Nature's Luminous Dreamscape

An illuminating organza sculpture eliciting an awe experience

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Graduation Project

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Abstract

Awe, the feeling of encountering something greater or more powerful, has been explored in design and the arts. However, the potential of creating awe through the interplay of light and textiles remains underexplored. While the possibilities are vast, the precise tuning of their respective qualities to elicit a sense of awe over time have yet to be thoroughly investigated. This project aims at creating a light sculpture that elicits a visual awe experience by experimenting with interactions between the material organza and lighting.

To start and give direction to the project, the Material Driven Design (MDD) method was used. Moreover, a literature review about awe, organza, light and light-material interactions was carried out. Besides, three separate experiments were conducted involving 22 participants in order to find which variables of organza and lighting would elicit what emotions, what rate of a visual awe experience and what meanings/associations by using an adapted version of the Experiential Characterization toolkit from the MDD method.

The results of the three experiments showed that high-intensity red and blue lighting colours, a hole-patterned organza construction and the room's lighting turned off elicits the highest rating of the awe experience.

The final light sculpture – made from organza with circular patterned holes, high-intensity red and blue lighting and projections of storytelling dynamic light textures – elicits a visual awe experience of different intensities during one loop of three light textures.

The process of designing this installation serves as a case study demonstrating how the interplay of light and organza can evoke awe and enhance people's experiences, potentially leading to benefits such as increased state of focused attention and awareness on the present moment and improved psychological well-being.

Keywords: awe experience, lighting design, organza, dynamic light textures

Hümeyra Koç, Master thesis, 2023, Delft University of Technology.

Terminology

Awe: the feeling when you encounter something that is greater or more powerful than yourself. You feel overwhelmed and need a moment to adjust.

BRDFs: Bidirectional Reflectance Distribution Functions

BTF: Bidirectional Texture Function

Collimated Light Source: A light source in which all light rays are parallel and do not diverge, often used in precision optical systems.

Glint Patterns: Patterns of bright, small, and transient flashes or reflections of light, often seen when light interacts with shiny or textured surfaces.

MDD: Material Driven Design

Occlusion Effect: A perceptual phenomenon where an object is perceived as partially hidden or obscured by another object, contributing to the sense of depth and realism in visual scenes.

Organza: A shiny type of textile that is available in many colours

Perceptual Psychology: A branch of psychology that focuses on understanding how humans perceive and interpret sensory information, including visual, auditory, and tactile stimuli.

Reflectance: The ability of a surface to reflect light, often expressed as the ratio of reflected light to incident light.

Spherically Diffuse Light Source: A light source that emits light uniformly in all directions, creating omnidirectional illumination.

Specularity: The quality of having a mirror-like or glossy surface that produces clear and distinct reflections.

Split (Off-)Specular Reflection: The separation or analysis of reflections that occur in directions other than the mirror-like specular reflection.

Split Specular Scattering: The isolation or study of the scattering of light in a single, mirror-like direction when it interacts with a surface.

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1. Introduction

Stress, anxiety, and low self-esteem is a result of insufficient sleep, declining grades, chronic procrastination, an unhealthy diet, and a higher risk of dropping out among college students of which 78% struggle with managing time during college (I Do Design Studio, 2021).

Experiencing awe has the potential to shift one's perception of time availability. This phenomenon is associated with a multitude of advantages for one's health and overall sense of wellness (Rudd et al., 2012). Additionally, the awe experience has been shown to boost emotions related to social connectedness, personal contentment, and the sense of having an abundance of time, as indicated by the research conducted by Monroy and Keltner (2022).

While the interaction between light and various materials, including textiles, presents numerous opportunities to evoke awe, the tuning and relations between the qualities of organza to consistently elicit this emotional response remains an underexplored area of study.

1.1 The assignment

This report covers the graduation project for the master Integrated Product Design. The project is in collaboration with Noëlle van der Hagen, an artist who works with organza - a shiny type of textile that is available in many colours - as the main material for her artworks. The assignment is to create an awe experience through research and experimentation on the interaction between organza and lighting, which will have multiple rounds of testing with participants. The project is given direction by the use of the Material Driven Design method by Karana et al. (2015), a flexible method for designers, whose starting point is a material.

The report will be presented in the following structure. Chapter 2 will provide a literature review on the awe experience, the organza material, lighting, light-material interaction and the Material Driven Design method, and a practice review on existing examples of light and textile sculptures. The experimentation consisting of three studies can be found in chapter 3. The final design is illustrated in chapter 4. Chapter 5, 6 and 7 lay out the discussion, conclusion and recommendations. The referencing has been done according to the APA style.

1.2 Noëlle’s Artworks

Noëlle van der Hagen is an artist mainly working with organza. She makes sculptures by shaping the organza fabric and attaching it in different parts with threads hanging from the top part of a metal frame (see figure 1). The ends of the threads contain weights in order for the threads to stay vertical and as a decorative part of the sculpture. She shapes each artwork differently and uses various combinations of colours. Lately, she started adding spots at the bottom of her artworks to enhance the artwork and create shadows.

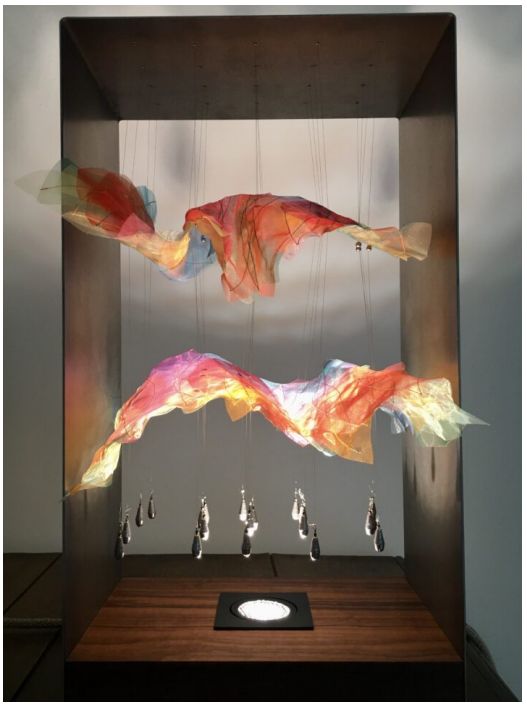


Figure 1: Noëlle’s artwork “Summer: Lichtsculptuur Summer” (Hagen, 2021)

2. State of the Art

This chapter starts with multiple contents of the conducted literature review, which are 1. Awe experience, 2. Organza, 3. Light, 4. Light-material Interactions and 5. Material Driven Design (MDD) method. The second subchapter “Organza" is the textile this project integrates and the last subchapter “Material Driven Design (MDD) method” is how the project will be approached. Afterwards, the findings from the review of practice and benchmarking of identified cases are presented.

2.1 Literature Review

The literature review is conducted by looking into different sources, like articles in scientific journals, websites and books by searching for particular keywords like awe, organza, atmosphere perception, lighting. Besides, there has been a look into areas like design, materials, emotions, light and textile interactions, etc. The organza subsection is complemented with observations on Noelle's practice.

2.1.1 Awe Experience

What is awe?

According to Emotion Typology (2022), awe is “the feeling when you encounter something that is greater or more powerful than yourself. You feel overwhelmed and need a moment to adjust.” It is commonly described as an emotional response to something vast, or extraordinary. “Vastness can refer to perceptual vastness, as in viewing an enormous mountain or a towering building – or it can refer to conceptual vastness, as in hearing an idea with enormous implications or meditating on the meaning of eternity” (Yaden et al., 2018). The more novel the awe eliciting situation is, the higher awe is experienced. It can be triggered by natural wonders, artistic masterpieces, etc. Awe shares a strong connection with fascination and dreaminess, as they are all emotional states that evoke a sense of wonder and enchantment (Desmet, 2012).

Experiencing awe can be both positive, like being on top of a mountain after a hike, watching the massive starry sky and negative, a threatening situation for example, like a natural disaster where a tornado is approaching, which goes hand in hand with powerlessness (Gordon et al., 2017). In this project, the focus will be on creating a positive awe experience.

What are the effects of an awe experience?

Awe causes both physical and psychological changes. According to Yaden et al. (2018), there are six 'facets' of awe, which include:

- Vastness, as mentioned above;
- The need for accommodation, changes in the mental schemas to be able to process an experience;
- Altered time perception, where time moves slower;
- Self-diminishment, reducing or making certain aspects of the self less conspicuous;
- Connectedness, deeper feeling of connection with surrounding people and things;
- Physical sensations, in psychophysiological and behavioural level (goosebumps, facial expressions)

According to Rudd et al (2012), experiencing awe is a way to change the perception of how much time is available. Awe has many benefits when it comes to health and wellbeing as well. The results of the study found that: people perceive that they had more time available; it lessened impatience of people; people have a more strongly desire to spend time helping other people; participants got a momentary boost in life satisfaction through a small dose of awe. In addition to these benefits, according to Monroy & Keltner (2022), the awe experience also increased feelings of social integration, personal well-being and feeling of having ample time. A more detailed visual can be seen in figure 2.

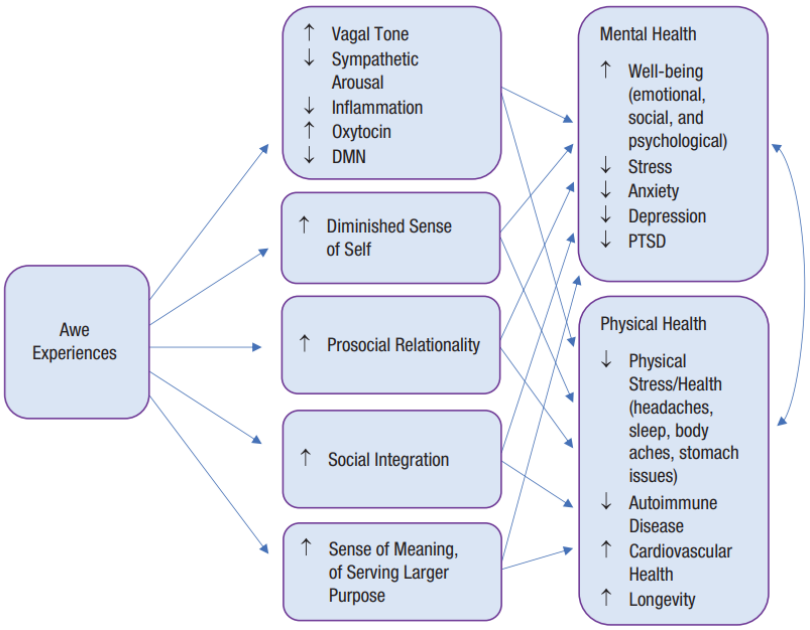


Figure 2: Effects of awe experience (Monroy & Keltner, 2022)

According to the findings of Piff et al (2015), the experience of awe influences prosociality. When looking at naturally aroused awe, where people looked at towering trees from below, it caused more helpfulness, more ethicality and less entitlement. People make more ethical decisions, are more generous to strangers and exhibit more prosocial values in the case of experimentally induced awe.

What are examples of awe experiences?

The concept of awe has been experimented/applied in various designs, in which some have integrated digital experiences such as virtual reality. Chirico et al (2018) argued that virtual reality (VR) is a powerful tool for inducing awe in controlled experimental environments, as it can induce a deep sense of "presence" in participants. Their study not only offered empirical evidence to support this idea, but also presented a well-supported design and validation of four immersive virtual environments (VEs).

Another study by Mueller et al. (2023) takes an innovative approach through three case studies (see figure 3):

1. Playful jogging experience: integration of quadcopter technology, achieved with a custom drone for a captivating hovering encounter;
2. A mobile app with ingestible wireless capsules: monitoring of gut gases advancing the understanding of their impact on health;
3. Shape-changing interfaces and interiors: bench changing shape to experiment interaction with the environment.

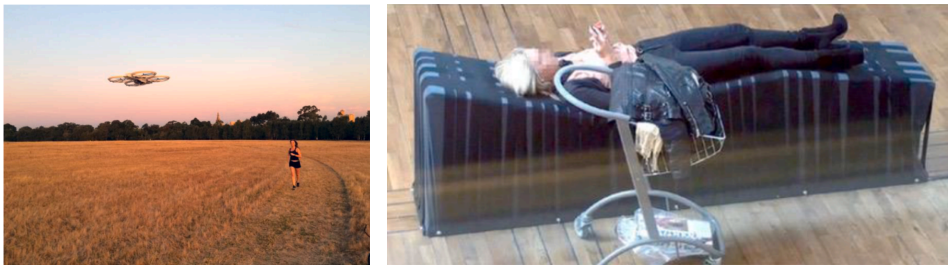


Figure 3: Jogging with quadcopter (left) and shape-changing bench (right)

2.1.2 Organza

What is organza?

Organza is a plain-woven textile that has a sheer and shiny appearance. It is originally made from silk, but there are also versions made from synthetic fibres, like polyester and nylon (What is organza Fabric? Exploring how it’s made, origins and uses, n.d.). It is a lightweight and breathable material, due to its weave consisting of holes. The more the holes per square unit, the higher the quality of the organza (MasterClass, 2021). The shininess and transparency make organza recognisable. It is also a stiff and regular textured fabric, so it is not stretchy when being pulled and comes in any colour (Areatecnica, 2023).

Organza consists of different types, in which the differences are mostly physical. Nearly all varieties of organza exhibit transparency owed to the relatively wide holes between the threads. Additionally, they display split specular scattering, resulting in double, rather than single, highlight structures or reflection lines due to the weave patterns (Pont & Koenderink, 2003). The topic of split specular scattering will be addressed in more detail in section 2.1.4 "Light-material Interactions".

Figure 4 on the next page shows the types of organza, of which the top row shows the previously mentioned double reflection lines especially. Crystal organza looks glittery, as if there are tiny little pieces of glitter reflecting the light. The glittery appearance is generated by micro-highlights, which are greatly influenced by both the lighting conditions and the viewing angle. This leads to glint patterns that exhibit rapid variations when subjected to movement or changes in perspective (Zhang et al., 2019).

Mirror organza on the other hand looks more shiny and transparent. It shines the most compared to the other types of organza, which occurs because the threads, it is composed of, have a high level of specularity, causing it to exhibit particularly strong highlights. The highlights, which are the lightest parts on the organza in the form of two lines - as mentioned earlier - created by light reflecting back, are clearly visible. Satin organza, as the name suggests, is a type of organza that shares the shininess of satin and looks less transparent. Crushed organza is also less transparent with intentional wrinkles. Shot organza consist of warps and fillings dyed in different colours, creating a colour gradient. The colour shifts observed - when viewing these fabrics from different angles - primarily results from an occlusion effect (Pont & Koenderink, 2003). When observing the fabric, foreground threads obscure those behind them in three-dimensional space. So, the frontmost thread's colour dominates the fabric's appearance. Front threads both block and obscure those behind them, influencing the fabric's colour perception. When the light source is behind the observer, the pure occlusion effect is observed with minimal shadowing. Changes in the light source's position can mask the occlusion effect. The fabric's colour shift is partially due to this (Lu et al., 2000). Lastly, embroidered organza, is either crystal or mirror organza with an addition of embroidery. All these examples of organza are commonly used in the fashion industry, for wedding dresses, evening gowns, decoration, etc. (MasterClass, 2021).

Figure 4: Types of organza (*Crystal Organza Wholesale Fabric in Ocean Blue 927*, (n.d.); *Mirror Organza Fabric Ivory, by the yard* (n.d.); *Organza two-tone – Brons met goud* (n.d.); *Ivory Crushed Organza* (n.d.); *Red And Blue Plain Blue Shot Red Organza, For Garments* (n.d.) and *Beige Sequins Embroidered Organza Fabric* (n.d.))

Where does organza come from?

Organza is mainly produced in Asia, as can be seen in figure 5 on the next page. Several millennia ago, silk, the original fibre with which organza is made, was produced and manufactured in East Asia, of which the countries are now known as China and India (Sewport, n.d.). In that time period, silk was so valuable that a trade route emerged, called the Silk Road. The ancient Silk Road was a way to export silk due to it connecting the West with the Middle East and Asia (Britannica, 2023). This was the only way to obtain organza in Europe in the time of the Middle Ages and the Renaissance. Till this day, China and India stay the biggest production markets and exporters of silk. Both countries produce organza yarn as well, which is sometimes spun into a fabric.

On the other hand, while the United States is the original developer of polyester/nylon fibres, China is the biggest producer of polyester and the biggest exporter of nylon. So in the case of synthetic organza, it is also made more commonly in China (Sewport, n.d.)

Figure 5: Countries where organza is produced (Organza Fabric Production in the World, n.d.a)

How is organza made?

According to Sewport (n.d.), the production of organza is done in five steps. Figure 6 on the next page shows a visualised summary of these steps. The first step of making organza fabric is the production of the materials itself, which can vary between silk or synthetic fibres, like polyester or nylon as mentioned before. After that, each fibre is twisted, which is followed by the fibres being twisted around each other in the opposite direction, like shown in figure 7. This makes organzine, coming from Organzi, the old name of a city in Turkestan, which at the time had a very famous market where silk was sold (Carletto, 2020). The next step is to comb and treat the yarn with acid in the case it is made from silk, since synthetic fibres are already stiff. This helps the final organza to be stiff before being spun into a fabric, which is the differentiating factor of organza from silk. The last step would be to weave the fabric into organza where factors like seam appearance, seam stiffness, and seam pucker

should be carefully taken into consideration (Sewport, n.d.). Figure 8 shows a simplified step-by-step flowchart of the material making process.

Figure 6: Production of organza (Organza Fabric Production in the World, n.d.b)

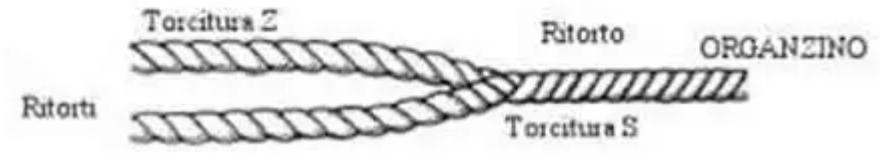


Figure 7: Fibre twisting into organzine (Silk Organzine, 2018)

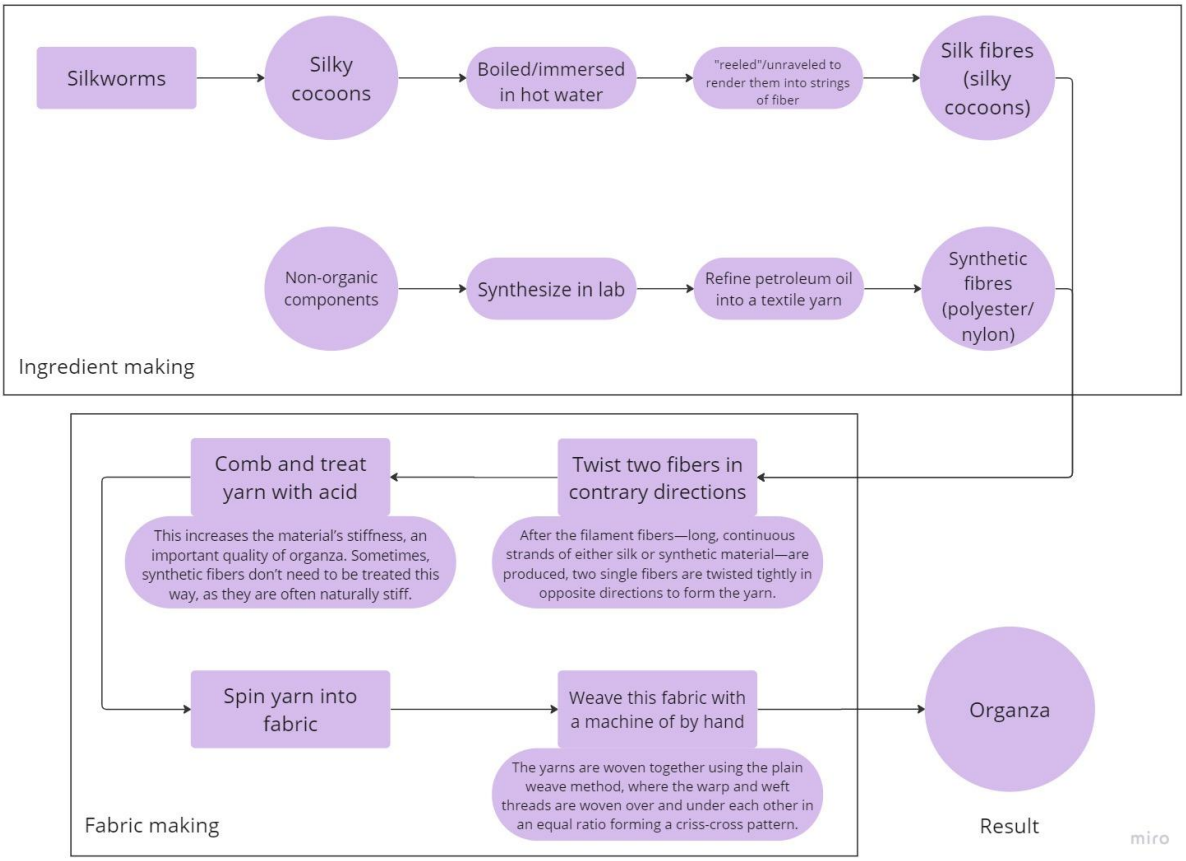


Figure 8: Simple material making process flowchart

How are Noëlle's organza artworks made?

In order to make the artworks of Noëlle, mentioned in the introduction, some post-processing techniques should be performed after the explanation of the making of organza in the previous section. Below is the follow-up flowchart of the post-processing part, which results in the final artworks based on the explanations of Noëlle (see figure 9 on the next page).

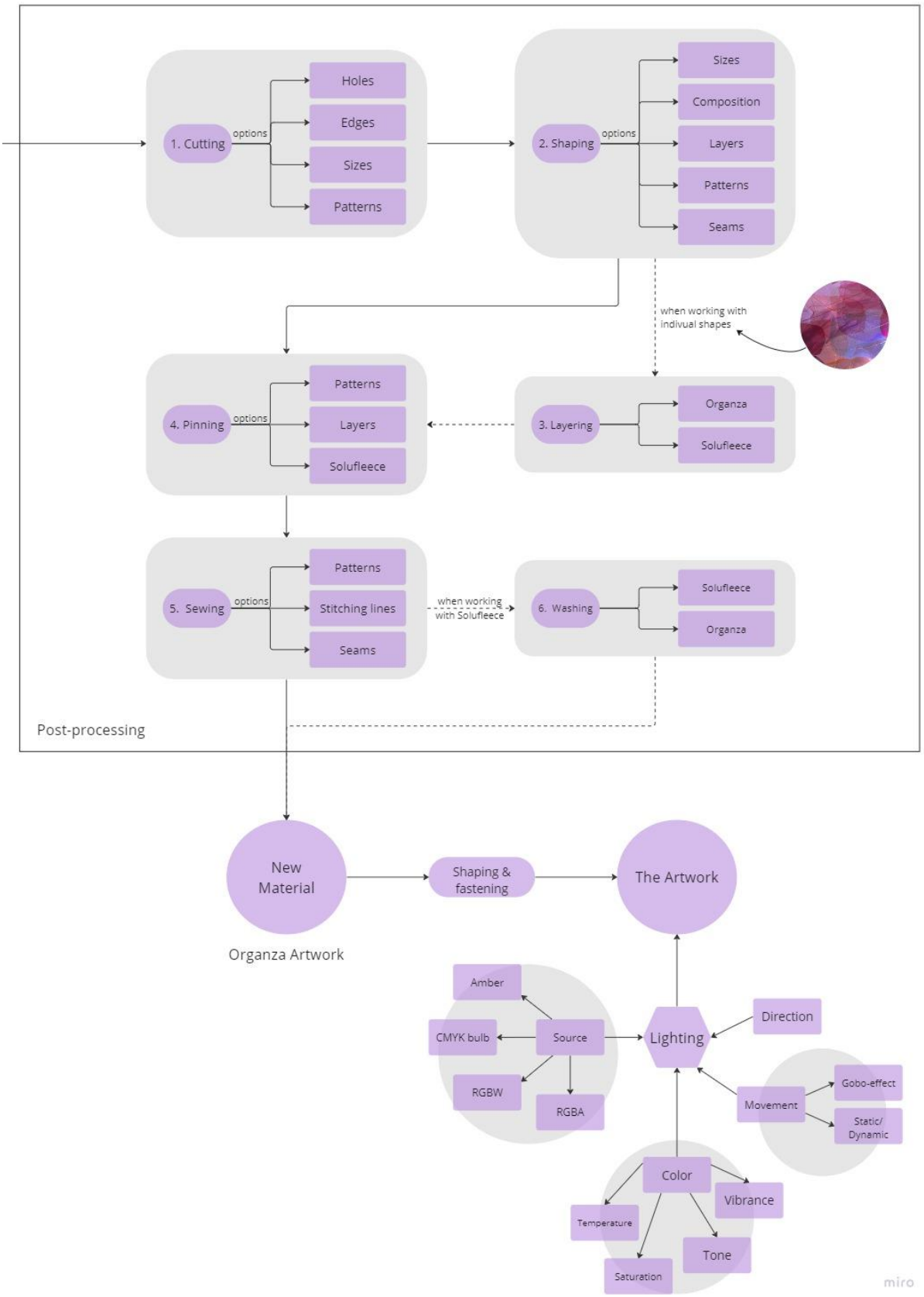


Figure 9: Post-processing flowchart

2.1.3 Light

According to Stokkermans et al. (2017), “light has a major influence on the impression of a space. Light has been found to affect the visual appearance, the affective appraisal and the appreciation of a space. Therefore, the lighting in a room should be carefully designed in order to support its function.” Without light, nothing visual could be perceived. Light is always involved when seeing something, in the form of daylight and/or artificial light.

Ambient, focus and brilliance

Richard Kelly, a *visionary in lighting design*, integrated ideas from perceptual psychology and stage lighting to create a groundbreaking concept. He introduced three functions of lighting: ambient, focal glow and play of brilliance (figure 10).

Ambient light provides general illumination for various visual tasks, facilitating orientation within spaces and enabling *smooth movement throughout***.** It lays the foundation for a well-lit environment, ensuring that fundamental needs are met.

Focal glow emerged as an essential aspect of Kelly’s approach, strategically highlighting significant areas of the object against a backdrop of ambient light. By creating a structured visual environment focal glow allows for *quick and effortless perception*, while also directing attention to specific objects and showcasing aesthetics.

The play of brilliance, the third function, acknowledges its potential beyond functionality. It is the beauty of light itself. From the mesmerising flicker of a candle to the grandeur of a chandelier, the play of brilliance enhances spaces with an atmospheric charm, elevating them into *captivating realms*.

Kelly’s approach empowered designers to synchronise light with architectural elements and fulfil the perceptual needs of space occupants (Ganslandt & Hofmann, 1992).

Figure 10a: Example ambient lighting (Nikel, 2018)

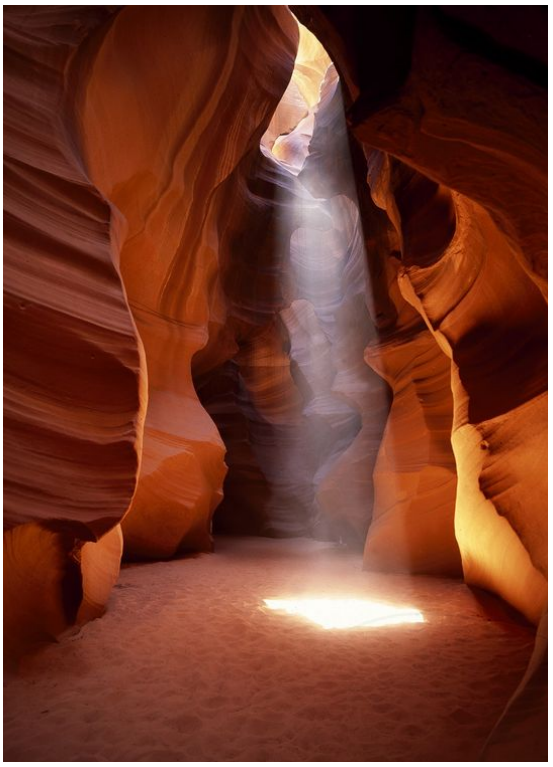


Figure 10b: Example focal glow (Highsmith, 2018)

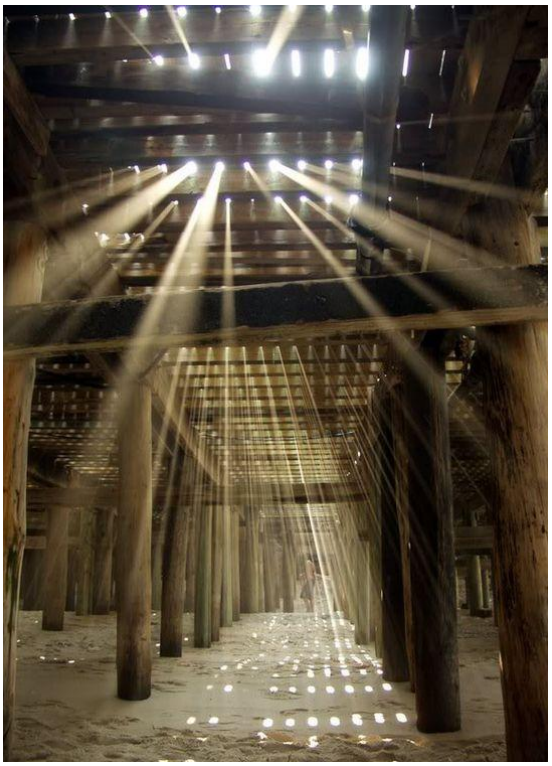


Figure 10c: Example play of brilliance (Galkovsky, 2007)

Atmosphere perception

The perceived atmosphere in a room is mainly determined by lighting, consisting of artificial light and natural daylight permeating the room (Stokkermans et al., 2015). It is capable of changing the affective state of people (Vogels et al., 2008). The concept of atmosphere perception encapsulates the affective meaning of an environment, which is capable of orchestrating shifts in individuals' long-term emotional states. It is known as the way the affective meaning of environments is experienced by people (Kuijsters et al., 2012).

Atmosphere delineates itself through four core dimensions: *cosiness*, *liveliness*, *tenseness* and *detachment*. Unlike mood, atmosphere is not an emotional state, but rather a cognitive appraisal of the environment. It is a subjective impression that is closely linked to anticipated effects on mood, but does not necessarily reflect the actual impact on emotions (Vogels et al., 2008).

Creating a particular atmosphere through lighting requires deciphering the interaction between atmosphere and the perceptual attributes of light. The process involves understanding how these perceptual attributes of light can be derived from its physical distribution. Changing luminaire types, spatial arrangements and the overall luminance of the light composition produces different perceptual attributes of light, which in turn create different perceived atmospheres. In order to establish a specific ambiance, it is imperative not only to outline the preferred levels of perceptual light attributes but also to quantitatively assess the physical dispersion of light that gives rise to these perceptions (Stokkermans et al., 2017).

Dynamic light textures

Dynamic light textures within an atmosphere encompass textures that undergo continuous transformation that have an impact on the visual and emotional experience of a space. Just like how Richard Kelly’s three lighting functions are not only functional but also have a profound impact on how individuals perceive and experience an environment. These functions contribute to the overall atmosphere and aesthetics of a space. The characteristics of a dynamic light texture shape its appearance, leading to perceptible qualities. Such textures can be categorised according to the following characteristics (Louwers, et al., 2019):

Organisation - Deterministic or Chaotic
Textures are characterised by the arrangement of their individual shapes, which show different organisational structures. These structures can differ significantly from each other and often show identical or related shapes.

Forms - Geometric or Organic Repetitions
The arrangements referred to above consist of individual elements that adhere to certain styles, called forms. These shapes range from organic to geometric, illustrated by patterns such as honeycombs (geometric) and fluid interactions such as ink and water creating swirls (organic). Geometric shapes often evoke notions of order, precision and formality.

Contrast - Variations in Colour, Brightness or Focus
To distinguish a light texture, it must contrast with both the background and its constituent forms. Specific colours can introduce subtle contrasts that harmonise with surrounding elements, while slight shifts in luminance can enhance uniformity. This contrast exists in terms of *colour (hue/saturation)* or *luminance*. For example, colour contrast illustrates sharp differences such as yellow and blue or subtle variations such as purple and red. Luminance contrast ranges from high to low. In addition, focus plays a role in creating contrast modulated by degrees of blur, called *sharpness contrast*. Combining these contrast forms accentuates the pattern.

Dynamics - Influencing the Above or Following its Own Rhythm
For a light texture to be dynamically perceived, at least one of its characteristics must undergo changes over time. These changes may involve organisation, such as spatial shifts in certain elements, or forms, such as those in kaleidoscopes. They can also affect contrast by changing colours, brightness or focus. Patterns are particularly repetitive, time-evolving visuals, allowing dynamics to create their own patterns through recurring changes. Yet even when chaos and randomness take hold in complex systems, underlying mechanisms depend on feedback loops and self-similarity, implying the inherent use of patterns. The choice to include randomness or rhythm in dynamic light patterns is context-specific and depends on the nature of the pattern. We often encounter some degree of apparent randomness in the natural world, reflecting its integration into organic and unpredictable forms. This concept reconnects us to the essence of nature.

The dynamic qualities of light align with Richard Kelly's lighting functions and both contribute to the overall atmosphere perception elucidated in the previous section.

2.1.4 Light-material Interactions

According to Zhang et al. (2019), lighting plays a central role in revealing or hiding specific material qualities. Various techniques in lighting set-ups allow different facets of an object's shape or material to be clearly depicted. The strategic configuration of lighting tools enables the manipulation of material appearance (see figure 11).
Notably, smooth surfaces manifest increased glossiness when exposed to collimated light sources compared to broader diffuse sources. Perceived glossiness is influenced to varying degrees by factors like diverse natural lighting environments, changes in lighting contrast and gamma, and the orientation and shape of highlights, influenced by the characteristics of the light sources. Human assessments of qualities such as glossy, smooth, or soft exhibit systematic associations with material classes and lighting contexts.

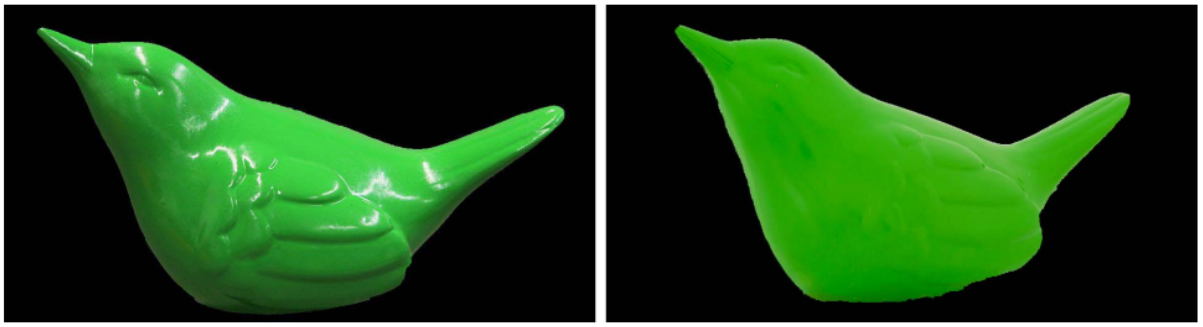


Figure 11: Same object under two different lighting environments (Zhang et al., 2019).

The study by Zhang et al. (2019) anticipates the effects of a wide array of lighting environments on the perception of diverse qualities across a broad range of materials. It confines itself to canonical modes, representing fundamental elements of naturally occurring light and materials. These modes encompass three lighting modes and four material modes. Notably, the three lighting modes align with the previously mentioned Richard Kelly's three functions of lighting: ambient light mode (ambient function) with a spherically diffuse light environment, focus light mode (focal glow function) using a collimated light source, and brilliance light mode (play of brilliance function) employing numerous small light sources.

Additionally, the study investigates different material finishes, including matte paint, glossy paint, velvet-like layers, and glittery layers. These finishes correspond to various bidirectional reflectance distribution functions (BRDFs), directly linking the concept of lighting to its profound impact on the perception of materials. These BRDFs represent a range of characteristics, including diffuse scattering, mirror-like reflection, asperity scattering, and specular multifacet scattering.

In essence, the study by Zhang et al. (2019) provides a scientific foundation for the ideas presented in the previous section 2.1.3 "Light" by exploring the impact of various lighting modes (similar to Kelly's functions) on material perception, which in turn contributes to the overall atmosphere perception within a space. It aligns with the notion that lighting is a tool influencing both material and emotional experiences in architectural and design contexts.

Combining these four canonical material modes and three canonical illumination modes (see figure 12), resulted in material qualities encompassing matte, velvety, specular, glittery, glossy, rough, smooth, hard, and soft qualities. Manipulating the spatial composition of

natural lighting, by altering factors like the direction, brightness, or light patterns, with the aim of achieving a particular lighting atmosphere or effect, can lead to alterations in the visual appearance of objects or surfaces. These changes in appearance, in turn, influence how these objects or surfaces are perceived (see figure 13).

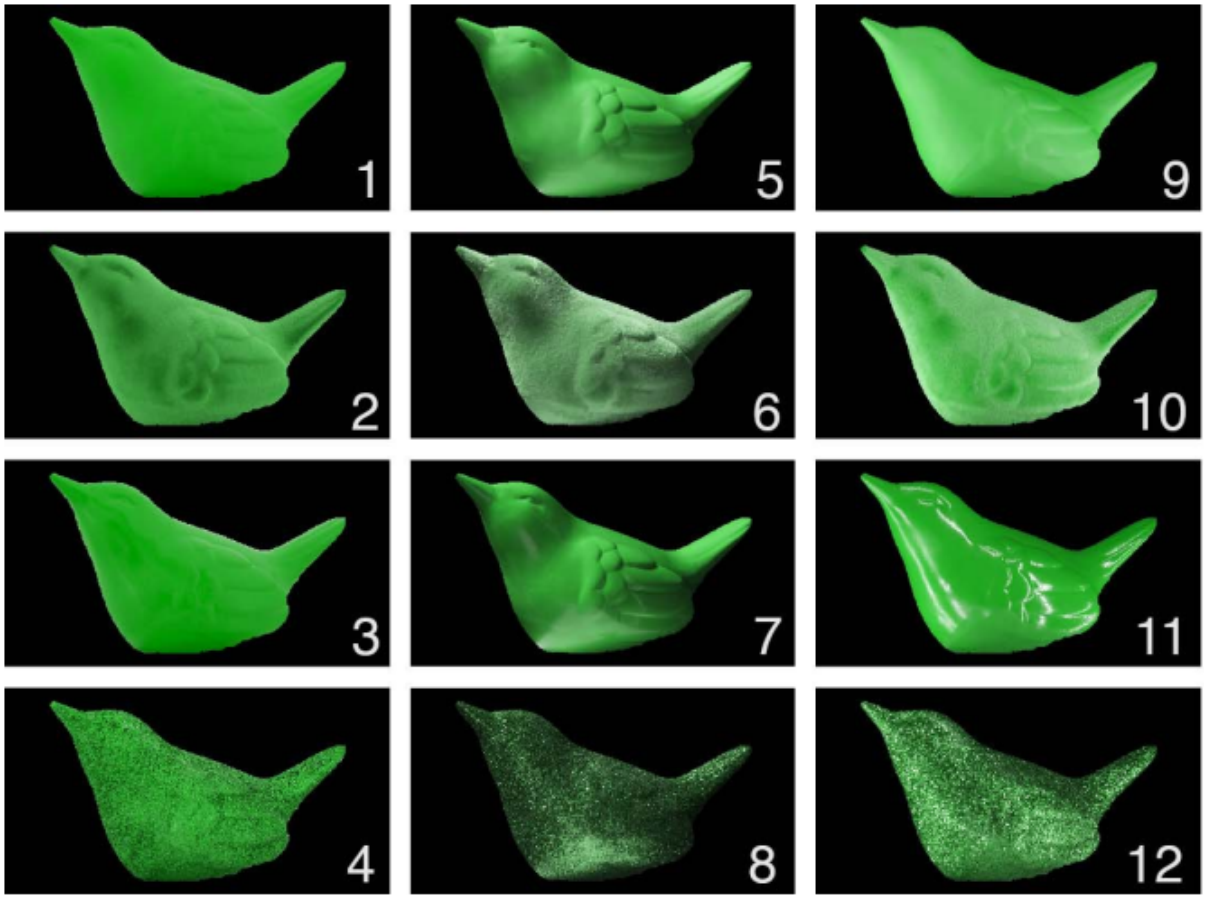


Figure 12: From top to bottom, the four rows represent the matte, velvety, specular, and glittery material modes. From left to right, the three columns represent the ambient, focus, and brilliance lighting modes (Zhang et al., 2019).

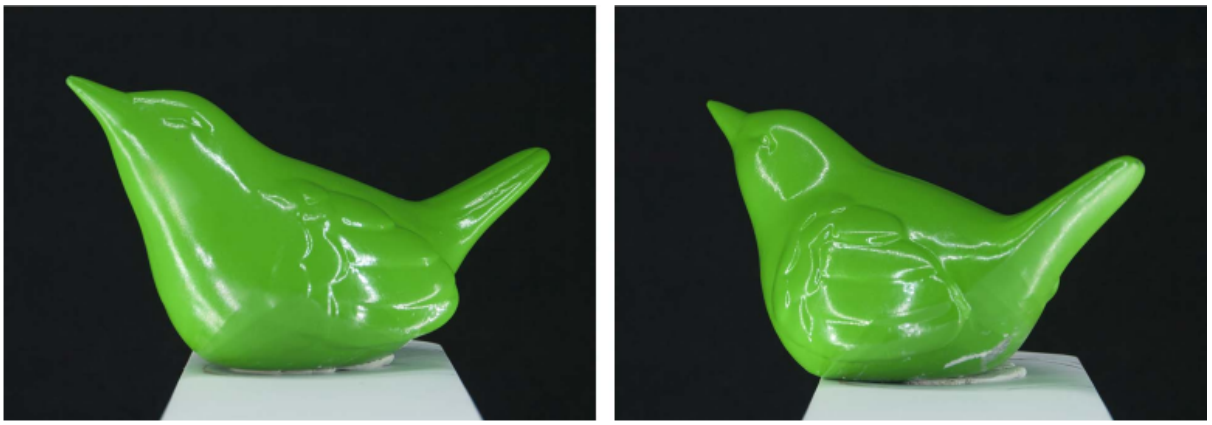


Figure 13: Same object in different orientations is perceived differently from the same viewing angle

In much the same way that lighting plays a pivotal role in shaping the appearance of opaque materials, its design is equally important for bringing out the aesthetic qualities of textiles. Accent lighting, achieved through focused light beams, can highlight objects, with the direction of light impacting the way textiles look (see figure 14). Notably, surface reflectance stands as a key of optical properties, as in most materials, a substantial portion of unabsorbed light is reflected from their surfaces. Textiles exhibit varied appearances due to their geometric attributes – like weave density, thread structure, finishing conditions, etc. – which lead to the scattering of incident light in different directions and strengths. Recalling the concept of the Bidirectional Reflectance Distribution Function (BRDF), and introducing the Bidirectional Texture Function (BTF), allows for the objective characterization of surfaces based not only on their reflectance but also their texture (Barati et al., 2015).

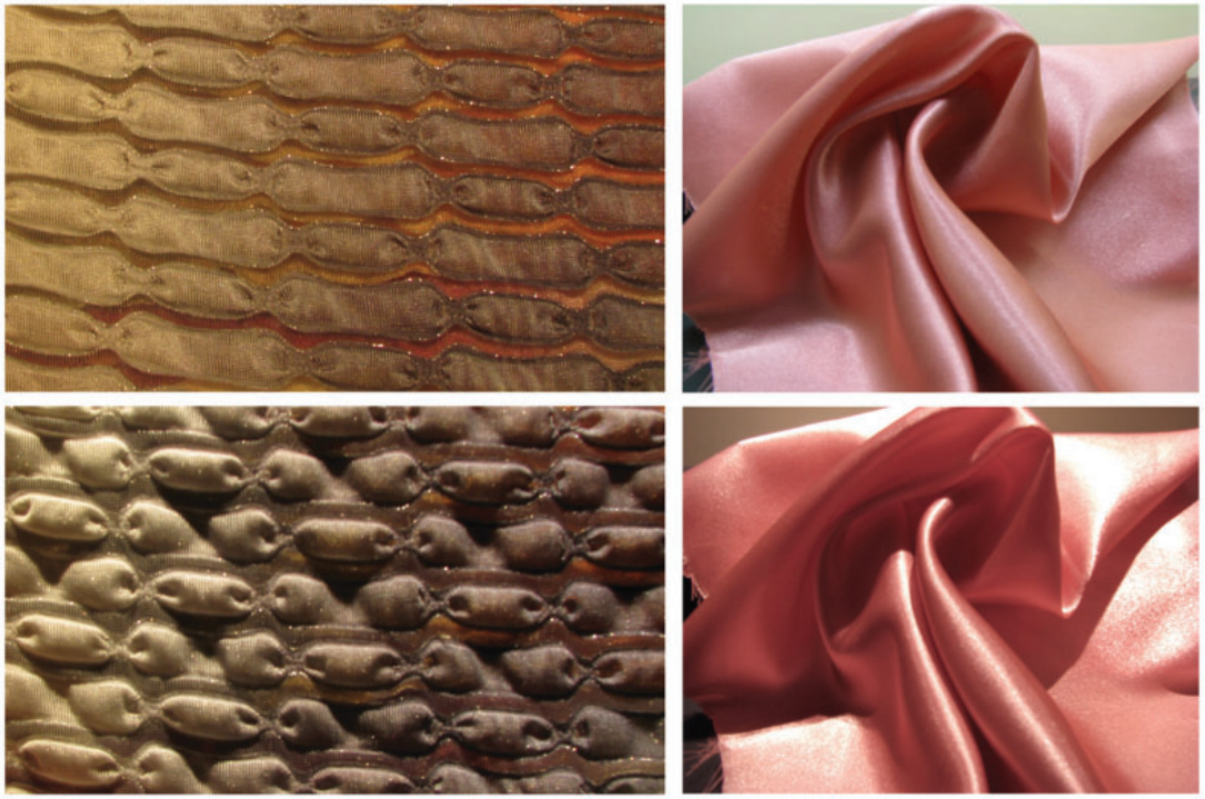


Figure 14: Two objects in different lighting environments (Barati et al., 2015)

The experience of appearance involves discerning varying levels and qualities of texture (grainy, plisse, crepe, napped), shine and lustre (silky, shiny, satiny, sparkling), transparency (sheer, see-through, thick), and colour – employing textile terminology. This study classifies textiles by their reflectance properties, utilising flat and cylindrical shape variants, which enabled the identification of several canonical optical traits. Delving into the relationship among visual attributes, optical properties, and lighting characteristics was a focal point. Evidently, lighting substantially influenced how visual attributes were perceived (see figure 15). The investigation delved into the correlations between modes of textile surface reflectance and six visual characteristics – shiny, silky, glittery, metallic, soft, and textured – to document how illumination diffusion and direction affect the appearance of textiles (Barati et al., 2015).

Building on this, according to Pont & Koenderink (2003), distinct observations for glossy plane weaves yielded including a split off-specular reflection in a situation where a specific set of parallel threads - weave or the weft - was aligned with the axis of a cylinder in an the same arrangement mentioned previously, where the textiles are encased around a circular cylinder and exposed to parallel illumination. This was because of wavy fluctuations in local thread slopes around the cylinder and a surface scattering lobe originating from threads running along the cylinder. This is attributed to the regular structures present in the artificial material samples.

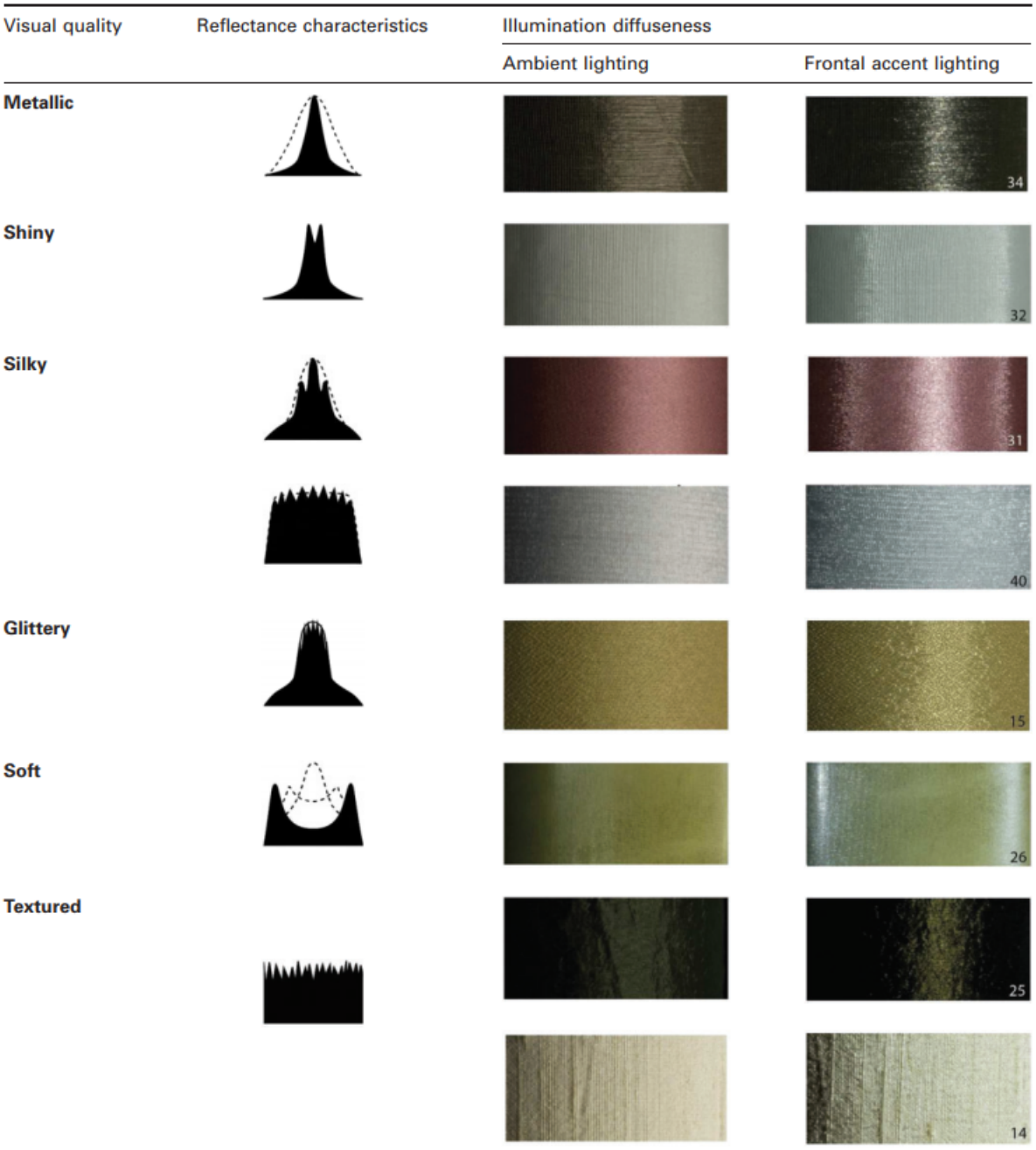


Figure 15: Relationship between the reflectance characteristics and the visual qualities of textiles (Barati et al., 2015)

2.1.5 Material Driven Design method

For this project, it is suitable to use a design approach that has the material as starting point and also considers experiences, particularly emotions. Hence, the Material Driven Design (MDD) method is chosen. MDD is an adaptable and iterative method for designers, which facilitates designing experiences with and for a material (Karana et al., 2015). This method is helpful for design processes that start with a material (or a material proposal) and end with a product and/or further developed material. It comprises four steps: Understanding the Material, Creating Materials Experience Vision, Manifesting Materials Experience Patterns, and Designing Material/Product Concept. Figure 16 shows these four steps in a clear visual. Each step contains various parts. The method can be customised to your needs by for example changing/skipping some parts and steps. Besides, it is possible to go back to a previous step and even go back to the beginning as well. This project has applied the method in the form of a loop: 1. Benchmarking; 2. Material making process; 3. Material taxonomy; 4. Tinkering 1; 5. Product development 1; 6. User studies 1; 7. Tinkering 2; 8. Product development 2; 9. User studies 2; 10. Vision & metaphor; 11. Tinkering 3; 12. Product development 3; 13. User studies 3.

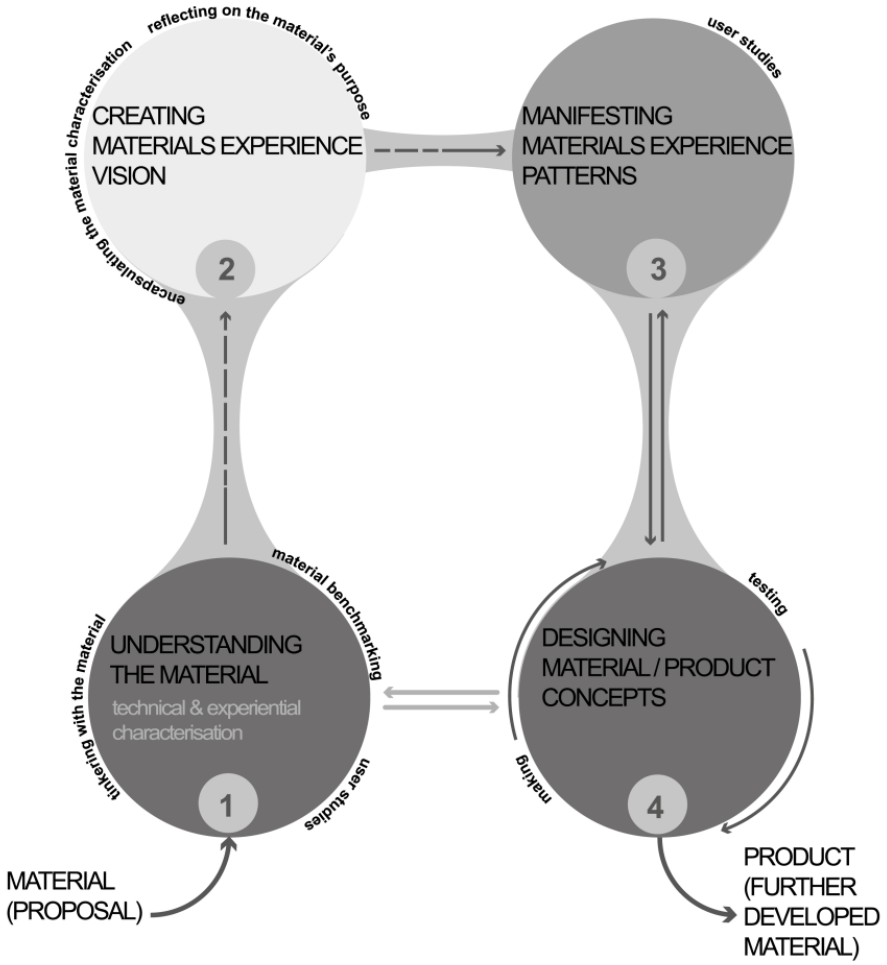


Figure 16: The four levels Material Driven Design (Karana et al, 2015)

According to Karana et al. (2015), the concept of materials experience refers to the experiences that people have with, and through, the materials of a product. Materials experience consists of four experiential levels: Sensorial Level, Interpretive Level, Affective Level and Performative Level (Giaccardi & Karana, 2015).

The sensorial level is what people encounter first when it comes to seeing, feeling, hearing, smelling and tasting materials. It is the first impression and inevitable. For instance, people like metal parts to have a *smooth* surface and dislike wood that has a *rough* surface with splinters. The interpretive level is how people interpret/judge the material after the first impression from the sensorial level. Here, people translate their experience by meanings and associations. The smooth metal part is associated with being *modern*, while the piece of rough wood is for example *vulgar*. The affective level describes our emotions that arise through a material. For example the modern looking smooth metal part is scratched easily, which raises the feeling of *disappointment* and the vulgar looking piece of rough wood can arouse the feeling of *surprise***,** when it is lightweight while expecting it to be very solid and heavy. Lastly, the performative level is influenced by the first three levels: sensorial perceptions, meanings/associations and emotions (Giaccardi & Karana, 2015).

Some examples of where the MDD method is applied are the waste-coffee grounds (Karana, et al., 2015), Textile Design (Ribul et al., 2021), 3D Printing Waste Recycling (Teixeira et al., 2021), Electroluminescent Materials (Barati, et al., 2018), Living Media including Mycelium-based Composites (Parisi et al., 2016), Plant Roots (Zhou et al., 2020) and Flavobacteria (Groutars et al., 2022).

The activities of the MDD method that are used for this graduation project are the following:

- Benchmarking
- Material making process
- Material Taxonomy
- Tinkering
- User studies - experiential characterization
- Vision statement
- Metaphor

The MDD method comprises some tools and templates that are available for designers who want to undertake an MDD journey, e.g. Material Diary, Inspiration cards, and Experiential Characterization tool (Camera & Karana, 2018).
Next to the MDD tools, this project integrated other tools to clarify the awe experience by selecting relatable emotions based on the nine categories in “25 positive emotions in human-product interactions” (Desmet, 2012), a design tool that communicates 25 pleasurable human-product interactions (Yoon et al., 2017) and expanded online resources (Emotion Typology, 2022). During study 3 another tool is used to integrate Experience Trajectories in the user testing part, (Tennent et al., 2021).

The potential to evoke awe through the interaction of light with various materials, including organza, is rich with possibilities. However, there is a significant gap in the understanding of how to consistently and effectively tune and relate their qualities to evoke this emotional response over extended periods, making it an underexplored area of research.

2.2 Practice review & Benchmarking

The practice review is conducted by looking into artworks from different artists of which the artworks consist of similar (looking) materials, e.g. organza, textiles and transparent polymers. These example practices are found through online sources, like websites of the artists, museums, magazines. These sources are found through the keywords: light installations, textile art, light and organza, etc. The analysis is based on the benchmarking template contained in the MDD toolkit, that is adapted for this project.

Several examples of designs using organza and/or similar textiles with and without lighting are found. First of all, organza on its own is mostly used for dresses, specifically evening/wedding gowns (MasterClass, 2021), but also other fashion items like scarves and even decoration too (Areatecnica, 2023). However, when looking more specifically at the material of the already existing artworks, there is a combination of lighting, colour and organza or a similar textile. The examples consist largely of other textiles, but the properties are similar to organza. They are translucent fabrics woven with plastic fibre. The difference is that the weave structure of some is a bit coarser than others, but if only the entire material is considered, the differences in aesthetics are minimal. The examples are similar to Noëlle's work. These captivating artworks that offer unique visual experiences share several similarities, particularly in their use of nature as a source of inspiration. Moreover, the use of organic shapes adds to the overall depiction of nature in the artworks.

An overview of the benchmarking is provided in figure 17. Most of them are large scale three-dimensional structures that consist of a textile combined with lighting and colour. However, some artworks move through dynamic lighting, generating a sense of depth and layers. This play of light and shadow mimics the ever-changing and transient nature of natural light, but it also conveys a sense of temporal progression and transformation like the slow movement of the sun setting (Echelman, 2015).

The textiles in these examples are very delicate and flexible and organza has a wiry feel and structured drape (MasterClass, 2021). Therefore, the material can be oriented in many different silhouettes. In addition, as previously mentioned, they are translucent which allows the creation of shadows and layers through light. Besides, the sheerness catches and reflects light (MasterClass, 2021). The examples are individually described below.

MATERIAL application picture				
name & designer		Mountainous Landscapes by Yuri Miyazaki	Dappled light by Rana Begum	Fall in pop by Mintdesigns & Nobuhiro
composition	organza	yes	no	no
	other textiles	yes	mesh	fabric coated with glass organdie (made from polyester)
	artificial light	no	no	projections
experiential qualities		natural elements (mountains, rivers, hills)	natural elements (clouds)	natural elements (forest, water)
		patterned	sculptural	structural
		geometric	ethereal	layered
		transparent	light	cascade of colours
		colourful	colourful	vibrant
			soft	lively space
			layered	dynamic
				constantly changing sprectrum of colour
applications	decorative	yes	yes	no
	art gallery	no	yes	yes
	architectural	no	no	no

MATERIAL application picture					
name & designer		Earthtime 1.8 Renwick by Janet Echelman	Magnetic reversal by Sara Coleman	Ferment by Christine Sciulli	Woven Light Interference by Elvira Jönssen
composition	organza	no	no	no	no
	other textiles	polyester & UHMWPE fiber	strands of silk	tulle	no
	artificial light	colored LED	yes	projections	yes
experiential qualities		Soft, voluminous	light	nature elements (clouds, water, mist, smoke, living organism)	nature elements (iridescence)
		layered	delicate	shadow	shadow
		vibrant hues	shadow	hypnotically slow movements	colourful
		coloured light	different shades of light	semi-transparent	semi-transparent
		shadow drawings		translucent	layered
		dynamically-changing shadow drawings		glowy	glowy
		vivid colors		ethereal	patterned
		temporal (change over time)		temporal (change over time)	temporal (change over time)
applications	decorative	no	no	no	yes
	art gallery	yes	yes	yes	yes
	architectural	yes	no	no	no

Figure 17: Benchmarking

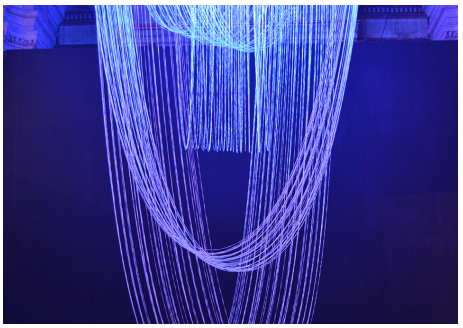
Yuri Miyazaki’s abstract embroideries show a palette of icy blues and winter whites interrupted by the odd flash of pink conjuring up images of isolated natural mountainous landscapes (Miyazaki, 2018).

A newly-created, ethereal cloud installation of diffused light, soft veils and layers of colour dramatically suspended within the Gallery exploring the perception of light, colour and form within sculpture, painting and installation (Begum, n.d.).

A screen structure by Mintdesigns et al. (2012) created by pleated cloth folded in multiple overlapping layers, on which a cascade of colours are projected to create a vibrant, colourful atmosphere where guests will almost be able to hear the heartbeat of the forest. A mysterious forest whose dynamic impulses are revealed to the viewer from one moment to the next, in a constantly changing spectrum of colour, image and sound.

Soft, voluminous net sculpture that surges through the air. Many layers of twines, knotted together in vibrant hues that interplay with coloured light and “shadow drawings” on the walls. Dynamically-changing shadow drawings which project in vivid colours from wall to wall, unfolding gradually. Reveals the artist's fascination with the measurement of time. It explores the contrast between the forces we can understand and control with those we cannot, and the concerns of our daily existence within the larger cycles of time (Echelman, 2015).

Light and delicate three-dimensional figures combined with light and shadow to give off different shades of light, revealing a variety of shades depending on the viewing angle (Coleman, 2015).



Ambiguous cloud seems to be a living organism. Circular lines gather and disperse thin ribbons of white light. All movements seem to be hypnotically slow. The fabric's weave is semi-transparent, and its nylon thread is translucent. It glows, catching some photons along the way. When translucent netting is illuminated only from the front or the side at a steep angle, it will appear opaque when everything behind it remains unlit. By controlling the ratio of projected light to its ground of darkness, this ambiguity generates an ethereal aesthetic as if water, mist, or smoke. Volume and motion, shape and colour are defined by the interplay of material and space, time, and projected light (Sciulli, 2022).

Woven Light Interference is a graduation project which explores the interaction between light and colour within the field of textile design. This research involves the integration of dichroic filters into the weaving process to create distinct structures and patterns. The result is a collection consisting of woven textiles, each with multiple expressions and both internal and external visual effects. These textiles propose innovative approaches to manipulating light and colour in textile design. In particular, they achieve this by adapting to the ambient lighting conditions of their surroundings (Jönsson, 2021).

3. Experimentation

This chapter presents three studies delving into the interaction of light and organza. The first study presents static light-organza interactions, the second study introduces dynamic lighting through projecting light textures and the third and last study is an evaluation on an improved version of the second study.

3.1 Study 1 | Static Light-Organza Interactions

This study is the first study that will result in a small-scale light sculpture made from organza and LED lighting.

3.1.1 Tinkering

The first tinkering sessions consist of getting familiar with the material and playing with different types of lighting (colour, intensity, etc.) and different types of organza (colour, texture, etc.). Before performing a hands-on tinkering session, an illustration of the material taxonomy is made in order to have an overview of all the material variables. Figure 20 on the next page shows the material taxonomy visual, which is part of the MDD method.

During the tinkering sessions, it became evident that the colour of the organza has a minimal effect on the colour of the shadows when illuminated by a coloured light. Instead, the dominant factor influencing shadow colour is the colour of the lighting itself. Multiple organza layers produce shadows that enhance the overall contrast of the installation. Notably, as the organza is positioned closer to the floor, the shadows become sharper and more intense in colours (see figure 18).

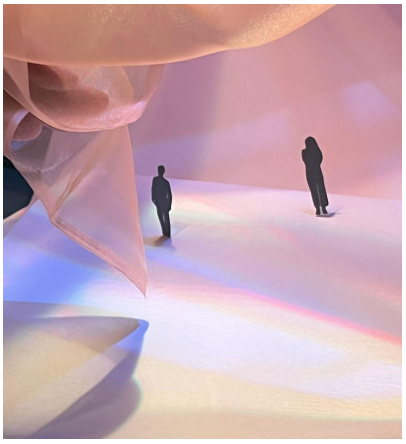


Figure 18: Sharp coloured shadows

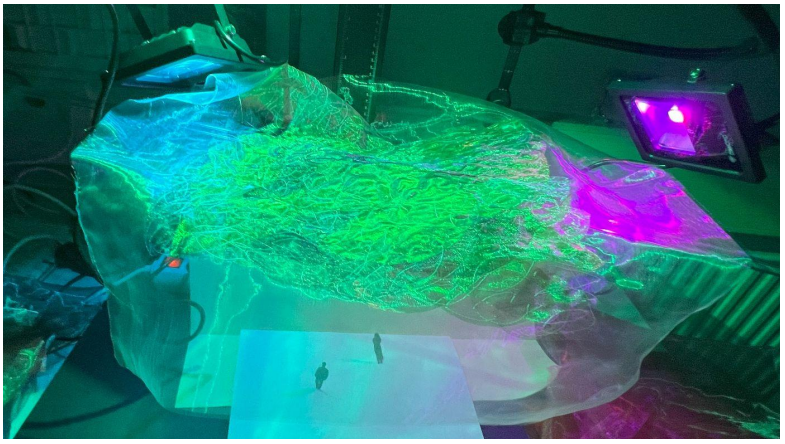


Figure 19: Coloured lighting on organza

The colour of the lighting also dominates the colour of the organza. Figure 19 shows an organza artwork of Noëlle, which originally has a different colour. Due to the green and purple lighting, the organza artwork is perceived as green and purple as well. This means that the colour of the organza is not so relevant as it changes according to the lighting colour.

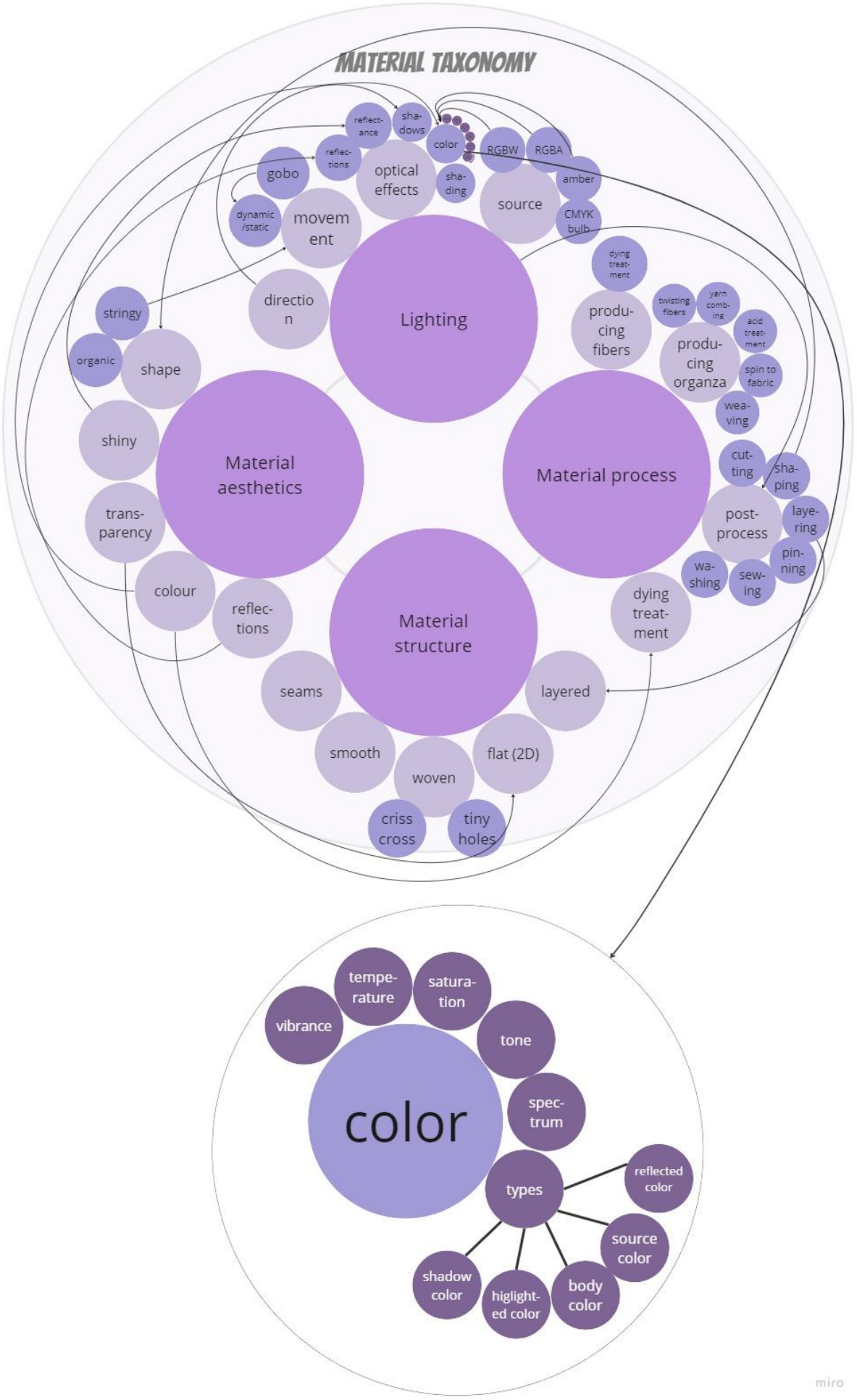


Figure 20: Material Taxonomy of Organza light sculpture

Moreover, whenever a coloured light illuminates organza, the highlight colours are also influenced by the colour of the lighting. Figure 21 shows organza fabrics with different weave patterns, illuminated with red, green and blue (CMYK bulb). The double reflection lines are the same colours. The left one has sharper lines with more intense coloured highlights, while the right one shows soft glittery lines with no sharp edges.

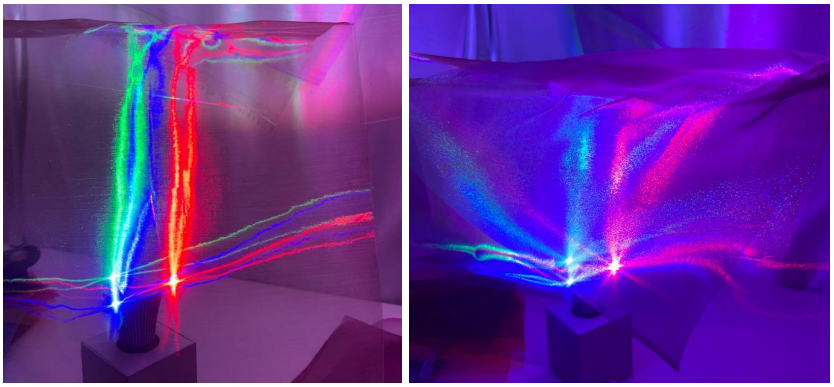


Figure 21: Highlight colours on mirror organza (left) and crystal organza (right)

Apart from the visual effects that were analysed, some associations with natural phenomena emerged (see figure 22). The Northern lights, lightning, iridescent feathers or scales from different organisms, coral on the seabed, shadows in the forest, rippling water, etc. are all related to nature, which is the start of an upcoming vision for this project.

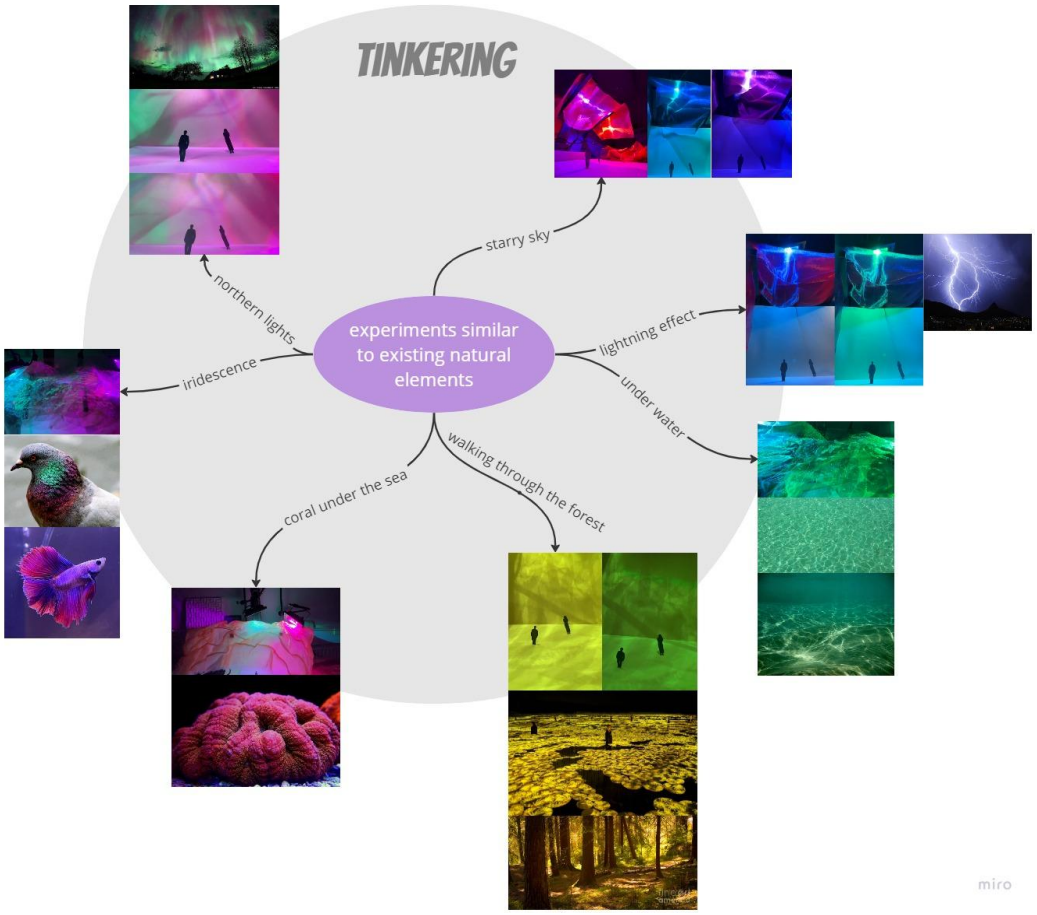


Figure 22: Association with nature

During a later session, an unexpected effect was created with an organza artwork consisting of leaf shapes. It was randomly hung and illuminated with a CMYK bulb. The shadows, colours and layers it creates were very close to awe according to myself and Noëlle. As mentioned, another organza construction is made by putting together leaf shaped pieces of organza with twisting stitches. It creates patterned shadows, because of the overlapping leaves and thick stitches. The last organza construction is a plain piece with some parallel layers. These constructions will be explored further in study 1 (see figure 23a and b).

Figure 23a: Organza constructions

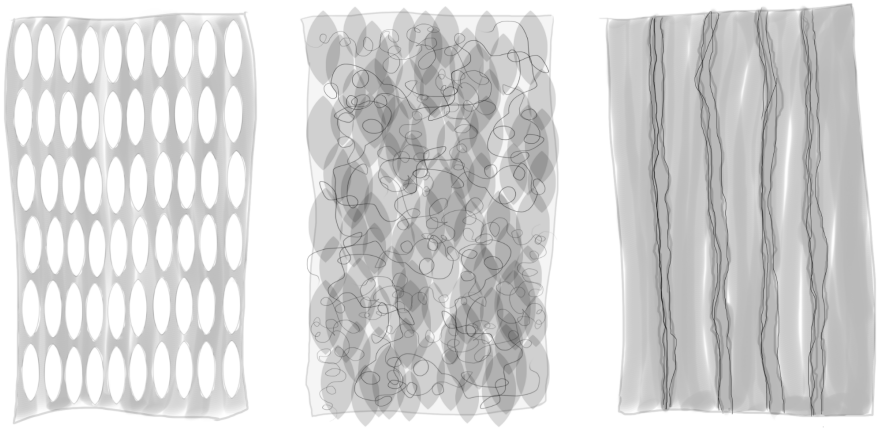


Figure 23b: Schematic sketch of organza constructions

The lighting colours for study 1 are chosen through the primary main colours red, blue and green, since the tinkering sessions were partly done with the previously mentioned CMYK bulb, which created beautiful subjective awe inducing effects. In order to choose the right lighting colour conditions, it is decided to have three lighting colour conditions to have an even amount of each variable: three organza constructions and three lighting colours. The lighting colours will vary from one colour, to two similar colours and two contrasting colours. The individual lighting colour is red because according to the study of Jonauskaite et al. (2020) on average, an equal number of positive and negative emotion concepts are associated with red, while blue and green are significantly biassed towards positive associations. In addition, the colour red is associated with a greater number of strong compared to weak emotion concepts. The similar lighting colour to red is yellow (a primary colour), which creates a perception of an orange colour. The contrasting lighting colour is blue (a primary colour) to create a perception of a purple colour.

3.1.2 User Testing

In this study, two experiential levels will be examined: the affective level and the interpretive level (visual only). The variables under consideration include organza samples and lighting colours, with the participants primarily consisting of students.

INTRODUCTION

Research aim

With this experiment the aim is to find out which sample-lighting combination will create an awe experience or an experience close to it. A sample-lighting combination contains a sample and lighting. The sample is a piece of *mirror* organza with glittery threads (see figure 24) that is constructed in a specific way, meaning the organza fabric is sewn in some parts to create a “construction”. The lighting in this case consists of two “RGB LED Floodlight 10W” armatures from the brand Dymond RFL-10 that are hanging down directed towards the sample. The sample-lighting combinations will differ in samples and lighting colours. Figure 25 shows a visual of the set-up and armature. This experiment will help narrow down the design process by choosing a direction according to the result, with which further experimentation will be done. The focus variables are the colour of the lighting and the construction of the organza sample, with a total of 3 organza samples and 3 lighting colours. This makes 3x3, a total of 9 conditions.

Figure 24: Mirror organza

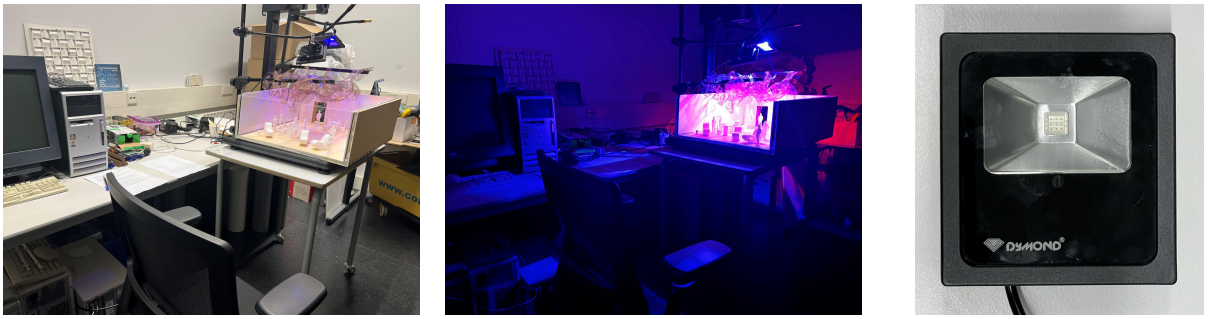


Figure 25: Set-up experiment (left: with room lighting, middle: without room lighting, right: armature)

Research questions

- What sample-lighting combination elicits what emotion?
- What association/meanings are elicited by this experience?
- Which sample-lighting combination is preferable to continue with in the design process? Why?
- What sample-lighting combination creates an awe experience?

METHOD

The experiment will be conducted with an adapted version of the ‘Experiential Characterization Toolkit’ (Camera & Karana, 2018). The performative level consists of a performative characterization, which according to the MDD tool, implies physical actions with the material, meaning tactile experiences, like holding, stroking, etc. However the project focuses on visual experiences. For this reason the performative level is not relevant and therefore excluded. The sensory level is excluded too, as the focus of the main goal of the research is investigating the affective level (i.e. awe and related emotions) and meanings (i.e. association with nature or other associations). Nevertheless, qualitative descriptions of sensory and performative components are taken into account in the study (e.g., the user verbalising any sensory components or observing performative components such as, mouth and eyes wide open, or goosebumps, etc.) through observations. So, there will be a look into the affective and interpretive level. Besides, the list of emotions in the user booklet map will be adjusted according to Sensorial Scales by Karana (2009) and positive emotions by Desmet (2012) in order for the booklet map to be relevant to the test.

Participants

The participants of this experiment will be students, since this will be the first user test. The simplicity of the test will make it easy to understand. Number of participants is 6.

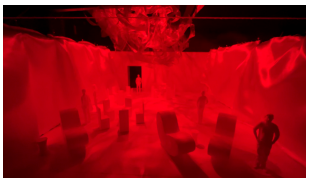
Stimuli & equipment

The experiment will be done with nine conditions (3 samples x 3 lighting colours). Each consists of a hanging one-coloured organza sample and two “RGB LED Floodlight 10W” armatures on top of a scale model that represents a room with tables, chairs and dummies. The walls of the model are pinned with white satin, imitating curtains. One wall is see-through, which enables looking through the wall of the model (see figure 26).

Figure 26: Participants view

The three organza samples are made from the same organza fabric (and thus colour), but with different constructions, see previous section “Tinkering”. Table 1 shows all conditions.

Table 1: Sample-lighting combinations

	Organza sample 1	Organza sample 2	Organza sample 3
Lighting colour 1 2x button “R”			
Lighting colour 2 button “R” + “orange button”			
Lighting colour 3 button “R” + “B”			

Procedure

The participant will fill in a consent form before starting the user test (see appendix E). After that one condition will be ready in a specific colour of lighting. There will be three rounds of lighting colour: one colour, two similar colours and two contrasting colours. The colours of the armatures are controlled by a remote that comes with the “RGB LED Floodlight 10W” armature. Figure 27a shows the remote that has been used for this experiment. The first lighting colour is created by clicking the button that says “R”. Both armatures were activated by this button. For the other two lighting colours, one armature remains on the “R” colour during the whole experiment, while only the other armature will change its colour.
The second lighting colour was created by changing one of the two armatures into another colour. This was done by clicking on the button above the button in the bottom left corner, which can be perceived as orange. So, now we have one armature on “R” and the other on the orange button (see figure 27b). The last lighting colour was created by again changing the colour of one of the two armatures. This was done by clicking on the “B” button. So, now we have one armature on “R” and the other on “B”. For each of these conditions, the booklet map will be filled in by the participant. All participants will have different orders of the sample-lighting combinations, so there is no built-up effect, which can influence the user's expectations.

Figure 27a: RGB LED Floodlight 10W remote

Figure 27b: Orange button

The first question is about filling in a matrix by choosing emotions that the user is feeling and putting them in the right place varying from pleasant to unpleasant (horizontal) and high or low intensity (vertical). The second question is about how much awe the user experiences by giving the participants a likert scale between 0 and 5. The word “awe” is not written in the booklet to not spoil it for the previous question. The last question is about associations/meanings that come up while looking at the conditions. For the first and last question, a list of emotions and a set of meanings is provided to the participant when needed. See figure 28 for both the adapted booklet, the list of emotions and the set of meanings.

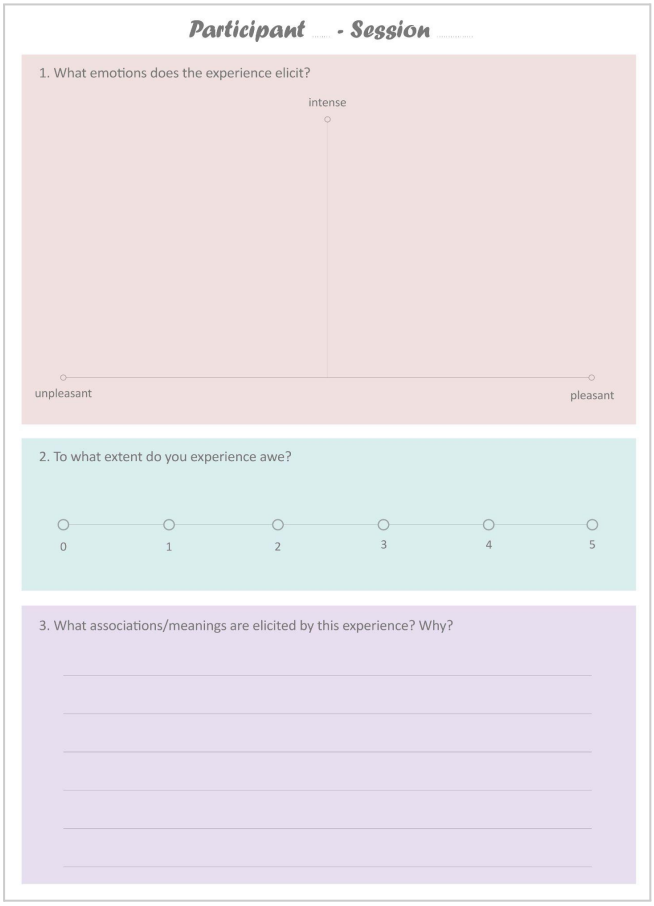


Figure 28a: Adapted booklet

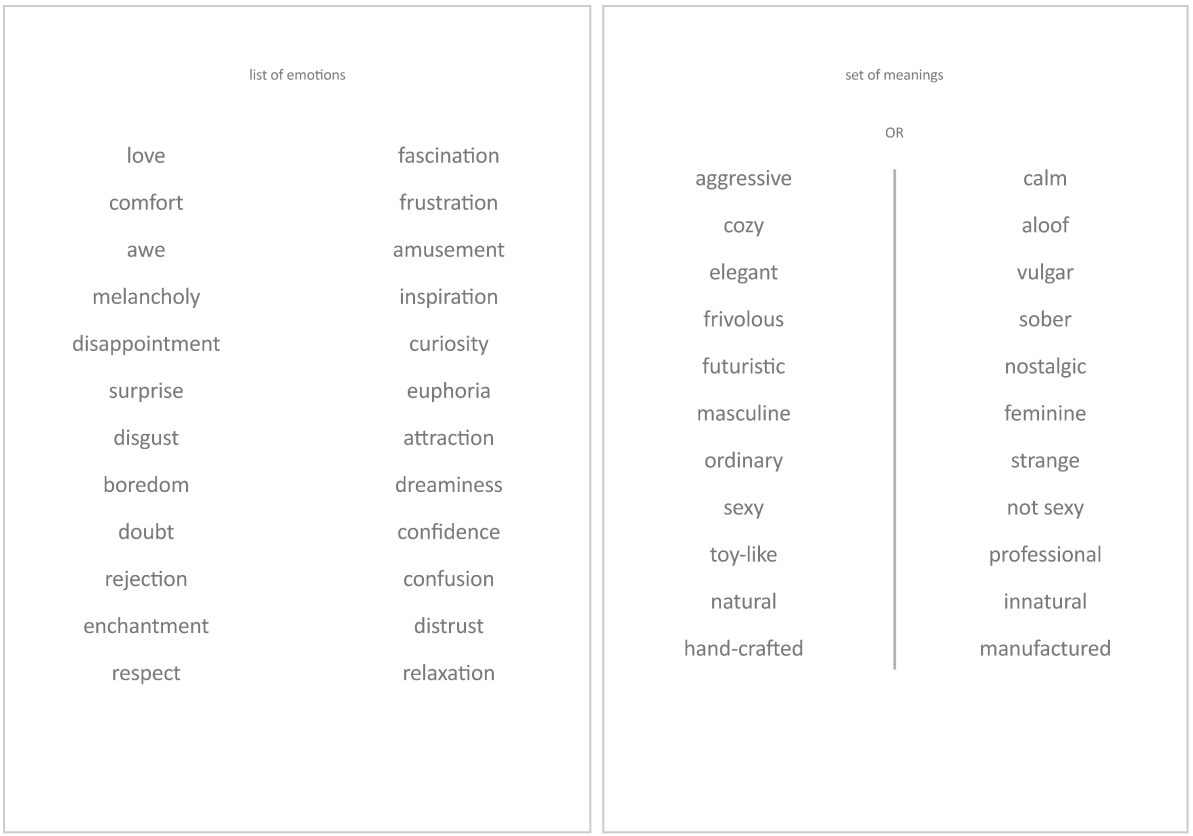


Figure 28b: List of emotions (left), set of meanings (right)

RESULTS

The results from the user tests divide in four categories, corresponding to each question and observations. The first category focuses on emotions. Fascination, dreaminess, enchantment and wonder are the closest to the emotion awe as explained in chapter 2.1.1.

Emotions

The first three graphs below (figure 29) show the emotions that are chosen together with the corresponding coordinates for lighting colour 1 of all participants together.

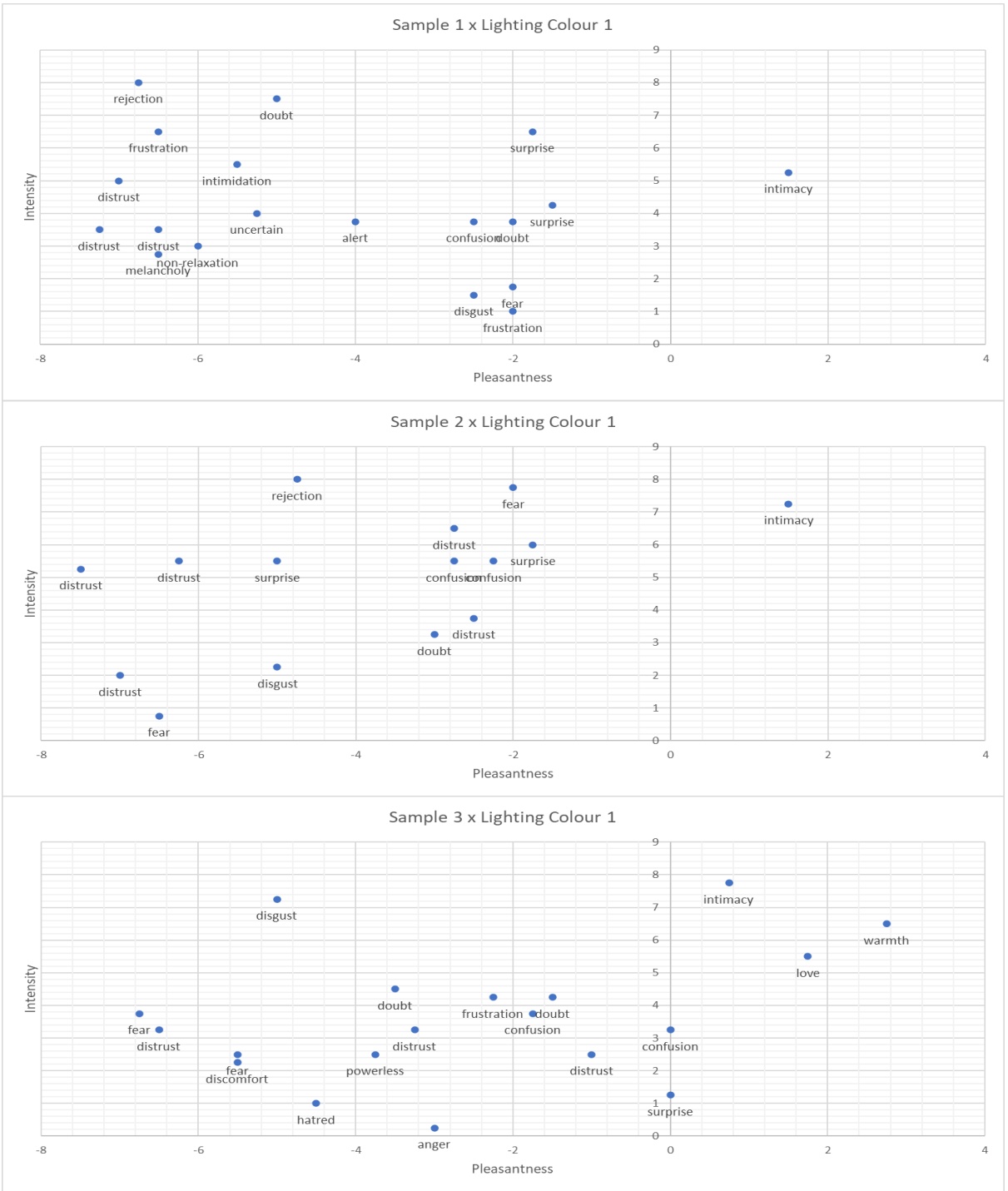


Figure 29: Plots of the ratings of pleasantness (horizontal axis) and eventfulness (vertical axis) with their associated emotions (words) lighting colour 1

Besides, the most frequently mentioned emotion is “distrust”, with an amount of eleven (see figure 30).

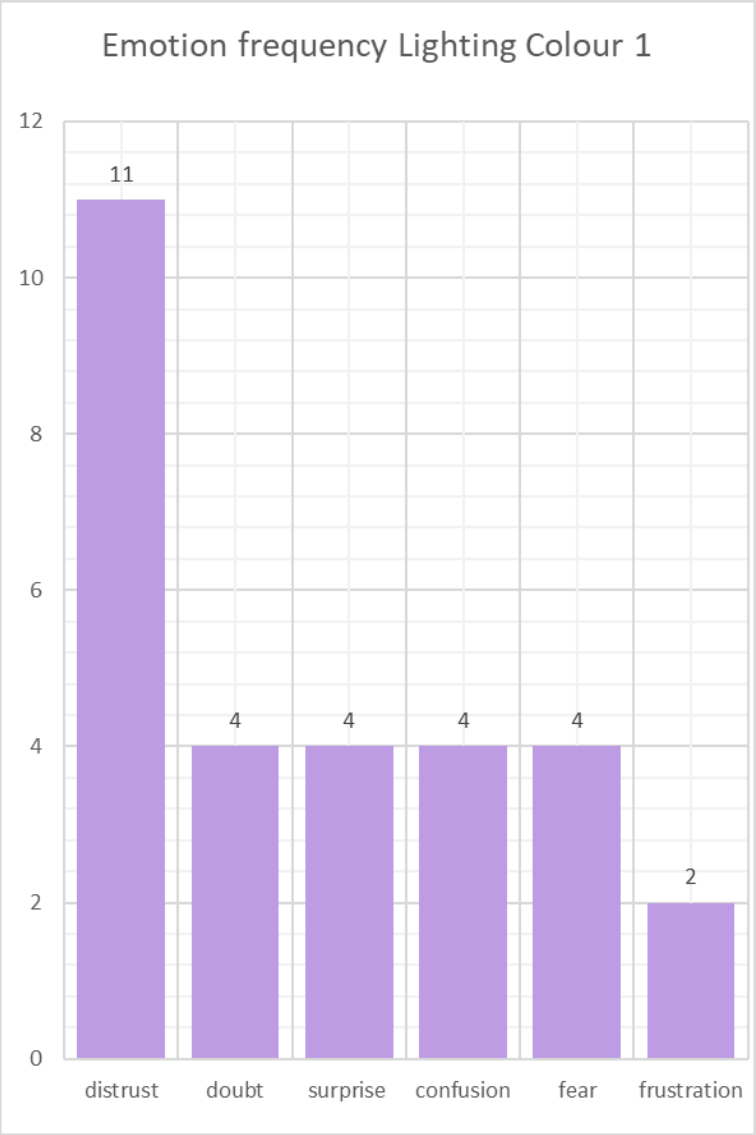


Figure 30: Amount of expressed emotions lighting colour 1

The next three graphs below (figure 31) show the emotions that are chosen together with the corresponding coordinates for lighting colour 2 of all participants together.

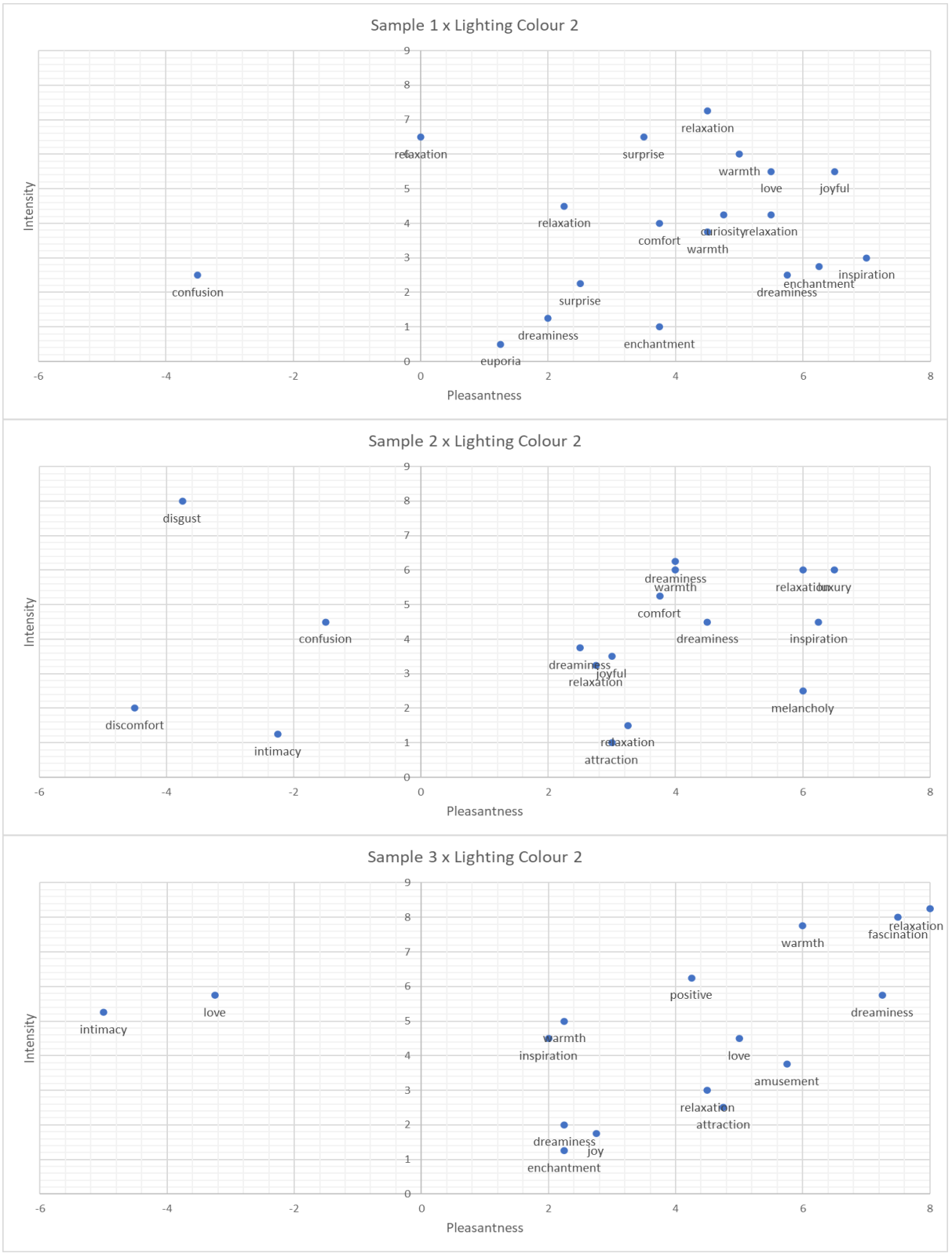


Figure 31: Plots of the ratings of pleasantness (horizontal axis) and eventfulness (vertical axis) with their associated emotions (words) lighting colour 2

The most frequently mentioned emotion for lighting colour 2 is “relaxation”, with an amount of nine (see figure 32). The desired emotions are dark purple.

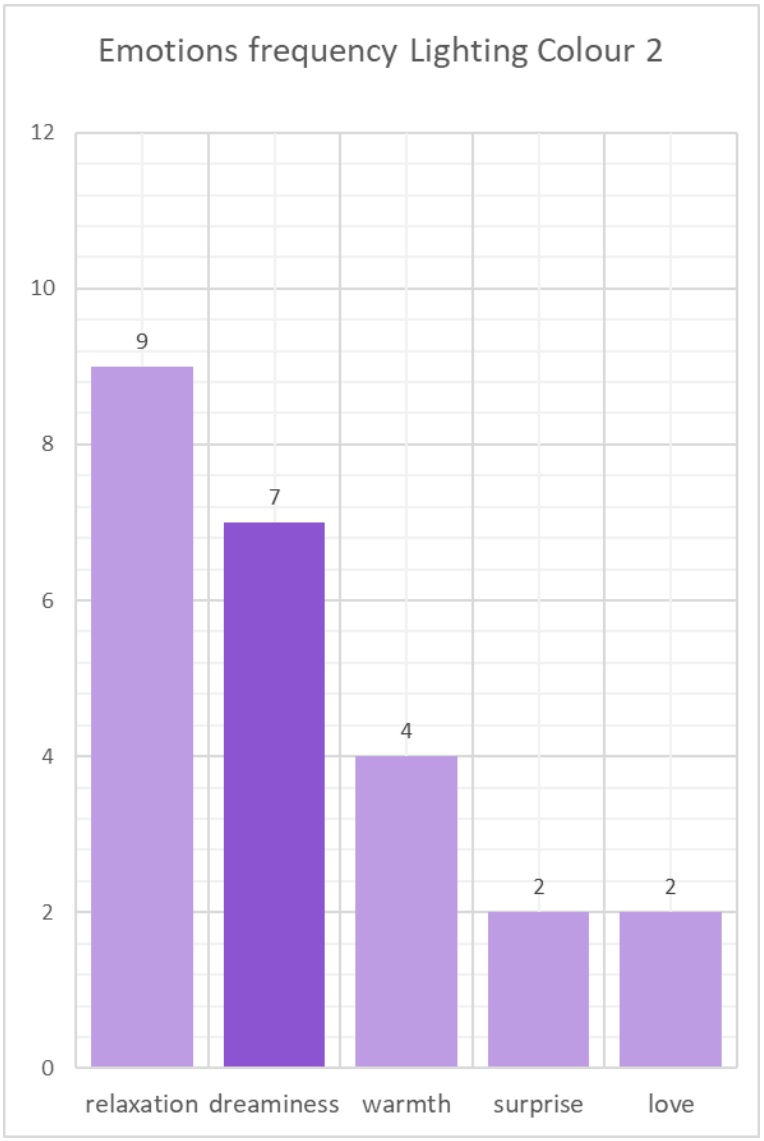


Figure 32: Amount of expressed emotions lighting colour 2

The last three graphs below (figure 33) show the emotions that are chosen together with the corresponding coordinates for lighting colour 3 of all participants together.

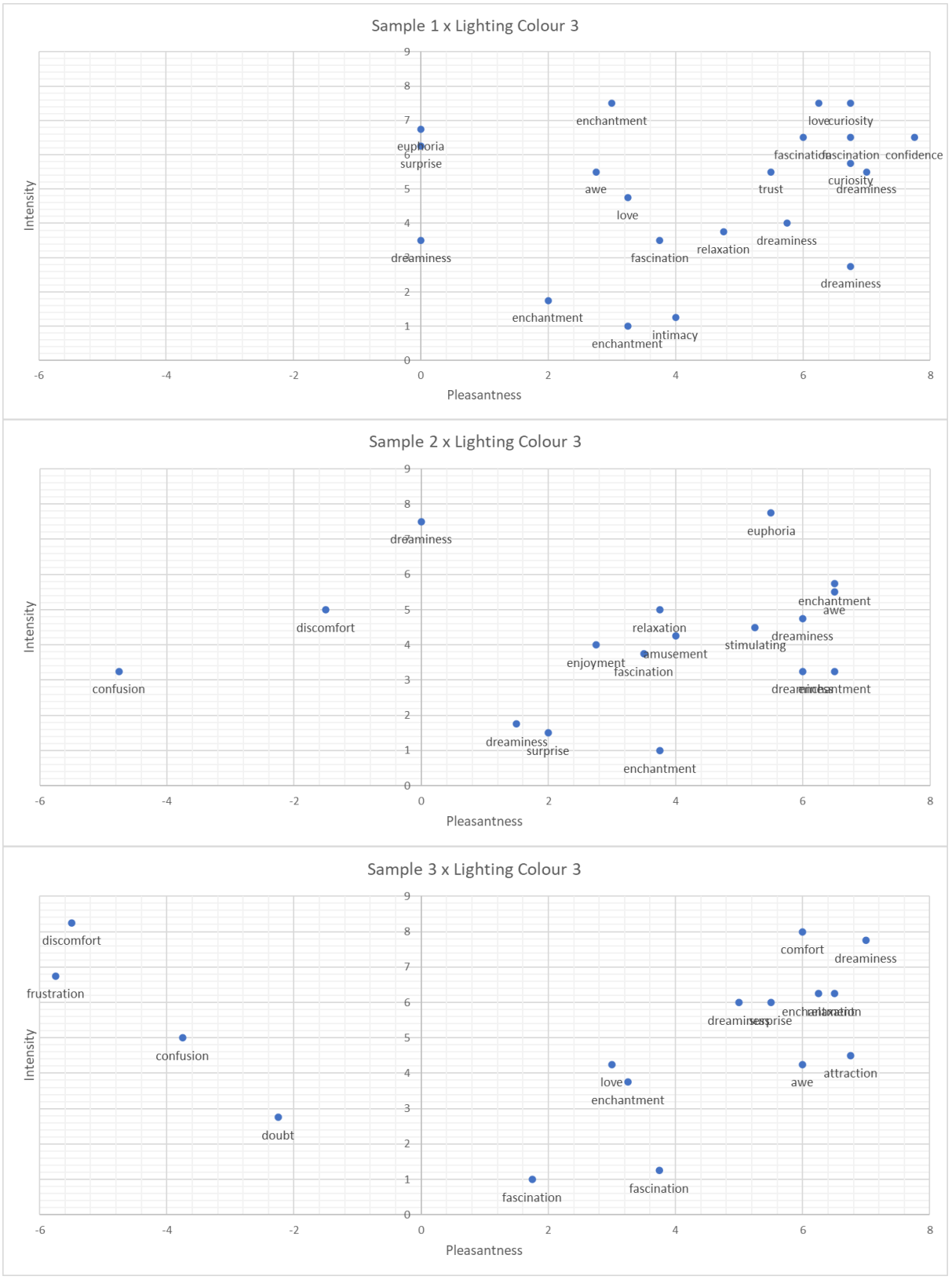


Figure 33: Plots of the ratings of pleasantness (horizontal axis) and eventfulness (vertical axis) with their associated emotions (words) lighting colour 3

The most frequently mentioned emotion for lighting colour 3 is “dreaminess”, with an amount of ten (see figure 34). The desired emotions are dark purple.

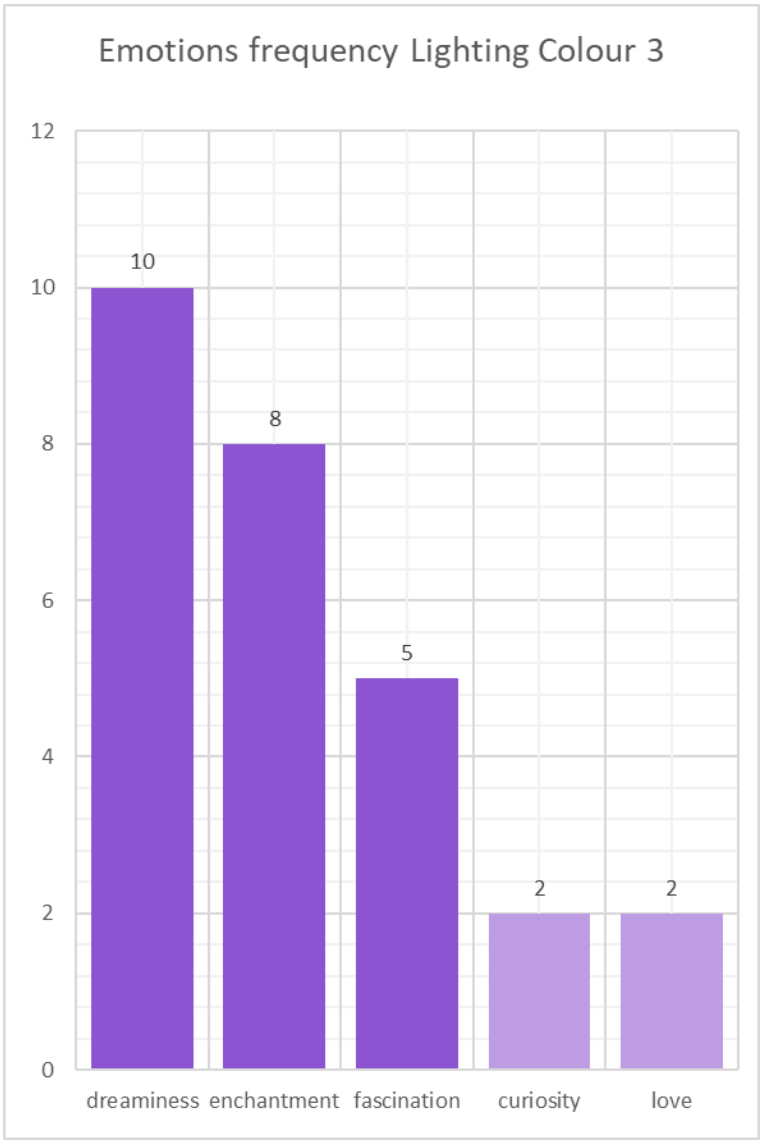


Figure 34: Amount of expressed emotions lighting colour 3

Awe experience

In this category all awe ratings for each condition and participant are put in table 2 (see appendix A). The first participant is a pilot test. With the ratings of all participants together, the means and standard deviations are calculated and put in a bar chart with error bars, see figure 35. There is a significant difference between condition S3L3 and condition S3L1.

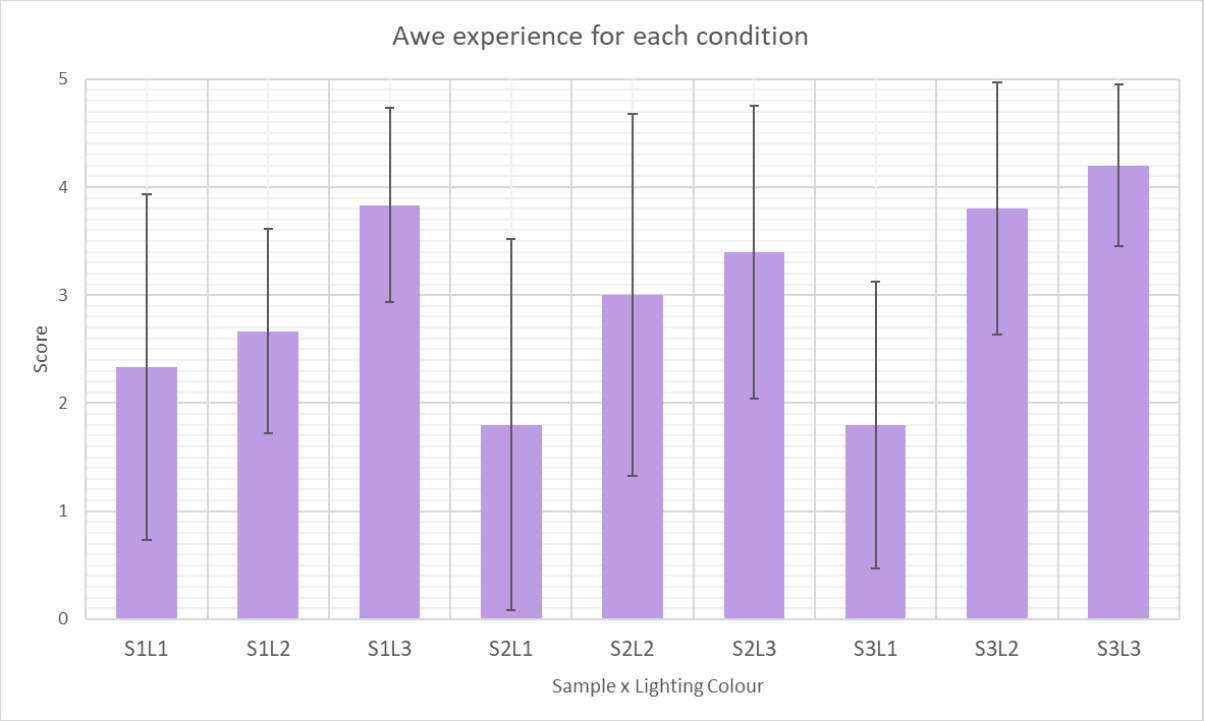


Figure 35: Means and standard deviations for awe ratings

Meanings/associations

The last category analyses what meanings and/or associations the participants think of. The meanings/associations of the participants are all joint and put into word clouds together in order to see the frequently used words, but also to find out if there is any logical connection with the earlier mentioned emotions per condition. The first three word clouds are from lighting colour 1 shown in figure 36.

Figure 36: Word clouds lighting colour 1

Most words are negative and are connected to “horror”/”thrillers”. Some of the other words do not really have meanings.

The next three word clouds in figure 37 are from lighting colour 2. The frequently mentioned meanings for lighting colour 2 are “warmth” and the “sun (-set, -shine, -rise)”. Next to that, there are some meanings related to “nature”, for example, forest, leaves, branches, etc.

Figure 37: Word clouds lighting colour 2

The last three word clouds in figure 38 are from lighting colour 3. The frequently mentioned meanings for lighting colour 3 are “party”, “disco”, “futuristic", but also “nostalgic”.

Figure 38: Word clouds lighting colour 3

Observations

One participant mentioned that he did not like the fact that the lighting colour hits the skin colour. It reminded him of jaundice. Another participant mentioned that it felt like time had stopped for a moment. This connects back to one of the facets of awe, “altered time perception, where time moves slower”. In terms of physical expressions, one of the participants gasped when viewing lighting colours blue and red. This relates back to the facet “physical sensations” according to Yaden et al. (2018).

CONCLUSION

Emotions

When looking at the coordinate system with the emotions, it is very clear that for lighting colour 1, almost all emotions are rated as unpleasant. Besides, also shown in the results section, the most frequent emotions are distrust (11) for lighting colour 1, relaxation (9) for lighting colour 2 and dreaminess (10) for lighting colour 3. Lighting colour 3 scores the closest terminology to awe. Lastly, the different samples had a small impact on the emotions compared to the lighting colours.

Awe experience

When looking at the graph of the average ratings, it can be seen that for each sample there is an increase in awe when going from lighting colour 1 to lighting colour 3. For each sample, lighting 3 has the highest awe ratings. Finally, there is a significant difference between sample 3 + lighting colour 1 (S3L1) and sample 3 + lighting colour 3 (S3L3).

Meanings/associations

Together with the frequent meanings for each lighting, it can be seen that there is a logical connection with the earlier mentioned emotions. For lighting colour 1, horror/thriller is mentioned, which is closely connected to a feeling of distrust. Lighting colour 2 is associated with warmth & the sun (-set, -shine, -rise), but also nature, which creates relaxation. Lighting colour 3, is associated with parties/discos and has futuristic and nostalgic associations as well. These are connected with the feeling of dreaminess.

All in all, to answer which sample-lighting combination is preferable to continue with in the design process and why, it can be concluded that the combination of sample 3 and lighting colour 3 (S3L3) is the most preferred condition to continue with since it rated with the highest average for an awe experience. Condition S3L3 is also the only condition that has a significant difference from sample 3 and lighting colour 1 (S3L1). Moreover, lighting colour 3 comes closest to the awe terminology; dreaminess, enchantment & fascination (Desmet, 2012).

RECOMMENDATIONS

The variables for the next test will be the dynamics, textures, movement speed and dimming of lighting. This way other aspects can be tested while also finding out what type of armatures are needed for the best awe experience.

The context for this art sculpture could be a working room/office area for students or employees to have a moment for themselves during a day of hard work or studying.

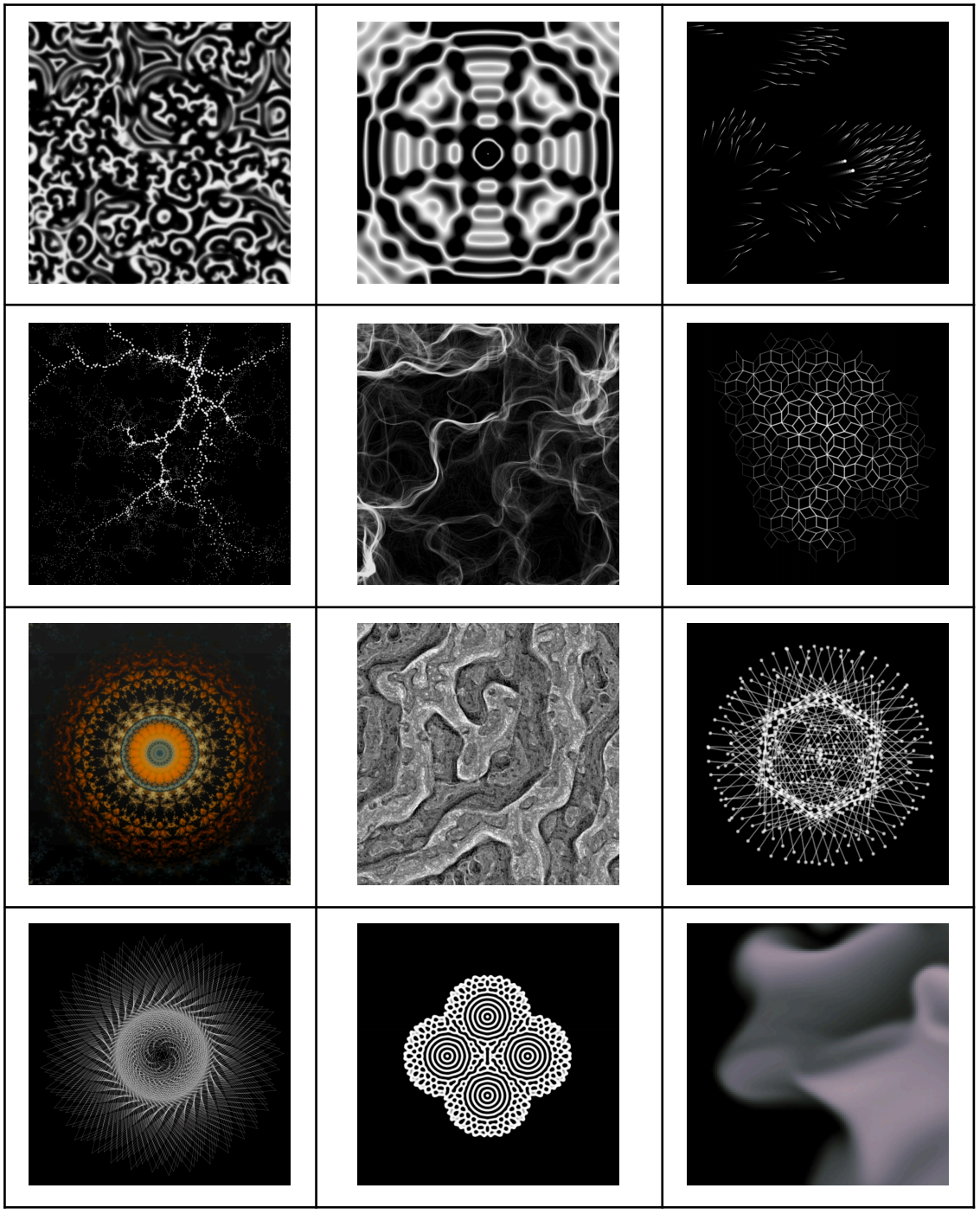
3.2 Study 2 | Dynamic Light-Organza Interactions

This study is the second study that will result in a scaled up light sculpture made from organza and LED lighting introducing light textures through projections.

3.2.1 Tinkering

Using the first experiment results as the basis, this tinkering process started with introducing different dynamic light textures that are provided by Louwers (2019), see table 3.

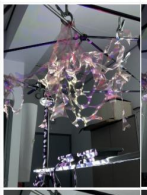
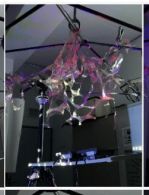
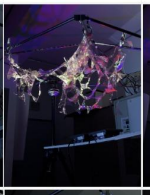
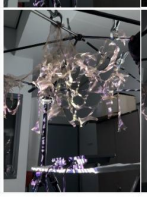
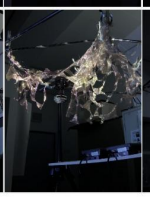
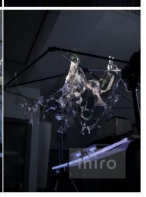
Tabel 3: Light textures (Louwers, 2019)



All light textures were projected one at a time on the organza sample from study 1 both with and without coloured lighting to choose suitable light textures (see table 4).

During the experimentation, it became clear that the available organza surface was too little, causing too much light to hit the surrounding walls. As a result, specific parts of the projector lens had to be partially covered to avoid illumination on walls and ceiling. Black and white projections worked better than coloured ones, which appeared harsh.

Table 4: Overview light textures on organza

	Light texture 1 Belousev2	**Light texture 2** Chladni1	**Light texture 3** Collectivemotion3	**Light texture 4** DLAbranching2	**Light texture 5** Flowfield1	**Light texture 6** Networks2	**Light texture 7** Phyllo2	**Light texture 8** Turbulence1
With Armatures Red & Blue								
Without Armatures Darkness								

Some light textures had drawbacks. Belousev2 and Collectivemotion3 were too dynamic and busy. Network2 and Phyllo2 were too geometric. Turbulence1, although interesting, only illuminated the organza from one side. DLAbranching2 evoked a twinkling starry sky, especially with red and blue hues. Flowfield1 revealed the organza in a constructive, mysterious way, gradually revealing hidden shapes and dimensions. Chladni1 added a pleasing rhythm with occasional dimming and patterning. The final selection for study 2 thus includes Chladni1, DLAbranching2 and Flowfield1.

Next to choosing the light textures, three aspects have to be looked at; the variables of the organza construction itself, the placement of the elements: armatures, projector and the organza artwork, and the way the organza artwork is going to be hung.

The resulting organza construction from study 1 tore a lot, creating large holes. Therefore, some elements are taken into consideration, such as the shape, the density and the placement of the holes (see figure 39). The tears are most likely caused by the sharp corners of the hole shape, which resulted in choosing circular shaped holes. As mentioned, there is a need for more surface/material from the organza to project on, which leads to a less dense hole pattern. The light textures and the way the organza is sculptured are random, so the hole pattern will be symmetrical to have balance.

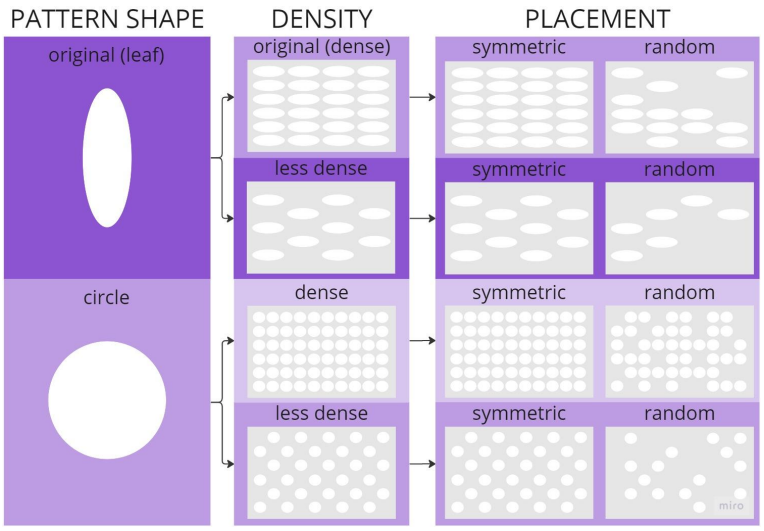


Figure 39: Variables of organza

In this study the projector and armatures will be directed upwards towards the organza artwork. This way the viewer looks up, which mostly is the case when looking in awe at something big. As mentioned in the observations from section 3.1.2, this placement avoids the lighting colour hitting the skin colour. Besides, the organza artwork will be acknowledged compared to study 1. The light sources should be above eyesight to not blind the eyes. Moreover, the organza artwork would be hung through fishing lines fixed to the holes of a wooden panel in the same colour as the ceiling to camouflage the panel through the effects created by the light sculpture (see figure 40a). However, making a prototype would be inconvenient due to the added weight (see figure 40b).

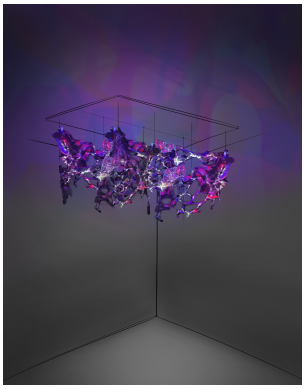


Figure 40a: construction concept

b: construction prototype

The improved construction method involves securing paper clips using sewing threads rather than reflective fishing lines. These paper clips hang between ceiling panels and are connected to the organza using small beads for height adjustment, with beige and grey threads selected for minimal visibility. Another experiment was a look at red and blue coloured organza instead of the coloured LEDs. However, this shows the individual pieces of fabric, not allowing a mix of colours, which is the case with the LEDs. The blue and red colour can be perceived separately, but also together, which creates a purple/pinkish colour. Therefore the original one coloured organza will be used in study 2.

3.2.2 Final Concept Design

The final concept is made of the same organza as study 1 as mentioned previously. In order to create the holes in the organza fabric, circular shapes varying from 5, 7 to 10 cm in diameter are printed out on paper and used as stencil. The fabric is folded thrice, whereafter the circular shapes are pinned. Using the paper circles as a guide, the fabric is cut by hand (see figure 41). Afterwards, it is hung with threads in different lengths with the help of small beads.

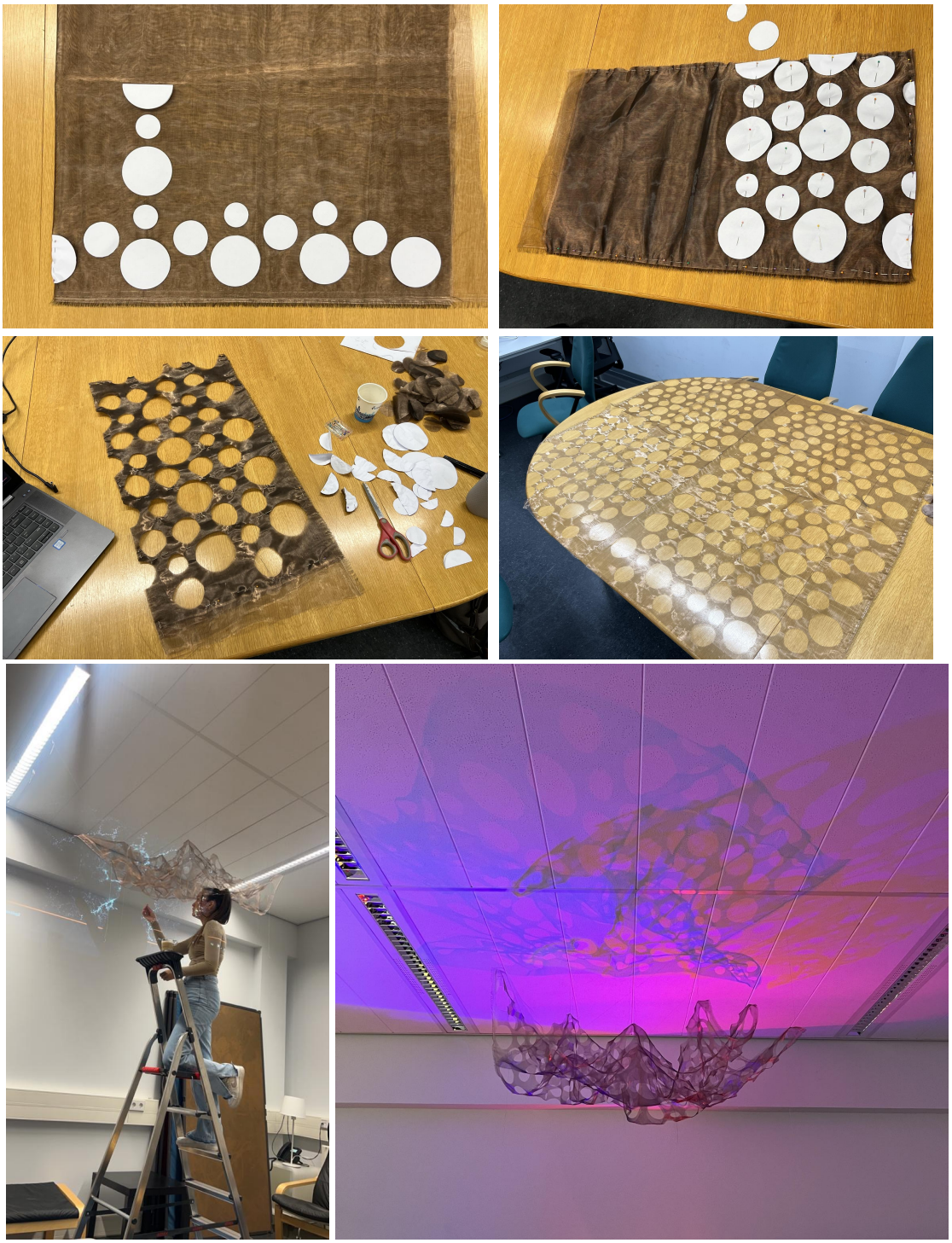


Figure 41: Making of prototype study 2

3.2.3 User testing

In this study, two experiential levels will be examined: the affective level and the interpretive level (visual only). The variables under investigation include projections, light intensity, and variations in room lighting conditions. The participant group will comprise a mix of students and Materials Experience Lab staff.

INTRODUCTION

Research aim

This second user test is a follow up experiment on the first user test. The aim of this second user test is to find out what other variables can enhance or elicit an awe experience. Together with the previous results, a second experiment was set up with an added variable. The added variable for this user test is “light texture”, which will be projected on the organza sample through the beamer model “Epson EB-FH52”. This experiment will be conducted at actual scale. This means that the organza sample is larger and the distance and angle of the armatures change compared to study 1. The basis of this test is the organza sample that resulted from the tinkering process described in the previous chapter along with the red and blue lighting colour.

The user test will experiment with three variables in total. The first variable will be 3 different light textures. The second variable will be 2 intensities of the red and blue lighting colours. The third variable will be 2 lighting conditions in the room of the test, so it is either fully dark in the room, or one of the armatures is on. In total, there are 3 x 2 x 2 = 12 conditions.

Research questions

- What condition elicits what emotion?
- What association/meanings are elicited by this experience?
- Which condition is preferable to continue with in the design process? Why?
- What condition creates an awe experience?

METHOD

The experiment will be conducted with the same adapted version of the ‘Experiential Characterization Toolkit’ (Camera & Karana, 2018). The performative and sensorial level will be excluded again, since that is not the focus of this project. So, there will be a look into the affective and interpretive level.

Participants

The participants of this experiment will be a mix of students and Materials Experience Lab staff at the TU Delft, since this will be the second and more detailed user test. It is helpful to have more experienced participants in order to get valuable results. Number of participants is 5.

Stimuli & equipment

The experiment will be done with twelve different conditions (3 light textures x 2 light intensities x 2 lighting conditions (room)). Each condition consists of a hanging one-coloured organza sample on the ceiling, two “RGB LED Floodlight 10W” armatures and a “Epson EB-FH52” beamer all directed upwards towards the organza sample. The room setting is like a lounge area/living room, where the participant takes place on the grey armchair (see figure 42 for the setup and figure 43 for the setup and a schematic sketch).

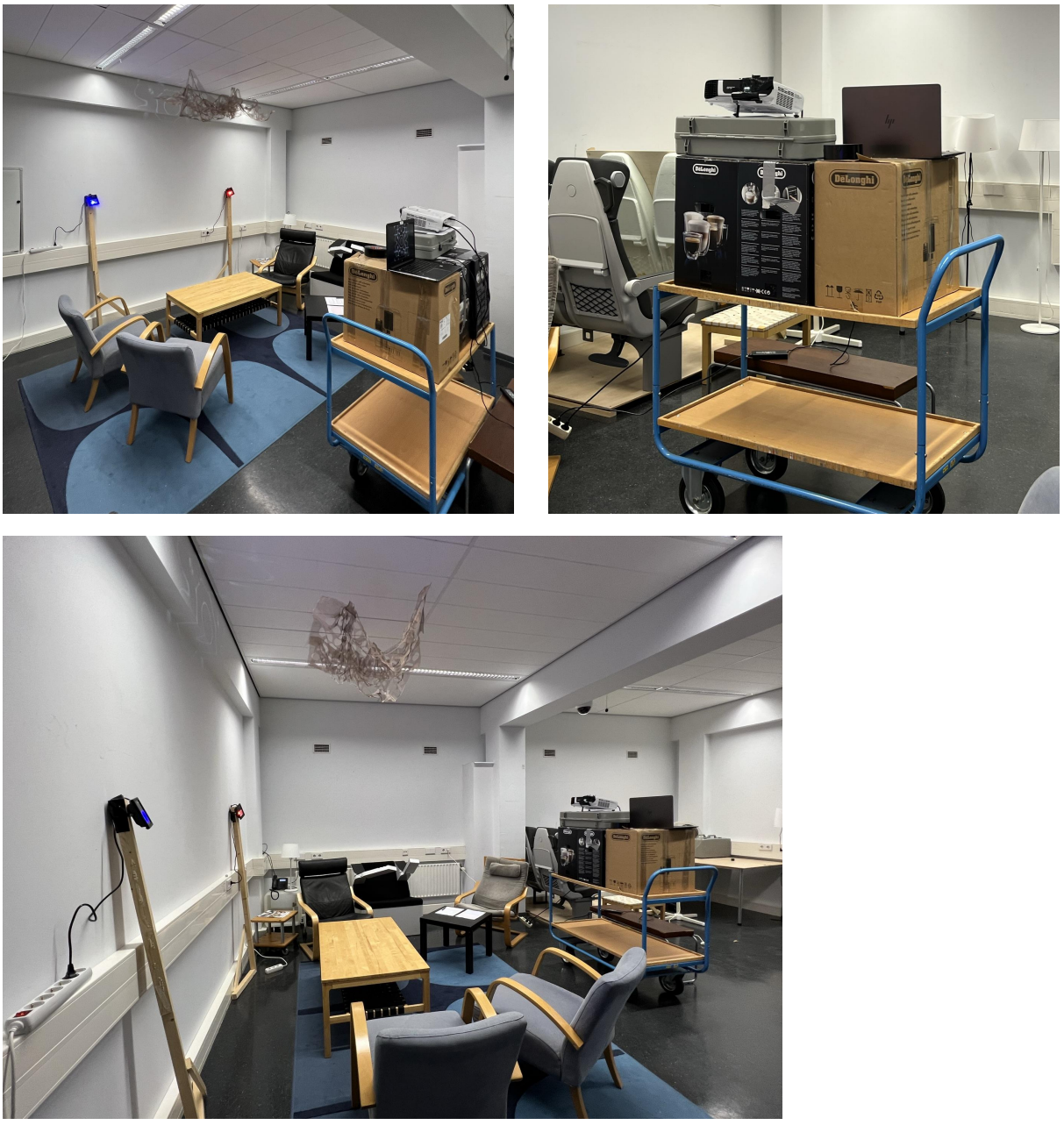


Figure 42: Setup study 2

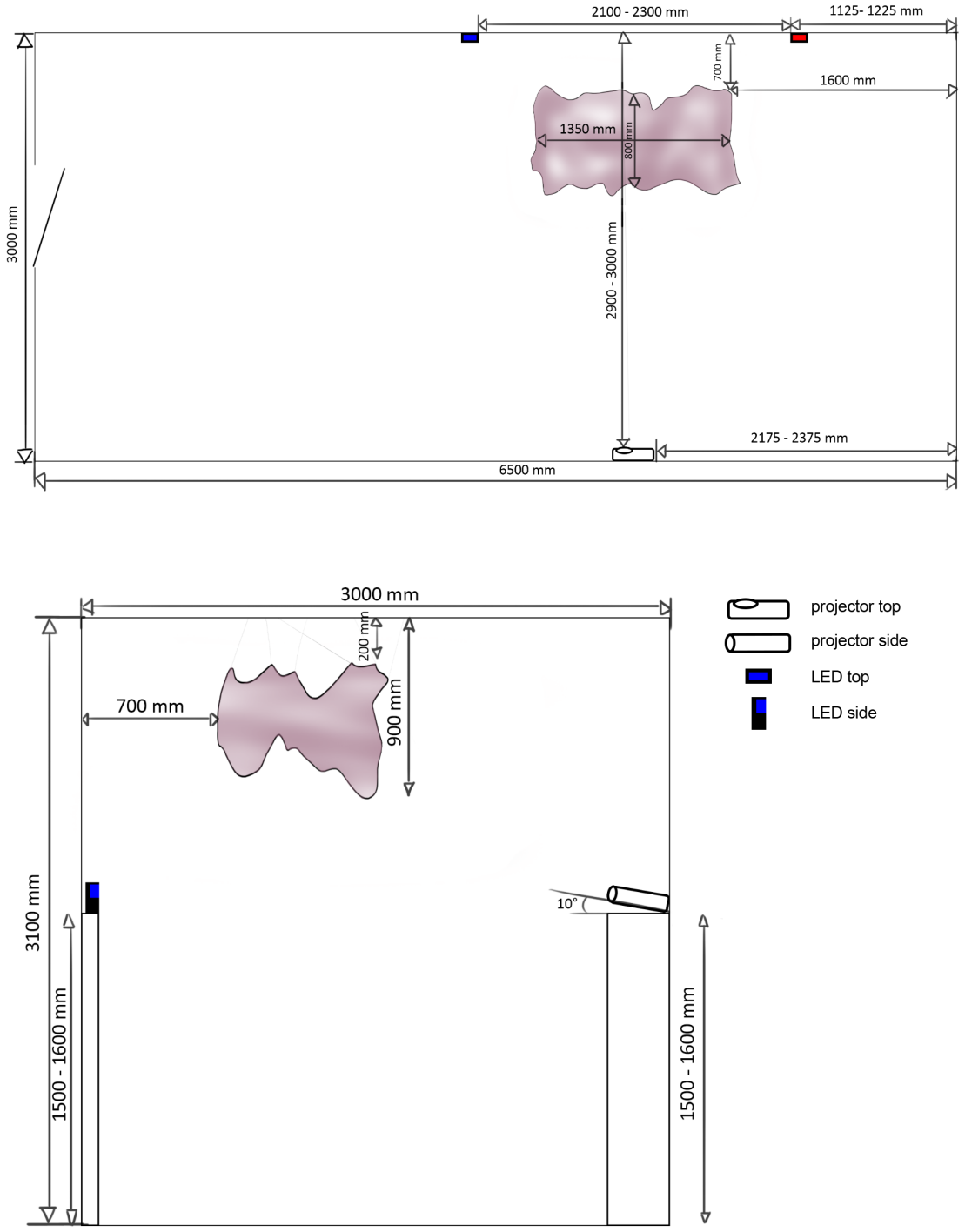


Figure 43: Schematic 2D sketch setup study 2 (top: top view, bottom: side view)

The light textures are all black and white videos, with different patterns, intensity and rhythm. The first light texture called “Chladni1” is a symmetric pattern that has a soothing rhythm and pulsing effect, because of the white lighting increasing and decreasing. It looks like the lighting from the pattern lights up and dims. The second light texture called “DLAbranching2” is a randomly shaped pattern, consisting of many small circles with different sizes. All the circles twinkle by also lighting up and dimming again. The pattern has an expanding effect by spreading in a larger space. The third light texture is called “Flowfield1”. It is a constructively growing light effect, which slowly reveals more of the organza sample. It is also a randomly shaped pattern, but organically shaped (see table 3). Figure 44 shows the 3 dark room conditions with high intensity of red and blue lighting for the user test.

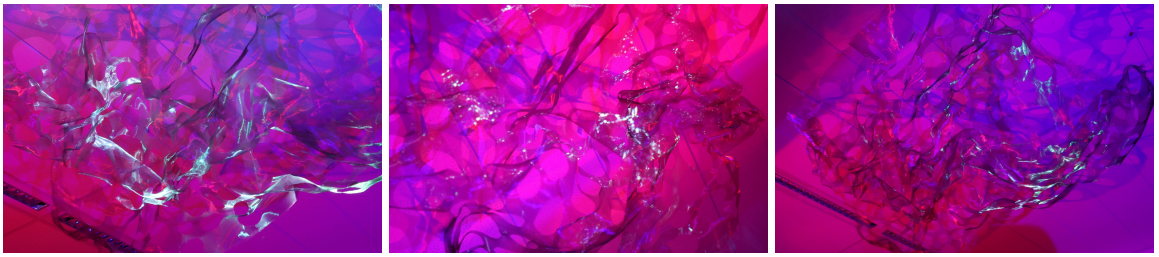


Figure 44: 3 conditions of user test (left to right: Chaldni1, DLAbranching2, Flowfield1)

Procedure

The experiment is taking place in a part of the Multisense lab, which is a rectangular shaped area (around 6.5x3 m) with no daylight. The participant comes inside and takes place in the grey armchair. First an introductory explanation takes place about the project, the expectations and the tasks. The participant will fill in a consent form before starting the user test (see appendix E). After that, the first condition is set up, while the participant has closed his/her eyes. For each of the conditions, the participant fills out the same adapted booklet as in the first experiment (see figure 28a in chapter 3.1.2). For the first question, they choose emotions, which are then rated according to pleasantness (horizontal axis) and eventfulness (vertical axis). The second question is another rating of the awe experience through a likert scale from 0 to 5. The last question is about associations/meanings that come up while looking at the sample-lighting combinations. For the first and last question, a list of emotions and a set of meanings is provided to the participant when needed (see figure 28b in chapter 3.1.2).

The conditions are changed through the projector, light intensity and light conditions in the room. In the first six conditions, one of the three armatures of the room is on and in the last six conditions all of the armatures of the room are off. The light intensity of the red and blue lighting from the two armatures are varied by level 3 (low) and level 7 (high), which means clicking the intensity button three or seven times (see figure 45). Lastly, for each of the projections, a “filter” (duct tape covering the projector lens partially) is used to avoid projections on the wall and ceiling. Since projection 1, Chladni1, is a square shaped projection, the filter is different compared to projection 2, DLAbranching2 and projection 3, Flowfield1. Chladni1 needs a very thin rectangular filter, while DLAbranching2 and Flowfield1 work with a square shaped filter in the same width as in figure 46 below.

Figure 45: Intensity buttons of remote

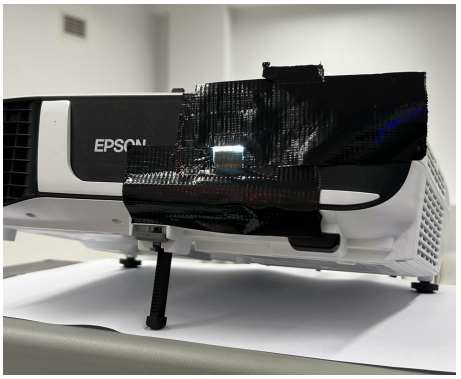


Figure 46: Filter on projector lens light texture Chladni1

This experiment contains two versions of the condition orders. Table 5 shows the order of the conditions each participant will experience.

Table 5: Two versions of condition orders

Condition	Version 1 (participant 1, 3 & 5)	Version 2 (participant 2 & 4)
1	Projection 1, intensity 3, light in room on	Projection 1, intensity 7, light in room on
2	Projection 2, intensity 3, light in room on	Projection 2, intensity 7, light in room on
3	Projection 3, intensity 3, light in room on	Projection 3, intensity 7, light in room on
4	Projection 1, intensity 7, light in room on	Projection 1, intensity 3, light in room on
5	Projection 2, intensity 7, light in room on	Projection 2, intensity 3, light in room on
6	Projection 3, intensity 7, light in room on	Projection 3, intensity 3, light in room on
7	Projection 1, intensity 7, light in room off	Projection 1, intensity 3, light in room off
8	Projection 2, intensity 7, light in room off	Projection 2, intensity 3, light in room off
9	Projection 3, intensity 7, light in room off	Projection 3, intensity 3, light in room off
10	Projection 1, intensity 3, light in room off	Projection 1, intensity 7, light in room off
11	Projection 2, intensity 3, light in room off	Projection 2, intensity 7, light in room off
12	Projection 3, intensity 3, light in room off	Projection 3, intensity 7, light in room off

The last step after finalising the adapted booklet for each condition is a short interview with questions like: What if all projections would be combined into one storytelling experience, would you prefer the storytelling experience or the current one condition experience?; In order to enhance the awe experience, what do you think of the current size of the light sculpture?; What are other suggestions that would help enhance the awe experience?; Where do you see this light sculpture hanging?; In what context does this light sculpture fit?

RESULTS

The results from the user tests are divided in five categories. Three are corresponding to each question of the booklet and the last two being the interview and observations. The first category focuses on emotions (also see figure 78 in appendix B for the emotions data). All conditions in the results are in the order of **version 1** (table 5). Fascination, dreaminess, enchantment and wonder are the closest to the emotion awe as explained in chapter 2.1.1.

Emotions

The graphs below (figure 47) show the chosen emotions of all participants together with the coordinates. The scatter charts show conditions 1-6 (light in room on) having more unpleasant ratings (9) compared to conditions 7-12 (4) (light in room off). The desired emotions are marked with colours for each condition.

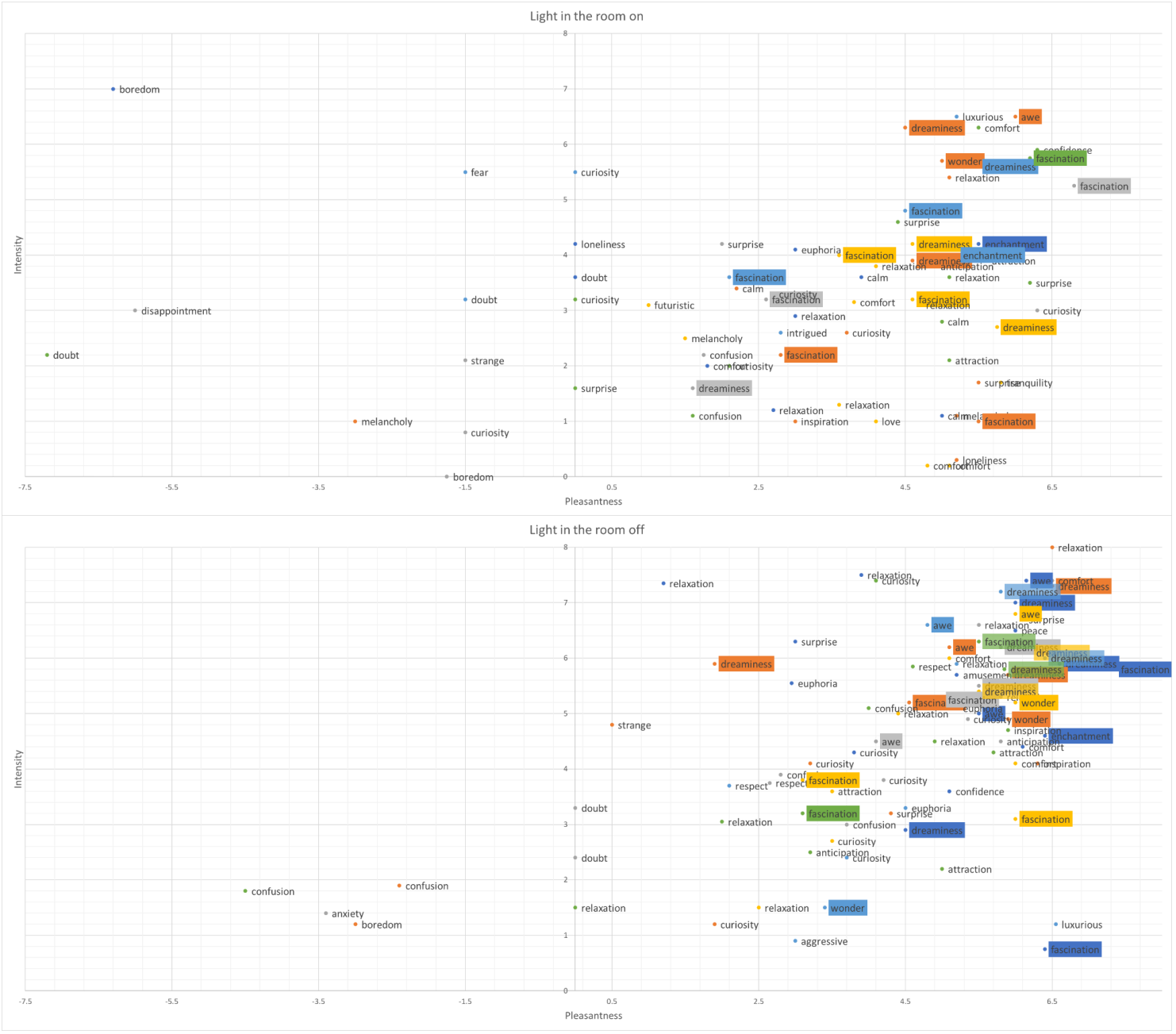


Figure 47: Scatter chart of all results (lights on vs lights off in the room)

Next, there is no clear difference between the intensity of the red and blue lighting colour in the scatter charts. Comparing the projections shows that projection 1 has the least unpleasant ratings (1) and projection 2 has more unpleasant ratings (5). Finally, projection 3 has the most unpleasant ratings (7) (see figure 48). The previously mentioned desired emotions are again marked with colours for each condition.

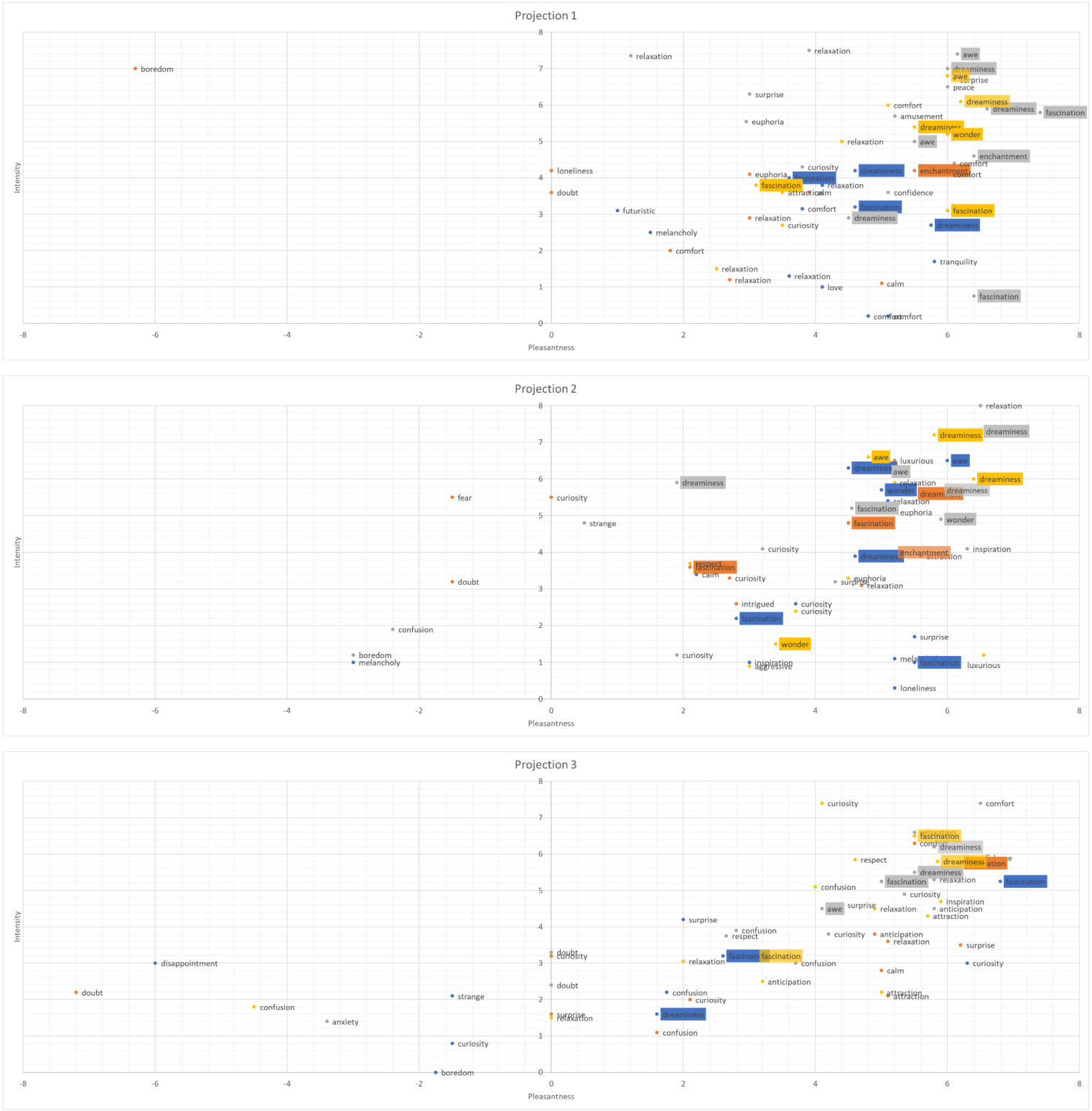


Figure 48: Scatter charts of all results (projection 1 vs 2 vs 3)

Besides, the most frequently mentioned emotions for each variable (projection, light intensity & room light condition) are also plotted in bar charts (see figure 49a, b & c). The bar charts show that for projection 1, relaxation (8), dreaminess (7) and fascination (6) are the most frequent emotions. It mentions awe twice as well. For projection 2 it is dreaminess (7), fascination (4) and curiosity (4) and for projection 3 it is curiosity (6) relaxation (5) and fascination (4). All three projections elicit the emotion fascination and two of the projections elicit dreaminess. The emotion fascination is slightly more frequent in projection 1 and the emotion dreaminess is equal in projection 1 and 2. The desired emotions are dark purple.

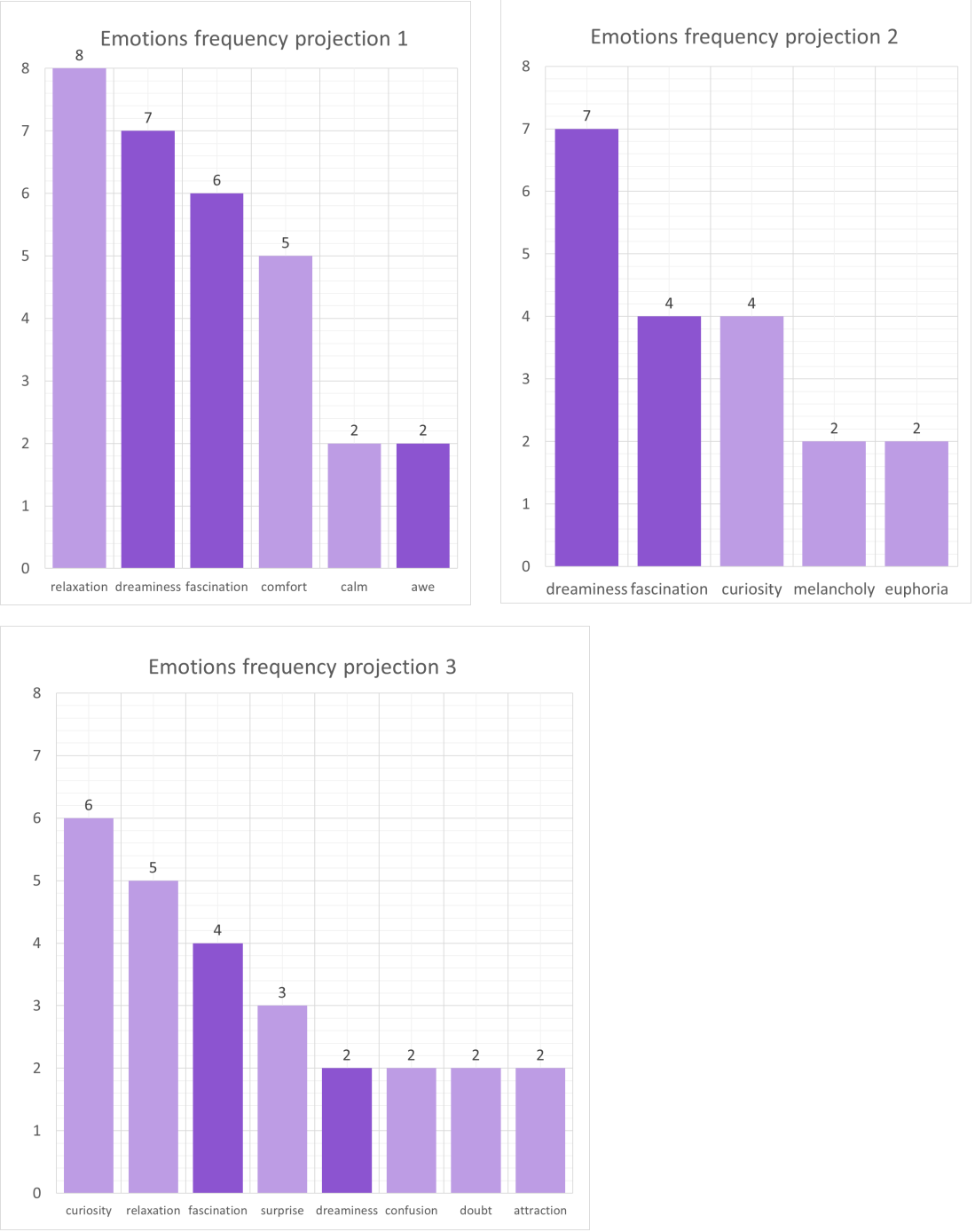
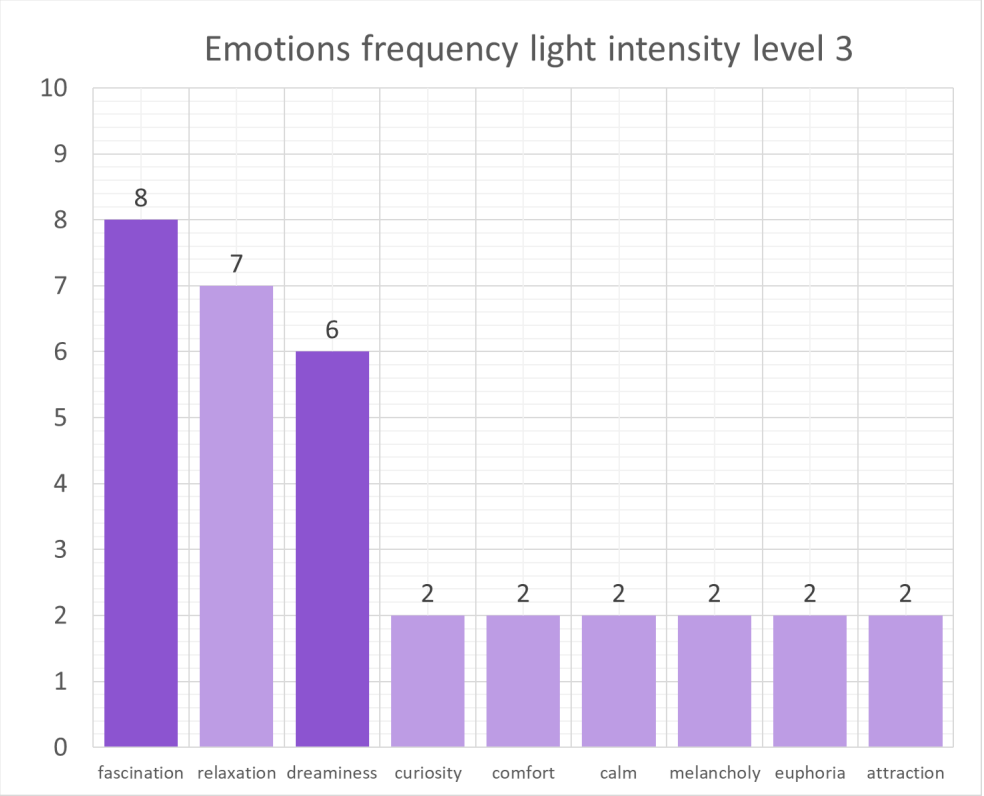


Figure 49a: Frequent emotions for each projection

Furthermore, light intensity level 3 has fascination (8), relaxation (7) and dreaminess (6) as the most frequent emotions and light intensity level 7 has dreaminess (10), curiosity (8), fascination (6) and relaxation (6) as the most frequent emotions.



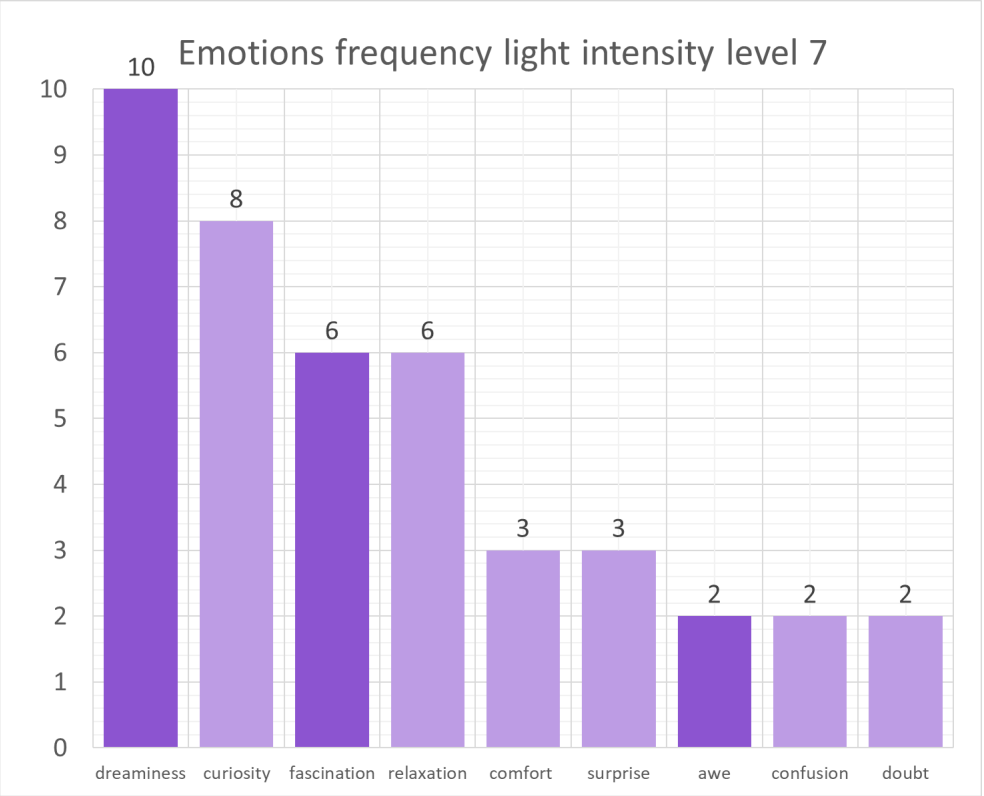


Figure 49b: Frequent emotions for each light intensity

Lastly, the conditions with the lights on in the room have fascination (8), curiosity (6), relaxation (4) and dreaminess (4) as most frequent emotions. The conditions with the lights off in the room have dreaminess (12), relaxation (9), fascination (6) and curiosity (4) as most frequent emotions with again eliciting awe (2) as well.

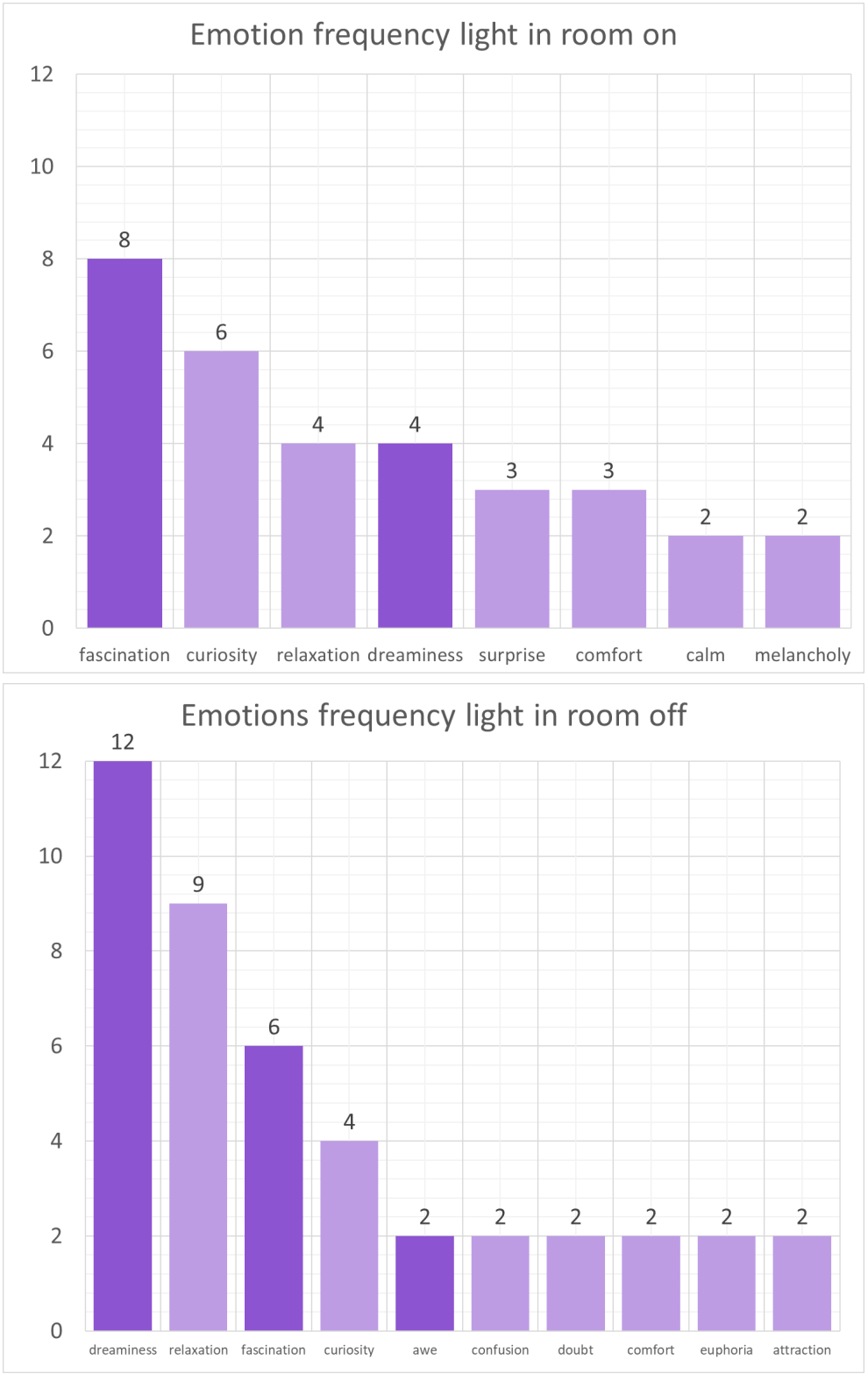


Figure 49c: Frequent emotions for each room light condition

Awe experience

In this category all awe ratings for each condition and participant are put in table 6 (see appendix C). With the ratings, the means and standard deviations are calculated and put in a bar chart with error bars, see figure 50. There is a significant difference between condition 7 and conditions 1, 3, 4, 5, 6 and 11, which makes it clear that the dark room conditions (7-12) are rated higher. There is also a significant difference between condition 10 and condition 1.

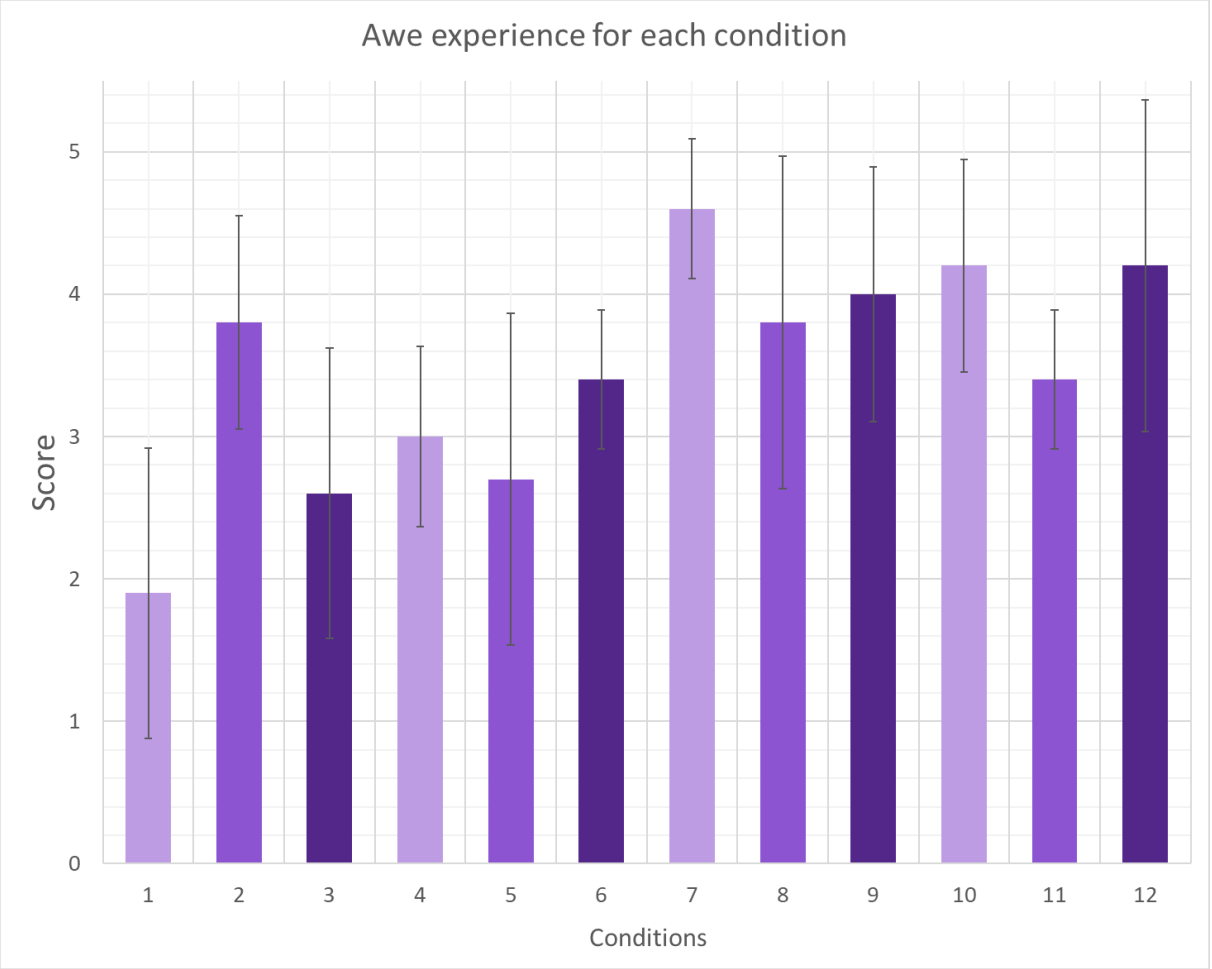
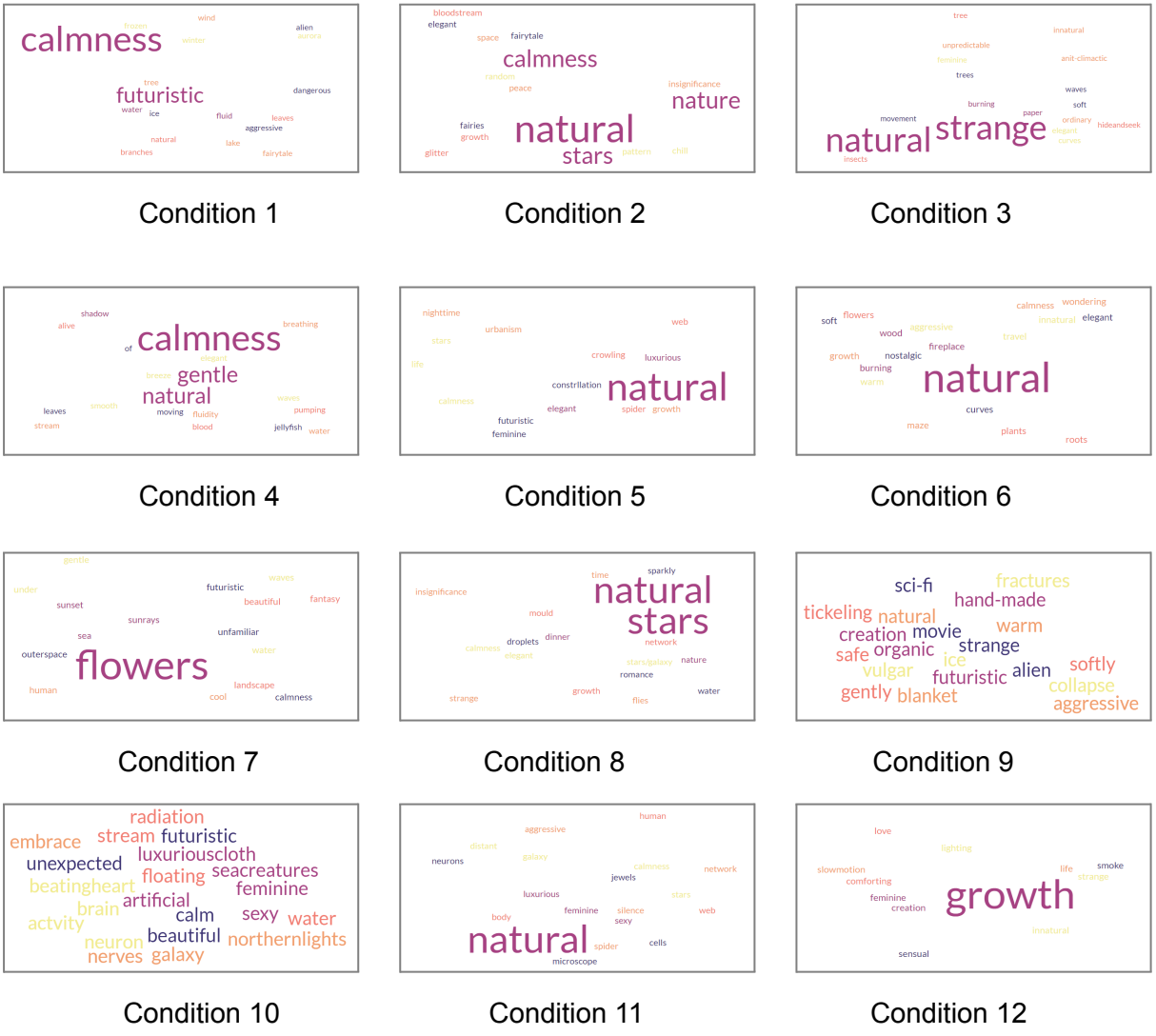


Figure 50: Means and standard deviations for awe ratings

- Conditions with projection 1 are light purple
- Conditions with projection 2 are purple
- Conditions with projection 3 are dark purple

Meanings/associations

The last category analyses what meanings and/or associations the participants think of. The meanings/associations of the participants are all joint and put into word clouds together in order to see the frequently used words, but also to find out if there is any logical connection with the earlier mentioned emotions per condition (see figure 51).



Condition 1 | Condition 2 | Condition 3

Condition 4 | Condition 5 | Condition 6

Condition 7 | Condition 8 | Condition 9

Condition 10 | Condition 11 | Condition 12

Figure 51: Word clouds all conditions

It is clear that “natural” is mentioned the most. Half of the word clouds have natural as the most mentioned word. Other word clouds also contain “natural” ones except for condition 7, 10 and 12. Apart from that, “calmness” is mentioned more than one time in condition 1, 2 and 4. Lastly, “stars” is mentioned more than ones in condition 2 and 8. Other words that are mentioned more than ones in one condition are “flowers” in condition 7 and “growth” in condition 12.

What condition do you prefer?
Participant 1: condition 8 (projection 2, intensity level 7, lights in room off)
Participant 2: condition 9 (projection 3, intensity level 7, lights in room off)
Participant 3: condition 8 (projection 2, intensity level 7, lights in room off)
Participant 4: condition 8 (projection 2, intensity level 7, lights in room off)
Participant 5: condition 9 (projection 3, intensity level 7, lights in room off)

What if all projections would be combined into one storytelling experience, would you prefer the storytelling experience or the current one condition experience?
Participant 1: Yes, I would prefer variation, otherwise it could get boring.
Participant 2: Yes, but it would even work when there is a loop, which is not perceivable.
Participant 3: Yes, but you can also have multiple light sculptures all having a different pattern
Participant 4: Yes, I think it can then be a longer experience, which stays interesting. One condition is already nice, but if it keeps starting and ending, you will be done with it quicker. The diversity works very well, when it will slowly change into another pattern, it will keep me entertained.
Participant 5: Yes, you would want it to change, so it stays interesting and continues to amaze me.

In order to enhance the awe experience, what do you think of the current size of the light sculpture?
Participant 2: I think scaling up the size to cover the whole ceiling would enhance the emotions in a stronger way when the object is very big.
Participant 4: I would like this light sculpture to be really big. Have some more sculptures. The shadows make it look a little bigger. I didn't really focus too much on the shadows, but it is nice to have in the background.
Participant 5: If it is bigger you would probably have a wow-factor, because it comes at you more. The shadows do make it appear larger. When first being in the dark, you could see the shadows very clearly, but continuing in the dark it faded away, because the shadows don't change.

What are other suggestions that would help enhance the awe experience?
Participant 2: Maybe add sound? It does not need to be the sounds of nature, because sometimes it looks a little artificial. So, natural sounds could work, like water moving, but even something that is electronically made, random repetitive music, like lo-fi that can make you feel like it can transport you to somewhere else, but also make you feel entertained. Reflecting the same thing with light, but then with music.
Participant 5: Maybe sound. I feel natural and organic elements, so it could be sounds from a forest or sounds like flowing water and/or rustling leaves.

Where do you see this light sculpture hanging?
Participant 4: Big hall, with just this light sculpture, cushions and people lying on the ground.
Participant 5: It could be a big, clean white space with the focus on only the light sculpture, or it could be a very organic space, which goes along with the light sculpture's form language.

In what context does this light sculpture fit?
Participant 4: I think meditation, unwinding, inspiring, makes you think of what you are seeing in the light sculpture, kind of like how you would lay down to look at the starry sky. I recalled things like a rippling lake, starry sky, beating heart, waves.
Participant 5: Meditation, festival or exhibition in a museum.

Remarks:

- The subtle movement of the organza due to the ventilation adds a nice dynamic feel.
- Subtle dynamic light intensity would be nice as well, which could create more harmony.
- More wind or vibrations to the organza

Observations

It was obvious when the lighting in the room was turned off, all the participants had a “wow” moment, just like in study 1 this relates back to one of the facets of awe “physical sensations” based on Yaden et al. (2018).

CONCLUSION

Emotions

The scatter charts show a preference in the conditions with the lights off in the room. Both level 3 and 7 intensity do not have a big impact on the coordinates of the emotions. Projection 1 has the least unpleasant ratings of the associated emotions.
The bar charts show that projection 1 is rated the highest in terms of desired emotions. Besides, it is the only projection that elicited the emotion of awe according to two participants. While level 3 intensity elicits fascination more frequently, level 7 elicits dreaminess more. Moreover, level 7 elicits the emotion of awe according to two participants. With the room lighting conditions “off”, the elicited emotions are more desired and again, it does elicit the emotion of awe, while lighting conditions “on” do not.
Condition 7 is the only condition eliciting the emotion of awe (2), scores highest on dreaminess (3) and scores on fascination (2) as well. Therefore, this condition is the best to go further with according to the emotion analyses.

Awe experience

Condition 7 is rated the highest on average (4.6 out of 5.0) for eliciting an awe experience. Condition 10 and 12 both are rated second highest on average (4.2 out of 5.0). Furthermore, the conditions with level 7 intensity are rated highest on average (4.13) and projection 3 is rated highest on average (3.55). The room light “off” conditions have an overall higher rating than the room light “on” conditions. Lastly, projection 3 has an increase in awe the more conditions are experienced.

Meanings/associations

The conditions with the light in the room “on”, but also all conditions with projection 2 are perceived “natural” the most. Half of the conditions with projection 1 mention “calmness”. Condition 8 has both “natural” and “stars” as meaning/association, which comes closest to the vision and metaphor.

Interview

Condition 8 is the most preferred condition according to three of the five participants. All participants would like a storytelling experience more. Scaling up the size is suggested in order to enhance the awe experience. Participants could see this light sculpture in a big hall and liked the subtle movement of the artwork due to the ventilation.

In conclusion, condition 7 is the most suitable option to continue with, but since the storytelling element will be added in study 3, the projections will no longer influence the choice. As a result, the only focus will be on continuing with a dark room and level 7 intensity of red and blue lighting (conditions 7-9).

RECOMMENDATIONS

Condition 7 could be scoring high, because it is the first condition where the light turns off, so people could be surprised at first glance and afterwards get used to the dark and the upcoming conditions too. Another variable that could be added according to the remarks is to have dynamic or dimming lighting (red & blue) or ventilators to have movement in the shadows of the organza artwork as well.
During this study it became clear that the context of the light sculpture would be an art hall/exhibition in a museum, due to participants liking the dark room conditions and suggesting a big hall as a suitable space. The previous context, a working room/office area for students or employees to have a moment for themselves during a day of hard work or studying, would not be suitable anymore, because of the need of a fully dark room.

3.2.4 Vision

The vision for this project is profoundly influenced by the awe-inspiring wonders of the natural world. This inspiration is deeply rooted in scientific research, as exemplified by studies like those conducted by Monroy & Keltner (2022), which underscore how awe often manifests in transcendent encounters, frequently found in the embrace of nature.

In study 1 and 2, using the “reflection template” from MDD (Camera & Karana, 2018), the exploration led to establishing associations between the light sculpture and the natural world. The organza artwork's organic shape evokes imagery of water, a connection drawn from its flowing form and dynamic illumination. The interplay of dynamic light textures conjures images of sea creatures and/or starry skies. Additionally, the circular hole structure of the organza itself serves as a reminder of rustling leaves in the wind.

These foundational connections with nature serve as the driving force behind the vision, next to nature being the main inspiration of product design for me as a designer. This project is about creating an experience that invites individuals to immerse themselves in the present moment, igniting within them a profound sense of awe and wonder, much like the natural world itself.

The *vision* states

My vision is to create a **captivating artwork** that seamlessly combines the **sheer** and **reflective** qualities of **organza** with the colourful and **dynamic** power of lighting, together creating textured layered shadows, all inspired by the beauty and wonders of **nature** to make people live in the moment by evoking an experience of **awe** and **wonder**.

With the corresponding *metaphor*

The light sculpture will feel similar to admiring the **fascinating** twinkling starry sky and catching the **dreamy** colours of the Northern lights while you’re laying on the ground being in the present moment *(see figure 52)*.

Figure 52: Viewing the Northern lights (Tarja, 2019)

3.3 Study 3 | Storytelling Light-Organza Interactions

This study is the third and last study that will result in the final product, “Nature’s Luminous Dreamscape”, a light sculpture made from organza, LED lighting and storytelling projections.

3.3.1 Improvements on the organza and lighting elements

Following the results of the previous study, a number of areas for improvement emerged. The first improvement that will be implemented is the size of the artwork. The size of the artwork from study 2 is 1350 x 800 mm. During the second study, more than half of the participants would have liked the artwork to be bigger, almost covering the whole ceiling. Therefore, in study 3, the size has increased to 3200 x 1100 mm with a new mirror organza piece, which is unfortunately not exactly the same as in study 1 and 2 (see figure 53). This is a mirror organza as well, but is lacking the glittery threads, which makes it less glittery. Apart from the change in size, the holes are cut differently as well. Instead of hand-cutting the circular holes, the circles are laser cut (see figure 54). The polymer fibres of the organza melt when lasercut, which provides a sealed edge of the circles that avoids the circles to tear when shaping and hanging the artwork on the ceiling. For this reason, paper has been added between each layer to avoid unwanted melting between the layers. The edges of the organza fabric are also cut to round the corners in order to create an overall organic shape compared to the rectangular shape from study 2.

Figure 53: Mirror organza study 3

Figure 54: Laser cutting the organza

Another improvement is having two projectors instead of one and changing their placement and angle. During study 2, the projection did not just illuminate the organza artwork, but also the wall, which is very distracting. For this reason, the two projectors are put on the floor and directed towards the ceiling, with a very large angle from the floor (see figure 55). This way the projection illuminates both the organza and the ceiling, creating a shadow of the organza artwork on the ceiling. The brightness setting of the projectors are lowered to 40 to decrease the sharp rectangular shape of the projection.

Figure 55: Projector angle

The shadow that is created by the projectors is a beautiful addition to the already existing two shadows created by the red and blue lighting. It creates a mixture of coloured shadows (see figure 56). Furthermore, the red and blue lighting armatures are upgraded to “LED Outdoor Light” with 20 W (see figure 57). These armatures are bigger than the armatures from study 1 and 2, and are additionally intense enough with the intensity setting on level one, meaning one tap on the brightness button.

Moreover, a shade is created with paper around the LEDs, to avoid blinding the eyes (see figure 58). The shades created more focus light on the light sculpture as well, which was an unconscious improvement. It set the focus on only the sculpture, which made it more prominent (figure 59).

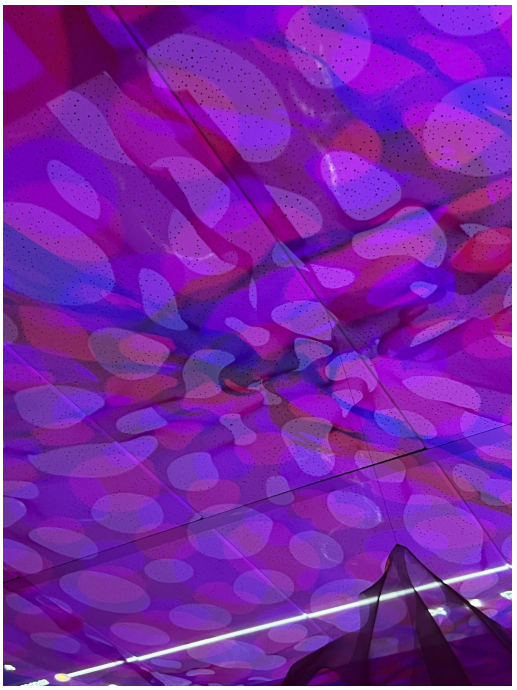


Figure 56: Coloured shadows

Figure 57: LED Outdoor Light & remote

Figure 58: Shades around LEDs

Figure 59: Ambient lighting (top) vs Focus lighting (bottom)

3.3.2 Storytelling extension

Next to the improvements, there is a change in the artwork as well, which is mentioned in the interview results from study 2. The participants all agreed that a storytelling experience through projections would be more entertaining, because of constant changes of the projected video. So how is the story of the video created?

To create a narrative for the video, the results were examined for the projections of study 2 (see figure 60). The first projection, Chladni1 is the most luminous and dynamic projection with a loop. Participants remained looking at it longer than the other two. The projection DLAbranching2 is the least dynamic, with several comments saying that it can become boring after a while. The third projection, Flowfield1, was often described as growing; with time, more and more of the organza is revealed through a growing illumination and when the illumination decreases towards the end, it is found to be disappointing, because people don't want the projections to stop. Through these observations, a three-act structure was chosen.

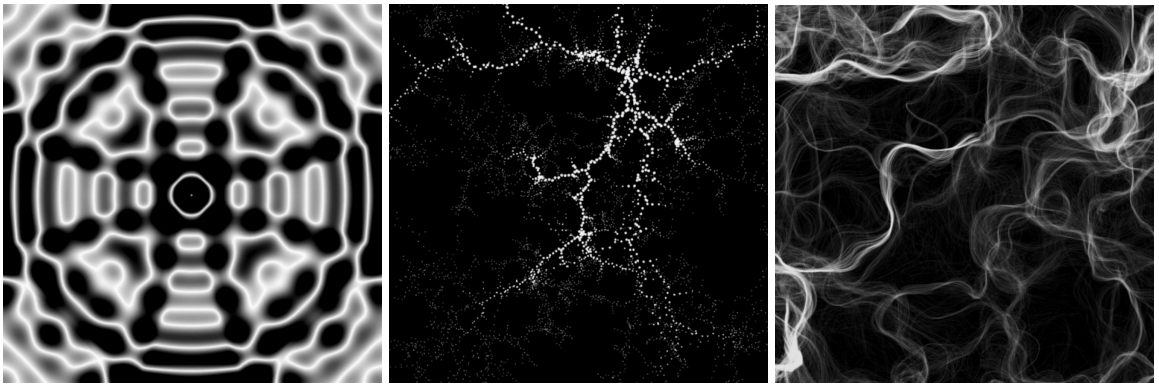


Figure 60: Projections from study 2 (from left to right: Chladni1, DLAbranching2 and Flowfield1)

3.3.3 Three-act-structure

The three-act-structure is a common writing tool for books and/or in the film industry to narrate a story. As the name says, it consists of three acts; the setup, the confrontation, and the resolution (beginning, middle, end). Each act drives the story forward with its own overarching element (Chesson, 2022). Figure 61 below shows an overview of the three-act structure, a visual describing the three acts.

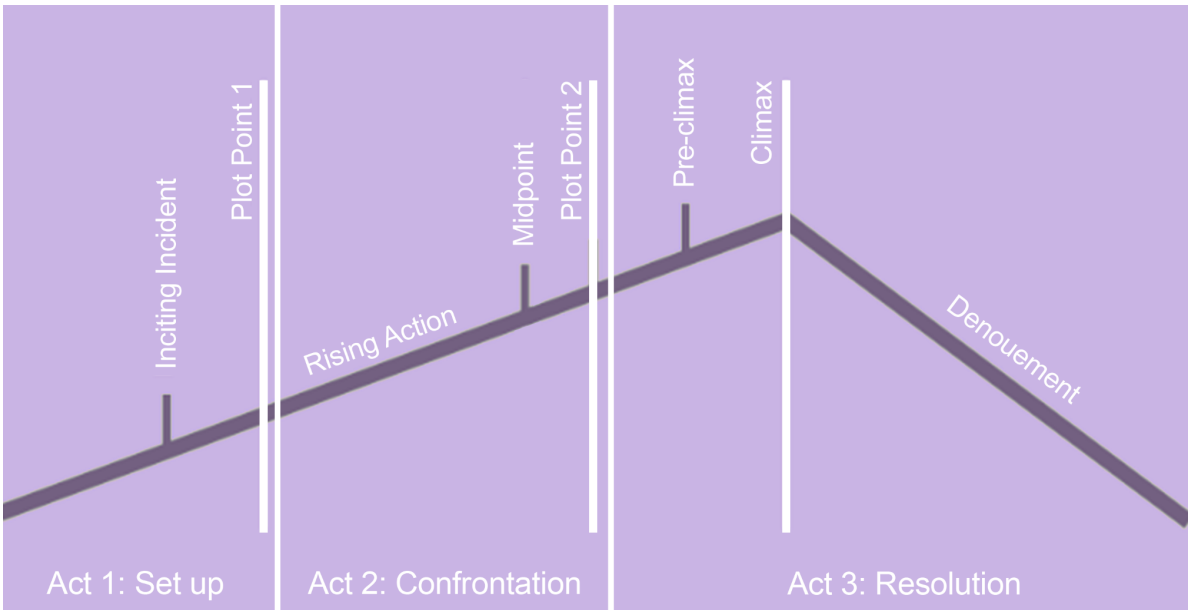


Figure 61: The three act structure based on Chesson (2022)

The story will have a clear start and end by illustrating darkness, which means that there are no projections, but only red and blue lighting. As mentioned previously, Flowfield1 has a growing factor in the first half, which is suitable in the beginning of the projections. The observer will get used to the slowly increasing illumination of the organza artwork and familiarise with how it is shaped (act one). Then there will be a gradual transition into DLAbranching2, which will be the first transition of the projections in the experience, creating more tension (act two). Afterwards, the climax will be Chladni1 with its dynamic and rhythmic illumination. So, there is both a build-up in the dynamic element and the illumination. After the climax, there will be a transition into darkness again to end the story (act three). This sequence also creates a loop, since it ends and starts with no projections, which on the other hand creates a clear beginning and ending. Figure 62 below shows the division of the projections per act. Eventually, this way of storytelling creates a never-ending experience, which gives the viewer the freedom to watch as long or short as they desire.

Figure 62: Implementation of the projections into the three act structure

Act 1: start with darkness, end with first projection (plot point 1)
Act 2: continue with first projection, end with second projection (plot point 2)
Act 3: continue with second projection, transition to third projection (climax), end with darkness

3.3.4 User testing

In this study, the rating of the awe experience will be examined (visual only) in relation to time. The participant group will comprise a mix of students and TU Delft staff.

INTRODUCTION

Research aim

This third and last user test is a follow up experiment on the second user test to evaluate the added improvements on the design. Together with the previously mentioned improvements, a third experiment was set up. The aim of this third user test is to research to what extent the final design elicits an awe experience in relation to time. The story that is explained in previous sections will be projected with the same beamer model “Epson EB-FH52”. There will be no comparisons like in study 1 and 2.

Research question

To what extent does the final light sculpture elicit an awe experience in relation to time?

METHOD

Participants

This study has been conducted with 11 participants, consisting of students and staff from the TU Delft. Since this is the last test with one question, the amount of participants has been doubled for more data.

Stimuli & Equipment

The experiment will be done with one setup, consisting of the three previous variables: a projection (with the story), high LED intensity and lighting off in the room. The setup consists of a hanging one-coloured organza sample on the ceiling, two “RGB LED Floodlight 10W” armatures and two “Epson EB-FH52” beamers all directed upwards towards the organza sample. The room setting is like a hall in a museum with as little furniture as possible, where the participants can walk around wherever they like (see figure 63 for the setup and figure 64 for a schematic sketch of the setup).

Figure 63: Setup study 3

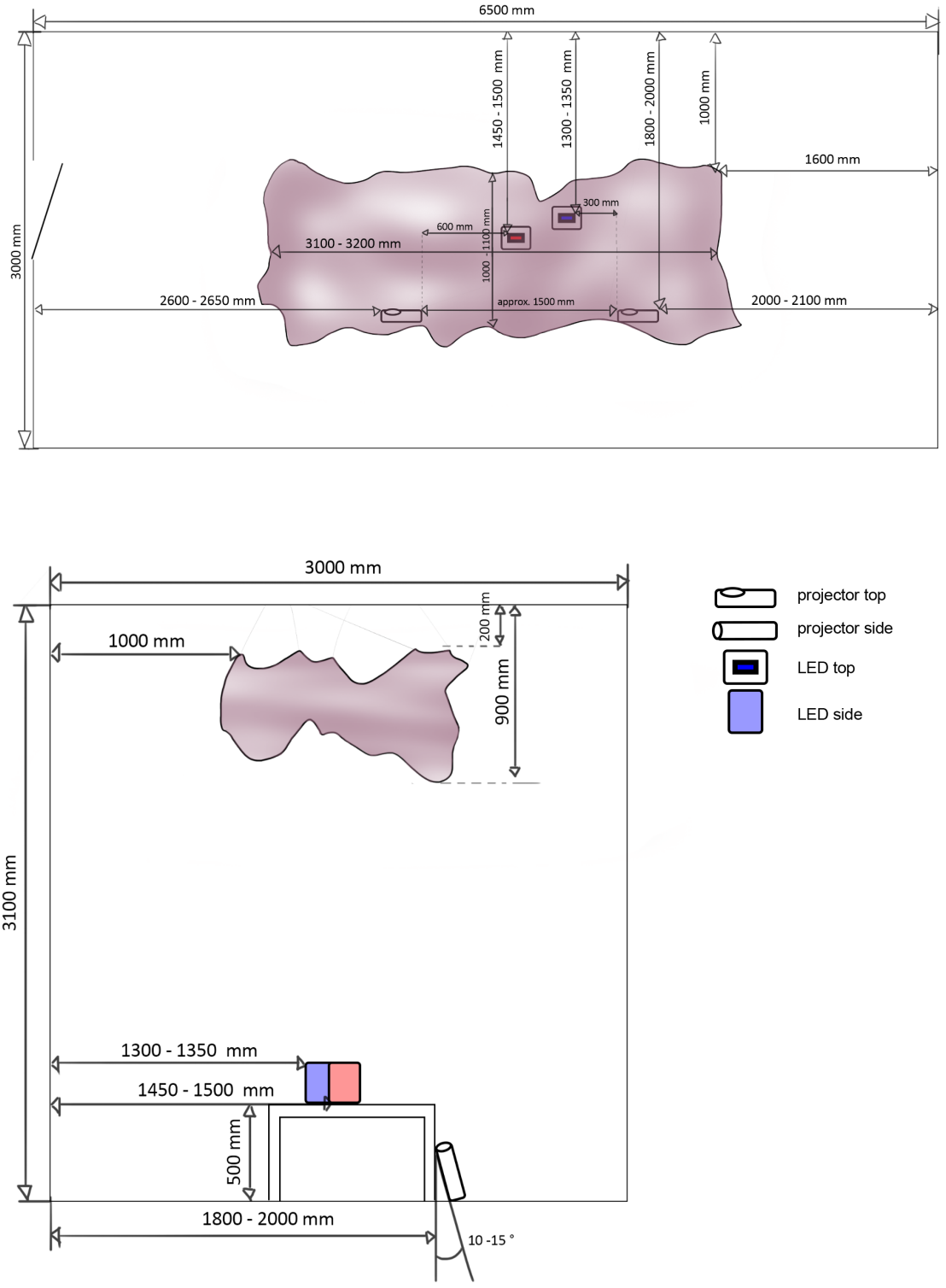


Figure 64: Schematic 2D sketch setup study 3 (top: top view, bottom: side view)

Procedure

This experiment is, like experiment 2, taking place in a part of the Multisense lab, which is a rectangular shaped area (around 6.5x3 m) with no daylight. A poster will be taped to the door as a first impression of the exhibition that is awaiting (figure 65). Before coming inside, an introductory explanation will take place about the project, the expectations and the tasks. The experiment will be done in groups of participants instead of individually (like study 1 & 2). Participants will be notified that they can walk around wherever they want. The participants enter the moment the projection starts.

Figure 65: Poster "Nature's Luminous Dreamscape"

After the experience of the light sculpture for a different amount of time (each participant can take as long as desired), the participants will fill in a consent form (see appendix E). This is after the experience to not bother them before the experiment, because the experiment does not include capturing photos/videos. Each participant fills out the same rating form by drawing a graph (see figure 66), which is an integration of the experience trajectories by Tennent et al. (2021). It is a linear chart with the rating of the awe experience (y-axis) from 0-10 in relation to the time (x-axis) of one loop of the experience.

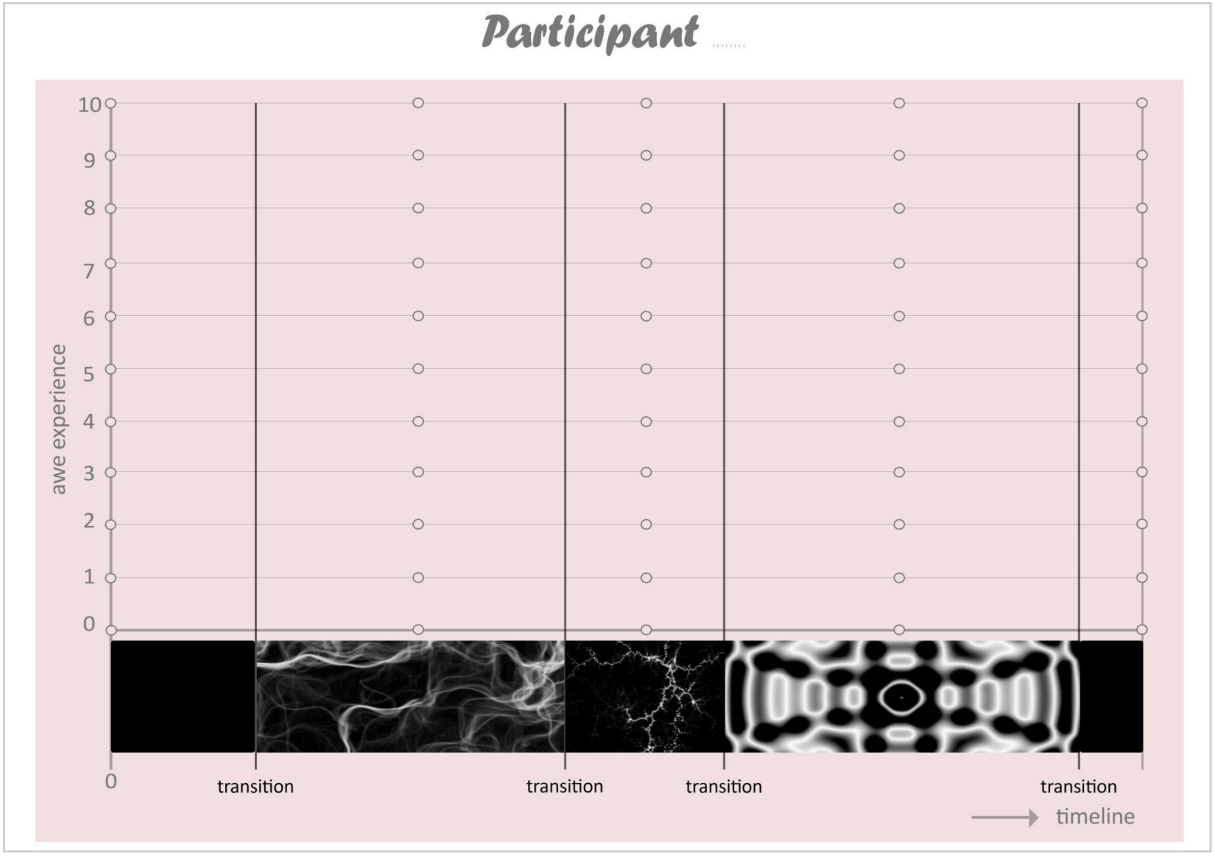


Figure 66: Experience trajectory study 3

RESULTS

Rating of awe experience

The graphs below show the results of all the participants. They are divided in two graphs, because two groups of similar results appeared. Group 1 shows an increase in an awe experience until reaching the peak during the third projection, while group 2 shows a peak in an awe experience during the second projection (see figure 67).

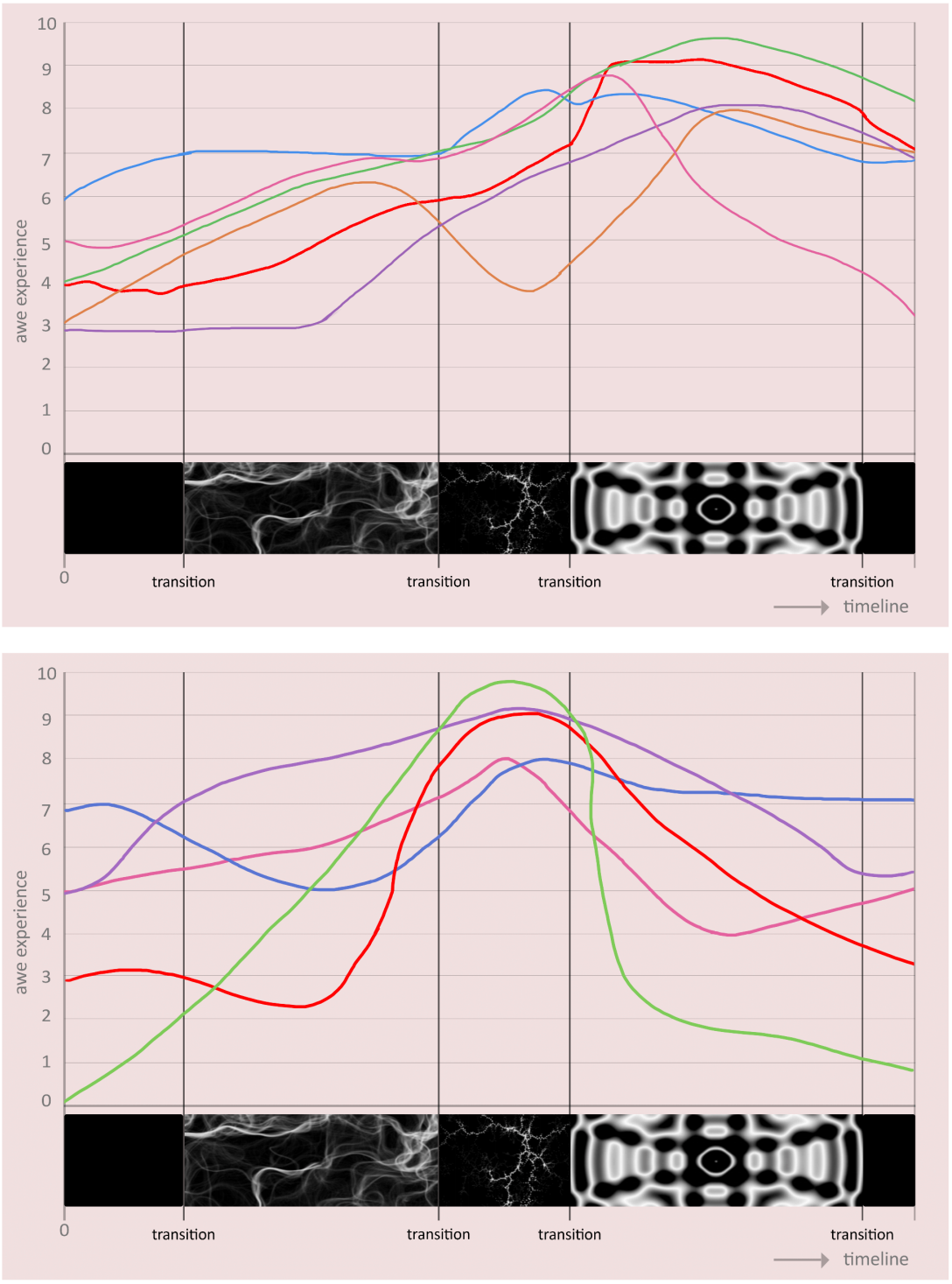


Figure 67: Group 1 (top) and group 2 (bottom)

Observations

Most participants were impressed by the latest projection "Chladni1". Whenever that projection first appeared, it immediately drew attention. But because it is a continuous loop in itself, attention goes away just as quickly too. Some people said things like “wow”.
Next to that, some participants looked more to what was happening on the ceiling instead of focussing on the organza artwork. Some of the observed behaviours among the participants included actions like opening their mouths, pausing while walking, maintaining silence, eventually sitting down on an armchair to be more relaxed, and asking for permission to touch the lower hanging pieces.

CONCLUSION

This experiment has shown that 6 out of 11 participants (group 1) rated the awe experience highest during the third projection “Chladni1”. This group confirms the three act structure technique where the climax, which is at the beginning of projection “Chladni1” is indeed the highest rated moment of an awe experience. 5 out of 11 participants (group 2) rated the awe experience highest during the second projection “DLAbranching2”. Both projections were rated the highest in an awe experience during study 2, so this study reinforces the previous outcomes, which were condition 7 and 8 (with projections 1: Chladni1 and 2: DLAbranching2.

RECOMMENDATIONS

As mentioned in the observations, some people looked more to the ceiling than the organza artwork. This happened because the projection could be seen more strongly on the ceiling. To ensure that the projection does not hit the ceiling or is minimised, a certain filter could be placed on the lens of the projector. In addition, this experiment is limited to university-owned equipment. A different projector with stronger contrast where black on the screen is also projected black would be less eye-catching.
The rating form from the experiments had circles in the graphs that were restricting the participants (see figure 66 from section “procedure” of this chapter). It could cause the participant to only fill in the circles while the rest of the timeline is neglected. During the experiment, all participants were informed to ignore the circles, but some participants still filled them in (see figure 79 in appendix D). An improvement could be to have a rating form with no circles to draw a graph, just as presented in figure 68.

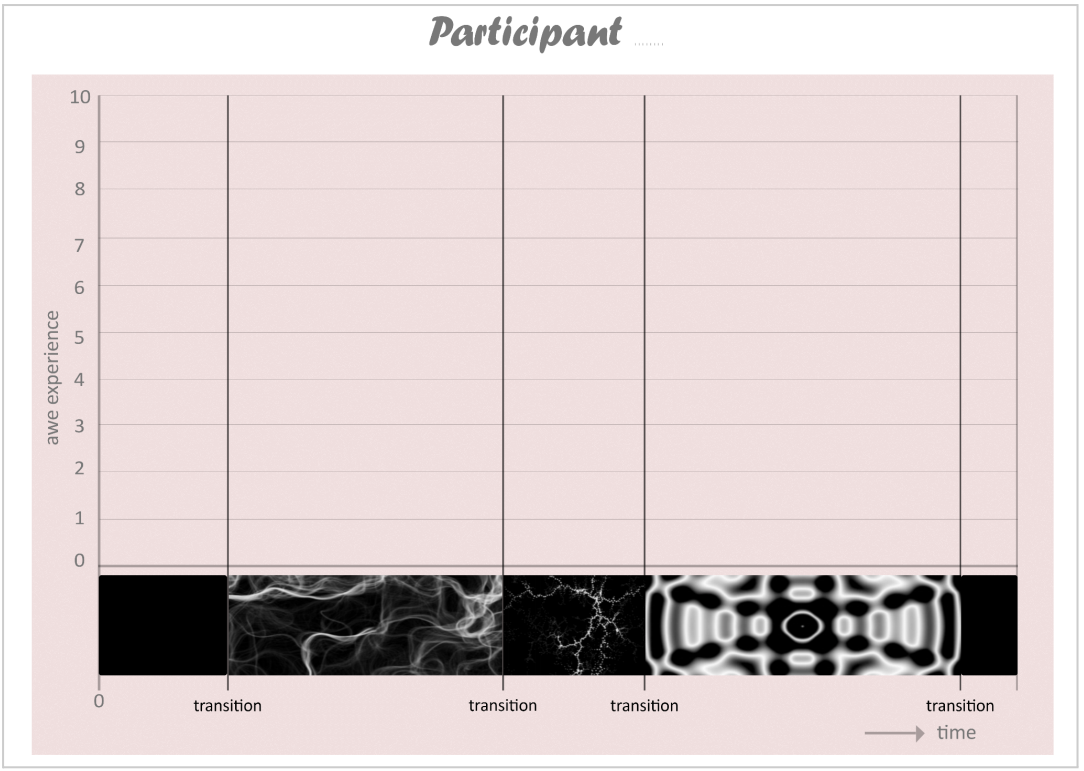


Figure 68: Rating form without circles

4. Nature’s Luminous Dreamscape

This chapter presents an overview of the final light sculpture, see figure 69, including some details.

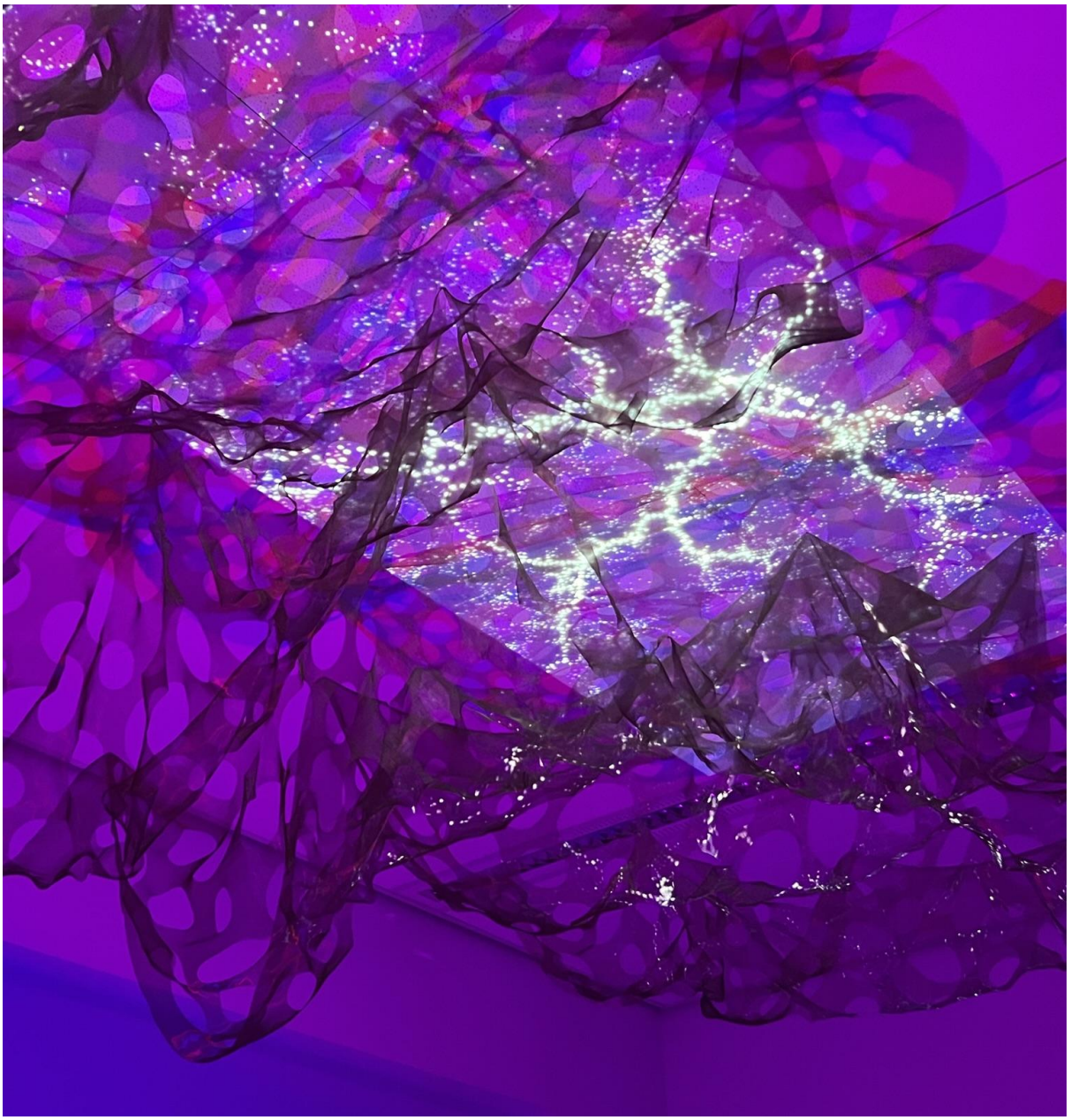


Figure 69: Final light sculpture

The organza artwork is hung randomly from different parts by using tiny beads and sewing thread. The bead ensures that the organza hangs at the desired height. Figure 70 shows an image of what it looks like up close.

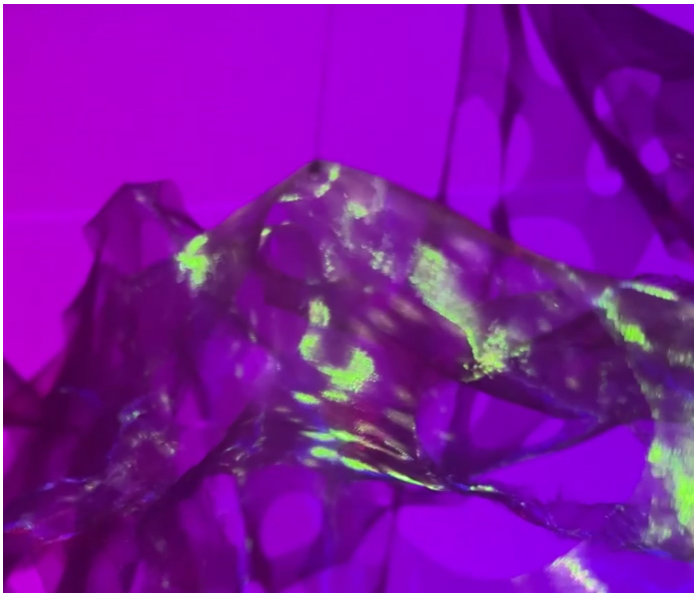


Figure 70: Bead with thread

Unconsciously, rays of light emerge along the edges of the projections enriching the atmosphere. These rays play a vital role in increasing the enchantment of the artwork and immerse the viewers in the experience of awe and wonder (see figure 71).

Figure 71: Rays of light

5. Discussion

5.1 Contributions

This project advances MDD by integrating lighting conditions into the design process, recognizing the profound influence of light on human emotions and/or meanings. It also refines experiential characterization by emphasising individual emotions, such as awe, and integrates established emotional design tools such as Desmet's emotion typology (2012) and experiential pathways.

It also shows the potential of organza by demonstrating how it can interact with light to create an awe experience. It introduces innovative techniques, such as laser cutting, to expand the creative possibilities of organza, making it a more accessible medium for designers. This contribution encourages future innovation in this field.

In addition, this project makes strides in the field of light and light-material interactions. It examines the interaction between light and different types of organza, revealing phenomena such as the creation of double highlights, glittery appearance, coloured shadows and the dominance of lighting colours. These discoveries increase the understanding of the interaction between light and materials, especially within the context of textile design.

At the same time, this project is promising when it comes to evoking awe. Through the use of lighting and organza, it evokes emotions such as fascination, enchantment and dreaminess. These emotional responses are further enriched by the project's ability to make strong associations with elements of the natural world, in line with the vision, that enhances the emotional resonance.

This project fulfils the client's brief by seamlessly integrating lighting into the organza artwork, incorporating specified lighting colours, managing dynamic lighting and intensity, using organic forms, setting up the light sculpture, and delivering an artwork of substantial scale.

5.2 Limitations

Several limitations of the project are worth considering. First, the projectors provided by the university, the only models available, showed certain limitations, in terms of image quality. In particular, they tended to produce a visible rectangular shape of the projected screen, even when displaying black content. This problem can be attributed to the contrast and brightness capabilities of the projectors, which even at the highest level contrast and lowest level brightness were unable to completely eliminate these edges of the screen. Consequently, the white-lit areas of the projection became more transparent.

Secondly, the project was limited to visual experiences. Although there was a desire to explore other sensory elements, such as sound and touch, these aspects were excluded from the focus of the project. The decision to limit the project to a visual experience was made mainly because of practical constraints, such as time limitations and the complexity of integrating multiple sensory elements into the installation. However, recognising the potential for a more immersive and multisensory experience, these aspects are discussed in the recommendations section.

In addition, the size and shape of the organza fabric caused limitations in the experiment. Study 3 found that even the largest organza size available could not cover the entire ceiling. Part of this limitation stems from the limitations of commercially available rolls of fabric, which usually come in a standard width, allowing the length to be adjusted but not the width. Custom orders may need to be placed to obtain the organza with dimensions suitable for full ceiling coverage or to achieve different installation shapes rather than long shapes.

Furthermore, the project was mainly limited to exploring one specific set of lighting colours and armatures in one study. This allowed an in-depth exploration of other variables. For example, the study included different light textures or other light-related aspects. Nevertheless, the project recognised the potential for further research in these areas, as indicated in the recommendations section.

Finally, a similar constraint applied to the colour and type of organza. Although the project showed that the choice of organza colour had minimal influence, this observation was made primarily in the context of study 1. Later studies did not elaborate on organza colour and type, despite the fact that different colours and types may interact differently with different lighting conditions. This was also noted as an area for further research in the recommendations section, providing a direction for future research.

5.3 Personal Reflection

This journey has been a profound learning experience for me. It has not only enhanced my understanding of design and material interactions but also provided insights into my own work style and capabilities. One of the key realisations I've had is that I thrive as a hands-on doer rather than a theoretical thinker. Engaging directly with physical objects and materials, as opposed to solely relying on digital tools or conceptualization, has proven to be the most effective approach for me. This practical orientation has strengthened my skills in prototyping, enabling me to efficiently create a substantial sculpture on my own. Another significant skill I've developed throughout this project is conducting user tests in a structured and professional manner. Engaging participants, collecting valuable feedback, and conducting post-test discussions have been instrumental in refining the project. Additionally, I've learned to step out of my comfort zone, a quality I aimed to develop at the project's outset. This was particularly evident when approaching strangers to participate in my tests, highlighting my growth in interpersonal and communication skills.

One of the most important takeaways from this journey is my improved ability to self-motivate and recognize my own capabilities. The dedication and hard work I put into this project were eye-opening. It's empowered me to tackle complex challenges with confidence, which I believe will be invaluable in my future career. This experience has provided me with a strong foundation for my career development. I now have a clear understanding of my preferred work style, strengths, and areas for improvement. These insights will guide my approach to future projects, allowing me to leverage my strengths effectively. Furthermore, the practical skills I've acquired, from prototyping to user testing, are directly transferable to various design and creative roles.

The journey was not without its challenges. Maintaining motivation and staying on schedule, particularly in the early stages, proved to be demanding. The project's conclusion seemed distant, and it was difficult to maintain focus. However, I overcame this hurdle by adopting a proactive approach, taking physical actions to move the project forward, and seeking inspiration from the dedication of fellow students. Witnessing the positive reactions of people to my light sculpture, observing their awe and genuine interest, was incredibly rewarding. It solidified my belief in my capabilities and served as a powerful motivator.

Additionally, the process of creating the entire sculpture, while challenging, was undeniably exciting. Seeing all the elements come together to form a cohesive and visually stunning artwork was a truly fulfilling experience. Overall, this journey has not only expanded my design skills and knowledge but has also offered personal growth and a greater sense of confidence in my abilities.

6. Conclusion

In summary, the main question of this project was to investigate how the interaction between organza and lighting can elicit an awe experience, taking into account factors such as lighting colour, - intensity, - texture and - condition in the room.
To answer this, three studies were conducted, each highlighting different aspects of the interaction between light and organza. Study 1 found that the condition S3L3, consisting of organza with leaf shaped holes and lighting colours red and blue (see figure 72), generated the highest average awe experience, with significant differences compared to condition S3L1 (see figure 73). Lighting colour 3, associated with dreaminess, enchantment and fascination, came closest to the terminology of awe.

Figure 72: S3L3

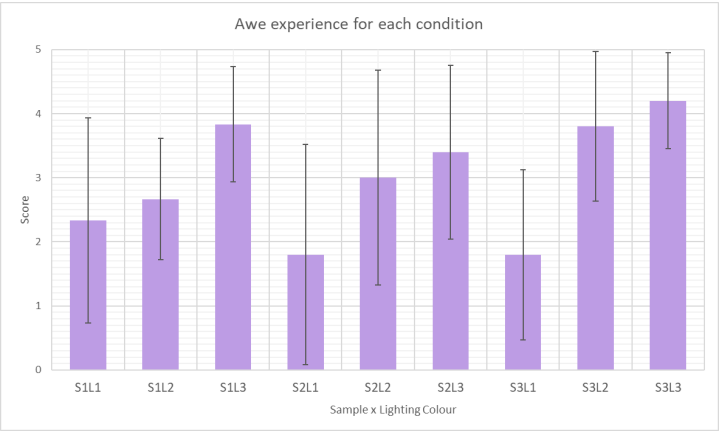


Figure 73: Bar chart with error bars of awe experience rating

Study 2 further explored emotions, an awe experience and associations. Condition 7 (see figure 74), characterised by high intensity of the red and blue lighting and projection 1 (Chladni1), consistently scored highest for desired emotions, awe experience and meanings associated with the vision of the project. It was also the only condition that evoked the emotion of awe in multiple participants.

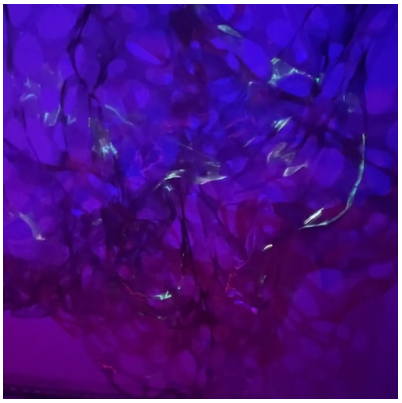


Figure 74: Condition 7

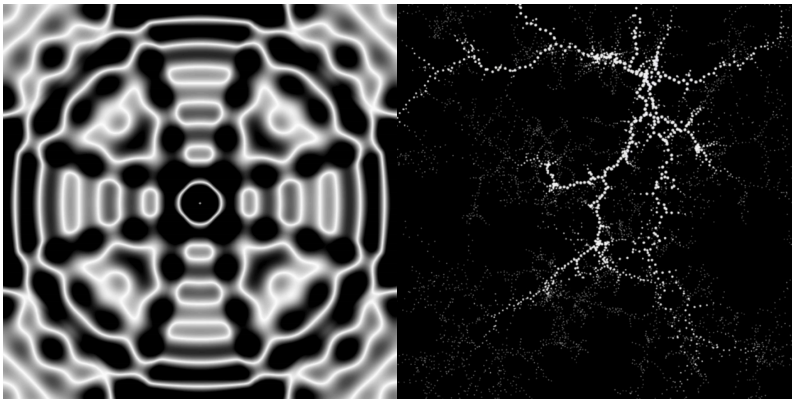


Figure 75: Chladni1 (left), DLAbranching2, (right)

Finally, study 3 introduced storytelling elements into the design. This study confirmed previous findings and highlighted the effectiveness of projections 1 (Chladni1) and 2 (DLAbranching2), shown in figure 75, in evoking awe experiences.
In conclusion, this project not only provided valuable insights into the interaction between light and organza but also successfully created an awe experience, making it an achievement in both material-driven design and human-centric design.

7. Recommendations

Exciting opportunities lie ahead for further exploration and innovation of creating an awe eliciting light sculpture through the interplay of organza and light.

7.1 Sensory elements

One of the most intriguing paths for future research is the addition of sound to enhance the awe experience. The challenge here is to design sound landscapes that harmonise seamlessly with the visual elements, avoiding unintended experiences like relaxation. Finding the right balance between auditory and visual stimuli could result in an even more intense experience for participants. Incorporating interactive elements adds a layer of engagement to the experience. Participants can physically interact with the installation, for example, by lowering certain parts of the organza, inviting tactile exploration or even walking paths. Such interactivity can deepen the audience's emotional experience.

7.2 Variables

This project experimented with a slightly glittery mirror organza in study 1 and 2 and a normal mirror organza in study 3. The glittery mirror organza reflected the various illuminations better, making the light textures more visible on the organza.
Therefore, it is also interesting to explore different types, such as crystal organza with an even more glittery look, and colours, such as how different colours, including colour combinations, affect the overall impact of the artwork. Similarly, different lighting colours and armatures provide a vast canvas for creative exploration. Exploring how different light colours and armatures interact with organza and their potential to evoke awe opens up exciting possibilities. Moreover, there is great potential to enhance the organza artwork itself. Experimenting with multiple layers of organza not only increases volume, but also introduces new textures, shadows and depth.

7.3 Dynamics

In addition, the dynamic manipulation of the intensity of red and blue light is an exciting prospect. By organising fluctuations in light intensity, a dynamic harmony between all variables can be created to enhance the overall emotional impact. The role of ventilation in enhancing dynamics is also worth exploring, such as how dynamic airflow, combined with dynamic lighting effects, can enhance the immersive quality of the installation and offer viewers a sensory journey. The concept of a dynamic interior design, with rotating movements, could maximise the immersive potential of the artwork as well. Creating organic shaped hubs where viewers can choose their point of view - standing, sitting or lying down - ensures that each facet of the artwork is fully appreciated and offers a new dimension of engagement. Figure 76 shows an example of how it could look like.

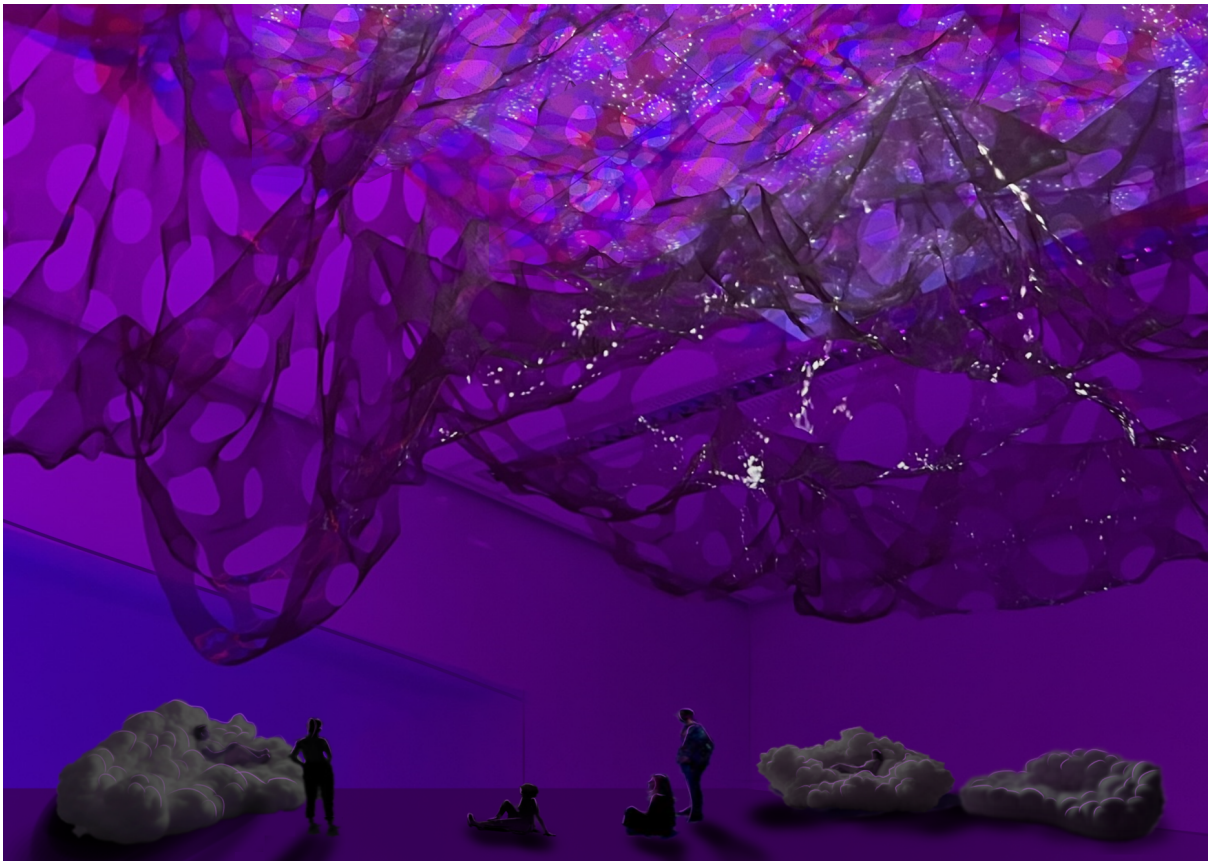


Figure 76: Imagination of the interior design

7.4 Literature

Conducting a comprehensive analysis of the six facets of awe (Yaden et al., 2018), mentioned in section 2.1.1 “Awe Experience”’ can provide deeper insights into the design process. By carefully examining these facets, it allows for more conscious and impactful design choices and ensures that the awe experience is consistently elicited.
Considering the long-term effects of awe-inspiring experiences is another exciting possibility. According to Rudd et al. (2012), encounters with awe contribute to increased well-being over time, which a salutogenic approach could help understand. This approach can potentially unlock a new dimension of the healing and therapeutic potential of such experiences.

7.5 Technical aspects

Precision shaping of projections presents a worthwhile technical challenge. By using projectors with distance sensors, specific shapes could be projected with precision, providing a refined and controlled visual experience. An alternative approach could be to adjust the projection setup to achieve the desired effect of coloured shadows while eliminating projections in undesirable areas. This adaptation involves projecting onto a black wall that absorbs lighting, such as Vantablack, while having a plain white ceiling. The projectors would be placed above eye level with a slight upward angle, directing light towards the organza artwork to the wall instead of the ceiling, similar to the arrangement used in study 2. A black velvety piece of fabric was tested on the ceiling, but it eliminated the mixed coloured shadows instead of the projections (see figure 77). To reintroduce the mix of coloured shadows on the ceiling, the introduction of plain projections or white light directed towards the ceiling is being considered. This innovation has the potential to eliminate the projections of the dynamic light textures onto unintended surfaces such as the wall or ceiling, while recreating the fascinating coloured shadows that contribute to the immersive experience.

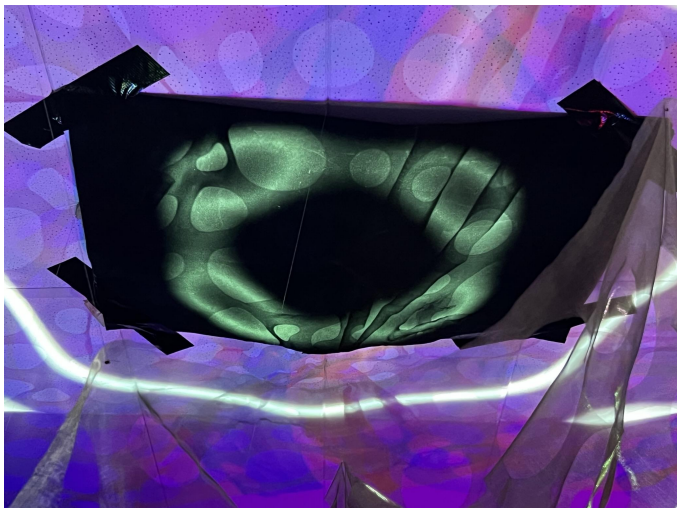


Figure 77: Testing with black velvety fabric

In sum, these opportunities for future research and development promise to push the boundaries of awe experiences in the realm of light, material, and design. Each direction represents a unique opportunity to expand the understanding of how lighting and textiles, specifically organza, can intersect to create awe eliciting encounters.

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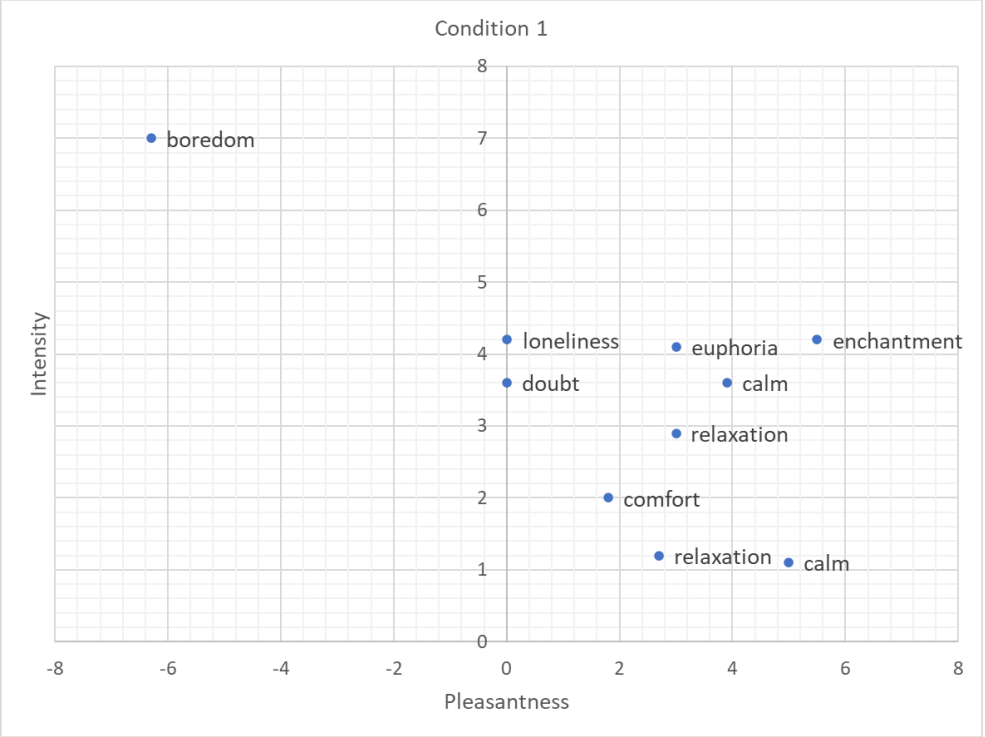
Appendices

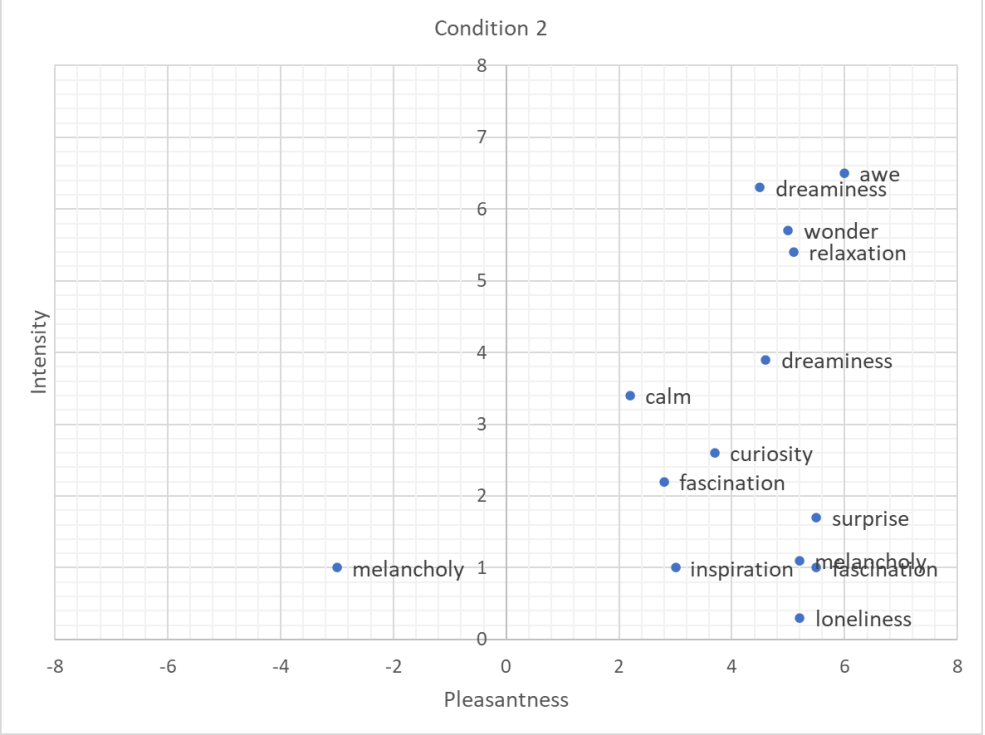
Appendix A: Results Awe Experience Study 1

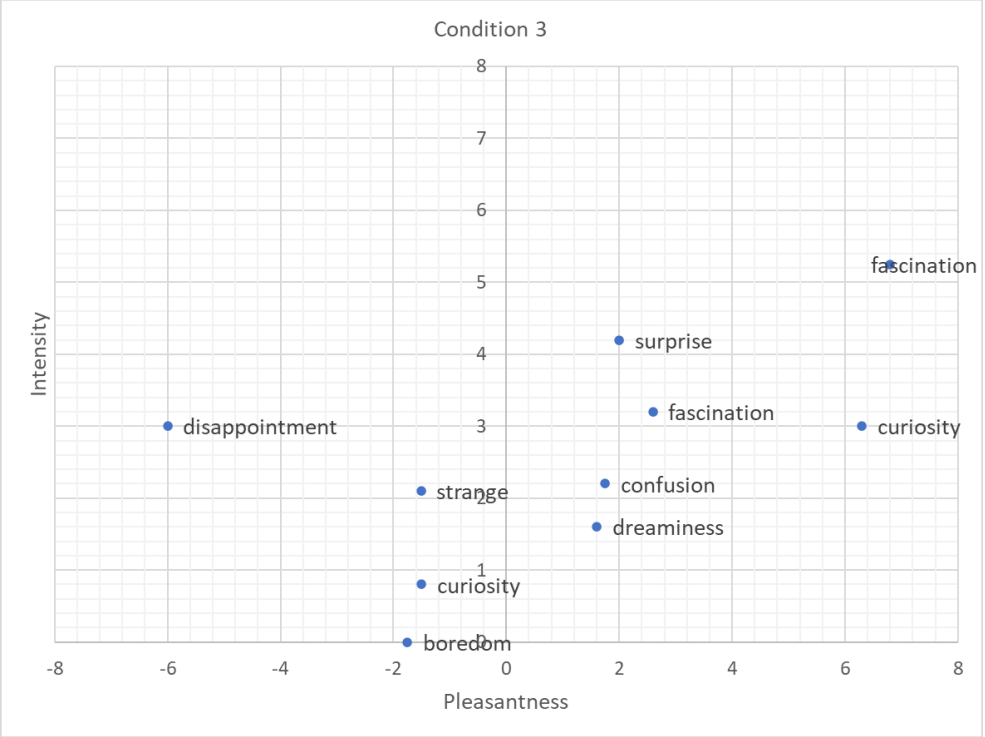
Table 2: Awe experience scores per condition per participant

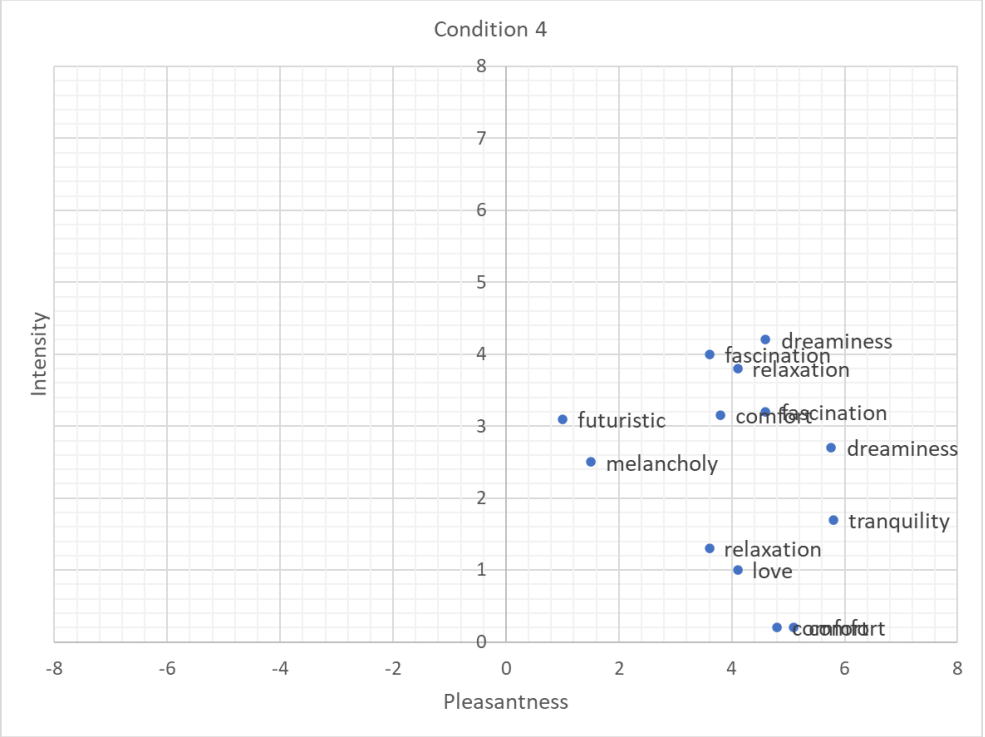
	S1L1	S1L2	S1L3	S2L1	S2L2	S2L3	S3L1	S3L2	S3L3
Participant 1	4	3	5	-	-	-	-	-	-
Participant 2	2	1	4	2	0	4	2	2	5
Participant 3	5	3	4	5	4	5	4	5	5
Participant 4	1	4	4	1	3	4	2	3	4
Participant 5	1	3	2	0	3	1	1	4	4
Participant 6	1	2	4	1	5	3	0	5	3
Average	**2.33**	**2.67**	**3.83**	**1.80**	**3.00**	**3.40**	**1.80**	**3.80**	**4.20**
Standard deviation	**1.60**	**0.94**	**0.90**	**1.72**	**1.67**	**1.36**	**1.33**	**1.17**	**0.75**
Maximum	3.93	3.61	4.73	3.52	4.67	4.76	3.13	4.97	4.95
Minimum	0.73	1.72	2.94	0.08	1.33	2.04	0.47	2.63	3.45

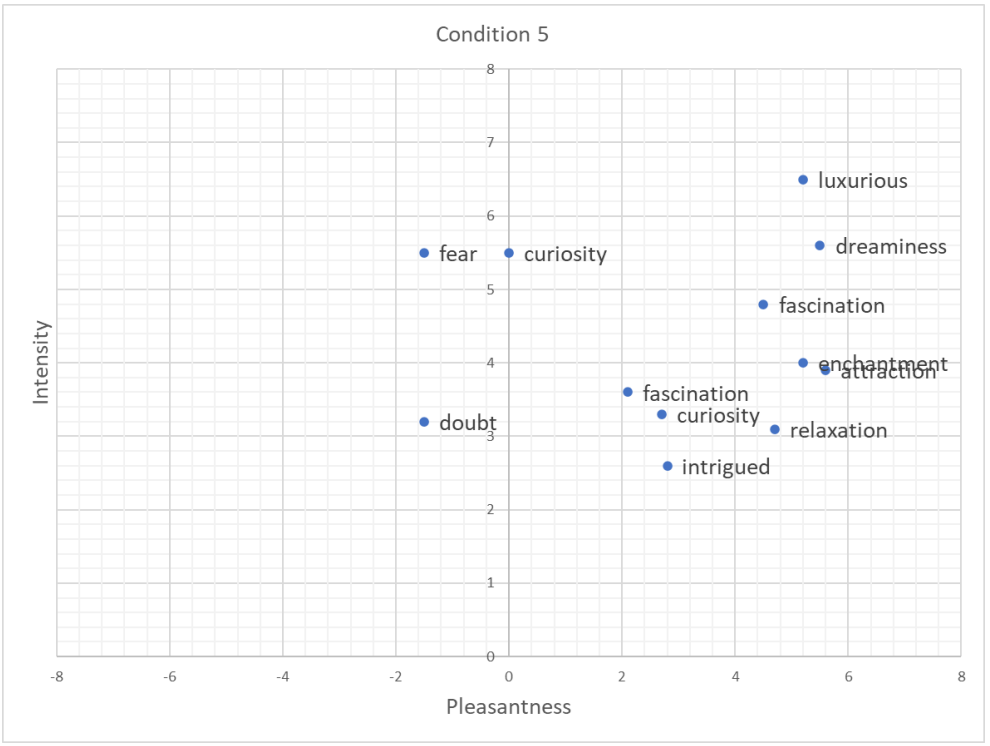
Appendix B: Results Emotions Study 2

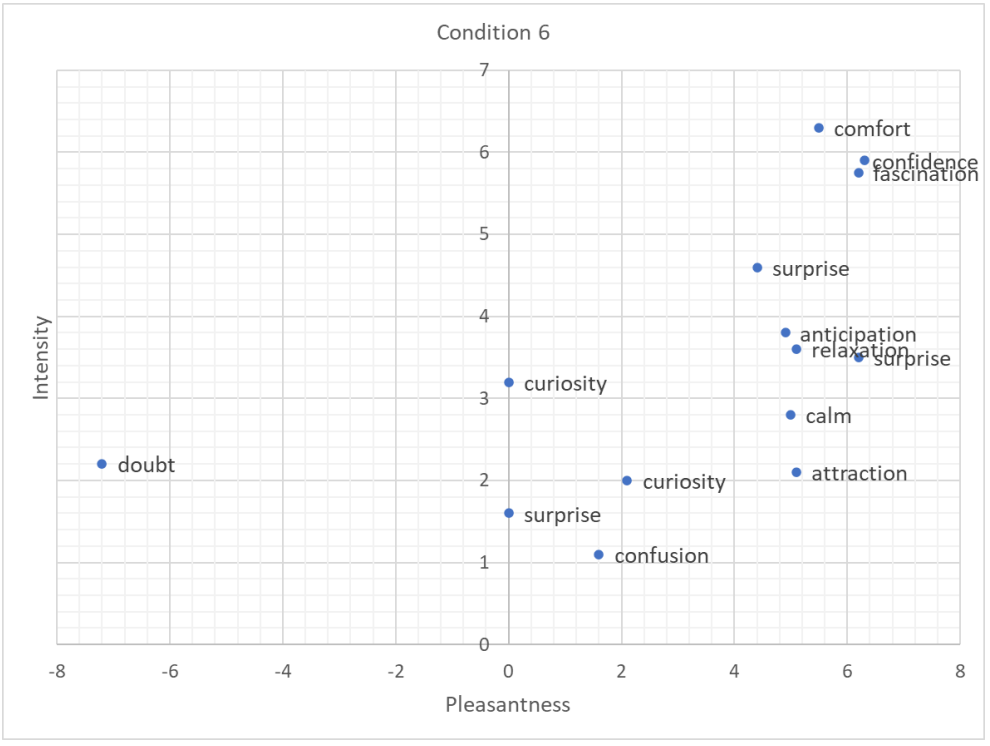


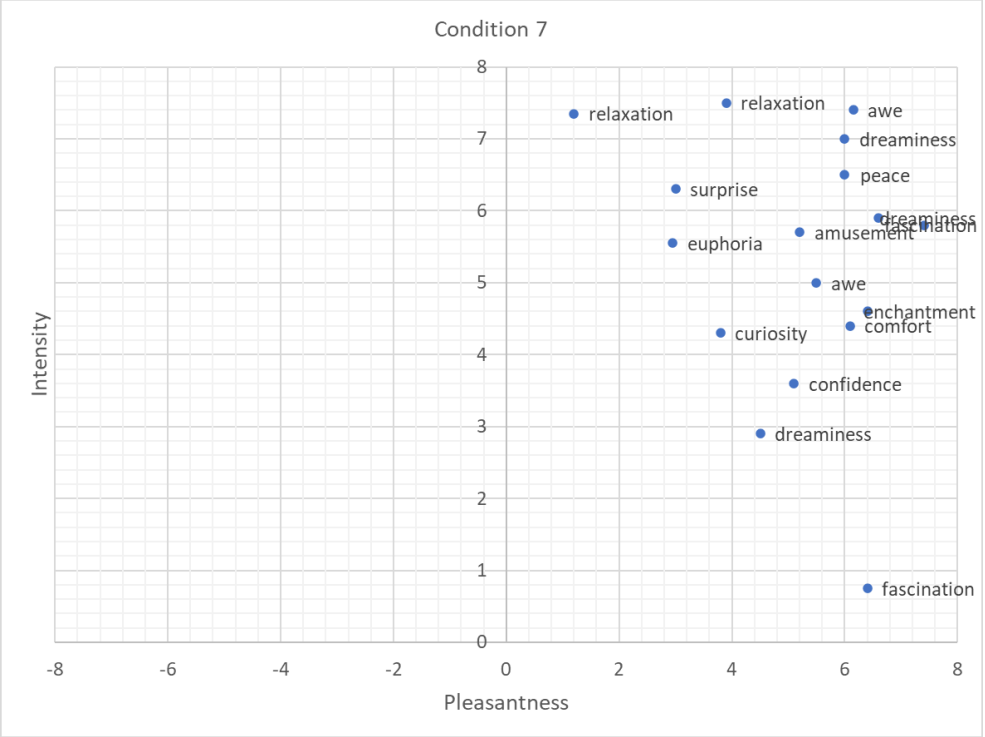


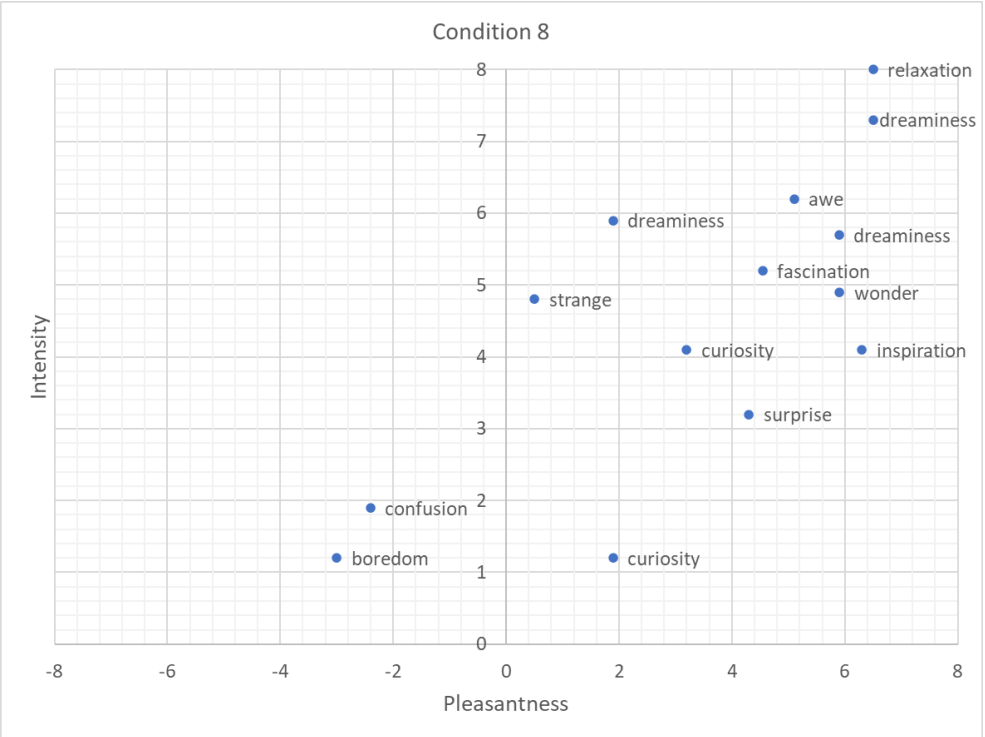

Condition 3
Intensity
Pleasantness
fascination
surprise
fascination
disappointment
curiosity
strange
confusion
dreaminess
curiosity
boredom

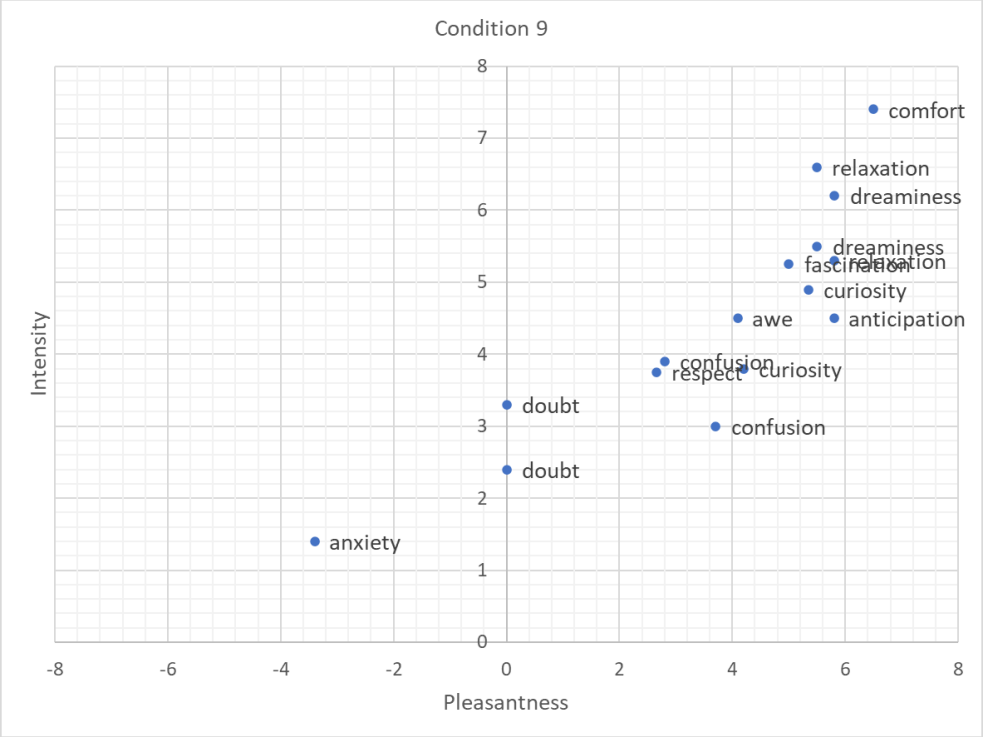

Condition 4
Intensity
Pleasantness
dreaminess
fascination
relaxation
futuristic
comfort
fascination
dreaminess
melancholy
tranquility
relaxation
love

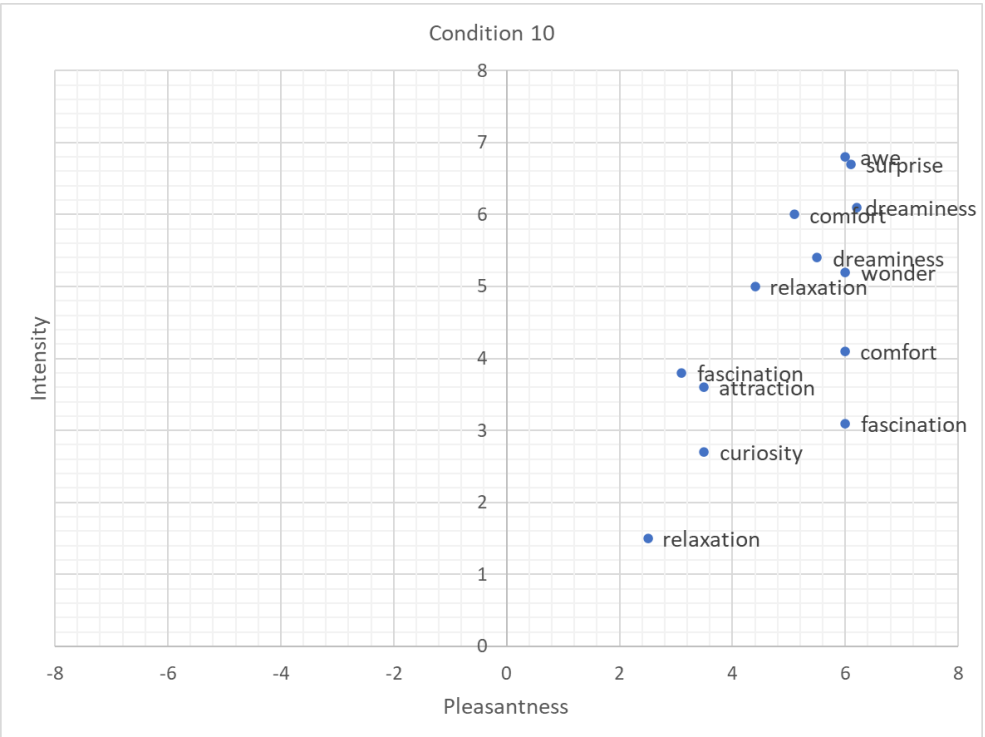

Condition 5
Intensity
Pleasantness
luxurious
dreaminess
fear
curiosity
fascination
enchantment
attraction
fascination
curiosity
relaxation
doubt
intrigued

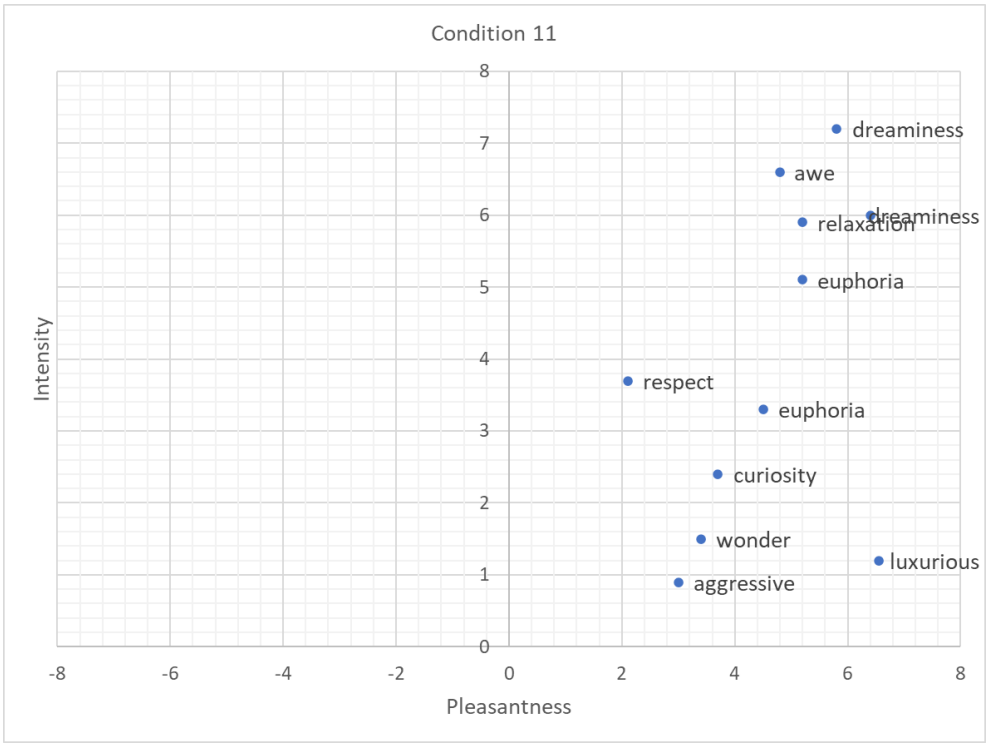

Condition 6
Intensity
Pleasantness
comfort
confidence
fascination
surprise
anticipation
relaxation
surprise
curiosity
calm
doubt
attraction
curiosity
surprise
confusion


Condition 7
Intensity
Pleasantness
relaxation
relaxation
awe
dreaminess
peace
surprise
dreaminess
fascination
amusement
euphoria
awe
enchantment
comfort
curiosity
confidence
dreaminess
fascination


Condition 8
Intensity
Pleasantness
relaxation
dreaminess
awe
dreaminess
dreaminess
fascination
wonder
strange
curiosity
inspiration
surprise
confusion
boredom
curiosity


Condition 9
Intensity
Pleasantness
comfort
relaxation
dreaminess
dreaminess
fascination
relaxation
curiosity
awe
anticipation
confusion
respect
curiosity
doubt
confusion
doubt
anxiety


Condition 10
Intensity
Pleasantness
awe
surprise
dreaminess
comfort
dreaminess
wonder
relaxation
comfort
fascination
attraction
fascination
curiosity
relaxation



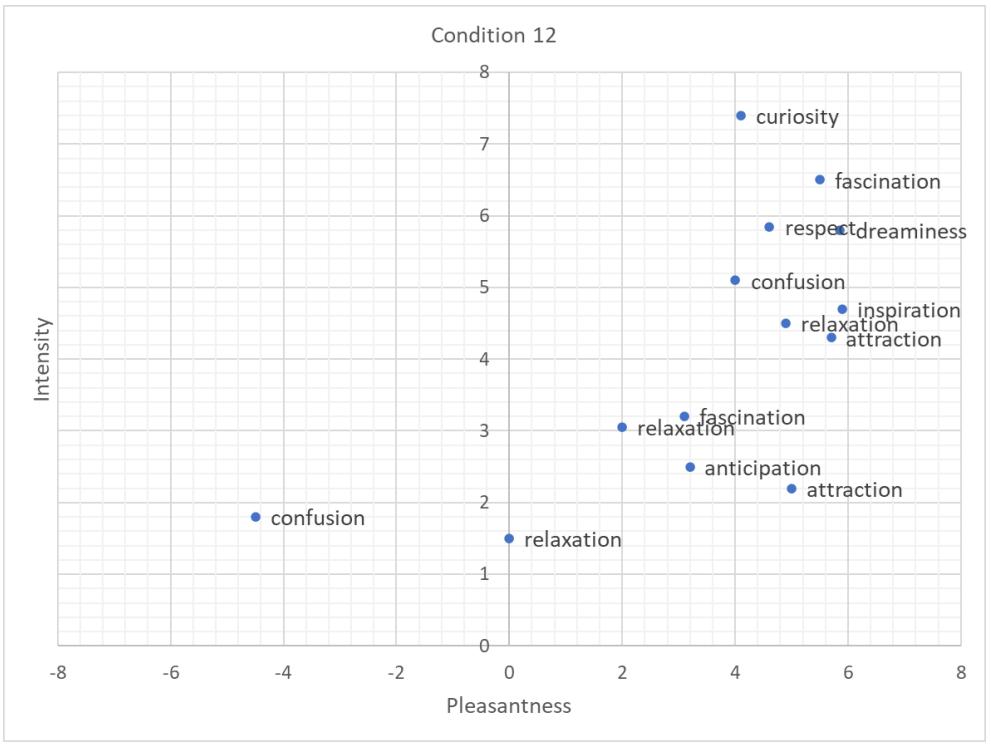


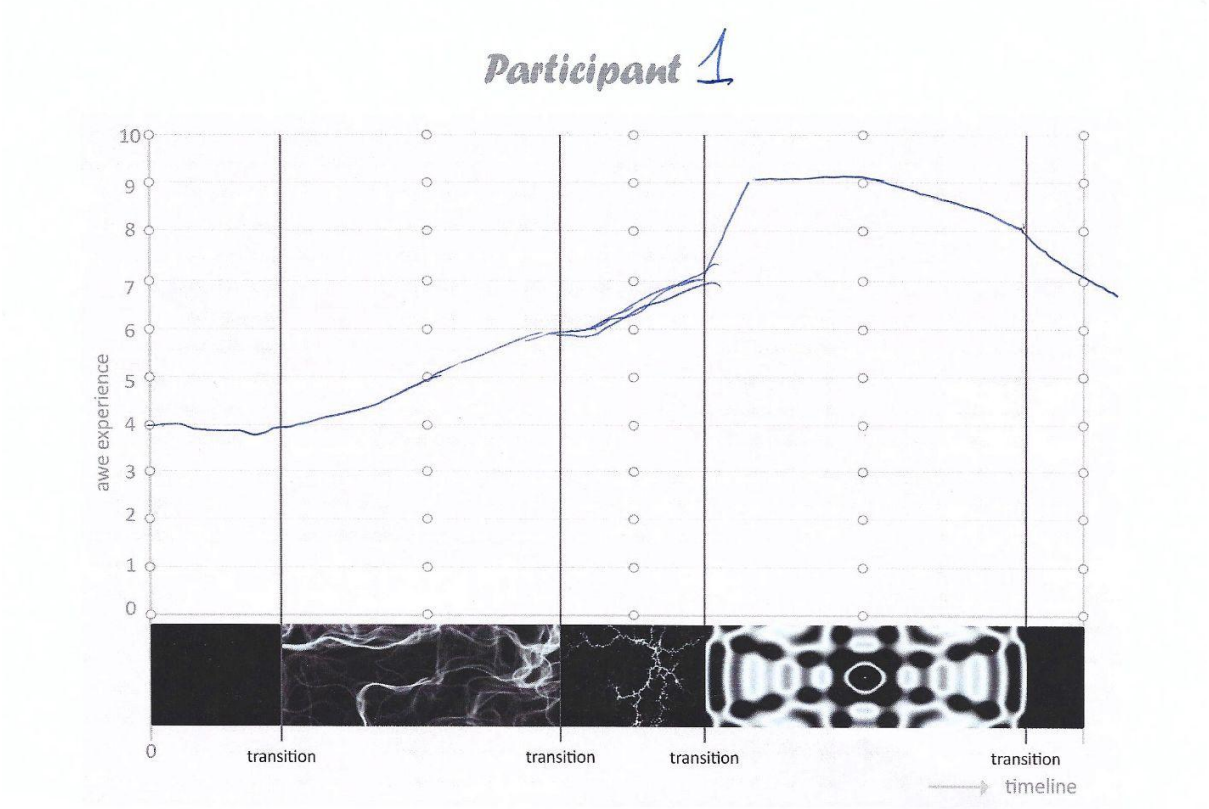
Figure 78: Plots of the ratings of pleasantness (horizontal axis) and eventfulness (vertical axis) with their associated emotions (words)

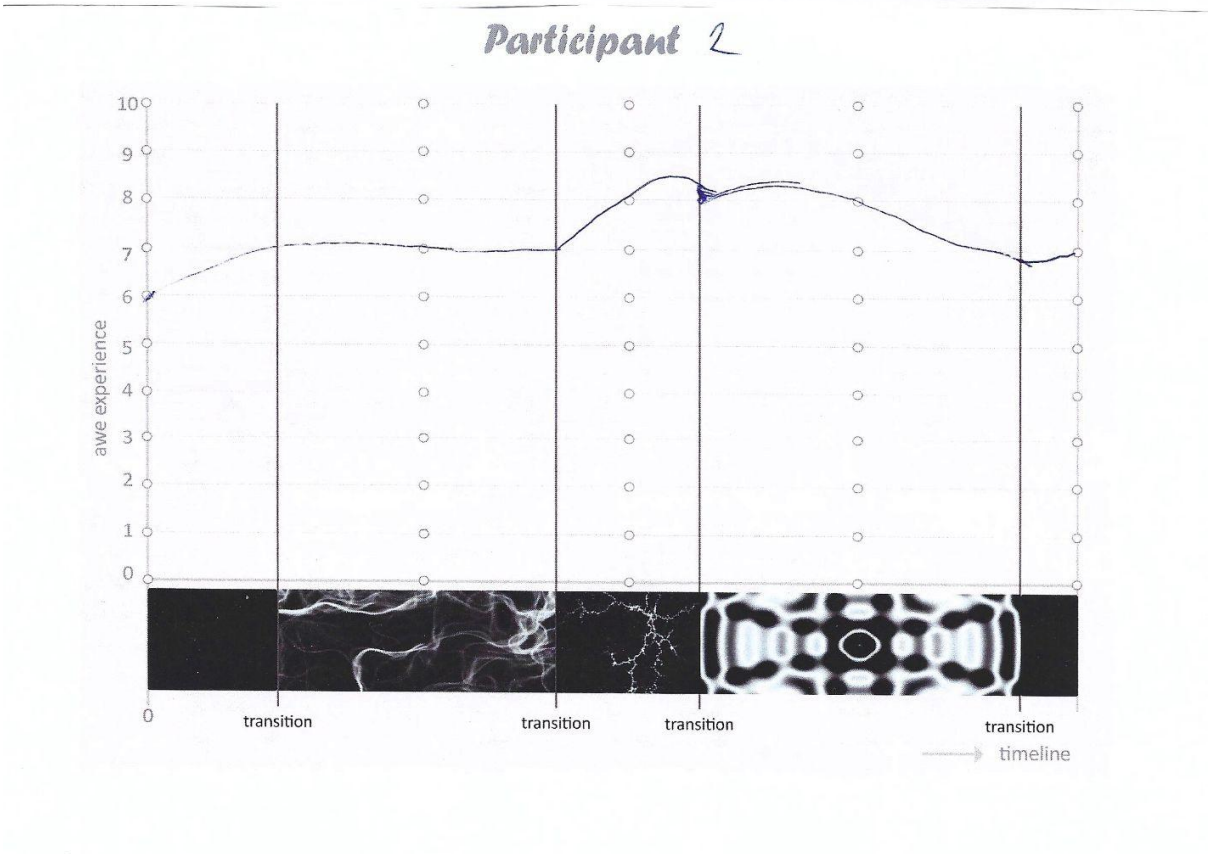
Appendix C: Results Awe Experience Study 2

Table 6: Awe experience scores per condition per participant

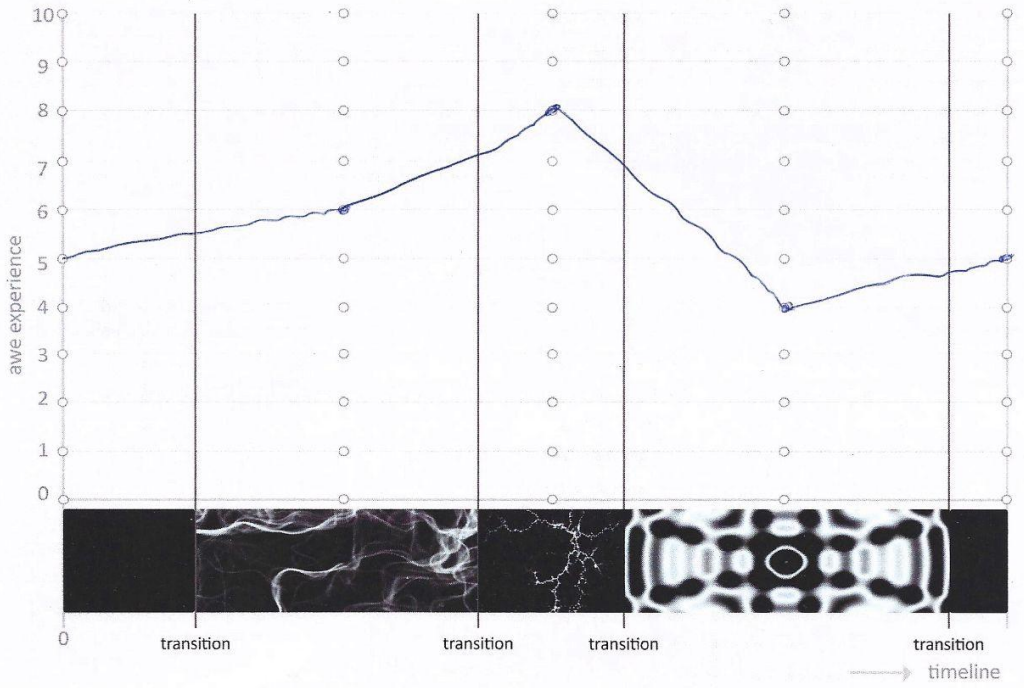
Condition	1	2	3	4	5	6	7	8	9	10	11	12
Participant 1	2	5	3	3	4	3	5	5	4	3	3	5
Participant 2	0	3	4	3	1	4	5	2	5	5	4	5
Participant 3	2	4	3	3	4	3	4	5	3	4	4	4
Participant 4	3	4	1	2	2	3	4	4	3	4	3	2
Participant 5	2.5	3	2	4	2.5	4	5	3	5	5	3	5
Average	**1.90**	**3.80**	**2.60**	**3.00**	**2.70**	**3.40**	**4.60**	**3.80**	**4.00**	**4.20**	**3.40**	**4.20**
Standard deviation	**1.02**	**0.75**	**1.02**	**0.63**	**1.17**	**0.49**	**0.49**	**1.17**	**0.89**	**0.75**	**0.49**	**1.17**
Maximum	2.92	4.55	3.62	3.63	3.87	3.89	5.09	4.97	4.89	4.95	3.89	5.37
Minimum	0.88	3.05	1.58	2.37	1.53	2.91	4.11	2.63	3.11	3.45	2.91	3.03

Appendix D: Raw Data Study 3

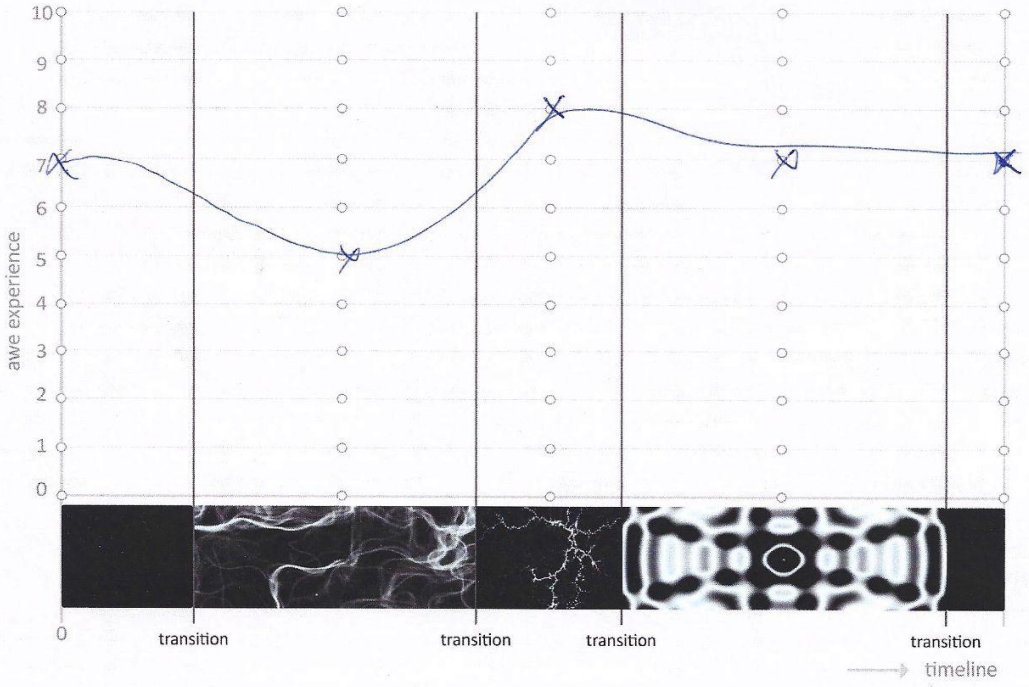




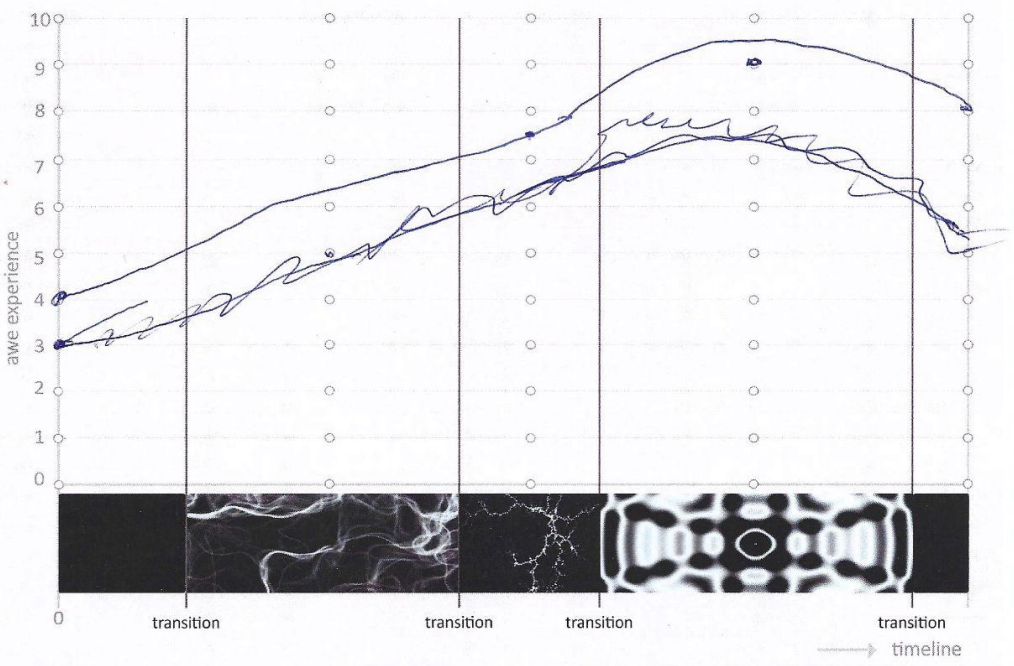
Participant 3



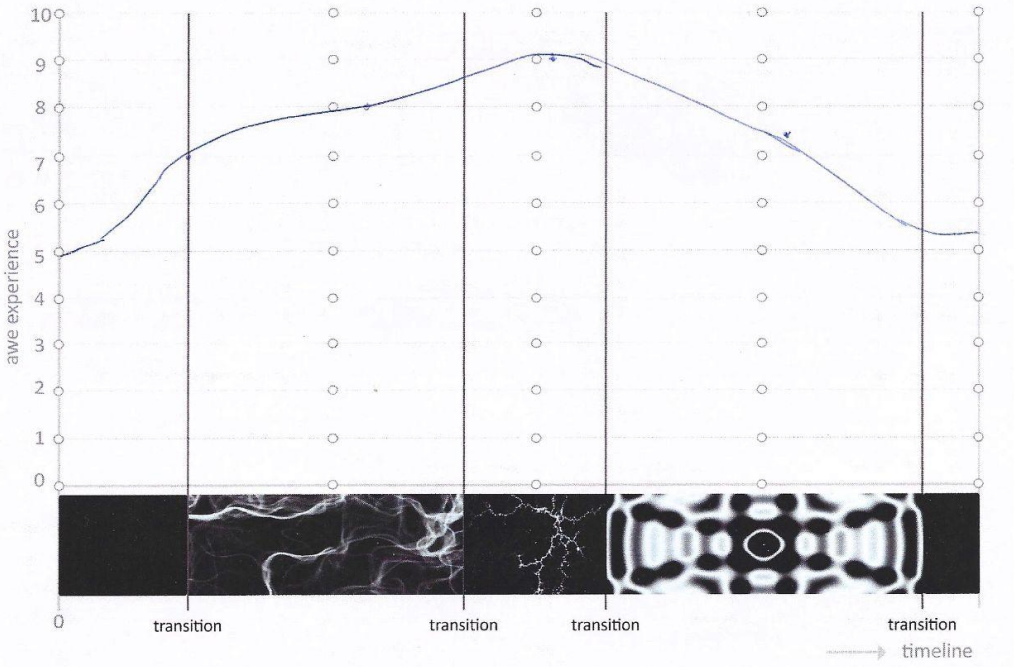
Participant 4



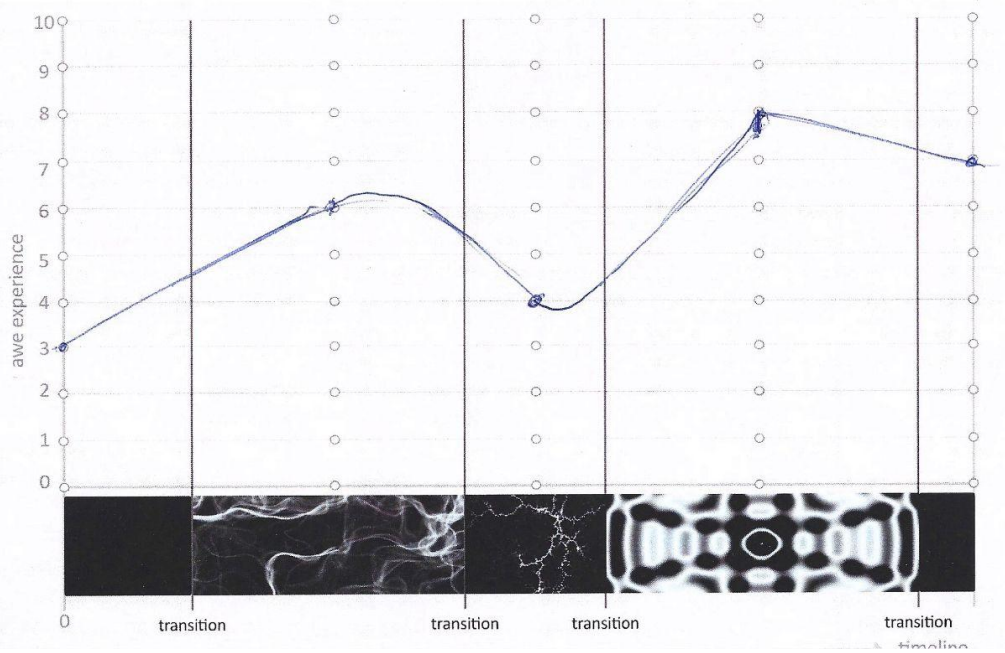
Participant 5



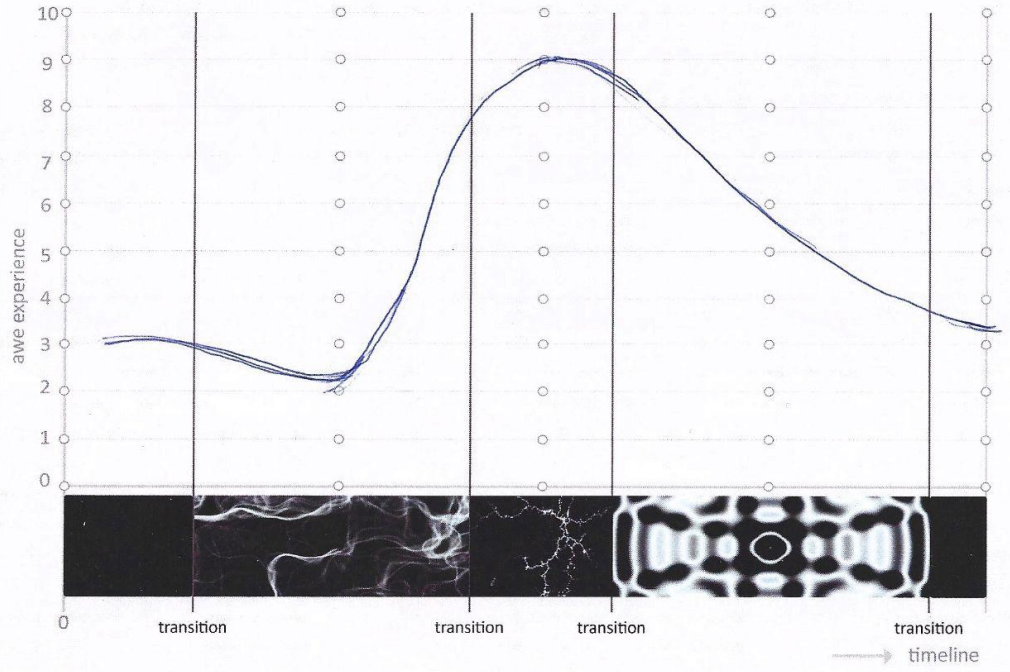
Participant 6

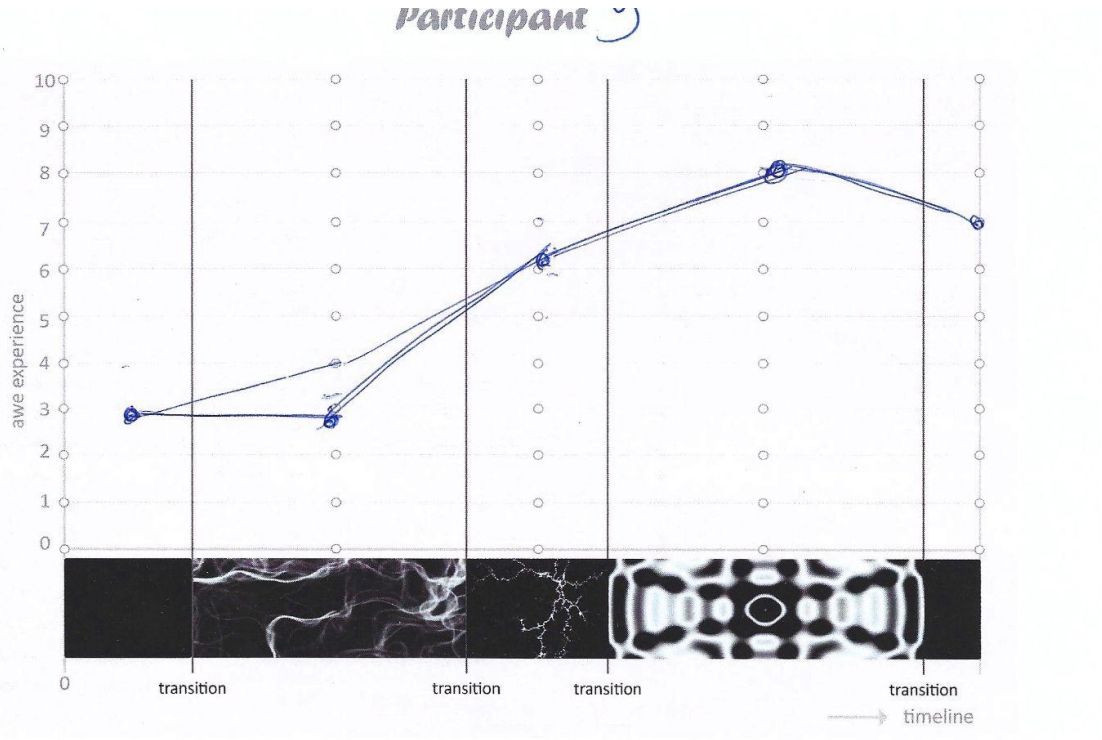


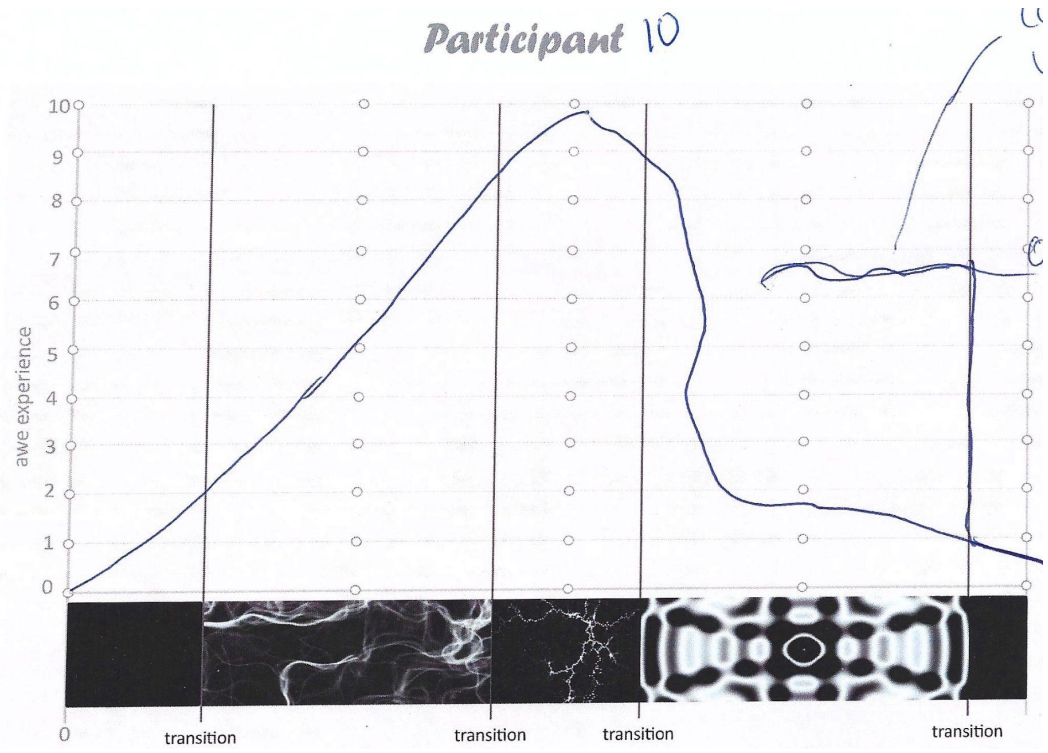
Participant 7



Participant 8




Participant 9
awe experience
10
9
8
7
6
5
4
3
2
1
0
0
transition
transition
transition
transition
timeline


Participant 10
awe experience
10
9
8
7
6
5
4
3
2
1
0
0
transition
transition
transition
transition

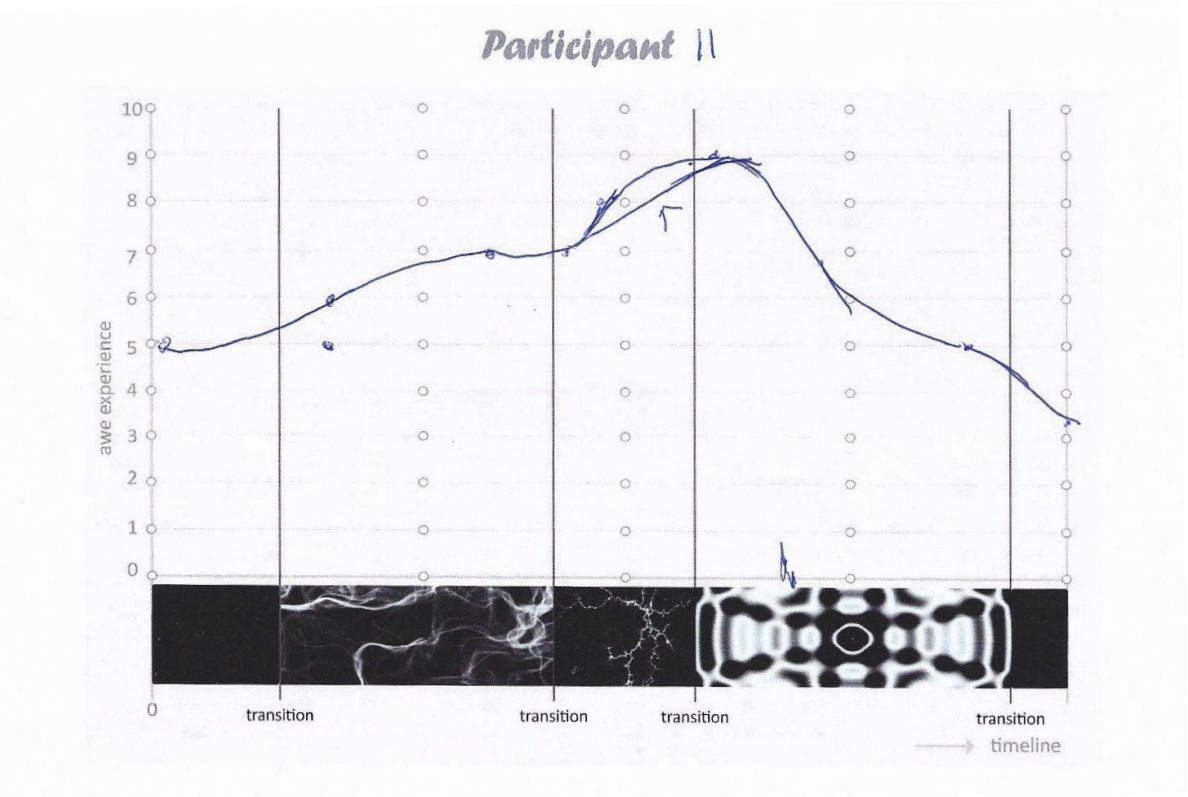


Figure 79: Raw data study 3

Appendix E: Consent Form

Participant ID: .....

USER EXPERIENCE - ORGANZA & LIGHTING

This research is conducted as part of the MSc graduation project of the study Industrial Design Engineering at TU Delft.

Student: Hümeyra Koç
Contact person: Hümeyra Koç, humeyra.koc@outlook.com

Informed consent participant

I participate in this research voluntarily.

I acknowledge that I received sufficient information and explanation about the research and that all my questions have been answered satisfactorily. I was given sufficient time to consent my participation. I can ask questions for further clarification at any moment during the research.

I am aware that this research consists of the following activities:

1. Questionnaire
2. Observations
3. Interviews

I am aware that data will be collected during the research, such as notes, photos, video and/or audio recordings. I give permission for collecting this data and for making photos, audio and/or video recordings during the research. Data will be processed and analysed anonymously (without your name or other identifiable information). The data will only be accessible to the research team and their TU Delft supervisors.

The photos, video and/or audio recordings will be used to support analysis of the collected data. The video recordings and photos can also be used to illustrate research findings in publications and presentations about the project.

I give permission for using photos and/or video recordings of my participation:
(select what applies for you)

- ☐ in which I am recognisable in publications and presentations about the project.
- ☐ in which I am not recognisable in publications and presentations about the project.
- ☐ for data analysis only and not for publications and presentations about the project.

I give permission to store the data for a maximum of 5 years after completion of this research and using it for educational and research purposes.

I acknowledge that no financial compensation will be provided for my participation in this research.

With my signature I acknowledge that I have read the provided information about the research and understand the nature of my participation. I understand that I am free to withdraw and stop participation in the research at any given time. I understand that I am not obliged to answer questions which I prefer not to answer and I can indicate this to the research team.

I will receive a copy of this consent form.

_____	_____
Last name	First name
___ / ___ / 2023	_____
Date (dd/mm/yyyy)	Signature

Appendix F: Project Brief

DESIGN FOR our future

TU Delft

IDE Master Graduation

Project team, Procedural checks and personal Project brief

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

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

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

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

family name	Koç
initials	H
given name	Hümeyra
student number	4729293
street & no.	
zipcode & city	
country	
phone	
email	

Your master programme (only select the options that apply to you):

IDE master(s):	★ IPD ☐ DfI ☐ SPD
2nd non-IDE master:	
individual programme:	- - (give date of approval)
honours programme:	☐ Honours Programme Master
specialisation / annotation:	☐ Medisign
	☐ Tech. in Sustainable Design
	☐ Entrepeneurship

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

** chair	Sylvia Pont	dept. / section:	HCD / HICD
** mentor	Stefano Parisi	dept. / section:	SDE / MM
2nd mentor	Noëlle van der Hagen		
	organisation:		
	city:	country:	
comments (optional)			

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

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

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

IDE TU Delft - E&SA Department /// Graduation project brief & study overview /// 2018-01 v30 Page 1 of 7

Procedural Checks - IDE Master Graduation

TU Delft

APPROVAL PROJECT BRIEF

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

chair Sylvia Pont date 22 - 03 - 2023 signature Sylvia Pont - IO Digitally signed by Sylvia Pont - IO Date: 2023.03.23 22:02:40 +01'00'

CHECK STUDY PROGRESS

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

Master electives no. of EC accumulated in total: 30 EC

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

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

★ YES all 1st year master courses passed

NO missing 1st year master courses are:

name Robin den Braber date 27 - 03 - 2023 signature Robin den Braber Digitaal ondertekend door Robin den Braber Datum: 2023.03.27 13:34:28 +02'00'

FORMAL APPROVAL GRADUATION PROJECT

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

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

Content: ★ APPROVED NOT APPROVED

Procedure: ★ APPROVED NOT APPROVED

comments

name Monique von Morgen date 04 - 04 - 2023 signature

Initials & Name H Koç Student number 4729293

Title of Project Visual awe experience by interactions between materials, lighting & form

Personal Project Brief - IDE Master Graduation

TU Delft

Visual awe experience by interactions between materials, lighting & form — project title

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

start date 13 - 03 - 2023 — 18 - 08 - 2023 end date

INTRODUCTION **

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

For a number of years, people have suffered from lack of time to carry out their daily activities. According to Carrol (2008) almost half of a thousand people have reported having too little time in their daily lives with activities like work and daily lists of to-dos, consisting of exercise, cleaning and socializing with friends and family (Newman, 2019). The change of time perception due to technologies is one of the reasons resulting in the feeling of lack of time. We think the smart products we have are overwhelming us with the many received notifications, while these products are tools for finding information quickly. However, what eats up our time is actually that many people spend time on social media. It is a free entertainment source, in exchange for time. Preventing these problems requires a digital detox (Wajcman, 2018). Moreover, our psychology has an effect on the feeling of lack of time; People devote time on things they value, but it also relates to our attitudes and mindsets about time (Newman, 2019). According to MacKay (2020), "The more we focus on the limited time we have, the more limiting our time feels."

Lack of time is also associated with having stress. More than half (54%) of people who have too little time to do their daily activities often experience stress. In contrast, people who do not, experience much less stress (27%) (Carrol, 2018). Besides, it has more consequences, such as sleep problems, difficulty in delaying gratification and postponing doctor's visits when sick (Rudd et al, 2012). How can you reduce this feeling of lack of time, with which stress and the mentioned unwanted consequences are associated? Surprisingly, according to Rudd et al (2012), experiencing awe is a way to change the perception of how much time is available. The paper defines awe as "the emotion that arises when one encounters something so strikingly vast that it provokes a need to update one's mental schemas". The various experiments were conducted by storytelling and showing a video of commercials with two groups of participants. The groups are compared by having one group experience a story and video involving the feeling awe and the other group experience a story and video excluding awe. Both groups then complete the same survey with questions about time perception and the feeling of awe. The results found that people perceive they had more time available when experiencing awe. Moreover, the feeling of awe can trigger calmness, since these are positive experiences that reduce stress according to Quesnel et al. (2018).
The goal is to design a product that creates an awe experience to result into a calmness and a reduction in the feeling of lack of time or give more value to their time. The artist I will be working with is Noëlle van der Hagen. She who works with organza, a shiny type of textile that is available in many colours. Her artworks have enchantment as core value and evoke curiosity, while being fun and surprising, see figure 1. You will get lost in her artworks, which creates distraction (van der Hagen, n.d.). People who will be involved in this project will be: the chair member (expertise: lighting design, visual communication of light, material, form and space, the measurement and tuning of appearance, and art) & mentor (expertise: material driven design, materials experience, and ongoing research related to textiles and wellbeing), as support staff; other TU Delft employees, as experts; TU Delft, resources; students, as user test participants; family & friends, as user test participants; public spaces, like lobbies, offices, etc. as context.
The feeling of awe can be achieved through different ways and equipment, like storytelling, visuals, sound, etc. The focus for this project will be on the visual part, which will start with the experimentation of the material organza (figure 2) and lighting. During the project, the fabric can change when needed according to findings and/or test results.

Carroll, J. (2008). Time pressures, stress common for Americans.
Newman, K.M. (2019). Why You Never Seem to Have Enough Time.
Rudd, M., Vohs, K. D., & Aaker, J. (2012). Awe expands people's perception of time, alters decision making, and enhances well-being. Psychological science, 23(10), 1130-1136.
Van Der Hagen, N. (n.d.). Over Noëlle.
Wajcman, J. (2018). Digital technology, work extension and the acceleration society. German Journal of Human Resource Management, 32(3-4), 168-176.
Quesnel, D., Stepanova, E. R., Aguilar, I. A., Pennefather, P., & Riecke, B. E. (2018, August). Creating AWE: artistic and scientific practices in research-based design for exploring a profound immersive installation. In 2018 IEEE Games, Entertainment, Media Conference (GEM) (pp. 1-207). IEEE.

space available for images / figures on next page

Initials & Name H Koç Student number 4729293

Title of Project Visual awe experience by interactions between materials, lighting & form

introduction (continued): space for images

image / figure 1: One of Noëlle's artworks (Van Der Hagen, n.d.)

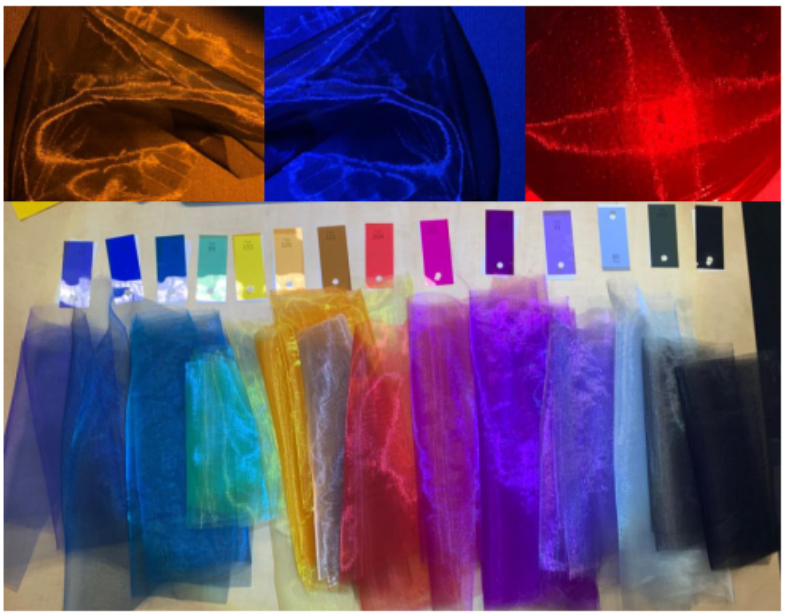


image / figure 2: Reflections on organza (Van Der Hagen, n.d.)

Initials & Name H Koç Student number 4729293

Title of Project Visual awe experience by interactions between materials, lighting & form

Personal Project Brief - IDE Master Graduation

TU Delft

PROBLEM DEFINITION **

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

Through the papers, we know that it is possible to change the perception of time with the feeling of awe and reducing stress by providing calmness. However, how do you create an awe experience with a fabric and light (visual) that can be implemented in an artwork? What effects are possible and which of these will help create an awe experience? There is also the possibility to explore the variable of time.

To realise the graduation project in a time of 20 weeks, I will limit myself in creating an awe experience by researching the effects of form, material and colours in combination with lighting, and conducting tests with participants.

The awe experience can be slightly different for people due to cultural, social, etc. effects, which need to be investigated. Apart from that, people perceive colours differently as well for the same reasons in the previous sentence. Due to these reasons, the users will be limited to people in The Netherlands, since there are already people with different backgrounds.

There are several senses that can be triggered to create the awe experience. For example, you can implement visuals, sound, smell and feel. By limiting these many options and combinations, the focus will be on a visual creations. If necessary, another sense could be added to enhance the visual effect. There are also many combinations between colour, form and lighting. Each of these can be examined separately, but a combination can produce unexpected results.

In order to create the best awe experience, the Material Driven Design (MDD) method will be applied. It is a systematic design process starting with a material (or a material proposal) and ending with a product and/or a further developed material. It facilitates designing for meaningful material experiences (Karana et al., 2015). The final product will be (part of) an installation, including fabric (and/or other materials) and lighting, that creates an awe experience.

Karana, E., Barati, B., Rognoli, V., & Zeeuw van der Laan, A. (2015). Material driven design (MDD): A method to design for material experiences. International Journal of Design, 9(2), 35-54.

ASSIGNMENT **

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

I want to design a product/artwork to create an awe experience to provide a moment of pausing . The final product will be (part of) an installation, including fabric (and/or other materials) and lighting, which together create a visual effect of an awe experience

I want to find out which colours, forms, material and lighting will give the visual effect of an awe experience. The way to do that is by first collecting research that have done similar studies. What different types of shapes can do with organza as material. Below are examples of research questions:

- What is the definition of an awe experience?
- What are the relationships between the "awe" experiences and the visual appearances?
- Which effects can be created combining materials, colours, form, light and context?
    - o What effects do forms/colours/materials/lighting create?
    - o How will these effects stimulate the experience of awe?
    - o What combinations of forms/colours/materials/lighting are increasing this experience?
- How does the material scatter the light and which gloss and shadow patterns can be created?
    - o How do forms and light interact?
- How do the colours of the materials and light interact?
    - o What colours/combinations create what kind of experience?

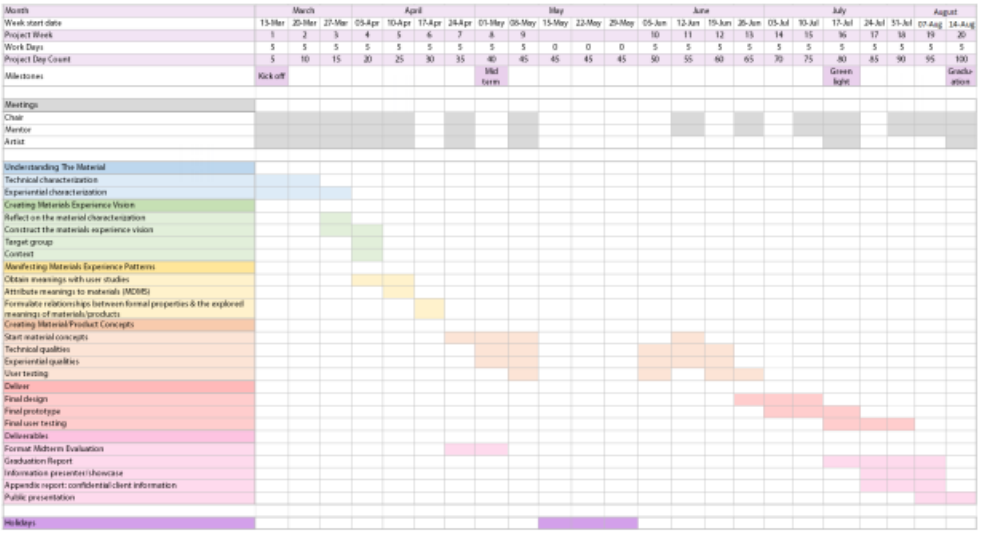
Initials & Name H Koç Student number 4729293

Title of Project Visual awe experience by interactions between materials, lighting & form

PLANNING AND APPROACH **

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

start date 13 - 3 - 2023 18 - 8 - 2023 end date



I will start with doing research by experimenting with organza and lighting. For this I will use the Material Driven Design (MDD) methodology as starting point to get to know the materials and their capacity. With the first experiments some user tests like interviews, observations and questionnaires inspired by the MDD method will be conducted. With that information, I will continue to define or redefine a vision, target group and context. Then, the iterative process starts from concepts until user testing. The first iteration will be done before the holidays and the second after.

Initials & Name H Koç Student number 4729293

Title of Project Visual awe experience by interactions between materials, lighting & form

Personal Project Brief - IDE Master Graduation

TU Delft

MOTIVATION AND PERSONAL AMBITIONS

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

I found this project through my course coordinator of the elective lighting design. I really enjoyed the course and found out about many important topics, such as the effect on lighting in a space and light pollution. I had the feeling that you can achieve so much with lighting and give a product or space such a big impact by adding a lighting aspect. This really inspired me to do a graduation project in this field, in order to learn and explore more about the capabilities of lighting.

Apart from this, I have a past with fabrics. As a child, I really enjoyed my mother's sewing and started exploring fabrics together with her. Eventually, I made clothing for my dolls as well, which I really enjoyed. It is a creative process after all. These experiences also gave me some prior knowledge about fabrics/materials and their form and properties. That is why this project really attracted me.

Personally, I am very curious about the awe experience and I would love to be able to create this experience for myself as well, next to the future users. I think we all need this moment of pausing in life.

What I want to learn and further develop in this project is to be more open and social. I want to be comfortable and confident when I am performing user research. I want to get out of my comfort zone and reach out to people to find out about their perceptions and thoughts. This way I will be able to co create and really centralize the user, while designing. The experience of the user is the centre after all.

Next to that, I really want to improve my visual communication skills by forcing myself to visualize my thoughtprocess. This way, it will be easy to show my client and other stakeholders what goes through my mind. It will also help me to memorize my own ideas from previous ideations.

Lastly, I want to focus on making the prototype and concepts as beautiful and realistic as they can be. I feel like I never really made a fully working prototype on my own and this will be a fun challenge.

All in all, I hope this project will be a very memorable experience and I already know for sure that I will learn a lot!

FINAL COMMENTS

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

Initials & Name H Koç Student number 4729293

Title of Project Visual awe experience by interactions between materials, lighting & form

Appendix G: HREC Checklist

I. Applicant Information

PROJECT TITLE:	**Visual awe experience by interactions between materials, lighting and form**
Research period: *Over what period of time will this specific part of the research take place*	**User tests and its duration: may-sept 2023**
Faculty:	**Industrial Design Engineering**
Department:	**Integrated Product Design**
Type of the research project: *(Bachelor's, Master's, DreamTeam, PhD, PostDoc, Senior Researcher, Organisational etc.)*	**Master's**
Funder of research: *(EU, NWO, TUD, other – in which case please elaborate)*	**TU Delft**
Name of Corresponding Researcher: *(If different from the Responsible Researcher)*	**Hümeyra Koç**
E-mail Corresponding Researcher: *(If different from the Responsible Researcher)*	**h.koc@student.tudelft.nl**
Position of Corresponding Researcher: *(Masters, DreamTeam, PhD, PostDoc, Assistant/ Associate/ Full Professor)*	**Masters**
Name of Responsible Researcher: *Note: all student work must have a named Responsible Researcher to approve, sign and submit this application*	**Sylvia Pont**
E-mail of Responsible Researcher: *Please ensure that an institutional email address (no Gmail, Yahoo, etc.) is used for all project documentation/ communications including Informed Consent materials*	**S.C.Pont@tudelft.nl**
Position of Responsible Researcher : *(PhD, PostDoc, Associate/ Assistant/ Full Professor)*	**Full Professor**

II. Research Overview

NOTE: You can find more guidance on completing this checklist here

a) Please summarise your research very briefly (100-200 words)

What are you looking into, who is involved, how many participants there will be, how they will be recruited and what are they expected to do?

Add your text here – (please avoid jargon and abbrevations)
My research is about creating a visual awe experience through the material organza and lighting. The three user tests are mixed qualitative / quantitative and involve 5-10 participants depending on the test. The participants are invited students and phd candidates. The user test is conducted individually by showing the participant different conditions of a lightsculpture consisting of an organza sample with lighting directed towards it (delivered with commercially available fixtures and projector). The variables change between lighting colour and/or texture and/or intensity, and also the construction of the organza sample. The participant looks to each condition and fills in a questionnaire of three questions for each. The questions are: "What emotions does the experience elicit?", "To what extent do you experience awe?" and "What associations/meanings are elicited by this experience? Why?" The first and last question are also provided with a list of emotions and a set of meanings in order to help the participant articulate their thoughts and gather rating data.

b) **If your application is an additional project** related to an existing approved HREC submission, please provide a brief explanation including the existing relevant HREC submission number/s.

Add your text here – (please avoid jargon and abbrevations)

c) **If your application is a simple extension of, or amendment to,** an existing approved HREC submission, you can simply submit an HREC Amendment Form as a submission through LabServant.

III. Risk Assessment and Mitigation Plan

NOTE: *You can find more guidance on completing this checklist here*

Please complete the following table in full for all points to which your answer is "yes". Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of Personally Identifiable Information (PII) and/or Personally Identifiable Research Data (PIRD) which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alighment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It's worth noting that you're much more likely to need to resubmit your application if you neglect to identify potential risks, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: • One or more collaborating research and/or commercial organisations • Either a research, or a work experience internship provider[1] [1] *If yes, please include the graduation agreement in this application*		**No**				
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? *If yes please provide a copy of the signed DTA/DPA*		**No**				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? *If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below*		**No**				
B: Location						

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?		**No**				
5. Will the research take place in a country or countries outside the EU?		**No**				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		**No**				
C: Participants						
7. Will the study involve participants who **may** be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		**No**				
8. Will the study involve participants who **may** be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?		**No**				
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? *It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student's failure to participate to your satisfaction to affect your evaluation of their coursework).*		**No**				
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?		**No**				
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups		**No**				
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)		**No**				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		**No**				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?		**No**				
E: Subject Matter *Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.*						
15. Will your research involve any of the following: • Medical research and/or clinical trials • Invasive sampling and/or medical imaging • Medical and *In Vitro Diagnostic Medical* Devices Research		**No**				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? *If yes see here to determine whether medical ethical approval is required*		**No**				
17. Will blood or tissue samples be obtained from participants? *If yes see here to determine whether medical ethical approval is required*		**No**				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?		**No**				
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) *Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.*		**No**				
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)		**No**				
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? *If yes please attach the advice/ approval from the Privacy Team to this application*		**No**				
22. Does your research investigate causes or areas of conflict? *If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.*		**No**				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences *If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.*		**No**				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		**No**				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		**No**				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		**No**				
27. Will the experiment involve the use of devices that are not 'CE' certified? *Only, if 'yes': continue with the following questions:*		**No**				
• Was the device built in-house?						
• Was it inspected by a safety expert at TU Delft? *If yes, please provide a signed device report*						
• If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? *If yes, please provide records of the inspection*						
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?	**Yes**		**Possible risk: COVID infection**	**Mitigation:** **1. Advise the participants to stay at home if they have any symptoms.** **2. Keep at least 1.5 m distance between researcher and participant.** **3. Disinfect space and objects used after every user test session.**		
29. Will your research involve **either:** a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants **and/or**		**No**				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
b) artificial intelligence or algorithm training where, for example biased datasets could lead to biased outcomes?						
G: Data Processing and Privacy						
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)	**Yes**		**A consent form will be provided to the participants to explain the purpose and procedure of the study. They will be informed about the data that will be collected. The identifiable information that will be requested from the participants are the name, signature and three options regarding the giving permission for the use of the photos/videos taken during the user test.**	**The personal data (name and signature) of the participants will not be published in any way, and will only be used in the process of analyses by the corresponding researcher.The photos/videos will be deleted after the completion of the graduation project. The provided options in the consent form give the participants the possibility to choose whether their photos/videos taken during the user test can (not) be used in publications where they are (not) recognizable. Nevertheless, the recognizable features of the participants in photos will be blurred/anonymized in case of publications. The videos are only for analyses purposes of the corresponding researcher and there will be no publication.**		
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and **what other Personal Research Data** (including personal or professional views) will you be collecting?	**Yes**		**The personal data (name, signature and photos/videos) are going to be stored on the personal laptop of the corresponding researcher during the graduation project. It will only be used for analyses and reporting on the findings.**	**After finalizing the graduation project, all the collected personal data (name, signature and photos/videos) will be destroyed. There will be no publications including personal data of the participants.**		
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		**No**				
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	**Yes**		**The findings will take part in the Master thesis and final presentation. However, all findings will not include any personal information or identifiable elements. The answers of the participants as results of the studies, referring to emotions, awe experience and meanings which they attribute to the light sculpture, will be included only. So, no actuall risks are identified.**			

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		*Please provide the relevant reference #*	
ISSUE	**Yes**	**No**	**RISK ASSESSMENT – what risks could arise?** *Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!*	**MITIGATION PLAN – what mitigating steps will you take?** *Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.*	**DMP**	**ICF**
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?		**No**				

H: More on Informed Consent and Data Management

NOTE: You can find guidance and templates for preparing your Informed Consent materials) here

Your research involves human participants as Research Subjects if you are recruiting them or actively involving or influencing, manipulating or directing them in any way in your research activities. This means you must seek informed consent and agree/ implement appropriate safeguards regardless of whether you are collecting any PIRD.

Where you are also collecting PIRD, and using Informed Consent as the legal basis for your research, you need to also make sure that your IC materials are clear on any related risks and the mitigating measures you will take – including through responsible data management.

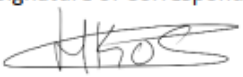
Got a comment on this checklist or the HREC process? You can leave your comments here

IV. Signature/s

Please note that by signing this checklist list as the sole, or Responsible, researcher you are providing approval of the completeness and quality of the submission, as well as confirming alignment between GDPR, Data Management and Informed Consent requirements.

Name of Corresponding Researcher (if different from the Responsible Researcher) (print)

Signature of Corresponding Researcher:



Date: August 24, 2023

Name of Responsible Researcher (print)

Signature (or upload consent by mail) Responsible Researcher:

Date: August 24, 2023

V. Completing your HREC application

Please use the following list to check that you have provided all relevant documentation

Required:

- **Always:** This completed HREC checklist
- **Always:** A data management plan (reviewed, where necessary, by a data-steward)
- **Usually:** A complete Informed Consent form (including Participant Information) and/or Opening Statement (for online consent)

Appendix H: Data Management Plan

Plan Overview

A Data Management Plan created using DMPonline

Title: Master

Creator:Hümeyra Koç

Affiliation: Delft University of Technology

Template: TU Delft Data Management Plan template (2021)

ID: 133612

Last modified: 14-09-2023

Master

0. Administrative questions

1. Name of data management support staff consulted during the preparation of this plan.

The data for my project was discussed with my supervisor.

2. Date of consultation with support staff.

2023-04-28

I. Data description and collection or re-use of existing data

3. Provide a general description of the type of data you will be working with, including any re-used data:

Type of data	File format(s)	How will data be collected (for re-used data: source and terms of use)?	Purpose of processing	Storage location	Who will have access to the data
Anonymised data on emotions, awe experience rating and associations/meanings	PDF	Survey and observations	To find out which conditions elicit the most awe and which emotions and meanigns are linked to that	Project storage drive	The project team (the professor: Sylvia Pont and the postdoc: Stefano Parisi)

4. How much data storage will you require during the project lifetime?

- < 250 GB

II. Documentation and data quality

5. What documentation will accompany data?

- README file or other documentation explaining how data is organised

III. Storage and backup during research process

6. Where will the data (and code, if applicable) be stored and backed-up during the project lifetime?

- OneDrive

IV. Legal and ethical requirements, codes of conduct

7. Does your research involve human subjects or 3rd party datasets collected from human participants?

- Yes

8A. Will you work with personal data? (information about an identified or identifiable natural person)

If you are not sure which option to select, first ask your Faculty Data Steward for advice. You can also check with the privacy website . If you would like to contact the privacy team: privacy-tud@tudelft.nl, please bring your DMP.

- Yes

only in the consent form, not on the survey

8B. Will you work with any other types of confidential or classified data or code as listed below? (tick all that apply)

If you are not sure which option to select, ask your Faculty Data Steward for advice.

- No, I will not work with any confidential or classified data/code

9. How will ownership of the data and intellectual property rights to the data be managed?

For projects involving commercially-sensitive research or research involving third parties, seek advice of your Faculty Contract Manager when answering this question. If this is not the case, you can use the example below.

The data I collect and the results from it will be co-owned by myself and my supervisors Sylvia Pont and Stefano Parisi.

10. Which personal data will you process? Tick all that apply

- Data collected in Informed Consent form (names and email addresses)
- Signed consent forms

11. Please list the categories of data subjects

TUD Students from my personal network and Materials labs staff (colleagues of my mentor)

12. Will you be sharing personal data with individuals/organisations outside of the EEA (European Economic Area)?

- No

15. What is the legal ground for personal data processing?

- Informed consent

16. Please describe the informed consent procedure you will follow:

People I test with will sign a consent form provided by TU Delft

17. Where will you store the signed consent forms?

- Same storage solutions as explained in question 6

18. Does the processing of the personal data result in a high risk to the data subjects?

If the processing of the personal data results in a high risk to the data subjects, it is required to perform a Data Protection Impact Assessment (DPIA). In order to determine if there is a high risk for the data subjects, please check if any of the options below that are applicable to the processing of the personal data during your research (check all that apply).
If two or more of the options listed below apply, you will have to complete the DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to receive support with DPIA.
If only one of the options listed below applies, your project might need a DPIA. Please get in touch with the privacy team: privacy-tud@tudelft.nl to get advice as to whether DPIA is necessary.
If you have any additional comments, please add them in the box below.

- None of the above applies

22. What will happen with personal research data after the end of the research project?

- Personal research data will be destroyed after the end of the research project

V. Data sharing and long-term preservation

27. Apart from personal data mentioned in question 22, will any other data be publicly shared?

- All other non-personal data (and code) produced in the project

29. How will you share research data (and code), including the one mentioned in question 22?

- My data will be shared in a different way - please explain below

My data will be shared as part of my graduation report in the TUD education repository.

30. How much of your data will be shared in a research data repository?

- < 100 GB

31. When will the data (or code) be shared?

- At the end of the research project

32. Under what licence will be the data/code released?

- CC BY

VI. Data management responsibilities and resources

33. Is TU Delft the lead institution for this project?

- Yes, the only institution involved

34. If you leave TU Delft (or are unavailable), who is going to be responsible for the data resulting from this project?

My project - along with all of its data - will likely be deleted if I leave the university. If I am working with anyone who wishes to continue the work, I will leave a copy of the data with my supervisor, Sylvia Pont.

35. What resources (for example financial and time) will be dedicated to data management and ensuring that data will be FAIR (Findable, Accessible, Interoperable, Re-usable)?

None - I will handle all data management on my own using resources provided by the university