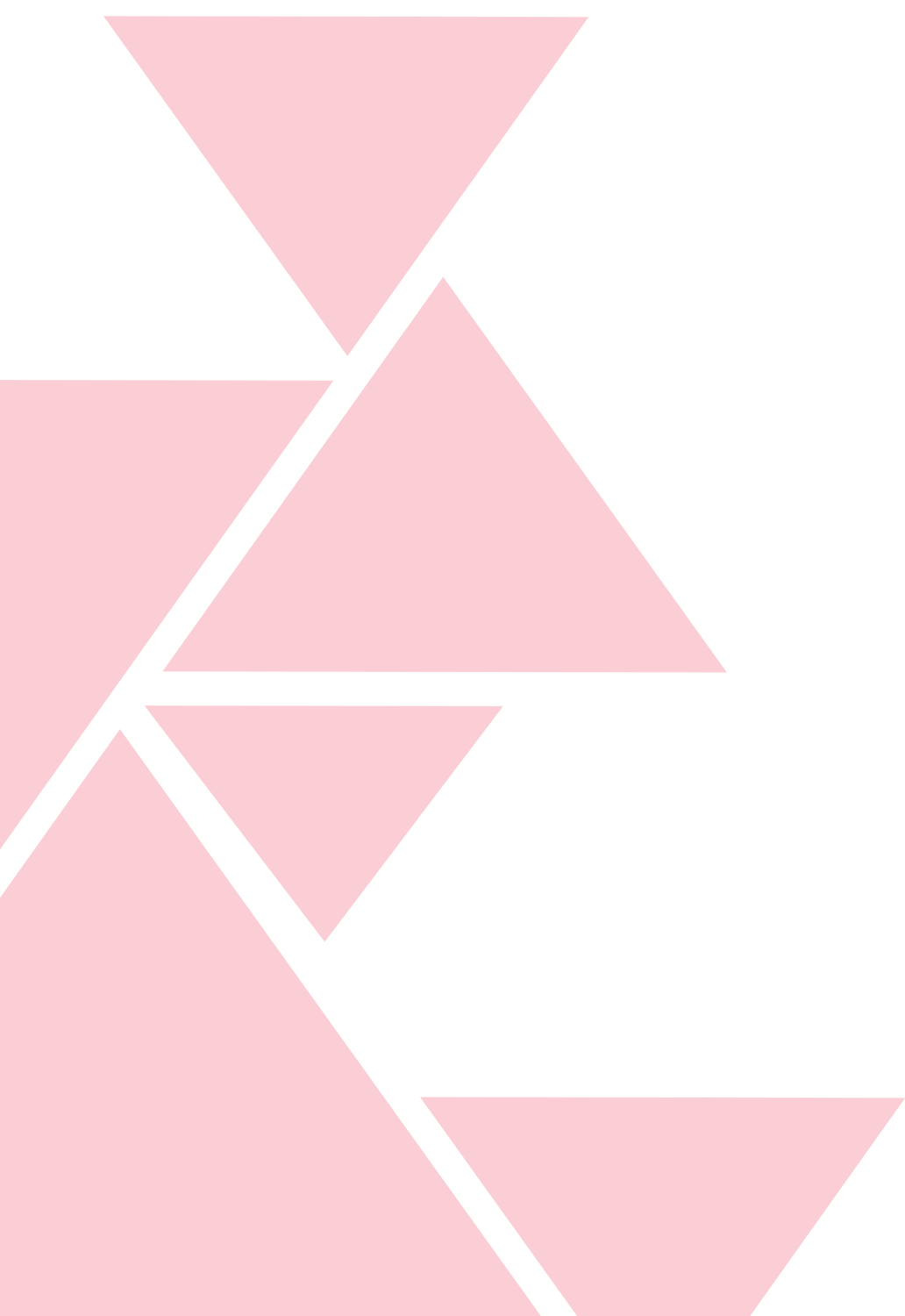


**Making art accessible  
to visually impaired  
museum visitors**





*Masterthesis by*  
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*In association with*  
the Rijksmuseum, Amsterdam

# Executive Summary

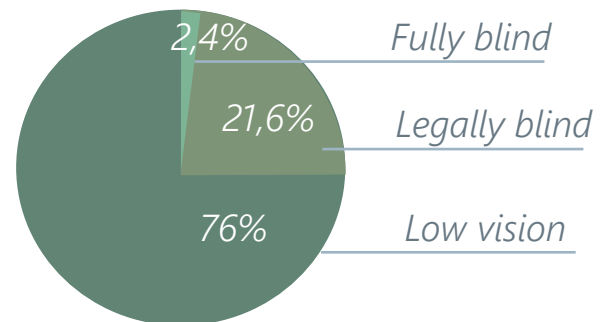
This is the reporting of the master graduation assignment of Hester de Blik, Design for Interaction, Industrial Design Engineering, TU Delft. The main goal of the assignment was to make visual art accessible to people with a visual impairment. This assignment arose from the PhD research of W.S. Elkhuisen about 3D printing and Fine Art Reproduction, in association with the Rijksmuseum, who are looking for ways to make the museum more accessible.

This report is constructed in three phases: Analysis of the user and the context, Ideation from the design brief towards the concept and Demonstration, where the concept is detailed and tested.

## Analysis

The first part of the analysis covers the basic characteristics of the usergroup. Besides, the museum context is explored in order to understand why people visit museums in general, what is important for such visits and which experiences take place.

Then, the relation between the visually impaired visitor and the museum is researched through literature and in practice. Accessibility of art for visually impaired is covered based on the five different senses, from which audio and touch seem most relevant.



Total: Visually impaired in the Netherlands (around 342.000)

This led to the design goal of *making the image, story and expression of paintings intuitively accessible for both blind and ill sighted visitors during an independent museum visit.*

The scope is defined, just as the requirements that the final concept should meet and the intended interactions in the interaction vision of unpackaging gifts (image 0.1).



Image 0.1: Interaction Vision

## Ideation

From this design goal, the ideation process is started, with help from several visitor scenarios. By doing a creative session with visually impaired and individual brainstorm sessions with multiple input sources, ideas are generated.

These ideas are evaluated and downsized in number, then assessed through PMI (Plus Minus Interesting) and clustered to create a morphological chart (image 0.2). By taking ideas from the different layers in this chart and merging them together, three concepts arose: 'Take your Technique', 'Exploration Table' and 'Splitting the Art'. These are worked out into a design sketches and storyboards.

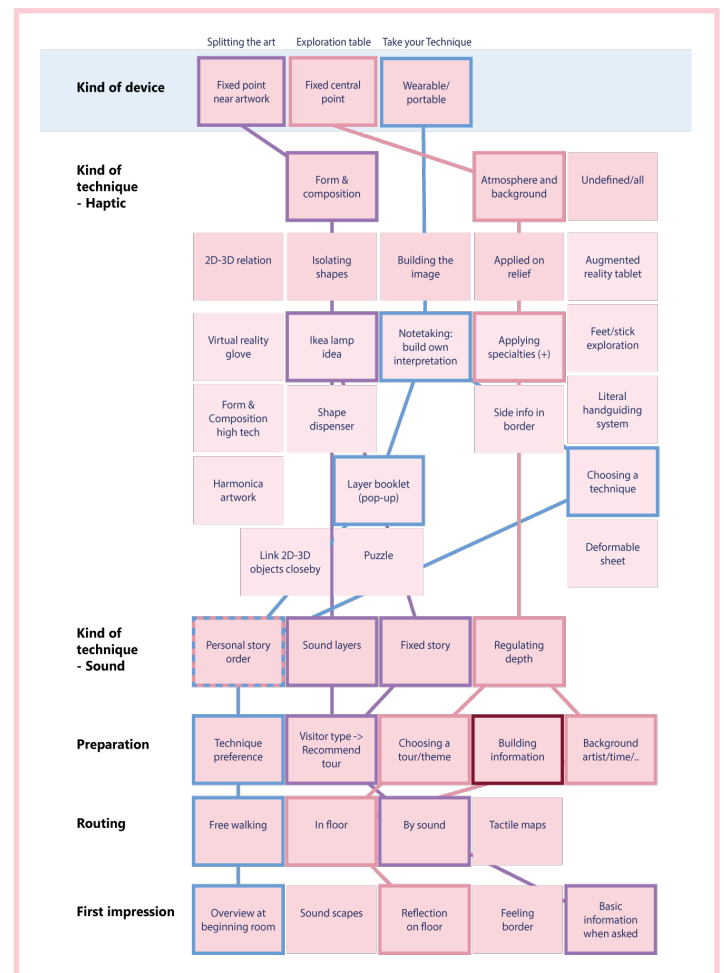


Image 0.2: Impression of the filled in morphological chart

Design goal	Take your technique	Exploration Table	Splitting the Art	Portable exploration table
User	Provides for blind visitors	Provides for ill sighted visitors	Provides for both	
Intuitive	Easily understandable	No confusion or overload		
Understanding	Image	Atmosphere	Background	
Opinion	Challenges opinion			
Other requirements	Visitor can choose	Visitor is in control	Visitor is not on display	Different expertise levels
Practical	Fits style of Rijksmuseum	Unobtrusive for other visitors	Not provoking to touch real art	Pastily available
Wishes	Independently and tour	Interesting for all visitors	Multiple visitors can interact	Easy to recognize
	No hinder from stick/dog	Suited for elder age	Applicable to all art	Easy to make
New				

Image 0.3: Impression of the Harris profile

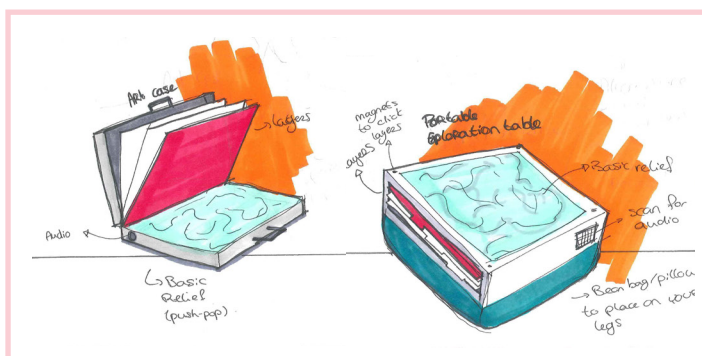


Image 0.4: First sketches of 'Portable Exploration Table'

The three concepts are assessed by two experts from the field of visually impaired and two experts of the Rijksmuseum. This resulted into valuable feedback with strong and weak points per concept. On the basis of this feedback, the three concepts are revised and a fourth concept, 'Portable Exploration Table' is created. All of them are assessed through a Harris profile (image 0.3) based on the requirements and through the Interaction Vision. Eventually, a decision was made and the '**Portable Exploration Table**' was chosen (image 0.4) which contains a relief of the artwork, an audio guide and several layers with specific information. This concept is iterated upon to find the best way to guide someone through an artwork without human interference. Eventually this is done with use of **vibration**.

## Demonstration

This last chapter explains the final concept in detail. Generally, the concept exists out of two main aspects: a *basic relief* to understand form and composition and *layers* on top of this to clarify other aspects of the work like materiality or lighting. The worked out prototype focusses on the first part.

The prototype guides people through the artwork in an independent way. It exists out of a relief of the artwork from which several parts can vibrate in order to guide and give feedback. It is accompanied auditory by narration. The vibration mechanism (image 0.5) is explored both theoretically and practically through research and prototyping simultaneously. The relief (image 0.6) is created through a heightmap. Last, the (background of) the guidelines for the accompanying story are outlined and the story is created (image 0.7). In between the story, complementary sounds are added, like bread and milk.

The prototype was tested by six participants with a visual impairment within the Rijksmuseum. The overall feedback was positive, participants expressed their wish to extend this concept to other artwork as well. The possibility of touching is desired although the relief can be strengthened. The vibration was received well and it's intended use understood. The narration was clear for most participants. It could use a rewind option. The intermediate sounds were received positive as well, for they added to the atmosphere. Scent was mentioned here as well.

In conclusion, the design goal was met fairly well, which is explained thoroughly and the concept definitely has potential. The recommendations outline further detailing and testing upon the current prototype and the possibility of adding layers on top of the relief. Also the placement and accessibility within museums should be considered well.

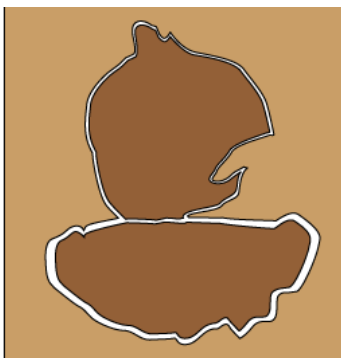


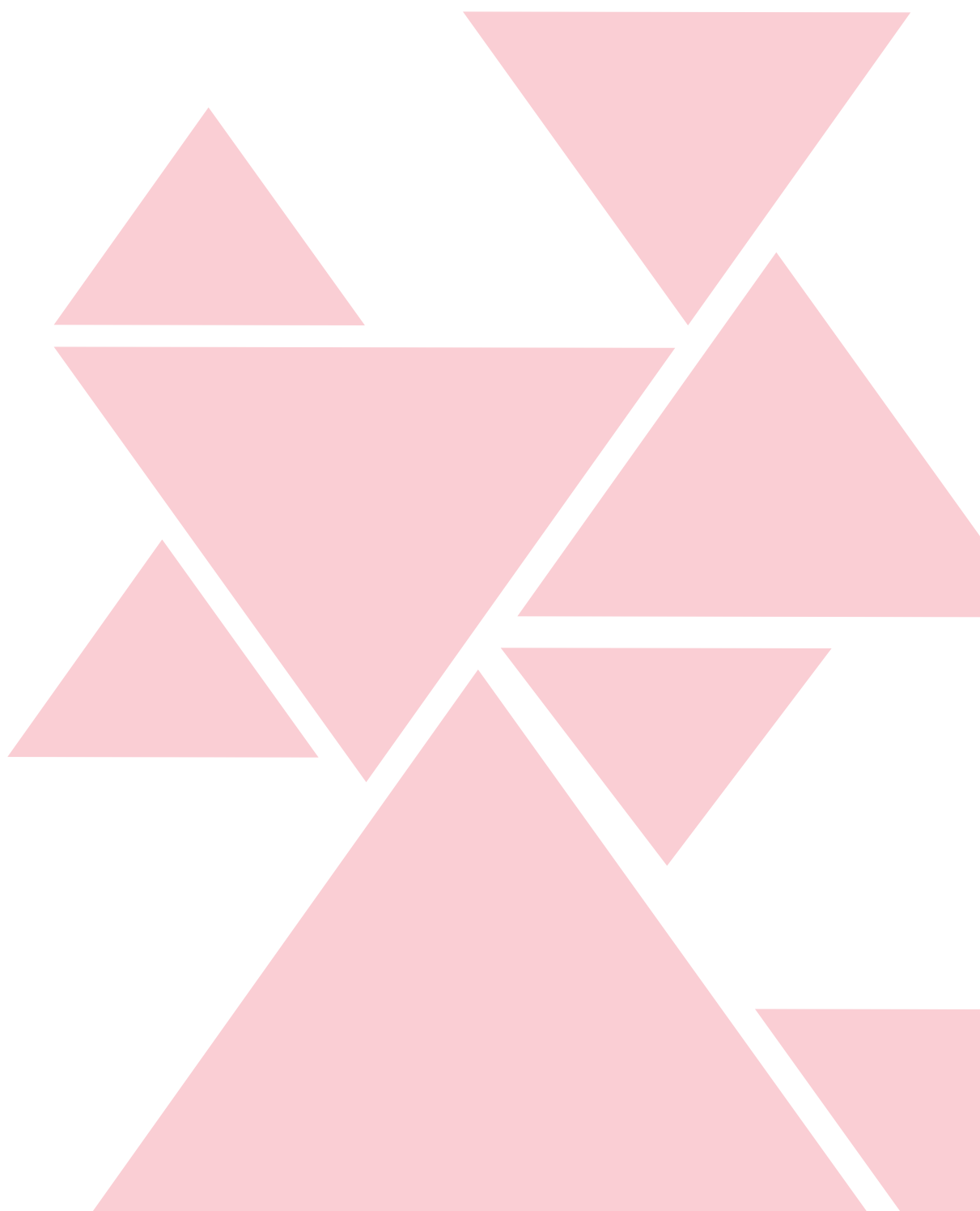
Image 0.5: Vibration mechanism



Image 0.6: Printed relief



Image 0.7: Elements of the story





*Image 0.9: 'The Milkmaid' by Johannes Vermeer*

# Introduction

In December 2006, the United Nations (2006) agreed on the convention on the rights of persons with disabilities. In 2016, this convention has become in force in the Netherlands. According to article 9, accessibility, people with a handicap should be able to take part in all facets in life. This naturally includes visiting museums as well.

Many museums cover visual arts such as paintings and historical objects, which aren't accessible for visitors with a visual impairment. Especially as it comes to paintings, letting these visitors experience the image is difficult. Some museums are taking effort, for which they often are providing (touch) tours. Going through a museum independently on the other hand is less common.

One of the museums which is planning to be accessible for all visitors is the Rijksmuseum, Amsterdam, which has appointed a function for inclusivity. Therefore they undertake ongoing efforts to provide better access and experiences to blind and visually impaired visitors, both in group and independently. Therefore, the project is done in association with Rijksmuseum, providing the case of 'the Milkmaid', an artwork painted by Johannes Vermeer on which the eventual design will be applied.

# INDEX

## A

### ANALYSIS

User group &  
context in general

Current museum  
applications

Design brief

## B

### IDEATION

From ideas  
to concepts

Concept evaluation  
& Iteration

## C

### DEMONSTRATION

Concept detailing

User testing

Evaluation

<b>ANALYSIS</b>	<b>12</b>
<b>User group &amp; Context in general</b>	<b>14</b>
A1.1 Research Methods	16
A1.2 Visual Impairment	17
A1.3 Museum Context	20
<b>Current museum applications</b>	<b>24</b>
A2.1 Research Methods	26
A2.2 Results	29
A2.3 Social Experience	30
A2.4 Physical and Cognitive Accessibility	34
A2.5 Using senses: Vision	39
A2.6 Using senses: Touch	42
A2.7 Using senses: Audio	50
A2.8 Other senses & Techniques	54
<b>Design Brief</b>	<b>58</b>
A3.1 Goal and Challenges	60
A3.2 Scope and Requirements	61
A3.3 Interaction vision	63

## **IDEATION**

	66
<b>From ideas to concepts</b>	68
B4.1 Visitor scenarios	70
B4.2 Idea generation	72
B4.3 Idea evaluation	76
B4.4 Concept development	78
B4.5 Concepts	80
<b>Concept evaluation and iteration</b>	86
B5.1 Expert feedback	88
B5.2 Concept evaluation	92
B5.3 Concept iteration	94

<b>DEMONSTRATION</b>	<b>100</b>
<b>Concept detailing</b>	<b>102</b>
C6.1 Concept & Focus	104
C6.2 Vibration iteration	106
C6.3 Physical prototype	110
C6.4 The narration	114
<b>User testing</b>	<b>116</b>
C7.1 Test setup	118
C7.2 Results	120
C7.3 Insights	122
<b>Evaluation</b>	<b>124</b>
C8.1 Conclusion	126
C8.2 Discussion	127
C8.3 Recommendations	129
<b>References</b>	<b>134</b>
<b>Appendices</b>	<b>138</b>

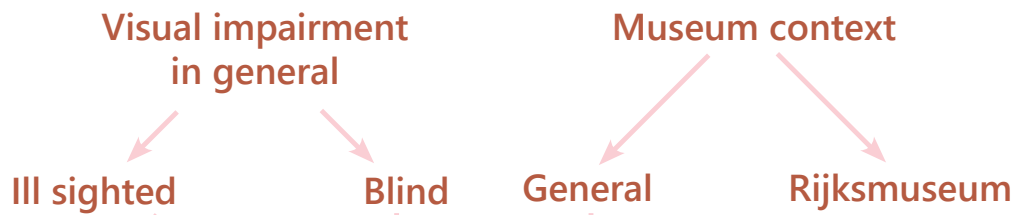
# ANALYSIS

This phase covers the analysis. The first chapter will take you through the foundation for the eventual design: the user, which are people with a visual impairment, and the context, which is a museum visit. The chapter covers the basic characteristics of the usergroup. Besides, the museum context is explored in order to understand why people visit museums in general, what is important for such visits and which experiences take place.

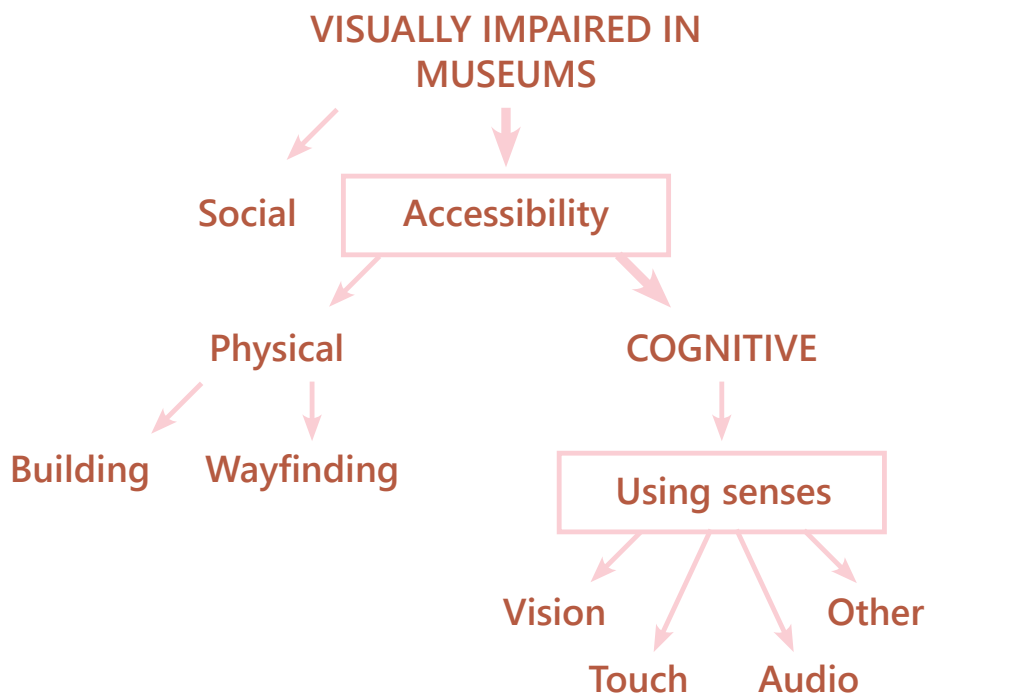
After clarifying the usergroup and context, the relation between them is covered in the second chapter. Section 2.1 and 2.2 explain the research setup and main results of the user encounters. Then, 2.3 to 2.8 describe these results more thoroughly, complemented by literature research. These paragraphs first cover social experience and accessibility in all forms, then the different senses and their relation to accessibility of art. At the end of every paragraph, the main insights are visualized.

As concluding chapter, the design goal is stated and explained. This will serve as starting point for the designing phase. Besides, the scope is defined, indicating what will and will not be taken into account and the requirements are stated, which the final design should meet. Last, the intended interactions of the design are caught in an Interaction Vision.

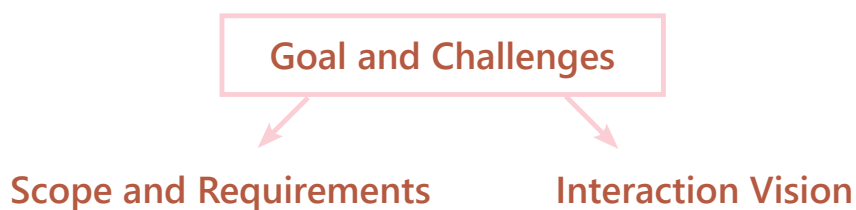
User group  
& Context



Visually impaired  
in museums

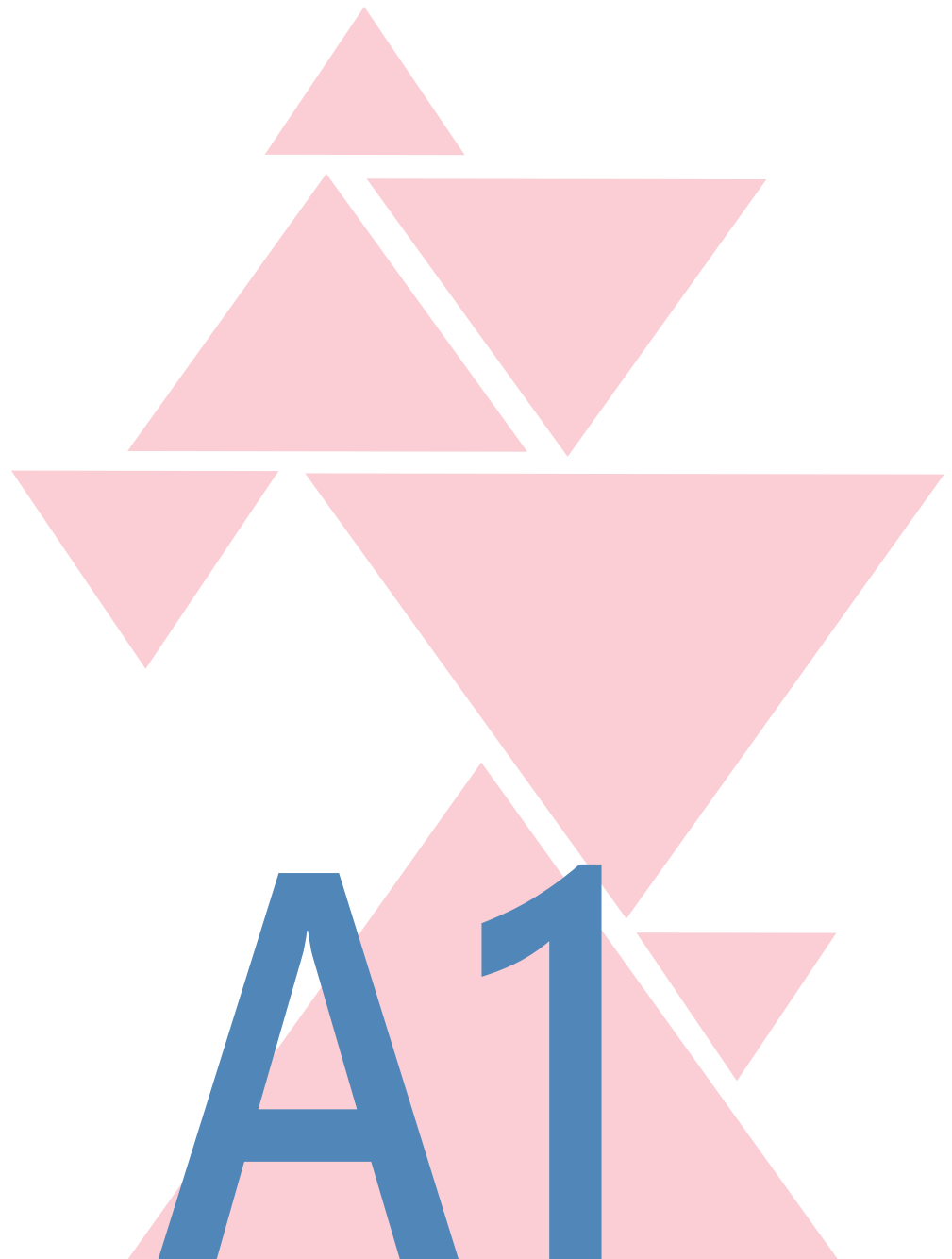


Design brief

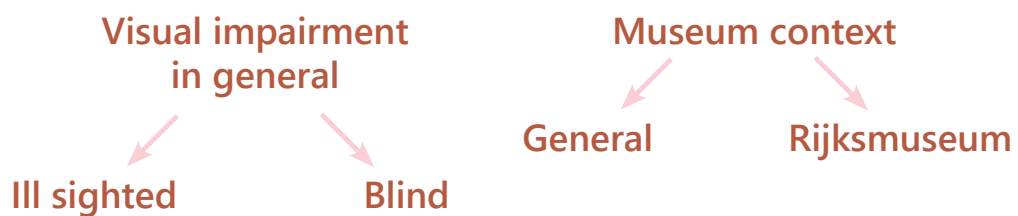


Schematic overview of the Analysis phase  
The thick arrows represent the chosen path

# User group & Context in general



*This first chapter will take you through the foundation for the eventual design: the user, which are people with a visual impairment, and the context, which is a museum visit. The chapter covers the basic characteristics of the usergroup. Besides, the museum context is explored in order to understand why people visit museums in general, what is important for such visits and which experiences take place.*



# A1.1

## Research Methods

In order to eventually design for people with a visual impairment, the implications of their impairment should be understood. Besides, the context where the design will take place, museums, has to be explored in order to understand where the eventual design will be placed.

### Research questions

- *Who is the target group?*
  - When is someone visually impaired?
  - What does their impairment comprise?
- *What is the context?*
  - What types of museums are there and how many people visit each year?
  - How are they trying to include (visually) impaired?
  - How is the Rijksmuseum doing in this matter?
  - Why do people go to museums?
  - Which experience(s) take place?
  - Which experience(s) are important for the visually impaired?

### Document review

To answer these questions, scientific literature has been consulted. This is complemented by documents like medical websites and statistics.

### Expert interviews

As addition to the document review, several experts from the museum world and advocates of the user group are, among others, interviewed about their knowledge of people with a visual impairment.

This will be explained more thoroughly in chapter A2.1.

# A1.2

## Visual Impairment

Worldwide, around 36 million people are blind and 217 million have low vision. (Vision2020, 2018). In the Netherlands this is estimated at around 260.000 people with low vision and around 82.000 people are marked as blind, according to a prognosis from 2005 (Limburg, 2007).

Visual impairment is defined as “when you lose part or all of your ability to see” (Vision2020, 2018). Williams (2018) adds to this definition by specifying that “The impairment must persist even with the use of eyeglasses, contact lenses, medication, or surgery.” It can be classified into four categories, according to WHO (image 1.1). These classifications are based on visual acuity and visual field.

Visual acuity means the clarity of vision. When having a clarity of vision of 0.3, this indicates the person can see an object from a distance of 30 meters, while someone with normal vision would see this object at a distance of 100 meters already (Oogvereniging, 2018). Visual fields explains the width of the field of view. A decrease in one or both indicates a visual impairment. Each country has its own scale, but these don't differ that much from the WHO, which is also used in the Netherlands.

	Visual acuity	Visual fields
Normal vision	more than 0.3	more than 30°
Moderate visual impairment	between 0.3 and 0.1	between 30° and 20°
Severe visual impairment	between 0.1 and 0.05	between 20° and 10°
Blindness	Less than 0.05	less than 10°

Image 1.1: The categories of visual impairment, according to the WHO

The female – male ratio of people with a visual impairment is about 2:1 (Limburg, 2007), meaning that twice as much women are visually impaired relative to men.



*Vision out of focus*



*Loss of central vision*



*Dark spots*



*Loss of side vision*



*Light sensitivity*



*Double vision*

*Image 1.2: Several effects of vision loss (Optelec International, 2018)*

## **Low vision**

Low vision can express itself in different ways. Some of them are: Vision out of focus, dark spots, loss of side vision or double vision. (Visio, 2018) This is illustrated by image 1.2. Many people with low vision often persist in using their remaining vision. Therefore, they are often still independent (Kal 2018, pers.comm., February 23).

Visual impairment is often due to ageing diseases like cataract, a clouded lens, or diabetes. Therefore, the majority of people with a visual impairment or blindness is over the age of 50. This also means that this group is increasing in size, due to aging of the population (Vision2020, 2018).

## Blindness

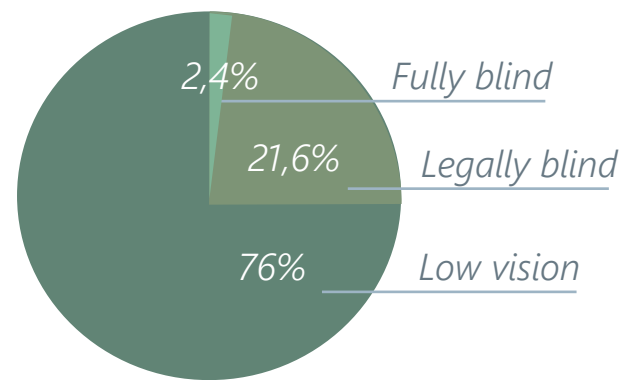
As seen in image 1.1, blindness means having less than 0.05 acuity. This indicates that people classified as blind might still be able to see contrast for instance (Oogvereniging, 2018). About 80% of the people called blind can still see something (Hopman, pers.comm., February). Since 24% of all people with a visual impairment is blind, the group of people who can't see anything is only nearly 5%, as seen in both diagrams.

A small group has been blind from birth, while a larger group becomes blind due to an accident or disease (Oogvereniging, 2018). Since many diseases that cause visual impairment are progressive, people with a visual impairment often have a large chance on becoming blind later in life (Optelec International, 2018).

### Early vision loss

When someone is blind from birth, this is called congenitally blind (Heller & Ballesteros, 2016). The main characteristic of people who lost their vision early (before about eight years old) is that they do not have a so called 'visual memory' (Hartjes 2018, pers. comm., February 20). Because their worldview is based on touch, audio and smell (Vlerick, 2009), they have no idea of colour or (2D) shape.

Since these people often have no memory of what it's like to see, they are well adapted to their situation. This, and their often received special education and training, makes them generally more confident and willing to use technology. Also many of them have friends with the same condition (SSMR, 2009).



*Total: All people with a visual impairment*

### Late vision loss

People who became visually impaired in later life can still recall on their visual memory. It is possible for this memory to fade and even disappear over time. Still, most of them do have an idea of space, perspective and colour. (Vlerick, 2009)

When having become blind recently, people can experience more difficulties for they know what it was like to be able to see well. Their independence is decreased and they can feel unsafe when leaving the house by themselves. Over time their confidence often increases as they get used to the situation and using other senses and learn to cope with their impairment. It is important for them to be able to keep doing what they have always done, be busy and be involved in social situations. (SSMR, 2009)

### Insights

There are great differences within the group of visually impaired, both in impairment and interests.

Only a small percentage is legally blind, so most of them can see something.

People with a visual impairment are often of older age.

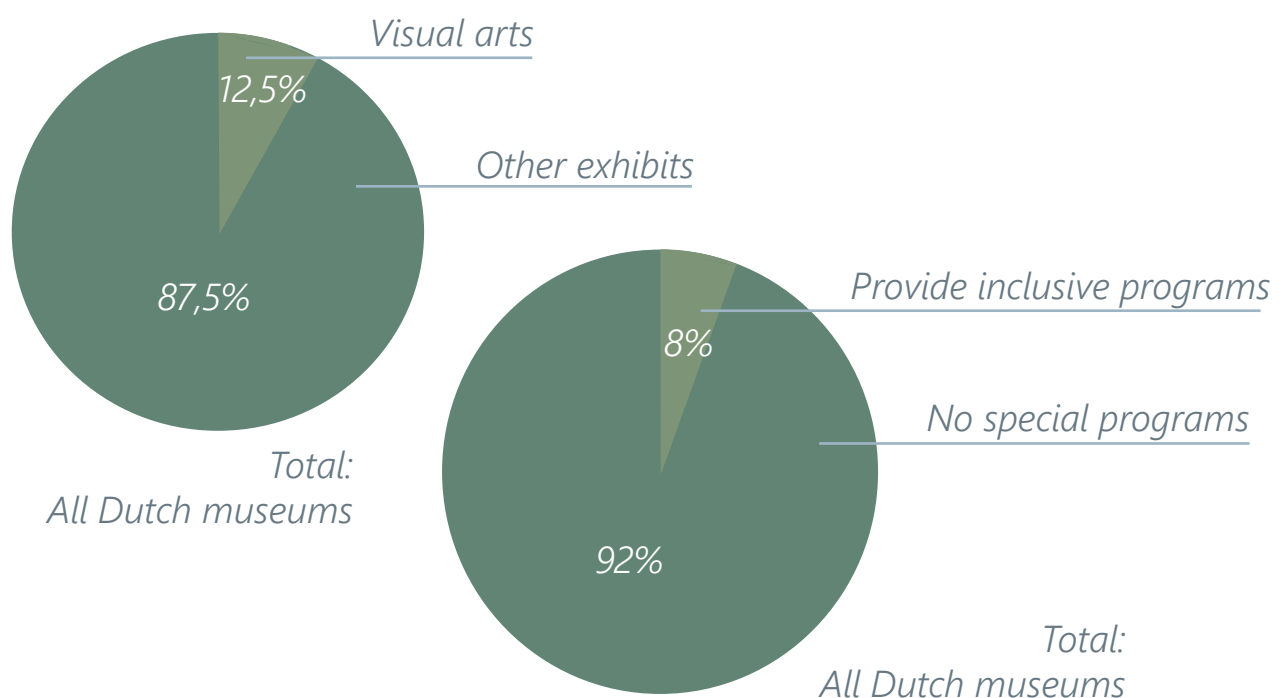
Most of them have seen earlier in life, so are aware of perspective and colours.

# A1.3

## Museum Context

The Netherlands has almost 700 museums according to the museum definition of the International Council of Museums. Their definition states that a museum is “a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment” (ICOM, 2007). Most of these museums exhibit historical artefacts and about 12,5% exhibit visual arts (CBS, 2017), like paintings and sculptures. Interestingly, the art museums attract relatively more visitors (AdresData). In total in 2016, around 34,4 million museum visits took place in the Netherlands, out of which 28 percent by foreigners (CBS, 2017).

Besides collecting, conserving and exhibiting a country's cultural heritage, museums also have a social task. They educate the public about (human) history and culture. Moreover, they promote unity by showing the common background of the visitors (Arinze, 1999). In order to do so, everyone should be included. However, in 2016 just 8% of the Dutch museums had programs for deaf or ill-sighted people (CBS, 2017) as seen in the diagram. Since these programs mostly exist of special tours, one might say almost no museum is fully accessible yet.



## Rijksmuseum

The final design should fit in the Rijksmuseum. Therefore, their facilities and possibilities are explored here.

### *Facilities for impaired*

When arriving at the museum by car, one can't park closely to the entrance. Some parking spots for handicapped are nearby. As stated on the website, the accessibility through public transportation does not always meet the requirements for visually impaired.

Within the museum, there is a 'fast lane' and special wardrobe for people with an impairment. The special groups provided for are people with a physical, hearing or visual impairment and people with a form of autism.

### *Programs and applications*

Once a month people with a hearing impairment can follow a free guided tour. An interpreter uses sign language to explain a different theme every month. Furthermore, children can use a tailored app which features role models and invites them to participate through the app Snapchat.

People with a visual impairment can borrow enlarged maps of the building and enlarged books of the high society. Dogs are allowed.

### *Coordinator Inclusion*

In order to improve the inclusion of several groups, the Rijksmuseum has appointed a coordinator especially focussed on making the museum physically and cognitively accessible. The main focus to start with will be people with a visual impairment and people who are stimuli sensitive.

## *Other programs and applications*

### *Rijksmuseum app*

This app features an interactive map with guidance on where to go. Furthermore, it provides different tours with spoken and visual information. One can scan the artwork to receive detailed information.

### *Tours and workshops*

There are several, mostly free, guided tours, classified by theme. Then, there are drawing tours and workshops.

### *Inzoomers*

Even though the gallery of honour is very crowded and additions to the building aren't desirable, the Rijksmuseum features so called 'Inzoomers'. These are detail maps, image 1.3, in boxes within the room, image 1.4, which give extra information about selected artwork. One can take such an image and place it back afterwards. They are used eagerly.



Image 1.3: Inzoomer (Rijksmuseumshop, 2018)

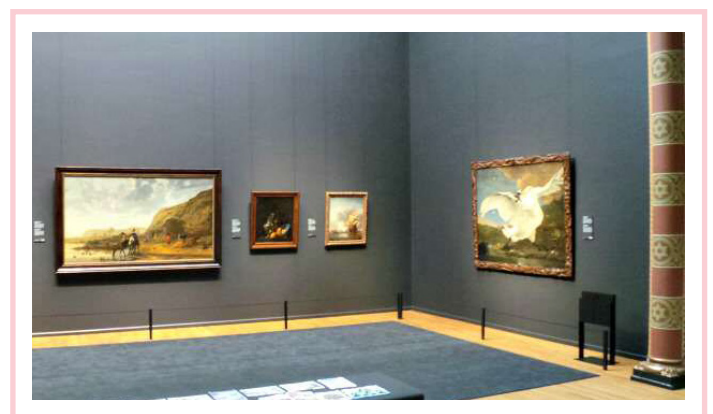


Image 1.4: Gallery of Honor (Mixed Grill, 2013)

## Museum experience

The experience of museum visitors isn't easily generalizable. It involves many personal characteristics like physical, intellectual, social and emotional background (Pekarik, Doering & Karns, 1999). These aren't the same at every moment and can change even over a short period of time (Smith, 2014). Their characteristics and previous experiences influence and help shaping the experience at that moment (Schaper, 1986).

According to the Smithsonian Institution (2002) there are four main types of experiences:

### **Object experiences:**

Being moved by beauty or seeing something real, rare and uncommon.

### **Cognitive experiences:**

Acquiring knowledge and enriching understanding.

### **Introspective experiences:**

Imagining other times or places and reflecting on meaning of what we see.

### **Social experiences:**

Interaction with others.

*(Smithsonian Institution, 2002)*

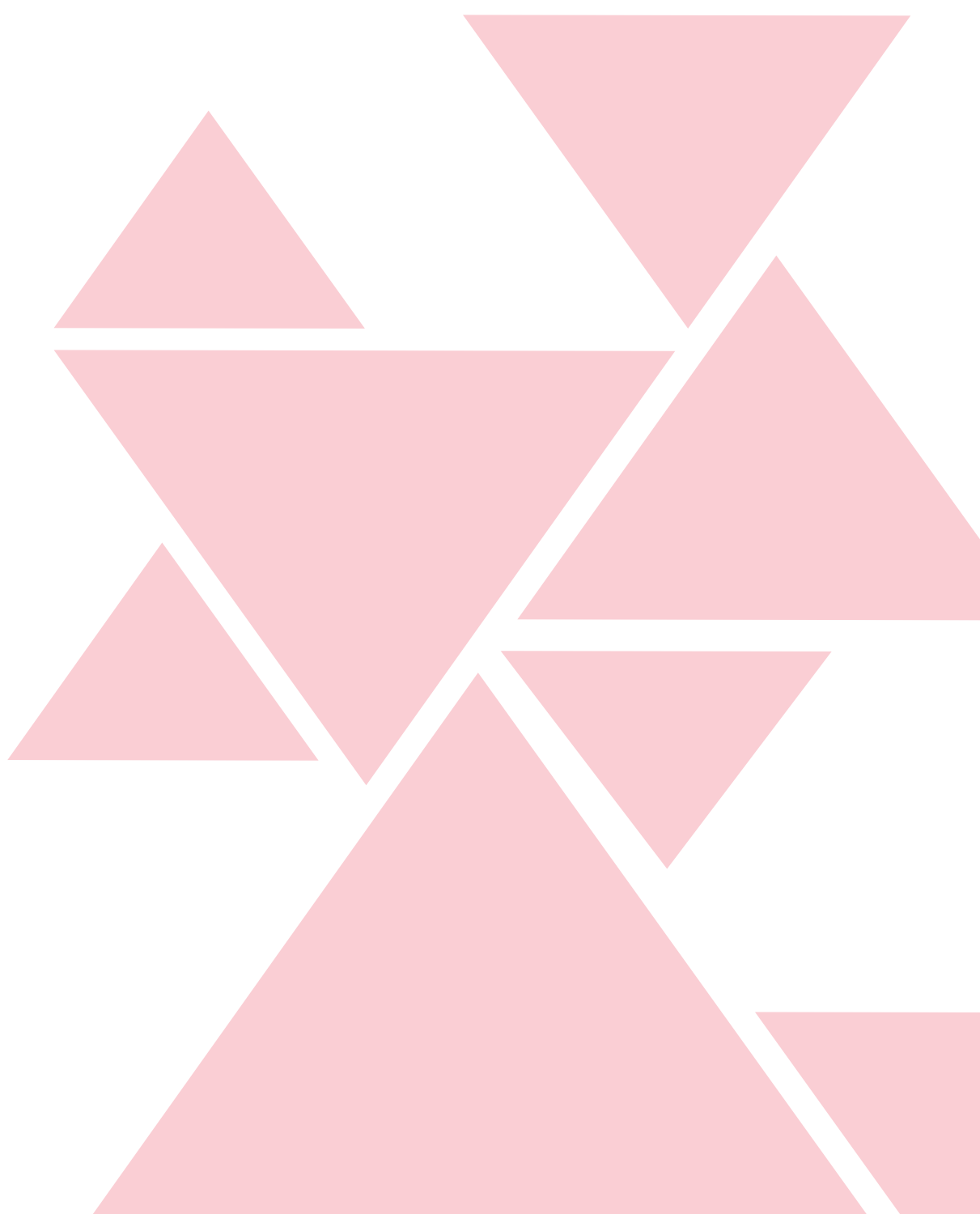
The strength of the effect partly depends on whether the visitor is open to the experience. The art acts as a 'mirror', making one reflect on their own lives. This is especially strong in museums, for there are multiple works of art, causing the visitor to reflect on different sides of oneself (Smith, 2014).

## Viewing time

The visitor study of Davey (2005) found that museum experience changes over time. The visitors interest and selectivity decreases during their visit, due to an information overload, physical tiredness, personality and (an interaction with) the environment. This is called museum fatigue.

Smith & Smith (2001) found that in general, sighted museum visitors spend just a few seconds looking at an artwork. Some of that time is even spent reading the caption. Spending more time at an artwork that speaks to you will, according to Professor Pawelski, help you to see more, connect to it and feel refreshed (Rosenbloom, 2014). This indicates that looking at art longer increases understanding and decreases museum fatigue. Besides, the Italian artist G. Gimini (2016) has shown that even though people have seen something a thousand times, they still can't remember it correctly. In an art project where he let people draw bikes from memory, this became very clear as the majority didn't even come close.

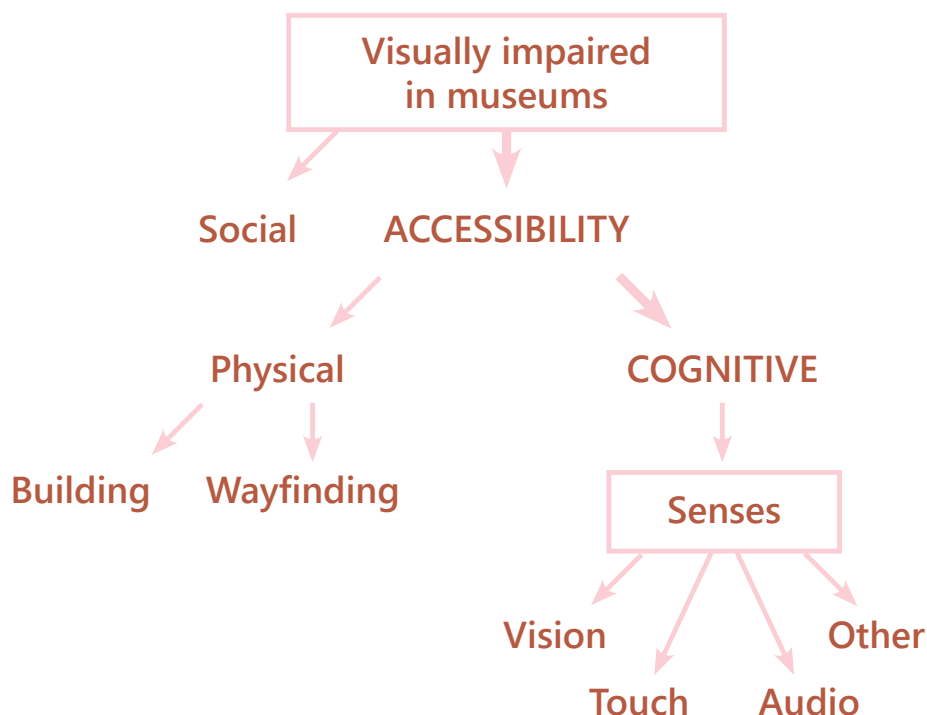
When people with a visual impairment visit museums, they often spend much longer with one work of art, for it takes time to understand the image or object. Therefore, it can be assumed that they have a deeper understanding of the art in the end and feel more connected to it. This indicates that a design for people with a visual impairment can also be useful for people with normal vision, for they might examine the art more thoroughly. Therefore, even though people with a visual impairment are just a small group, designing for them can be very valuable for a museum.



# Current museum applications



*After clarifying the usergroup and context, the relation between them is covered in the second chapter. Section 2.1 and 2.2 explain the research setup and main results of the user encounters. Then, 2.3 to 2.8 describe these results more thoroughly, complemented by literature research. These paragraphs first cover social experience and accessibility in all forms, then the different senses and their relation to accessibility of art. At the end of every paragraph, the main insights are visualized.*



# A2.1

## Research Methods

In order to provide people with a visual impairment with a well suited museum visit, their needs and expectations regarding to such museum visits should be explored. Besides, since the visual sense is not the main focus, the other senses are to be understood well.

### Research questions

- Why is a museum visit interesting for visually impaired people?
- What is important to them (when visiting a museum)?
- What is already done? What can be improved?
- How do people with a visual impairment relate to the other senses?
- How can the other senses be exploited within the context?

### Document review

Various types of documents have been reviewed to serve as a starting point for this analysis report. Scientific literature is complemented with (museum) accessibility guides, books and reports.

### Field research

#### *Expert interviews*

About seven experts were interviewed on their experience with the needs of the user group and current practices in museums. Others were consulted on their expertise upon certain senses or techniques related to visually impaired people. The questions and results can be found in appendix A1 and A2.

#### *Guided tours in Dutch museums*

In order to understand the current practices and how these came to be, five museums were contacted that either have a tour already or are setting up one. Two of the interviews were done by phone, three face to face. These were semi structured interviews.

#### *Companies and foundations*

These companies and foundations stand for the needs and interest of visually impaired. They provide information and equipment for this group and were therefore addressed due to their experience with the target group and specific practices regarding them.



2.1 'Couple with their Heads full of Clouds'- Dali



2.2 'The Peddler'- Jeroen Bosch

### *User interviews and observations*

#### *Joining guided tours*

Through the contact with museum experts, two tours could be joined, one at Boijmans van Beuningen and one at the van Abbemuseum.

At Boijmans, four visually impaired visitors participated, one blind (Hilde) and three with low vision (Anton, Isabel and Yfke). The paintings visible in image 2.1 and 2.2 were addressed during this tour.

At Van Abbemuseum also four people participated, two blind (Henk and Evelien) and two with low vision (Mirjam and Bas). The paintings visible on image 2.3 to 2.5 were visited.

#### *Other interviews*

Apart from the guided tours, four people with a visual impairment were interviewed upon their experiences (Peter, Evert, Marjolein and Dries). Since most of these encounters took place spontaneous during different times of the process and with different purposes, these interviews were casual.



'What kind of bird are you?'  
2.3 - Max Ernst



'Senza Titolo'  
2.4- Jannis Kounellis



'Concetto Spaziale: Atteze'  
2.5- Lucio Fontana

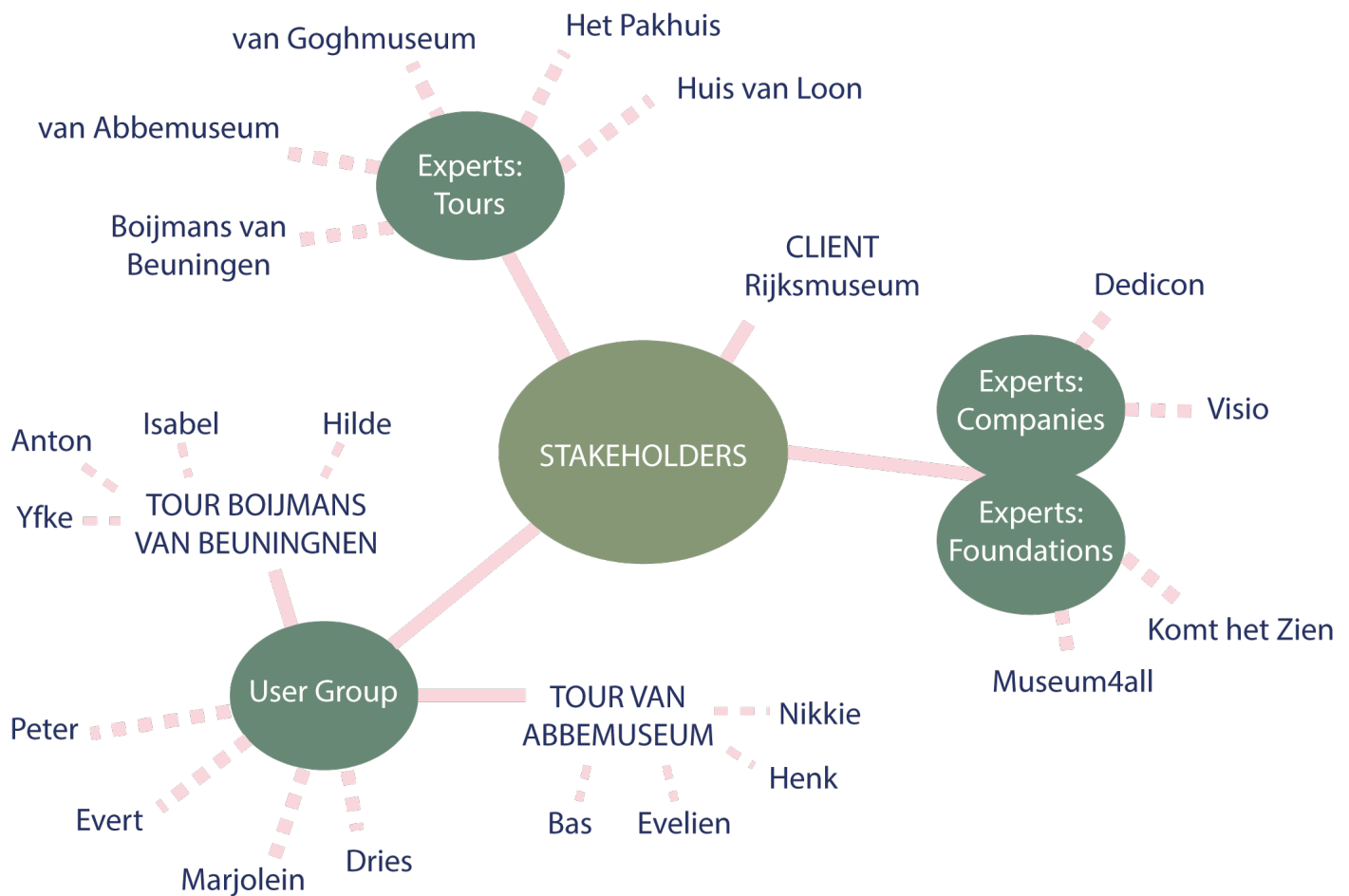


Image 2.6: Stakeholder overview  
The names of the people involved in this research have been changed

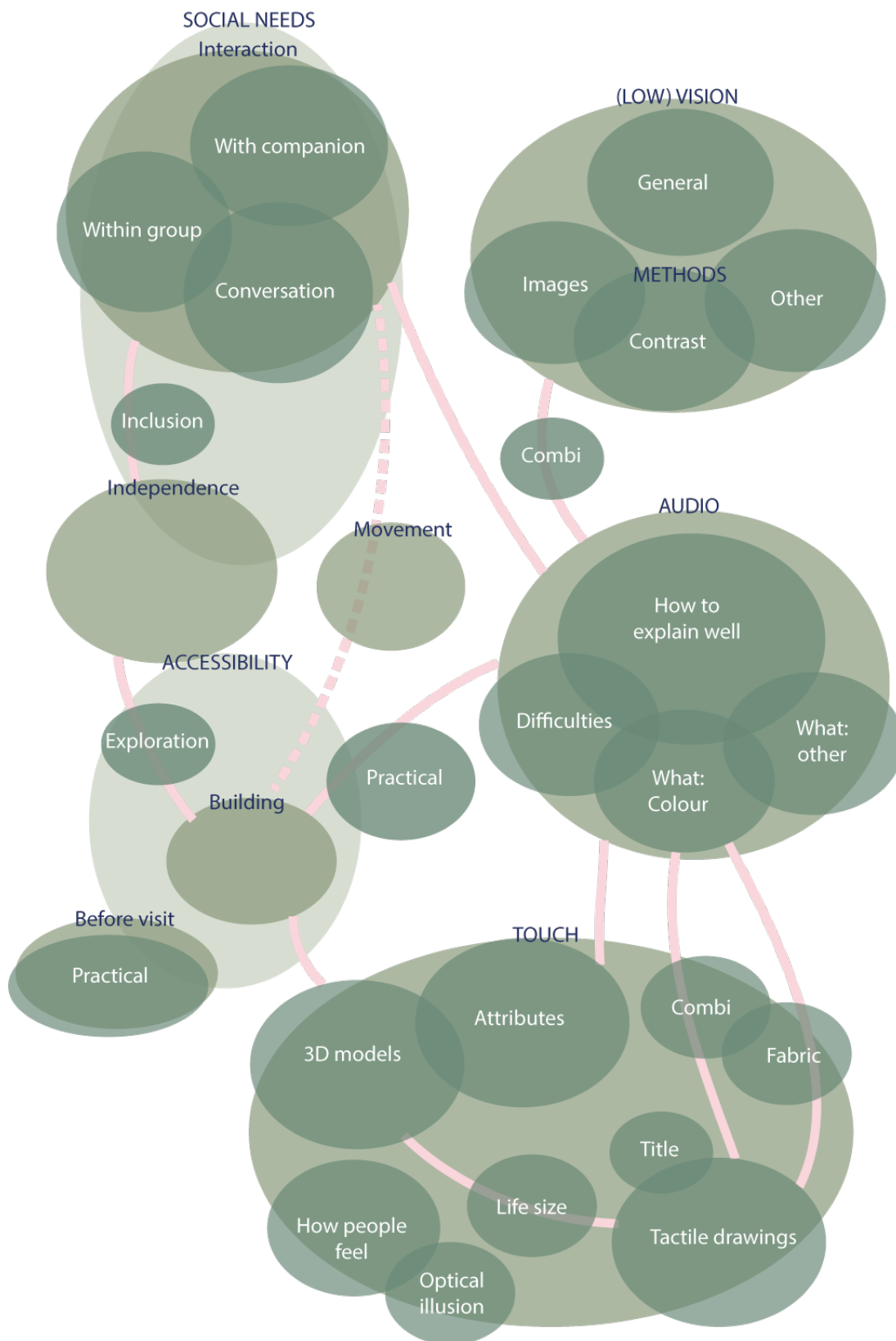
## Analysis method

The documents about museum accessibility and several expert interviews were analysed with the focus on museum experience of visually impaired people. Here from, attention points were derived and grouped into three categories: Visually impaired, Visitor behaviour and Interaction with art. Translated into a format, these could be used as a starting point for the joined guided tours.

Throughout the tours, notes were made according to observations, their feedback afterwards and casual interviews during and after the tour. These can be found in appendix A3.

The notes of both tours were translated into new attention points, which could be grouped independently from the previous categories, as seen in chapter A2.2. These are used as guidelines for the structure of the report and complemented by other literature and expert interviews.

# A2.2 Results



*Grouped insights of both user encounters during the joined guided tours.  
The main categories (in capitals) are explained in chapters A2.3 to A2.8.*

# A2.3

## Social Experience

### Independence

Many people with a visual impairment want to be treated like anyone else and live their life as normal as possible. This is important for both younger people, as they want to fit in and prove themselves, and people becoming visually impaired later in life, because they want to live like they used to. Therefore independence is of great importance. This means not being patronized or people doing things for them. (SSMR, 2009)

People with low vision are often more independent, due to their (little) sight (Kal 2018, pers.comm., February 23). This was confirmed by Anton who often visits museums by himself and Henk and Evelien who go together with just the two of them. Especially when being blind, traveling to new places can be a burden. It requires a lot of planning and confidence (SSMR, 2009) and often reliance on relatives (Mesquita & Carneiro, 2016):

**Peter:** *'I followed training to go out on my own, but I never visit an area alone where I haven't been before.'*

According to Adam (2017), this is the case when getting older in particular.

### Inclusion

To be treated like everyone else, there is a need for social inclusion (Candlin, 2003): Many people with a visual impairment do not want to be separated from others and be able to do activities with sighted people as well (SSMR, 2009). They want to take part in normal activities for sighted people (van Uffelen, 2018, pers. comm., March 7). This works the other way as well: There is a wish from sighted people to include their impaired friends and family.

**Bas' companions:** *'We visit the museum more often and like that we can share this experience with Bas now.'*

Furthermore, visually impaired visitors would rather be in the museum during visiting hours, even though it might be more impractical due to noise etcetera.

**Hilde:** *'It's difficult to focus with all people walking by. But I'd rather have to focus more than being apart from the other visitors.'*

Although some visitors with a visual impairment who follow guided tours on a more regular basis like to have the benefits of their special status.

**Dries:** *'We can touch some things that others can't and go places others are not allowed to go.'*

When it comes to inclusion, leisure (or free time) plays an important role. To choose and do an activity whenever one wants to will improve their cognitive and social skills, decrease stress and increase their self-confidence (Adam, 2017). According to a recent study in Ghana, visiting recreational areas is, after jogging and playing board games, high on the wish list of visually impaired as it comes to leisure activities (Adam, 2017). This includes museum visits. For many visually impaired visitors a museum visit is, besides an art experience, also a social occasion. This was visible at the tour at the van Abbemuseum, where most of the visitors and the guides knew one another and came back often. Being among the people, feeling the atmosphere and the space already plays an important part in feeling included (Candlin, 2013).

**Bas:** *'Before I only saw art on television. I liked being here in front of it.'*

Low income and the way people with a visual impairment are treated by others can be obstructive when it comes to visiting museums. Often sighted people are not aware or supportive and can offer unwanted help (Mesquita & Carneiro, 2016). They may feel like being treated as mentally impaired as well (Candlin, 2003) or be hindered in their ease of movement (SSMR, 2009).

## Interaction

As said, visiting museums is a social occasion too. Social interaction about art can help shape opinions and enhance the museum experience (vom Lehn, 2010). Dialogue forms the basis of inclusion (Cachia, 2013) and there is a need for personal relationships among the visually impaired (SSMR, 2009). For many became visually impaired in later life, they have close contact with sighted people and often visit museums with a sighted companion (vom Lehn, 2010). Isabel, Nikkie, Peter and Dries have a sighted partner. Also, Hilde, Yfke and Bas visited the museum with sighted companion. Most interaction therefore occurs between visually impaired and these sighted companions, which is confirmed by van Uffelen (2018 pers. comm., March 7). This can lead to new insights for sighted people as well.

**Anton:** *'The colours in the woman painting are less bright than in the man. Is that on purpose?'*

**Dries:** *'One of the blind visitors felt the sculpture and noticed the muscles were tight, like she had to go to the toilet. None of the sighted people had ever noticed that before.'*

Conversation can be more challenging for visual cues like body language can't be seen (SSMR, 2009) and people who are early blind have less facial mimicry for sighted people to read (Peter, 2018, pers.comm., February 8), but this seems mostly challenging for new encounters.

When a group knows each other and visit museums more often together, group interaction appears more present. The participants at van Abbemuseum were interested in each other's experience and asked questions to one another.

**Evelien:** *'I liked what you said about..'*

Still, the group discussion at van Abbemuseum had to be led by the guides though. Questions about the personal opinions were hereby important, as well as direct questions to the ones more on the background. This seemed to make people form their own opinion, get different perspectives and therefore create a deeper understanding of the artwork. In Boijmans van Beuningen, this interaction was less present, due to the guide only asking for questions in the end and not triggering any interaction.

## Expectations

When going to a museum, visitors with a visual impairment have several expectations. This was found during both tours. They want (different levels) of information and have an (aesthetic) experience, as seen on image 2.7

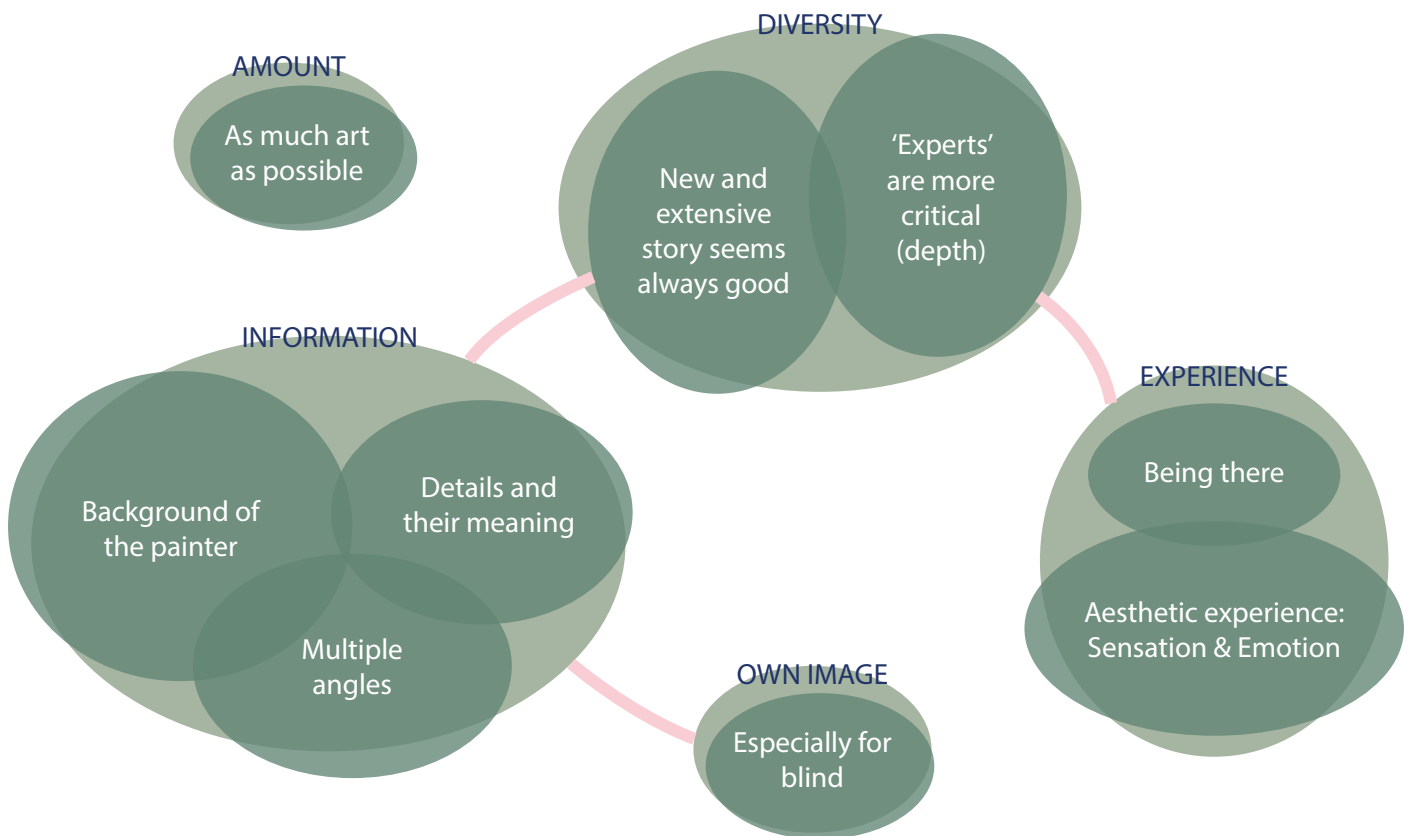
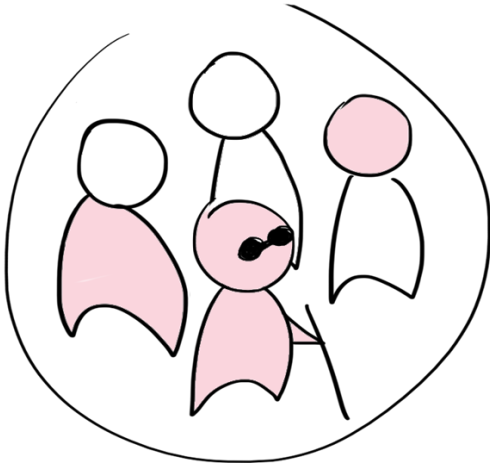
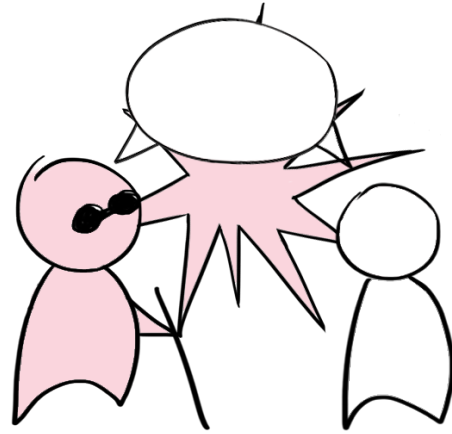


Image 2.7: Grouped expectations of what of the art should be conveyed by several visitors of the two joined tours

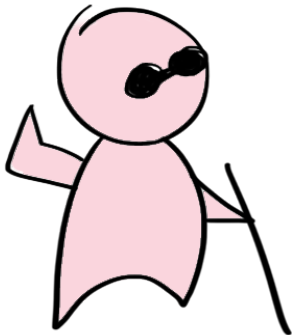
## Main insights:



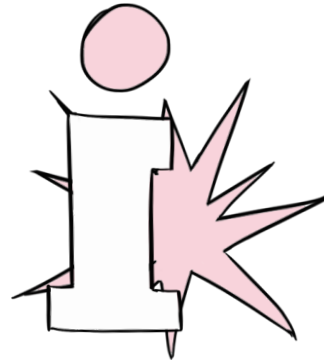
*Visually impaired visitors want to be included with the normal visitors*



*Interaction between sighted and visually impaired leads to a deeper, more enjoyable experience for both groups*



*Visually impaired visitors would like to visit museums whenever they like and be independent*



*Visitors expect both an informative and experience based visit*

# Physical and Cognitive Accessibility

Accessibility means that all people, with or without a disability, should be able to take part of society in a normal way, best independently. This doesn't state physical access only, but includes access to information as well (DBSV, 2011). In order for visually impaired visitors to access art, they should first be able to (independently) access the museum and find their way through.

## Why museums should take effort

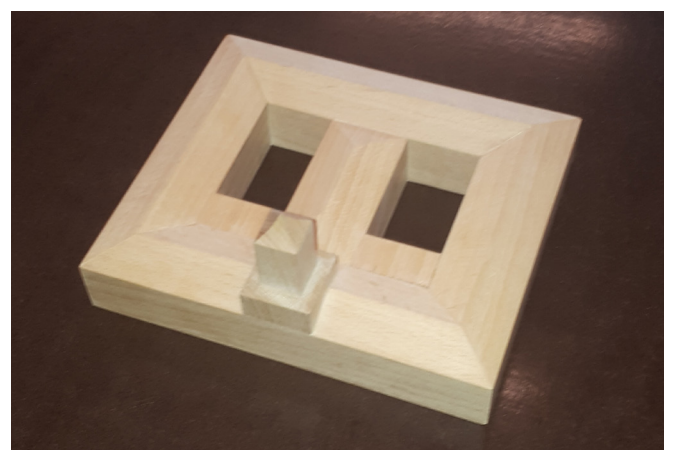
A museum should be accessible for all disabled groups (Cachia, 2013). Their value depends partly on their cultural objects, but also on the information it conveys to the public. Therefore, a museum loses value when visitors with a(n) (visual) impairment are unable to experience the artworks and artefacts (Mesquita & Carneiro, 2016). Furthermore, a museum works as reflection of the cultural and social identity (Cachia, 2013), so should give an example by providing for all visitors with a disability. This is even legally defined in the United Nations Convention on the Rights of Persons with Disabilities (2006) which is now has become in force in the Netherlands as well.

With regard to physical disabilities like people in wheelchairs some action has already been undertaken, but providing for visitors sensory disabilities seems more difficult (Handa, Dairoku & Toriyama, 2010).

Accessibility begins whenever the visitor wants to visit a museum, already before actually going. The right information should be accessible through multiple channels. This is necessary in order to reach most people with a visual impairment (Dewitte, Jacobs, & Mellarets, 2009). The following paragraphs will outline what visually impaired visitors need when actually going to the museum.



*Image 2.8: Wooden stairs at Boijmans (Museum Boijmans van Beuningen, 2018)*



*Image 2.9: Scale model Van Abbemuseum*

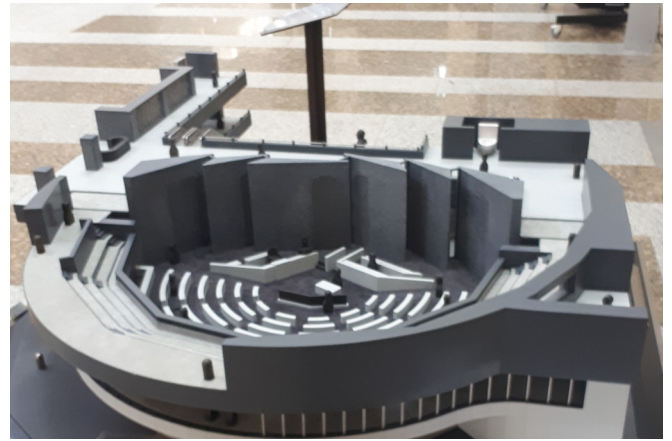
## Building

A building is accessible when people can “function independently and equally”. This means everyone should be able to interact with the building and be able to go around without help of others. Sighted people normally take in a new environment in one glance. This isn't possible for the visually impaired, which makes them feel insecure and in need of specific guidance. In order for people with a visual impairment to orient themselves throughout the museum, all areas should be easily accessible. This already starts outside with a clearly visible entrance. Within the museum, appropriate indoor design is important.

**Anton:** *'How are we going back? I'm not going down that wooden stairs!' (Img 2.8)*

For people with a visual impairment, objects and obstacles should provide tactual and audio feedback (Wijk, Drenth & van Ditmarsch, 2003). Also the right light, providing routing through colour or tactile additions are important. (Mesquita & Carneiro, 2016). Besides, knowledge of the building in general through for instance scale models can come in helpful.

**Nikkie** when the building of an earlier visit was explained to her through a wooden replica (Image 2.9): *'Ah now I get what you meant with symmetry. We were here? Good to know! I would like to have this of the other building as well.'*



*Image 2.10: Scale model Tweede Kamer*

A good example is the audio-tactile scale model of the Tweede Kamer in the Netherlands, especially developed by and for visually impaired visitors as seen on image 2.10. By touching certain beacons within the model, auditive information is provided. The visitors can turn on different sound layers: background noise, guide explanation or explanation by the architect.

Most of the literature and experts discuss the building in a practical way, while barely any of them talks about the building as part of the experience. Still, from the user encounters arose that many of the visually impaired visitors would like to get a grip on this as well. Hilde and her companion stood still in most rooms to explaining what it looked like and what was there. She also stated this in the end, which was confirmed by the rest of the group. In the van Abbemuseum, the look and feel of the room was part of the experience which the group could discover on their own. This was perceived as pleasant.

**Evelien:** *'I liked that we first could explore the room.'*  
Rest of the group agrees.

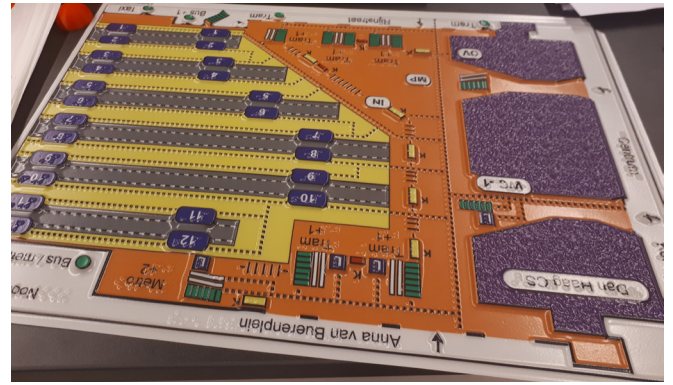
## Wayfinding

When visitors with a visual impairment are able to walk through a museum themselves, they still need to know where they are and where to go. Also, it is important for them to identify obstacles and which items can or can't be touched (Mesquita & Carneiro, 2016). There are many ways to help a visitor navigate through the museum, which will be outlined in the following paragraphs.

First, tactile information can be used. As discussed in the previous part, scale models can be very effective. Only they are difficult to take through the museum or to be placed in every room.

Relief maps are in that way more easy to take along. Both provide a good overview of the different museum locations relative to one another (Mesquita & Carneiro, 2016). Relief maps do need time and explanation in order to understand. Only giving a legend doesn't do the trick. Furthermore they work better with multiple layers, providing more information than raised line drawings (in 't Veld, 2018, pers. comm., March 16), as seen on image 2.11. It can't replace all other navigations, but can give an opportunity to understand the site (scale, layout etc.) (VocalEyes, 2016).

Also additions to the building can be used for wayfinding. These can be edges, paths for their cane or different floorings and acoustics. Especially interesting are so-called attention fields (Image 2.12): relief on the ground indicating the presence of an artwork, obstacle, chairs, stairs, etcetera (DBSV, 2011).



*Image 2.11: Relief with depth of a station*



*Image 2.12: Attention field  
(Kumar, L., 2018)*

Sound systems can be useful as well (Mesquita & Carneiro, 2016). Around two third of the participants in the research of Freyer, Freeman & Pring (2013) preferred audio over tactile maps. This can be provided in several ways like GPS or infrared, also see chapter 2.6. Ginley (2013) found that directional information appears to be difficult in complex buildings. According to him, self-guiding in large museums only works with internal GPS-like systems.

When it comes to the way of providing audio, it is important to use the right language. Using stride length or visual cues for instance isn't effective according to Ginley (2013). Still, people with a visual impairment are very able to understand and apply spatial information. Verbal directions are preferred over non-verbal signals like beeps.

When visually impaired describe routing themselves they use twice as many words as sighted people. Besides naming turns, it seems important for them to note many checking points verifying the way, even multiple at one spot or the absence of checking points. These can be roads (including the names), pedestrian crossings, cages, stairs and smaller items like street furniture. Their canes can provide tactile, audio and spatial information, so it's important to appoint these. Other auditory feedback and smell are unreliable. (Freyer, Freeman & Pring, 2013)

Last, having someone to guide a visually impaired person is also possible. This can be done by a companion, but also by a museum guide (Image 2.13). When being guided by a specially trained museum guide, this is often done in a group. With just one guide, it can be difficult to keep the group together and give everyone the guidance needed. As stated by several experts and seen at both museum tours, the group moves slowly and fragmented. During the tour in Boijmans, another interesting difference was noticed. The visitors with low vision stayed longer at one painting to actually look at it while the blind visitors left whenever the talk was done, for there wasn't anything else to discover.



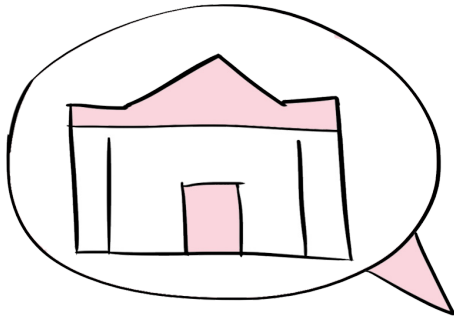
*Image 2.13: Guided tour at Boijmans*

## Exploration of the art

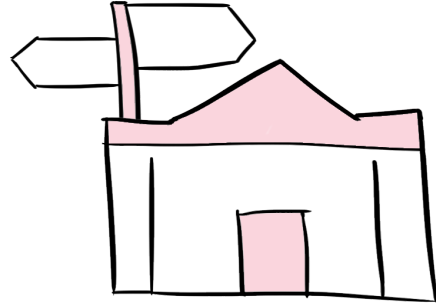
Besides being able to find the art, the visitor should be able to explore it as well. This means receiving information about the artwork both during, but also before their visit (Mesquita & Carneiro, 2016). For there are many differences within the group of people with a visual impairment, both in the impairment and in background and knowledge, one should provide different sources of information (Beerens & Stichting Dedicon, 2017; Candlin, 2003).

This information should be on different levels of depth and detail. When choosing the easiest, most straightforward explanation, more experienced visitors might feel overlooked (Candlin, 2003). Also, here there are differences due to their impairment. For instance for people who have been blind from birth it is hard to understand 2D art. Still, they can be interested in (art) history and wanting to meet the masters (Vlerick, 2009). This does mean that there isn't just one approach which works for all. Therefore, it is important to provide information through different ways, so everyone can choose the one of their liking (Beerens & Stichting Dedicon, 2017). The main two approaches often offered by museums are audio and touch (Mesquita & Carneiro, 2013). Ways to explore the art through the different senses will be approached in chapter 2.4 to 2.7.

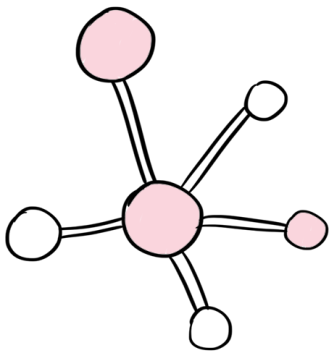
## Main insights:



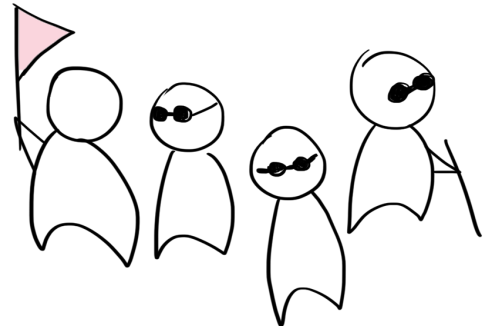
*Explanation about the building is valuable and wanted*



*Both the building and wayfinding should be taken into account for an independent museum visit*



*No one way works for all, so different approaches are needed*



*It's hard to keep a group together when moving*

# A2.5

## Using senses: Vision

As discussed in A1.1.3, there is just a small group of people that really can't see anything. The majority of the ones who can still want to use their remaining vision (Vlerick, 2009; Kal, 2018, pers. comm., February 23). This was also observed during both museum visits, so, providing for low vision is an important requirement. Even though the different visual impairments make it difficult to provide for every visitor, there are several ways in which visual accessibility can be improved.

### Closer and larger

Looking up close is often preferred by visitors with little vision (Vlerick, 2009). Due to fragility of the art, this is often not possible (Uffelen, 2018, pers. comm., March 7). Therefore, a replica could be a possible solution.

**Anton:** *'I liked the copy of the 'Heads full of Clouds'. It allows me to look closely.'*

Kal (2018, , pers. comm., February 23) explained in personal communication on February 23 that because they have to focus more on what they see, they often look better and longer. This was confirmed during one of joined guided tours:

**Anton:** *'Seeing just takes more time. I often visit museums twice. Once to take a global look, then to study those I really like.'*

In order to get a better grip on the art, having enlargements also works very well, especially for detail (Vlerick, 2009). During the visit in Boijmans, all the visitors who were able to see something liked the enlargements of 'the Peddler' very much.

**Anton:** *'I can look closely and see every detail very well.'*

**Isabel:** *'It supports the story and conveys the image easier.'*

Besides having separate enlargements, this can be done manually as well with the use of aids (Vlerick, 2009). Magnifying glasses, screens and portable devices are useful (Mesquita & Carneiro, 2016). Some people even take their iPad to make photo's and enlarge them on their screen (Leeuwen, 2018, pers. comm., February 20).

Last, when the artwork is too large, it can't be viewed as a whole, which makes it difficult to interpret (Vlerick, 2009). Therefore, people need some space. Distance helped Bas in the Van Abbemuseum to see the whole outline of 'Panting Crow' by Elly Strik (Image 2.14). Another possibility to provide for this would be to give a smaller replica.



Image 2.14: 'Panting Crow' - Elly Strik  
3x1.5 - needs distance to be viewed

## Text and description

Besides taking a better look at images, the text explaining the art should be taken into account as well. This is used by approximately 75% of the visitors with low vision and 36% of the blind visitors (VocalEyes, 2016). Here clear panels and identification labels are important (Mesquita & Carneiro, 2016). Having information on separate papers works even better, so visitors can take them and look closely (Dewitte, Jacobs, & Mellarets, 2009). In both cases, the information should be easy to find and the placement consistent in every room (VocalEyes, 2016). It is also a possibility to make information downloadable on forehand so people can read them on their own devices (VocalEyes, 2016).

Really specific, the typeface should, according to the VBFO (2011), be sans serif to easily distinguish between the letters, preferably Arial, Verdana or Helvetica and 16 pt or more as advised by VocalEyes (2016), depending on the viewing distance. Furthermore, Mesquita & Carneiro (2016) advise the line spacing to be at least 25% of the text, so the lines won't blend in with one another.

## Contrast and Colour

The human visual system is very sensitive to edges and directions of edges (Hartcher, 2018, pers.comm., March 15). Therefore, contrast is very important. This can, among others, be achieved through brightness. Also, when having an artwork in more or less the same shades, it can work very well to pick out details and put them on a separate background, for it creates these edges and provide focus. This was used in the tour of Boijmans with the enlargements of 'the Peddler' and perceived well. More contrast is also important when it comes to objects. There should be a clear distinction between the object and the background (Kal, 2018, pers.comm., February 23).

It's very useful to pay attention to colours, for not everybody can see every colour, differences between them (red/green for instance), no colour at all or have difficulties with contrast (Vlerick, 2009, Daams, 2013). Therefore, one should be aware of colour blindness and provide for proper contrast. Besides, in communication it's important not to use colour only, but visual elements and text as well. In the case of written text, there should be high contrast between the text and the background, as seen on image 2.15. (Beerens & Stichting Dedicon, 2017)

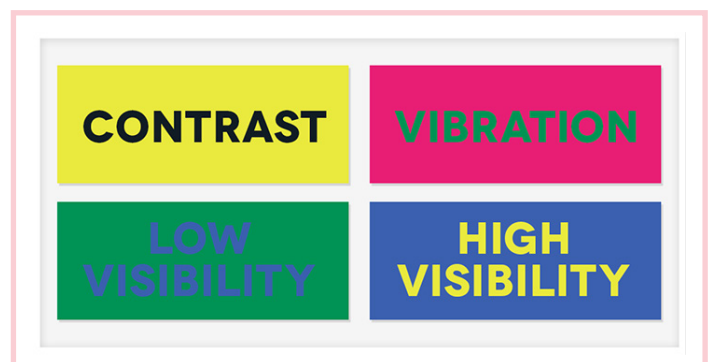
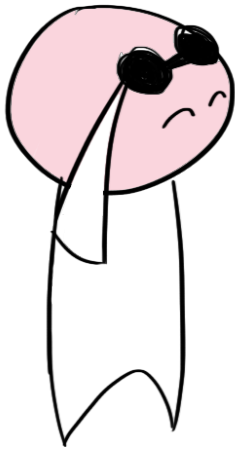
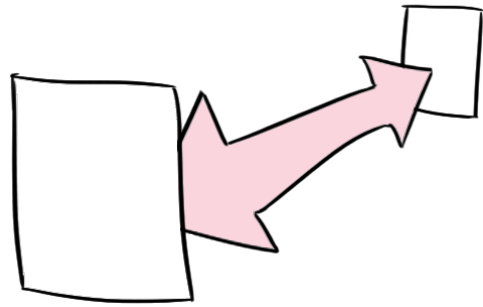


Image 2.15: Readability explained through colour contrast (Beerens&Stichting Dedicon, 2017)

## Main insights:



*Many visually impaired want to use their remaining vision, so this should be provided for*



*Visibility of an artwork can be increased by reducing the viewing distance or, for example, by using enlargements*



*An artwork can be conveyed piece by piece; Applying focus appears helpful*



*Edges and contrast increase visibility*

## A2.6

# Using senses: Touch

When sighted people use the verb 'seeing' they often mean 'perceiving'. It is also related to (keeping your) distance, while touch is related to closeness and the social sense (Sonneveld & Schifferstein, 2008). Therefore, 'touching' is often related to 'feeling'. For people with a visual impairment, this is different. They perceive through touch, and therefore use the verb 'seeing' as well. Touch is thus a logical sense to use in relation to art. It allows for deeper exploration with more detail, a more independent experience and confirmation of information (Mesquita & Cerneiro, 2016).

The main difference between seeing and feeling is that seeing provides an overview in one glance. Feeling, especially in 2D, is done serial and works from detail to the whole. This makes it more difficult and time consuming (Wijntjes et al, 2008). What is also important in regard to making art tangible, is to learn how to provide for active touch, which will be explained in the next paragraph (Handa, Dairoku, & Toriyama, 2010). Many museums don't pay enough attention to how people touch, which leads to poorly executed tours (Candlin, 2003).

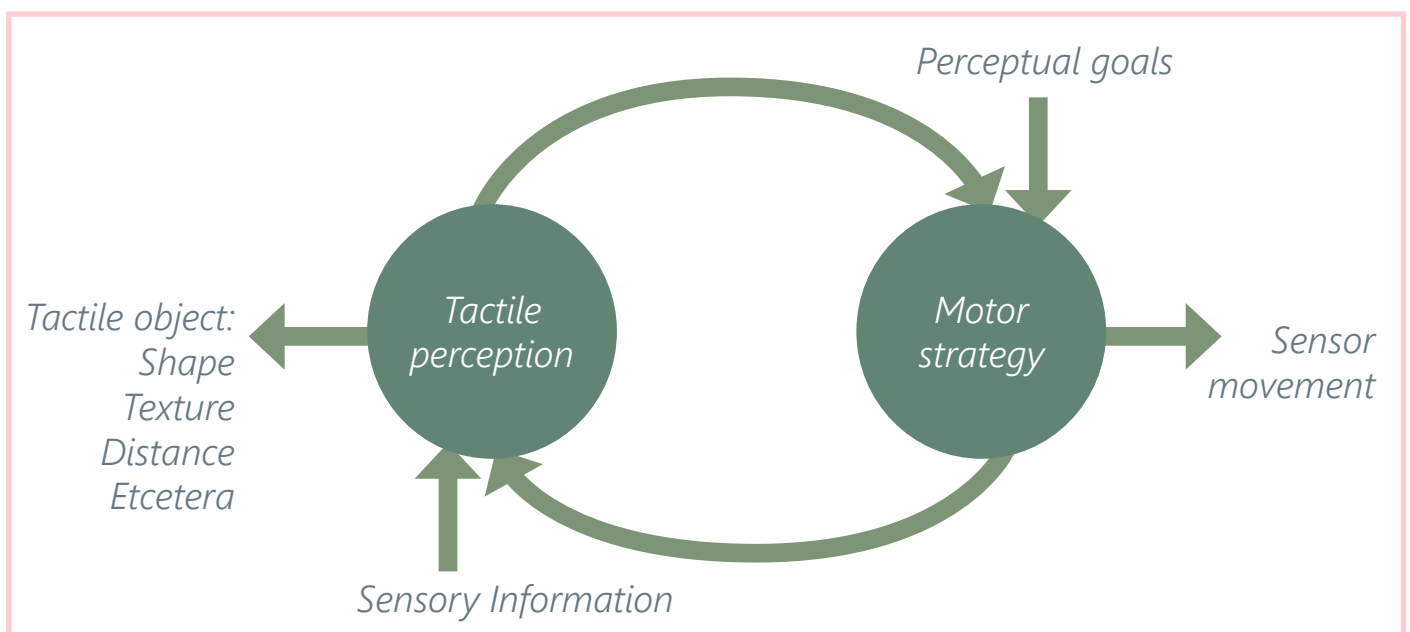


Image 2.16: Most simplified touch model by Gordon (2016)

## How people touch

Touching always implies direct contact (Gordon, 2016). Touching can be active (a person touching something) or passive (something touching the person). In the first kind one focusses on what is being touched, in the latter one focusses on the sensations in the skin. Both can happen at the same time (Sonneveld & Schifferstein, 2008). Since visually impaired want to be independent and in control, and in order to provide for exploration, the focus will be on active touch.

Active touch implies movement (Gordon, 2016). Humans often use their hands, for they (together with the lips) are most sensitive. This means that at these places, there are more touch receptors in the skin. It allows for distinguishing different points with only two millimetres distance between them (Prescott & Volker, 2016). One can also touch through an object which then becomes an extension of the body, for instance the end of a walking stick (Sonneveld & Schifferstein).

When presented to an object, identification of it is the first step. Without vision, recognizing 3D objects is far more easy than 2D objects (Sonneveld & Schifferstein, 2008). Touching can be done in different ways in order to perceive different characteristics. For instance stroking can be used to determine texture, finger tracing for the contour and squeezing to determine hardness (Prescott & Volker, 2016).

Also the position, temperature and material etc. can be determined through touch. The information hereby perceived is framed as 'tactile perception' (Gordon, 2016). This can be seen in image 2.16. Many of these tactual properties can be perceived through vision as well, but it's physicality can only be explored through touch (Sonneveld & Schifferstein, 2008). This means that touch is valuable for sighted people as well. Touch can give a different message than vision though. Something might look very light and warm, but can feel cold and heavy (Candlin, 2003). Therefore, converting the perceptual experience of vision to touch isn't possible one to one.

## Sensory compensation

Since people with a visual impairment rely on their other senses, these senses are used more often and are therefore better developed (Heller & Ballesteros, 2016). This increases their haptic skills, which is called 'sensory compensation' (Prescott & Volker, 2016). Especially people who have been blind from birth, without visual memory, often have better mobility skills and can read braille more easily. Blind children and adults do better on haptic tasks than their sighted counterparts. Only, with aging, the tactile sense also declines, for both blind and sighted people. People who became blind very late in life can have difficulties with haptic tasks, due to their visual experience. (Heller & Ballesteros, 2016)

## Braille

Braille is a way of writing with the use of six tactile points, developed by Louis Braille, as seen at image 2.17. One letter or symbol in braille is about 6 by 4 millimeters (Vereniging Onbeperkt Lezen, 2018). There are two types of braille: Grade 1 and Grade 2. Grade 1 just uses the alphabet, where grade 2 translates often used words, like “the”, into symbols (Ginley, 2013; VocalEyes, 2016). The text is best readable on a flat surface around 70 to 80 cm from the floor (Ginley, 2013).

In general, reading Braille is slower than normal reading. Additionally, for a late blind person the technique is more difficult due to the less sensitive sense of touch. They might use it for small notes etcetera (Peter, 2018, pers.comm., February 8). Many can read small pieces of information (VocalEyes, 2016).

Late blind **Bas** when reading Braille: *‘It says something about birds.’*

Because of this and the more size braille takes, it’s needed to keep the texts short and concise (Greving, 2018, pers.comm., February 23).

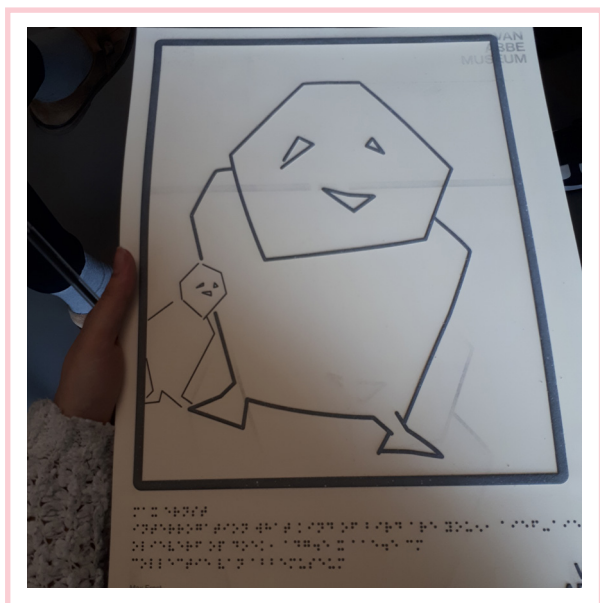


Image 2.18: Raised line drawing of ‘What kind of bird are you?’

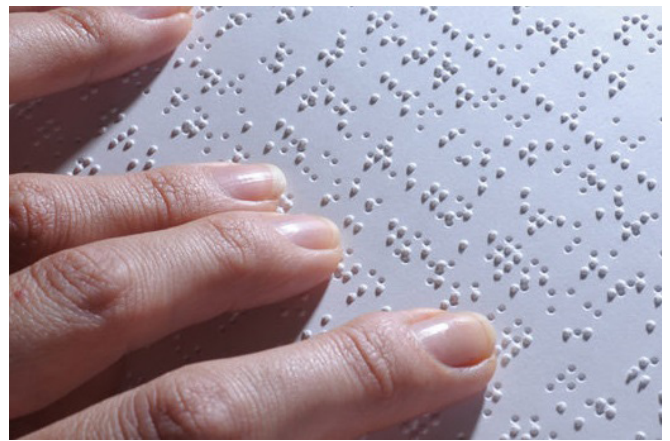


Image 2.17: Reading Braille (Blind Foundation, 2018)

## Tactile drawings

With tactile drawings, every kind of tangible drawing is meant. Through raised lines and surfaces, images can be conveyed. These can be the artwork, pictures, maps, diagrams etcetera (VocalEyes, 2016). They can vary from simple raised line drawings to detailed 3D images. They will here be described from simple to extended:

Since not all people with a visual impairment know how to touch (Ginley, 2013) identifying raised line drawings (Image 2.18) can be difficult (Heller & Ballesteros, 2016), the images should be simplified to the key elements (Ginley, 2013).

**Henk** when feeling a tactile raised line drawing: *‘It’s a bit of guessing.’*

They should be clear and lack detail (Jacobs, 2017). Filled drawings are easier to grasp than just lines, for it guides the person more easily and gives additional information on what is outside and inside (Wijntjes et al, 2008). This was also visible when Hilde was feeling the outlines of ‘Couple with their Heads full of Clouds’. Feeling the outlines in cardboard was far more easy for her.

Relief with depth seems to work better. Some people, especially with less tactual experience, prefer simplified layered depth diagrams (Image 2.19) that help quickly grasp the overall composition. These give a sense of depth and have no crossing lines, which often happens in raised line drawings. Others prefer full textured reliefs (Image 2.20) that also convey texture and fine details (Reichinger, Maierhofer & Purgathofer, 2011).

**Henk** about these reliefs: 'You feel the figure coming out of the painting. It brings life to the art.'

When experiencing this full textured relief **myself**, it appeared quite difficult, even with prior knowledge of the work. In contrast to her face, which was quite easy to grasp, the children and skirt were very difficult to discern.

One to one printed replicas are useful to convey the technique of the painter (van Uffelen, 2018, pers.comm., March 7). Although Vlerick (2009) points out that this only works when the brush strokes are tangible.

Last there is a technique that converts colour to fabric, the Taktila® method as seen on image 2.21. This technique does require training (van Leeuwen, 2018, pers.comm., February 20), but can be very effective.

**Nikkie**: 'I got moved when I felt her van Gogh.'



Image 2.19: Layered depth diagram (Reichinger et al, 2011)



Image 2.20: Full textured relief (Reichinger et al, 2011)



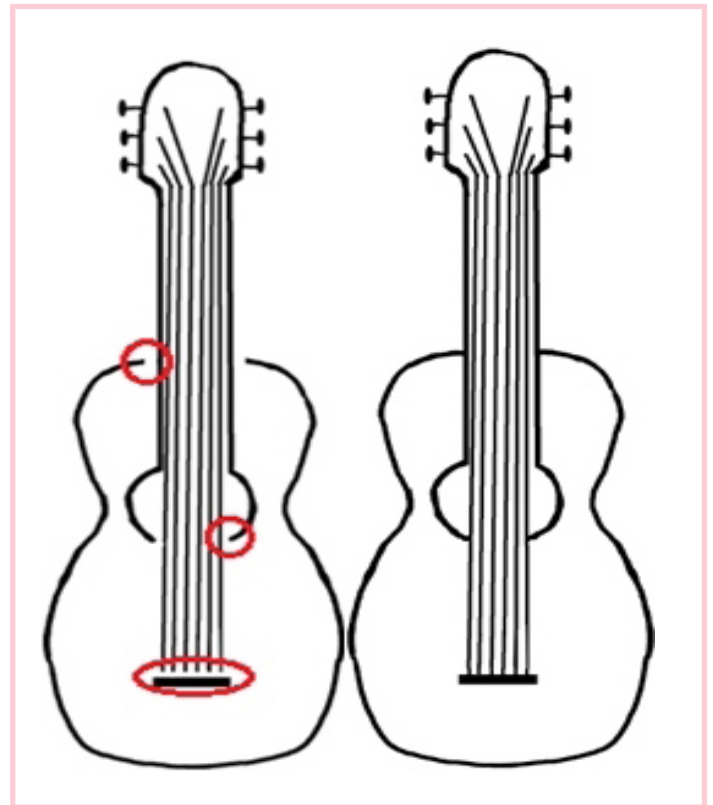
Image 2.21: Taktila® method

In general, not many visitors with a visual impairment have experience with identification through touch. Especially when becoming visually impaired at later age, many of them did not receive any training, causing tactile techniques to be relatively new for them. This makes it more difficult to understand the art.

In the tours for visually impaired, raised line drawings are mostly observed. Such a drawing might be compared by using a sketch to explain something to a sighted person. The sketch should support the story, just like a raised line drawing should. One of the techniques to create such a drawing is by using Swell paper in combination with carbon ink. Other techniques are elevated printing and vacuum form thermoform (in't Veld, 2018, pers.comm., March 16). An image should be built from simple outlines to more detailed drawings of the same art (Dries, 2018; Kal, 2018, pers. comm., February 23). There are quite some guidelines and attention points on how to make and explain raised line drawings, one is seen at image 2.22 (Rieken, 2016).

These images do not stand on their own, but have to be accompanied by textual information like braille, audio or large prints (VocalEyes, 2016). The descriptions should explain the image and important detail like size, date and rotation (Ginley, 2013). Also the title is important.

**Nikkie** when feeling 'What kind of Bird are you?' (Image 2.18): 'Ahh birds, that's why the mouth is a triangle.'



*Image 2.22: Leave space between lines  
Rieken (2016a)*

When audio accompanying a line drawing, the person can be told where to focus on and what is being sensed (Rieken, 2016b). It helps to locate forms, but also colour location can be explained. This was observed at Van Abbemuseum. People who are guided along raised line drawings can identify the image more easily than people who explore the drawing themselves. Wijntjes et al (2008) explains that hereby the one guided does not have to plan the next move and can therefore better focus on what is felt. According to Vom Lehn (2010) on the other hand, people with a visual impairment gratefully use the opportunity through touch first, after which descriptions are provided. This description is then based on their actions. Rieken (2016b) formulates this strikingly: 'It shouldn't become a search image'.

### 3D objects

Since 3D objects provide multiple viewpoints at the same time, they are more easy and quick to understand (in't Veld, 2018, pers.comm., March 16). Therefore many museums in the Netherlands who provide touch tours take elements out of the painting. This has to be done in the right way though:

**Evelien and Henk:** *'We got to feel a glass that was on the painting. If I want to feel a glass, I can walk to my kitchen cabin.'*

Also for people with low vision, these objects are unnecessary and can even come across as belittling:

**Anton:** *'I can still see a little, so I don't need to feel a spoon.'*

When objects have a symbolic meaning, it can still be useful to hand it to the visitors. This should be done with interaction though, by handing for instance lemons, letting them guess what they are holding and asking why they think this would be on the painting (van Helbergen, 2018, pers.comm., February 17). Objects can also be used to convey size and possibility. For the 'Sunflowers' from van Gogh, the van Goghmuseum displays the real vase and sunflowers to create an image of the (im) possibility of so many flowers in a vase (van Uffelen, 2018 pers.comm., March 7). Unknown objects can be valuable as well, like a spatula and palette that explain the technique of the painter and not everyone knows as seen at Boijmans or one of the big collars nobility used to wear which is difficult to explain.



Image 2.23: Scale model of 'The bedroom' by van Gogh as used by the van Gogh museum

Also authentic fabrics can work, just as letting them try on clothes (van Helbergen, 2018, pers.comm., February 20, pers.comm., February 17). Also a scale model of a painting can work well. It can give insight in depth and relations of objects as seen at image 2.23 of 'The bedroom' by Van Gogh (van Uffelen, 2018 pers.comm., March 7).

It is very important that these attributes fit (the moment of) the story, which might be difficult when passing along objects. Otherwise it can be very distracting.

**Hilde:** *'At the next painting I'm going to ask her not to hand me the objects. It distracts.'*

Therefore when in a group, multiple objects should be present in order to give everyone the same experience. During both tours it was observed that the last person did not know what to do with the object after everyone had felt it. This caused a bit of confusion and these people stuck with hands full of materials.

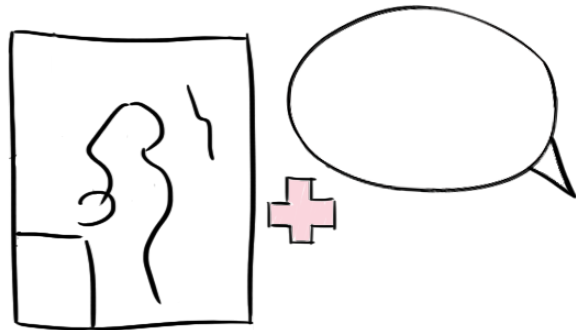
## Main insights:



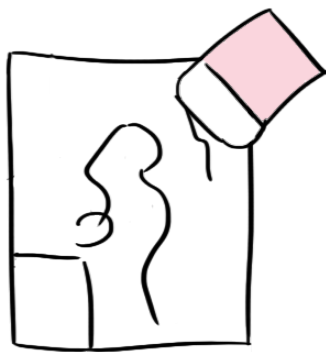
*Feeling is done serial, so requires more time and effort to build an image*



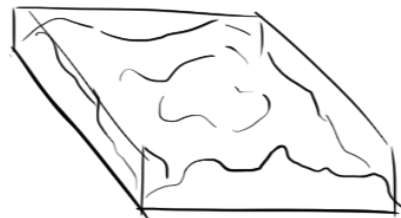
*Many can read short pieces of Braille*



*A tactile representation always needs additional information*



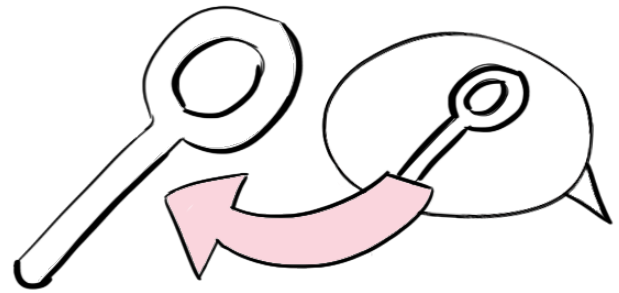
*Only a limited amount of details should be included in a tactile drawing*



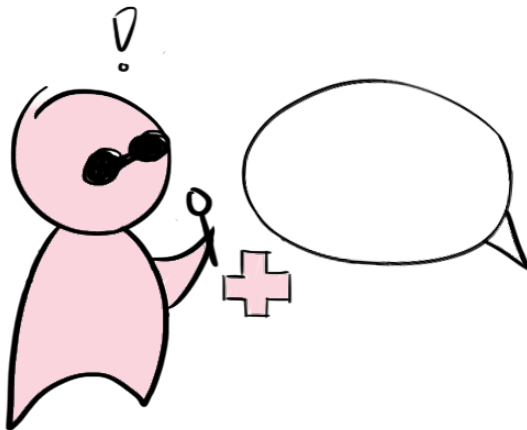
*More depth gives a better understanding and room for more detail*



*Taking 3D objects from a painting should be done with caution*



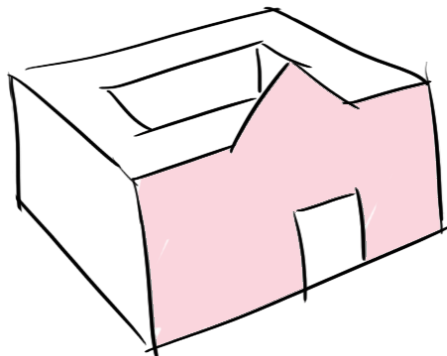
*The object given should align with the part of the story*



*Feeling well-known objects is unwanted, unless when meant for interaction*



*Feeling unknown objects can be supportive for understanding the image*

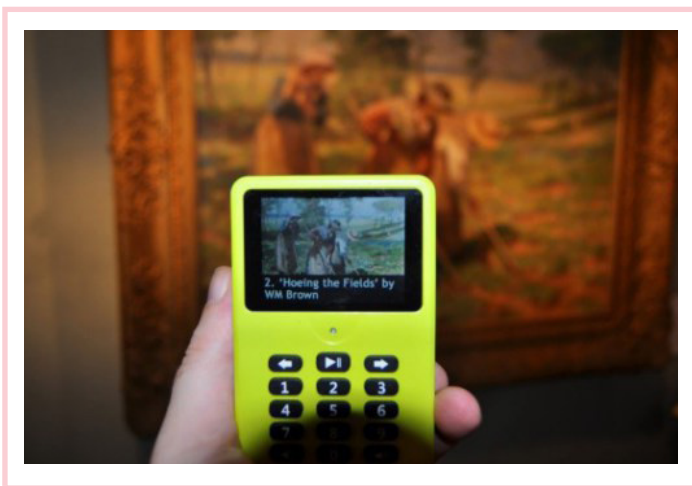


*Scale models (of buildings or rooms) work well for understanding the building*

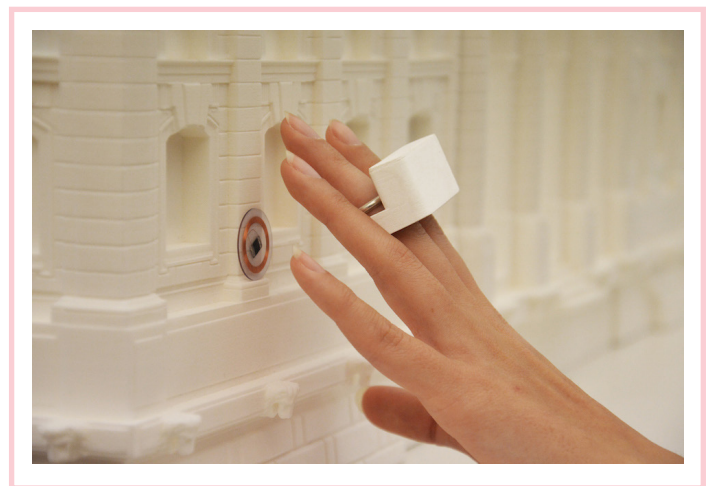
# A2.7

## Using senses: Audio

Speaking and listening are most commonly used for communication. Next to that, hearing is used to localise and give meaning to audio sources (Daams, 2013), especially by people who are visually impaired. Through sound, they can understand movement and direction. The end of a walking stick is especially made for good echolocation. The echoing sound is different per object, but it does need training. (Daams, 2013). Many visually impaired rely on the sounds different objects make while touched with their walking stick (Fryer, Freeman & Pring, 2013).



*Image 2.24:  
Audio guide at the British museum  
(John Gray Centre, 2018)*



*Image 2.25:  
Device that triggers recordings when  
being near tags within the object  
(Tooteko.com, 2018)*

## Technology

Many museums offer audio guides to their visitors. These are mostly not suitable for people with a visual impairment, because they often only describe additional information and not the image itself. Still, since most of the objects can't be touched and not many people with a visual impairment can read long pieces of braille, audio is often the next best option (Ginley, 2013). There is a variety of audio techniques that can be used. A museum can loan or rent out physical interactive devices (image 2.24) that have to be activated manually or are activated automatically, for instance using location based sensing (Mesquita & Carneiro, 2016; Ginley, 2013). Other possibilities are an app for phones or MP3 files to download in advance (VocalEyes, 2016), which allow visitors to use their own system (Ginley, 2013). Furthermore, there can be fixed audio posts next to the art (Mesquita & Carneiro, 2016) or combined with touchable (art) objects, for instance with a scale model. This can be done through touching the object with the hands or with an extra device that detects (NFC) tags as seen on image 2.25 (Tooteko.com, 2018). Last, a guide can go along, often with a group, to explain the art on sight. Such a tour makes the experience more social and interactive. On the other hand, recorded audio guides provides independence and are available at any moment (VocalEyes, 2016).

## Descriptions

As explained in the paragraph 2.4, vision allows the viewer to create an image in one view. It's not just about what you see, but about what you see first as well and even about what you didn't see. Not only the story itself, but the way it is told is just as important. Besides, it's better to give a clear description without details than the other way around (de Coster, 2017).

A verbal description is distinctly different from a tactile experience due to it's intensity and concreteness. A disadvantage is that listening to audio asks a lot of energy from the listener in order to stay focussed on the story and is 'linear' as well. Therefore, verbal and tactile should go together (de Coster, 2017). As explained in the previous sub chapter not only the art, but the environment should be described as well. This also means relation of the artwork to the surrounding work.

In general when describing an artwork, the story has to be logical with a clear main line:

**Isabel:** *'The story needs to be structured well. With too many expansions, I can't follow the main line anymore.'*

It should be clear when auditory information describes the image or provides background information.

**Hilde:** *'Sometimes you were talking about something and I didn't know whether it was background explanation or actually about the image.'*

It's important to use everyday language (Ginley, 2013) and be aware of abstract and visual terms. Here, the difference between early and late vision loss becomes very clear, due to whether they have visual memory. Especially concepts like clouds or colours can be very difficult to understand for someone who has never seen this (in't Veld, 2018, pers.comm., March 16). Colours can call on feelings (Vlerick, 2009), but the kind of colour and their appearance have to be explained. This was seen at the Van Abbemuseum. Words as 'a vibrant red' or 'the colours seem to come at you' work well. Also the technique of the painter and references to well-known objects or daily life trigger the imagination.

**Guide** about the Tower of Babel: *'It looks like the Colosseum.'*

**Visitors:** *'Ohh the Colosseum!'*

There are different opinions and preferences on the order of how an artwork should be described. One should always start with a general overview (title, size, etc.) (Ginley, 2013; de Coster, 2017). While some enjoy description from the whole to details (Hartjes, 2018, pers.comm., February 20), others prefer building up from the detail without a general overview:

**Hilde:** *'When the general image is described first and then the detail, the image in my head often appears to be wrong.'*

More detailed guidelines on how to describe an image well can be found in appendix A4.

## Other

Next to descriptions, other auditive art can be helpful during guided tours. Poetry evoked a lot, for the visitors can create their own interpretation. Also the way of reciting this is powerful.

**Nikkie** after hearing poetry related to 'What kind of Bird are you': *'That's so beautiful!'*

Music can also fit the atmosphere of the art. This especially when the art is abstract (Pont, 2018, pers.comm., February 19). It can give a sense of the time or event of which the artwork is about as well. Music that was of inspiration for the artist can be valuable as well (Hartjes, 2018, pers.comm., February 20).

## Age

From the age of 30 onwards hearing decreases, the reason why many elderly have hearing aids. This is important, for eighty percent of the people with a visual impairment are above fifty.

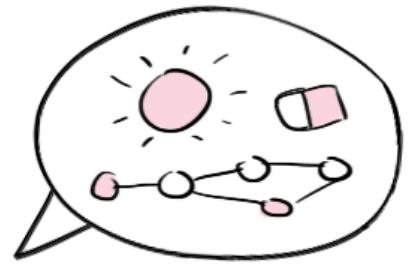
The characteristics of an auditory impairment are:

- Higher hearing threshold
- Difficulties with understanding speech
- Less cooperation between both ears
- Reduction of the processing of sound (Daams, 2013).

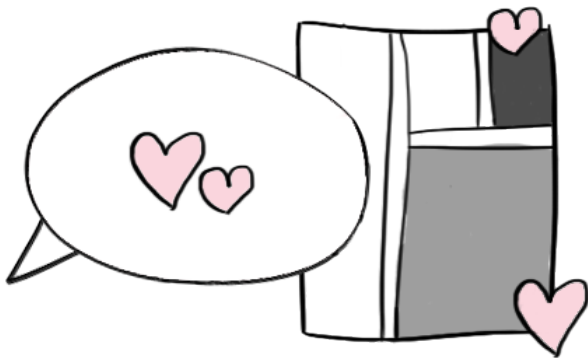
## Main insights:



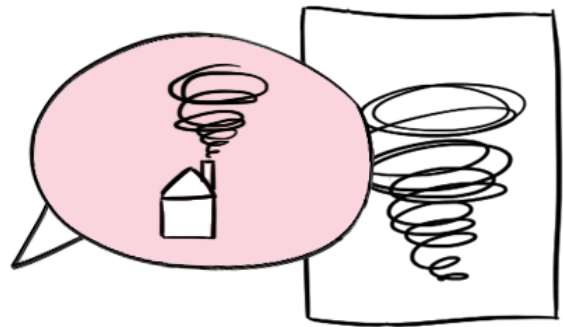
*Descriptions are serial as well.*



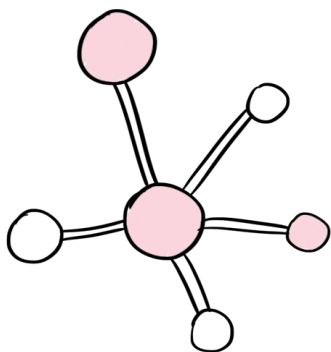
*The story has to be clear, structured and leave out detail*



*The feeling that colours express should be put into words.*



*References to well-known objects/phenomena work well*



*No one approach in explaining works for all visitors*



*Poetry and music are less experimented with and more personal*

# A2.8

## Other senses & Techniques

### Smell and Taste

Everything has smell, although it often isn't noticed in particular. Wood and leather are rather easily distinguished, but also metal, paper and plastics can have their own smell. Smell can be very intricate and call on emotions. Therefore it can have an influence on someone's mood and explain a certain atmosphere. Not everyone can smell exactly the same, so it is different per person. The sense of smell can't be manipulated or shut down, same with taste. (Daams, 2013).

Smell can be direct, flowers or lemons etcetera, or indirect, which are associative scents, for instance popcorn and candy floss representing the atmosphere of a fair (Hartjes, 2018, pers.comm., February 20). This way, it can convey the ambiance of a painting. Same as with objects that support a story, smell should be used well. For instance when having a still life with cheese, people know what this smells like. It can be purposeful though when it's for instance explaining the context of the painter: *'Can you imagine he would have been painting in this awful cheese smell all day?'* (van Leeuwen, 2018, pers.comm., February 21).

The difficulty with smell is that it's very personal. Some immediately recognise the intended atmosphere, while others have no idea what they are supposed to smell (van Uffelen, 2018, pers.comm., March 7). Also, preserving smell is difficult, it needs quite some maintenance (Voorn, 2018, pers.comm., March 20). With taste, this is even more difficult, also due to hygiene.

### Performance

By letting people touch performers who stand in the same position as the people on the painting, many emotions and recognition can be evoked:

**Henk:** *'By feeling the man, an image rises. (...) I feel a strong affinity to the painting.'* (Kabel, 2015)

The visitors can form their own image, supported by the deepening questions asked by a guide.

It also works well to let them take the positions as well as seen on image 2.24. How does that feel? (Hartjes, 2018, pers.comm., February 20)

## Connected senses

It was found that there are interconnections between the senses. For one of 20 people, this is a very strong neurological phenomenon called synaesthesia. They relate for instance Friday to yellow or three smells like chocolate. Still, everyone associates on some level. Higher sounds are often associated with lighter colours, lower sounds with dark colours, and people can distinguish 'round' or 'pointy' sounds.

When relating observations of the different senses on purpose, this is called cross-modal perception or multi-sensory integration. (Daams, 2013) A multi-sensory experience of the art is therefore very important for visitors with a visual impairment (Handa, Dairoku & Toriyama, 2010).

Multiple senses at the same time can be used to create a more complete image and richer experience. There should be congruency or alignment, which can be done on different layers, for instance with music and touch: Smooth tones can be related with smooth brush strokes, while on another layer the aggressive appearance of a painting can be combined with aggressive music. (van Lier, 2018, pers.comm., February 20) It's important to find balance. The different senses should enhance each other (Pont, 2018, pers.comm., February 19).



*Image 2.24: Taking the arts position at the van Abbemuseum [screenshot] (vanabbemuseum, 2015)*

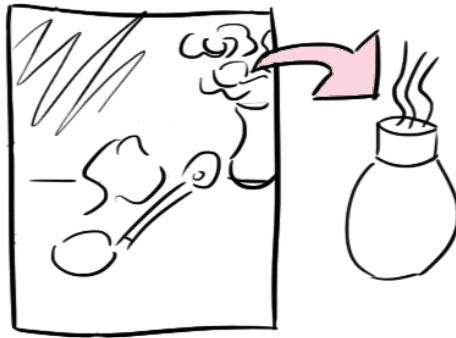
## Main insights:



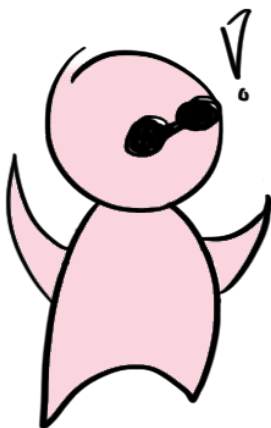
*Smell can explain atmosphere*



*Smell is highly personal*



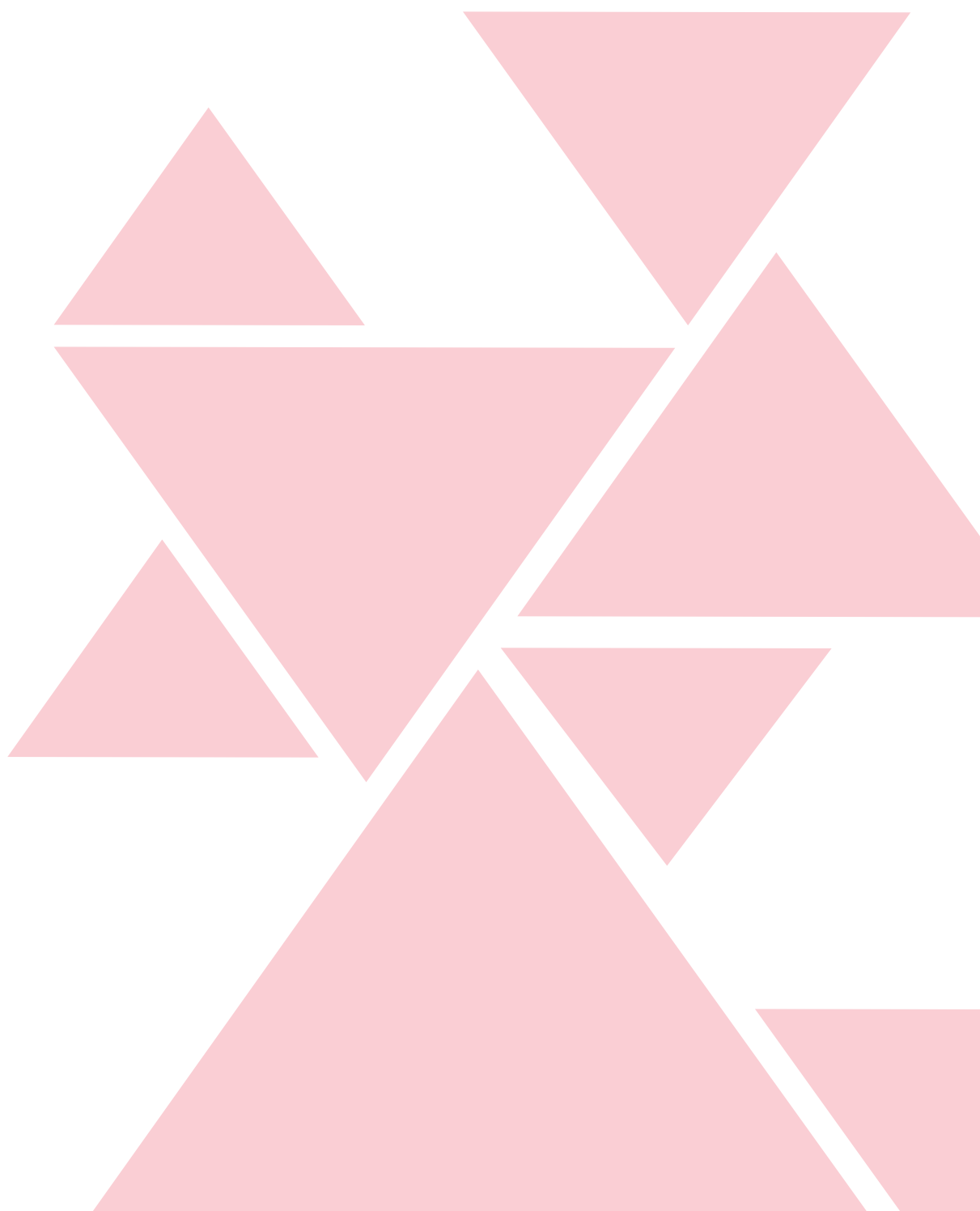
*Same as with objects, how to use smell should be considered well.*



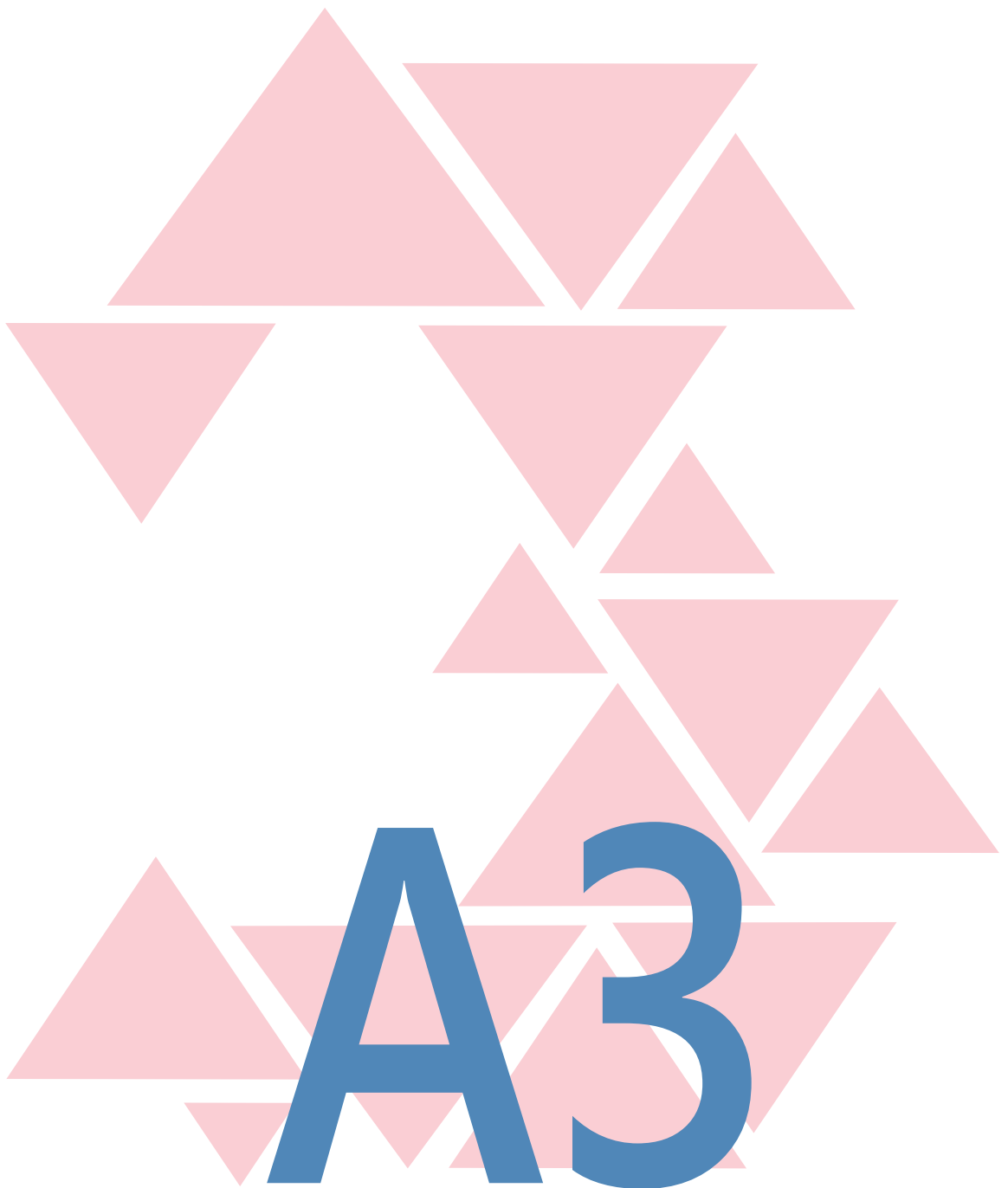
*Feeling or standing in a certain position is powerful*



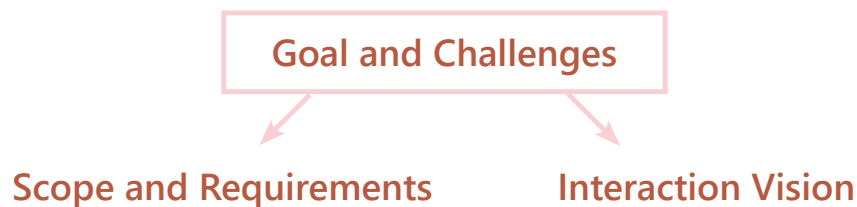
*Multiple senses should be used (at the same time)*



# Design Brief



*As concluding chapter for the analysis section, the design goal is stated and explained. This will serve as starting point for the designing phase. Besides, the scope is defined, indicating what will and will not be taken into account and the requirements are stated, which the final design should meet. Last, the intended interactions of the design are caught in an Interaction Vision.*



# A3.1

## Goal and Challenges

*Making the image, story and expression of paintings intuitively accessible for both blind and ill sighted visitors during an independent museum visit.*

### Image, Story & Expression

In order to provide visitors with an aesthetic experience, these three elements should be conveyed:

**Image:** Starting with form and composition, then colour, style etc.

**Story:** Reason for the form and composition. Also the context and background of artist and technique.

**Expression:** The feelings that are evoked by the appearance of the art.

### Intuitive accessibility

The design should be easily understood. Many techniques require learning to be applied, not one works for all. Besides, understanding art through tactile stimuli is often new for visitors with a visual impairment. Last, it takes more time and energy, which can prevent the visitor of having an aesthetic experience.

### Differences between blind and ill sighted visitors

Ill sighted visitors still want to use their visual sense while blind visitors rely on hearing and touch. There are differences in visual memory and knowledge and expertise within the group as well.

### Independent visit

Many experiences now are designed for group visits. Even though it is a step in the right direction, this still devalues the inclusivity, for the visually impaired are dependent on others and can't visit the museum whenever they prefer.

# A3.2

## Scope and Requirements

### Scope

In order to set guidelines, the aspects that would and would not be taken into account while designing were defined first: the scope. This created boundaries and define the extent of the challenge.

#### *Inside the scope*

People with a visual impairment:  
Both blind and ill sighted people.

Different levels of knowledge and expertise

The interaction between visitors and paintings in museums.

As exploration object, *'The Milkmaid'* from Johannes Vermeer is used.

#### *Outside the scope*

(Independent) wayfinding.

Adjustments to the museum building.

Conveying 3D museum objects to visually impaired .

Other impairments.

### Requirements

Also, a set of requirements was created. These requirements would, together with the interaction vision, further explained in the next paragraph, later serve as measurement for the concepts. The most important requirements were created according to the design goal, to measure whether the final design would fit the goal. In light blue, the statements from the design goal are set. Next to that, these are explained in black.

Besides these, other requirements are stated which have to do with the context of the concept. The context mainly exists out of the user and the (Rijks)museum and therefore has to fit both of them.

Last, wishes are stated, which aren't tiebreakers, but should be integrated within the concept in the most ideal situation.

## Design goal

### *User*

*The design should:*

provide for blind visitors  
provide for ill sighted visitors  
provide for both simultaneously

### *Intuitive*

be easily understandable  
not cause confusion or overload

### *Understanding*

convey the image  
convey the atmosphere  
convey the background

### *Opinion*

challenge visually impaired to create their own opinion

## Context requirements

### *Visitor perspective*

*The visitor should:*

have a choice according to their interests  
be in control of the interaction  
not be on display  
be provided for upon different levels of expertise

### *Practical*

*The design should:*

fit style of Rijksmuseum  
be unobtrusive for other visitors  
not be provoking to touch the real art  
be fastly available  
be durable

## Wishes

*The design should:*

be usable independently and tour  
also be interesting for sighted visitors  
allow for multiple visitors to interact with one artwork  
be easy to recognize  
not hinder from stick/dog  
be suited for people of elder age  
Applicable to all art  
Easy to make

New/innovative

# A3.3

## Interaction vision

The purpose of this interaction vision is to generate an intended feeling that the user should have while interacting with the product. An analogy is created to illustrate this intended atmosphere.

From the research can be concluded that for the visually impaired understanding an artwork is a longer process which occurs step by step, revealing the image bit by bit. Even though this process is necessary, it doesn't have to be bothersome. Therefore, the chosen analogy is the one of unpackaging presents, as seen in image 3.1. Here, the present represents the artwork, while the unpackaging itself represents the process of understanding the artwork without vision.



Image 3.1: Interaction vision

## Interaction vision

Before the unpacking event, often the question arises of what the person would want. One can either personalize the gifts by stating wishes or ask to be surprised.

The person is often looking forwards to the event of receiving presents.

When unpackaging, one goes through several steps:

The first step is to choose a package, based on basic information like size and colour.

Or get one handed by the giver.

Then, the gift is revealed after going through multiple layers, like feeling the weight and texture. Taking off the wrapping paper, looking at the brand and taking the gift out of the box.

## Intended interaction

Before going to the museum, the visitor can prepare oneself and already gather knowledge about the exhibited art or go without previous knowledge.

The visitor should feel excited and look forward to the museum visit.

The visitor chooses a painting to explore further.

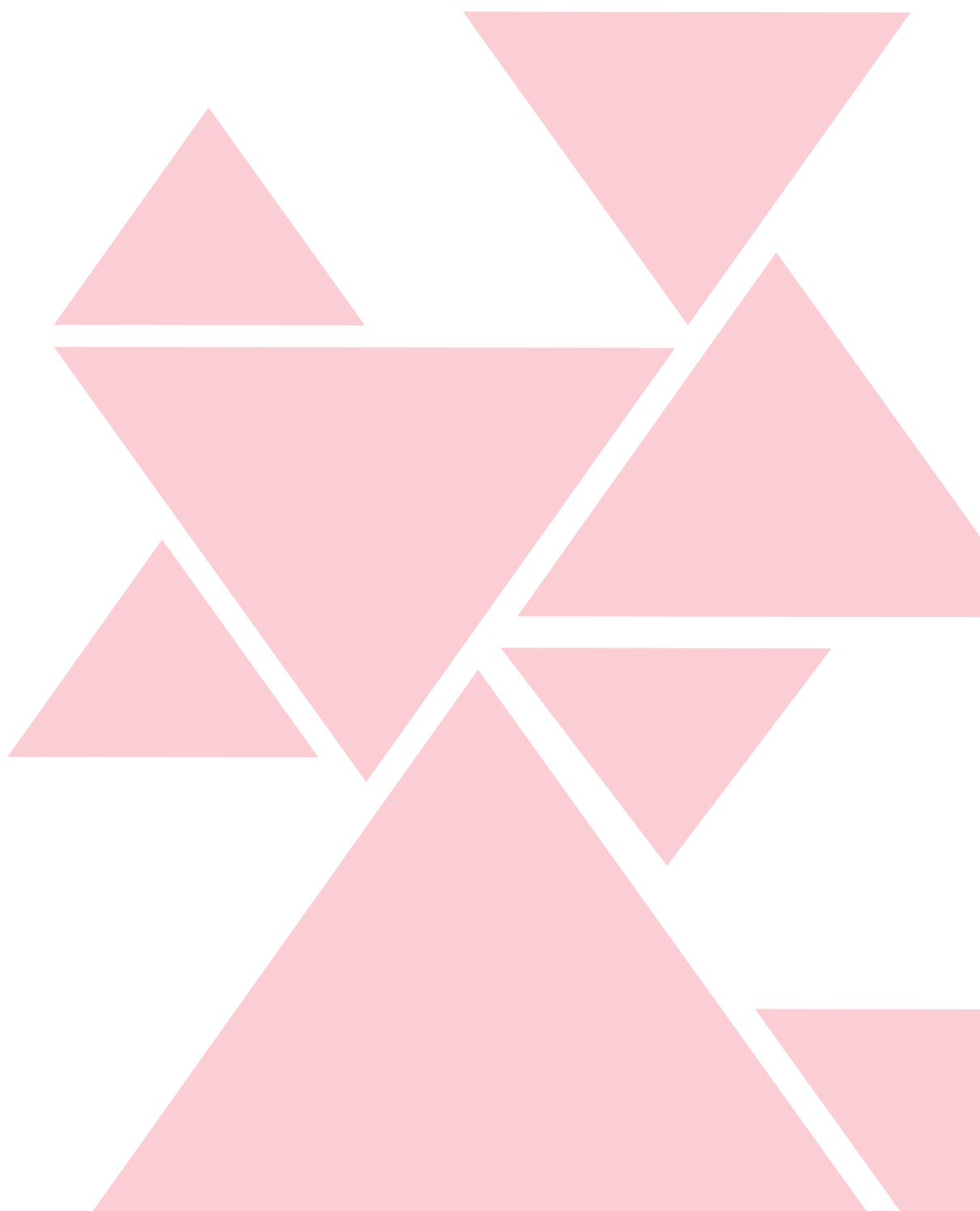
Or follows a guided tour explaining which artwork to choose.

The art is revealed through several layers, getting information about the form and composition, colours, light, materials, style/technique and background of the artist.

## Qualities of interaction

The process is *activating* and *challenging* to explore further. It *sparks interest* and makes the person *wonder*. Furthermore it often is *surprising* and *satisfying* when the gift is revealed. These are the qualities that should be in the final design.

The interaction vision is used to express the intent of the design, inspire the ideation process and evaluate the ideas and concepts.



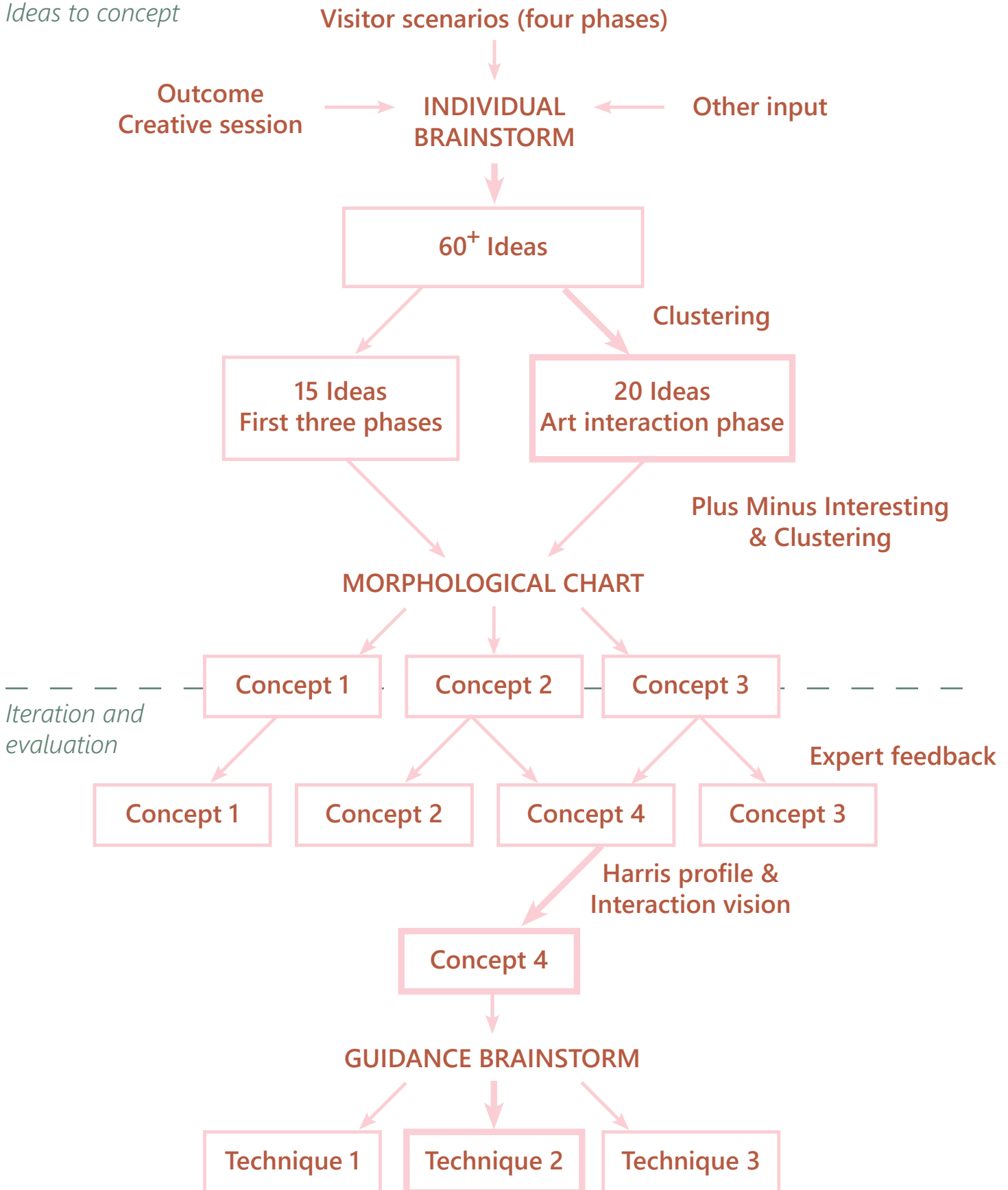
# IDEATION

This phase covers the development from the design brief towards the final concept. The first chapter explains the ideation process, starting from several visitor scenarios. By doing a creative session with visually impaired and individual brainstorm sessions with multiple input sources, ideas are generated.

These ideas are assessed and divided into the different phases of the visitor scenarios. The ideas of the art interaction phase are assessed through PMI (Plus Minus Interesting) and clustered again to create a morphological chart. By taking ideas from the different layers in this chart and merging them together, three concepts arise: 'Take your Technique', 'Exploration Table' and 'Splitting the Art'. These are worked out into a design sketches and storyboards.

The three concepts are assessed by two experts from the field of visually impaired and two experts of the Rijksmuseum. This results into valuable feedback with strong and weak points per concept. On the basis of this feedback, the three concepts are revised and a fourth concept, 'Portable Exploration Table' is created. All of them are assessed through a Harris profile based on the requirements and through the Interaction Vision. Eventually, a decision was made and the 'Portable Exploration Table' was chosen.

Again, this concept is iterated upon to find the best way to guide someone through an artwork. Eventually this is done with use of vibration.



*Schematic overview of the Ideation phase*

*Text with boxed: Output*

*Texts without boxes: Methods*

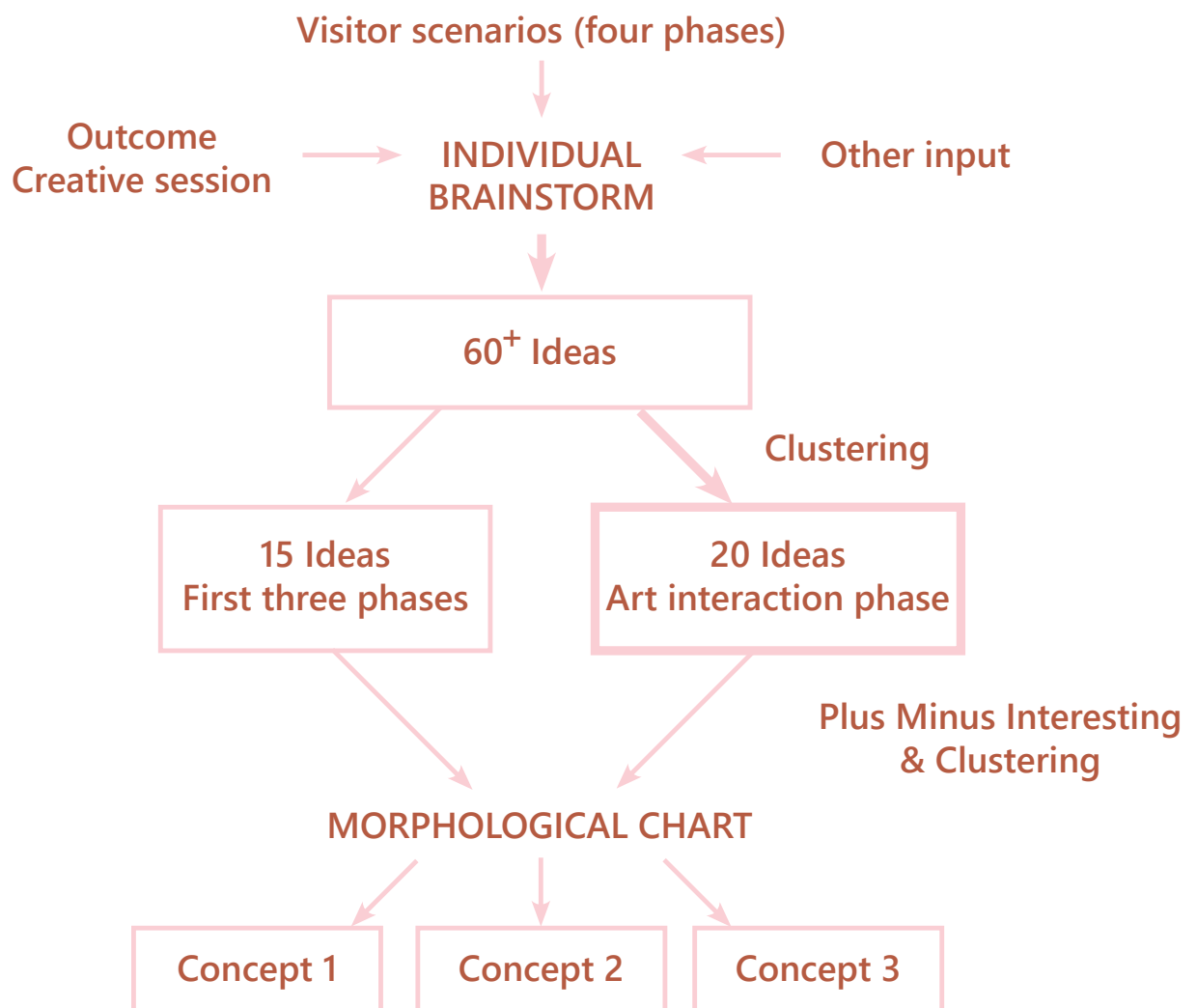
*Thick lines: Decisions*

# From ideas to concepts



*This first chapter explains the ideation process, starting from several visitor scenarios. By doing a creative session with visually impaired and individual brainstorm sessions with multiple input sources, ideas are generated.*

*These ideas are assessed and divided into the different phases of the visitor scenarios. The ideas of the art interaction phase are assessed through PMI (Plus Minus Interesting) and clustered again to create a morphological chart. By taking ideas from the different layers in this chart and merging them together, three concepts arise: 'Take your Technique', 'Exploration Table' and 'Splitting the Art'. These are worked out into a design sketches and storyboards.*



*From Ideas to Concepts -  
Detail of Schematic overview of the Ideation phase*

# B4.1

## Visitor scenarios

From the research it appeared that there are some important differences within the user group. These are mainly based on type of impairment, personal background and interest in art. Also important for the user experience is with whom they visit, how they prepare and what they take with them.

These characteristics are converted into three personas with their own needs, as seen in image 4.1a-c. Enlargements can be found in Appendix B5.

### Phases in the visitor experience

According to these persona's, three storyboards are created. In genera, each story covers the following phases:

- \* Preparation
- \* Coming in and wayfinding
- \* First encounter with the art
- \* Deeper interaction with one artwork

These storyboards are used as starting point of the individual brainstorm sessions. They cover the diversity of the user group and can therefore provide new perspectives to ideate upon.

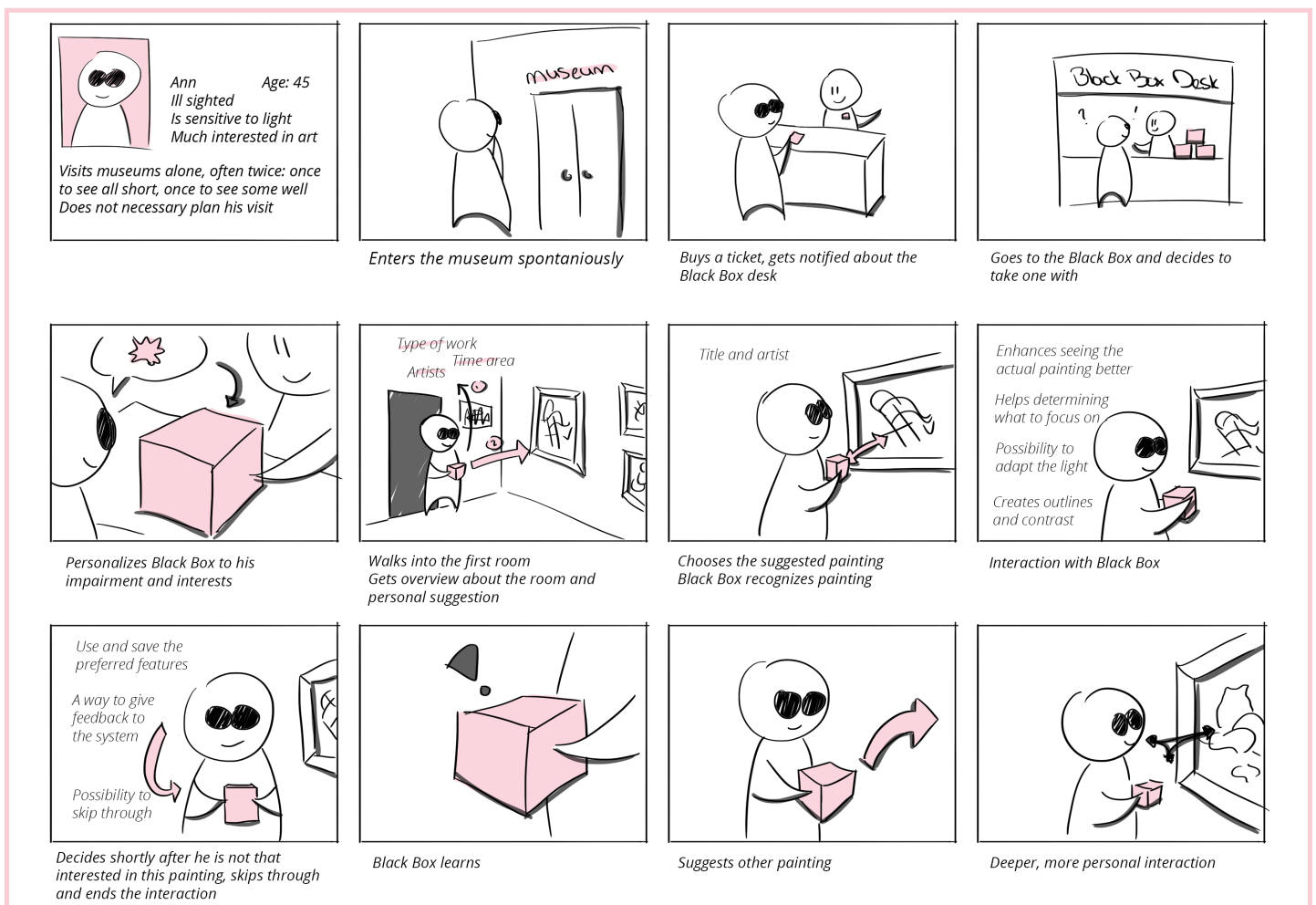


Image 4.1a: Ann: Receives a portable black box when coming in.

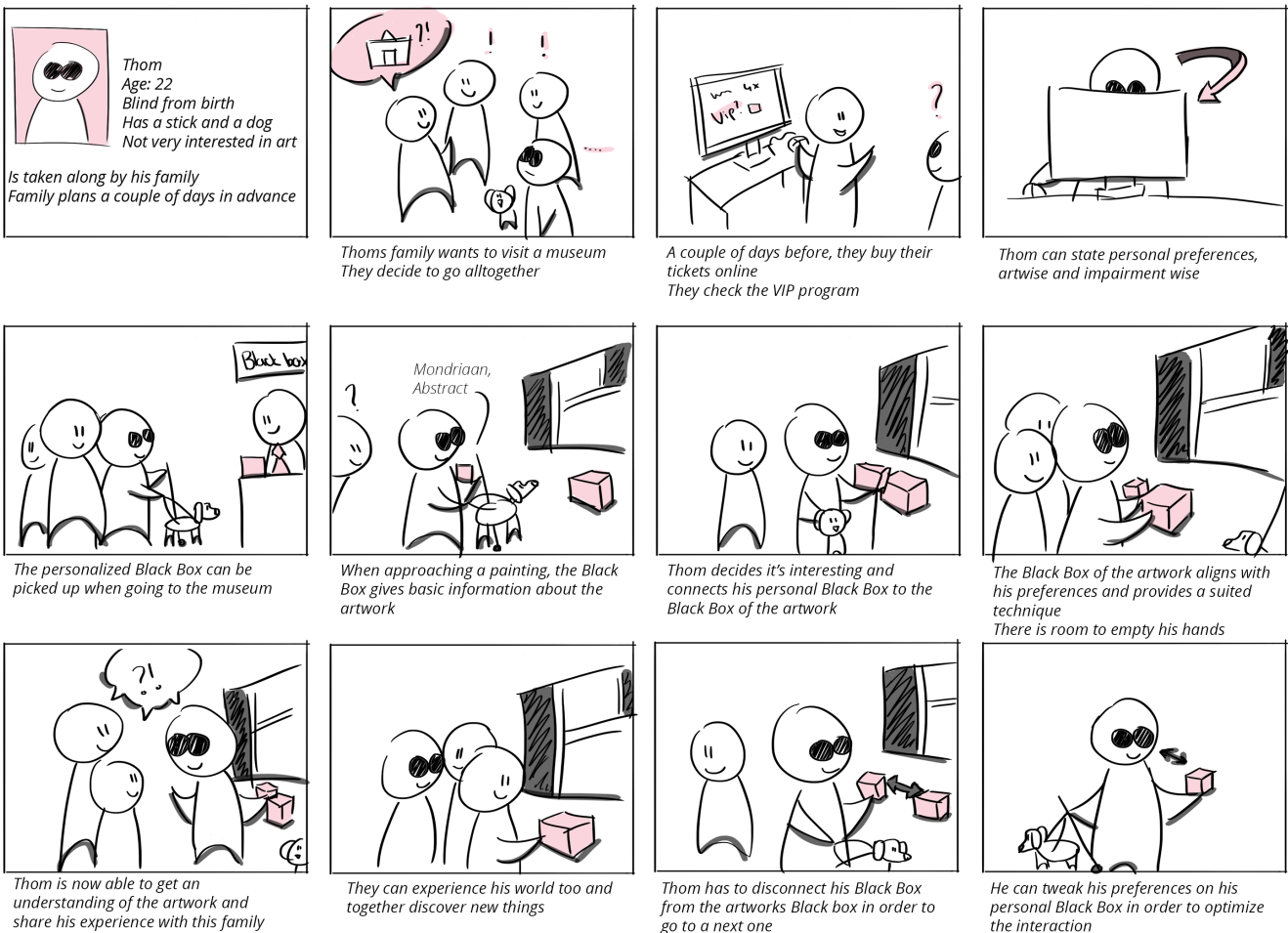


Image 4.1b: Thom: Has a portable black box interacting with static black boxes.

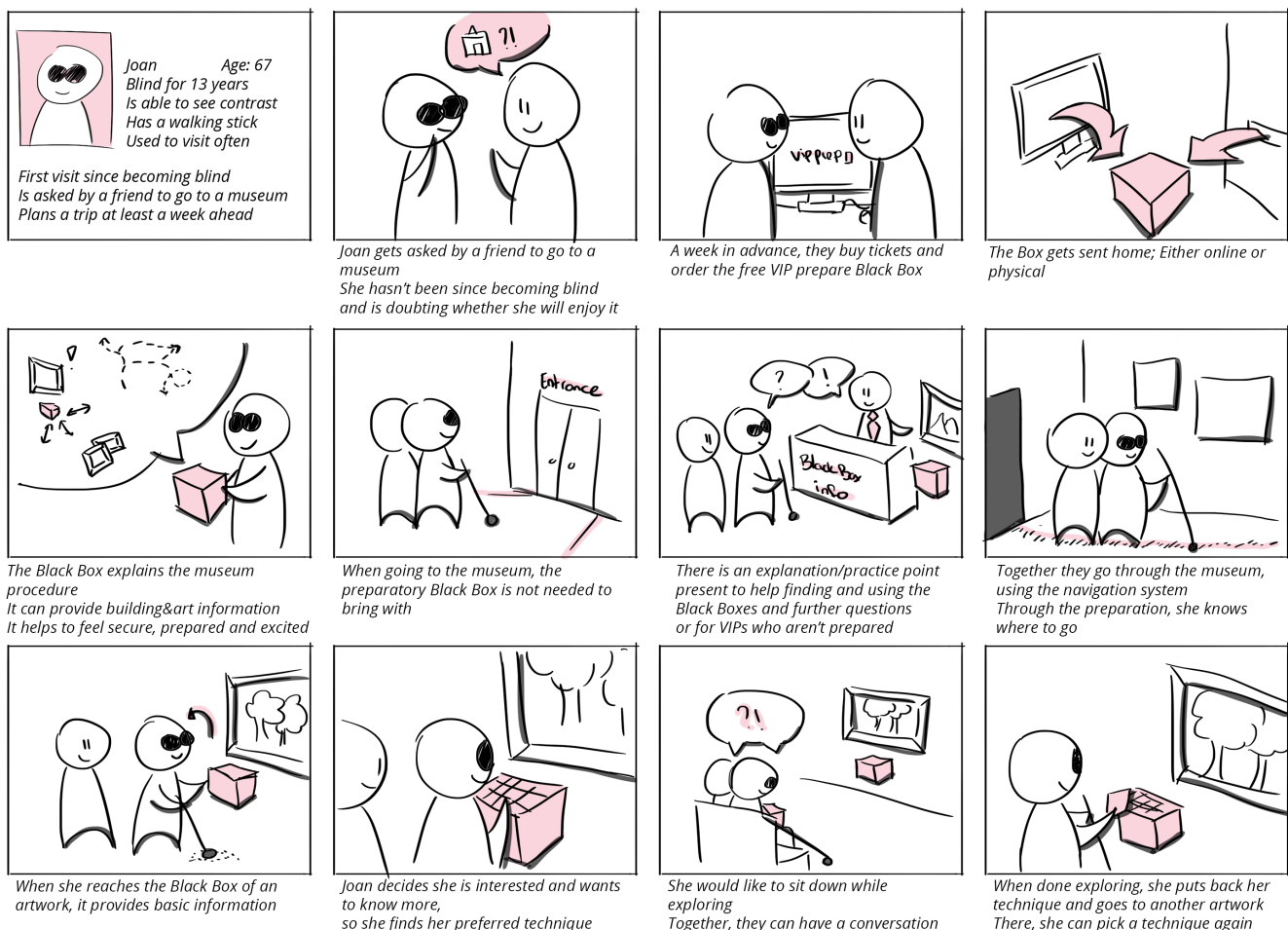


Image 4.1c: Joan: Encounters static black boxes within the museum.

# B4.2

## Idea generation

During the ideation phase I did several individual brainstorm sessions with different methods and input.

The three visitor scenarios, as explained before, were taken as starting point. In order to involve expertise of the user group in the idea generation, a creative session was done with eight visually impaired museum visitors.

### Creative session

This session took place at the Rijksmuseum and answered the question: *'How can you translate the feeling/experience of a painting towards people who cannot (properly) see the painting?'*

An artwork of Vermeer, the Milkmaid, was used as topic and reference to explain the ideas well.

### Set-up

During two hours, three phases were covered: problem definition, idea generation and selection and idea improvement (image 4.5 - 4.7). More details can be found in appendix B6.

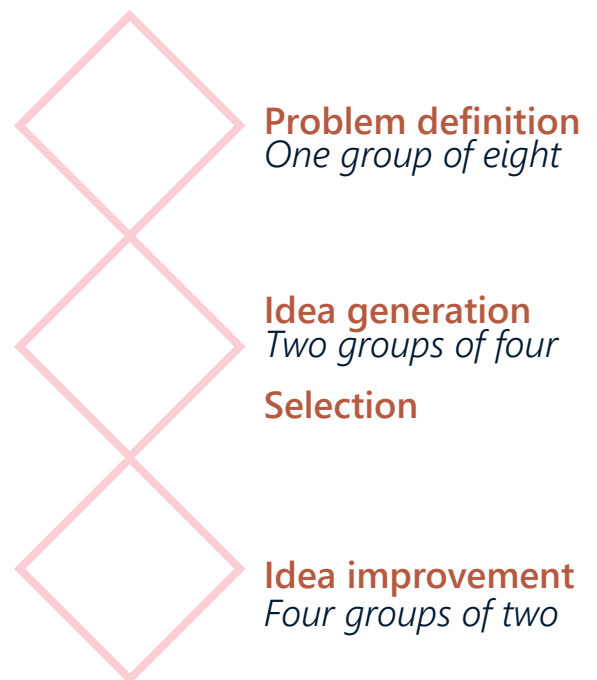


Image 4.5: Phases of the creative session



Image 4.6 & 4.7: Photo's of the session with visually impaired

## Results

The session resulted into four different concepts:

- \* An auditory explanation of the artwork. A voice guides one through the kitchen where the maid stands, as if actually being in the artwork. It only happens in the mind of the listener.
- \* A real size 3D reproduction of the artwork. Here, the visitor can take the place of the milkmaid, wearing her clothes, taking her position and pouring milk themselves.
- \* A real size 3D reproduction with different audio buttons (image 4.8). Here, the visitor can touch all the elements present to get a sense of the space. Some of the elements provide auditory explanation when being triggered.
- \* An exploratory book. Every page covers a different aspect of the artwork or provides for a different kind of impairment.

Besides the concepts, notes were taken during the ideation, which can be seen at image 4.9, and the whole session was audio recorded.

These ideas, notes and recordings were used during individual brainstorm sessions to both substantiate existing ideas and provide other perspectives to generate new ideas.

## Other input

Besides the output of the creative session, inspiration was found in other ways like the insights from the analysis report, haptic technologies and discussions with fellow students.

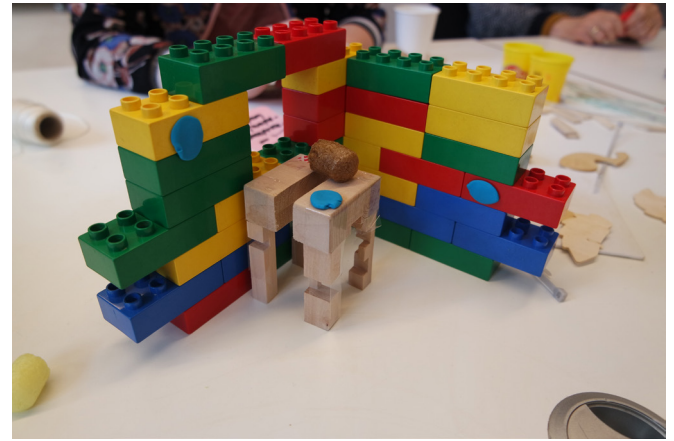


Image 4.8: A physical representation of one of the concepts made by one of the participants

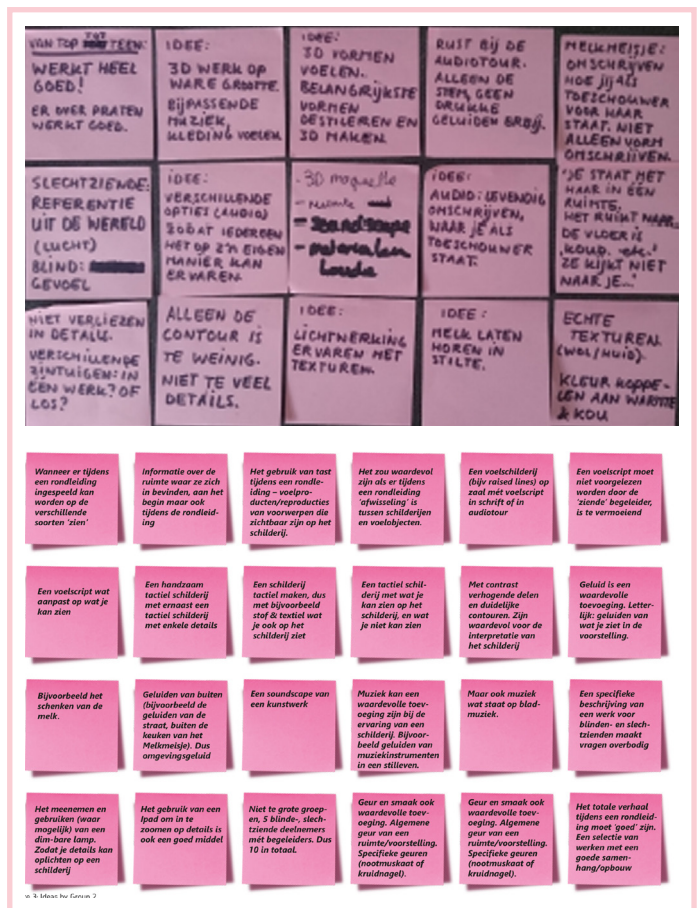


Image 4.9: Ideas on post-its of both tables

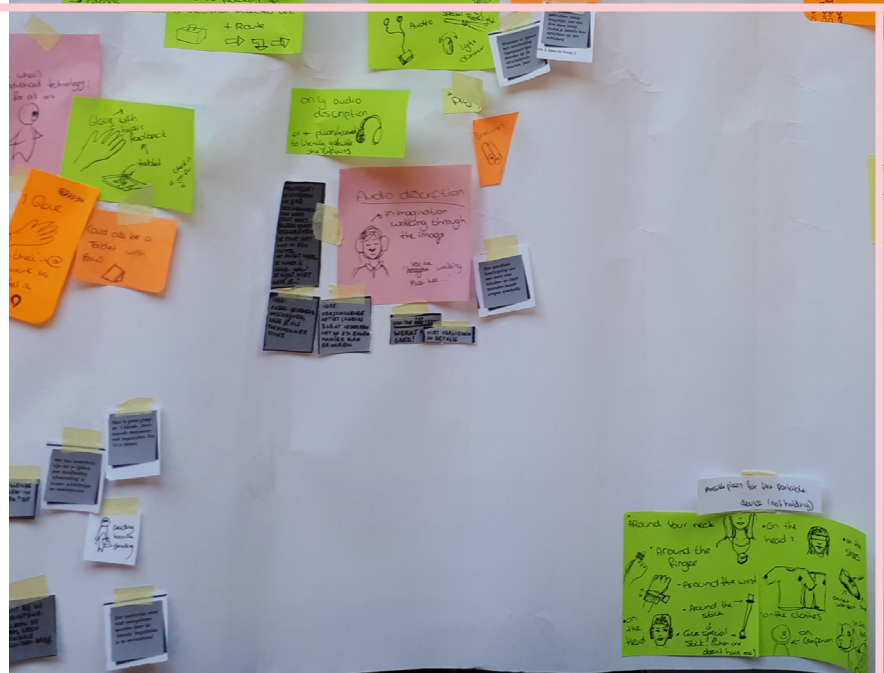
## Results

The ideas cover different phases of the visitor experience from the scenarios (as seen in chapter B4.1). Preparation, coming in and wayfinding, and first encounter with the art are put together under the name 'first phases' as seen on the y-axis in image 4.10. The phase of deeper interaction with one artwork, also on the y-axis, is the one for which the final design will be developed. Therefore, the ideas for the 'first phases' are taken apart and stalled for the moment.

### First phases (preparation, coming in & wayfinding and first encounter)



### Phase of deeper interaction with one artwork



Portable device

The ideas for the 'phase of deeper interaction with one artwork' can be divided by kind of device as to be seen on the x-axis in image 4.10. This refer back to the scenario's as well, where each one of the personas interacted with either a portable device, a static device or a combination of the former two. Within each category, similar ideas are put together, often dividing ideas for blind and ill sighted visitors.



Image 4.10: All ideas clustered per phase and kind of device

# B4.3

## Idea evaluation

After examining all the ideas, the most promising were taken and worked out into more detailed sketches (image 4.11). This way, the ideas could be developed further, so their value could be examined better. It resulted into twenty ideas, which could then be evaluated again.

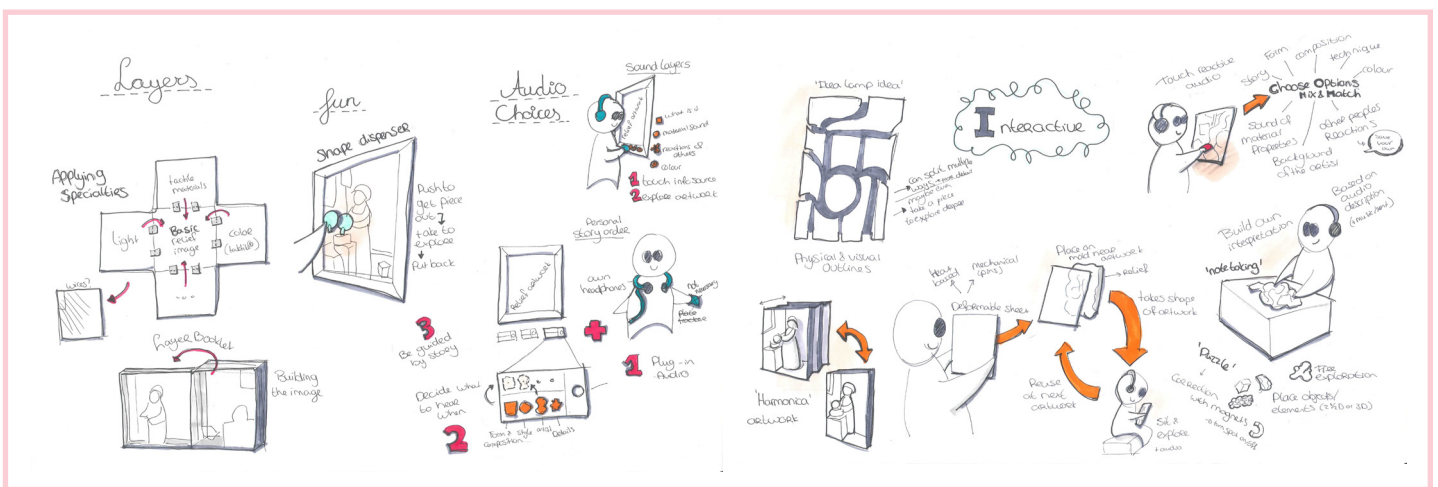


Image 4.11: Some idea sketches of interaction with the art

### PMI

The ideas were first evaluated upon their innovativeness and ease of implementation in a C-box (Appendix B7). Since this did not cover other important aspects like the value for the user, the more qualitative PMI method {Van Boeijen et al, 2014) was used to assess the ideas (image 4.12).

The abbreviation PMI stands for Plus, Minus and Interesting. Every idea was assessed according to these measures while mainly focussing on the perspective of the visitor, transferring the art well and practicalities. This created a deeper understanding of the value of the ideas.

Puzzle	<ul style="list-style-type: none"> <li>+ Exploration and information of isolated form</li> <li>Composition is corrected</li> <li>- Seems like a task</li> <li>Could be seen as bit childish</li> <li>! Building from form to whole</li> </ul>	Deformable sheet	<ul style="list-style-type: none"> <li>+ Re-usable. Multiple people</li> <li>Able to take and explore</li> <li>- Molding might go wrong easily</li> <li>Only form and composition</li> <li>Detail might be difficult?</li> <li>! One for all</li> </ul>
Notetaking: build own interpretation	<ul style="list-style-type: none"> <li>+ Free exploration</li> <li>Challenged to create own image</li> <li>- Might only be fun for one work</li> <li>Can be childish/task/not serious</li> <li>! Own interpretation</li> <li>Better memorization</li> </ul>	Feet/stick exploration	<ul style="list-style-type: none"> <li>+ Using something they know</li> <li>Literally standing in the work</li> <li>- Other people in front of art</li> <li>Takes quite some space</li> <li>People might feel viewed</li> <li>! Using a totally different space</li> </ul>
Applying specialties (+)	<ul style="list-style-type: none"> <li>+ Build up of different aspects</li> <li>- Only four options now</li> <li>One per person</li> <li>Might be difficult to understand</li> <li>! All applied on one image</li> </ul>	Link 2D-3D objects closeby	<ul style="list-style-type: none"> <li>+ Both 2D and 3D</li> <li>Isolation for ill sighted</li> <li>- Might be difficult to link</li> <li>Can get a mess</li> <li>! Everything around the work</li> </ul>
Personal story order	<ul style="list-style-type: none"> <li>+ Personal (to some level)</li> <li>Multiple people</li> <li>- Too many variables can make it hard to apply this to many works</li> <li>! Own preferences at spot</li> </ul>	Virtual reality glove	<ul style="list-style-type: none"> <li>+ Able to take with and usable for every artwork</li> <li>Can be customized</li> <li>- Expensive</li> <li>Might not be the same sensation</li> <li>! New technology</li> </ul>
2 1/2 D + side info in border	<ul style="list-style-type: none"> <li>+ Efficient use of space</li> <li>Highlighting atmosphere</li> <li>- Not on same location, so might be more difficult to link/follow</li> <li>! Ability to highlight certain parts</li> </ul>	Technique library	<ul style="list-style-type: none"> <li>+ Can take personal technique</li> <li>Can stand/sit where you like</li> <li>Available for multiple people</li> <li>- Have to leave the artwork to get</li> <li>Obtrusive in the space</li> <li>! Central point</li> </ul>
Form & Composition high tech	<ul style="list-style-type: none"> <li>+ Multiple artwork at one spot</li> <li>Ability to sit</li> <li>Both 2D and 3D</li> <li>- Only form and composition</li> <li>Hard to realize and expensive</li> <li>! Link to 3D exploration</li> </ul>	Pick your painting	<ul style="list-style-type: none"> <li>+ Can take personal technique</li> <li>Next to artwork, so closeby</li> <li>- Might elicit touching actual art</li> <li>Can take interest away from art</li> <li>! Also interesting for sighted</li> </ul>
Literal handguiding system	<ul style="list-style-type: none"> <li>+ Not that much effort</li> <li>Positions exactly clear</li> <li>- No control</li> <li>One person at the time</li> <li>Might break easily</li> <li>! Creating movement</li> </ul>	Sound layers	<ul style="list-style-type: none"> <li>+ Exploration on different levels</li> <li>Able to choose own preference</li> <li>Can be touched by multiple VIP</li> <li>- Not very innovative</li> <li>Might be hard to link all stimuli</li> <li>! Materiality through sound</li> </ul>
Harmonica artwork	<ul style="list-style-type: none"> <li>+ Relation between 2D and 3D</li> <li>Vertical and horizontal space</li> <li>- Might break easily</li> <li>What really is the added value?</li> <li>! Interaction needed</li> </ul>	Extension to Rijks box	<ul style="list-style-type: none"> <li>+ Own technique</li> <li>Fits Rijksmuseum style</li> <li>- Not very innovative solution</li> <li>Might need more space than a box</li> <li>! Fairly easy to integrate in Rijks</li> </ul>
Ikea lamp idea	<ul style="list-style-type: none"> <li>+ Creates both visual and tactile borders</li> <li>Possibility to go more into detail</li> <li>- Only form and composition</li> <li>One might get hurt</li> <li>! Interaction and depth (detail)</li> </ul>	Layer booklet	<ul style="list-style-type: none"> <li>+ Gradual build-up (detail)</li> <li>Good understanding of f&amp;c</li> <li>- Might be difficult to make</li> <li>Where to store</li> <li>Both hands needed</li> <li>! Building on the same image</li> </ul>
Shape dispenser	<ul style="list-style-type: none"> <li>+ Possibility to explore seated</li> <li>Creates focus</li> <li>Multiple people at once</li> <li>- People might not put it back</li> <li>Cumbersome? Expensive</li> <li>! Keepsake</li> </ul>	Augmented reality tablet	<ul style="list-style-type: none"> <li>+ Highly personalizable</li> <li>Extension of vision</li> <li>- Only for ill sighted</li> <li>Seeing the art through a screen</li> <li>! Interaction with actual artwork</li> </ul>

Image 4.12: PMI

# B4.4

## Concept development

### **Morphological chart**

Morphological charts are used for concept development as stated by the method 'Morphological Chart' of Van Boeijen et al (2014). Every layer in the chart represents an element of the final design. By choosing one idea of every layer, full concepts can be created.

### *Creating the chart*

Through the deeper understanding of the ideas gained by PMI, they could be clustered into different layers of the chart. These layers cover the kind of device and kind of technique: haptic and sound as seen in image 4.13. Within the haptic technique layer, the ideas are sub-divided.

The ideas of the other phases which were set aside before were brought into in the chart as well to create a full concept.

### *Creating the concepts*

The layer 'Kind of device' was taken as starting point, for it would result into inherently different concepts. From there, the most suitable haptic and sound techniques were chosen. This was done by looking back at the PMI's and fitting suitable ideas together to create the most promising concepts. Last, the preparation, wayfinding and first impression were connected to the concepts.

This resulted into three concepts. These were worked out into detailed design sketches and complementing storyboards of the whole user journey.

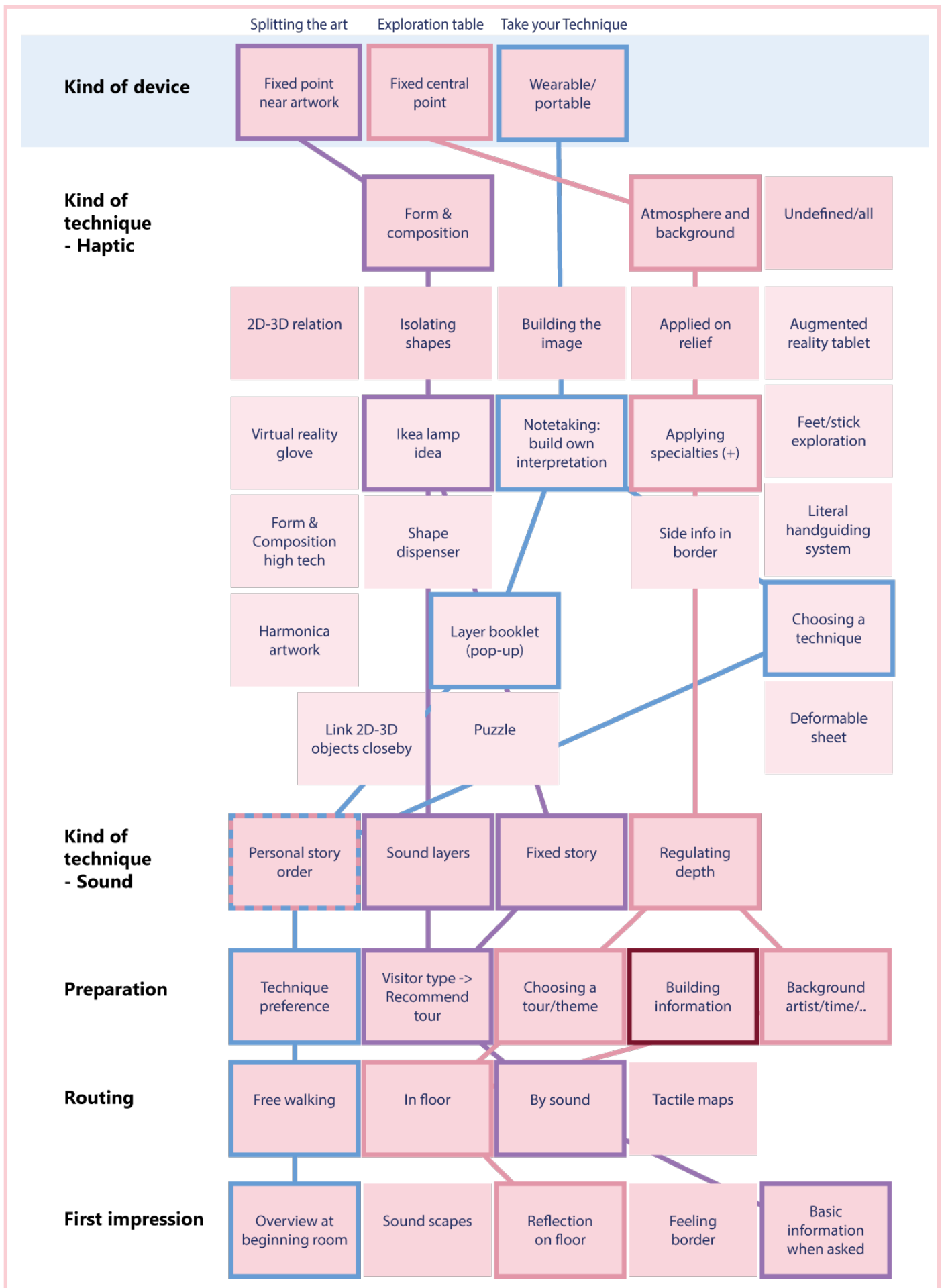


Image 4.13: Filed in morphological chart, each colour represents an idea.

# B4.5

## Concepts

Each concept communicates both form & composition and atmosphere & background. Every idea contains a combination between audio and touch, for these complement each other very strongly.

The storyboards only represent the interaction with the concept, for the total experience, the full storyboards can be found in Appendix B8.

### Concept 1: Take your Technique

Since there is a wide variety of personal preferences within the group of people with a visual impairment, this concept allows the visitor to choose their own preferred technique. When coming into the museum, the visitor gets a portable board to place the techniques on. While walking through the museum, the visitor will encounter the technique boxes and interact with them.

One box contains several artworks for which multiple techniques are available. Through auditory and haptic feedback, the visitor can choose both an artwork and the preferred technique(s). These can be enlargements, pop-up books, materials & textures etcetera. After taking them out and placing them on the board, the visitor can decide whether to stand in front of the work to explore or sit down somewhere.

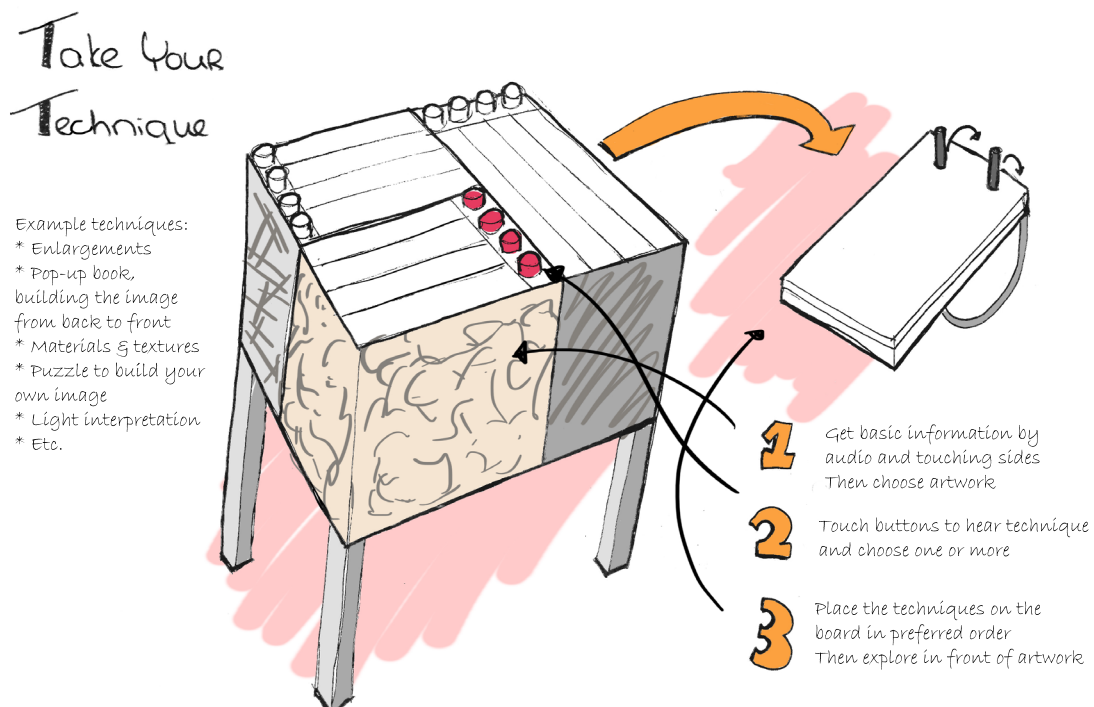
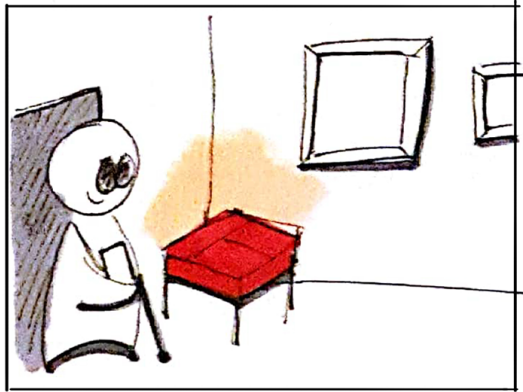
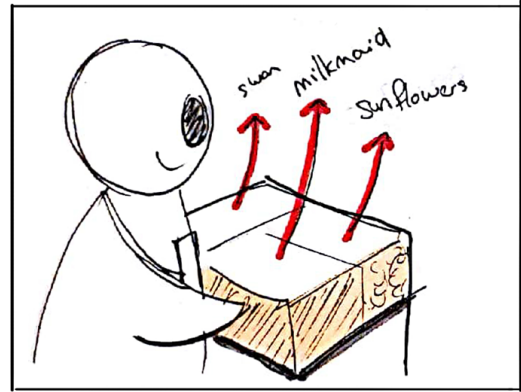


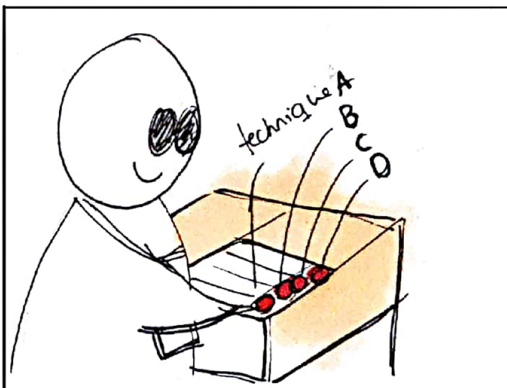
Image 4.14: Take your Technique



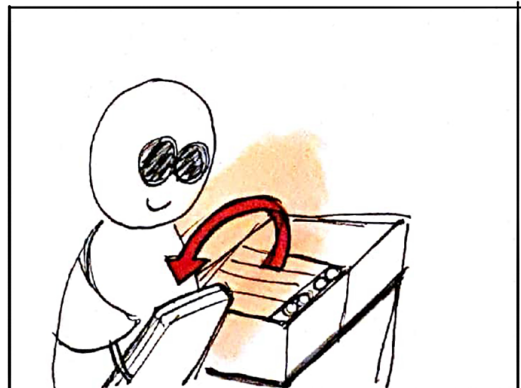
When entering a certain part of the exhibition, encounter the technique point



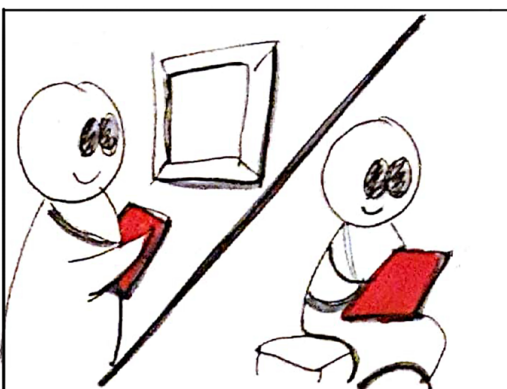
Get an overview of the available art by auditory information and/or a tactile atmosphere representation



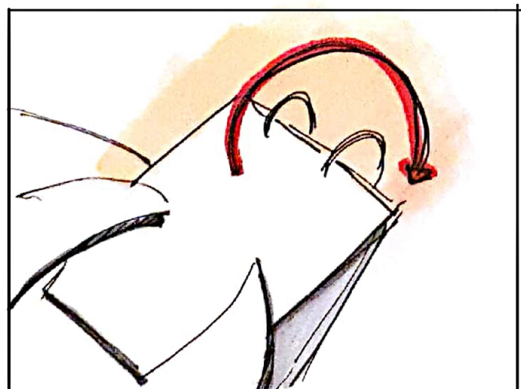
Choose an artwork and touch the buttons to get information about the technique



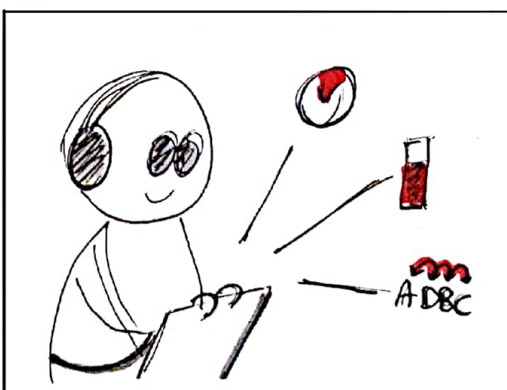
Choose one or more techniques and place them on the wearable



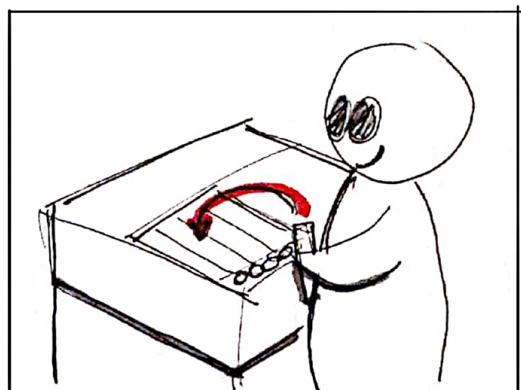
Explore the art through the technique whilst standing in front of it or sitting on a bench



Be guided by the audio and flip the technique when you are done with it to go to another layer



This way, decide your own timespan, depth and order



When done, place the techniques back and take another artwork at the same or different point

Image 4.15: Take your Technique storyboard.

## Concept 2: Exploration Table

This concept invites the visitor to create a deeper understanding of an artwork by sitting down for an exploratory session. Guided by audio, the visitor goes through the basic relief of the artwork, exploring the forms and composition present. When having an understanding of the image, the visitor can choose a preferred topic by applying layers onto this relief.

By touching the labels of the layer on the left, the visitor will receive haptic and auditory feedback of the topic of the layer. This can be colour, light, style or materials etcetera. To choose, the visitor takes one out and places it over the basic relief. This relief will still be perceivable, with additional information on top of it, again guided by audio. This way, the visitor can explore a new perspective of personal interest without losing sight of the form and composition.

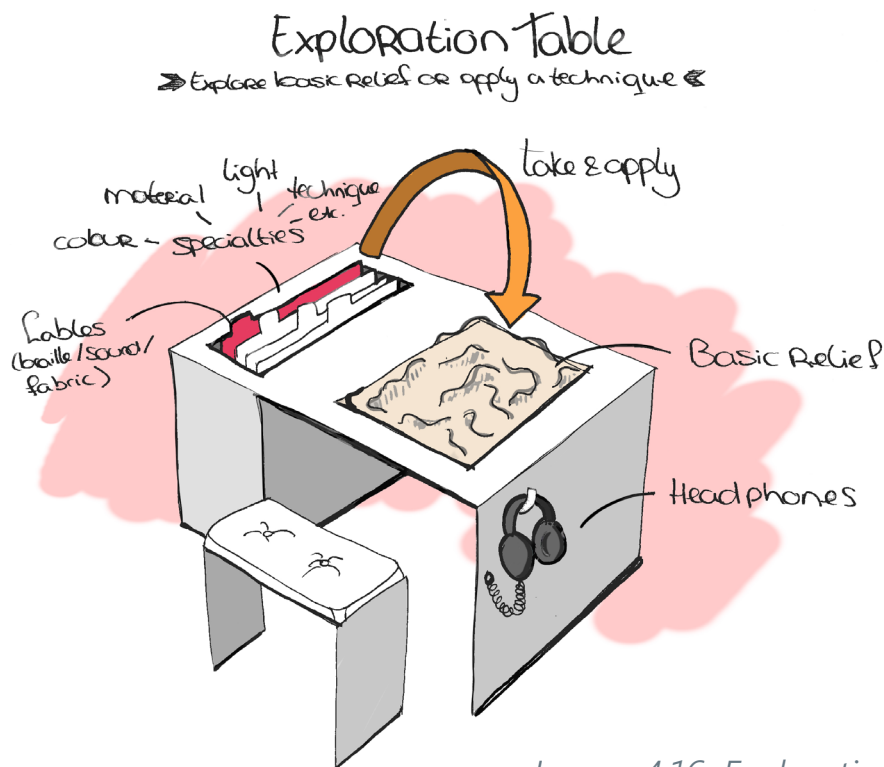
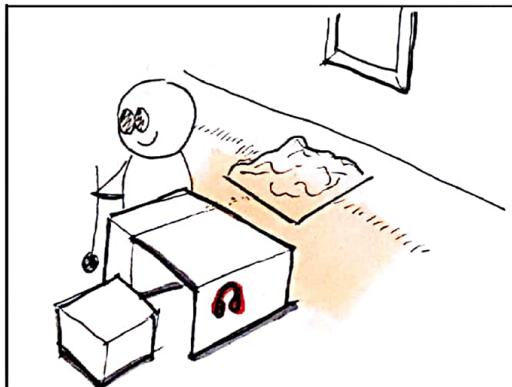


Image 4.16: Exploration table  
Concept drawing



When interested, go to the exploration point nearby



Sit down, scan your token to turn it on and put on the headphones



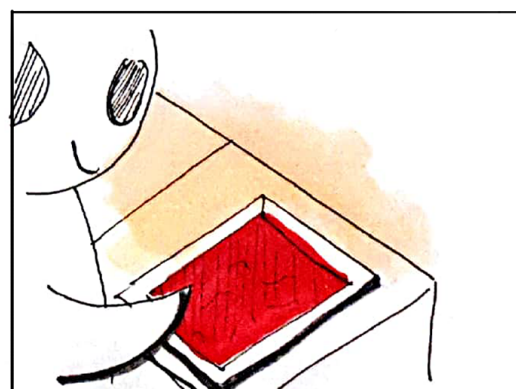
Start with the basic relief  
The audio guide will tell you how to go



Touch the labels to feel the specialties  
You will receive audio or tactile (braille) information



Choose one, take it and put it on the basic relief  
It will click on with magnets



Listen to the audio guide who will tell you how to interpret the layer

Image 4.17: Exploration Table storyboard.

### Concept 3: Splitting the Art

The basis of this concept is a full coloured relief version of the artwork, next to the real work, that can literally be split up into different elements. This applies focus for both blind and ill sighted visitors by creating visual and physical contours; the separate elements can be felt and seen more clearly.

The visitor can interact with the artwork by moving the slider on the panel to make the art separate. When then touching the work, the visitor will receive audio feedback about the part that is touched. The slider contains several buttons which link to different audio layers, according to the preferences of the visitor. These audio layers convey material properties, background information, other visitors reactions etcetera.

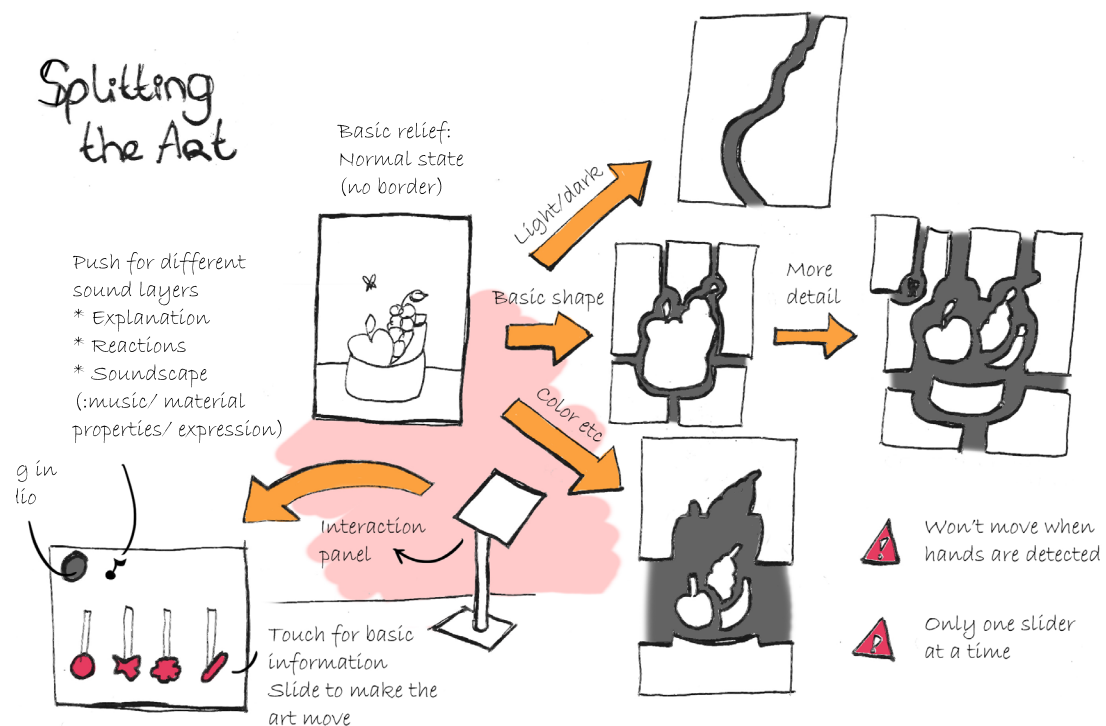
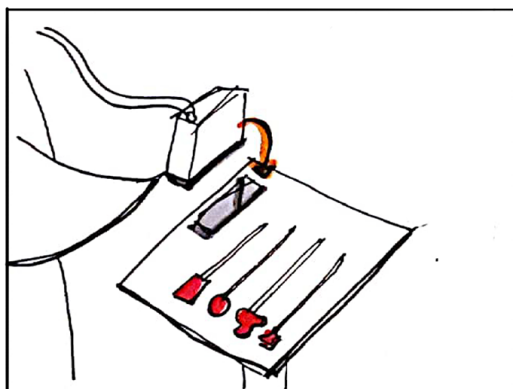
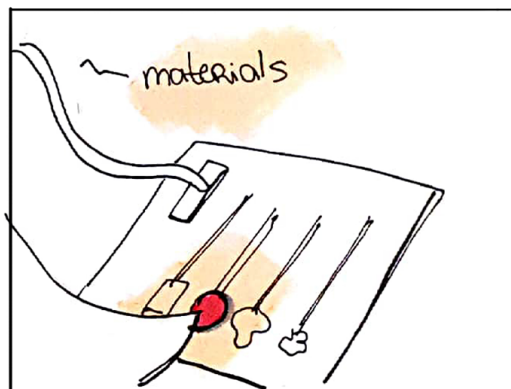


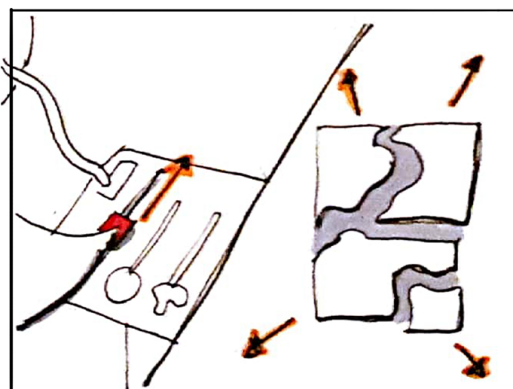
Image 4.18: Splitting the Art  
Concept drawing



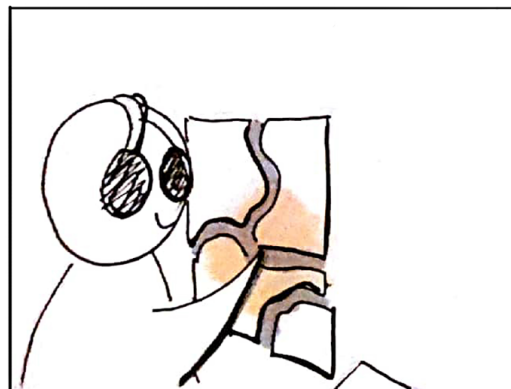
When interested, place the audio device in the board to connect



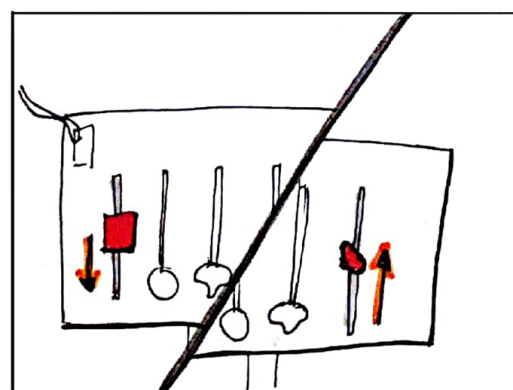
Touch the buttons to get information what it's about



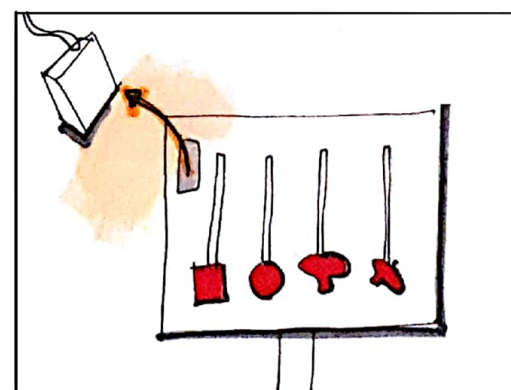
When sliding, upwards, the artwork will split accordingly: the further, the wider  
It will provide tactile and visual edges



Explore the artwork with your hands and get audio feedback according to the mode you're in



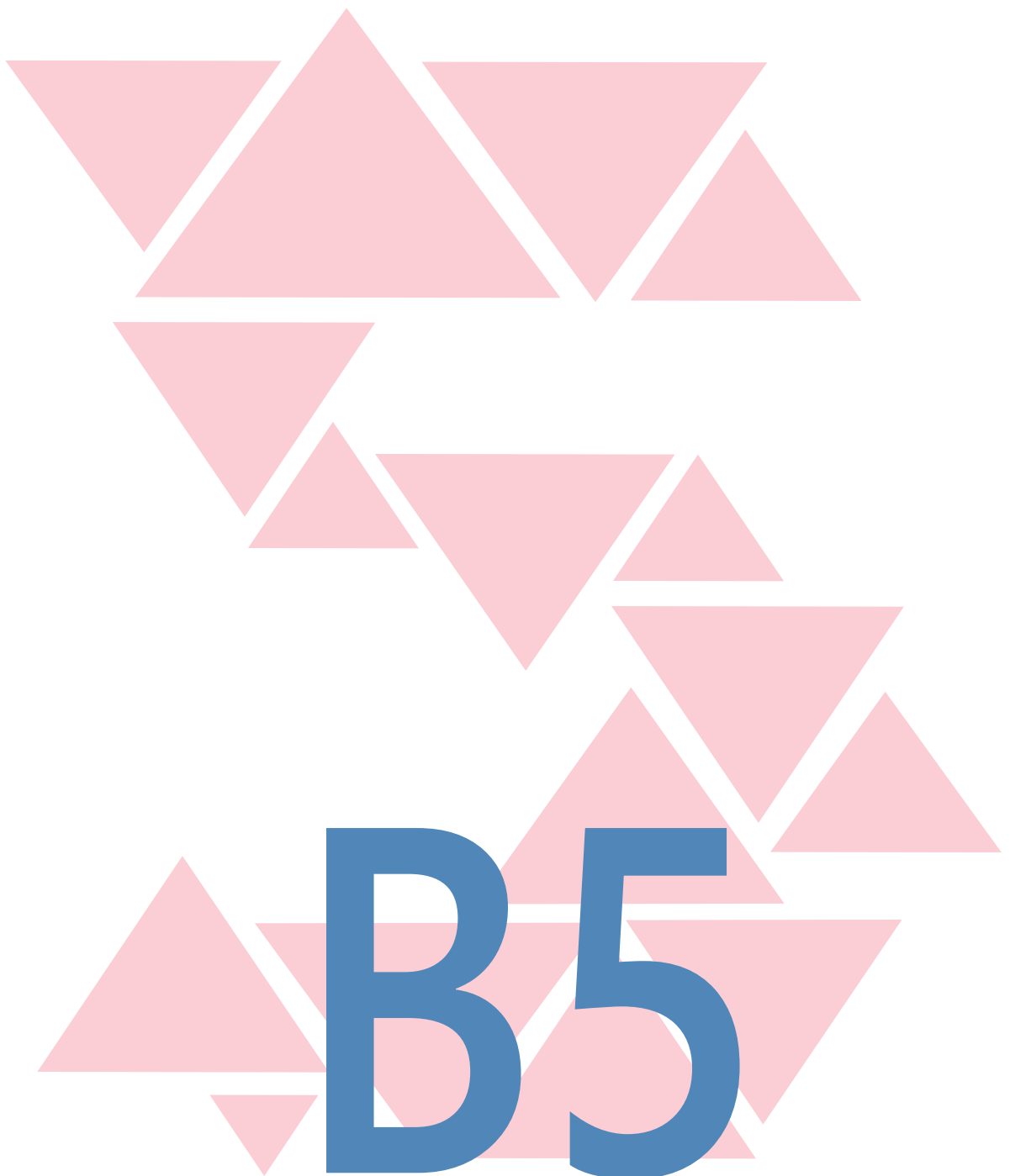
Turn the slider back to it's basic position, before sliding another button to get a different approach



When done, slide the button back and take out your audio device

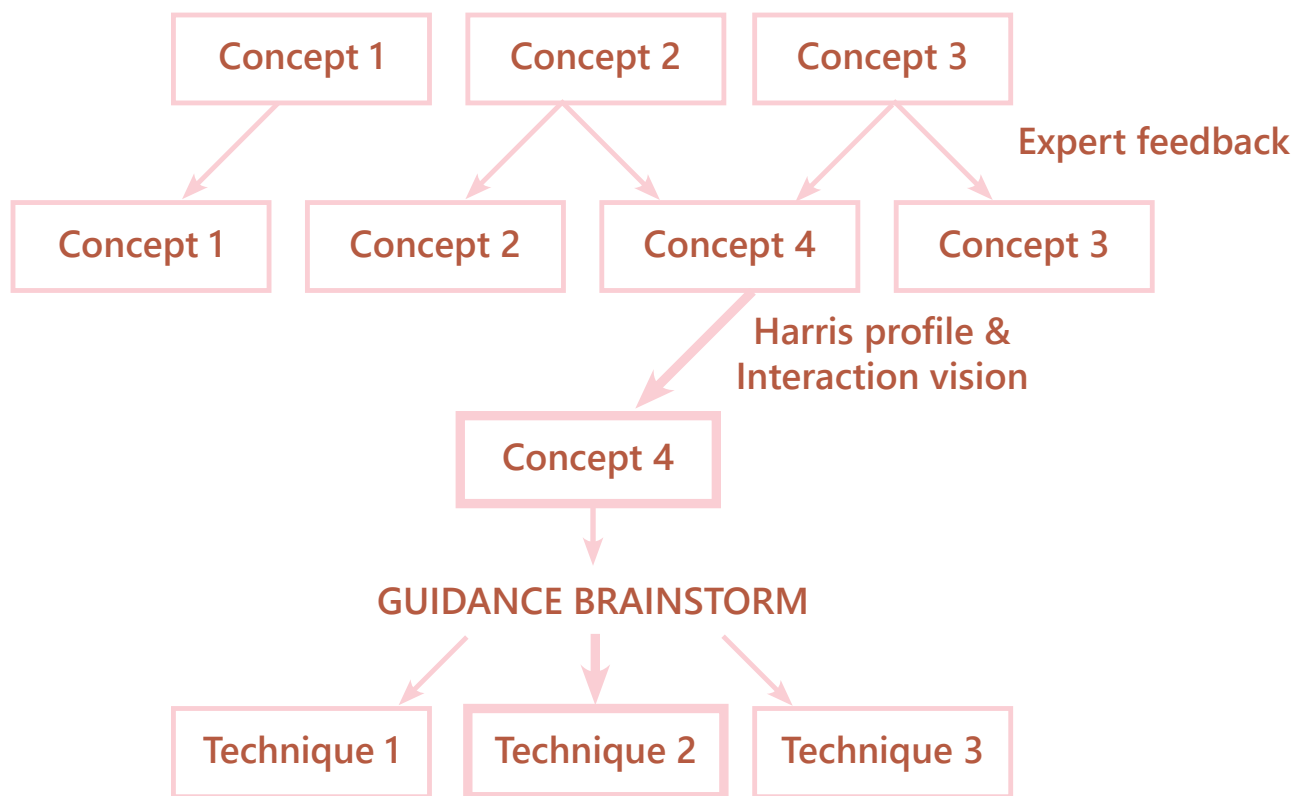
Image 4.19: Splitting the art storyboard.

# Concept evaluation and iteration



*The three concepts are assessed by two experts from the field of visually impaired and two experts of the Rijksmuseum. This results into valuable feedback with strong and weak points per concept. On the basis of this feedback, the three concepts are revised and a fourth concept, 'Portable Exploration Table' is created. All of them are assessed through a Harris profile based on the requirements and through the Interaction Vision. Eventually, a decision was made and the 'Portable Exploration Table' was chosen.*

*Again, this concept is iterated upon to find the best way to guide someone through an artwork. Eventually this is done with vibration.*



*Concept Evaluation & Iteration -  
Detail of Schematic overview of the Ideation phase*

# B5.1

## Expert feedback

In order to validate the concepts, improve them and have the ability to make a well-grounded decision, feedback was asked for.

Since it would take too much time to turn the visual ideas into a prototype that could properly be understood and explored by the user group and oral explanation would become easily biased, four experts were consulted. Besides being able to easily judge the ideas, these experts have a clear overview of diversity within the group, so less opinions were needed.

Two of the experts came from the field with expertise of the usergroup, while the other two experts were from the Rijksmuseum in order to make sure the design would fit the museum context.

### Field experts

The field experts were van Leeuwen of the company Mikxs (which developed the tour for visually impaired at Boijmans) and in't Veld of Dedicon (a company creating tactile images).

The experts were sent the concept sketches and storyboards via mail, accompanied by an explanation and questions to answer. One reaction was given over the phone, one by mail. The set-up can be found in appendix B9.

Their reactions were divided into positive and negative points for each concept, as seen in image 5.4 in light blue.

It appeared that not all design drawings were clear, so two of them were altered (img 5.1). Also, the concept 'Splitting the Art' appeared to be very complicated and was therefore simplified (img 5.2).

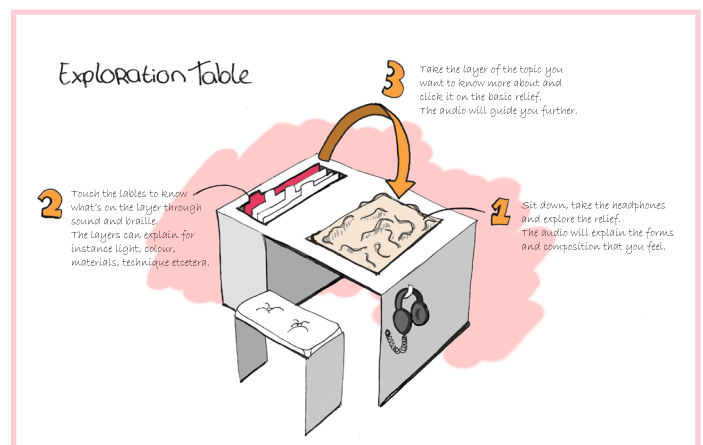


Image 5.1: 'Exploration Table' clarified

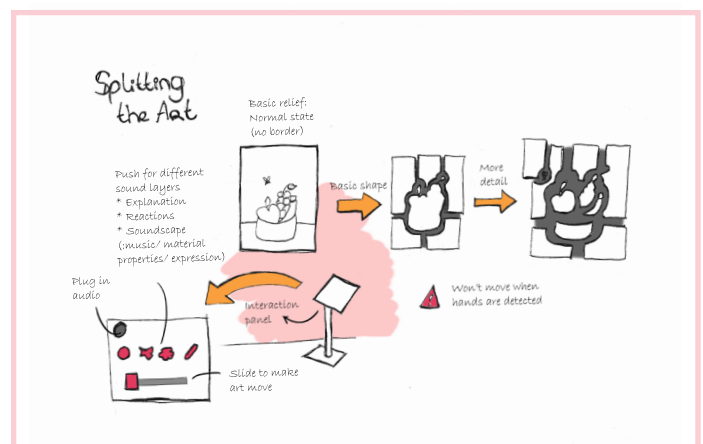


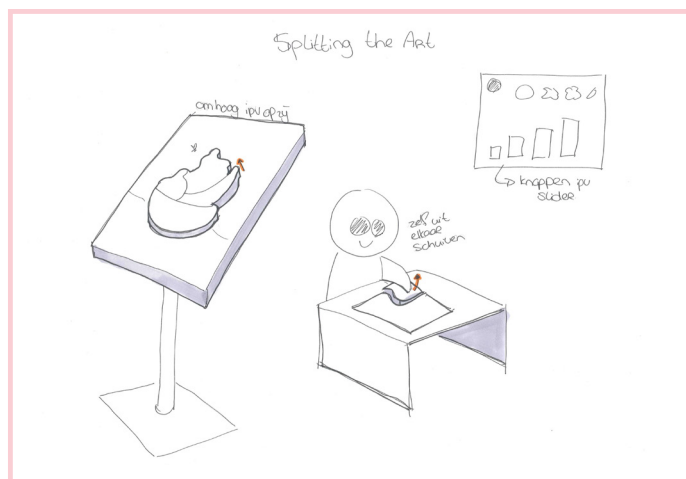
Image 5.2: 'Splitting the art' simplified

## Rijksmuseum experts

The Rijksmuseum experts were van den Berg, head of Inclusion, and Daams, one of the educators experienced with people with a visual impairment.

The meeting started with a recap of the project and explanation of the interaction vision, then discussing the three concepts. Besides the concepts and storyboards, design sketches were included showing other (physical) possibilities of the same concept as seen on image 5.3. Last, the expert feedback was discussed to react upon.

Their reactions can be seen on image 5.4 in dark blue. Besides focussing on the value for people with a visual impairment, their feedback was, as expected, also focussed on the feasibility of the concepts.



Img 5.3: Other sketches of 'Splitting the Art'

## Positive/Negative points

	Take your technique	Exploration table	Splitting the art
Positive	Choice between techniques(1)(2)(3)	Strong to choose your own preference (2)	Different soundlayers, own choice of information (2)
	Practically achievable (3)	Simple (1)	Compact, can be placed well (2)
	Suitable for multiple people (3)	Has a point of focus (4)	Nice to feel separate shapes (2)
	Nice that you have it with you (2)	Works from one basis (2)	(More) fun if it can come forwards (4)
	Doesn't stand out much (1)	Nice that you can sit (1)(4)	Also fun for sighted people (1)
	Multiple artwork at one point (2)	The interaction vision is presented well (4)	Most original (4)
Negative	Choice between sitting and standing (1)	Blind don't have to be near the work (1)	Nice if people can buy it (1)(3)
	Carrying can be hard (stick/dog) (1)(4)	Large installation for one work (2)	Possibly complicated for the user (1)(3)
	Will everything be brought back (in the right way)? (2)	Can't be in the gallery of honour like this (3)	Fragile through moving parts (1)(2)
	Relatively large installation (2)	Much space for one group (2)	Needs quite some maintenance (3)
		Hand-made, takes some time (1)	Materials are missing (3)
			How for modern art? (1)

in't Veld (1) & van Leeuwen (2)  
van den Berg (3) & Daams (4)

Image 5.4: Positive and negative points according to the feedback stated in order of importance

## Conclusions

All the concepts had their strong and weak points.

### *Take your Technique*

The main advantage of this concept is freedom of choice. Choice between techniques and choice of where to explore. Furthermore, it fits the Rijksmuseum style well.

The main disadvantages are portability and bringing back the materials in the right way.

### *Exploration Table*

This concept is strong for again freedom of choice, being able to sit and applying focus. Also the interaction vision comes back well.

The main drawbacks are the time it takes to make and the space it requires.

### *Splitting the Art*

Positive about this concept is mainly it creating focus, for both blind and visually impaired. Also it was mentioned as most renewing.

Challenging about this concept are the complexity and the fragility. Besides, audio only might not be sufficient; It missed the physical materiality.

### *General*

For all concepts, vulnerability and complexity should be considered well.

As for the Rijksmuseum, the design should be non-obtrusive within the exhibition space. It should be small and desirably portable.

The portability should be easy though.

For all the experts, personal choice was favourable. This could be in standing/sitting, kind of technique or interest.

## Iteration

'Splitting the Art' appeared most complicated, but also most innovative. To remain the focus, but create a more compact design, it was decided that parts would move forwards instead of sideways. This was merged with the layer system of 'Exploration table' to cope with the missing materiality. Then, the concept was made portable in order to fit the style and space of the Rijksmuseum. This resulted into a new concept: 'Portable Exploration table' as seen on image 5.5.

## Elaboration

For both concepts, design briefs were created, accompanied by several design sketches. These can be found in appendix B10. One of them to serve as starting point of the further development of the concept and the other to hand over to the Rijksmuseum in order for them to develop to their liking.

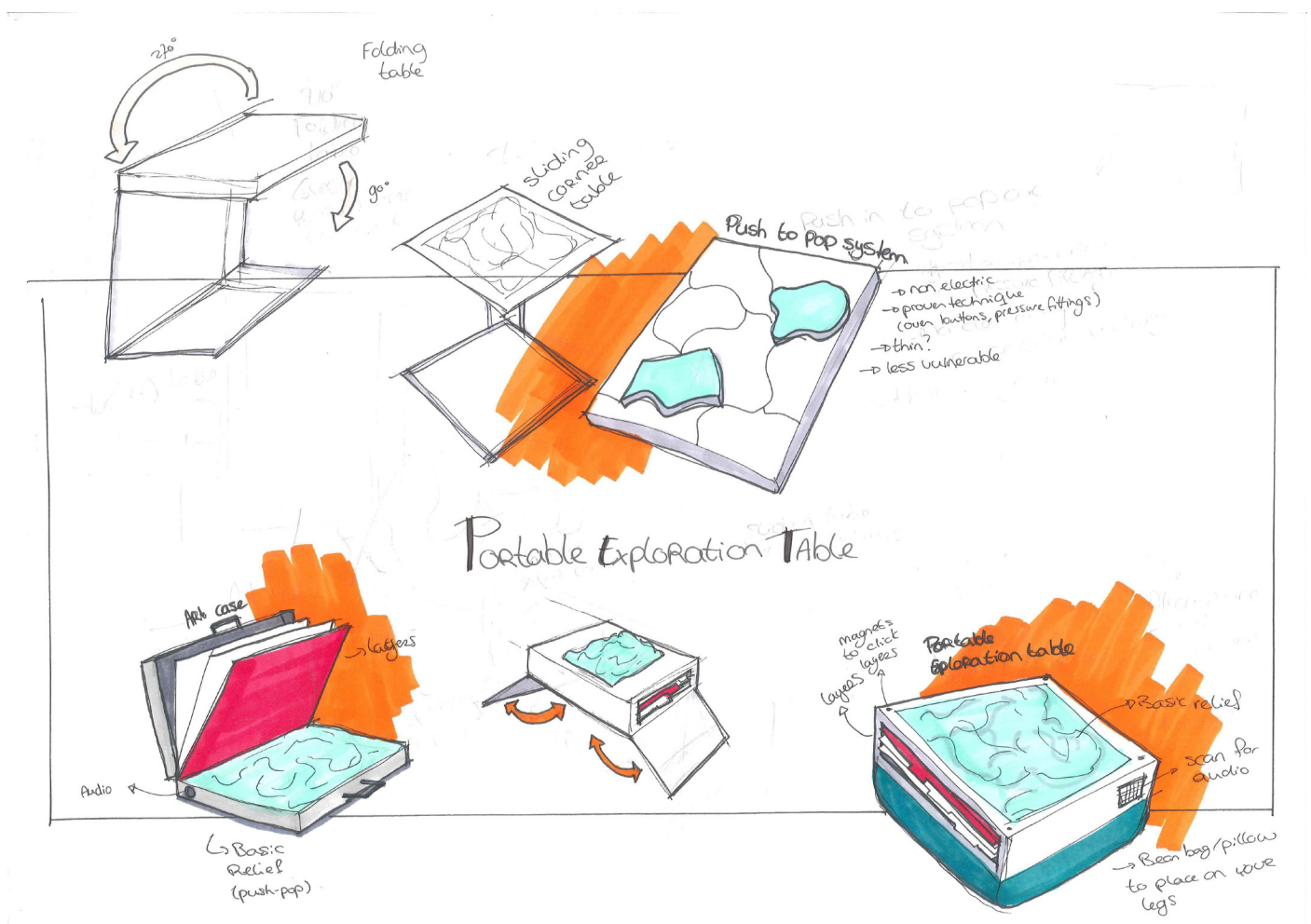


Image 5.5: Portable Exploration table

# B5.2

## Concept evaluation

### Requirements

In order to make a grounded decision, the method of a Harris profile {Van Boeijen et al, 2014) was used. According to the requirements set in the design brief (chapter A3.2), the concept is evaluated. The profile shows the strength and weaknesses of the concepts in a visual way.

After merging 'exploration table' and 'Splitting the art' into the 'Portable Exploration table' according to the expert feedback, all four ideas were evaluated through the Harris profile as seen in image 5.6.

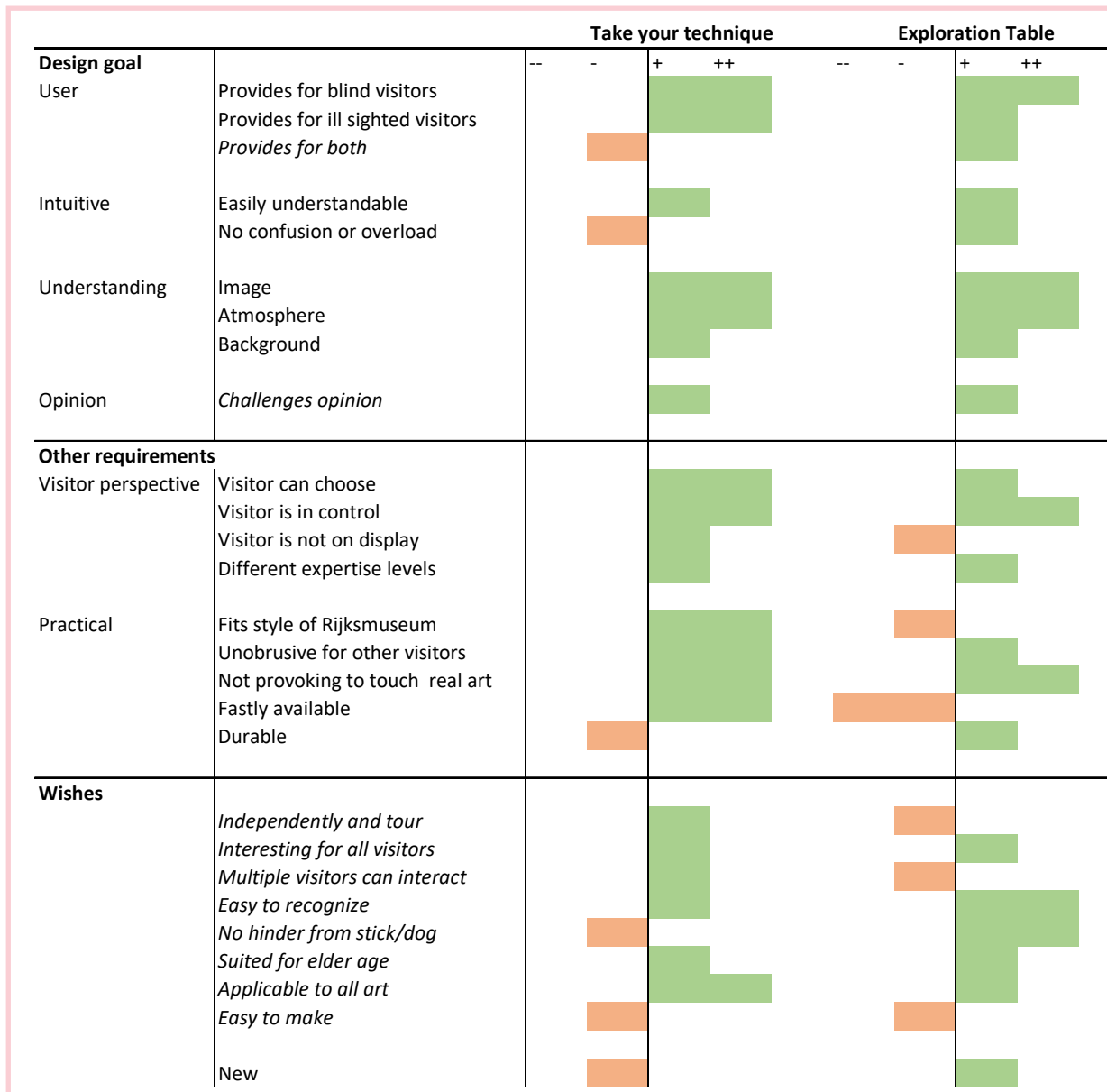


Image 5.6: Harris profile on the four concepts

## Conclusion

### Requirements

As immediately visible, 'Exploration Table' and 'Splitting the Art' are less promising than the other two concepts. Therefore these are rejected.

Where 'Take your Technique' might become confusing through the many different techniques and having to take them which can be hindered by hands full, the 'Portable Exploration table' is more straightforward and only requires two hands after sitting down. Besides, this concept carries the advantage of being more innovative.

### Interaction vision

Next to the requirements, also the interaction vision was taken into account when deciding upon concepts. This comes back in both concepts in the way that the visitor can choose their own artwork to explore. Also, in both cases the visitor can decide on which topic they want to know more about.

The layers of the 'Portable Exploration Table' represent the layeredness of the interaction best. The concept stimulates the visitor to investigate another layer while exploring, where 'Take your Technique' requires the visitor to decide on the preferred knowledge on forhand.

Together, these are the reasons to develop 'Portable Exploration table' further.



# B5.3

## Concept iteration

In the chosen concept, a certain piece comes forward in order to apply focus for the visitor. Through conversation it appeared that making a piece come forward might not be the best solution to make it stand out.

Therefore, a brainstorm (appendix B11) was held during the Makerlunch of Applied labs at Industriële Ontwerpen, Delft to explore other ways of doing this. About six PhD'ers and staff workers were present. This resulted into a variety of solutions, as to be seen in image 5.7.

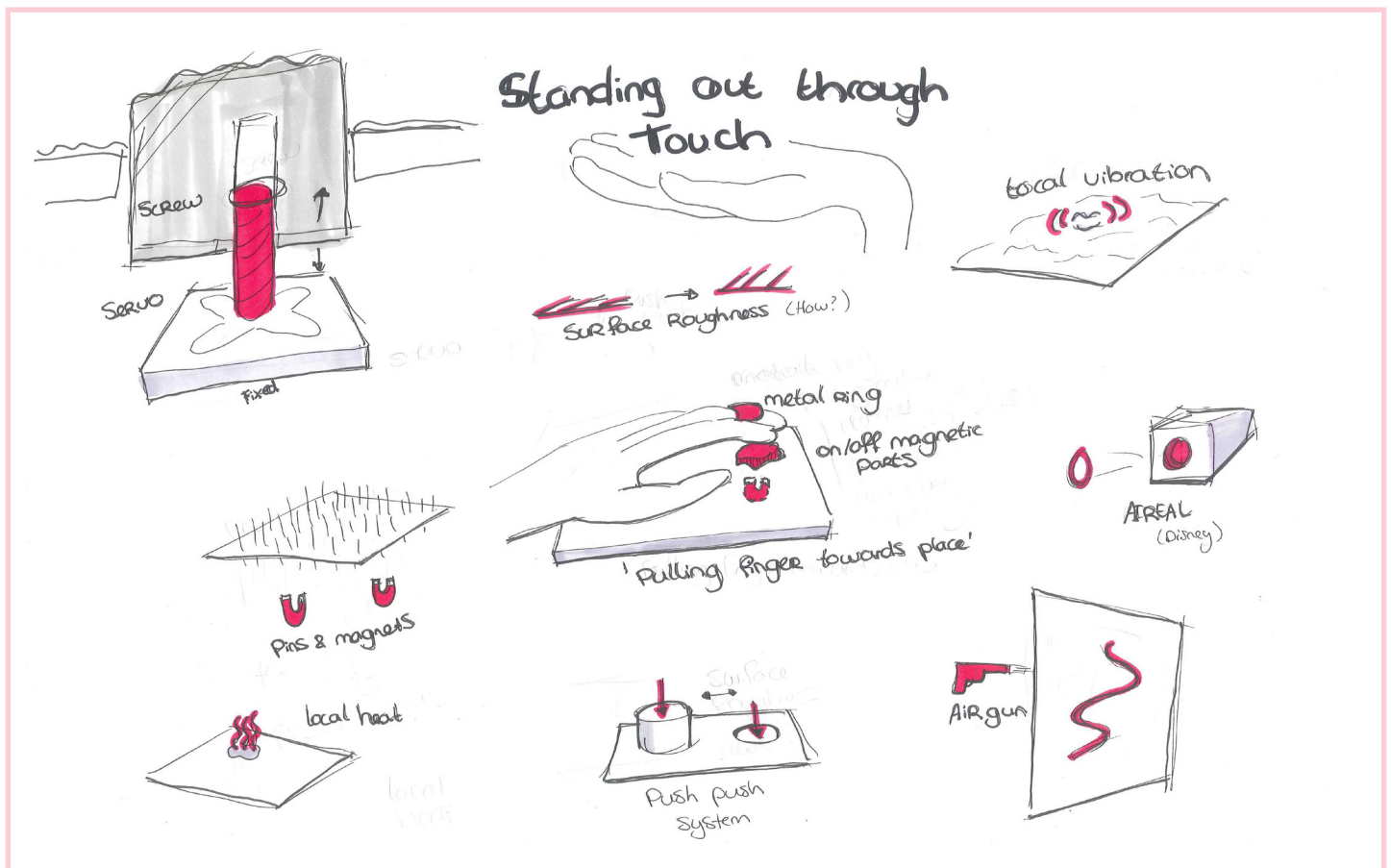


Image 5.7: Results of the brainstorm session

### Analysis of the outcome

The solutions are evaluated upon technical feasibility and enhancement of the concept. Three solutions were evaluated to be most fitting: Creating height differences, vibration and magnet guidance. These cause different interactions of the user with the artwork, which were tested.

## Test goals

Finding out how to guide the participants through the story best.

Finding out if a relief works better than a flat materialized representation.

## Test material

Representations of the artwork, *The Milkmaid* of Johannes Vermeer.

- a. **Height**: Wooden relief with add-ons of the pot held by the maid in three different heights, as seen in image 5.8a.
- b. **Vibration**: Cut-out of wooden relief where the pot and the bowl in catching the milk can vibrate, driven by two vibration motors with a button.
- c. **Magnet**: Flat representation with different structures and magnet on top which was moved manually by moving the magnet on the bottom (image 5.8c). Detailed descriptions can be found in Appendix B12.

## Participants

In order to be able to test quickly with a target group which is difficult to reach, the user was simulated. This way, six students (age 22-25) and two adults (45-55) were blinded with a with foil covered pair of glasses on, to decrease their vision as seen on image 5.9.



Img 5.9: Blinded glasses

## Story and questions

In order to engage in the context, an introducing story was told. The participants were orally guided through the tactile representations.

After each subtest, the participants were asked about their experience with the way of guiding and the way of representing the art. After the second and third test, first their experience and then a comparison with the previous one(s) was asked for. To prevent the outcome being biased by the order of experiencing the prototypes, not all participants started with the same prototype.

The detailed story and questions can be found in Appendix B13.

The tests were recorded on video and audio to be analysed afterwards.



Image 5.8a:  
Height prototype

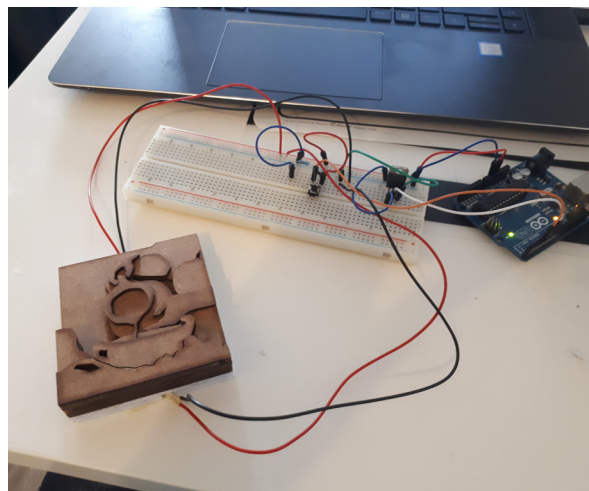


Image 5.8b:  
Vibration prototype



Image 5.8c:  
Magnet prototype

## Results

### *General observations*

At the pilot test, the participants often asked for reassurance and feedback. Also, I automatically started guiding the participant from the most recognizable starting point, which however isn't the most interesting part of the work. Therefore, guidance and feedback appear to be the two most important features of my design.

The first time, the participants needed time to explore the artwork.

Participants start feeling very close to themselves, uncomfortable to reach out.

Many participants mentioned the relation between the pot and the rest of the artwork, directly (3/8) or indirectly (3/8).

### *Height*

Most of the participants were able to find the object in the audio. (6/8)

Elevation works to get a better understanding of shape (5/8) and/or detail (4/8).

### *Vibration*

Vibration works well for localizing (7/8) and feedback (3/8).

Feeling the shape of the object became difficult for some (3/8), helpful for others (2/8).

The sound was mentioned a couple of times, both positive (2/8) and negative (1/8).

### *Height vs. Vibration*

Half of the participants specifically mentioned vibration over height. (4/8)

### *Magnet*

The guidance by magnet was helpful for all participants, except one, due to focus (3/8) and it being easy to follow (3/8).

Most participants didn't start exploring the surface until being told to do so. (6/8)

Also half of the participants went back to the magnet quickly. (4/8)

Most of the participants thought the magnet was a barrier between them and the work. (6/8)

### *Preferences*

Being guided by the magnet was chosen the least. Most participants preferred vibration. One participant who during the test mentioned vibration over height switched back to height at the end.

One participant was divided between magnet and vibration.

### *Relief*

For most, the relief provided more information. (5/8)

### *Materials*

The materials sometimes helped for identification of the objects. (5/8)

By some, the materials aren't understood or don't match expectations. (4/8)

Feeling the shape is difficult. (6/8)

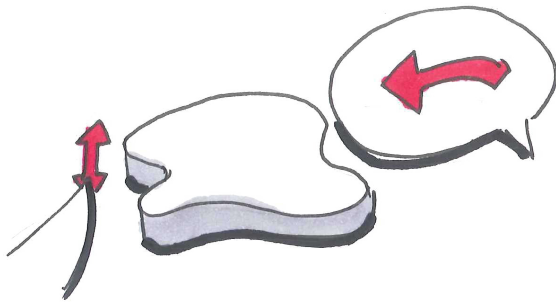
### *Combination*

Some would like to have a combination of form and texture. (3/8)

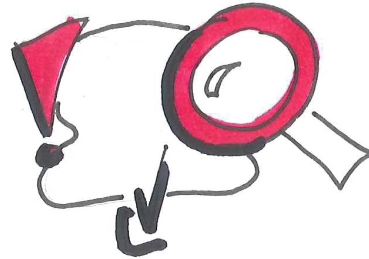
For others this wouldn't be helpful. (2/8)

## Main insights

These are the main insights derived from the results, which can be found in Appendix B14 and B15.



*To find the elevated part, one needs to feel a difference or audio guidance.*



*Elevation provides a better understanding of shape and detail.*



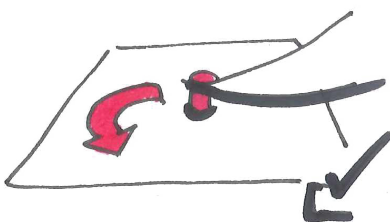
*Vibration works well for localizing*



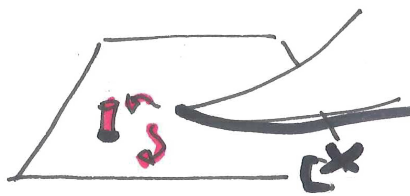
*It needs to be subtle and limited to the shape*



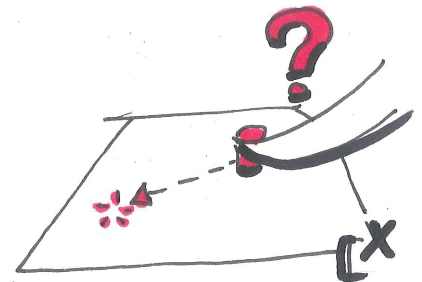
*Shape recognition and the sound are experienced both positive and negative*



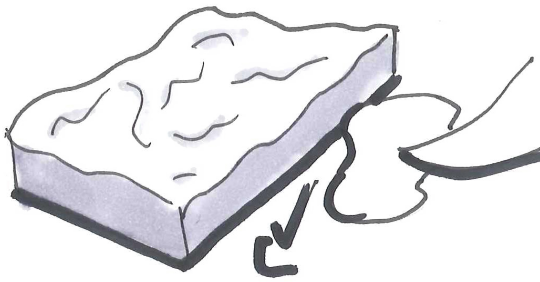
*A magnet works well for guiding (especially outlines)*



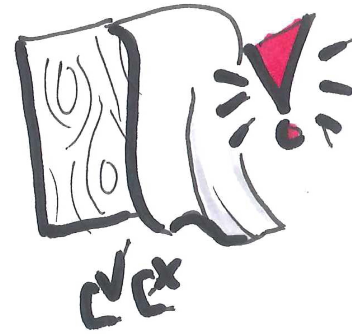
*But works against self-exploration*



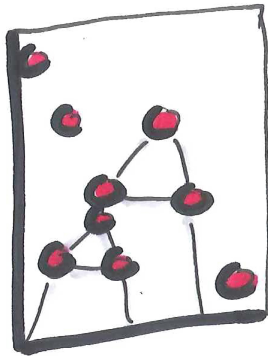
*Searching through a magnet is difficult*



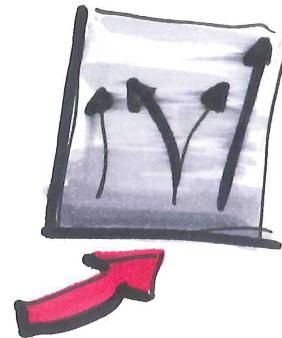
*Relief works best for form exploration*



*Materials work well for understanding of the objects and fit the experience, although this is very subjective*



*One needs to understand the objects and their relation to each other, before going into detail*



*People naturally stay close to themselves and need to be stimulated to reach out and feel the whole relief*

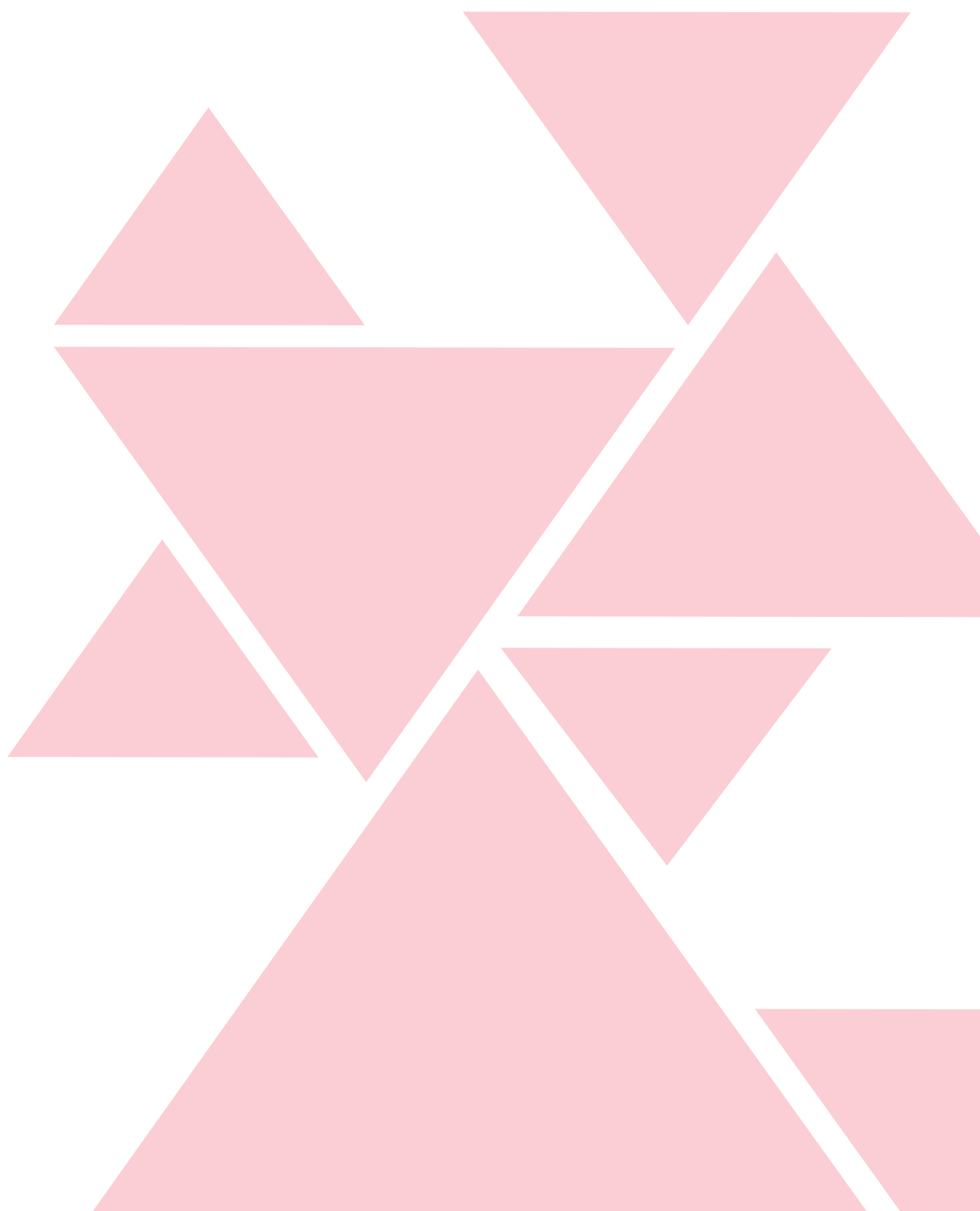
## Conclusions

In order to guide people with minimal tactile experience through a tactile artwork, **vibration** is decided as most applicable. It is most easy to find, mentioned by most participants as most pleasant solution, does not obstruct self-exploration and no barrier.

**Relief** is chosen, because it works well for form exploration, congruent to the research of Reichinger, Maierhofer & Purgathofer (2011). The materials can be one of the layers as it adds to the experience of the artwork, but too personal for the main relief.

## Other

First all the important elements of the painting should be explained, before going into detail. Also, the relationship between these elements should be clear, so the participants can find their way from one element to another.

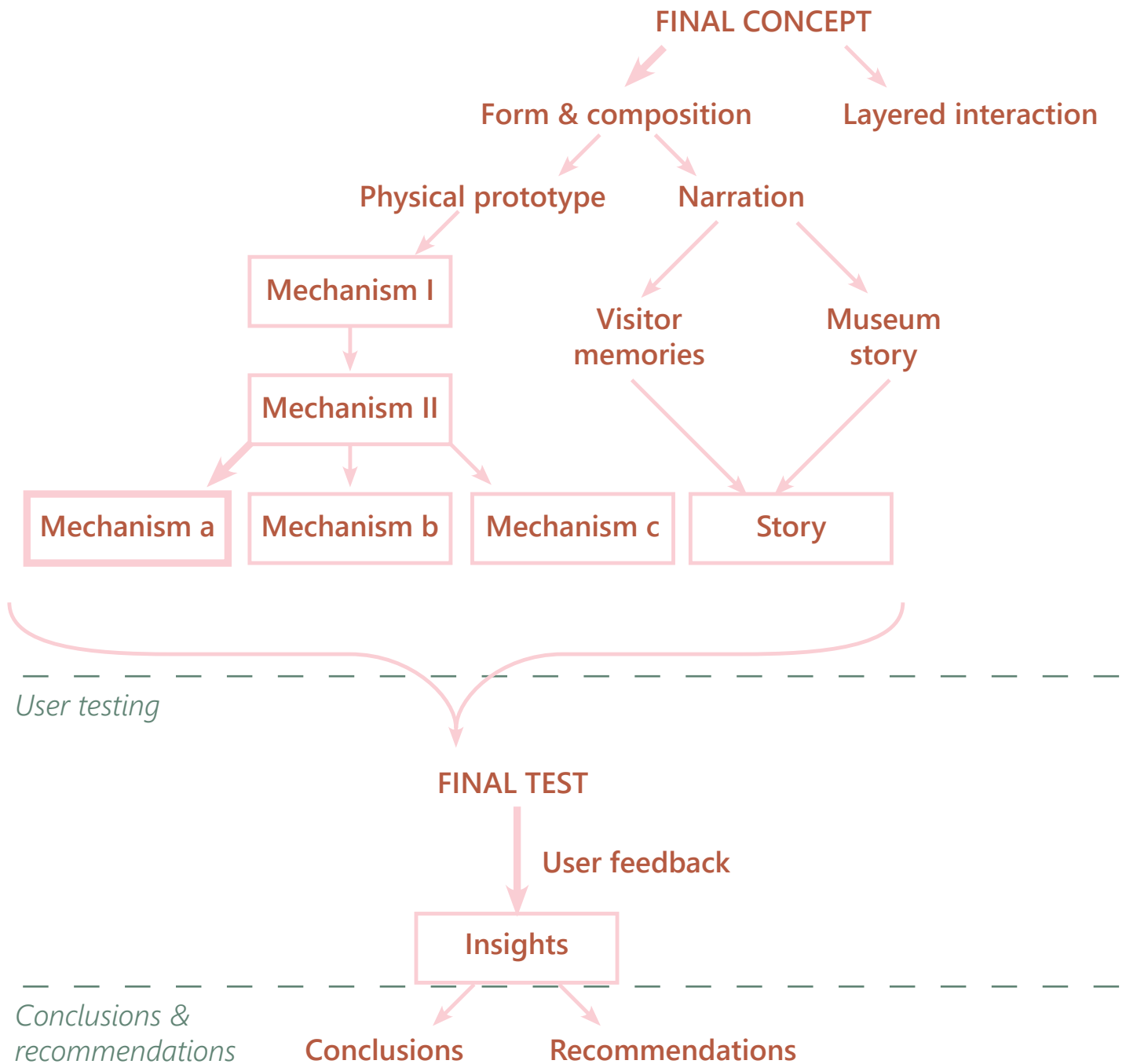


# DEMONSTRATION

This last chapter explains the final concept. Understanding form and composition was chosen to focus on within this concept to be developed further. Another part of the concept, the layered interaction, is explained and visualized.

The prototyped guiding people through the work exists out of the vibration mechanism and the relief, and is accompanied auditory by narration. The vibration mechanism is explored both theoretically and practically through research and prototyping simultaneously. Furthermore the (background of) the guidelines for the accompanying story are outlined.

## Concept detailing



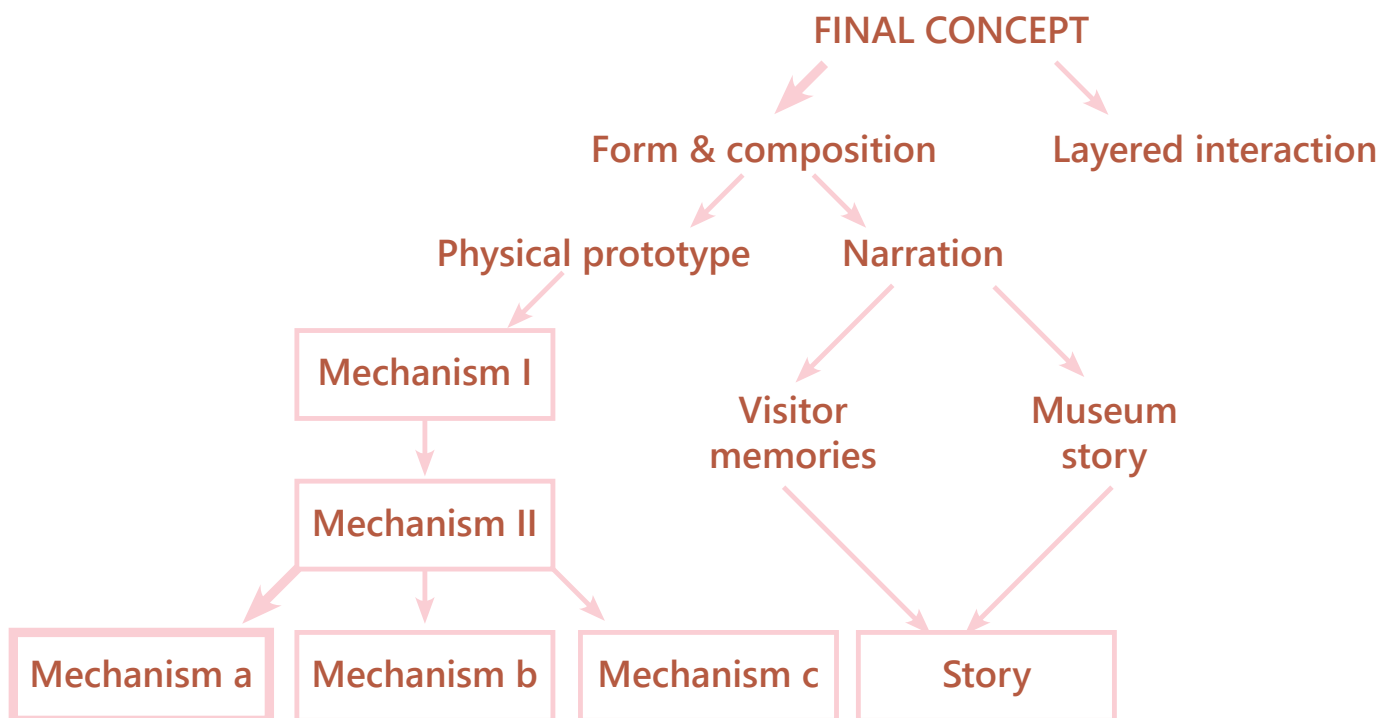
*Schematic overview of the Demonstration phase  
The thick lines represent the chosen path in case of  
multiple options*

# Concept detailing



*This last chapter explains the final concept. Understanding form and composition was chosen to focus on within this concept to be developed further. Another part of the concept, the layered interaction, is explained and visualized.*

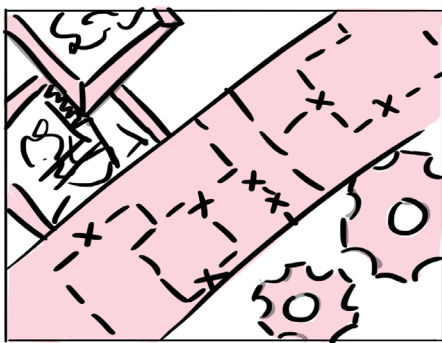
*The prototyped guiding people through the work exists out of the vibration mechanism and the relief, and is accompanied auditory by narration. The vibration mechanism is explored both theoretically and practically through research and prototyping simultaneously. Furthermore the (background of) the guidelines for the accompanying story are outlined.*



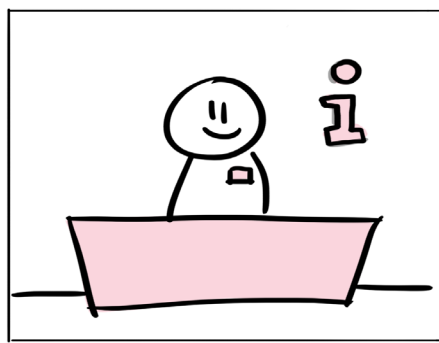
# C6.1

## Concept & Focus

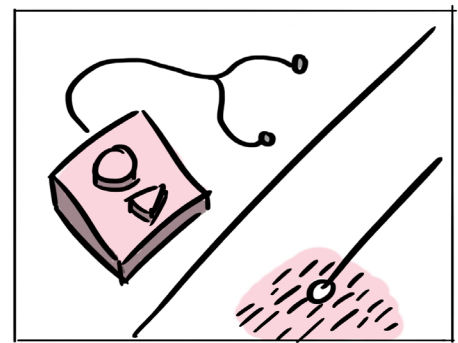
The complete concept exists out of multiple phases, from preparing before your visit, to wayfinding, a first interaction the art hanging around and deeper interaction with one artwork, as seen in image 6.1. Within this concept, deeper interaction, so understanding one artwork into detail, is worked out.



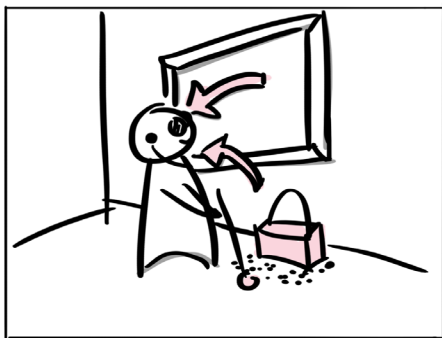
**Preparation at home:**  
 Recommendations based on interests (tour)  
 Building information (routing/background)  
 Design information (how it works)



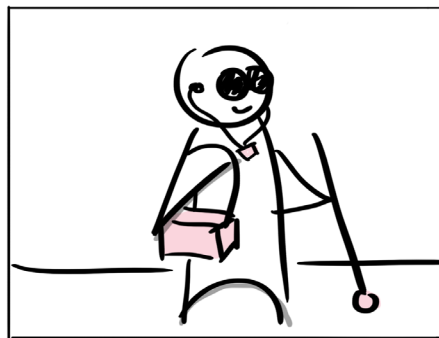
**Counter in museum:**  
 Receive audio guide  
 Practical information (routing/design)  
 Answering questions



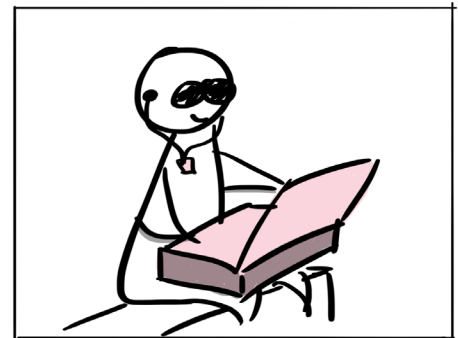
**Wayfinding:**  
 Audio: Directions and confirmation  
 Tactile: Orientation and notification



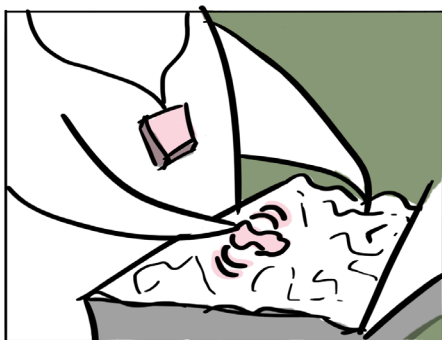
**First artwork interaction:**  
 Basic information  
 Availability design  
 Choosing whether to delve into the work



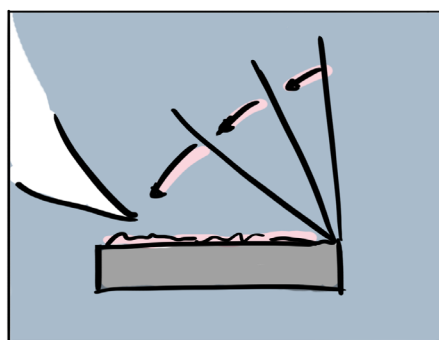
**Portability:**  
 Always at the same place  
 Only one hand needed, hang over shoulder  
 'Reserved' seats



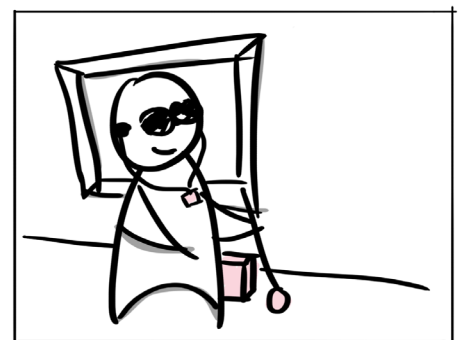
**Design installation:**  
 Stabilize  
 Right orientation  
 Audio connection



**Form and composition:**  
 Relief (tactile shapes)  
 Vibration (guidance and feedback)  
 Auditive information (possibility to skip)



**Specific art information:**  
 Materiality/Colour/Style/Light  
 Folding down layers to explore  
 Skip through according to interests



**Continuation:**  
 Close the case after the last layer  
 Audio detachment  
 Place back and continue

Image 6.1: Storyboard of the whole experience

## Portable exploration table

As explained in B2.2 Concept evaluation, the 'Portable exploration table' is chosen as concept with most potential.

When going through a museum, one can choose to engage into deeper interaction with one artwork of preference by taking a portable exploration table, placed near the work. When opening it, two elements can be found: First, a *basic relief* to understand the form and composition of the image as depicted on the artwork (green background in image 6.1).

Then when the image is clear, several *layers* can fit onto this relief to understand other aspects of the artwork like light, colour or materiality, according to the preference of the user (blue background in image 6.1). These layers can also provide for different kinds of visual impairments.

Both the basic relief and the layers are guided by audio.

### Basic relief

What appeared from the research is that in order to understand form and composition, a two-and-a-half-D relief works best as more depth provides room for more detail. Through testing, it became clear that feedback and guidance are important when going through such a relief. This guidance and feedback is provided by audio explanation and vibration, as explained in B5.3.

The basic relief was prototyped and tested. This will be explained in the following sections.

## Layered interaction

As explained, exploring the other aspects of the work is done through layers. This can be in the form of a booklet at its side, pulling down layers as seen in image 6.2. Another way would be to have the layers in a separate place, picking them out and placing them over the relief. The best interaction should be explored further.

An advantage of the layers is that visitors decide which aspect to discover and when. Every layer provides a different tactile experience and comes with a corresponding auditive story. The layers are shaped in order to fit the basic relief as seen on image 6.3. By placing them over this relief, the form and composition remain at the same place to avoid confusion.

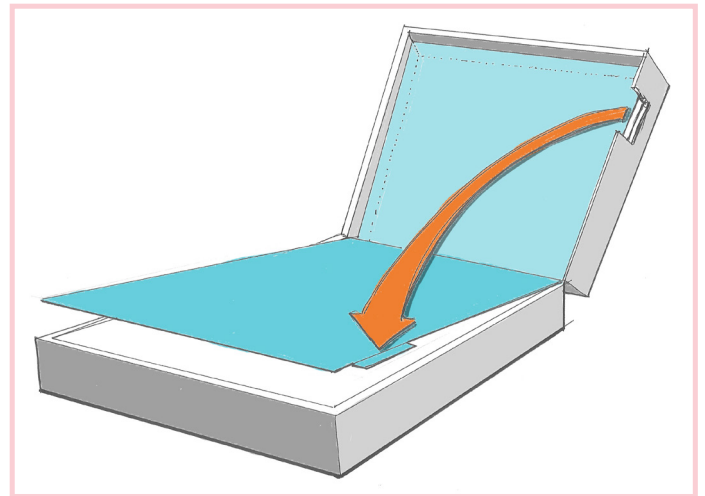


Image 6.2: Layer case

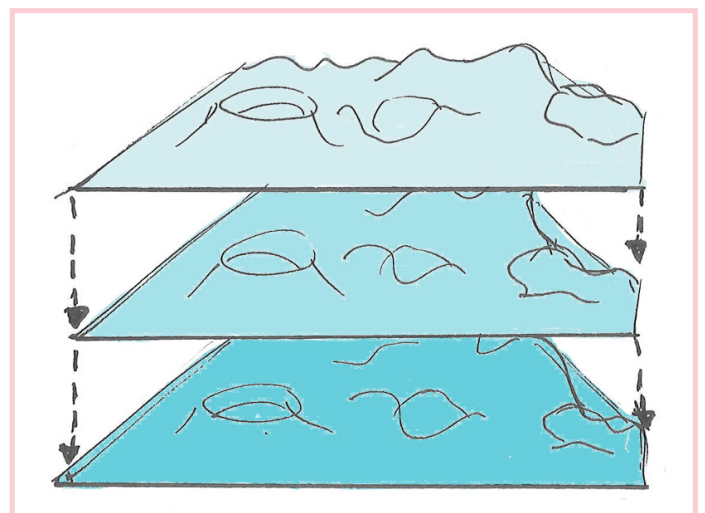


Image 6.3: Fitting the layers

# C6.2

## Vibration iteration

Out of the exploration in B2.3, it appeared that vibration was the most promising technique to provide guidance and feedback. During this exploration though, it was found that the sound and locality of the vibration could be improved. Therefore, the vibration was explored further, with the following goal in mind: Limiting vibration to one certain piece of the artwork, subtle and silent. In order to understand how to control vibration, additional information was gathered and several tests were done simultaneously.

### Evaluation vibration prototype

As starting point, the prototype from the concept iteration (B5.3) was evaluated. This prototype existed out of a fixed basic structure with loose wooden elements having space to vibrate, as seen at image 6.5.

The prototype probably because of the space it had to move around. The sound could be more subtle and the vibration could be felt at other parts of the prototype as well, even at best at the sides of the prototype instead of at the top.

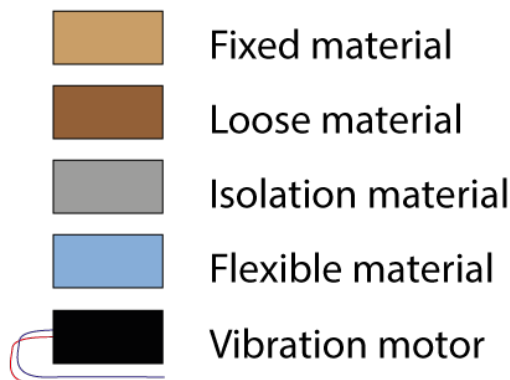


Image 6.4: Legend

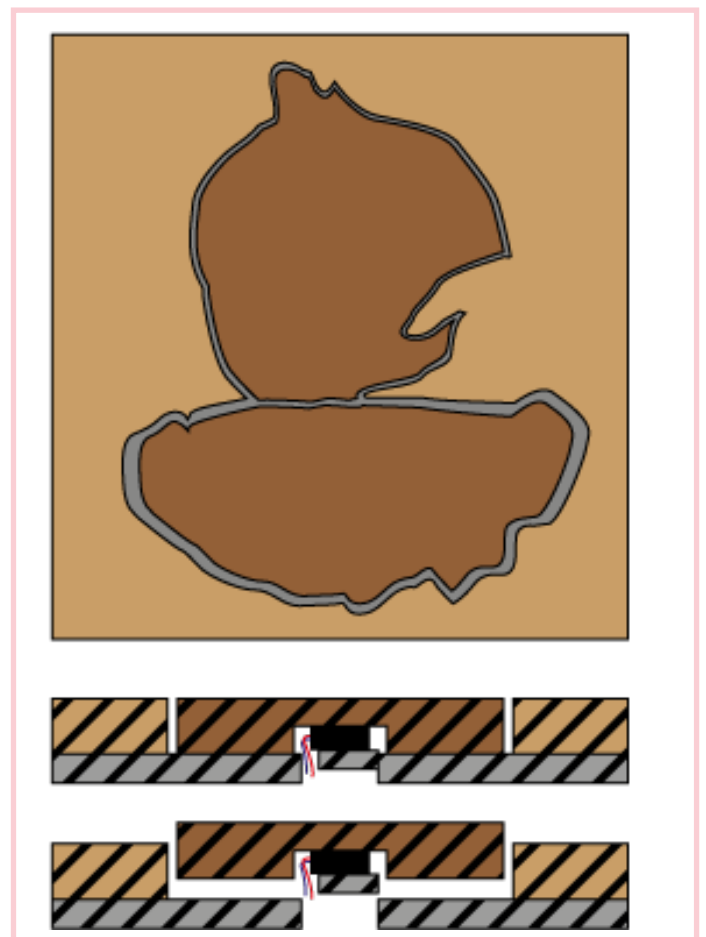


Image 6.5: Test prototype top and cross-section

## Vibration motor theory

An object vibrates due to unbalancing force, causing the motor to move a little. When a vibrating object is connected to another object, this will vibrate as well because of Newtons 2nd law:

*The acceleration of a body is directly proportional to, and in the same direction as, the net force acting on the body, and inversely proportional to its mass.*

(Precision Microdrives, 2018).

In the prototype, coin vibration motors are used. These vibrate from left to right (image 6.6). Therefore, when immediately connected to the element, cause the most vibration to be felt at the sides. For the final product, an LRA (Linear Resonant Actuator) would be more appropriate, since this motor vibrates up and down. Further exploring vibration motors is out of the scope.

In order to convert the vibration direction, the motor is placed on a perpendicular piece of wood as seen in image 6.7.

## Vibration isolation theory

In order for the vibration to be constricted to just one place, vibration isolation is used. The isolation 'stops energy passing from one point to another' as stated by Farm Noise & Hearing Network (1998). Vibration isolation system is proven and used on a larger scale to create seismic isolation, as seen in image 6.8 (Verma, Gupta & Nath, 2017). In this case however the isolated object (building) shouldn't vibrate, but the same principle is used to prevent the vibration from passing. This prevention can be achieved through flexible, vibration absorbing materials like springs, rubber, silicone and others.

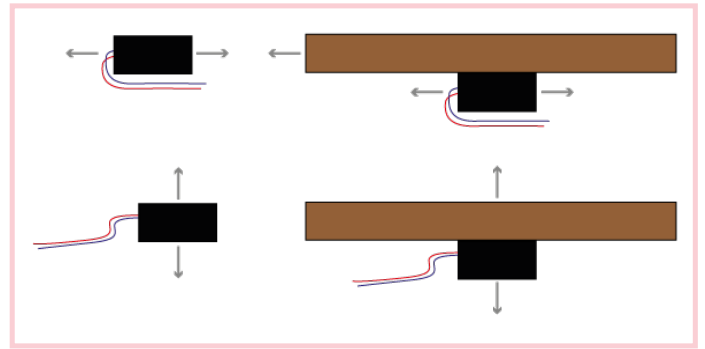


Image 6.6: Coin and Linear vibration motor

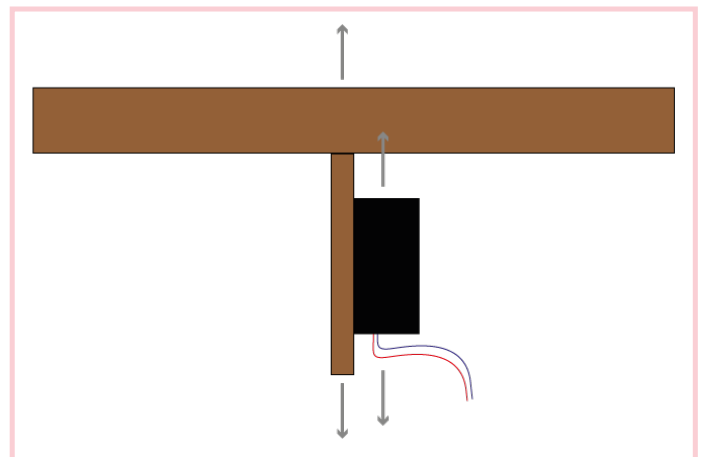


Image 6.7: Perpendicular structure coin motor

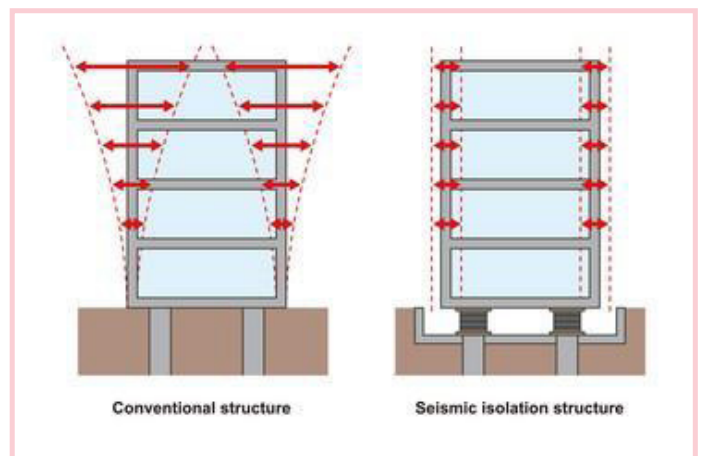


Image 6.8: Seismic isolation (Verma, Gupta & Nath, 2017).

## Vibration isolation tests

### One-piece prototypes

The idea behind this mechanism was to isolate the vibrations by adding flexible material around the vibrating object (img 6.9 I). Here, a sub goal was taken in mind as well: making the design feasible in one piece for easy manufacturing without additional labour afterwards. Therefore this prototype was printed at once with alternately hard and soft materials by a Connex printer of Stratasys (img 6.10).

This did not work, for the flexible material did not have any room to expand and therefore still transferred the vibration.

In order to give the absorption material more space to vibrate, a second mechanism was printed with small pieces of soft material (image 6.9 II). This mechanism worked slightly better, but still not as intended.

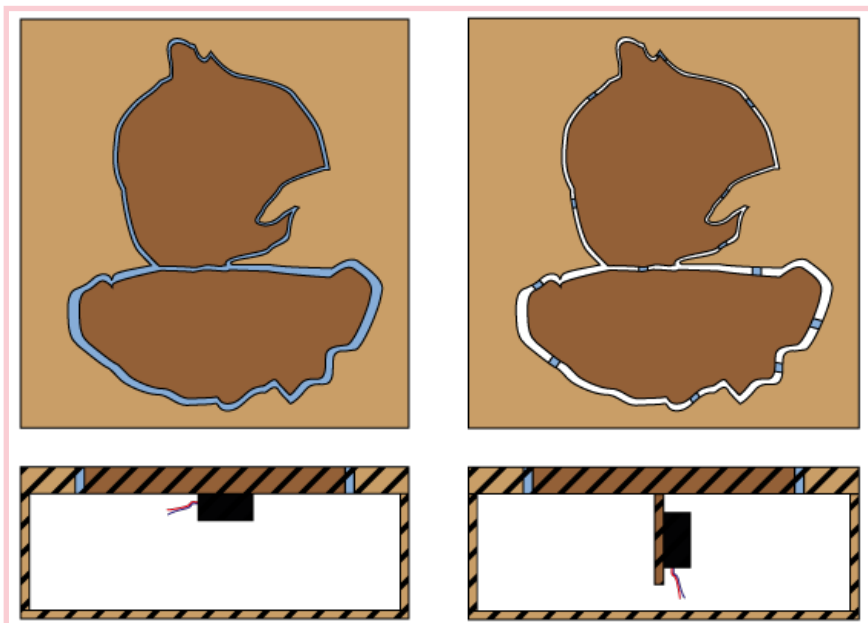


Image 6.9: Mechanism I & II  
Top & cross-section



Image 6.10: Mechanism II  
Photo of the print

### Separate part prototypes

As flexible material in between the parts did not seem to work, the material was placed underneath with three different mechanisms (image 6.11 & 6.12):

- Only silicone stands at the vibrating parts.
- Silicone stands between the vibrating and solid parts.
- Connections underneath the vibrating and solid parts, not touching the bottom layer.

Mechanism a works very well. It is silent (until the parts touch each other) and the vibration is very isolated. It might be less stable than the other prototypes. Mechanism b works also, although less. It is silent, but the other parts still vibrate as well. Mechanism c doesn't work. Extended results can be found in appendix C16.

Due to this results, mechanism a is chosen to be developed further.

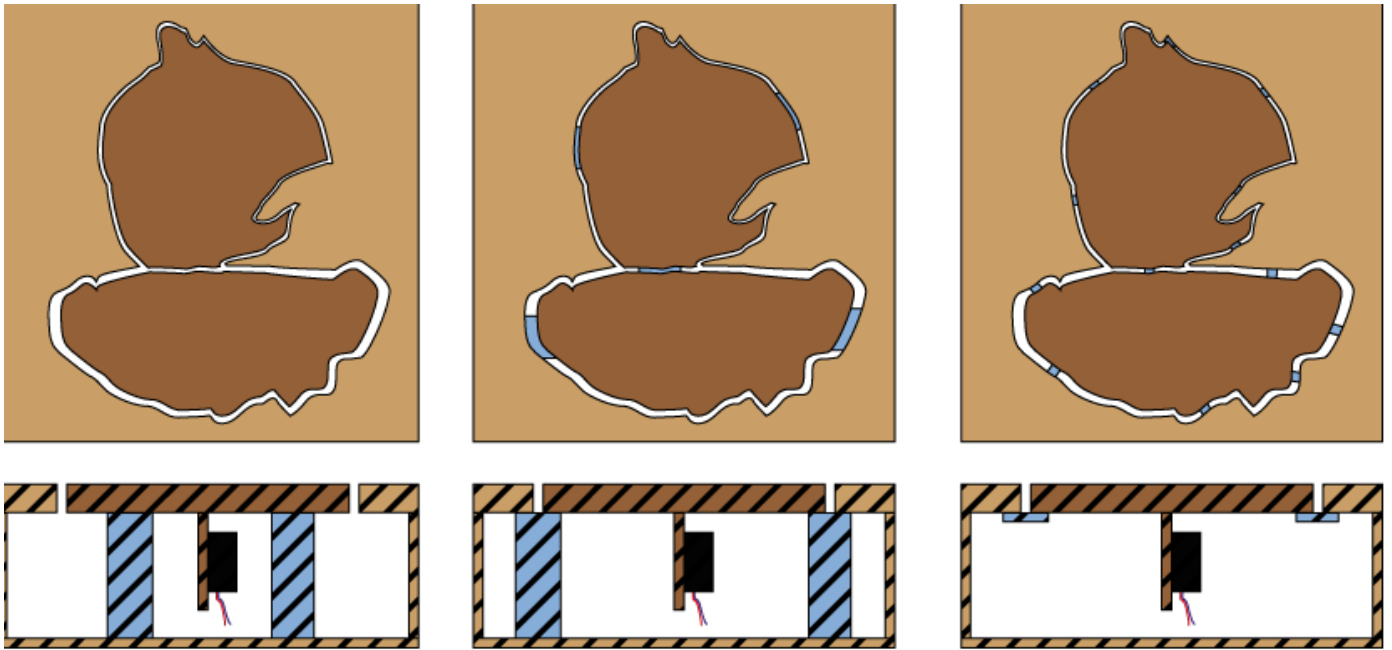


Image 6.11: Mechanism a, b & c, Top and side view

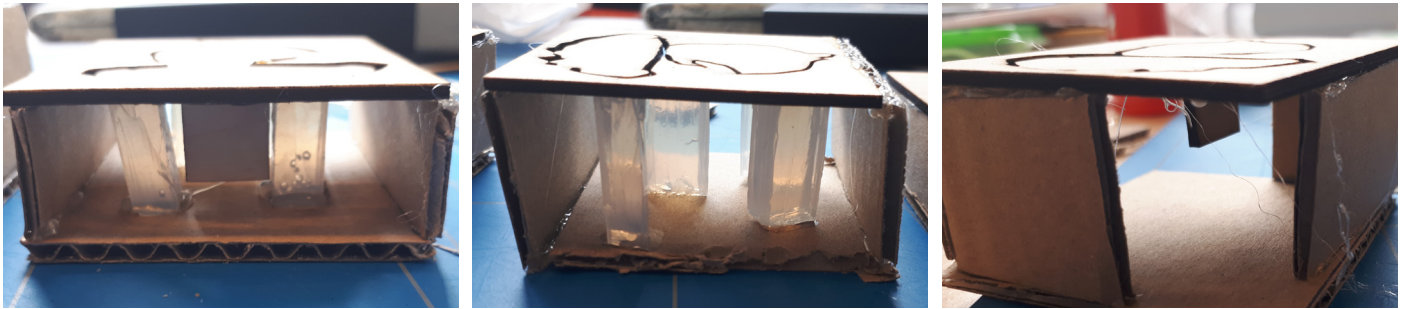


Image 6.12: Mechanism a, b & c, photo's

## Silicone as damping material

For the chosen mechanism, silicone was used because of its availability at that moment. The other obvious choice would be (polythane) rubber. Still, silicone appeared to be the best choice due to it's flexibility.

The main disadvantage of silicone is its adhesive quality. Almost no glue is compatible with silicone, except for sil-poxy, which is rather expensive.

Some products, like cameras and drones, use preproduced dampers for stabilization. These dampers can be seen at image 6.13 and 6.14.



Image 6.13: Silicone damping bobbins (Getfpv, 2018a)



Image 6.14: Silicone damping balls (Getfpv, 2018b)

# C6.3

## Physical prototype

For convenience, the same piece of the artwork as used during prototyping the vibration is used to explain the final prototype. The images have the purpose of explaining the mechanism and therefore aren't construction drawings.

### Prototype build-up

The silicone damping balls are used as flexible material. In order to provide more stability, at least three damping balls are applied underneath every vibrating part. The balls are clamped to the prototype by pieces that are slightly larger than the diameter of the balls, as seen in image 6.16.

Also visible here is the relief, placed on top of the structure. The main part of the relief is printed on Dibond to prevent it from breaking. It is fixed to the mechanism with L-profiles, nuts and bolts (image 6.17), so can be replaced in case the material wears off. On top of the Dibond, a frame is placed.

Furthermore, an extra layer is added on the bottom to create space for the electronics.

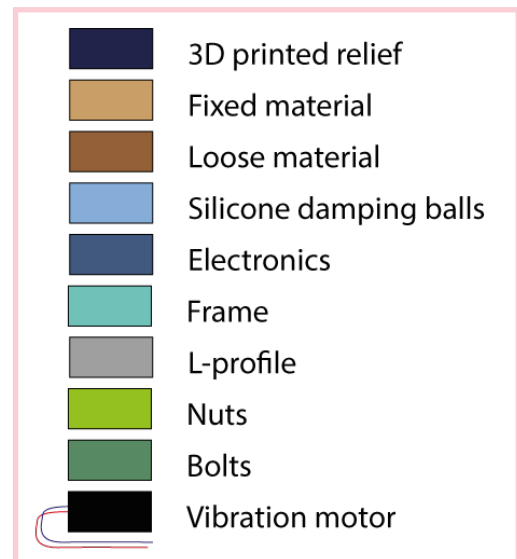


Image 6.15: Legend

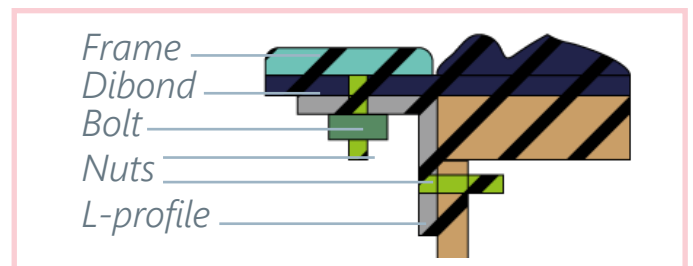


Image 6.17: Detail prototype attachment

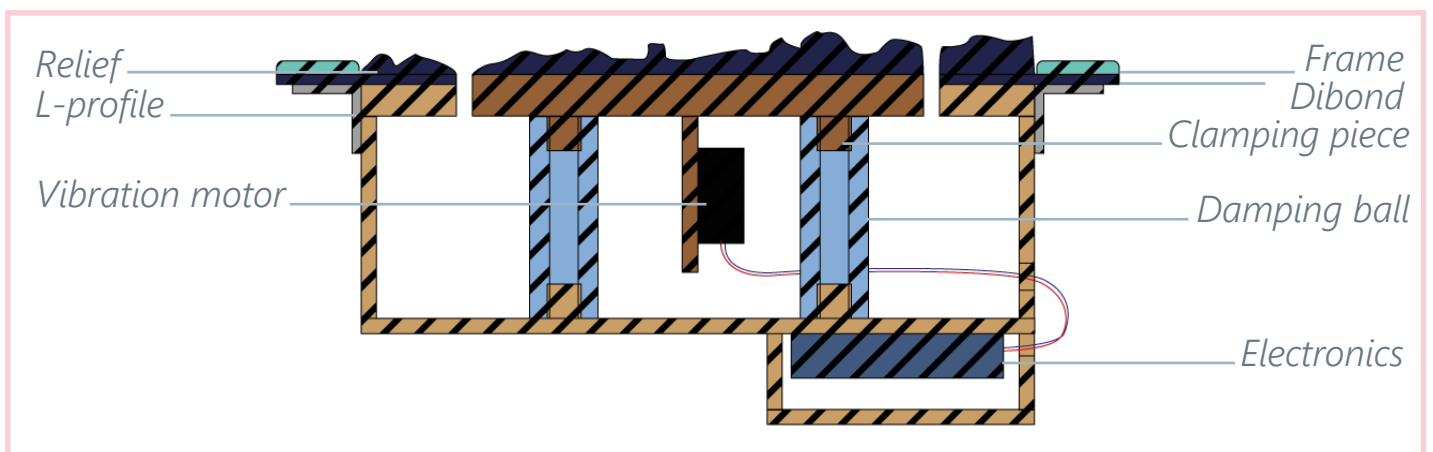
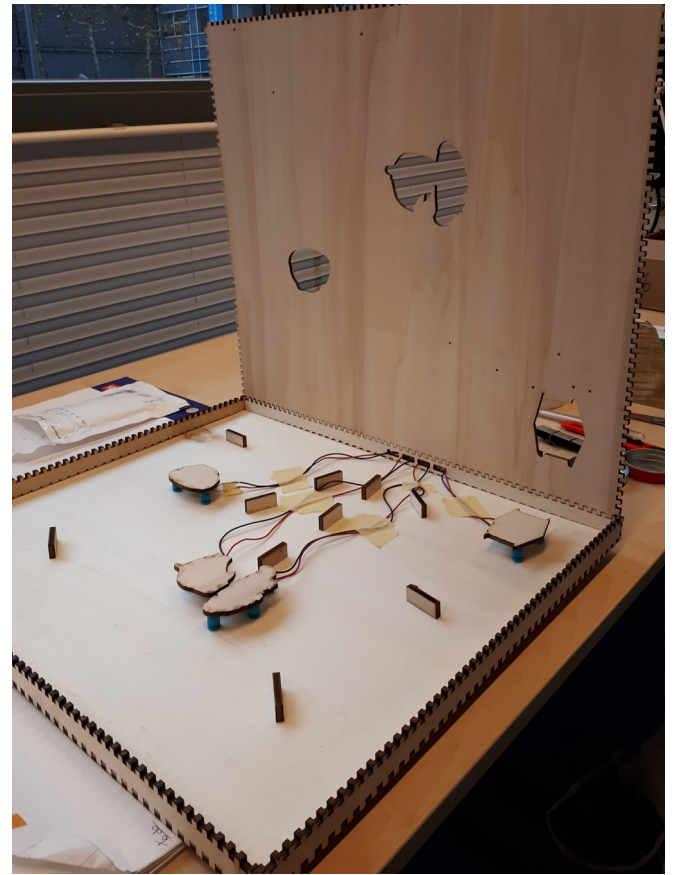


Image 6.16: Prototype drawing, cross section

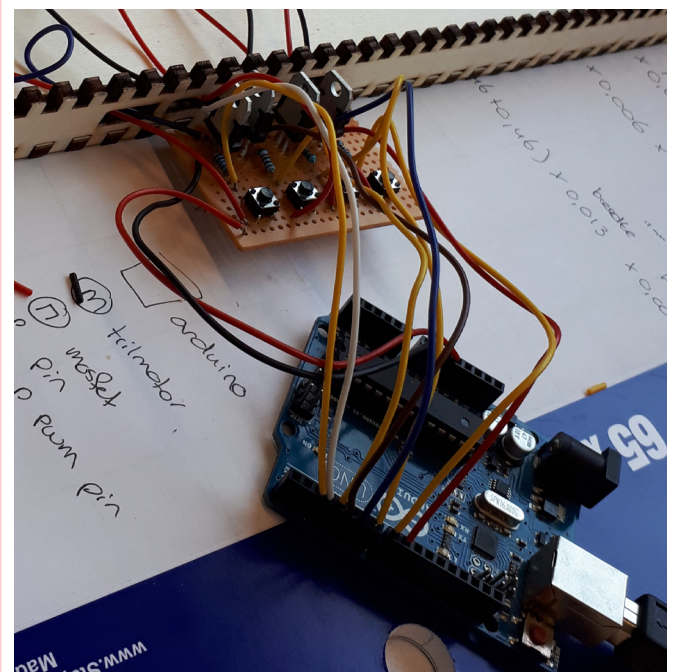


*Image 1.18: Prototype detail damper balls*

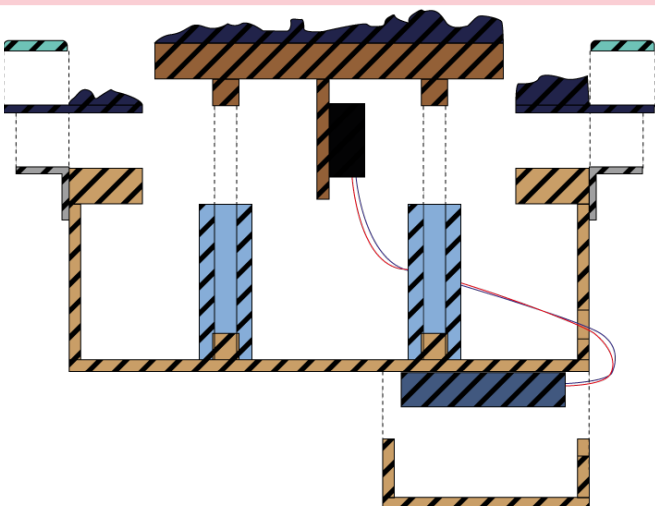
In order to reach the electronics in case something breaks down, the prototype can be taken apart. This can be done in multiple ways, as seen at image 6.21. The vibrating pieces can be taken out in order to reach the vibration motor and the bottom can be taken off in order to reach the circuit. This is placed on the back of the prototype, so no wires will detach while taking off the bottom or placing it back. The circuit itself will remain the same as the one of the guidance prototype (Appendix B12). The corresponding code is added in appendix C17.



*Image 6.19: Prototype opened up, showing the loose parts and wires*



*Image 6.20: Prototype electronics coming out of the side*



*Image 6.21: Prototype detached*

## Relief

As explained before, a 2-and-a-half-D relief is used to make the image tangible. This is done with use of a height map as seen in image 6.22: a black and white image where black is highest and white the lowest. This image is printed in depth and colour by the company Océ (image 6.24). They make use of the technique *elevated printing* "wherein liquid droplets of different colors are used for applying solid material in several layers one upon the other". This technique is also used for tangible maps of stations for visually impaired among other things (Draad, 2016).

In the future, the creation of these maps could be automated as seen in the paper of Liao, Shen&Eisemann (2017). This technique resulted into the heightmap displayed in image 6.23, which isn't detailed enough. Therefore, for now the image is traced manually to create the final heightmap (image 6.22).

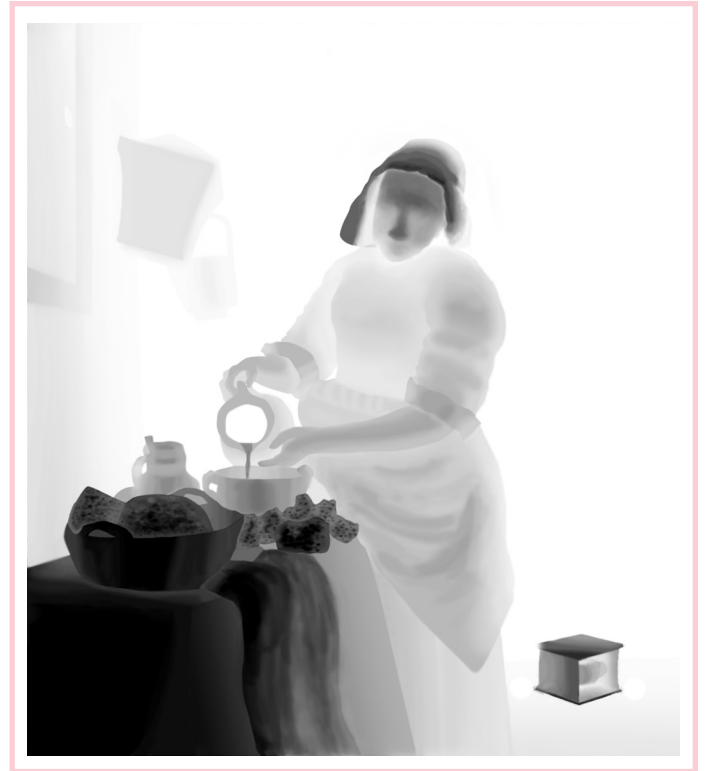


Image 6.22: Final heightmap



Image 6.23: Heightmap by Liao



Image 6.24: Printed heightmap



*Image 6.25: Final prototype*

# C6.4

## The narration

A tactile representation can't ever be without a verbal description, which was already found and discussed in the research phase (chapter A2.7). In order to design story guidelines accompanying the prototype, it is important to know how a story is told properly.

### Storytelling in museums

Many museums already use storytelling. Bedford (2001) explains that stories are more powerful as they leave space for the listener to fill in parts themselves. Relatability and familiarity make the visitor connect to the art. Also, stories are used to let them think and create their own meaning. Wyman et al (2011) suggest to start with a vision for the story. What is it that the visitor should experience?

Many of these principles are universal and for instance also used in marketing. (Albrighton, 2013).

When it comes to the story, simplicity is key. According to Barros & Musse, there should be one main storyline, which was confirmed by Isabel during the user research. Here, it also appeared that the background of the artist is interesting, as well as details on the work and their meaning. Last, multiple perspectives should be covered, confirmed by Wyman et al (2011). They also state that the approach throughout the museum should be consistent: Either some deep stories, as is the case for visually impaired, or many shallow ones.

### Guidelines

Combining this literature with the findings of de Coster (2009) about verbal description for visually impaired as discussed in chapter A2.7, some main principles can be derived. These principles can be used when designing a story guiding and accompanying the tactile experience. Here they will be stated in short, in appendix C18, the full description can be found, which was used as guideline of the story during the test.

- *Who is the audience and what they are looking for*
- *Goal and reason for telling the story*
- *Why is it interesting or what makes the story matter?*
- *Think about priority*
- *Engage the visitor*
- *Place the work in perspective*
- *Involve the tactile sense*
- *Close the story properly*

## Storytelling applied to 'the Milkmaid'

### Memories of 'the Milkmaid'

During the concept iteration of chapter B5.3, the participants were asked for their prior knowledge of 'The Milkmaid' by Johannes Vermeer as side question. This was done to get an idea of what is interesting and memorable about the artwork, so what should be conveyed to the visually impaired visitors. The raw data can be found in appendix C15.

Many participants started describing *the maid* first: her *clothing and posture or action*. All participants referred to *colour* somewhere in their description, in contrast to the milk which was only mentioned every now and then.

The *surroundings* were often mentioned as well. Interestingly, the *window* was mentioned quite often, by four out of eight participants, just as the *lighting or atmosphere*.

### Explanation by the Rijksmuseum

Besides the visitors experience, the explanatory story of the Rijksmuseum was taken as inspiration as well as they have a more professional perspective on the work and background knowledge. Here, the emphasis is put more on the perspective and choices of Johannes Vermeer and the context of the work. Together this resulted into the story accompanying the prototype to create an image for people with a visual impairment.



Image 6.26: Chosen elements of "The Milkmaid"

### Story accompanying the prototype

Four elements are taken out of the artwork (image 6.26):

1. The face
2. The pot
3. The bowl
4. The stove

The amount of elements is limited to ensure the technical working of the prototype and time limitation. These four are chosen due to importance in the story and location.

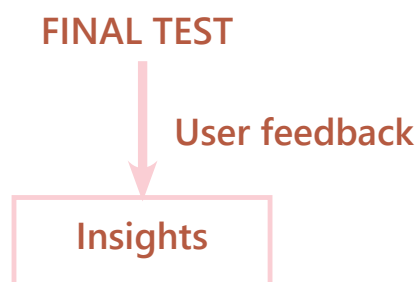
The face is the starting point in the story, leading to the pot from which the milk is flowing, which is the most important element of the painting. The bowl catching the milk is near the pot to show this is technically possible and the stove is chosen because it is in a completely different spot.

The narration accompanying the prototype can be found in Appendix C19.

# User testing



*The prototype was tested by six participants with a visual impairment within the Rijksmuseum. Within this chapter, the set up of the test is outlined and the results are stated. Out of these results, insights are derived.*



# C7.1

## Test setup

### Goals

- Evaluating whether the participants are able to form an image of the work without needing additional help.
- Evaluating vibration as way of guidance.
- Receiving their opinion upon this concept within an individual museum experience.

### Materials

Physical prototype  
Recorded narration  
Recording device  
Lighting device.

### Participants

P1	M	Only side vision
P2	M	Some vision
P3	M	Very low vision
P4	F	Some vision
P5	F	Quite some vision, bad focus
P6	M	Legally blind

All participants were between 40 and 60 and have seen (well) before.

### Planning

5 min	Introduction
5 min	Prototype experience
5-10 min	Interview

The setup can be seen in image 7.1-7.2.

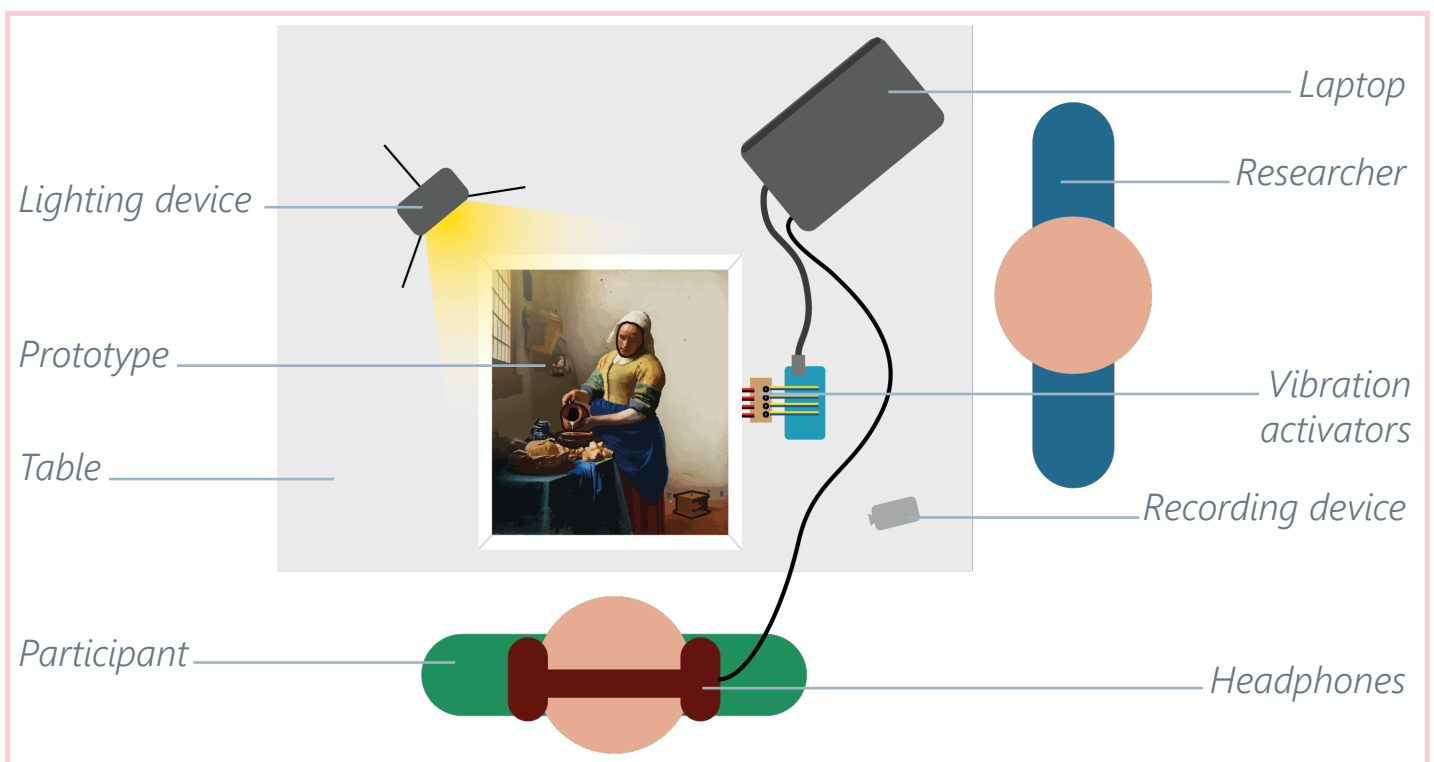


Image 7.1: Test setup

## Accompanying story

First, the participants were introduced to the background of the test and the planning. Then, context was provided to the prototype and its limitations (less vibrating parts, short story, no possibility to pause and play back) were explained. Here the audio guide took over until the end of the narration as explained in chapter C6.4. The audio specified when the experience was over. Finally, feedback on the design was gathered in semi-structured interviews. The Layered Exploration concept was left out due to time limitations.

The full description of the accompanying story can be found in appendix C20.

## Questions

The participants were asked about their experience with the prototype. The questions were derived from the test goals as stated in the beginning of this chapter (forming an image, vibration as guidance and an individual experience) and can be found in appendix C21.

## Documentation

Audio recordings of the interview were made to be analysed afterwards so no details would be missed.

Notes were written down when something in particular happened, so questions could be asked about this directly after the test.

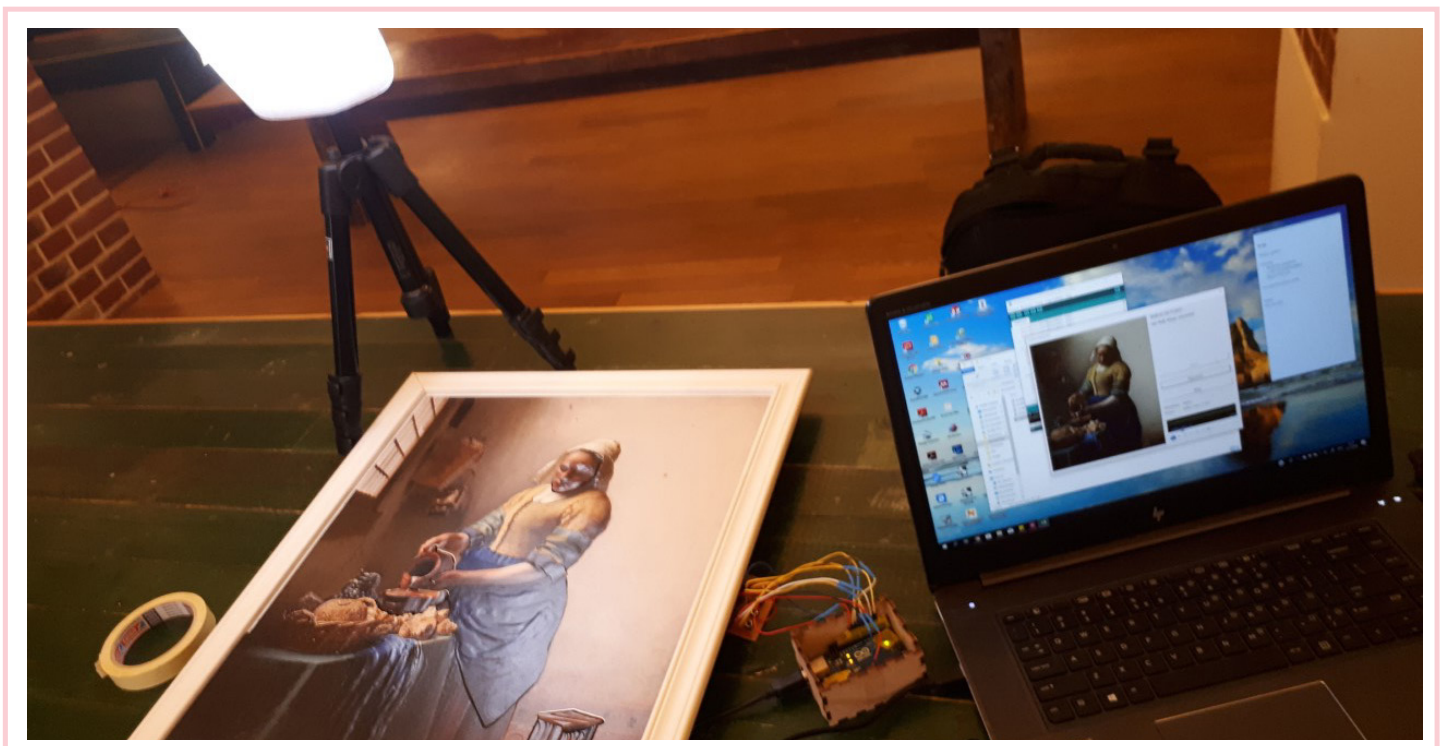


Image 7.2: Actual setup  
119

# C7.2 Results

Displayed below are two images (7.3&7.4) of participants exploring the artwork through the prototype. The interviews after were transcribed and combined with the notes taken during the test. Out of this, interesting statements about the test goals were taken (image 7.5a). These were put together into the following categories: General comments and comments about the Story, Sounds, Relief and Vibrations. Within these categories, the user statements are clustered (image 7.5b) and summarized into one or two words (image 7.5c). The main overview can be seen in image 7.6. The categories with user statements as in image 7.5b are available in Appendix C22.

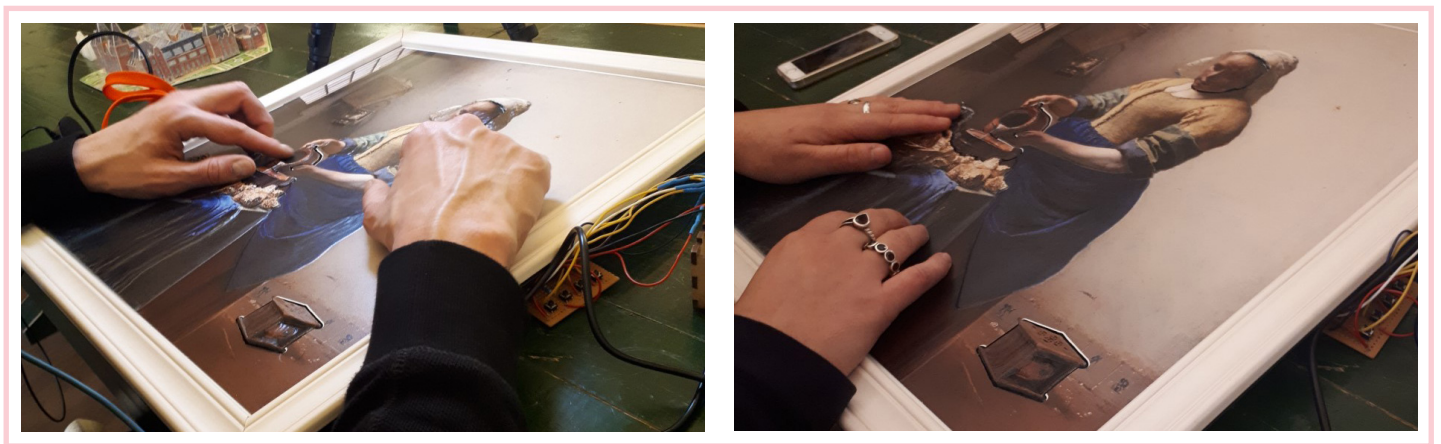


Image 7.3 & 7.4: Participants testing the prototype

**Wel grappig, creatief.** Knisperen en puntjes. Goed voelbare puntjes. Als ik niks zou zien, zou ik me wel afvragen wat is dan de arm. (...)

**GENERAL**  
It's funny and creative  
... it was very interesting, useful and other terms. So I'm quite about this  
I liked it. I notice, as visually impaired I know I miss certain aspects of the work, but you added other aspects, I like that

**GENERAL**  
Overall positive

Image 7.5a:  
Statement taken from  
audio descriptions

Image 7.5b:  
Statement in the category  
'General', clustered with  
other positive reactions

Image 7.5c:  
Summarized cluster in main  
category 'General'

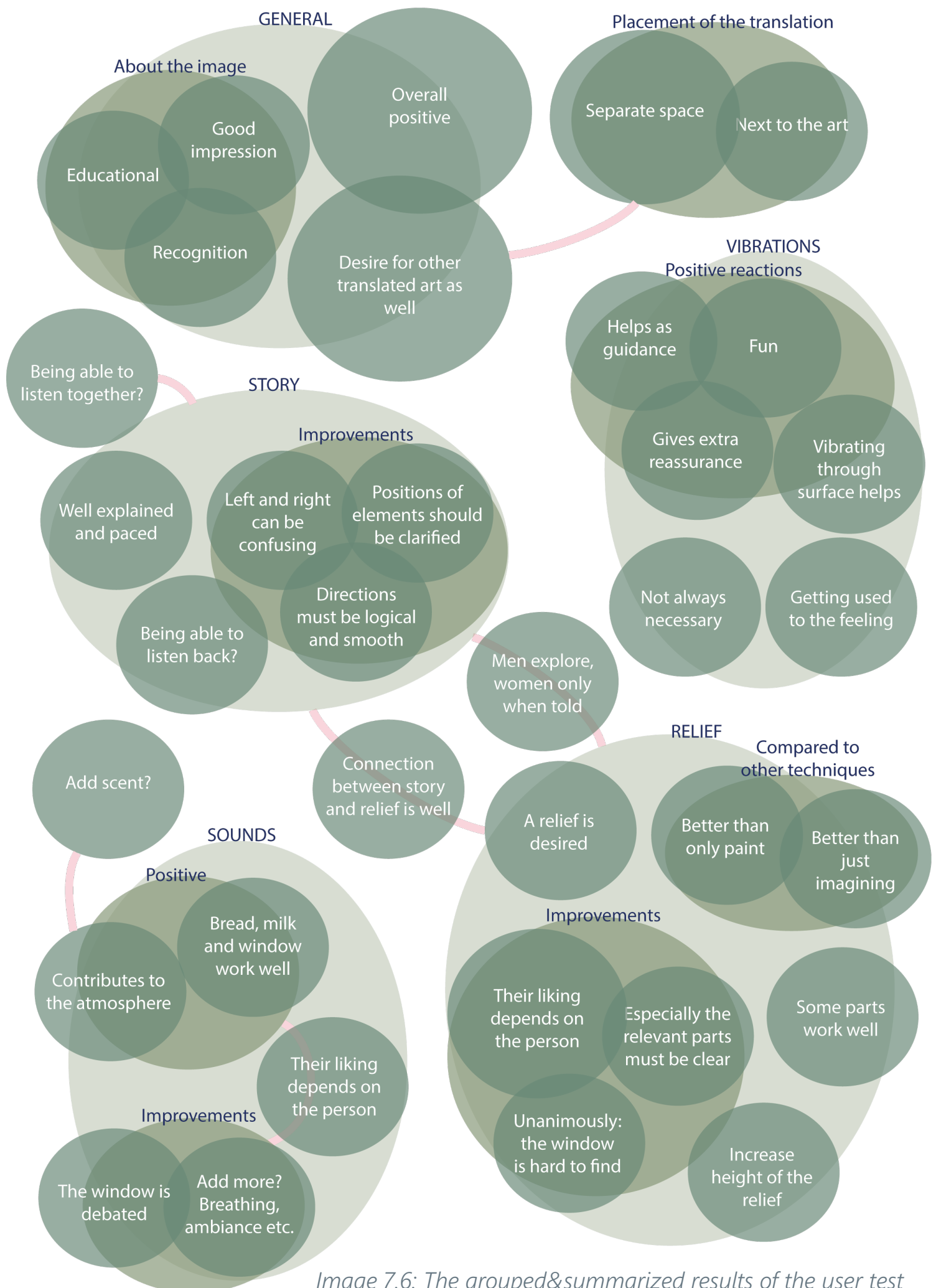


Image 7.6: The grouped&summarized results of the user test

# C7.3

## Insights

### General appreciation

The concept generally appeals to visually impaired. The execution can be improved as will be clear in the rest of this chapter.

The concept has added value upon the current ways of explaining and potential for visually impaired within museums.

### Placement within the museum

The participants need a quiet place and to be able to sit in order to experience the work well.

But not too separated from other visitors

### Relief needs clarification

The relief provides visually impaired visitors a stimulus for the tactile sense, which they highly enjoy.

The relief needs to be very clear, especially the parts used for guiding the participants, like the arm and the window.

This could be done by increasing the relief.

*'Educational' P1*  
*'Funny' 'Creative' P2*  
*'Interesting' 'Fun' 'Useful' P3*

*'As visually impaired I know I miss certain aspects of the work, but you added other aspects, I like that.' P5*  
*'Especially someone who was able to see it before will find recognition' P3*

*'They should do this with every artwork' P4*  
*'I would love to have this of other paintings as well' P1*

*'It's kind of heavy [...] You shouldn't carry it far.' P4*  
*'I like that I'm sitting here now and that it's quiet here' P5*

*'Visually impaired should be among the visitors' P3*

*'I immediately liked the relief' P5*  
*'I love that you can feel' P1*

*'You want to say something, so make it more clear' P2*

*'I would like it to be more towards 3D' P6*

## Vibration works well

Guidance through vibration works as intended.

The vibration is clear after one time.

The vibration might not always be necessary, according to the impairment, but was never stated as bothersome.

## Narration should be smooth

The combination of audio and tactile is highly preferable. It should be aligned well.

Some visitors do not listen very well. An option to rewind might be useful.

Some explanations of the relief and the directions should be clarified. Especially left and right can be confusing.

Transitions from one point to the other should be smooth and logical.

There should be an option to listen together.

## Soundscape for atmosphere

The sounds are received quite positive and add to the experience.

The sounds are personal and could be improved. Generally, the sound of milk and bread are received very well. The sound of fire and cloth seem unnoticed and the sounds from outside debated.

The possibility of adding smell could be looked at.

*'I like the vibration, it ensures you are at the right place' P2*

*'It vibrates slightly throughout the whole surface so I can find it easily' P6*

*'I had to get used to the vibration, to know how it's supposed to feel' P4*

*'I can still see quite a lot, so sometimes the vibration wasn't necessary. [...]  
Here with the pot it's dark, so not easy to see, then the vibration was useful' P5*

*'You can describe something, but then you still don't know exactly what is where' P4  
'Everything that had to vibrate, vibrated' P3*

*'I would like to listen back a bit, what did you say exactly?' P2*

*'I didn't get her face, I thought you saw her from the side' P2  
'I was confused, she is looking at the right, but for me that's left right?' P3*

*'For me it wasn't clear that we went from top left (window) to down right (stove).' P2*

*'I would like that someone can listen with you. It's nice to be able to do this together' P5*

*'The crackling of the bread made it very lively' P3  
'It made you get into the atmosphere of that time' P5*

*'At the window you talk about the lighting, but you hear sounds from the outside, that seems odd' P1  
'I thought the birds were cool' P2*

*'Maybe you can add scent? It makes you get the atmosphere so well' P4*

# Evaluation



*In conclusion, the design goal was met fairly well, which is explained thoroughly and the concept definitely has potential. The recommendations outline further detailing and testing upon the current prototype and the possibility of adding layers on top of the relief. Also the placement and accessibility within museums should be considered well.*



# C8.1

## Conclusion

The goal of this project was to make the *image, story and expression* of paintings *intuitively accessible* for both *blind and ill-sighted visitors* during an *independent* museum visit through a design.

Overall the participants, even though being with a limited amount, were all positive about the design and would like to see it for other work as well.

### Image, story and expression

**Image:** The qualitative evaluation seems to suggest that the image is more clear through the design. This especially appears to be reached through the relief, which adds to audio alone. The relief wasn't always clear though.

**Story:** Within the narration, the background of the work and the artist can be expressed as was discovered through research upon storytelling (for visually impaired). It was mentioned by one of the participants to like the work better now she knew more about it.

**Expression:** The sounds in between seemed to add to the atmosphere of the work. This should be enhanced by the layers, only this couldn't be tested yet. Also, for instance scent could add to the experience.

### Intuitive accessibility

Five out of six participants went through the prototype without difficulties or questions, so it can be labelled as intuitive. The congruity of the audio with the tactile experience is very important. When adding the layers, the intuitivity might become more difficult.

### Blind and ill sighted visitors

The concept appears to work for both blind and ill-sighted participants.

That the relief still displays the actual work visually seemed very helpful for those who could still see a little during the qualitative evaluation. For specific impairments this might be enhanced in the layers. Also adjustable lighting can be an improvement, but this wasn't tested thoroughly.

The vibration isn't always necessary for people who see relatively well, only in the dark/less visible parts, but for these participants, it didn't seem to be annoying or distracting.

Whether it works for visitors who are blind from birth wasn't tested.

### Independent visit

The guidance by audio and vibration seemed to enable most visually impaired evaluation participants to individually experience the artwork.

Only for one of them it went too fast and he became lost, so needed to listen back a bit.

# C8.2

## Discussion

A functional prototype enabled the visually impaired participants to experience the Milkmaid without help of a guide. The user evaluation was able to show the combined benefits of vibration, narration, and a relief. However, the design, concept and user evaluation had some limitations:

### **Participant limitations**

The prototype was tested with a small number of participants. Therefore, it can't be said with certainty that the outcomes are representative for all visually impaired. Also there were no participants blind from birth, so even though this is just a small percentage, it remains unclear if it works for them too.

### **Optimal concept parameters**

The amount of time during the qualitative evaluation was limited, so the prototype didn't display all aspects of the Milkmaid. The narration was short, there were only some vibrating elements and a couple of soundscapes. How long the story should be or how many elements and sounds it should include remains unclear.

Even though the participants did not comment on the level of the vibration, the optimal vibration wasn't tested. Also, other heights of the relief weren't tried, due to printing limitations.

### **Comparison current techniques**

Even though the participants had a tour right before testing the prototype (and some of them commented upon this concept in comparison to only descriptions) they weren't able to see the Milkmaid. Therefore, there wasn't an a/b test upon whether they get the same (or a clearer) image from the independent design in comparison to a tour.

## Concept elaboration

Due to the set amount of time for this project, only one part of the concept could fully be developed and tested. The layered interaction was left out, so only assumptions (based on the research) can be made about that part.

The concept was tested for just one figurative painting. If and how it can be expanded to other artwork with different themes and/or in different styles isn't tested.

Also, the translation was one to one in size. It is unclear what the maximum size can be, nor how bigger artwork should be translated.

Furthermore, the prototype was only partly tested within the context. They did not have to navigate or find it themselves and could ask for help. Also, they did not have to operate the prototype themselves, so how this would fit within a museum isn't clear yet.

## Product development

The development of this prototype takes quite some time and effort in relation to the size of the user group. Therefore, it isn't clear whether a large scale application within museums is possible or worth the effort.

There is just a limited amount of technique, but the mechanism isn't tested for durability. Also, the wear resistance of the relief isn't tested, as it will be touched by many visitors.

# Recommendations & Future work

In the discussions (C8.2), some limitations of the concept and user evaluation were stated. In order to proceed, first should be determined whether it is worth the effort to further explore this concept. If so, the prototype should be enhanced and tested with more participants. The added value of the layered interaction could be explored for a deeper interaction. Then, the concept should be turned into a product and be accessible within the Rijksmuseum.

## Determining the value

### *Cost-benefit analysis*

To find out whether the concept is worth exploiting, a cost-benefit analysis should be done. Here, time and effort should be taken into account, but the value reputation and branding as well. Furthermore, this concept should be placed alongside existing techniques like the tours.

### *Scalability to other art*

Furthermore, the concept should be applied to other types of art and to other sizes of paintings to evaluate its possibilities. This do not have to be fully functioning prototypes.

## Improvement of the prototype

The final evaluation was done with six participants. For a more reliable understanding it should be tested by more participants. This could be before and/or after enhancing the prototype.

## *Relief*

Especially parts of the relief that matter for continuation of the story and navigation should be clarified. Some problem areas seem to be the window and the, for the viewer, right arm.

This can be done through increasing the relief in general (if possible with elevated printing), but there can also be looked at increasing the relief relatively to each other, so the table won't necessarily be the highest part. Both options should be explored and tested.

## *Narration*

The story should be extended or multiple options (short or long story) should be available as there is much more to the work. Also, from the initial user research it appeared that participants wanted as much information as possible. The amount of elements should be adjusted to the story and chosen carefully.

### *Other parameters*

The soundscape could be improved and more could be added according to the story as they add greatly to the atmosphere. The right amount should be explored.

Then, a pleasurable strength for the vibration should be determined and if the possibility of personal adjustment is desired.

Also, the possible addition of light and their adjustment should be explored.

Last, for the atmosphere, the addition of scent can be investigated.

### *Interface*

An interface should be created for the visually impaired to easily operate the design by themselves. How to start, pause, rewind and stop audio intuitively has already been researched and turned into existing operating systems. Such a system can be used, but should align with the vibrations, so be made compatible with product.

## **Exploration of the layered interaction**

Even though the design as it is expresses already quite a lot, the interaction of layers might still be valuable, as all participants expressed the value of touch. This provides more tactile stimuli, but could also respond to the types of visual impairments.

### *Type of layers*

As explained, examples of layers could be light, expressed by roughness of the surface, materiality of the actual materials, like fabric and clay, or black outlines. These should be worked out and tested whether they add to the concept.

### *Technical exploration*

If determined that the layers are valuable for the concept, there are multiple challenges to take on.

Here you can think of where to place the layers relative to the basic relief, how to find and how to attach the layers properly.

Another challenge is how to make this compatible with the audio and the interface.

This should be explored thoroughly and tested in order to make it work intuitively.

## **Turning the concept into a product**

In order for the concept to be actually taken in use, it should fit some requirements.

For starters, the electronics should be secured into the product, in a way that they still can be reached. The product has been tested for durability in terms of wear and tear.

Also, there has to be a power supply. This can be chargeable batteries in case of a portable product or fixed to a power socket.

Last, the materials have to be chosen well in order for it to be durable, light (when portable), and cost efficient.

All of it has to be safe so there aren't any risks of causing a fire or an electrical breakdown.

## **Bringing the product into the museum**

It has to be determined how many works within the museum should be translated in order to provide the visually impaired visitor with a satisfying feeling.

There shouldn't be too many as visually impaired visitors can only experience a couple, but they should still have a choice in which work they want to explore.

## *Placement of the concept*

In order for the visually impaired visitors to actually use the design independently, it should be accessible somewhere within the museum. Where to place and how to find and access should be explored well.

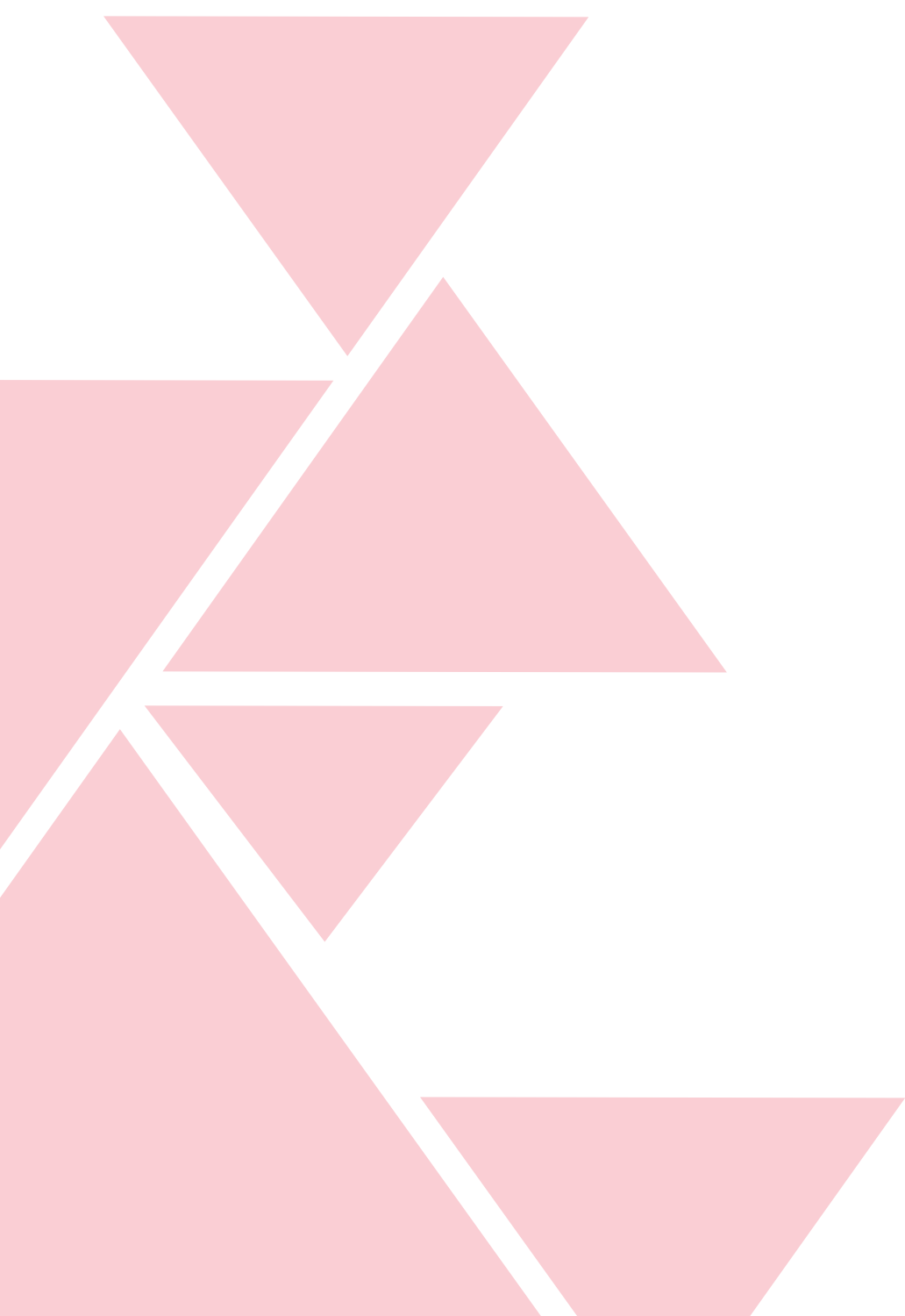
In contrast to my first intention, a more quiet, separate place might be recommended. The visitors should be able to access the real art as well though. Therefore a right place should be found, one or more, within the museum.

Also, whether to make it portable should be discussed, in relation to the placement.

## *Accessibility*

Thought should be put in how to find the design. This corresponds with wayfinding in general, which is already being explored within the Rijksmuseum. Furthermore, the design should be available for visually impaired visitors, so not occupied by sighted visitors. It might be interesting though to let them experience it as well when not in use by visually impaired visitors.

Last, the museum should advertise their approach to the visually impaired community.



**Special thanks to:**

*My coaches:*

*Willemijn Elkhuisen and Arnold Vermeeren*

*The support from the Rijksmuseum:*

*Cathelijne van den Berg; Sander Daams; Pauline Kintz*

*The other contributors to my project:*

*Boijmans van Beuningen; van Abbemuseum; van Goghmuseum; het Pakhuis; Huis van Loon; Mikxs; Dedicon; Visio; Museum4All; Komt het Zien; Kubes*

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