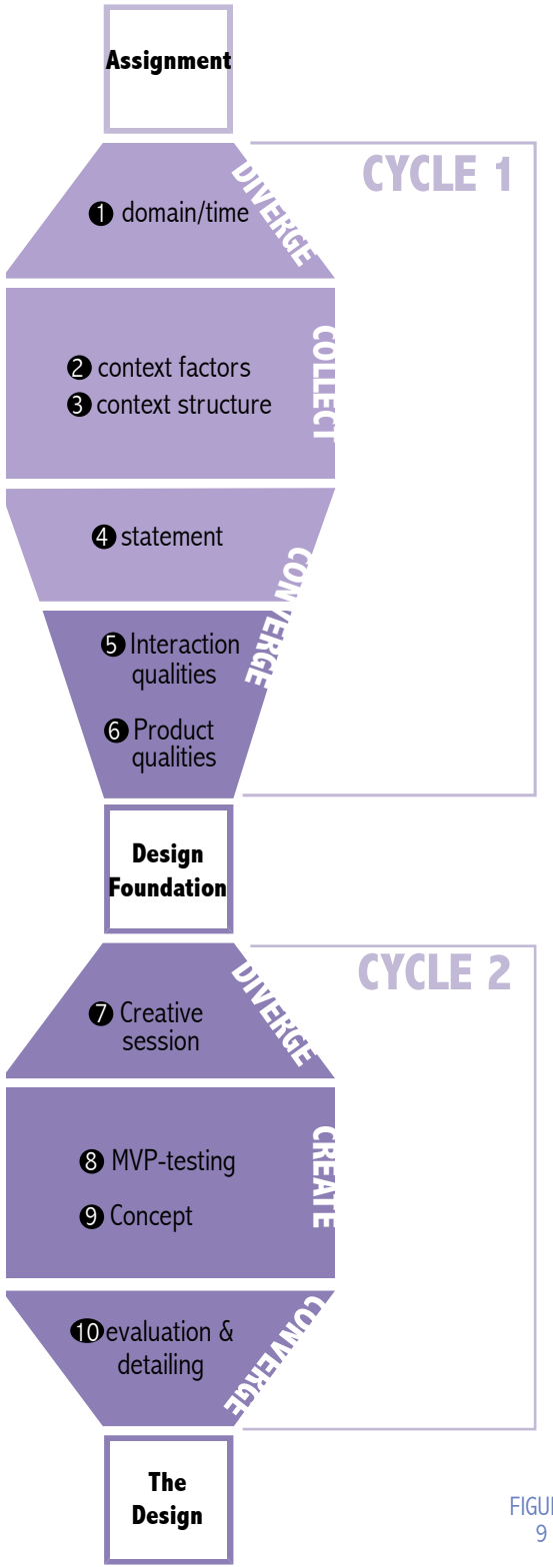



FIGURE 9 | Diverging and converging process

## 1.2.3. Cycle 1: Setting the design foundation

The content and results of Cycle 1 (and the deconstruction phase) are discussed in Chapter 2 and 3.

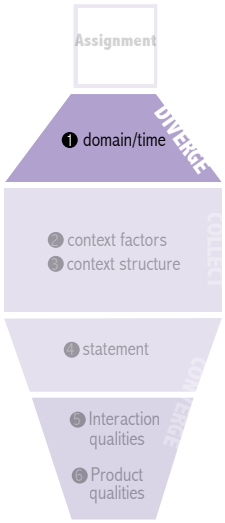



FIGURE 10 | Cycle 1: Diverge

### Diverge

The first step of the designing phase is focussed on broadening up the assignment: diverging into the domain(❶)(see figure 10). The goal is to explore the possibilities of the Seabubble regarding to social interaction. The domain is stated as *"Shared social travelling"*, This first step widens up the search-area for context factors(❷).

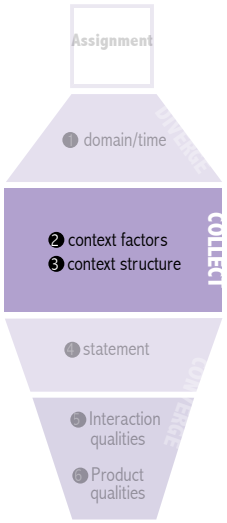



FIGURE 11 | Cycle 1: Collect

### Collect

Collecting context factors(❷) in the domain of *social travelling* resulted in clusters relating to individual and social behaviour, and the human response to the (fast) development of the world (all the factors & clusters can be found in Appendix E). The clusters are the base of the context structure(❸) (see figure 11). The context structure is used to formulate 4 types of travellers. The statement (❹) is based on connecting two types of those travellers.

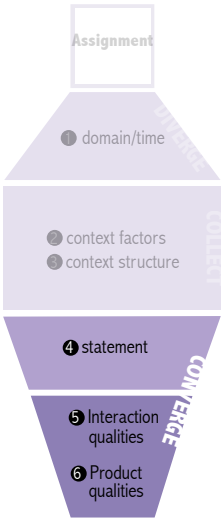
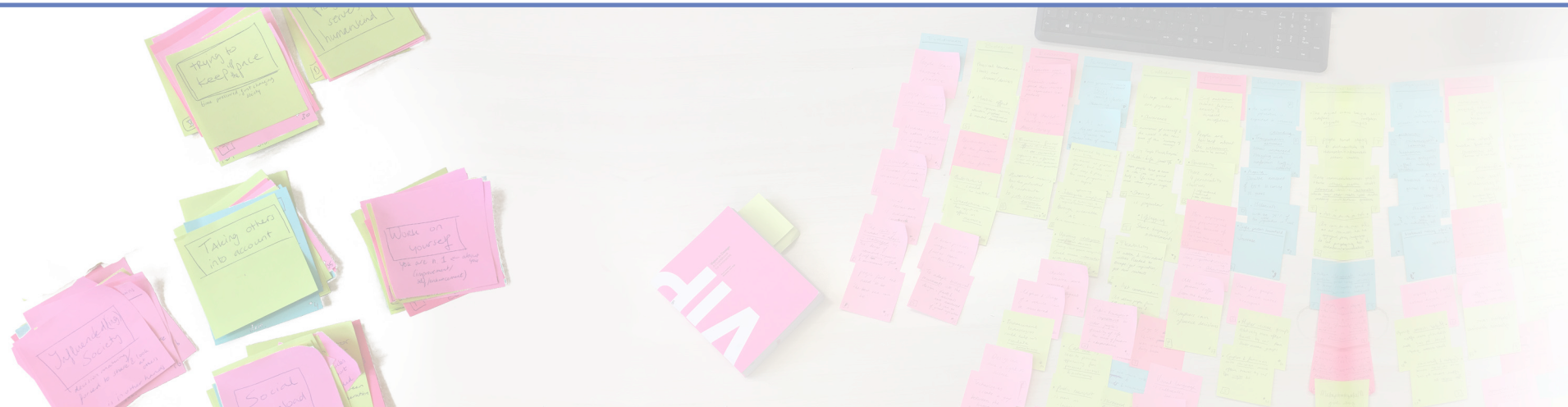



FIGURE 12 | Cycle 1: Converge

### Converge

The statement (❹) gives direction to the project; it states what the design should be able to accomplish. The desired interaction amongst travellers is specified by an analogy, this is called the interaction vision together with its interaction qualities(❺). Towards the end of this cycle the focus is being shifted towards the design itself (figure 12). Therefore the last step of this cycle focusses on formulating the (product)qualities that the design should posses (❻).



# 1.2.4. Cycle 2: An interative process towards a design

The content and results of cycle 2 are discussed from chapter 4 onwards.

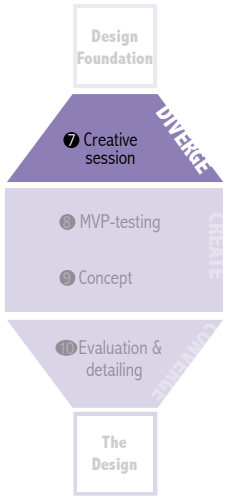



FIGURE 13 | Cycle 2: Diverge

### Diverge

The design foundation gives guidance for cycle 2, in which the focus lies on the design itself. To diverge into possibilities of a design within the set goals of the design foundation, a creative session is organised (❼) (figure 13).The creative session has taken place with 6 people with different backgrounds to have a wide variety of creative input. The session consists of a couple of creative techniques to guide the participants through the process.

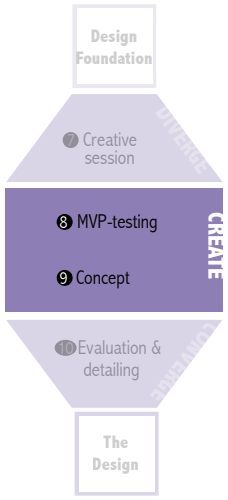



FIGURE 14 | Cycle 2: Create

### Create

Several ideas from the creative session are tested by Minimum Viable Products(❽) (figure 14). Hereby various stimulative factors for interaction can be tested with low fidelity prototypes. The insights from the tests are contribute to the design guidelines. The guidelines lead to a design of a concept (❾).

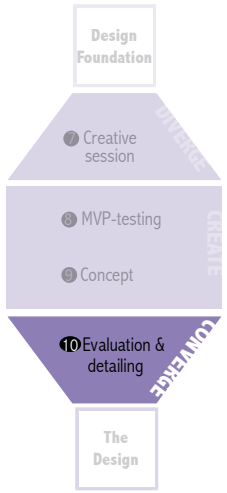



FIGURE 15 | Cycle 2: Converge

### Converge

The concept is evaluated in a test set-up. The evaluation of this test, together with the design guidelines, is used to design a guide (❿) (figure 15).

Stakeholders in the field of shared autonomous vehicles can use the insights of this design & research process since the guide presents the design guidelines as tools to stimulate interaction amongst passengers.

# 2. Deconstruction

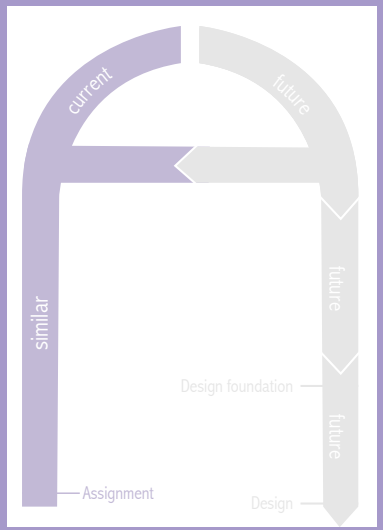
# 2.1 The sharing experience

## Intro

The project domain is phrased as "**socially shared travelling**". This determines the scope of the project and therefore the deconstruction phase includes all kinds of travelling in which a vehicle is being shared.

It is chosen to focus on a specific area in which the Seabbubble could connect the neighbourhoods an therefore enable *community sharing*. This focus area is called Haven-Stad, an area that will be transformed into a mix of residential- and workplaces between 2029 and 2040 in the Westelijk Havengebied in Amsterdam.

Regarding to the domain, the way people perceive shared travelling and consequently act towards fellow passengers, research is conducted by literature-research, a survey and several interviews. The interviews are focussed on either the social influential factors within shared travel-services in general, or specifically within the Seabubble. This process is part of the deconstruction-phase of the project, which is meant to understand the underlying reasoning of passenger interaction in relation to the Seabubble in the domain of socially shared travelling.




## 2.1.1. Community sharing

Rather than actually owning something, people nowadays attach more importance to solely having access. Being able to use something when you need it along with the financial benefits makes sharing and trading more popular by the day ("Travel experience tomorrow", 2016).

The Sharing economy is defined as *"An economic system that is based on people sharing possessions and services, either for free or for payment, usually using the internet to organize this" ("Sharing economy", 2020)*. As this explains, sharing takes place in various forms, to name some examples: *Tulerie* offers a platform for peer-to-peer clothing rental ("Tulerie", 2019) and when someone wants to rent out his/her home or spare room, Airbnb offers the platform to find renters ("Vacation Rentals, Homes, Experiences & Places", 2019). These are examples of not using something simultaneously and so being able to rent it out, but another way of looking at sharing can be explained by the example of shared gardens image 16) or shared spaces in a apartment complex (image 17), in which sharing and using it yourself comes simultaneously. The focus of this project will lie on this type of community sharing.

FIGURE 16 | A surrounded community garden design for Utrecht (Grozdannic, 2015)

FIGURE 17 | Shared dining area, Kalkbreite in Zurich ("Shared spaces", 2018)

# 2.1.2. Shared transport

### Shared transport services

Sharing transport is very common when relating it to public transport, but another emerging way of sharing transport is enabled by platforms for sharing a personally owned vehicle. An example of such a platform is *BlaBlaCar*. This is a carpooling service that enables others to join a journey that people otherwise would have made on their own ("BlaBlaCar", 2020). Other easily accessible and popular ride-sharing platforms are *Uber* and *Lyft* ("Ridesharing services in the U.S.", 2019). Sharing a smaller (and often personally-owned) type of transport comes with a completely different experience than the experience of shared travelling by public transport. Both types of shared travelling are taken into account.

### Sharing the Seabubble

The Seabubble is another type of small shared transport (figure 19). It provides shared transport in inland waterways and it makes it possible to get to hard-to-reach wetlands. The Seabubble provides 6m$^2$ interior surface and limited headroom of 1.43m (Appendix B). This compact space with 5 seats could result in other codes of conduct than people using the public transport. A similar interaction (but a different context) could arise when travelling with People-mover systems (figure 18). These are automated small vehicles that are used for intern transport on for instance business parks and airports. Like in Seabubbles, passengers sit closely to each other and face one another; making it inevitable to make some sort of contact with each other (something that is often avoided in public transport). However, in relation to the context, *People movers* and the *Seabubbles* are completely different.

The Seabubble provides a flawless journey without vibration on waterways, which is something that People movers do not provide. Because of this substantial difference, it is chosen to not research the experience of travelling by People mover although the insights of the research and the design can be implemented in transport like People Movers.

To get a better understanding of the actual experience of sharing products and/or services, multiple interviews are taken and a survey is conducted. This research focusses on influential factors towards social behaviour in existing (commonly known) shared transport, but moreover it is focussed on people who have experienced travelling by Seabubble. The results are discussed in chapter 2.1.3 and 2.1.4.

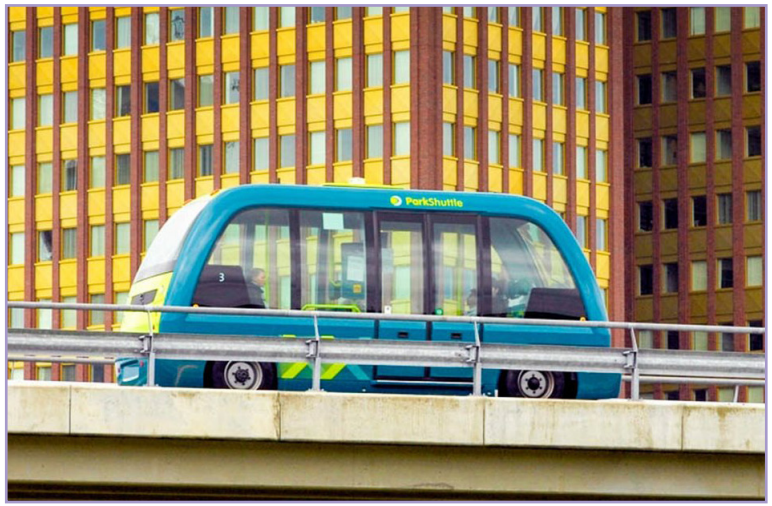



FIGURE 18 | A People-mover system in Rotterdam: the Parkshuttle ("Parkshuttle Rivium", 2020)

FIGURE 19 | The interior set-up of the Seabubble

# 2.1.3. Survey – Social influential factors (in all kinds of shared transport)

Sharing a ride, going on a cruise-ship holiday, sitting in a train or even waiting in an elevator: all examples of a sharing experience. Of course, in all these examples there are substantial differences: the duration of the sharing moment, the size of the sharing-medium, the amount of people or the ability to move freely. I have researched which factors have the most influence on social behaviour during the moment of sharing a ride. The research is conducted with 54 participants, who all participated individually. The main findings are discussed below (refer to appendix C for all results).

## Insights

### Transport type

63% of those surveyed said that the type of (shared)transport is not influencing their social behaviour, although a part of this group mentioned that the amount of time that they are travelling is an important factor. The amount of time is actually closely related to the type of transport, for instance in most cases a (city)bus is used for shorter distances than a train. So it can be concluded that in relation to travel time, the type of transport is also of influence on social behaviour.

### Seating position

The remaining 37% mentioned that, amongst other things, differences in configuration of seating is depending on the type of transport and so it is an influential factor on their social behaviour. They also mentioned that there is a difference in social behaviour in public transport and in taxis: people tend to be more social during a taxi-ride. Noteworthy is the link of social behaviour with the size of the vehicle. During a taxi-ride (or something similar like using *BlaBla-car* or *Uber*) people get into someone's personal vehicle and the space is quite limited, this might be a trigger for interaction.

### Mood & Attitude

Other's attitude and people's individual mood has a negative and positive influence on social behaviour (figure 20). Quite a logical outcome, since the two factors influence each other continuously. It is proven that a negative mood enhances thoughtful processing (influencing decision making) and a positive mood leads people to respond more intuitively (Elen & D'Heer & Geuens & Vermeir, 2013). So people with either a good or a bad mood will perceive and process other's attitude differently as well. The majority of the participants of the survey described their behaviour towards other travellers as either "neutral, but polite/considerate" or as "closed/isolated/anonymous/distant/ignoring" (figure 21). This behaviour could reflect on other behaviour, like mentioned before, which is why this is an important aspect to take into account.

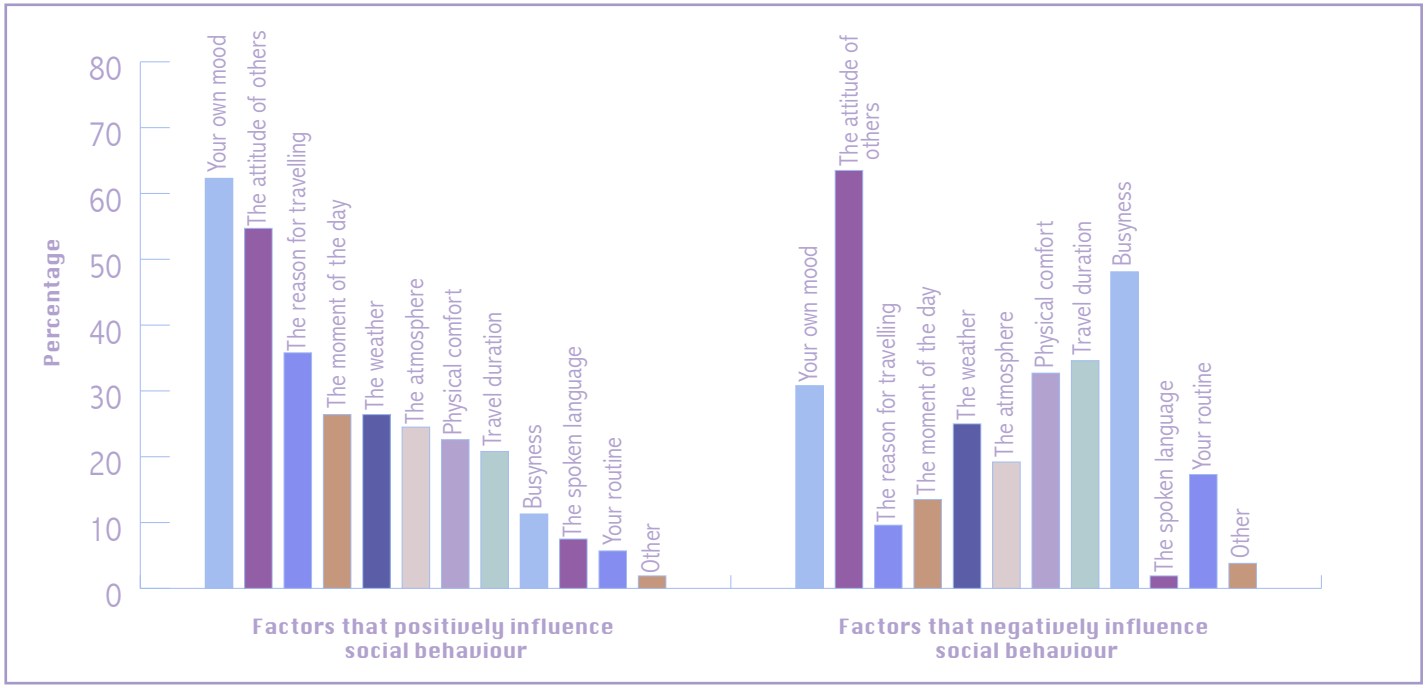



FIGURE 20 | Results from survey: influential factors on social behaviour

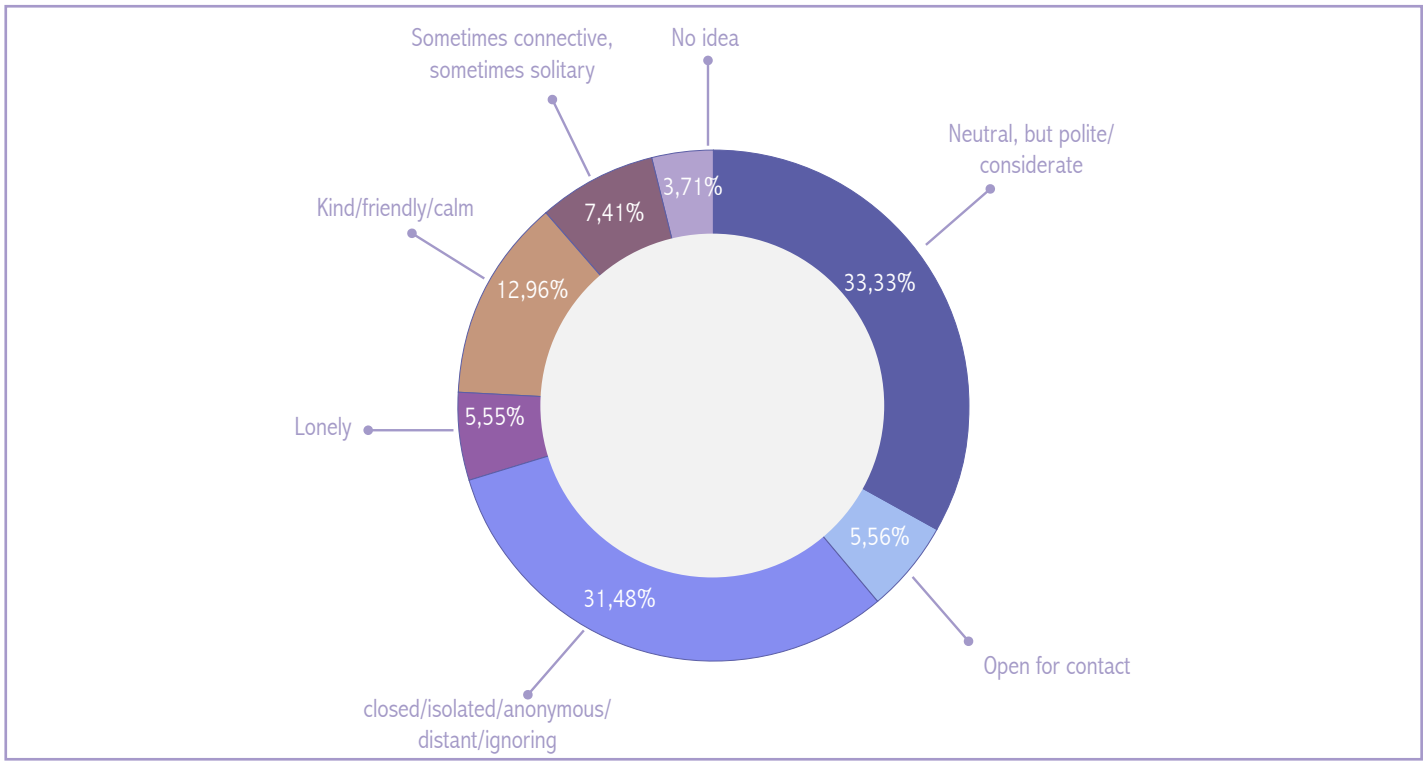



FIGURE 21 | Results from survey: Attitude towards other travellers

# 2.1.4. Interviews – Social influential factors (in the Seabubble)

As mentioned in the previous page, several elements can influence social behaviour during shared travelling. Moreover there are some additional influential elements when specifically relating it to travelling by Seabubble. People who had the opportunity to travel by Seabubble are mostly people from ministries or other companies that are looking for opportunities to deploy the Seabubble. These stakeholders are the ones questioned about their view on possible socially stimulative factors of the Seabubble (refer to appendix D for the interviews).

## Insights

### Interior setup

In the current setup of the interior of the Seabubble there is one driver's seat facing forwards and 4 passenger seats facing each other (specifications can be found in Appendix 4). According to the ones questioned, this seating position is one of the main stimulative factors for social interaction, which is in line with the results of the questionnaire about other types of shared transport. One of the interviewees even mentioned that in the current interior setup he would not feel at ease when his activity would be individually oriented (refer to quote 1).

### Special experience

Travelling by Seabubble is a whole new and special experience. This experience might surprise people which could lead to a conversation about the matter (quote 2).

A surprising experience like when something unexpected happens while travelling with public transport (a delay or an emergency stop) could also be a stimulative social factor. The downside is that when these things occur more often (or people start to travel by Seabubble on daily basis), it will not be so special and surprising anymore. To conclude several unpredictable (or changing) experiences would be needed to continue to surprise people, and so stimulate social interaction.

### Amount of space

In a research based on (inter)personal space it is being concluded that "spatial behaviour is a key aspect of our socio-emotional life and possibility of acting." (Iachini & Coello & Frassinetti & Ruggiero, 2014) The possibility to control the amount of interpersonal distance is needed to let people feel comfortable in their social setting.

With the Seabubble being quite compact, the chance that people will feel inconvenient with the amount of personal space is quite high. On the other hand the little amount of space could also have a stimulating social effect, because the boundary of talking might be lower then when needing to raise ones voice (publicly).

### Accessibility

One of the interviewees mentioned that there is also a social sense to the amount of accessibility to the society of the Seabubble (quote 3). When a technological development becomes a special phenomenon, there is a risk that it becomes something exclusive. This could result in discrimination of the biggest group of people that would want, or need, to use it. Unfortunately, this factor can not be controlled because it is not a social influential factor within the Seabubble, rather a possible consequence.

Quote 1

“It is socially stimulative. In the current sitting-position I would not feel at ease to start doing something for myself. Definitely when you are facing each other, then it feels like you’re being anti-social and as if you do not communicate.”

Minze (52)

ADVIER MOBILISEERT

Quote 2

“You are seated with 5-6 people in a small space in a social arrangement (half a circle). There are no armrests or any other partitions. You are also quite curious to the way of travelling so there is already a conversation about it. The social part is being stimulated by the compact space and the fact that all of it is quite a special experience.”

Rick (53)

Rijkswaterstaat
*Ministerie van Infrastructuur en Waterstaat*

Quote 3

“It could be social in the sense of accessibility to the society .. technological development of mobility should stay adding value to the entire society, it should not become more and more exclusive which could become discriminating.”

Gerwin (49)

Rijkswaterstaat
*Ministerie van Infrastructuur en Waterstaat*

# 2.2 Focus area

## 2.2.1 Haven-Stad

Since the Seabubble is still in its testing phase, it is not yet deployed in a fixed area. Therefore it is chosen to focus on an area that might be interesting for the future deployment of the Seabubble.

**The future neighbours of Haven-Stad** will be the ones in need of transport by water. Although these neighbours will not be direct neighbours, there is a chance that they share their journey in the Seabubble with each other once in a while. This community sharing could motivate the passengers for social (or at least polite) behaviour.

Haven-Stad is a part of the Westelijk Havengebied in Amsterdam (figure 22), this area is currently occupied by companies, but in between 2029-2040 this area will be transformed into a mix of residential- and workplaces (Haven-Stad: herontwikkeling gebied, n.d.).

Four specific areas of Haven-stad are surrounded by water. Therefore these areas are very suitable for the Seabubble to be used as daily transportation. These water-rich areas are: Cornelis Douwes 0-1 & 2-3, Minervahaven and Coen- and Vlothaven (figure 23).

At this point there is no better alternative than travelling by water; metro, buses and trams do not cross the 4 mentioned areas ("Haven-Stad: versnellingsstrategie Haven-Stad", 2019). The quickest way for people living in Haven-Stad to reach transport hubs, would be by water transportation. This scenario is explained in chapter 2.2.2 and 2.2.3.

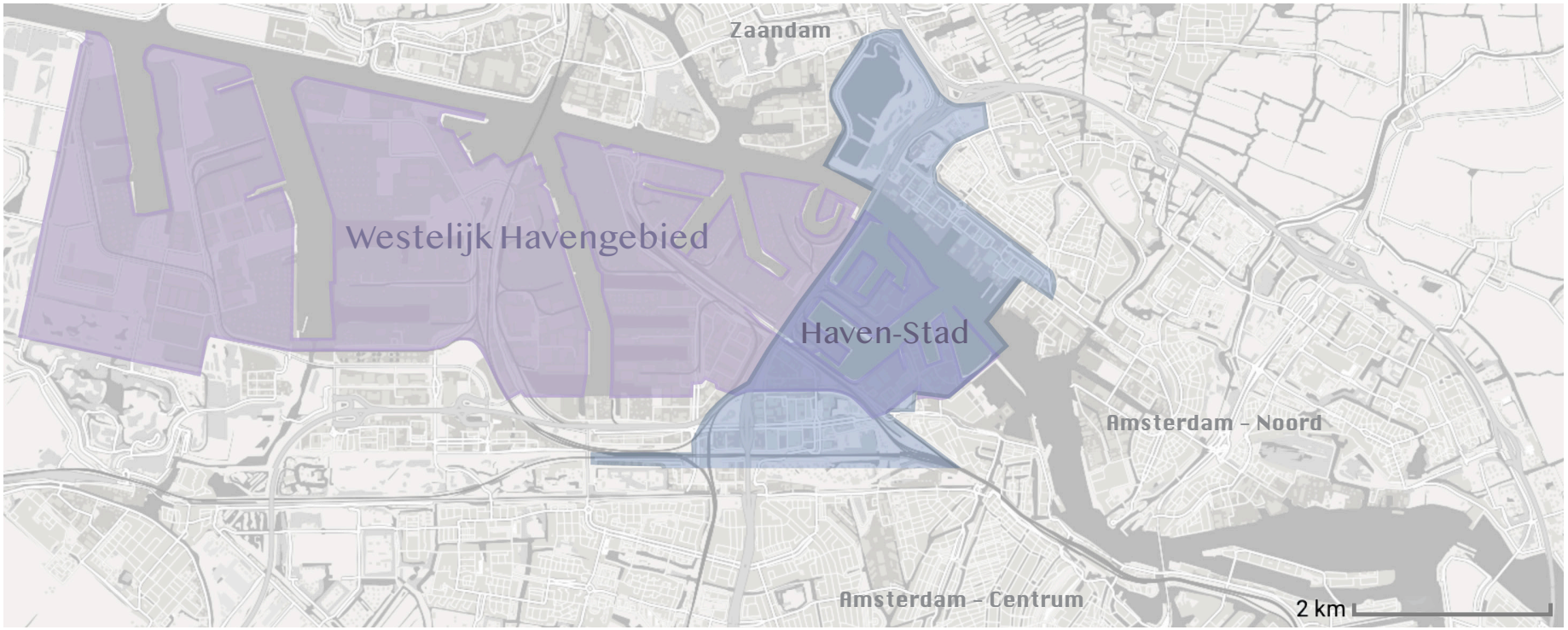



FIGURE 22 | Haven-Stad as a part of the Westelijk Havengebied in Amsterdam

### Cornelis Douwes 0-1
(development after 2029)

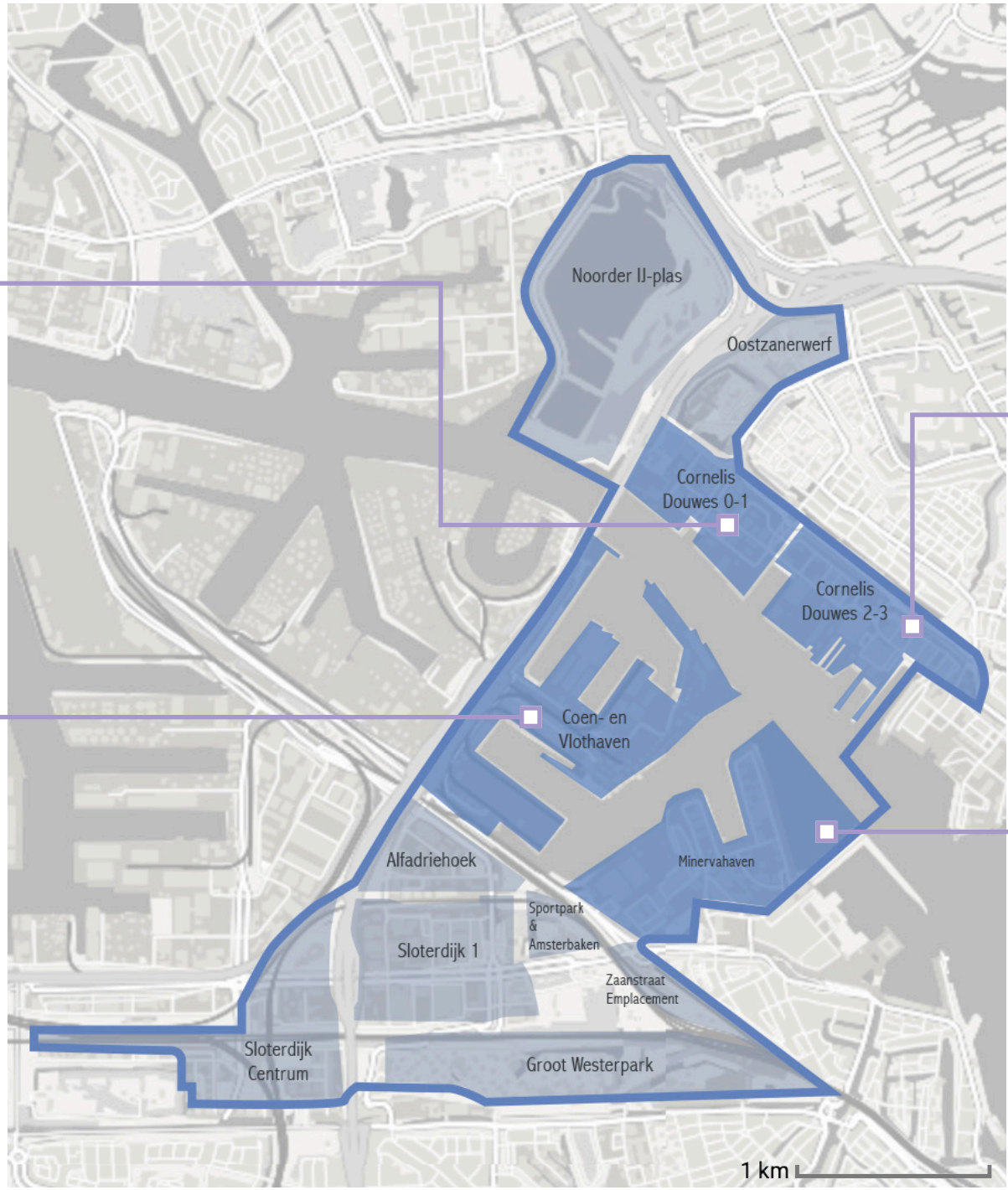
This area functions as the link with the outskirts.

Building plan:
6.900 residences

### Coen- and Vlothaven
(development after 2040)

This area is the heart of Haven-Stad and is surrounded by water.

Building plan:
15.400 residences




### Cornelis Douwes 2-3
(development after 2029)

Dutch cultural- and historical heritage

Building plan:
9.600 residences

### Minervahaven
(development after 2029)

Mix of residential- and working area

Building plan:
11.620 residences

FIGURE 23 | Haven-Stad: focus areas ("Haven-Stad: versnellingsstrategie Haven-Stad", 2019)

## 2.2.2 Transport network

The 4 areas of Haven-Stad, that are directly connected to the water, have limited access to transport routes. The current (public) transport network and the possible extension of the network is shown in figure 24. Although an extension of the public transport-lines is planned, this still does not connect these areas. Crossing the water is the easiest and quickest way to hop from one area to another, or to be able to reach (public) transport hubs (shown by the orange dots). Furthermore, the Seabubble does not require an entire railway- or road-network, but merely a few docks. These docks do not require a lot of extra space. The fact that no fixed rail-or road-network is required means that it is easy to implement (aside from the possible regulations).

## 2.2.3 Time interval

When the Seabubble would be implemented into the transport infrastructure of Haven-Stad, all types of transport would be connected to each other. The white dotted line in figure 24 shows possible Seabubble-routes, connected by 5 docks:

- Route A is 930 metres
- Route B is 1,62 kilometres
- Route C is 1,2 kilometres
- Route D is 2 kilometres

These routes illustrate that a passenger would roughly be travelling 1 to 3 kilometres, (it could be that a stopover is needed to pick up passengers). Since the Seabubble will utilise waterways, the regulations of boats will be applied. When a draught of a boat is less than 4 metres, a maximum speed of 18 km/h is set (Noordzeekanaal, 2020). This implies that the Seabubble may fly at 9.7 knots with as a result that passengers of the Seabubble would be travelling for approximately 3 to 15 minutes. An example of a possible scenario is given below.

A resident of Cornelis Douwes 2-3 who needs to reach the metro-station to go to work on daily basis, would be travelling route C+D. Since this route counts 3 stops, it is assumed that the Seabubble needs half of the journey to get to speed and to slow down. With a take-off speed of 8 knots the average speed would be 8.85 knots (=16.39 km/h). The distance of the route C+D would be covered in 8 minutes. A couple of minutes extra will be required for the stopover. The fact that the Seabubble would operate in such short intervals requires the design to be self-explanatory and easily accessible.

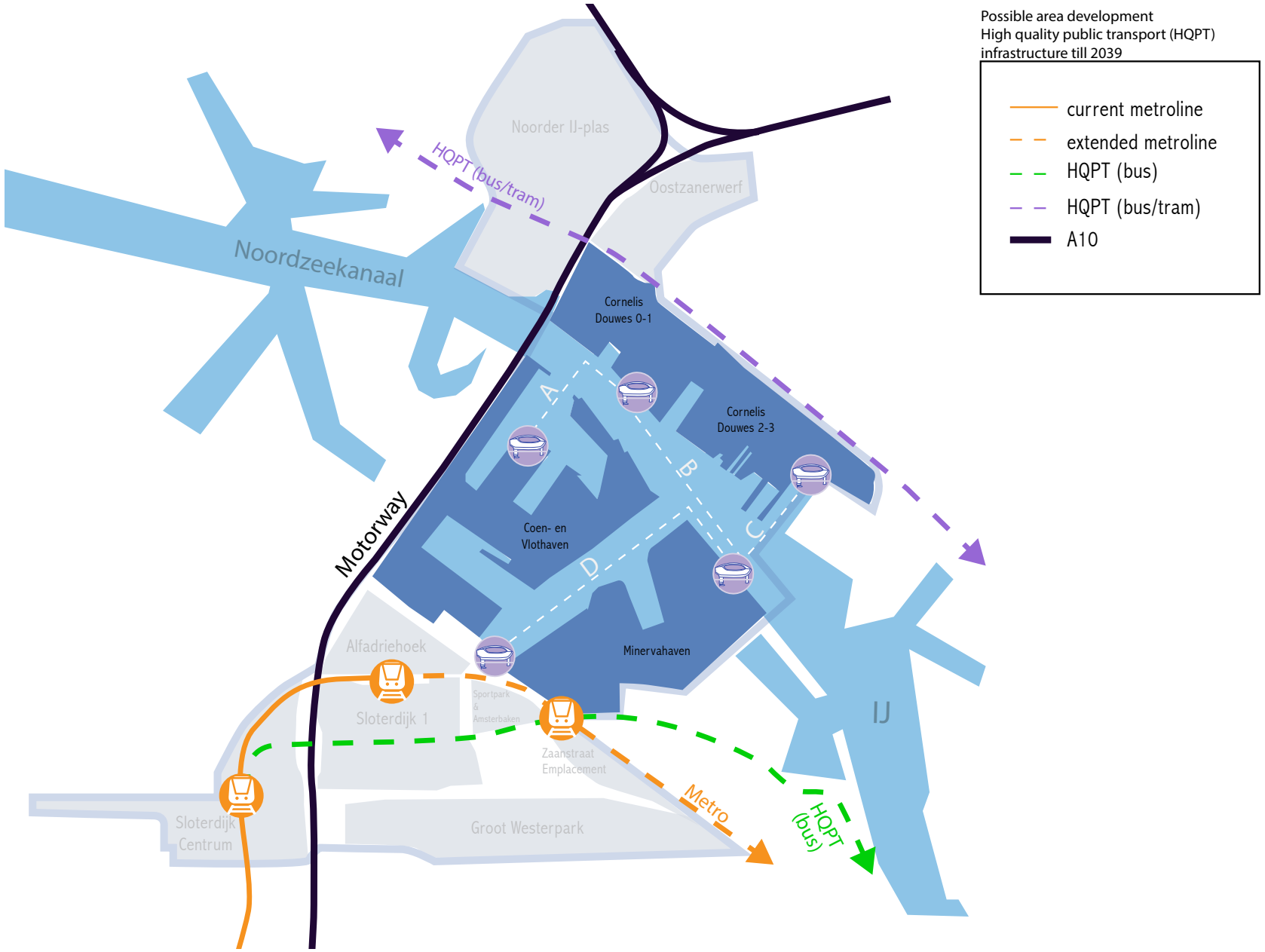



FIGURE 24 | Haven-Stad: possible area development regarding transport routes ("Haven-Stad: versnellingsstrategie Haven-Stad", 2019)

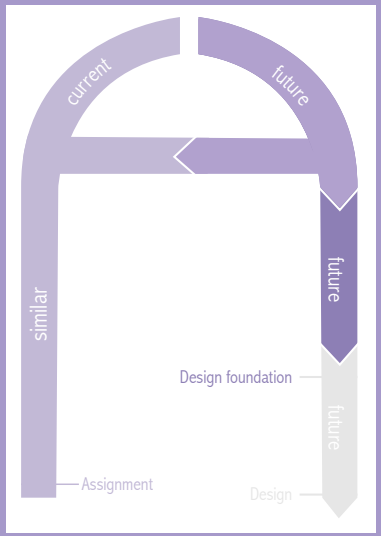
# 3. Foundation

# 3.1 Focus

## Intro

The focus of the project is based on further exploration of the domain "*Socially shared travelling*", this is the area in which the final design should make a contribution.

The exploration of the domain will form a context: the future world in which the design will operate. By going through the several stages of the context the design foundation is set.




## 3.1.1. Shaping the context

Designing the context consists of 5 stages: collecting factors, clustering, defining themes by linking clusters, formulating future passenger attitudes and lastly formulating a statement. A first impression of the structure is shown in figure 25. At first, the function of the 5 stages is explained, thereafter their application in relation to the domain is clarified.

### Factors

The research within the domain of "*socially shared travelling*" is categorized into factors. These factors are the building blocks for a (possible) future world and they can either be changing or developing (trends & developments) or referring to stable situations (states & principles). The factors can be sort into 8 fields: culture, economy, politics, sociology, psychology, technology, biology, demography or evolutionary sciences (Hekkert & van Dijk, 2011). The factors are listed in Appendix E.

### Clusters

The next step in composing a future world is to structure the factors into clusters. The clusters are not just overarching themes, but they each tell a future-oriented story that will influence shared travelling in the future. The relation between factors is presented in 9 different clusters, these are explained in chapter 3.1.2.

### Themes

Some clusters might relate to each other, while others might conflict. This relation of clusters is structured into 2 themes: *The behaviour (amongst travellers)* & *The response to the (technological) development of the world*. The relation between these themes is called the context structure which is visualised as a chart in which the axes relate to the themes. The context structure is illustrated in chapter 3.1.3.

### Attitudes

The axes of the context structure assorts the themes into a future world. How travellers take a position in this future world is described by attitudes. When people relate to the theme "behaviour (amongst travellers)", they can either show an individual attitude or a more social attitude. Likewise people can either show a curious or conservative attitude towards technological developments. Refer to chapter 3.1.3. for the description of the attitude-types.

### Statement

As a response to the context (the constructed future world), a statement is formulated. The statement describes the desired ability of the design in relation to the described passenger attitudes. The elements out of which the statement is composed are described in chapter 3.1.4.

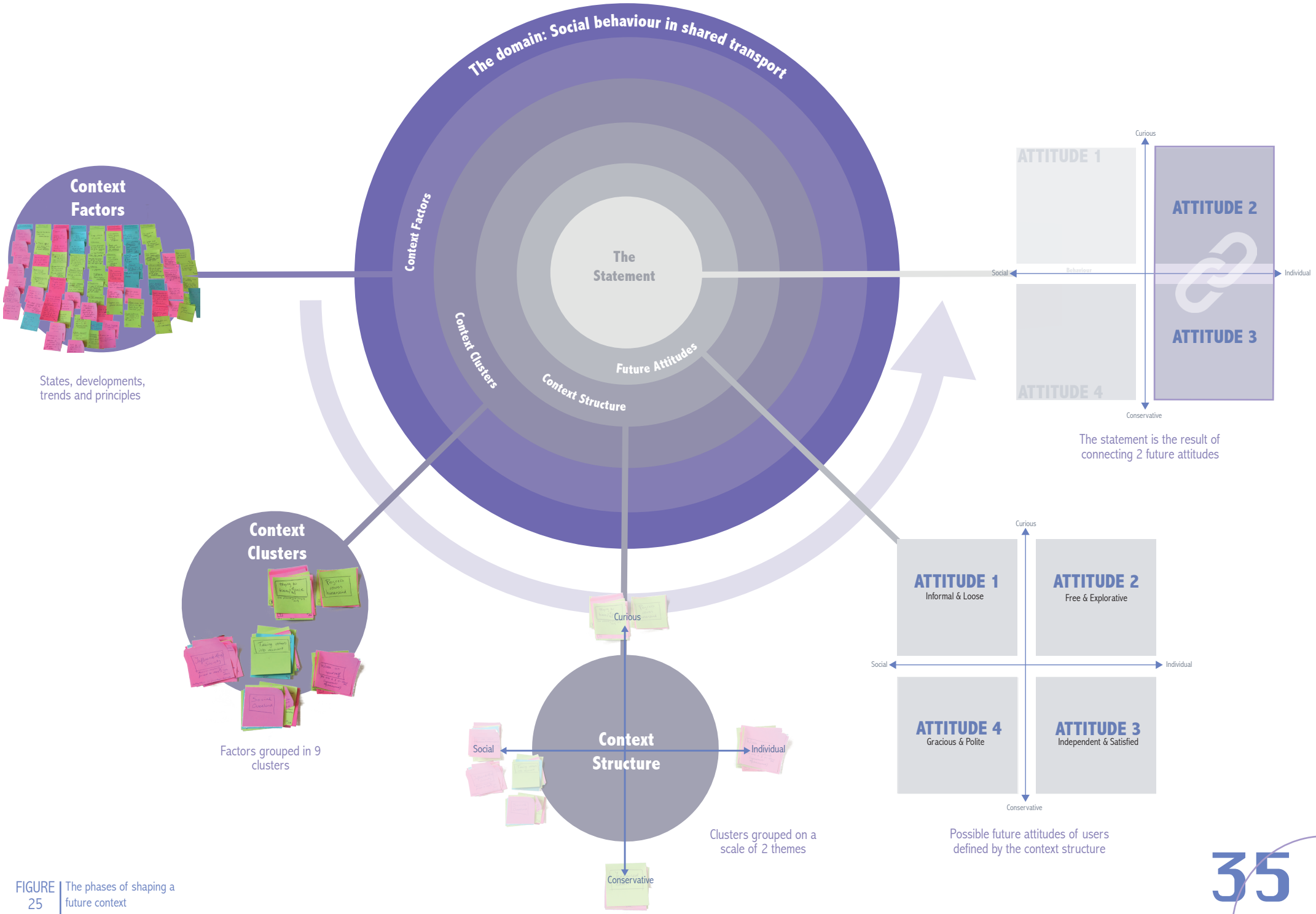



FIGURE 25 | The phases of shaping a future context

# 3.1.2. Clusters

## Enabling a creative design space

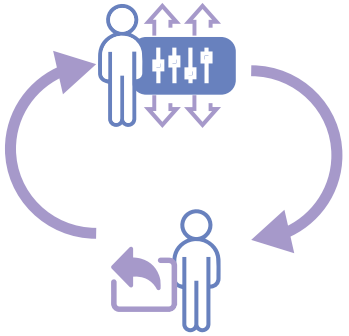
Every cluster enfolds a number of factors. Factors are meant to build an inspiring future context in order to enable a creative design space. Therefore not all of them are based on proven facts. They can be based on all kinds of sources: people's beliefs, current trends or even observations. The list of factors that relate to each cluster can be found in Appendix E.

The correlation between multiple factors can be obvious because of their corresponding subjects, but it does not have to be the case. Categorizing factors in less obvious clusters results in interesting and possible inspiring directions for the future context. In this chapter the clusters are explained in such a way that it can be used to construct a possible future world (the context structure).

### All-round communication

A spoken language can be extended by visual expressions and/or metaphors, but a message can also stand on alternative (visual) expressions alone. A gesture, a facial expression or even an art display can communicate on itself; this can become an important communicative tool between different cultures.

### Influenc(ed)(ing) Society



We influence others, and others influence us in our daily decisions: we creatively share, monitor & adapt. It is an instinctive reaction to imitate choices of others and to be guided by the majority opinion of people in the direct surrounding. Similarities in beliefs in combination with metaphors and/or visuals could be a solid base for persuasion.

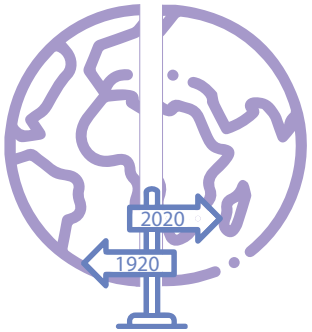
### Taking others into account

Being aware of people around us becomes more important: The population keeps on growing and the future lies in sharing homes, products and transport. Many transport-types remain unchanged, although it is used by a rising amount of people; forcing them to be flexible and adapt to each other's individual preferences.

### Trying to keep up the pace

Within the same amount of time as people had before, more has to happen. On the one hand high speed technological development makes this possible, on the other hand we are limited by our physical capabilities. This forces people to live at greater speeds, to start multitasking and to adapt to the fast changing society/technology.

## Best of both worlds
(Nostalgia for the old <-> curiosity to the new)

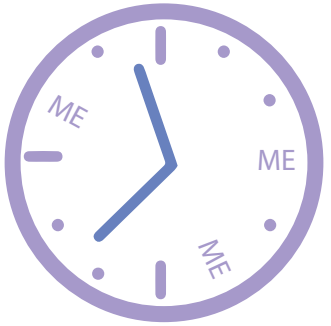



On the one hand people are hesitant about the unknown (that what is yet to come) and cherish the nostalgic ambience of traditions, experiences and of vintage products. On the other hand there is curiosity to new (technological) products and experiences. But when maintaining a 'Multi-life' there is no clear segregation in preference but rather an interest in best of both worlds (eras).

## Social overload

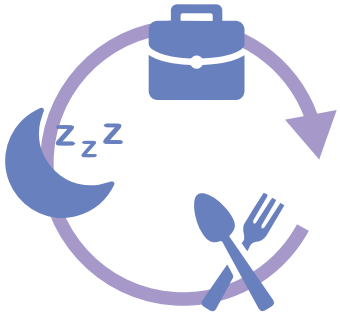
How people share an behave amongst each other originates in early humans, but this type of sharing evolves through time because of upcoming sharing-services and products. How people deal with these kind of new products and services is something mankind needs to adapt to. This asks for a new distribution between social- and private-moments and the (social) behaviour that fits these moments.

## Work on yourself
(you are n.1)



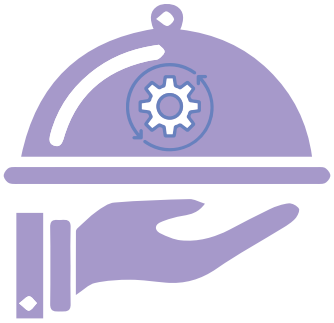

Developing yourself and your skills by scheduling personal time can be a time consuming practice. Mindfulness can be a tool for this self-enhancement. The search for freedom and personal control are related to these practices: it could be a means for self-expression and to be able to explore individual preferences (like when choosing a fitting type of transport).

## Ingrained habits



Out of tradition a lot has been defined, and people feel comfortable with the known. How it was done before, can still be done in the same way now. The way that people travel is influenced by money and habits: for instance higher income groups more often travel by car than lower income groups. For these higher income groups it might be hard to get used to sharing transport with strangers since it doesn't fit their routine and status.

## Progress serves humankind



Designing, discovering, doing research: Developing keeps us busy. This development could be inspired on advanced technology or on ancient biological phenomenons. Developments and designs can shine a light on science and result in economic growth (and so can contribute to job creation). In short, it's a chicken and egg situation: humans keep on developing and developments drive and inspire them to keep on going.

# 3.1.3. The context structure

## Themes

The relationship between clusters are the drivers for the context structure (figure 26). This relation unites the clusters in 2 themes:

- The behaviour (amongst travellers)
- The response to the continuous (technological) developments of the world.

The drivers for the context structure are slightly contradicting. The theme "behaviour (amongst travellers)" consists of a social and a individual driver, to which people could relate to. The theme "response to the (technological) developments of the world" consists of a conservative- and curious driver. People (in this case passengers) could relate to these drivers. For instance when a passenger relates to the conservative driver, one could be very comfortable with the known or does something out of tradition, without the need to change something just because it is made possible by technological developments.

How people could relate to both themes at the same time is described by attitude-types.

## Attitude-types

The attitude-types related to a curious response towards (technological) developments are attitude 1 & 2. These attitudes differ in the matter of behaviour amongst travellers (figure 26). While attitude-type 1 relates to the social side, attitude 2 relates to a more individual kind of behaviour.

**Attitude 1 : informal & Loose**
Interact out of real interest. Sometimes distracted by amount of stimulus.

**Attitude 2 : Free & Exploratory**
Always in search for opportunities, but will never be influenced by group pressure.

The attitude-types related to a more conservative way of looking at (technical) developments are attitude 3 & 4. These attitudes also differ in their behaviour amongst travellers: attitude-type 3 relates to the individual-oriented side, where attitude-type 4 relates to the more social-oriented travellers:

**Attitude 3: Independent & Satisfied**
Voluntarily excludes his-or herself to be able to maintain sentimental thoughts.

**Attitude 4: Gracious & Polite**
Values old-school manners, but keeps up with time in his/her own way.

The challenge of the design lies in connecting all passengers of the Seabubble who relate to individual attitude-types. This challenge is formulated in the statement in chapter 3.1.4.

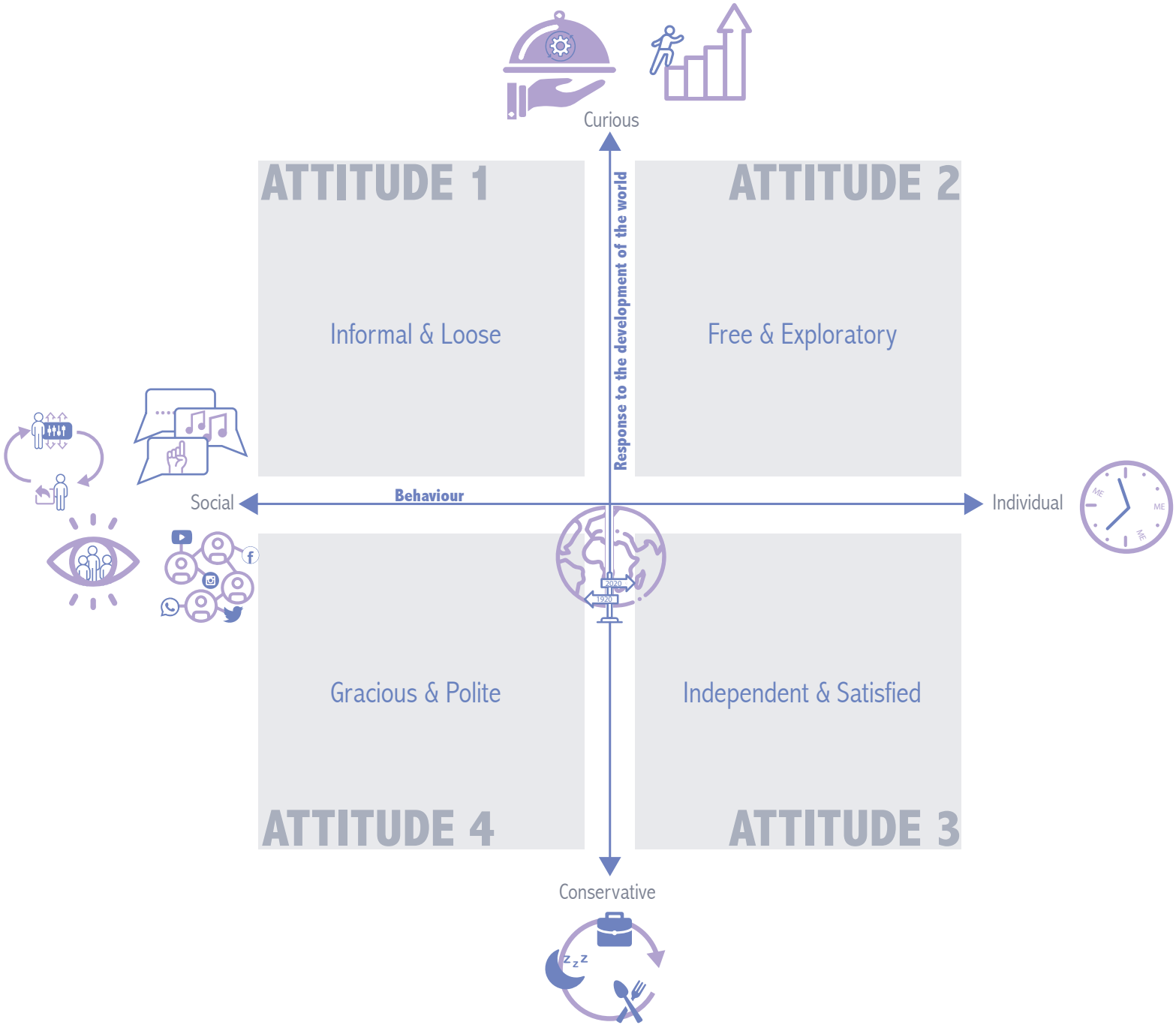



FIGURE 26 | The context structure: how the clusters and attitudes relate

# 3.1.4. The statement

**"The Seabubble needs to be a place to connect individual-oriented passengers with divergent preferences in a spontaneous way"**

The desired function of the design for the Seabubble within the domain "socially shared travelling" is formulated by a statement.

The VIP-method advices to focus the statement on one attitude-type, but in this specific case it seems more useful to choose two. This decision relates to the fact that someone's behaviour could strongly effect someone else's behaviour and in addition that people's mood could influence how they process and perceive other's attitude (explained in chapter 2.1.3). So next to the fact that not every traveller could relate to one type of attitude, people (and so their attitudes) effect each other: meaning it is a more realistic choice to relate the statement to two type of attitudes (figure 27).

The statement consists of three interesting components: (1) connecting individual-oriented passengers with (2) divergent preferences in (3) a spontaneous way. These three components all derived from the context structure; the relation between the components and the context structure is explained below.

(1) connecting individual-oriented passengers

Both attitude 2 and 3 relate to individual (social) behaviour. Stimulating interaction amongst passengers that relate to these types of attitudes might be the biggest challenge, because they are not characterized as social passengers. However, when it succeeds to connect the individual-oriented passengers, the passengers relating to the other half of the context structure (the social-oriented passengers) might be covered as well.

(2) divergent preferences

Passengers relating to either attitude 2 or 3 differ in their response to the development of the world. Attitude 2 describes a more curious position towards (technological) developments, although attitude 3 describes a more conservative position in which it is seen as something comfortable when things remain the same as they have been. It should be taken into account that both types of passengers will use the (technologically progressive) Seabubble, although some of them might react somewhat reserved towards the way of travelling and the tools that are needed for this progressive technology.

(3) a spontaneous way

Since it is not in nature of the individual-oriented passenger's to start a social interaction whilst travelling, the passengers need some form of intrinsic motivation to start an interaction. When the interaction feels spontaneous, the passengers might not feel consciously occupied by it. When this unconscious, spontaneous feeling is induced, passengers might not feel obligated or forced but it would rather feel as if the interaction came naturally.

The desired spontaneous feel of the interaction is clarified by an Interaction Vision (also known as an analogy), which is explained in chapter 3.2.

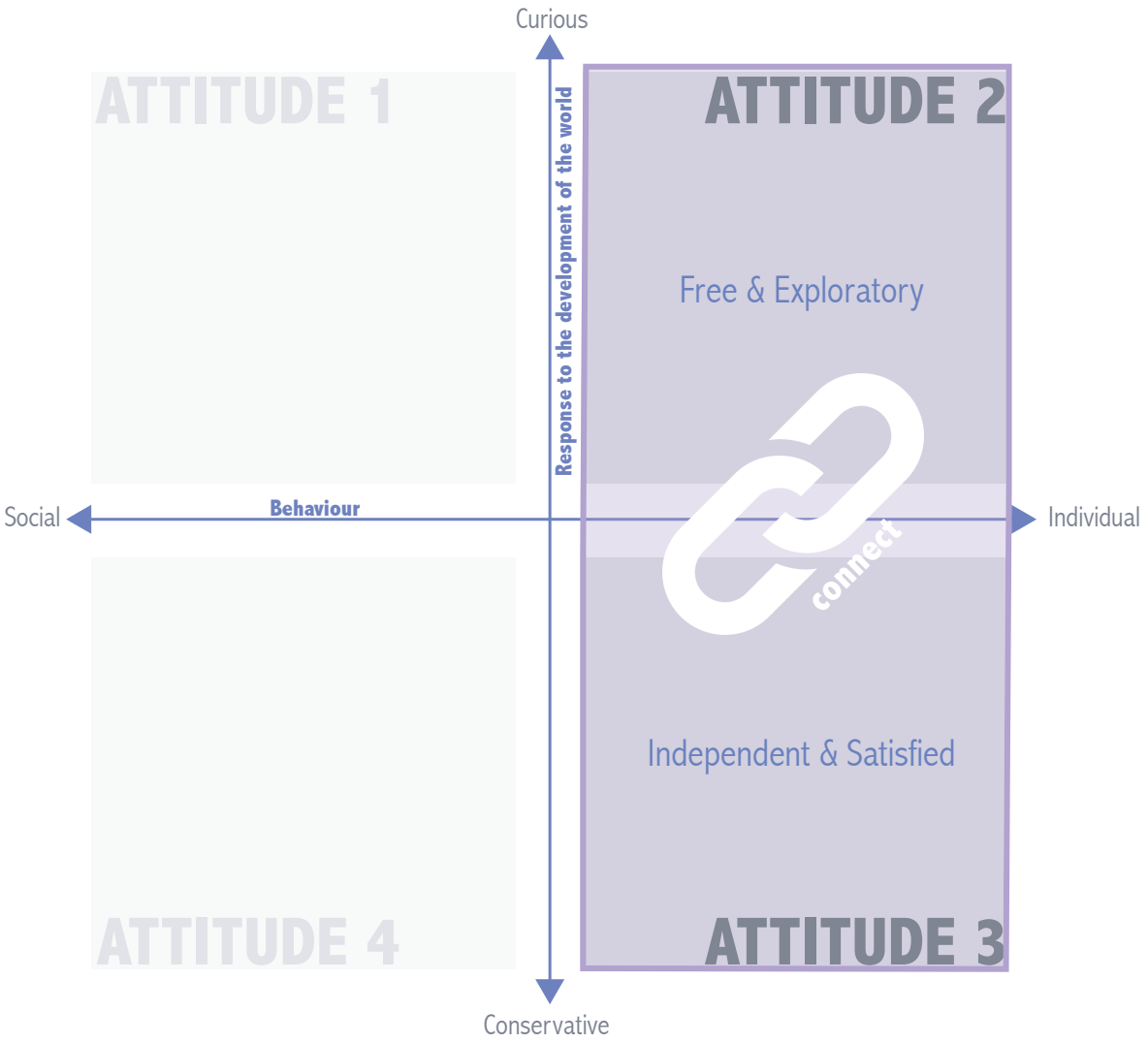



FIGURE 27 | The attitudes of interest in relation to the Statement

# 3.2 Vision

The small size of the cabin of the Seabubble (lxwxh: 3.57x1.69x1.43m, Appendix 6) makes it almost inevitable to have some sort of social interaction, which is quite the challenge for most travellers, since most travellers do not describe themselves as social travellers during shared transport (proven in chapter 2.1.2).

Assuming that some sort of interaction will take place because of the limited size of the cabin; the (presumable) interaction needs to feel comfortable in order to let passengers choose for this type of transport on a frequent base.
A spontaneous type of interaction comes without a lot of rules or expectations since it is not planned or obligatory, it is rather an instinctive and casual interaction. This kind of interaction could let neighbours (who are not familiar with each other) feel more comfortable when sharing the small space of the Seabubble.

To get a better understanding of what characterizes a spontaneous interaction, the interaction is specified by 3 qualities: *Flexible*, *intuitive* and *creative*. This spontaneous interaction needs to be provided by the design. If the design is succeeded, the passengers would be able to characterise the interaction with these qualities.

A helpful tool for designing for interactions, is to translate the desired interaction into an analogy (also known as an *interaction vision*; explained in chapter 1.2.3, figure 12). The desired interaction is described by the following analogy: The tension of confidence and doubt during **improvisation** (figure 28).

This characterization of improvisation is derived from an interview with an improvisation-actor (refer to appendix F for the interview). Therefore the analogy of improvisation is based on the experience of acting in improvisation theatre.
*Doubt* during improvisation is the result of 2 factors: the response(s) of the other actor(s) and the insecurity of (both) actors in reaching the actual core of the theme. *Confidence* also relates to 2 factors: a fixed group of actors gives confidence in each other, (resulting in a more relaxed vibe before entering the stage)and the confidence when getting the feeling that you reached to the core of the theme together.

The tension between confidence and doubt is what makes improvisation so spontaneous, although there could be some kind of rule-set (like the restriction of a theme, or like an obligation to talk in rhyme).
During the desired interaction in the Seabubble this set of rules could be set by the design (for instance the way of interacting).

The qualities that the product itself should characterize to be able to provoke such an interaction, are called *product qualities*, these qualities are: *unfixed*, *accessible* and *surprising*.

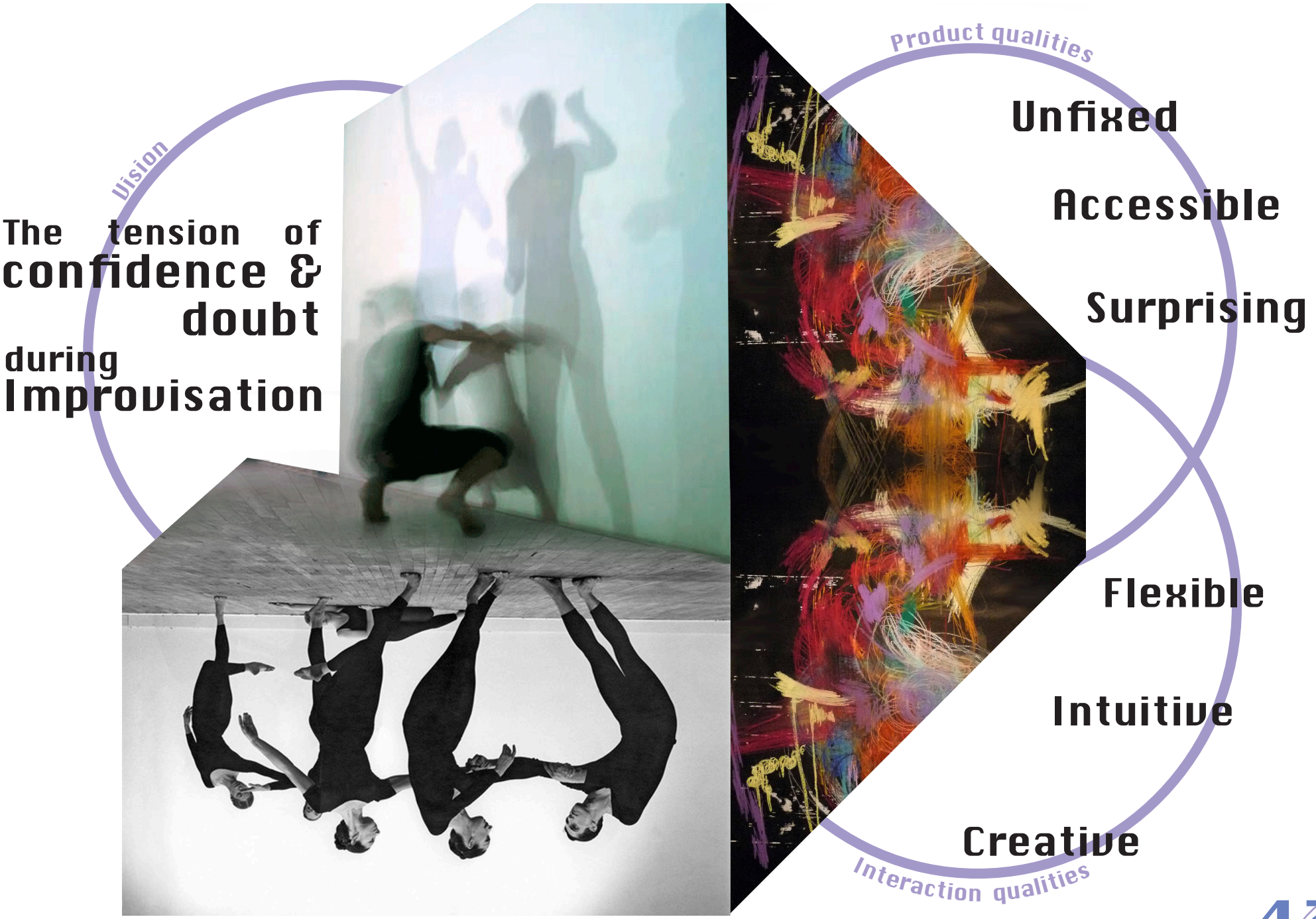



FIGURE 28 | Visualization of the interaction vision

# Take aways

# Design foundation
## Restrictions, possibilities & goals

The design foundation is being set by a clear formulation of the contribution of the design and the context in which it will operate. A lot of possibilities for a design for the Seabubble that would not be possible in other vehicles, are provided by the Hydrofoil technology. This technology provides a silent and stable journey. How to deal with these possibilities is formulated by a statement. Furthermore, restrictions and possibilities of shared transport is listed below to be taken into account during the design process.

### Statement & Vision

The challenge is set by the statement: **"The Seabubble needs to be a place to connect individual-oriented passengers with divergent preferences in a spontaneous way"**. These passengers differ in their opinion towards technological development, in which some of them show a conservative attitude and others a curious attitude towards technological developments. The desired spontaneous interaction is characterized as **flexible, intuitive and creative**. This interaction shows resemblance with the character of improvisation. The tension of confidence and doubt during improvisation is used as an analogy for the spontaneous interaction between (unfamiliar) passengers. This leads to the following the product qualities: **unfixed, accessible and surprising.** The analogy is referred to as the interaction vision.

### Possibilities & Restrictions

The possibilities and restrictions of shared transport, and more specifically, of the Seabubble are analysed by literature research, a survey and multiple interviews. The most important ones to take into account during the design process are listed below.

#### Community sharing

The Seabubble will be used by people living in the neighbourhoods of Haven-Stad. The Seabubble will provide daily transport over water-ways to connect the neighbourhoods to other types of transport that are bounded to rails, roads or other fixed networks.

#### Time interval

Taken into account the current waterway-regulations, people would be travelling by Seabubble for 3 to 10 minutes. The design should be adapted to this limited time, therefore the design needs to be self-explanatory and easily accessible for passengers (a low threshold).

#### Space limitation

The design is limited to the amount of free space. It is restricted to 6m$^2$ surface and a maximum headroom of 1.43m. Furthermore, in this compact setting, passenger's interpersonal distance needs to be taking into account to let them feel comfortable in a social setting.

#### Mood influences mood

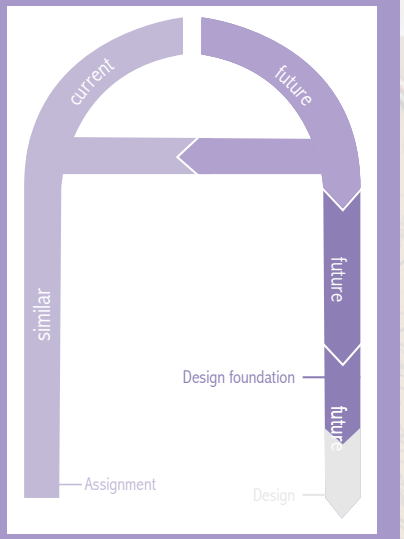
Passengers' social behaviour is influenced by other's attitude and mood (chapter 2.1.3, figure 20). The majority of the respondents of the survey pointed out that their social behaviour during shared travelling is either "neutral but polite" or "closed", "distant", "anonymous", "isolated" or even "ignoring" (chapter 2.1.3, figure 21). It is important to take into account that these attitudes could reflect on others and that the design needs to appeal these closed and/or isolated-type of passengers.

# 4. Design

# 4.1 Ideation

## Intro

In the ideation-phase, the focus shifts from the contribution of the design towards the design itself. Parts of the design foundation are explored by multiple creative methods during a creative session. A couple of ideas that resulted form this session are tested. The results of the tests give insights into how to stimulate the desired interaction amongst passengers. Therefore the insights are summarized into guidelines for the final design.




## 4.1.1 Creative Session

The creative session functioned as a first exploration of the domain within its context. By letting others explore the domain, the interaction vision and (part of) the statement; personal views on the topic come to light. These insights led to inspiration for the further ideation process.

The creative session counted 8 participants with various backgrounds. The session counted 6 different stages and it lasted 3 hours in total.

After a short introduction of the Seabubble (the size, the context of use and its function), the session started with a loosen-up exercise. Thereafter several exercises provided guidance and stimulus in the creative thinking- and visualization-process. All the ideas are documented using templates (Refer to appendix G) .

A detailed description of the stages of the creative session is given on the following page.

## Creative Session Structure

### Loosen up & Introduce

To get acquainted with one another, all the participants chose a template and personalized it into a symbol. The symbol had to be linked to their (parts of their) personality. It was used to introduce themselves and to get comfortable with their drawing skills.

### Purge

The Purge stage is focussed on getting the obvious and expected options off the table (Heijne & van der Meer, 2019). After introducing the domain "*socially shared travelling*", all the participants simultaneously wrote their first associations, within the theme, on post-its (Appendix G1). This lasted for a couple of minutes. Subsequently the results of the purge are used to generate ideas in the "reversal technique"- stage.

### Brainstorm

The group is split into two and is seated on two ends of the table. In the middle of the table is a big piece of paper with 2 themes: '*improvisation*' (linked to the interaction vision) & '*making a connection*' (linked to the statement). The participants were asked to write down their associations within the theme in front of them. They build on the first 8 associations that they produced (swapping groups twice), by doing this they created a lotus flower full off associations (Tatsuno, 1990) (Appendix G2). Subsequently the participants made groups of two and had to choose 2 subject from the lotus flower-associations. The participants were asked to ideate within the domain (*socially shared travelling*). Templates helped the participants to document the ideas (Appendix G3). After presenting the ideas to all the participants, the ideas were handed over to another group, this group note down their follow-up ideas.

### Reversal Technique

Two or more post-its from the purge session were chosen by each duo. They reversed the association of the post-its (Michalko, 2006) and needed to ask themselves the question: *"How can this still work in a design when linking it to socially shared travelling?"*. The teams used the same template to draw & note down their ideas. After presenting them, it was passed on once more to give the possibility to share follow-up ideas (Appendix G4).

The ideas are a source of inspiration for the Minimal Viable Products.

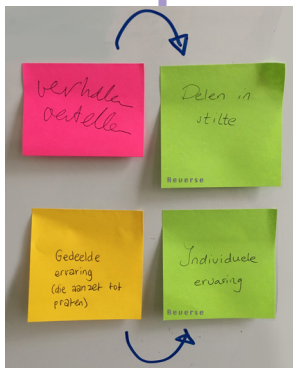
**Loosen up & Introduce**
(Personal logo)

**Purge**

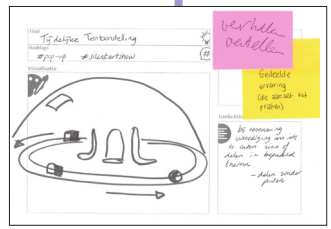

**Brainstorm**
(Flower Association)

**Ideation**
(Using a template)


**Reversal technique**
(using the outcome of the Purge)




**Ideation**
(Using a template)



# 4.1.2 MVP-testing

### Intro

The outcome of the creative session gave the inspiration for three Minimal Viable Products (MVPs). These MVPs are low fidelity prototypes which primarily serve as a means of testing in what degree certain insights/ideas stimulate social contact.

Prompting social interaction amongst strangers via external stimuli is a concept called *Triangulation* (Whyte, 1980); these stimuli could be physical objects, street views or sculptures. It could link people and bring them together. The occurrence of extraordinary events (unplanned situations or disruptions) could stimulate interaction too (Simões Aelbrecht, 2016). The MVPs serve as a medium to test these kind of stimuli. By repeating the process of MVP-testing (figure 29) several times, the effect of different stimuli is analysed.

A general introduction and overview of all the MVP-tests is shown, followed up by a detailed explanation of every single test.

### Set-up

Every MVP-test is conducted with 2 or more participants at a time. The function of the tests is presented by several research questions. It is not shared with the participants that the focus lies on stimulating interaction, instead there is a only a brief explanation of the test set-up. During the test, the participants are being observed and afterwards they fill in a short survey. The survey contains a couple of general questions about the just gained experience plus to what extent the experience relates to the interaction qualities (Appendix H). An overview and introduction of the MVPs is given on page 51, thereafter the tests are individually explained.

### Outcome

The results of every MVP-test do not only lead to ideas for follow-up MVP-tests, they give direction towards reaching the final goal (*connecting individual-oriented passengers with divergent preferences in a spontaneous way).* Therefore the results are formulated as guidelines, meant to instruct during the further design process (figure 29).

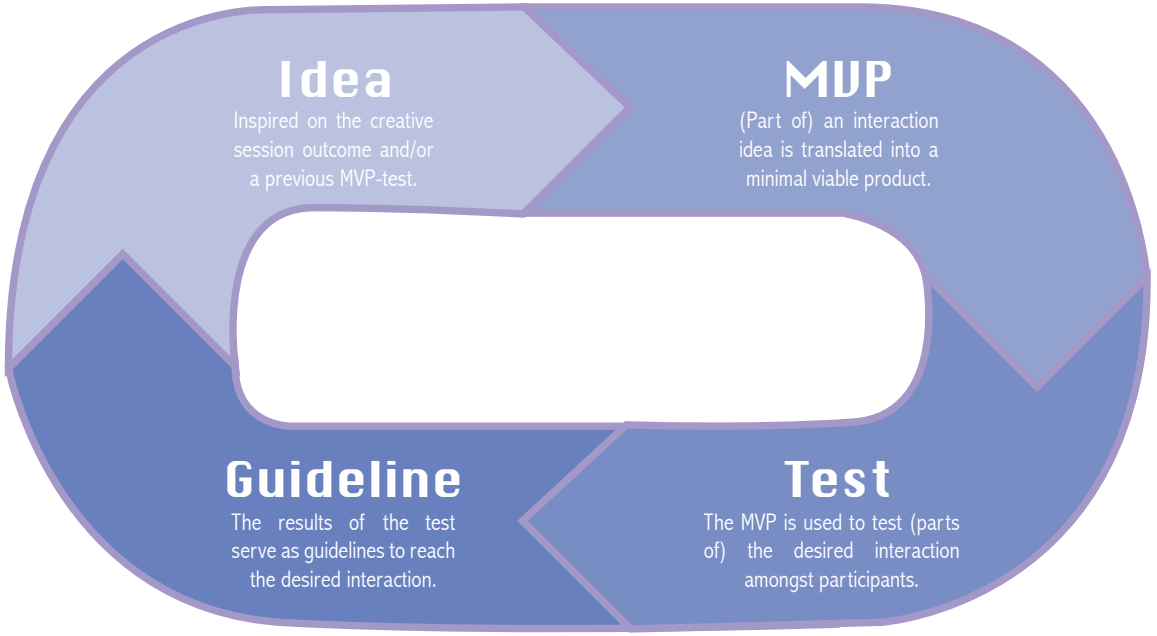
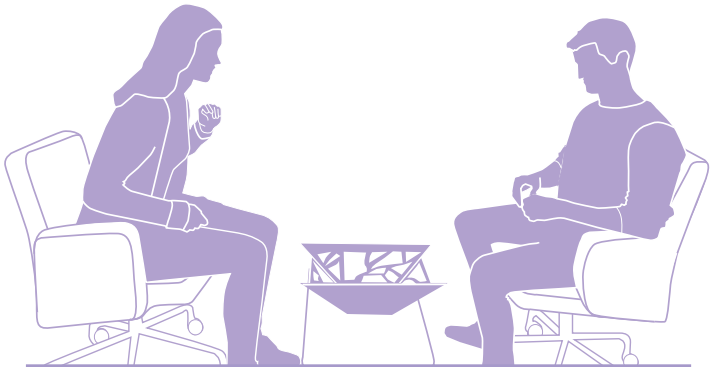


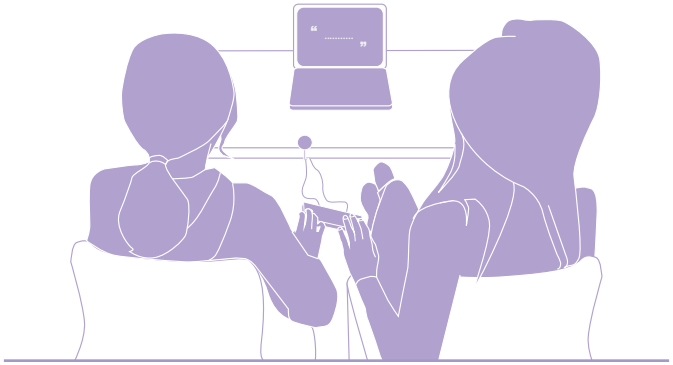

FIGURE 29 | The MVP-test cycle



## MVP TEST #1
### Stimulating interaction by:
### unintentional eye-contact

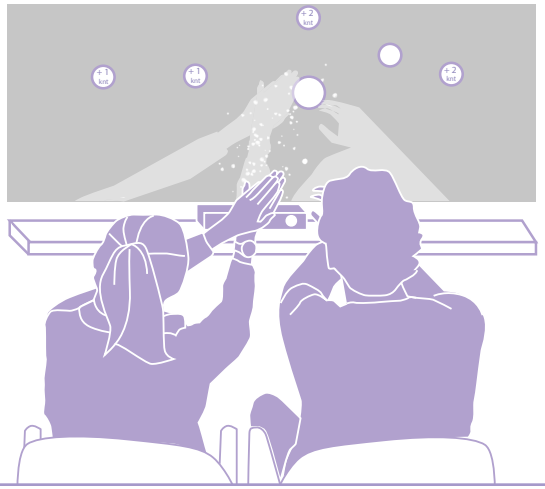
One of the ideas from the creative session is the *VisionMission*: sharing each other's field of vision by projecting it onto the window (Appendix G3). Others will get a peak of what attracted a person's attention and so people can discover each other's interests and might be triggered to reach out to each other.

The *VisionMission* raised the question if solely catching each other's eye would already be enough trigger for further interaction (and a feeling of making contact). Therefore the first MVP-test is focussed on *stimulating interaction by unintentional eye-contact*. The test is explained at page 52 and 53.



## MVP TEST #2
### Stimulating interaction by:
### Silently discovering similarities

The indirect way of making contact like in the first test was seen as quite comfortable. The second test focusses on a even more indirect way of contact: the participants do not face each other and communicate through the MVP. By having the MVP as a communicative facilitator, the participants are able to *silently discover similarities.* The test is explained at page 54 and 55.



## MVP TEST #3
### Stimulating interaction by:
### Team-up influence

While during test 2 the participants had to deal with little feedback of their actions, a more visual and direct way of feedback was given to the participants during test 3. Test 3 is inspired on the *Bye Bye Bubble* idea, which is another result of the creative session; it is a multi-player game in which travellers can reach a high-score by reaching for projected bubbles with one another (Appendix G3).

In MVP-test 3 this high-score is directly linked to the speed of the cabin. In contrast with the other MVPs; this MVP has a very playful character with a clear (functional) goal. The test is explained at page 56 and 57.

# TEST #1
## Stimulating interaction by: unintentional eye-contact

### Research Questions

- Is unintentional eye contact a stimulus fur further interaction?

- Does contact by surprise make people feel more comfortable with the presence of others?

## Set-up

For each test, 2 participants were asked to sit across from each other with the prototype in between them (shown in figure 30).

Four LED's (placed inbetween mirrors, figure 31) flickered in turns during the test to attract attention towards different angles of the MVP and to stimulate participants to move around.

The participants were asked to change their angle of vision by:
1. Moving forward an backward while sitting down.
2. Moving their heads and bodies sideways
3. Standing up and walk in half circles around the object.

After the test was conducted, the participants answered questions relating to their personal experience. Furthermore, 3 scales were provided in which participants could rate the interaction regarding to the interaction qualities (flexibility, intuitiveness and inviting to creativity).

## Results

### Contact

The majority of the participants experienced a form of contact with each other, but very minimal and/ or rapidly.

### Focus

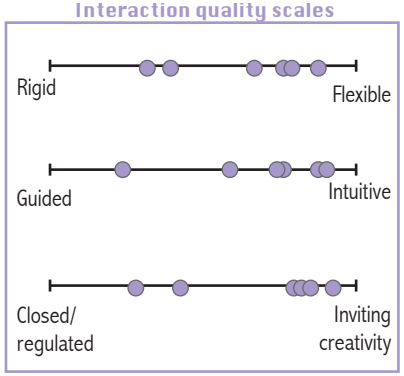
The main focus of the participants was to discover how to find each other's sight in the object, in which all of them showed a very active attitude. One of the participants interpret the test as "discovering something together".

The MVP led the attention away of direct interaction between the participants. This resulted in a relaxed atmosphere in which the participants seemed to be comfortable. In some cases, when the participants crossed each other view of sight; verbal interaction was stimulated. Refer to appendix H1 for the question-sheets, in which the participants explained their personal experience.

### Qualities

The *interaction quality scales* provide an insight in how the participants experienced the interaction in relation to the interaction vision. The scales show a divergent experience, although the majority of the participants seemed to trend towards the desired interaction qualities (shown on the right side of the scales).

Interaction quality scales



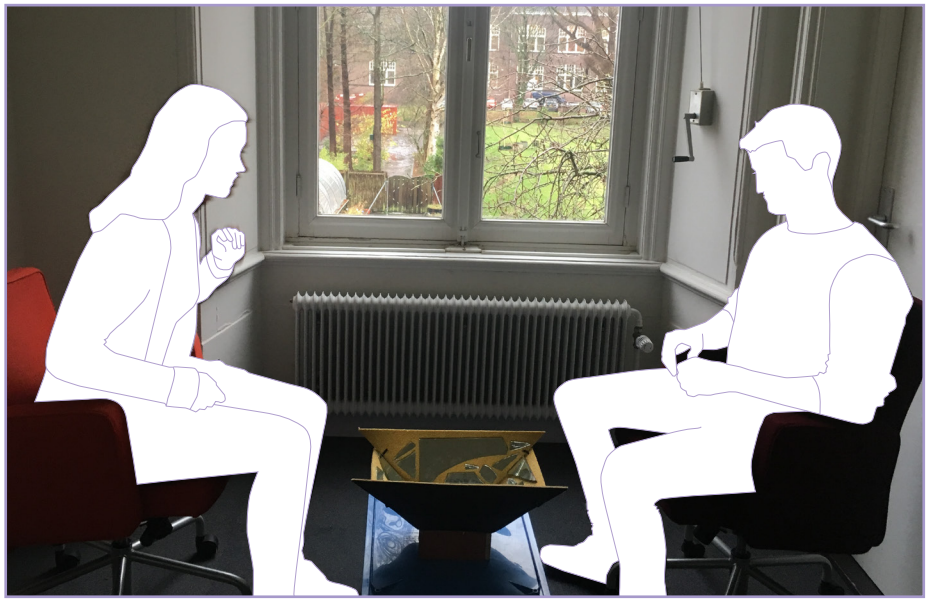



FIGURE 30 | Test-setup of MVP 1

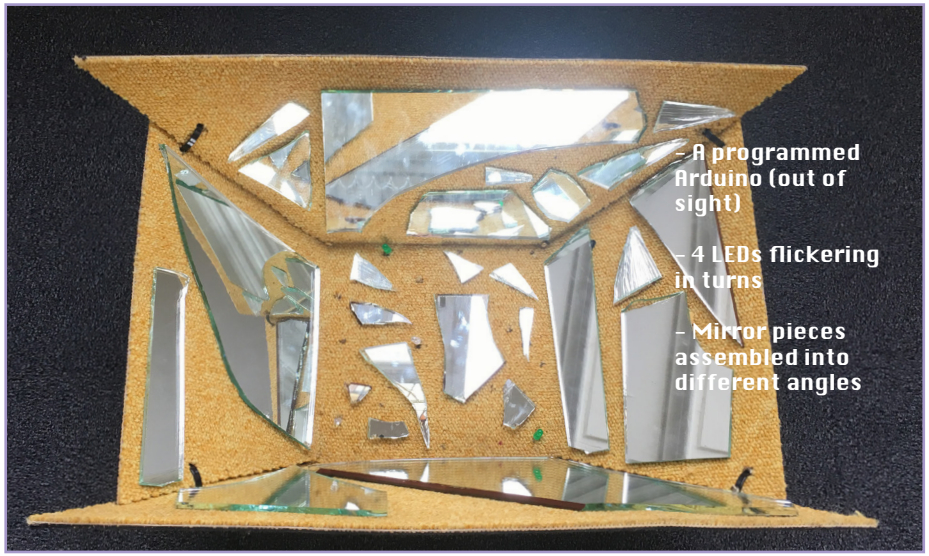



FIGURE 31 | Components of MVP 1

> *It felt as if we were discovering something together*
>
> - Jelmer K. (25) -

> *The contact was stimulated by the surprise in looking at the mirror in different positions.*
>
> - Aliene (56) -

## Conclusion

In this case, unintentional eye contact is not enough stimulus for everyone for further interaction, but because the focus shifted more into a challenge of consciously finding each others sight, it can hardly be called unintentional eye contact. Furthermore, the participants had to put in a lot of effort to get into contact, which made it more of a game than a natural interaction (the interaction is described as "A search" and "uneasy).

It seemed that discovering something together (and both not knowing what was coming) was a bonding activity (the interaction is described as "mysterious" and "sometimes"),

The interaction did not make all the participants feel more comfortable with the presence of each other, but it was mentioned that the test-object made the interaction less direct; making the interaction a bit more comfortable (in relation to direct interaction).

Also, some of the participants were mainly occupied with trying to find some sort of interaction instead of how it made them feel.

**Guidelines:**

- The interaction needs to be stimulated in a natural way, with the object as a facilitator for interaction amongst passengers, without attracting too much attention.

- A form of indirect contact (the contact through the mirrors) can be used for an easy (almost anonymous) interaction kick-off.

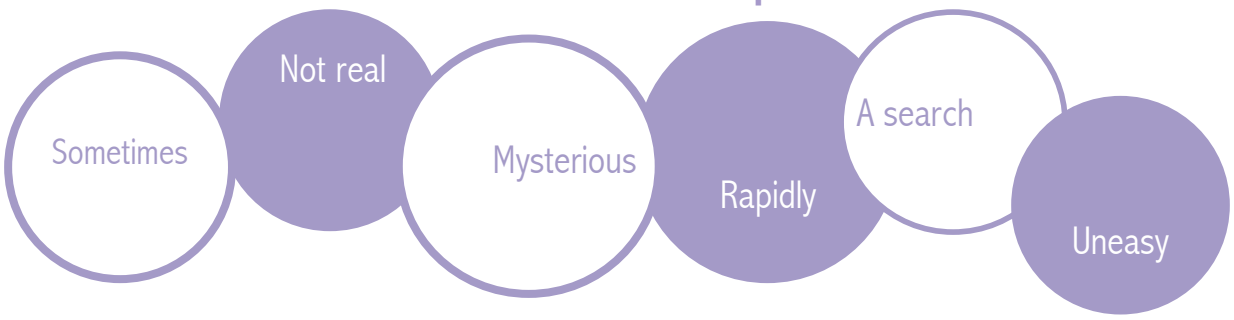
- The interaction should not become too much of a challenge (the actual function gets lost).

- The 'facilitator' for interaction should not be too static: it will translate into a static interaction.

> *It's not 'real' eye-contact, but through a mirror. So less direct and therefore more comfortable.*
>
> - Sophie (25) -

> *It could stimulate a verbal reaction, "Hey I can see you!"*
>
> - Elke (39) -

## Interaction description



MVP

# TEST #2
## Stimulating interaction by:
## Silently discovering similarities

### Research Questions

- Do people feel less timidity in undertaking social interaction when they already discovered consensus of opinion in a non-verbal way?

- Do people feel a certain connection translated by the Led-light?

### Set-up

For each test, 2 participants were asked to sit next to each other while holding a button on their armrest. In front of them a ball (including a light inside) and a screen was set up (shown in figure 32 & 33).

The participants were subjected to a range of statements; if they would agree with the statement they needed to press the button on their armrest. When only one of them would press their (personal) button, the ball would not light up. But if they would both press their button, the ball would light up.

By being exposed to several statements, the participants could discover what they have in common, without verbal contact.

### Results

#### Contact

Some participants felt some sort of a connection by the clicking sound of the button. If only one of the participants pressed the button it had an effect on the other participant; it awakened curiosity or it provoked a moment of reflection of one's own opinion.

Undertaking something simultaneously (Focussing and reading the same statements / both agreeing and pushing the button) is also seen as a way of connecting. The glowing of the light was seen as a literal connection by agreeing with each other, although not everyone noticed the light.

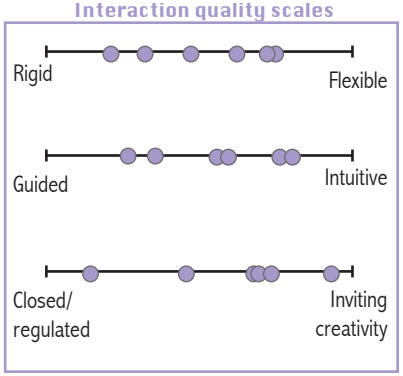
Although the test did not stimulate any further interaction between the participants, most of them said that the test made them feel more comfortable with the presence of each other.

Refer to appendix H2 for the question-sheets in which the participants described their personal experience.

#### Qualities

The participants experienced the interaction in various ways. The *interaction quality scales* show a very diverse opinion in relation to the interaction qualities. This could relate to the fact that the participants did not had a lot of interaction with each other and so most are personal experiences, not shared ones.

Interaction quality scales



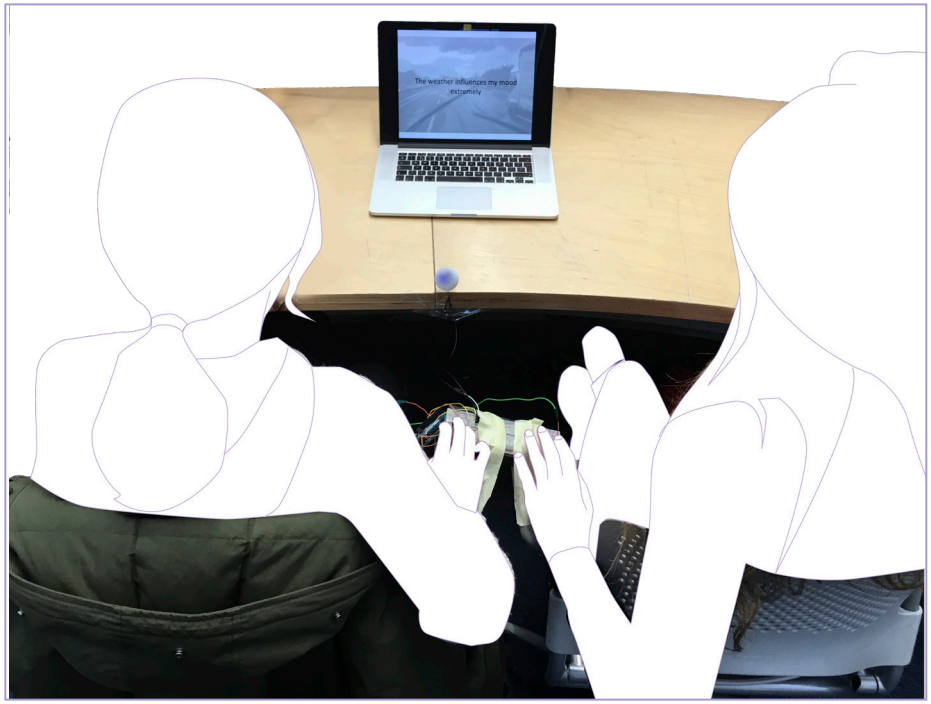



FIGURE 32 | Test set-up of MVP 2

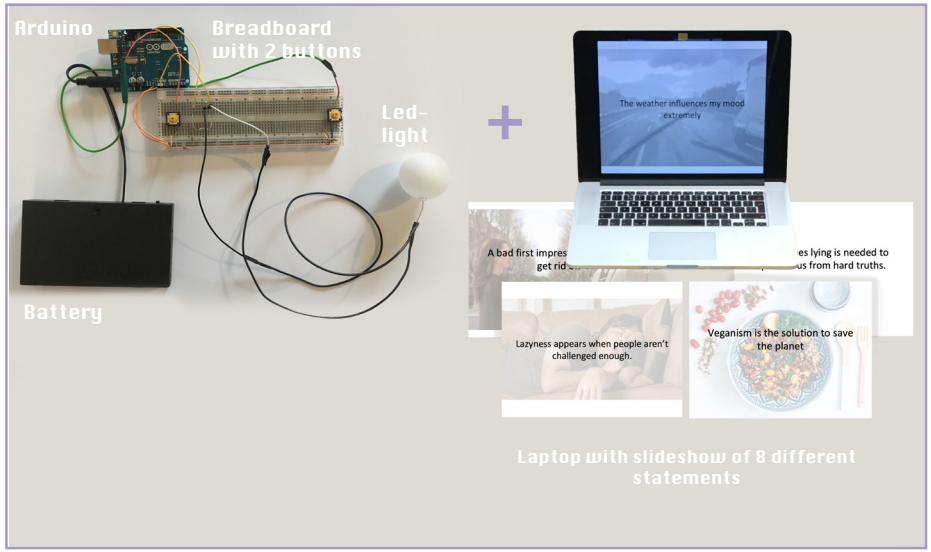



FIGURE 33 | Components of MVP 2

> *It made you think about the question again if the other person had another opinion.*
>
> - Beau (20) -

> *I noticed the blue light popped up when we "agreed" on something, which implied some form of connection.*
>
> - Rahul (20) -

## Conclusion

The sound when clicking the button seemed to have a bigger impact than the light when the participants agreed on a certain subject. The sound had as a result that people started to reflect on their own opinion or became curious about other's opinion. Unfortunately this did nog trigger enough to actually start sharing their personal reflections/thoughts. The way the participants described the interaction ("*a realization moment*", "*makes you think again*" and "*closed*") emphasizes the fact that it was perceived as an individual experience.

Something to follow up the action of clicking (and so hearing the sound) so people would be able to show their interest, would be an interesting addition to the test. Additionally the interaction did not fit all the interaction qualities, this could be the result of the diverging personal understanding of the statements or because of the lack of sharing-possibilities/feedback moments. Giving people the idea that they are influencing something simultaneously, might give the 'connected' feeling towards each other.

**Guidelines:**

- When there is too much "info" (related to one's opinion) left out in the open, people seem to feel held back in undertaking interaction.

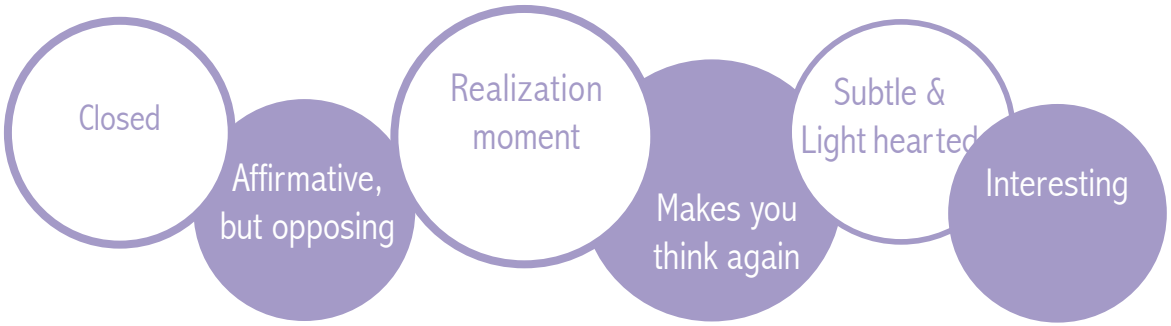
- A combination of successive stimuli might give people the space/trigger for further interaction.

- The feedback should be given in a notable, but subtle way (the light was too subtle). It should not be distracting, yet it needs to be able to pull people out of their thoughts.

> *I sometimes felt it when she pressed the button and I was curious what she would do, but I did not feel in contact*
>
> - Romy (23) -

> *It was a "realisation moment" with some of the statements: he agrees, but I don't.. why?*
>
> - Lydia (19) -

## Interaction description



# TEST #3
## Stimulating interaction by:
## Team-up influence

**Research Questions**

- Do people feel connected towards each other by influencing a significant factor of their journey?

- Does the MVP trigger people to join in, and interact, with the projected control-system and each other?

## Set-up

Two participants at a time were asked to get seated next to each other within a metre of a screen-projection (figure 34). While they were getting seated, they were asked to imagine themselves in the following scenario:

" *You will get into a cabin for approximately 5 minutes with people you do not know very well. Since you will take this journey several times a week, you might run into the same people sometimes. The cabin moves autonomously, but you could control it by influencing the projection. Try to behave like you normally do when you take a journey of a couple of minutes.* "

The participants could influence the speed of the cabin by moving parts of their body in front of a Kinect (a camera detecting movement), this Kinect sends the movement to a program on the computer and shows a projection of the detected elements. It is programmed that the centre of gravity of all the detected elements is projected by a purple dot. By placing the purple dot on one of the "speed"-dots, the participants thought they could influence the speed of the cabin.

Afterwards the participants were asked to fill in a questionnaire (with the same format as the previous tests: Appendix H3).

## Results

### Contact

Half of the participants mentioned that the feeling of contact was the result of figuring out how it works and if it works better when working together. Another connecting element was the feeling of uncertainty: how the situation would develop and wondering what the effect of their actions would be. The fact that they had to put in a bit of effort (by reaching for the "speed"-bubbles) also gave a feeling of connecting to each other. Everyone was triggered to join in, some watched the other one, but after a while they would also join in. Furthermore, all of the participants discussed during or after the interaction about their experience.

### The presence of others

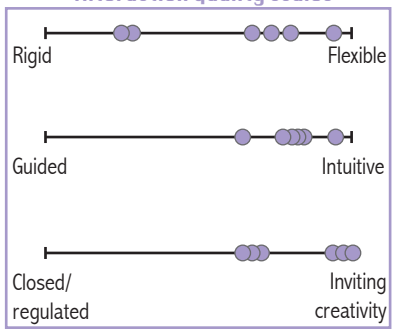
Everyone felt more comfortable with the presence of the other participant because of the interaction with the projection. The most mentioned reasons were that the projection:

- Broke the ice
- Gave something to talk about
- Gave a sense of control
- Took over the interaction and made it feel as if it was not happening in "real-life".

### Qualities

The interaction quality scales below show divergent experiences in relation to flexibility. Nonetheless, the majority of the participants experienced the interaction as intuitive and inviting to creativity.

**Interaction quality scales**



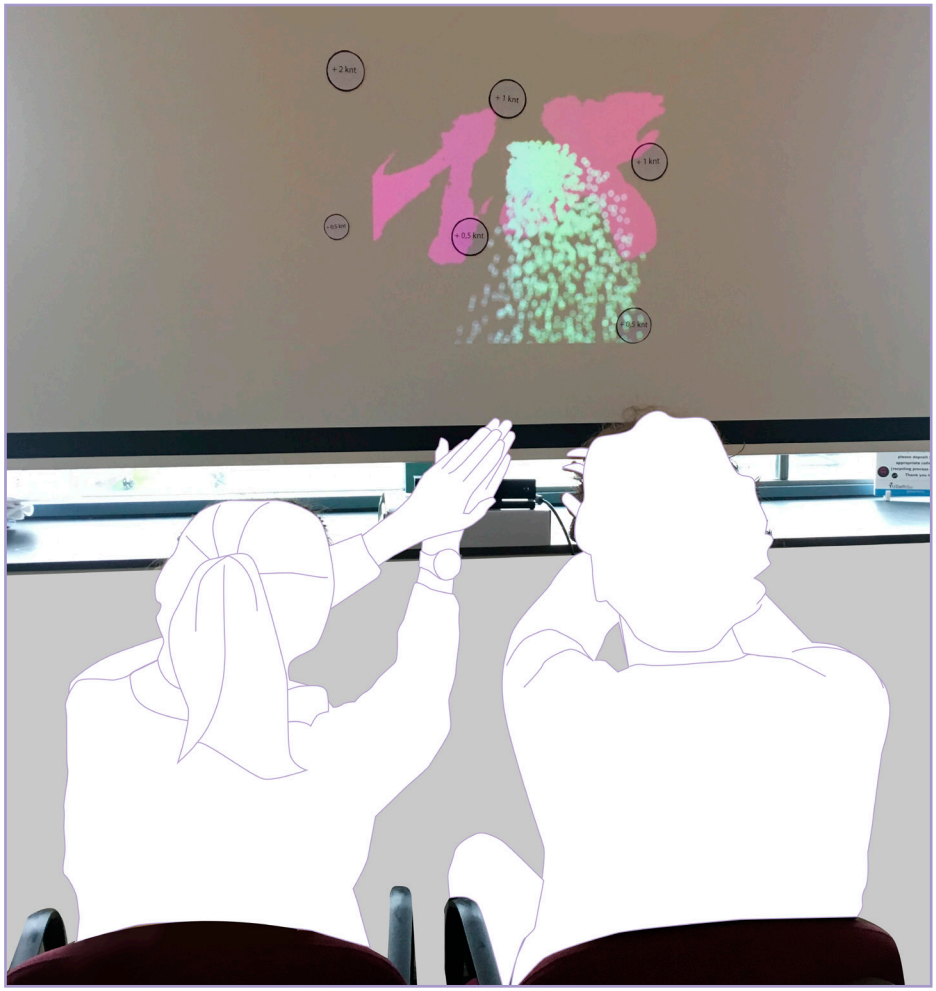



FIGURE 34 | Test set-up of MVP 3

> *I like the playfulness and that it does not work perfectly. In regular life this would be annoying, but it bonds.*
>
> - Charlotte (25) -

> *It gives you something to talk about and a sense of control*
>
> - Eva (25) -

## Conclusion

The fact that the interaction was described as "exploratory", "playful" and "socially interactive" could be the result of that the passengers were simultaneously exploring how they could influence the projection. This, together with the fact that they had to be a bit creative because it did not work perfectly, evoked a feeling of connection towards each other.
The uncertainty of the result of their actions also stimulated interaction with each other.

Everyone participated and started interacting. This could be because they felt obligated towards the other one (who was using the interface already), the playful character of the interaction, or the possibility to have control (as well).

Not every participant thought the interaction was flexible, this could be the result of the limitations of the projection (sometimes it faltered) or it can be because of the amount of effort that had to be put in: reaching and searching for the centre of gravity to be able to have control (some experienced it as quite heavy).

One of the participants mentioned that a low-threshold of interaction was obtained by the interaction being in "another world". This "virtual" and "future based" type of indirect interaction would be a good fit to the progressive character of the Seabubble, although it should be taken into account that it might not be so attractive for the passenger who has a less curious attitude towards technological developments (this could be linked to the "disconnected" character which one of the participants mentioned).

**Guidelines:**

- A way to stimulate interaction is to let participants figure out together how something should be operated in a playful way.

- Having a feeling of control (and being able to see the direct result of one's actions) could be a stimulus for people to join in on the interaction and could stimulate further interaction amongst participants.

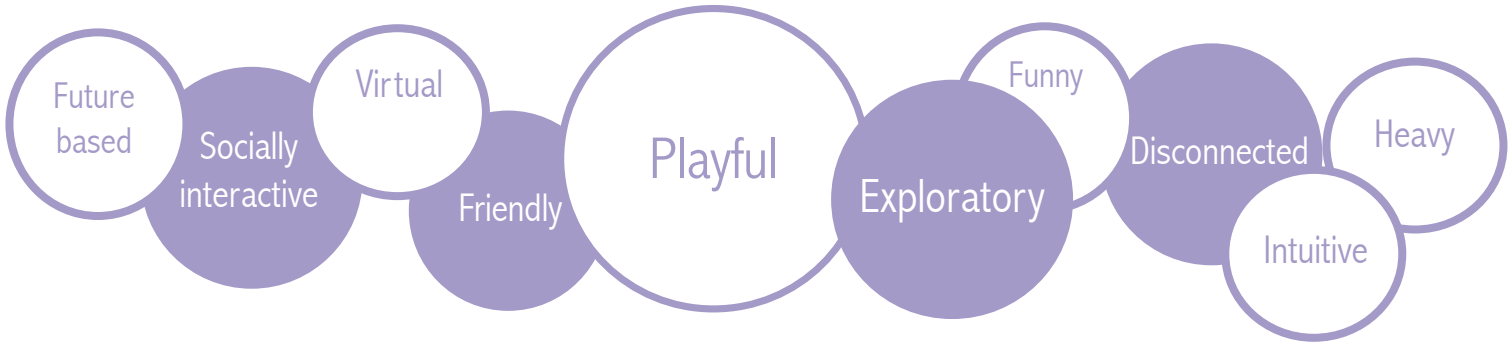
- Simultaneous effort could feel as a way of connecting.

- A virtual world as a the medium of interaction could fit the future-oriented autonomous way of travelling. In this way, the interaction (and it's medium) matches the way of travelling.

> *The "+0,5 knt" is not giving feedback on our trip, so there might be no incentive to keep doing it.*
>
> - Richard (27) -

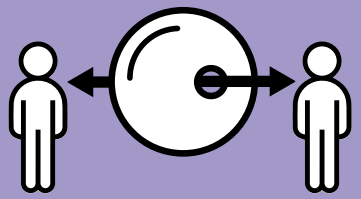
> *The interaction happening in "another world" results in a low-threshold (good).*
>
> - Jelmer (25) -

## Interaction description



# Concept and/or interaction requirements

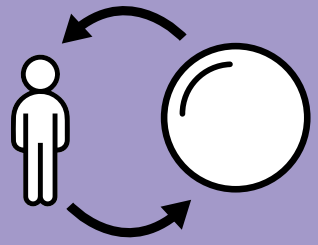
A summary of the most important findings is listed below (in random order). It is a combination of observations, participant's personal experience and descriptions of interactions during the MVP-tests. The bubble in the icons simulates the means for interaction and the bold text indicates a reference to another guideline.



## A facilitator for interaction

A form of indirect contact could lower the threshold of starting an interaction. It requires an indirect focus point, taking in sort of a facilitator role, in which the kick-off of the interaction feels more anonymous, almost unintended. This unintended character might trigger a feeling of surprise (passengers were not planning it to happen), which could be the trigger for passengers to start talking about how they all experienced it.

The so called facilitator should not take the focus of attention; passengers should have the feeling that the interaction came naturally, with the facilitator primarily as a means for this interaction.

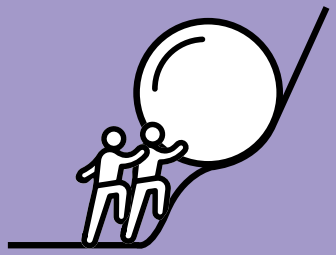


## Balanced feedback

A form of feedback should be provided so passengers do not feel (too much) left in the dark during the interaction. It is not about negative or positive feedback, but more about the effect and reasoning of their actions and those of others.

The feedback should be given in a notable, but subtle way. It should not take attention, yet it needs to be able to pull people out of their own thoughts (or even comfort-zone). If there is too little feedback, passengers might keep their experience to themselves. It might lead to passengers starting to reflect on their own what is happening, resulting in a more individual experience.

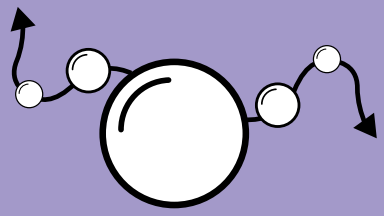
Furthermore a balance should be obtained in which passengers feel informed, although not everything is completely spelled out (a bit of room is left to generate **uncertainty**).



## A need for simultaneous effort

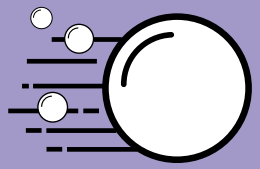
There should be a need for simultaneous effort to get something done, in which a balance should be found between keeping passengers stimulated to put in effort, but not so much that they get discouraged. Also, it should be kept in mind that asking for too much effort, will attract too much attention towards the facilitator. In this case the facilitator does not fulfil its main task anymore which is having an unobtrusive role, but instead it will take the focus of attention.

This requirement also asks for direct **feedback** to show the effect of the passenger's effort and to keep them stimulated to continue.



## Successive stimuli

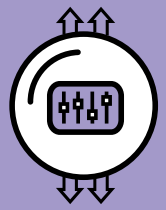
There should be a combination of successive (discrete) stimuli, instead of one stimulus, which are spread over the entire length of the journey. The stimuli should mainly be a means for interaction, without it taking the focus of attention (adopting a position of a **facilitator**). The chances of triggering divergent types of passengers are being raised by maintaining several (different) stimuli. When it is self-learning, it could even measure if (and which) stimuli are needed for that specific moment and specific type of passengers. In this way, the entire length of the journey can be used to stimulate interaction and to incorporate as many passengers as possible.



## A non-static character

The feedback should be supplied in a non-static way. A non-static character will result in a loose atmosphere, which could positively affect the social attitude of passengers. Moreover it could function as a warm-up to get passengers in the right active mind-set in relation to interacting amongst each other.

This character could be achieved by continuously providing **feedback** or by actively stimulating **(simultaneous) effort** and/or taking **control.**



## Supply a sense of control

The passengers should be given (a sense of) control over something that influences their direct surrounding. If the (feeling of) control can be influenced together and/or simultaneously, passengers' curiosity will be triggered, which could result in interaction. The effect should be made clear in some way, showing what the passengers are accomplishing (together). This relates to the **balanced feedback** that should be given. The way of supplying control should fit the way of travelling and the type of passengers (it should not be too future-oriented if the vehicle or the type of passenger is the opposite).

## Create uncertainty (offer a mystery)

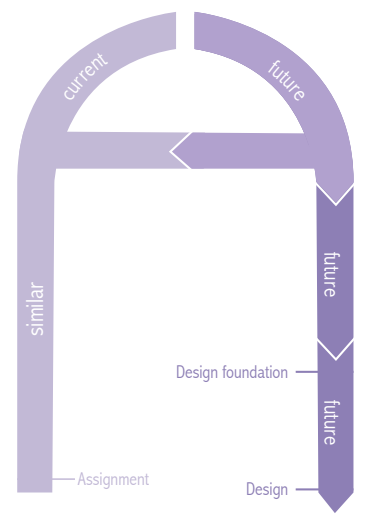
A certain amount of uncertainty should be created, related to a function and/or related to the effect of passengers' actions. The mystery of what might happen or how something might work, could trigger passengers to start explore together (which relates to **simultaneous effort**). The fact that the passengers already share the feeling of uncertainty could feel as if they have something in common which they might want to share.

# 4.2 Conceptualization

## Intro

The insights conducted by the MVP-tests (illustrated in the previous page) are translated into a concept. Where the MVP's did not take into account the size and seating position of the Seabubble, the concept is indeed designed with an eye on these matters.

The concept is evaluated by a user-test amongst neighbours. It is being evaluated how the gathered insights can have a role in reaching the set goal (the statement).




## 4.2.1 A matter of joint control

Although all of the requirements (shown on the previous page) play a role in the suggested concept, it mainly relies on the requirement of letting passengers have (a sense of) control. It is a conscious choice to let this requirement play a leading role since this could be the glue between the divergent type of passengers, which has been set as one of the design goals (mentioned in the statement).

When a certain amount of control over the autonomously operating Seabubble is given to the passengers, it might weaken the rejection of the passengers with a more conservative attitude towards (technical) developments/the autonomous operation of the Seabubble. The Seabubbles can still operate completely autonomously (or take over control when needed), but passengers have a certain amount of influence over the speed. The passengers are required to work together in order to influence the speed. This amount of control softens the matter of passengers being "passive passengers", which is how the new role of the passenger in automated vehicles is being called. In the eyes of the majority of the public, this does not fulfil mobility needs (Wolf, 2016).

Related to this high acceptance rate of the passive passenger, Wolf (2016) states: "*A situation-specific transfer of driving tasks to the autonomous vehicle may [. . .] represent a more fruitful alternative*". This statement fits the possibility of controlling the speed for those who have this desire, while the Seabubble could operate by itself as well.

How the other requirements relate to the concept is explained in chapter 4.2.2.

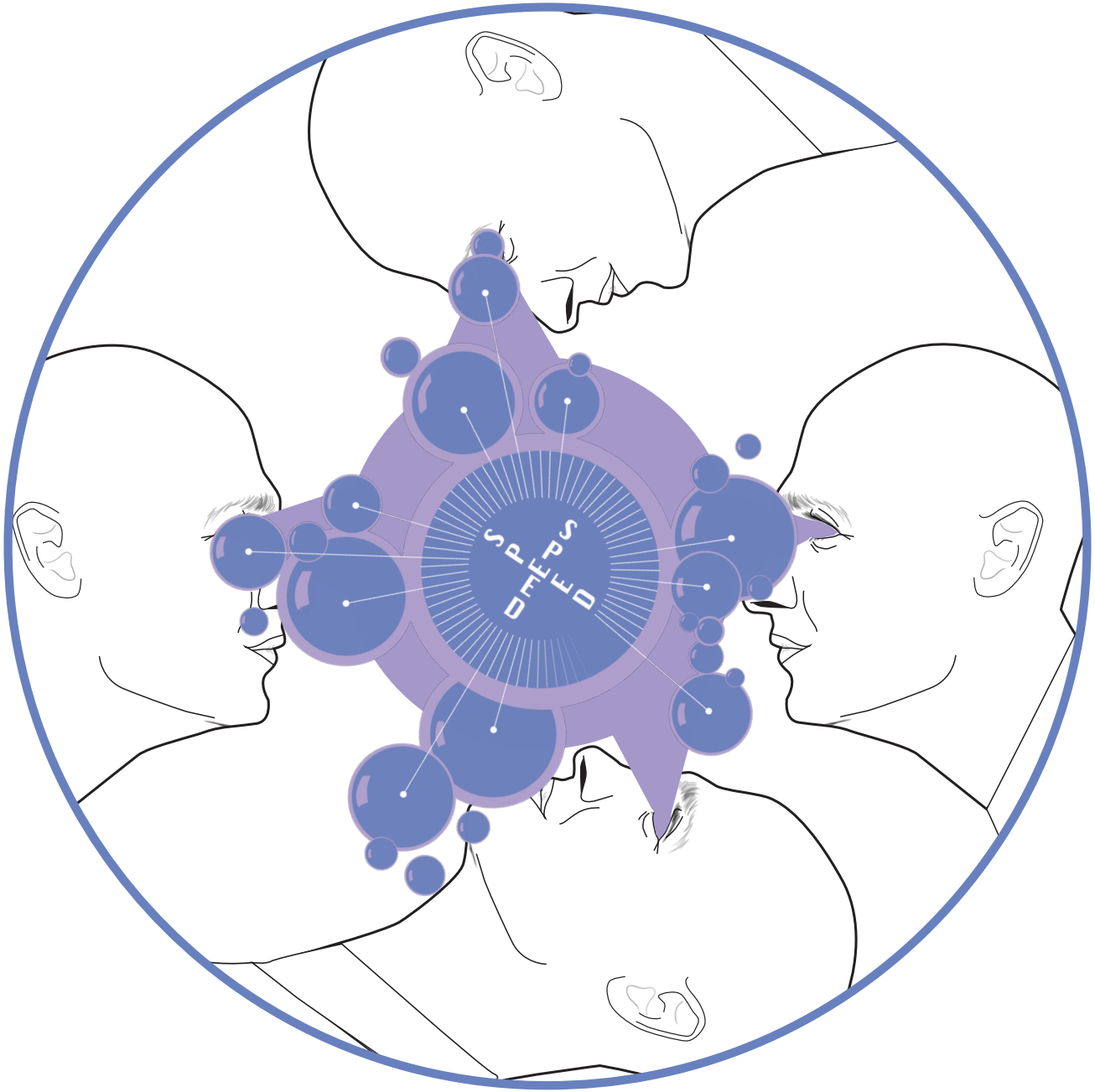



FIGURE 34 | Inspirational illustration: as an answer to the Dutch saying “Hoe krijgen we de neuzen dezelfde kant op?”: Give the passengers a common goal.

# 4.2.2 The SpeedBubble concept

The concept designed for the Seabubble is called the SpeedBubble. It is explained below in which the bold text refers to the requirements (listed at page 58 and 59).

### The concept

Passengers can have **control** over the speed of the Seabubble by usage of the *SpeedBubble*. It facilitates indirect interaction by providing a joint focus-point (**facilitator-role**): a projection that can be operated as a control-system. When none of the passengers interact through the *SpeedBubble*, the Seabubble will fly on 25% of its speed capability (taking into account the waterway regulations). The passengers can speed up the Seabubble (up to 50% of the speed capability) by collecting bubbles with their hands or feet (relating to the requirements **simultaneous effort** and **non-static character**). The speed can only be controlled in clock-wise, successive order (explained in figure 35). Therefore the behaviour of one passenger effects the amount of control of the other passenger(s). This restriction relates to the interaction vision, since improvisation often requires a rule-set as well (as explained in chapter 3.2). When one passenger decides to drop out, the speed will decrease, effecting everyone. Subsequently bubbles will start to flicker in turns to stimulate the passengers to start over again (**successive stimuli**).Being dependent on each other and not knowing who will start (again), creates a feeling of **uncertainty.**

If passengers have put in the effort to control the speed together, the next time they will get into the Seabubble together, they could notice their earlier cooperative behaviour by a couple of bubbles being present already (providing **feedback**). Less effort is required when they already have collected some bubbles on a previous trip together.

### Evaluation

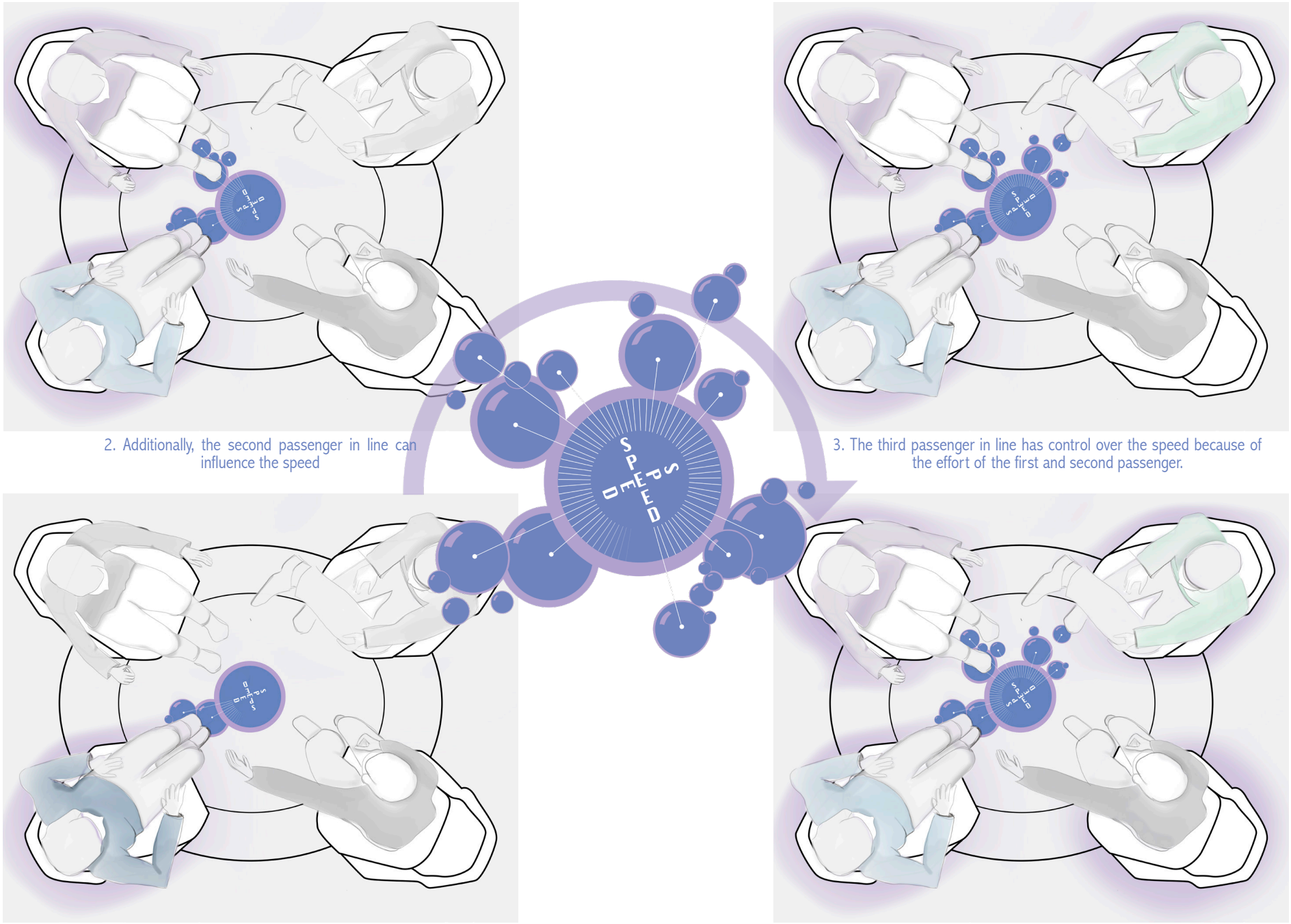
A test is conducted to validate the effect of the concept (and if the used requirements have enough effect in reaching the desired design statement).

This validation test set-up differs from the previous tests because of the fact that in this case it lies closer to the actual way of usage (although the test is still conducted in a test set-up and not in an actual Seabubble). To let the set-up of the test get as close as possible to the actual situation of usage, the participants are introduced to an usage scenario (explained in chapter 4.2.3). Furthermore, the following factors are taken into account:

- The size of the space,
- The amount of passengers,
- Participants living in the same neighbourhood,
- Participants that are individual-oriented when sharing transport.

Although the concept is meant for the future (autonomous) Seabubble, the current passenger seating set-up is used for the test. This excludes the front-seat, meaning that the test is conducted amongst 4 passengers who face each other with the same in-between distance as in the current (human-controlled) Seabubble. During the interviews with the ones already travelled by Seabubble, it was being mentioned that this interior-set-up already had some social stimulating influence (chapter 2.1.4.). The measurements of the interior set-up are known and so it is interesting to get to know if this set-up is indeed already socially stimulative and/or if the concept adds a social stimulative factor.

A minimal amount of information is shared about how to control control-system, so there is room left for the participants to explore together and by themselves.




2. Additionally, the second passenger in line can influence the speed

3. The third passenger in line has control over the speed because of the effort of the first and second passenger.

1. The first passenger in line kicks-off and starts to take control by collecting (speed)bubbles

4. The fourth passenger depends the most of the effort of the others, if he/she wants to have an amount of control, everyone needs to participate.

FIGURE | The SpeedBubble concept 35

# 4.2.3 Concept evaluation

**Research Questions**

- Does the possibility of having control influence co-operation?

- Are people willing to put in effort and motivate others (with as result a social situation)?

- Are (individual-oriented) people triggered to co-operate when it's with their neighbours?

- Is it a comforting factor that people are rewarded the next time they travel (together)?

## Set-up

Four Participants of the same neighbourhood are introduced to a scenario in which they had to imagine that they would live in an area in which they had to share a small vehicle with their neighbours for 5-10 minutes on daily basis. They were told that the vehicle operates autonomously and that it usually moves forward at 25% of its top-speed. However, they are informed about the fact that they could influence the speed if they want to.
The participants were asked to imagine how they would behave in a certain situation (how they would act and react) and they were asked to consider how much control they would like to have.

Some participants did not know each other yet, others were slightly familiar with each other.

After the test they answered questions about the experience and their behaviour (Appendix I).

## Results

The participant who was in charge of kicking off (the first one in line) took immediate initiative, showing others how it might work (figure 36). Since the follow up participant did not take over, the "speed" got stuck at a certain point. This stimulated the third participant in line to take over and do the job for the second participant (figure 37), but when the third participant thereafter additionally interacted with his side of the projection, the "speed" decreased all the way to the first participant: this stimulated interaction amongst all participants. The second participant was stimulated to join in and in the end everyone collaborated to reach the top-speed. The fact that they had a common goal, was a strong motivation for this collaboration. Nevertheless there should be taken into account that it was a test set-up in which the participants did not have any other distractions or stimulus. One participant rightly pointed out that it could work in reality, but only when the cellphones are turned off.

All the participants were trying to discover how it worked, some cautious and/or passive, others very active. These different approaches actually stimulated interaction amongst them.

During the "discovering" phase, the participants were very occupied with the projection, afterwards a conversation started about personal matters. Asking each other where in the neighbourhood they precisely live and what they do in daily life.

Several participants described the interaction with the projection as surprising, but this might not be the case when the participants would try it for the second or third time. They wouldn't need to discover as much as they did right now.

FIGURE 36 | One of the participants taking initiative

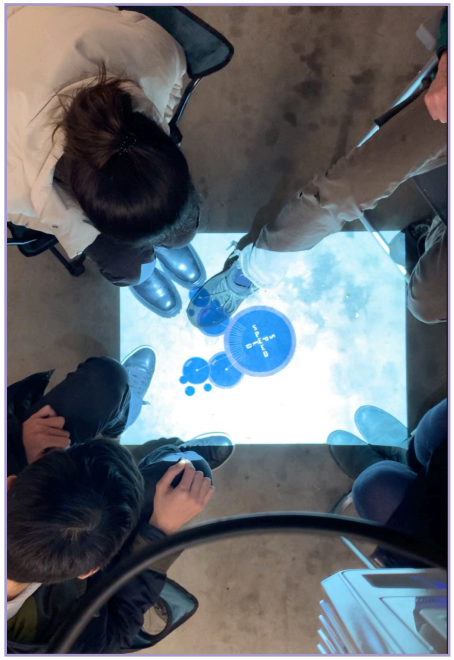


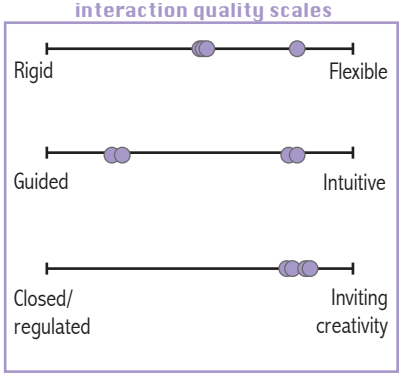
FIGURE 37 | One of the participants taking over

### Qualities

Most of the participants agreed on the fact that in the beginning the interaction felt quite rigid, but as the interaction with each other (and with the projection) progressed, it was perceived as more flexible. on the fact that it invites creativity.

There are divided opinions about the interaction being guided or intuitive, which is a big difference with how it was rated in MVP-test 3 (although MVP 3 and SpeedBubble have a lot of elements in common). This could be the result of the fact that the participants actually depend on each other and by stimulating each other to join in, participants could feel guided by others. In MVP 3, participants didn't actually rely on each other; joining in just reduced the amount of needed effort per person.

interaction quality scales




## Discussion

The fact that the participants had a common goal (having control/ influencing speed) stimulated co-operation: they started working together to figure out the control-system. When one of the participants was a bit hesitant in joining in, one of the participants took over, but afterwards the participants stimulated each other resulting in everyone joining in. It became a social situation in which participants started to ask each other to help out. The fact that the participants need each other to reach their desired goal hands them a reason for interaction, this might lower the threshold.

Participants pointed out that they were surprised by the way the projection reacted to their behaviour. This could have resulted in the fact that everyone kept putting in effort and stayed active. It should be taken into account that after using it a couple of times, people will not be surprised anymore and will get familiar with the control-system (adding up to the conclusion of the "special experience as a social link", stated in chapter 2.1.4.). This might lead to a different way of interaction or even no direct interaction at all (only indirect via the projection).

Everyone looked relieved and relaxed after the effort was put in, making room for a conversation between the neighbours who aren't so familiar with each other. It seemed that the indirect interaction through the projection worked as an ice-breaker.

Every type of passenger was being included and stimulated to join in: one of the individual-oriented passengers immediately took initiative, saying he was coordinated by the suggestion of the projection (the blinking of the first bubble) and the passenger that described himself as a more conservative person (towards technical developments) was very assertive as well (immediately taken over the task of the other passenger). The fact that these divergent type of passengers took initiative and included the rest of the social- and individual-oriented passengers concludes that the projection is a means of indirect first connection and a social stimulation.

Of course it needs to be taken into account that it's a test set-up and that the participants weren't actually travelling.

The participants had a hard time to imagine the effect of the reward (the fact that they wouldn't have to put in as much effort the next time that they travel with (some of) the same neighbours). One of the participants imagined that it would be easier and more relaxed to collaborate, because of the fact that the reward-bubbles remind you of the fact that it isn't the first time that you need to collaborate. Another participant looked at it from the amount of effort perspective, in which she pointed out that it could be very comfortable because she would be able to seclude herself from the group. So based on the type of passenger, the function of the reward can be interpret in either a social- or a non- social way.

The conclusion regarding the test is included in chapter 5.

# 5. Conclusion

# 5.1 Conclusion & Recommendations

The implementation of the hydrofoil Seabubble in neighbourhoods creates opportunities for *community sharing*. The question is how can the Seabubble **connect individual-oriented passengers, with divergent preferences, in a spontaneous way.**

A water-rich residential area in Amsterdam is used as a case-study during the design process. This yet to be developed area is called Haven-Stad and the majority of the people who will live in these neighbourhoods will be in need of transport, by water, to be able to reach further transport hubs.

A future-oriented design method, called ViP (Hekkert & van Dijk, 2011) in combination with an extensive testing-phase with low-fidelity prototypes, resulted in a list of requirements. These requirements function as guidelines for a design tailored for the Seabubble (called *the SpeedBubble)*, however it can be implemented in all kinds of autonomous vehicles to stimulate interaction amongst passengers.

Hence the requirements are bundled in a booklet that will guide stakeholders who are interested in optimizing interaction in shared autonomous vehicles. It will benefit these parties to implement the guidelines since it could stimulate acceptance of the new passenger-role that is required in autonomous vehicles (regarding the amount of control). *The SpeedBubble* uses a concept of balancing the amount of control between human and autonomous system to stimulate engagement with the Seabubble. The design requires passengers to cooperate and therefore it facilitates indirect interaction.

*The SpeedBubble* is evaluated in a test set-up with neighbours to determine if the design delivers the desired effect regarding the abovementioned question. In what follows, you find a conclusion (C), followed up by a redesign consideration and/or recommendation (RC).

## Passengers' attitude

The *SpeedBubble* concept is designed to stimulate interaction amongst divergent individual-oriented passengers. A survey conducted amongst 54 people of all ages who use shared transport-services showed that one third acts in an individual way while travelling. The survey also showed that the attitude of other passengers influence passengers' social behaviour. Taking into account these two findings, it is possible passengers could reflect the behaviour of other individual passengers, resulting in a very closed individual atmosphere. This would be a waste of sharing travelling facilities since it could optimize the atmosphere and cooperation in all kinds of communities. For this reason the focus lies on individual-oriented passengers (social passengers are not necessarily excluded, but it might already be in their nature to start some sort of interaction). The passengers differ in their acceptance of continuous technological developments: some have a more conservative attitude and others a curious attitude towards this matter. Some requirements that are applied in the design of *the SpeedBubble* came with (positive and/or negative) side effects, which are pointed out below.

C

The passengers have to collaborate to obtain a sense of control. This collaboration comes with a low threshold and it fits the character of the divergent types of passengers for the following reasons:

- The passenger with a more conservative attitude towards technological development is not being asked to give full control to the machine (the Seabubble). Offering a sense of control to these types of passengers can help them in accepting the autonomous way of travelling. A figurative dialogue is stimulated between the passenger and the machine, in which decisions are made in consultation instead of the machine having full control. Because of this, passengers do not have to take the role of the so-called "passive passenger" (Wolf, 2016).

- The passenger with a more curious attitude towards technological development could interpret the

control system as a way of working together with the machine. Their curiosity could be triggered by the collaboration with an autonomous machine.

The concept challenges the individual attitude of the passengers by asking each of them to contribute and cooperate. The passengers can make the first (indirect) contact through the SpeedBubble projection, in other words the SpeedBubble facilitates the interaction. On the one side, this individual contribution is a comfortable way of kicking-off further interaction, like an ice breaker. On the other side, it needs to be taken into account that individual passengers, who gain more and more experience, might eventually give a helping hand without any other form of interaction. As mentioned before, to keep these passengers actively involved, they need to be continuously triggered in surprising and unobtrusive ways.

**R** **C** To maintain the SpeedBubble-projection as a means for stimulating direct contact, passengers should be prevented from hiding behind it. Passengers who meet each other once again while travelling would get rewarded for their previous effort. *The SpeedBubble* would require less effort of these particular passengers, however the test showed that it is likely to result in even more individual behaviour, because people would not be actively involved anymore. A different type of reward-system could be the solution. This could be a reward-system in which passengers are not rewarded individually, but in groups. In this case passengers can be rewarded directly during their current trip (and not during their next trip, as originally planned). It should be tested if such a reward-system would enhance the group spirit and stimulate active involvement.

## Interaction Vision

An analogy can contribute in providing an understanding in the definition of an interaction. The chosen analogy in relation to a spontaneous interaction is the interplay of confidence and doubt during improvisation. Because the analogy merely serves for an extensive explanation of the interaction, it is referred to as the interaction vision. The Interaction Vision is characterised by three interaction qualities: flexible, intuitive and inviting creativity. During the evaluation of the SpeedBubble concept, these qualities were tested. The opinions varied about whether two of those qualities correspond to the character of the interaction. The referred qualities are the amount of flexibility and intuitiveness.

**C** *The SpeedBubble* concept comes with a guided interaction-character, because it requires every passenger to actively participate and the passengers need to follow-up one another. The way that the passengers have control requires further study. Currently passengers depend on each other by needing to contribute subsequently (related to the requirement “Simultaneous Effort”). Consequently, the last passenger to enter had to wait for the passengers ahead of them to take action. As a result, they may lack a sense of control.

**R** **C** The abovementioned restriction gets in the way of letting the interaction feel intuitive. Therefore, this restriction should be shifted towards a less dependent way of control in which passengers are stimulated more out of curiosity than peer pressure. If passengers could decide together who is the next one in line, it could be more fitting to everyone’s individual desire to provide input. Moreover, it could be an extra stimulant for interaction if they have to make this decision together.

**C** The interaction felt rigid at first; the passengers had to get used to each another and needed to figure out the mode of operation. Later on, when things became clear and passengers started to feel comfortable with each other, a more flexible interaction emerged. The high level of uncertainty resulted in this rigid character. The exploration in which uncertainty and certainty interchange, suits the interaction vision perfectly.

Although uncertainty can create room for collaborative exploration, a balance should be found between what is clear and what is left open for exploration. It is plausible though that passengers gain experience through repeated use, so the amount of experience per passenger may vary in future uses, which brings a whole new experience. To evaluate how the amount of experience is transferred between neighbours, and what kind of interaction it engenders, longitudinal testing is required. To trigger passengers into active participation whilst some of them might be quite familiar with the system already (for instance those commuting on daily basis), a self-learning, adaptive system might be the solution. This system needs to gauge the level of familiarity of the passengers and adjust the amount (and types) of successive stimuli over the entire journey to avoid the possibility of self-exclusion.

## Focus Area

A part of the harbour of Amsterdam will be transformed into a mix of residential- and work-areas. This area, called Haven-Stad, is used as a case-study because the Seabubble would be able to transport the residents from their homes to other modes of transport. With an allowed speed of 9 knots and distances of 1 to 3 kilometres, people would be travelling for 3 to 10 minutes. If the SpeedBubble-concept is evaluated in a test set-up. The participants that tested the concept are neighbours, from which some of them knew each other only superficially or not at all.

During the concept test, the participants were actively involved for 8 minutes, which fits in the time-frame of travelling in Haven-Stad. However, it has not yet been tested how the SpeedBubble would work in situations in which the Seabubble would have multiple stops, and passengers would enter and exit at different moments. In this scenario, every passenger would have different travel-durations and the group composition would change every couple of minutes.

It is recommended that different usage scenarios are tested, for instance to analyse the effect it on passengers when some take a long journey and others a short one. It might become a challenge to keep stimulating the long-distance travellers, because they have to start over after every time a passenger exits or enters. Another important scenario to test is when passengers are travelling for just 3 minutes. This would ask for a high level of experience (they have to act quickly) and a strong motivation.

The neighbours were simultaneously involved, in which the *SpeedBubble* acted as an icebreaker. They started a conversation afterwards; first about the way of operating and thereafter about personal matters. The fact that they are neighbours gave them something in common and seemed to motivate them to get to know each other. Because of the chance of seeing each other again, the effort was made to show interest towards each other.

The test is conducted in a small neighbourhood that is divided by a couple of small streets. The level of motivation to get to know each other might be different when people are living in bigger neighbourhoods that are separated by water; the neighbourhoods typically suited for Seabubbles. Extra tests are required to analyse how people would behave in these types of neighbourhoods. Additionally it is recommended to analyse how the SpeedBubble will influence groups of passengers with the same travel patterns (travelling at the same hours). Extra group-challenges might stimulate a group spirit, such as gaining credits when the same composition of passengers is actively involved.

## Stakeholders

The *SpeedBubble* concept could be offered as a customization-option for parties that would want to implement it in community sharing contexts. Minze Walvius from Advier (The Dutch representative of Seabubbles) highlights that Yacht builders, like OceanCo, are already showing an interest in customizing the Seabubbles to the wishes of their clients.

*The SpeedBubble* concept is a future-oriented design specifically designed for the Seabubble.

However, the insights can be of use for other (contemporary) shared-transport services as well. Therefore all the insights are translated into a list of requirements and bundled in a guide (figure 40). The guide will serve stakeholders in the field of public transport or other types of shared (autonomous) transport services. The list of requirements gives a summary of the insights in a generic state. This makes it easily applicable for stakeholders who want to implement it in slightly different contexts. A concrete example of implementation of the list of requirements is given by means of the SpeedBubble concept in its context of use (these pages are shown in figure 38 & 39). Refer to appendix J for the entire guide.

To conclude, the SpeedBubble-concept can connect individual-oriented passengers with divergent preferences as well as that it triggers a spontaneous interaction just as intended with the interaction vision (the interplay of confidence and doubt during improvisation). Nonetheless this result might be feasible with another design as well; the list of requirements in the guide can give direction towards this goal.

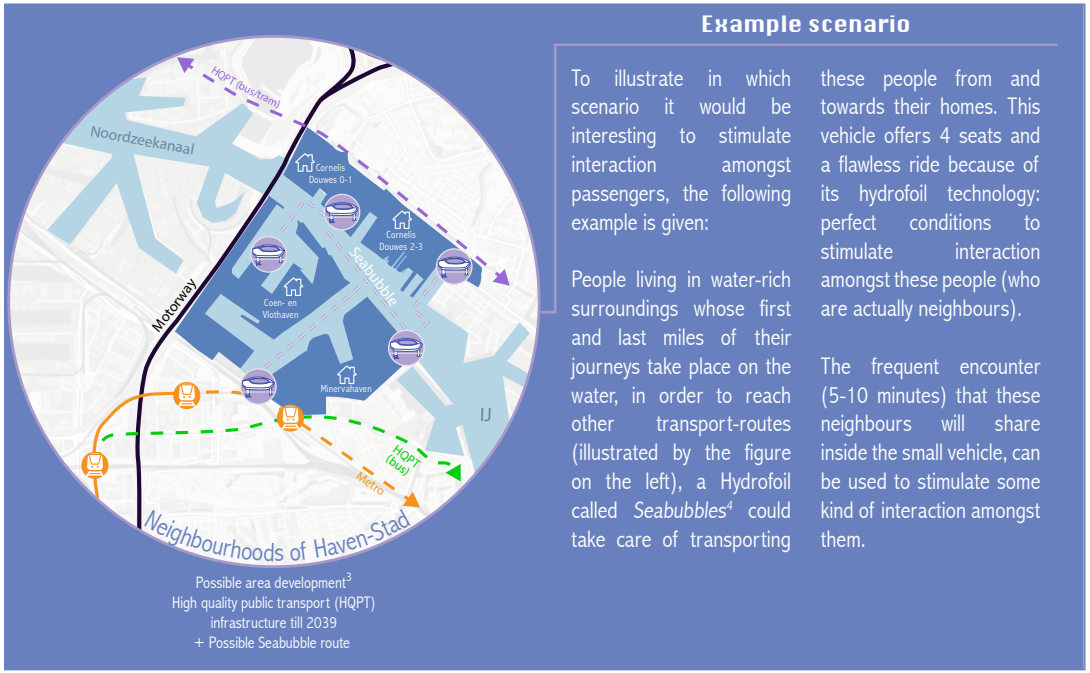



Figure 38 | An example scenario as a part of the booklet

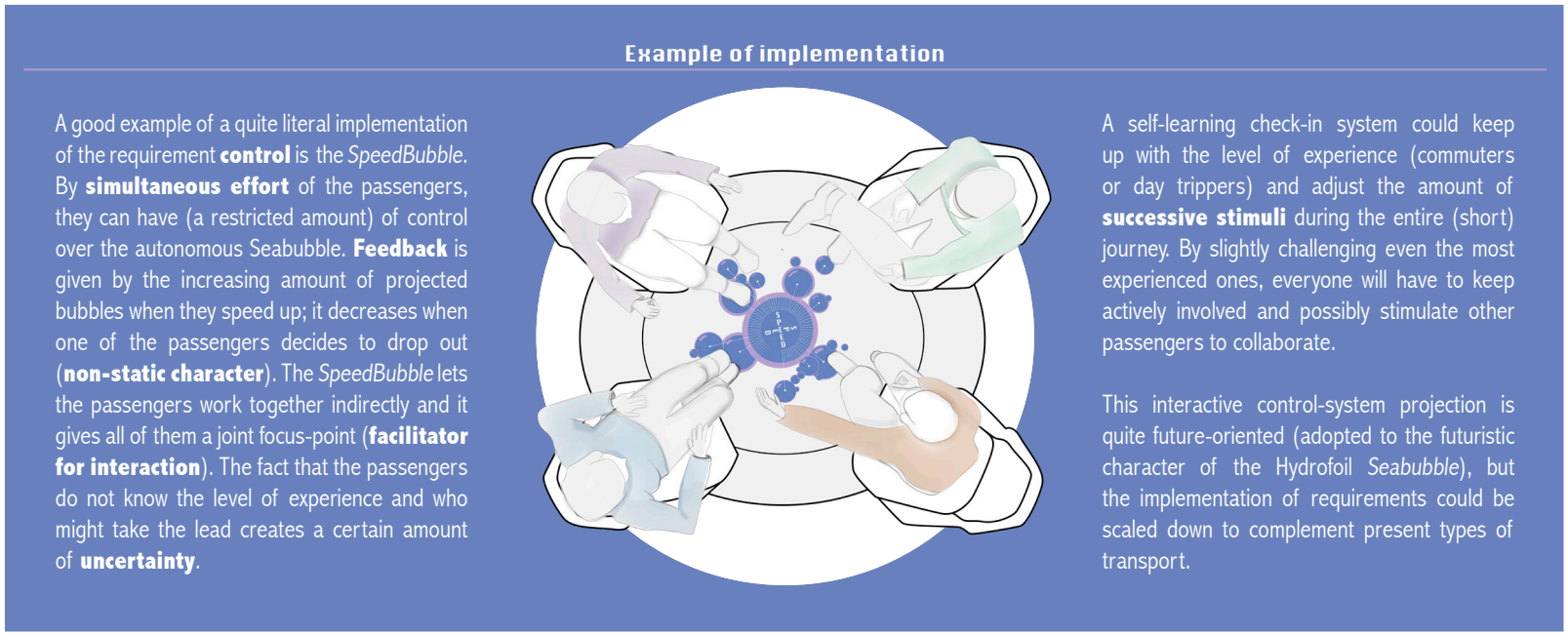
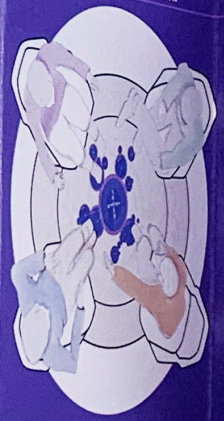



Figure 39 | An example of implementation of the requirements

A certain amount of uncertainty should be created, related to a function and/or related to the effect of passengers' actions. The mystery of what might happen or how something might work, could trigger passengers to start explore together (which relates to **simultaneous effort**). The fact that the passengers already share the feeling of uncertainty could feel as if they have something in common which they might want to share.

A good example of a quite literal implementation of the requirement **control** is the *SpeedBubble*. By **simultaneous effort** of the passengers, they can have (a restricted amount) of control over the autonomous Seabubble. **Feedback** is given by the increasing amount of projected bubbles when they speed up; it decreases when one of the passengers decides to drop out (**non-static character**). The *SpeedBubble* lets the passengers work together indirectly and it gives all of them a joint focus-point (**facilitator for interaction**). The fact that the passengers do not know the level of experience and who might take the lead creates a certain amount of **uncertainty**.

## Example of implementation



A self-learning check-in system could keep up with the level of experience (commuters or day trippers) and adjust the amount of **successive stimuli** during the entire (short) journey. By slightly challenging even the most experienced ones, everyone will have to keep actively involved and possibly stimulate other passengers to collaborate.

This interactive control-system projection is quite future-oriented (adopted to the futuristic character of the Hydrofoil Seabubble), but the implementation of requirements could be scaled down to complement present types of transport.

## Situation specific points of attention

Although the requirements can be implemented in many different kinds of (autonomous) transport, every type of transport comes with situation-specific points of attention. These points are briefly discussed.

### Type of passenger

Different kinds of passengers require different approaches. The level of familiarity can be an influencing factor in people's motivation for interaction. Furthermore, individual-oriented passengers are in need of a different approach than social-oriented passengers.

### Length of the journey

One needs to take into account that every passenger is still following their own scheduled journey, meaning that most of them have different destinations and so their travel-times will differ. The requirements should be applied in a way that is usable for both short and long trips. This leads to two points of attention:

1. The passengers who remain while others depart should be motivated for (another) interaction.
2. An easy entry option is needed to maintain a low-threshold for the passengers entering in the middle of another passenger's journey.

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Berlin, Heidelberg

Figure 40 | The stakeholder's guide

# 5.2 Limitations

This project faced several limitations during both the design- and testing-phase. Limitations regarding the specific design goals are mentioned in the previous chapter, therefore this chapter is focussed on the limitations of matters regarding the entire process.

### A design for the future

The neighbourhoods of Haven-Stad will be realised between 2029 and 2040 and the SeaBubble is still in its testing phase. Therefore it was not possible to test the *SpeedBubble* in its actual context of use. Because of the stable conditions of travelling by Seabubble it was possible to simulate the interior set-up without a moving vehicle, however the effect of the experience of actually traveling (by water) could not be tested. This experience could be of influence in the interaction amongst passengers.

During the design process of the *SpeedBubble* it was kept in mind that it should fit its future context, hence a futuristic control-projection is designed. Whether the design is viable, in relation to technical aspects, depends on the speed of technological developments. Unfortunately it is hard to predict in what extent this technology will develop and if it would fit the (future) regulations.

Nowadays the SpeedBubble might help in the transition of human-driven vehicles to autonomously driven vehicles, but it should be evaluated if the control-system of the SpeedBubble is still required in a few years time. In the design of the SpeedBubble the requirement of 'control' is directly linked to the speed, although it might be that in the future this need disappears because of the possible acceptance of control by autonomous vehicles. For this reason, it is recommended that the both the SpeedBubble-concept and the guide are revised every year in order to let it stay in tune with the spirit of times.

### Method

The VIP-method is a future-oriented method that requires a 'self'-developed future world. Although this future context is constructed mostly out of (scientific) research and trend reports, the method also allows to include highly debatable sources in order to construct this future context.

The construction of the future context is a large part of the method. This benefits the research-part since it gets a lot of attention and therefore the possibility of sticking to obvious solutions will be limited. The construction of the future context requests a lot of attention, the consequence is that there remains less time for detailing of the design.

### Cultural differences

The design is based on a Dutch context of use. The factors that are used to construct the future context are mainly based on the European culture. Moreover the design is evaluated with Dutch participants. Therefore the design (and the list of requirements) might not give the desired social effect amongst passengers from different cultures.

In some cultures the set design goal might not even be suitable because of different views on social behaviour in shared transport.

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# Appendix

The appendix is a separate document. It is available through the TU Delft repository.


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