Exploring relations between Interaction attributes and Pleasures in multisensory interactive art

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Abstract

The interest in designing interactive systems is going beyond their functionality and more towards their aesthetics. Often, research fails to address how qualities of the interaction as a medium can actually create pleasurable experiences. However, it points out the importance of understanding temporal aspects of interactions to understand their aesthetics. The aim for this thesis is to address this by the creation and evaluation of an interactive artwork working as a platform to explore relations between Interaction attributes and Pleasures, as well as how temporal aspects in interactions can affect these Pleasures. This to help interaction designers think more clearly around and make better design choices regarding interactions within interactive systems. The results of this showed that there can be many such relations, but also that they are complex. Additionally, it is discussed that Pleasures might also partly be experienced before or after the interaction with the artwork.

Keywords: interaction design, interactive art, playful behaviour, user experience, pleasure, multisensory experience design, Interaction Vocabulary, Pleasure framework
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1 Introduction

As pointed out in poems by Charles Bukowski, it is often not the big things, but the small, that drive people mad. Details in the interaction with things and with other people can make a big difference in the experience of interacting with them. According to Saffer (2010), the fundamental ethical guide for interaction designers is the quality of interaction, which is determined in the design choices. He states that “even the placement of a button is an ethical act” (p.214). He means that interaction designers need to consider the consequences of their design choices as they have to be good, and that design research can help designers create empathy for their users by avoiding design choices that would drive them mad.

Now, the interest in designing interactive systems is going beyond their usability and more towards the aesthetics in the interaction with them. There are many types of interactive systems – from voice assistant robots to ATM-machines – that humans engage with. As it will be referred to in this thesis; engaging with an interactive system can mean having a conversation with it. As humans perceive the world around them through their senses, this conversation has to address at least one of the human senses. In addition to the spatial dimensions, this conversation also happens in time, which makes it important for interaction designers to not only consider the spatial dimensions in the design choices for interactions but also the temporal.

To strive for the design of pleasurable experiences resulting from playful behaviour with interactive systems, this thesis aims to explore how interaction as a medium can have different qualities that may result in different types of pleasurable experiences. In this project, an artefact in the form of a multisensory interactive artwork was created as a platform to, through users’ playful behaviour, explore this question. This was made by describing interactions on a technology- and modality-free way, i.e. their Interaction attributes (from the Interaction Vocabulary by Lenz, Diefenbach, & Hassenzahl (2013)) and identifying how they could influence different kinds of pleasurable experiences, or simply Pleasures (from Thirteen Pleasure Categories of Play by Costello (2009)), that were experienced within the artwork. This will be referred to as relations in this thesis. This could potentially aid interaction designers to better understand how their design choices affects pleasurable experiences and by that, make better future design choices regarding them.

1.1 Field

The field for which the artefact created in this project was designed is public research exhibitions for interactive art. One example of such an exhibition is Beta_Space where for example Iamascope, described in section 2.6.4, has been exhibited and evaluated. Costello (2009) explains that these spaces...
provide a field for research within artworks that may be at various stages of completion. Because of this, artworks exhibited in these spaces can be evaluated in an earlier stage compared to a regular public exhibition (Costello, 2009). According to Saffer (2010), laboratories like these are efficient and can benefit the research and evaluation of interactive artworks since they can be evaluated in a controlled environment.

1.2 Research questions

The overall aim in this thesis is to explore relations between Interaction attributes and Pleasures in multisensory interactive art. I am interested in what types of pleasurable experiences that might be linked with the way interactions are designed for users to engage with the artwork, which leads to the question:

- How can we use different Interaction attributes to influence what Pleasures users can experience with multisensory interactive art?

Different Interaction attributes address different dimensions of interactions, and one of those is time. As the research done in this project shows that temporal aspects are fundamental to interactions but there is a lack of knowledge on their impact on the Pleasures, I also want to explore the question:

- How may the temporal aspects of the interaction affect the Pleasures experienced in multisensory interactive art?

1.3 Relevance and target group

One of the main concerns of Interaction Design is *usability* which means that a product should be easy to learn, effective to use and provide an enjoyable user experience (Preece, Rogers, & Sharp, 2002). According to these authors, user experience means how the interaction with a system *feels* like to users, which is what this study focuses on. By creating a multisensory interactive artwork, a new and unfamiliar use situation is presented to users that encourages playful behaviour from which Pleasures can emerge. Costello (2009) means that since play is a universal human behaviour, her Pleasure framework is applicable not only to interactive art but to the field of interaction design in a broader perspective.

Understanding how certain qualities of interaction could result in certain pleasurable experiences with interactive systems could potentially help interaction designers think more focused around the user experience of interactive art as well as other interactive systems and by that, make their design choices more efficient. Because of this, the target group of this thesis is interactive artists, interaction designers as well as the interaction design community.
1.4 Background

Saffer (2010) writes about interaction design as a way for communication that has been around probably since humans used smoke signals to communicate over long distances and stone markers to communicate over time. According to him, the job of interaction designers is to invent future things and make them more humane. Saffer argues that technology is becoming a bigger part of human life through means such as Internet of Things (things communicating with each other and Internet through sensors) and Ubiquitous Computing (embedded invisible computers in things all around humans), which means that interaction designers have a big responsibility in designing these things.

With interactive art, designers are concerned with issues relating to Human-Computer Interaction (HCI) in the same sense as painters are concerned with paint (Edmonds, 2010). Edmonds describes that since the 1960’s, active user engagement has become a part of artworks. Due to the rise of technology and the many ways computers and internet can facilitate it, the interactive processes in interactive systems are complex, but humans can also control these processes in a way that was previously impossible. Edmonds means that this has made the field of interactive art much more common the last decades.

1.5 Definitions

In the literature research done in this project, a variety of different words was come across for explaining the same thing. It is obvious that a common language is important for communicating and discussing the topic, which resulted in Table 1 containing definitions of what significant words used in this thesis refer to.

<table>
<thead>
<tr>
<th>The artwork</th>
<th>The multisensory interactive artwork created as a platform for exploring the research questions within this project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversation</td>
<td>The exchange of input and output between the user and the computer behind an interactive system</td>
</tr>
<tr>
<td>Interactive product</td>
<td>The outcome of a design process that may be an interactive product or a service. This could be an interactive artwork or other interactive system</td>
</tr>
<tr>
<td>Experience</td>
<td>User’s subjective perception of the conversation with an interactive</td>
</tr>
</tbody>
</table>
system that concerns emotions, thoughts, feelings, meaning and pleasure

<table>
<thead>
<tr>
<th>Interaction attributes</th>
<th>Descriptions of interactions on a sensomotoric level according to Lenz et al.’s Interaction Vocabulary (2013) (described in section 2.3.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasures</td>
<td>Categories of the framework called Thirteen Pleasure Categories of Play by Costello (2009) (described in section 2.4.3), which are a part of the user experience of interactive art resulting from playful behaviour</td>
</tr>
<tr>
<td>Relations</td>
<td>Links between Interaction attributes and Pleasures that may explain how they are connected to each other. Relation in this sense could explain how different Interaction attributes may affect the Pleasure users experience with interactive art. This means how the very way we interact with something can affect the way we experience its response</td>
</tr>
<tr>
<td>Temporal aspects</td>
<td>Qualities in interactions that concern how they exists in or unfold over time</td>
</tr>
<tr>
<td>User</td>
<td>The audience, or the human engaging with interactive artworks. Exceptions of these are in the sections called Methods and Evaluation where they will instead be called participants</td>
</tr>
</tbody>
</table>

Table 1. List of significant words used in this thesis.
2 Theory

This chapter presents theory used in different phases of the design process within this project. Each section includes a motivation for why it is relevant to understand.

2.1 Interaction design

This section explains what interaction design is as well as some key factors of interaction. The purpose of this is to form an understanding of what constitutes an interaction, which is crucial to describe Interaction attributes.

“Interaction design is the designing of interactive products to support people in their everyday and working lives.” (Preece et al., 2002, p. 6)

Saffer (2010) means that every time a designed product behaves, it involves interaction design which has its roots in industrial and communication design, human factors, and human-computer interaction. He explains that much of the interaction is invisible and because of that, two products looking identical can feel different because of their behaviour being different from each other.

Apart from having commercial value, interaction designers need to create things that have great human value and relevance to human life (Saffer, 2010). According to the author, it is a responsibility of interaction designers to understand the emotional, cultural and aesthetic context that their design will exist in.

2.1.1 Materials of interaction

In contrast to other design disciplines using raw materials, the design elements within interaction design are more conceptual (Saffer, 2010). Saffer describes that one of these materials is motion. Without motion, there is no interaction. He explains that movement happens in some kind of space which can be either physical or digital, and that interaction designers often mix these. Users can make a movement in a physical space, for example moving a computer mouse on a table, and see the results on a digital display, or make a movement in the digital space, such as pressing a play button on their computer, and hear a song playing from the stereos in the physical space.

In addition to this, interaction designers need to be aware of the fact that interactions do not only take place in space, but also over time (Saffer, 2010). According to Saffer, tasks can be easy or complicated, but they always take a certain amount of time to accomplish. This will be further discussed in section 2.5.
2.1.2 Affordances and signifiers

The term affordances was coined by James Gibson in 1966 but perhaps more popularized by Norman (2013). Gibson and Norman have different backgrounds in design, and in this project, Norman’s explanation will be used because it resonates with what is relevant to know about affordances and signifiers to apply it to my work. It might be considered questionable to mention these terms in this project since Norman is from the world of usability and the interest here is aesthetics. However, I want to try and include these as they might help explain some factors of the interaction with my interactive artwork that are relevant to understand the Pleasures that users can experience with it.

“An affordance is a relationship between the properties of an object and the capabilities of the agent that determine just how the object could possibly be used.” (Norman, 2013, p. 13)

There is an intention behind every physical action (Bialoskorski, Westerink, & van den Broek, 2009). Affordances describe what actions are possible to do with an object. However, they do not describe how to do so. For that, Norman (2013) writes about signifiers as indicators that tell users about appropriate behaviour in the interaction with the object. Physical attributes such as size, shape and weight can let users know something about an object that affects the way they engage with it (Saffer, 2010). Saffer explains that the appearance of the object also conveys emotional content. Additionally, he describes that how an object feels in the hand can inform the user about the object in the same way as appearance can. The sensation of the object can tell something about how, as well as when and where, to interact with it. And just like appearance, Saffer means that textures can convey emotion as users create meaning in what physical qualities they can feel of the object.

2.1.3 Feedback and controls

Digital products often have some kind of feedback, in other words, an indication or acknowledgement that something happened when a user interacted with it (Saffer, 2010). Saffer means that designing appropriate feedback is the designer’s task and therefore they have to determine how, and how quickly, the digital product will respond to users.

Saffer (2010) explains that digital products are made up of technical components that lie behind an interface which is where users can engage with a design. According to Saffer, controls manipulate the feature of a design and provide both the information needed to understand how to use a design as well as the means to do so. Saffer explains that different types of controls have different feedback mechanisms that interaction designers should consider. He gives many examples of qualities of different controls such as the stepwise interaction of a simple switch to the fluent range of a slide, which relates to the Interaction attributes explained in section 2.3.4.
2.2 Multisensory experience design and tangibility

The artwork created as a platform to explore the research questions in this project is a multisensory artwork containing a tactile interface and audio-visual feedback. This section describes multisensory experience design and tangibility which played a role in the design choices for the artwork (see chapter 4).

In the field of HCI, vision and audition has long been the dominating senses to use for interaction (Obrist, Gatti, Maggioni, Vi, & Velasco, 2017). However, there are more human senses that interaction design can make use of. Obrist et al. explain that multisensory experience design is a relatively new design field that addresses the human senses as well as how they interrelate when designing experiences. According to them, multisensory experience design is of particular interest for museums and art galleries as they hope it can help engage users with artworks, convey meaning and enhance the user experience of the artwork.

According to Obrist et al., (2017), human senses can be divided into the chemical ones – taste and smell, and the physical ones – sight, hearing, and touch, and one challenge for understanding multisensory experience design in HCI is how to meaningfully stimulate the senses when interacting with technology.

Humans process much information via the sense of touch and this particular sense is fundamental in many interactions (Obrist et al., 2017). Obrist et al. have made several projects to explore the possibility to use touch as a way for communicating emotional content. And closely linked with the sense of touch, there is tangibility. Tangible design combines digital information with physical objects and surfaces (Preece et al., 2002). Sheridan and Bryan-Kinns (2008) illustrate three different types of tangible interactions shown in Image 1.
The feeling of tangible interactions can also be related to Löwgren’s (2009) concept of pliability which describes a quality in interactions that “feels tightly coupled and highly responsive” (p.5). This response to human action could be understood as similar to shaping a physical material such as clay with the hands.

2.3 Interactive art

This section describes interactive art as the platform to explore my research questions is an interactive artwork. For my knowledge contribution to make sense, it is therefore important to understand what constitutes interactive art and how interaction works as a medium within it.

Researchers in the field seem to agree on interactive art being an ambiguous field requiring interdisciplinary research involving art, technology and science (Muller, Edmonds, & Connell, 2006; Edmonds, 2010). According to evaluations of previous work, the experience of interactive artworks seems to be meaningful to the user in the very moment they interact with it (Costello, Muller, Amitani, & Edmonds, 2005; Muller et al., 2006). What is significant with interactive art compared to other art disciplines is that it invites users to engage with it, which is also where the creative process finishes (Edmonds, Bilda, & Muller, 2009). As Edmonds et al. argue, this means that the interactive art itself is created when a user is actively engaging with it, making them not only a spectator but also a creator of the art.
2.3.1 Engagement

Edmonds (2010) explains that, when creating interactive art, the artist is interested in how the artwork behaves, how the user interacts with it as well as their experience and level of engagement with it. This is strengthened by Costello and Edmonds (2007) who describe that one concern in the design process of interactive art is how to motivate users to interact and engage with the artwork. Edmonds (2010) defines engagement with interactive art as direct and physical participation that explicitly changes the artwork. According to him, this engagement is an interactive activity that can be seen by movement, sound or changing images rather than only existing in the user’s head.

2.3.2 Exchange of input and output as a conversation

Engaging with interactive art can be explained as actively being a part of a cyclic process where users have conversations with the artwork through interaction (Edmonds, 2010). Muller et al. (2006) continue to explain that, with interactive art, this conversation is not only psychological but also material in the exchange of input and output between the user and the computer behind the artwork. They mean that this results in a unique piece of art for each person encountering it. This is also discussed by Lopes (2001) who questions that interactive artworks are artworks themselves but rather devices to generate many individual works of art.

The conversation between the user and the computer behind the interactive artwork is driven by the user’s curiosity or aim for satisfaction (Edmonds, 2010). In addition to this, there are other aspects involved in this conversation called attractors – factors of the artwork that call for the user’s attention, and sustainers – factors of the artwork that keep the user’s interest in interacting with it (Edmonds et al., 2009). This suggests that an interactive artwork can, apart from answering to user actions, also call for initiating a conversation and manipulate the user into wanting to keep the conversation going.

2.3.3 Playful behaviour

One way of encouraging engagement with interactive art can be through playful behaviour (Costello, 2009; Costello & Edmonds, 2007). Previous research shows that focusing on play is one approach to encourage engagement and exploration which therefore is a useful approach to the design of interactive art as well as other playful interactive systems (Costello, 2009). Costello and Edmonds refer to Groos (1901) who explains that play occurs when an act is performed only because of the pleasure emerging from it.

According to Costello (2009), engagement and exploration both occur during playful behaviour. Lenz et al. (2013) also explore playful behavior as a way of achieving a deep level of audience engagement with interactive art. Costello
explains that the unfamiliar becomes familiar during exploration which results in play where the user switches back and forth between the questions of what an object can do and what they can do with the object.

### 2.3.4 Interaction as the medium of engaging with interactive art

According to Lenz et al. (2013), few researchers in the interaction design community and related design fields explicitly discuss links between how interactions are performed and what experiences they convey. They refer to Hassenzahl (2010) who suggested to divide designs in the What-, the How- and the Why-level. The What-level is the functionality; what is possible to do with an interactive product. The How-level is the sensomotoric; the way in which interactions with the material were arranged to do something with the product. The Why-level focuses on experience; the subjective impression emerging from the interaction in the use situation. Lenz et al. argue that all levels are important, but that researchers and designers need to acknowledge their conceptual difference and their relation to each other. This because many address the experiences emerging through interaction in the Why-level but fail to explain how interactions actually can form these experiences in the How-level.

Based on the Why- and the How-level, Lenz et al. (2013) created a framework called the Interaction Vocabulary that describes attributes of different interactions on the How-level. They explain that these descriptions of interactions, or as they call them, the Interaction attributes, are technology- and modality-free and provide a language to communicate how an interaction feels. The Interaction Vocabulary consists of a set of eleven dimensions that interactions can traverse between as illustrated in image 2.

![Image 2. Illustration of the eleven dimensions of Interaction attributes in the Interaction Vocabulary.](image2.png)

When referred to, these Interaction attributes will be written with a first capital letter in this thesis to be easily identified in the text.
2.4 Experience

As touched upon in the last section, many studies in the field focus on experience but fail to explain that they actually emerge from interaction (Lenz et al., 2013). Muller et al. (2006) argue that studying the user experience of interactive art is fundamental to understand interaction as a medium.

Experience is one fundamental factor to address in this project as it covers pleasure which is part of the aesthetic experience with interactive art and one main focus for the evaluation of my artwork. In this section, aesthetics will be described in a broad perspective as part of the user experience in interaction design followed by a motivation for why I narrowed down my scope of it to Pleasures.

Experience is a complex process that has long been studied within social sciences but is by no means easy to evaluate (Costello, 2009). At the same time, many agree that it is a fundamental issue in interaction design (Forlizzi & Battarbee, 2004; Norman, 2013; Preece et al., 2002). Norman means that experience is critical because it is how users remember their interactions. According to him, user experience in interaction design covers aesthetics, pleasure and fun. Understanding this is central for interactive art making (Edmonds, 2010).

2.4.1 Aesthetics

As explained in the section above, aesthetics plays a major role in the user experience of interaction design. Nonetheless, Edmonds (2010) explains that there is a lack of a simple recipe for interaction and experience design. Previously, interaction design was mostly concerned with the functionality of interactive products but today, interaction has to feel good and be beautiful (Lenz et al., 2013). This is interaction aesthetics, which according to Lenz et al. is crucial for designing interactive products. Petersen, Iversen, Krogh, & Ludvigsen (2004) explain that aesthetics goes beyond the immediate visual impression of designs. In fact, they mean that aesthetics lies in the interaction itself. This lead to the question of what constitutes an aesthetically pleasing interaction.

Löwgren (2009) writes about aesthetic statements of interactive products as a positive or negative taste judgement of a sensory impression and that the valence of these statements does not have to do with the product’s appearance.

“To say that something looks good, feels stimulating or smells awful is an aesthetic statement; factual reports on sensory impressions – looks blue, feels uneven, smells acidic – are not aesthetic statements.” (Löwgren, 2009, p.3)
2.4.2 Pleasure

Norman (2013) describes that the challenge in design is to create products that adds to users’ pleasure and enjoyment. To try and contribute with knowledge to this, I chose to target my perspective on aesthetics by focusing on pleasure. My interpretation of pleasure resonates with the description by Löwgren (2009) as a positive aesthetic statement referred to in the section above because of their positive emotional value tied to the interaction with an object.

With interactive art, Edmonds (2010) describes that the interaction with a computer-controlled device can be driven by some form of pleasure or curiosity. He writes that the conversation between the user and the artwork continues until a goal is reached or the human is satisfied or bored (Edmonds, 2010). When viewed alongside Costello’s (2013) framework (described below) which describes pleasure as an output of the interaction, this seems to mean that pleasure can be both an experiential result of the interaction as well as a driving factor for interacting with interactive art.

2.4.3 Costello’s Pleasure framework

To distinguish between different kinds of pleasures that users can experience with interactive art through playful behaviour, Costello (2009) created a framework called Thirteen Pleasure Categories of Play. Costello has used this as a tool to address key Pleasures to strive for in the creation of interactive art, as a base for user surveys in artwork evaluations as well as a code during evaluation analysis of interactive artworks. She explains that this framework is useful as a tool in the evaluation of interactive art as it helps create a common language between the designer and the user. In this project, it was therefore used in the evaluation sessions as a tool to communicate about experiences with participants (see section 4.4) as well as a tool to analyse relations between the Pleasures to the Interaction attributes experienced with the artwork (section 4.5).

This project more thoroughly covers six of the Pleasures that were the most prominent during the evaluation sessions and therefore became the main focus to analyse with the Interaction attributes in section 4.5. Based on Costello and Edmonds’ (2007) explanation of the framework, these six Pleasures are described in table 2.
<table>
<thead>
<tr>
<th>Pleasure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td>The pleasure of exploring an unfamiliar situation that all interactive artworks provide.</td>
</tr>
<tr>
<td>Discovery</td>
<td>The pleasure of discovering how something works within the interactive artwork, for example how to control elements within it. This can relate to aesthetic aspects such as understanding how to provoke different visuals or sounds with different actions.</td>
</tr>
<tr>
<td>Danger</td>
<td>The pleasure of feeling afraid or uncertain about how an interactive artwork will respond to actions.</td>
</tr>
<tr>
<td>Captivation</td>
<td>The pleasure of feeling immersed, spellbound, driven or controlled by something within the interactive artwork.</td>
</tr>
<tr>
<td>Sensation</td>
<td>The pleasure emerging from feelings of physical objects of the artwork, or actions made when interacting with it, such as body movement, touch, hearing and seeing.</td>
</tr>
<tr>
<td>Camaraderie</td>
<td>The pleasure of socializing and feeling a sense of friendship, fellowship or intimacy with a perceived entity within the interactive artwork.</td>
</tr>
</tbody>
</table>

Table 2. *Six Pleasures from Costello’s framework used in this project.*

According to Costello and Edmonds (2007), each of these categories can create pleasure as much as displeasure. They clarify that they are only possible pleasures experienced with interactive art and do not determine whether the artwork is good or bad. Interactive artworks can involve a combination of Pleasures, only one of them or all. As Costello (2009) points out, the users’ personalities can play a big role in which of the pleasure categories they experience with an interactive artwork as they approach the situation with different expectations, aims and values.

Just like the Interaction attributes, these Pleasures will be written with a capital first letter when referred to in this thesis to be easily identified.
2.5 Time

Two of the dimensions in the Interaction Vocabulary illustrated in section 2.3.4 cover temporal aspects of interaction, namely Fast – Slow and Instant – Delayed. Löwgren (2009) means that interactions happen over time and that their temporal aspects need to be addressed to understand their aesthetics. In addition to this, Costello (2009) explains that play is a movement that involves both action and response which points to the importance for designers who wish to work with play to address the temporal aspects of this movement.

Frisk and Karlsson (2010) write that there are art practises that are embedded in time, which means that time has a fundamental role in the creation and experience of it. Along with this, it is argued that interactions in real-time art forms are subject to constant change. From this, it seems like the experience with interactive art itself is also dynamic and will change throughout time. The authors point out the question whether or not real-time art can be represented independent of time. On this note, they refer to Xenakiz (1971) as an early example of an argument that the existence of a piece of art can extend outside time as a representation in people’s memory that can be navigated through and accessed at any time. This opens up for the idea that the Pleasure categories may be prolonged and re-experienced outside the interaction with the artwork as well since users may access the memory of them retrospectively.

Frisk and Karlsson (2010) refer to Dixon (2007) who describes that theory and criticism about digital arts relate to how works explore, challenge, reconfigure or disrupt notions of time. Despite this, few studies involving the Pleasure framework directly address temporal aspects when evaluating interactive artworks, as will be described in the next section.

2.6 Related works

This section will describe other artworks related to this project. In section 2.6.5, it is motivated why they are relevant.

2.6.1 Elysian Fields

Together with artist Ian Gwilt and sound artist Dave Burraston, Brigid Costello created Elysian Fields in 2003 (Costello & Edmonds, 2007). It is an interactive installation consisting of a screen and interactive animations and sounds (see image 3). The visual animation represents a field of abstract grass that is projected on a wall-sized screen. The participant interacts with the installation by moving around in front of the installation. This triggers music playing in the background as well as the grass on the screen to move, change shape and rhythm. This interactive installation was designed with three different levels of viewer experience that Costello and Edmonds (2007) describe as fascinated observation, non-goal-oriented exploration and goal-
oriented interaction. It was then evaluated with Costello’s Pleasure framework explained in section 2.4.3.

Image 3, Two views of Elysian Fields interactive artwork (Costello & Edmonds, 2007).

2.6.2 Sprung!

Shown in Image 4, Sprung! is partly a toy and partly a musical instrument that was created by Brigid Costello in 2004 in collaboration with animator and sound designer Alastair Macinnes (Costello, 2009). When participants stand on one of three pressure sensitive pads on the floor, a sound is played and three coil springs are animated to release bubbles in a cartoon style on a large wall-sized screen in front of them. This work was also evaluated with Costello’s Pleasure framework.

Image 4, Two views of the Sprung! interface (Costello & Edmonds, 2007)

2.6.3 Mood Swings

Created by Bialoskorski et al. (2009), Mood Swings uses movement through a tactile interface as an input for coloured light as output (see Image 5). It consists of eight luminous orbs hanging from the ceiling. Bialoskorski et al. write that it is claimed that the characteristics of movement change depending on what emotion a person is feeling. Therefore, these orbs have sensors to measure the participants movements, and lights up in a specific colour depending on how the participant moved.
2.6.4 Iamascope

Iamascope was created by Sidney Fels in 1997 and is an interactive kaleidoscope projected on a large screen (Costello et al., 2005). It records and translates the participants movements through a hidden camera beneath the screen and projects a distorted image of them on the screen as shown by Image 6. Fels presents four embodied relationships that can be experienced with Iamascope which he calls Response, Control, Contemplation and Belonging (Costello et al., 2005). The first relationship, Response, is when the participant perceives the interactive artwork to be separate from their own self. Control is when the participant feels like they are in control over the artwork and able to play with it. Contemplation is a non-interactive relationship where the participant is stimulated by observing what the artwork is communicating. Belonging is when the participant gets pleasure from the feeling of being controlled by the artwork.

2.6.5 The artworks relevance to this project

Looking across these interactive artworks, there is a common interest in identifying different kinds of pleasurable experiences with interactive art. However, the focus is often on using these as a starting point for the desired experience in the creation of the artwork rather than addressing how the qualities of the interaction designed within it can help achieve these
experiences. As previously stated, considering temporal aspects is also important to understand aesthetics of interactions, which has little focus in these works.

3 Methods

As explained in section 2.4, experiences emerge from interaction and interactions in interactive art means an exchange of input and output between a user and a computer behind the artwork. This argues for the need of practical work when exploring relations between Interaction attributes and Pleasures. Image 7 shows how the design process in this project went back and forth between literature research and creation of the interactive artwork to redefine the research questions according to a deeper understanding of the theoretical and practical knowledge produced.

It was important to have a theory-heavy approach to this project to create a thorough understanding of the ambiguous terms investigated (such as aesthetics, experience and relation). To be able to explore relations between Interaction attributes and Pleasures, it was needed to understand what factors lie as a foundation for them. The literature research showed that many of these words are multi-layered and need to be unpacked to understand their relevance in the field of multisensory interactive art. In addition to this, different knowledge from the theory concerned different parts of the artwork, making the parallel process a good way to read literature always relevant for a certain element of the artwork as well as see where knowledge was needed to progress within the project.

Image 7. Model of how the design process went back and forth between literature research and practical work.
3.1 Literature research

Literature research was made in this project to understand what interactive art is, what engagement with interactive art is, what user experience with multisensory interactive art means, what aesthetics could mean in those experiences, whether interaction as a medium could potentially facilitate the emergence of pleasurable experiences and ultimately, to find two frameworks that could be used to describe these factors within multisensory interactive art. The literature research was made in the following topics: interaction design, interactive art, multisensory media, user experience, interaction aesthetics and tangibility.

3.2 Workshop

The platform for exploring the research questions within this project required some kind of interface for users to interact with it. From the theory, it was evident that the physical attributes of things can give users hints about how to interact with them (see section 2.1.2) and that experiences emerge from interaction (section 2.4). A workshop was conducted to gain some initial practical knowledge on how these two insights come to play when users are introduced with everyday objects. This workshop was designed by me as it would then work as inspiration for the controls (described in section 2.1.3) within my artwork to match its envisioned concept explained in section 4.3.1.

Based on the notion of affordances and signifiers described in section 2.1.2 and multisensory experience design and tangibility described in section 2.2, this workshop explored how users interact with objects with different physical attributes as well as what subjective experiences can emerge from doing so. This with the aim to aid the design choices regarding the physical material of the artwork in the next phase to encourage playful behaviour and exploration.

3.3 Prototyping

Following the inspiration gained for the controls of the artwork, the creation of it started to be able to explore the research questions through the platform.

Saffer (2010) describes that controls are just documents and cannot be interacted with by themselves. For that, he means that the designer needs to prototype which is about refining a design in a way that involves timing, animation, movement and interaction.

According to Saffer (2010), prototypes express an interaction designer’s vision. In this phase, an artefact in the form of a multisensory interactive artwork was created as a prototype of a platform to explore the research questions presented in section 1.2. Based on Saffer’s explanation that appearance, texture and sound constitute any interaction designer’s toolkit,
this prototype was designed as an artwork including interactive elements that were visual, tactile and audial.

3.3.1 Framework for creating

Lenz et al.’s Interaction Vocabulary (2013) described in section 2.3.4 was used in the prototyping phase to plan and make a model of the intended interaction within the artwork. This is further explained in section 4.3.2.

This framework was used to make the thinking as well as the design choices regarding the interaction within the artwork as focused as possible by purposefully plan a certain type of interaction. This resulted in a text-based model of the interaction within the artwork. In the analysis phase, this model was then compared to the data from the evaluation with users to try and link back the reason for why certain Pleasures were experienced to the Interaction attributes of the artwork. More is written about this in section 4.5.1.

3.4 Evaluation

The evaluations in this project were conducted to collect detailed data on users’ experienced Pleasures and try to relate that back to the Interaction attributes of the artwork created. Six participants were invited to individual sessions where they engaged with the artwork and discussed their experience of doing so. This data was then compiled and analysed, trying to link the reason for why the Pleasures emerged back to the Interaction attributes within the artwork.

Due to the scope of and the resources within this project, the evaluation sessions could not be conducted in a real setting of a research exhibition lab. Instead, they were conducted in a calm, enclosed and dark room where the participants were alone with the artwork which was meant to encourage playful engagement. With this, there comes a risk of producing a false view on the relations between Interaction attributes and Pleasures identified. However, Costello (2009) means that such a context is important if the aim of the evaluation is to produce all the possible Pleasures that users can have with the artwork, whilst the aim of this evaluation was to identify relations between Interaction attributes and Pleasures and therefore it is not needed to produce the whole range of possible Pleasures within the artwork. One advantage with this could be that it could reduce the anxiety that users can experience in public exhibitions (Costello, 2009), which encourages the playful behaviour needed to experience the different Pleasures.

3.4.1 Framework for evaluation

Previous work shows that there is a fundamental need for a language around interaction and experience to be able to describe, compare and discuss interactive art (Edmonds, 2010). With regards to this, Costello’s Pleasure framework (Costello 2009) was used to identify and discuss around different
types of Pleasures the participants experienced in the interaction with the artwork created.

### 3.4.2 Video-cued recall + interviews

Since the artwork used audio-visual output, video could allow participants to retrospectively look back at their interaction with the artwork and remember the experience in more detail. To gather data as a foundation for analysing what Pleasures were experienced with the artwork, the video-cued recall method was therefore used. Many agree on the video-cued recall method being a good method for evaluating user experience of interactive art (Bialoskorski et al., 2009; Costello, 2009; Costello & Edmonds, 2007; Edmonds et al., 2009) This is because it enables users to freely interact with the artwork while also being able to remember their experience when seeing it on video without being interrupted (Costello, 2009). According to Costello, this is a big advantage of the video-cued recall method when compared with for example the think-aloud method where users are asked to talk about what they are doing while they are doing it, which can cause them to be very self-conscious about their performance.

Costello and Edmonds (2007) write that researchers at the Creativity and Cognition Studios (CCS) encourage the use of video-cued recall when collecting data for interactive art evaluations. According to them, CCS also points out that expert users can be significantly useful when evaluating interactive art prototypes due to their ability to conceptually engage with its unfinished nature.

This method is often paired with complementary interviews, which are great for understanding attitudes and experiences (Saffer, 2010). A qualitative research approach was taken in the interviews since it, according to Saffer (2010), is targeted with a smaller and targeted sample size and more subjective due to the questions concerned more with the How and the Why, in contrast to a quantitative approach involving large sample sizes and questions concerned with the What. To identify what Pleasures may emerge from Interaction attributes in this project, the How and the Why were the most important dimensions to address in the evaluation phase.

### 3.4.3 Analysis

When the data from the evaluation sessions was gathered, it was analysed to find relations between Pleasures and Interaction attributes. The data was colour coded and sorted on a big piece of paper to get a broad overview of the data and to able to link different expressions from the participants to the Pleasures and the Interaction attributes within the artwork.

### 3.5 Ethical considerations

In addition to what is efficient, effective and aesthetically pleasing, interaction designers need to think of ethics which concerns how to
distinguish between good and bad design in terms of what is just and humane (Saffer, 2010). This project follows the ethical guidelines from Vetenskapsrådet (2017). All participants were treated with transparency, respect and anonymity as were informed about their rights and the potential risks of participating in my project.

In this project, ethical considerations concern subjective matters such as pleasure in interaction with multisensory interactive art. Identifying this could potentially be used in unjust or inhumane ways, if used in design with non-ethical considerations. Using this knowledge makes the designer capable of determining what users can feel when engaging with the artwork. What is considered a pleasurable experience for some people could potentially cause displeasure for others which, when used in a design, raises the question of whether some people are more deserving of experiencing pleasure, or displeasure, than others.

In addition to this, pleasure might not always be the most desirable experiential outcome of interactive systems. If using the knowledge on how Interaction attributes can affect Pleasures, it is therefore important to consider if the context for that future design should encourage playful behaviour. For instance, even if systems used in medical purposes should have a good usability, it may not be appropriate for them to be playful.

4 Design process

Initially, the main interest in this project was to explore how an interactive artwork could be perceived as a character and how interaction as a medium could facilitate the feeling of having a social relationship with it (similar to Camaraderie in Costello’s framework). As very little previous research was found on this narrow topic, and with regards to the timeframe within this project, it was difficult to find an effective way of continuing in that direction. The choice was then made to take a step back and explore different types Pleasures in a broader sense and how they relate to Interaction attributes in the field of multisensory interactive art.

According to Lenz et al. (2013), describing interactions with the Interaction Vocabulary also requires experiencing the interaction itself. This argues for the relevance of practical work and need of an artefact to explore this. It was chosen to work with the physical senses referred to by Obrist et al. (2017) in section 2.2 (vision, audition and touch) since it seemed possible to explore Pleasures emerging from Interaction Attributes by creating an artwork with audio-visual output that responds to an input through a tactile interface.
4.1 Literature research

The literature research was made by reading books and papers about interaction design, the nature of interactive art, aesthetics, theories on experience of interactive art as well as reviewing creations and evaluations of interactive artworks, particularly those with Costello’s Pleasure framework. This data was then compiled and presented in chapter 2.

4.1.1 Findings

Due to the subjective and ambiguous fields of aesthetics and experience, researchers in the field seem to use different words for describing the same thing, as well as the same word to describe different things. When searching for literature of aesthetics within interaction design and interactive art, authors sometimes used the word aesthetics only to describe visual appearance of designs while others described it as an overarching dimension that exists in all parts of an artwork (which is the definition adopted in this thesis). As image 8 shows, many mind maps, drawings and diagrams were made to link the findings from the literature together.

Image 8. Trying to make sense of the literature by drawing mind maps and diagrams.

Here, it was found that authors also argued for the importance of considering temporal aspects within interaction when evaluating experience in interactive art (Frisk & Karlsson, 2010; Löwgren, 2009), which was something found to be little discussed in evaluations of interactive artworks using Costello’s Pleasure framework (Costello & Edmonds, 2007; Costello, 2009). This is why the choice was made to include this in the research questions to explore within the artwork created in this project.
4.1.2 Insights

The literature research made it very obvious about the importance of words when describing design. This led to the insight that a shift of focus was needed in the framing of the project as the abstractness of the words made it difficult to find an effective way of working with the topic. To simplify the design activities and clarify the language when writing about interactions and experience, the two frameworks for distinguishing different kinds of Interaction attributes and Pleasures were chosen as a foundation for the creation and evaluation of the interactive artwork in this project.

4.2 Workshop

When the focus was narrowed down to exploring Interaction Attributes and Pleasures in multisensory interactive art, a workshop was conducted to gain inspiration for what controls to design for the artwork as that would be one main element for the interaction with it. The workshop was conducted with five participants that were all between 23-25 years of age. It was explained to all of them that they were part of a study as well as its purpose. They were informed about the potential risks and the benefits of their participation and that their personal data would be respected and handled anonymously. All participants could cancel their participation at any given point and signed a consent form to agree to these statements.

With regards to the writing on affordances and signifiers described in section 2.1.2, the workshop consisted of two activities and one discussion regarding what subjective experiences could emerge from tactile interaction with texture of physical objects.

The first activity was a creative exercise where the participants were asked to make art with different techniques such as drawing with pencils, drawing with oil crayons, drawing on a digital Wacom tablet, oil painting with brushes and oil painting with sponges. This activity ended with a discussion about how it felt, in the sense of the How-level described in section 2.3.4, to create art with these different techniques.

Since the controller for the artwork would be tactile, the second activity more deeply explored the sense of touch. The aim was to identify physical attributes of objects by letting the participants, blindfolded, examine objects with their hands and explain their physical sensation as well as what interactions they thought they could do with them. This activity was made blindfolded to prevent the participants from being biased by the visual appearance of the objects and only rely on what they felt like in their hands.

Lastly, the participants were asked to discuss around the pleasurable sensations they felt in response to the physical attributes of, as well as the interactions they had with the different objects. All quotes in the following section are translated from Swedish to English by the author.
4.2.1 Findings

In the first activity, all participants thought that the techniques they felt like having the least amount of precision of, such as painting with a sponge or choosing a Special Effect Spatter brush in Photoshop when drawing on the tablet, made them the most explorative in the creation of art because it was intriguing to see how different the output was each time they made a paint stroke. Participant 2 expressed that this was especially apparent when painting with the sponge that had a big surface compared to the brushes, for example. Some participants also thought that the techniques they had to refill with colour – i.e. painting with brushes and sponges – were disruptive of the workflow which they felt affected their creativity negatively.

In the second activity, Participant 5 described the feeling of a fur scarf as “light” whilst a metal ball was “round” and “smooth” (personal communication, 2019) (see Image 9). Participant 1 described the interaction with light objects as “throwing”, “rolling” for round objects and for smooth objects, Participant 3 said “stroking” (personal communication, 2019).

![Image 9. Participants interacting with physical objects.](image)

In the discussion, it became apparent that objects that took a longer time for the participants to recognize were more interesting for them to interact with compared to those they could identify immediately. For example, objects with holes seemed to encourage exploration. Participant 4 thought that there was something intriguing about putting his fingers inside the holes because he wanted to know how it felt inside.

Overall, heavy, hard and smooth objects made the participants treat them more gently and carefully compared to light, soft and rough textured ones. Light and fluffy objects were thrown in the air. An exception was the fluffy fur scarf that Participant 1 and 3 thought of as a “pet” which made them want to stroke it and treat it gently. Participant 2 said that the heavy silver sphere “felt almost magical to touch” (personal communication, 2019) due to its round shape, weight, the smooth surface and size to perfectly fit in the hands.

All participants expressed that it was intriguing to feel the strong contrasts between different materials in a short amount of time, and that the subjective experience of interacting with an object could intensify the more time passed by. One example of this was a piece of hair extensions that no one could recognize immediately, but as they continued touching it, they understood
that it was hair. Participant 4 said that he imagined himself touching a foreign human’s hair which made him feel uncomfortable.

4.2.2 Insights

As mentioned in section 2.1.2, there is an intention behind every physical action (Bialoskorski et al, 2009). The results from the workshop resonate very much with what is written about affordances and signifiers in the same section as it showed that the intention for what actions to do with an object can emerge from the object’s physical qualities. This was especially interesting when removing the vision from the examination of objects as tactile sensations seemed to be enhanced and could contribute to strong emotional reactions to the texture and other physical qualities of the object.

It also seemed like isolating human physical senses, such as touch, could contribute to users’ will to explore objects as their desire to understand what they could do with it seemed to increase when they could not rely on the appearance of things to identify them. This relates to Costello’s notion on playful behaviour as the switch back and forth between the questions of what an object can do and what they can do with the object.

The workshop created an idea of different materials and Interaction attributes that could be interesting to use in the creation of the interactive artwork as will be described in the next section.

4.3 Prototyping

The creation the artwork started with a vision of what it would be, as explained in the following section. It resulted in an artefact used as a prototype for a platform to explore the research questions given within the project. This prototype was created with quite high fidelity because of Saffer’s (2010) description that high-fidelity prototypes are more appropriate to use when focusing on look and feel and animation. He explains that when creating high-fidelity prototypes, aesthetics matter as the feedback will be more accurate. This was important in this project since the prototype was going to be used to explore Pleasures relating to the Interaction attributes of the interaction, and some of the Pleasures directly relate to the physical appearance and functionality of the artwork itself. Saffer describes that high-fidelity prototypes include details in for example interaction, visual design and code and require more investment in time and resources compared to low-fidelity prototypes.

4.3.1 Vision

It is part of artistic practice that the designer of interactive artworks will have a personal artistic vision which can drive the artefact creation forward (Costello, 2009). This is relevant to address because some of the design choices for the artwork were made to achieve this vision. Initially, the main influence within this project was the aim for creating a sense of vitality – a
separate character or entity within the artwork by utilizing different sensory feedbacks that a computer behind digital art can offer. This because I was interested in what emotional responses there might be from the conversation between interactive artworks and humans described in section 2.3.2, if the artwork was perceived as a character or an entity.

Therefore, the initial vision was to create an experience of, without the use of words, conversing with a multisensory interactive artwork that was perceived as a mystical character. I wanted this conversation to be manifested with audio-visual art through a tactile interface. A big inspiration for this was the concept of how aliens are typically portrayed in movies; intriguing and exciting yet a bit intimidating because there is no way of being aware of what they are capable of.

4.3.2 Interaction

First, a “user journey” was created to match the interaction within the artwork to the vision explained in the previous section and to get an understanding of what components would be necessary to develop within the artwork to achieve that.

Image 10. A model of how the interaction within the artwork was planned.

Image 10 shows how the conversation between the human and the artwork within this project was planned. Since interactive art requires interactive
elements that answers to human input, the choice was made to create a digital application that would react by animating audio-visual elements when the user is moving a physical element. This with the aim to create a sense of vitality by enabling a live and immediate digital response to the user input. With this interaction, the focus was on achieving playful behaviour with exploration as the main focus because, as explained in section 2.3.3, that is one way of engaging users in interactive art to experience the Pleasures. Technically, it was planned to work as the following: The user makes an input to an application through a tactile interface. The artwork reacts with an audio-visual output accordingly. These outputs are controlled by code and always reacts the same to the user input. The output is then interpreted by the user who then answers with a new input.

Since attractors can call for initiating a conversation with the user and have certain qualities (see section 2.1.2), it was assumed that they will have some impact on the user’s expectation of the artwork before they start interacting with it. It was also assumed that their experience unfolds and changes over the course of the whole interaction period and last for an undetermined amount of time after it in the form of memory of the interaction. Based on this, a model explaining that the experience was expected to unfold over time was drawn (see image 11).

![Image 11. A drawing on how the experience of the interaction was expected to unfold over time.](image)
With regards to what experiences the participants got from interactions with different physical objects in relation to the model illustrated above as well as the vision explained in section 4.3.1, the Interaction vocabulary was used to make a model of the intended interaction with the artwork with the aim to encourage playful behaviour and the emergence of Pleasures. This is illustrated in Image 12.

![Image 12. The set of Interaction attributes planned for the artwork.](image)

The reasoning behind this model was to design an interaction that would be Approximate because those interactions made participants from the workshop more explorative than Precise ones. As they appreciated a non-disruptive flow, the choice was made to make it Fluent. Things that were not easily identified were more interesting to explore, which is why a Covered interaction was chosen. Hard and smooth objects made the interaction feel more Gentle, which would fit the vision of an exciting but a bit intimidating experience with a perceived entity within the artwork.

A balance between Slow and Fast as well as Instant and Delayed was chosen to leave room for tweaking when exploring the temporal aspects of the interaction. To decrease the level of control the user would feel, Diverging, Inconstant, Approximate and Incidental were all chosen to create a sense of vitality as that would fit the vision of the artwork. The reason for Mediated and Spatial Separation was to make use of the space around the artwork, hoping for a more extensive experience.

### 4.3.3 Visual elements

The first element created within the artwork was the digital application for the visual output. This because the visual elements would be one of the main interaction feedback elements within the artwork. A MacBook Pro was used as a control device that managed all interactive processes and the code languages used within it was jQuery, CSS, and HTML.
The visual elements were created with Adobe Photoshop and animated with CSS, resulting in an abstract kaleidoscope. The kaleidoscope was chosen with inspiration from Exploration, Captivation and Sensation from Costello’s Pleasure framework (explained in section 2.4.3) as these seemed possible to aid the mysterious feeling of the vision of the artwork. Using a detailed image with variations in colour and size of elements for the visual animation could result in many different perceived images and create an immersive experience while being relatively easy to create and control in code.

The code used for the animations of the kaleidoscope is based on a library from Script Tutorials. The kaleidoscope is divided into 12 different parts, each of which position is determined by the position of the cursor on the screen. They all rotate simultaneously as the cursor moves, although the cursor was not displayed on the actual application so that it would not be obvious to the user to orient themselves on the screen when interacting with it. Screenshots of this are shown in Image 13.

![Image 13. Four screenshots of the visual animations as output within the artwork.](Image13)

The images used for these kaleidoscopes are painted with the Magic Brush in Adobe Photoshop (see Image 14). The paint used are multicoloured gradients with various blending options to create depth and vibrancy.

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The artwork also uses this visual animation as an attractor (explained in section 2.3.2) for users to be curious and want to initiate interaction with it. This attractor was a pulsating animation created in CSS with keyframes controlling the transform property of the elements that rotated them 5 degrees back and forth with a time interval of 3 seconds in an endless loop.

4.3.4 Controls

The next step was to try out what controls were going to be used to interact with the visual elements. A tangible interface was chosen since, as explained in section 2.2, the sense of touch is fundamental in many interactions. For the creation of this interface, different kinds of input methods were tried. The initial goal was to use Arduino for a hands-free interaction with hand movement as input (see Image 15). However, because of technical restrictions, this choice seemed too ambitious and therefore the time it would take to come up with an interesting and technically functioning interaction with Arduino was considered not being worth it due to the time restrictions given within the project.
This led to the insight of working with an input that would be as easy to control as possible but that would create an output as striking as possible. As referred to in section 2.1.1, movement is one fundamental material in interaction which led to the choice of trying other ways of working with movement, as shown in Image 16, and find one that would be easier to handle with code.

Image 16. Trying out different ways of controlling the cursor on the screen.

One easy way to technically handle elements on the screen is with a computer mouse. Therefore, different ways of controlling the cursor were tested such as a wireless computer mouse and a Wacom tablet. However, since these are familiar ways for humans to interact with computers, these seemed too ordinary and not very likely to engage users in a high level of playful behaviour which was necessary to experience the Pleasures explained in section 2.4.3. Nor did it comply with the insight from the workshop that objects taking a longer time to recognize were more interesting to interact with. Therefore, I tried to combine the use of a computer mouse with other objects to find a more unusual way of controlling the cursor on the screen.

Because the interaction of touching and rolling the round sphere was interesting to the participants in the workshop, this movement seemed interesting to explore further (see Image 17). Its physical shape creates the possibility to place it on top of another surface, which led to the idea of building a box that would contain a computer mouse to easily be able to control the cursor on the screen.
This tactile interaction could be described as an **Impactive interaction** from Image 1 in section 2.2, one that gives direct control through touch (Sheridan & Bryan-Kinns, 2008). However, the visual output was mediated. This seemed like an effective way of creating an interaction that would encourage playful behaviour due to its unfamiliarity while it was also easy to implement. Thus, this was chosen as the definitive means of the tangible interface within artwork.

### 4.3.5 Audial elements

The next step was to include the audial elements within the artwork. These sounds were produced with regards to the vision of the artwork (from section 4.3.1). They were produced in Logic Pro X and composed so that they were loopable and could play either independently or together in a symphony. The sounds were then accessed and played with the jQuery library as responses to the user hovering over specific div-elements on the screen, each covering 25% of the screen (see Image 18).

The aim for the audio was to enhance the mysterious and intriguing atmosphere of the artwork. The sounds used to do this were all produced by Apple and are called **Unlikely Brass, Crystal Rain + Mystical Vox, Dreamscape**, and **Seismic + Snapback** drum kits.
The Unlikely Bass is also used as an attractor by the artwork before any interaction is initiated by the user, looping continuously to create an exciting and alluring sound from the artwork.

4.3.6 Physical artefact

So far, the interaction within the artwork had been was very apparent which I didn’t think matched the vision I had of a mysterious artwork. Therefore, I chose to make it more covered by adding a physical artefact around the sphere, as shown by Image 19. This also matched with what participants had expressed during the workshop that objects with holes seemed to encourage exploration with the object which, as described in section 2.3.3, can be a result from playful behaviour and also evoke the experience of Costello’s Pleasures.

Image 18. Illustration of how the four div-elements containing the four different sounds were placed in the application.

The physical artefact was created with various materials. It has an inner core made from bended steel bars and chicken wire to create the overall shape of the object. White fur fabric was used to cover this hollow object in which a steel sphere was placed on a box, as seen in Image 20.

Image 20. Inside the physical artefact. The image to the left shows the box containing the computer mouse and the image to the right shows when the sphere is placed on top of the box.

This box contains the laser computer mouse placed upside down. A hole was sawed at the top the box to hold the sphere in place as well as let it move on top of the computer mouse, which in turn moved the cursor on the screen. The box was covered with soft fabric that made the interaction with the heavy sphere very Fluent and Precise.

The intention for this artefact was to encourage people to explore the situation and by that, achieve playful behaviour. To aim for a more extensive experience with the artwork, the choice was also made to move the visual elements outside of the computer screen and project them onto a larger surface. A projector was connected with HDMI to the computer and placed behind the user to project the visual elements in the corner of two white walls and the ceiling. It was placed in this corner to maximize the spread of the visual elements and to create an immersive 3D-effect. The computer was then placed close to the projector to not be visible to the user when interacting with the artwork.
Because of how the different elements of the artwork were implemented, the interaction resulted in slightly differently compared to the planned one presented in section 4.3.2. See Image 21 for the model over the final interaction described with the Interaction vocabulary. Note: The input was very Direct and the output was Mediated, which explains the two dots on this dimension.

This constitutes the finalized artwork as shown in Image 22.

**Image 21. The final interaction with the artwork described with the Interaction vocabulary.**

**Image 22. The finalized artwork.**

### 4.3.7 Insights

The most prominent insight from the prototyping phase was that a high-technological implementation is not necessary for a successful interaction. To meet the time restrictions given within the project, the most effective way of designing the interaction was instead to create an easy technologically implementable input that would cause an output as impactful as possible.
The Interaction vocabulary was very valuable to use in the creation phase as it distinguishes different qualities of the interaction from each other, making it easy to focus on one or several of them at a time which I feel makes the prototyping activity focused.

4.4 Evaluation

When the artwork was completed, an evaluation phase was initiated with the aim to gather data on how the design decisions regarding the Interaction attributes of the artwork could relate to the Pleasures users can experience with interactive art. Image 23 shows that the aim for the setup in these evaluation sessions was to create an enclosed space to encourage playful behaviour while also leaving room for exploration.

Image 23. From two different evaluation sessions.

Some technical tweaks on temporal aspects within the audio-visual animations were made in between the evaluations to gather information on how those changes affected the Pleasures they experienced. The first tweak was to change concerned the Slow – Fast dimension of the Interaction Vocabulary. This was made by changing the speed of the animation of the audio-visual feedback, which changed the overall tempo of the interaction. The second tweak concerned the Instant – Delayed dimension. Normally, the interaction with the artwork was very Instant, meaning that the audio-visual feedback was an instant result of the user rotating the sphere. In this tweak, the speed of the animation remained the same, but a delay of 2 seconds was added which meant that the feedback happened 2 seconds after each movement of the sphere was made.

The six participants involved in the evaluation phase were between 21-56 years old. Two of them were interaction design students and the others had various different backgrounds. All of them were informed that they were going to engage with a multisensory interactive artwork and that they would be videotaped while doing so. Following this, and as described in section 4.4, The Pleasure framework was used as a tool in the interviews to describe different Pleasures to the participants and evaluate which ones they experienced. The participants were asked to describe how much they experienced the Pleasures and then to motivate their answer to understand
what Interaction attributes of the interaction that made them experience that certain level of the Pleasures. To clarify, the Pleasure framework was used as a tool for communication with participants to form a common language around their experience.

The native tongue of all the participants was Swedish. To avoid a language barrier and make the setting as comfortable as possible for the participants as well as receiving as detailed reports as possible, the decision of conducting the evaluations in Swedish was made. This may have resulted in loss of some information when translating it back to English to be able to compare the data with the Pleasure framework. However, a relaxed setting of the evaluation session was considered more important to reduce the risk of the participants not being able or comfortable to express their experience. All quotes in section 4.5.1 are translated from Swedish to English by the author.

### 4.4.1 Findings

As explained in section 2.3.3, playful behaviour can lead to exploration. This was evident during the evaluation sessions as all of the participants showed interest in engaging with it because of the audio-visual attractors that created a mysterious atmosphere in the room. On average, the participants interacted with the artwork for 5 minutes. They all seemed to follow Costello’s (2009) explanation that play means to move back and forth between the questions of what an artefact can do and what they can do with the object.

There was a clear pattern that the most prominent Pleasures that participants experienced with the artwork were Exploration, Discovery, Captivation, Danger, Sensation and Camaraderie. Therefore, the two last evaluation sessions focused specifically on these Pleasures to aim for more thorough and qualitative data that could perhaps be more accurately related back to the Interaction attributes within the artwork. These six Pleasures were also the ones to be analysed since the experiences reported regarding other Pleasures provided little or no valuable insights on how Interaction attributes could affect them.

The findings regarding relations between Interaction attributes and Pleasures will be presented in section 4.5.1.

### 4.4.2 Insights

The framework was very successful to describe and communicate around Pleasures, especially for those two with a background in interaction design as it was previously known to them. The video-cued recall seemed to work good as a method for the participants to communicate around their experience as it was easy for them to complement the imagery with words.

As pointed out in section 3.4.2, peers can be valuable to include in the evaluation phase (Costello & Edmonds, 2007), which argues for the choice of inviting interaction design students in the evaluation of this project. They
proved to be valuable in the communication around Pleasures since the terms used within it was previously known to them and they more concretely expressed their experience in relation to the framework compared to participants with other backgrounds.

4.5 Analysis of evaluation sessions

When all data was gathered from the evaluation sessions it was compiled and mapped out with post-it notes to find patterns of why the participants experienced certain Pleasures based on their expressions from the interviews (see image 24). I chose to colour code the post-it notes according to what element of the artwork the expressions addressed to get an overview of how these may relate differently to different Pleasures. Yellow notes were about sounds, pink ones about visuals, green ones about tactile elements, blue ones about time and brown ones for general thoughts or expressions that could be applied to all elements.

![Image 24. Mapping out data according to what Pleasure and element of the artwork it addressed.](image)

Following this, I made an analysis of the data by comparing the map above to my model of the artwork with the Interaction Vocabulary (image 21 in section...
4.3.6) to identify what Interaction attributes the experienced Pleasures concerned.

4.5.1 Findings

In this section, each of the six most prominent Pleasures will be analysed separately in relation to Interaction attributes. Then two models will be presented, showing where the different relations were located within the artwork as well as how Pleasures may exist over time.

**Exploration**

The participants experienced the pleasure of Exploration in a Direct manner through the tactile interaction with the sphere as well as Mediated when perceiving the audio-visual output in the room around them. The Direct interaction with the sphere seemed to make the pleasure of Exploration high since the bodily contact with the artwork made them feel like being one with, or being a part of, the very thing that they explored.

All of the participants thought that it was not apparent what this artefact would do by the look of it. Since the interaction with the artwork had the attribute Covered (the controller was hidden inside the physical artefact), the participants did not know how they could interact with it when walking into the room. However, the attractors made them curious about what the artefact could In addition to this, the fur fabric on the physical artefact seemed to work similarly to an attractor because all of the participants stated that it looked “cozy” or “nice” to touch (personal communication, 2019), which resulted in them starting to explore the situation by stroking or petting it. In turn, that lead to them finding the holes on the sides and the exploration of the inside of the artefact. The pleasure of Exploration within the artwork was quite high to the participants because of the excitement of searching for an answer to the question of what they can do with the object.

The Interaction attributes Mediated and Spatial separation also seemed to influence the Pleasure of Exploration. The fact that the visual elements within the artwork were spread out across two walls and the ceiling in front of them created a large area of different artistic patterns that the participants could look at. This seemed to strengthen the pleasure of Experience because they thought it looked beautiful on the walls. Participant 4 stated that:

“It was cool that I could change the whole room with a little movement with my hand.” (personal communication, 2019)

**Discovery**

The expression above also relates to the Mediated attribute in relation to Discovery as the participant felt this Pleasure from understanding that they could affect elements of the room around them by interacting with a small thing in front of them. This also seemed to be linked with the attribute
Covered as the pleasure from understanding how to manipulate the artwork was big when it was not obvious by just looking at it.

Some participants could feel a quite strong Pleasure from discovering something within the artwork. For example, Participant 2 expressed that he felt empowered when understanding that he could control the audio-visual input he saw and heard in the room when he found and first rotated the sphere inside the artefact.

The Instant interaction gave the participants a bigger sense of control over the artwork. This made it easier for them to manipulate the audio-visual elements as they wanted because they behaved as they expected. When the interaction tweaked to Delayed, it was harder for them to understand how their input changed the audio-visual elements. This reduced their sense of control, which also resulted in a stronger pleasure of Discovery as it took longer for them to figure the interaction out.

**Danger**

The Interaction attribute Covered seemed to be very involved with the Pleasure of Danger. Participant 5 related the action of putting his hands inside the physical artefact to memories of putting his hands inside a mystery box that contains unknown objects that often have intimidating textures.

Interestingly, the animations of the visual animations caused a strong sense of Danger to Participant 6. This because he related the movement of the visual elements to the psychological state of having a psychosis which was both intimidating but also a bit exciting to him. He expressed that this feeling was strong because the visual elements surrounded him, which relates to the Spatial Separation attribute.

Danger was something that some participants felt decreased the more time passed by with the artwork, in line with when the pleasure from Discovery increased. As they became more and more familiarized with the artwork and they understood how they could control it, it was no longer intimidating. Participant 3 said:

> “You enter the room feeling submissive but leave feeling superior.”
> (personal communication, 2019)

This can be described as a feeling of the interaction traversing from the Diverging – when the user does not understand how their action caused a reaction within the system – to Uniform when it reacts the way they expect it to.

**Captivation**

The Spatial separation seemed to have a big impact on the pleasure of Captivation experienced within the artwork. This because of the distance between the different elements of the artwork which the participants said created a feeling of it surrounding them. Participant 4 said:
“It felt like entering another world because of all the beautiful images on the walls.” (personal communication, 2019)

The symmetry in the visual animations also seemed to contribute a lot to this pleasure. Since the movement of them feels very Fluent, it seemed like they created a hypnosis-like feeling which was very captivating for the participants to look at. This also seemed to relate to the Precise and Instant manipulation of them, as Participant 1 expressed that he felt a connection between himself and the room around him as it responded very accurately to his movements on the sphere.

Once the participants understood how they were in control over the audio-visual feedback, they felt that the interaction became more Constant than Inconstant, which seemed to decrease the amount of Captivation as they were no longer surprised or intrigued about how their input changed the artwork.

Another important interaction attribute relating to Captivation was Slow. A Slow interaction made the participants’ movement with the sphere more Targeted and Precise, which resulted in a strong feeling of immersion with the visual animations as they concentrated more on the look of them. When compared to when the tweak to a Fast interaction, the participants felt more stress and were more concerned with understanding how they could get control over the manipulation of the audio-visual elements than letting themselves become immersed by the look of them.

Sensation

The pleasure of Sensation was very diverse for the participants because what elements of the artwork they paid more attention to differed from person to person. Participant 1, 4 and 5 expressed that what they liked the most was look at the surrounding visual elements, Participant 3 experienced more pleasure from being able to listen to the changes in the music and Participant 2 and 6 enjoyed it more to explore the different tactile parts with their touch.

The participants who paid more attention to the visual elements described the feeling that Sensation was stronger from the symmetry of those, which made them intriguing to look at. For these experiences, the Interaction attributes Spatial separation, Mediated and Fluent are important since they describe the feeling of the visual output of the interaction.

For the participants who experienced more Sensational pleasure from the tactile element, the Direct attribute played a big role. Exploring and discovering what was inside the physical artefact with the sense of touch created a lot of pleasure as they thought this was exciting and intimidating due to the contrasts of the physical touch of the smooth and heavy sphere and the furry and soft artefact.

This feeling of the Direct interaction could also appear with other elements within the artwork. Participant 5 explained that his hand came close to the speaker inside the physical artefact. This was expressed to be a significant
feeling because he could physically feel the bass of the pulsating music which also created a strong Sensational pleasure.

**Camaraderie**

The evaluations showed that the Direct interaction with the physical artefact seemed to be very influential on the Pleasure of Camaraderie. Participant 2 expressed this by saying:

"The round shape of the fluffy thing, as well as the fact that it was warm and cozy, made me think of it like a polar bear so I wanted to treat it with care." (personal communication, 2019)

Experiences relating to Camaraderie seemed to be positive for some while they were quite uncomfortable for others. Everyone who perceived the artwork as some form of creature or entity interacted with it more carefully than the others, which made their interaction with it more Gentle. The participants whose experience was more positive saw the artwork similarly to a friendly pet because it was soft to the touch and showed them beautiful images when moving the sphere inside it. Participant 4 said that she thought of it as giving her flowers when she stroked it, which she related to giving it affection through massage.

For the participants that also saw the artefact as a creature but were more intimidated by it, the Covered interaction seemed to play a big role. This sparked their imagination of touching the intestines of an animal when touching the sphere. Participant 6 described that in the beginning of the session, he felt uncomfortable to put his hands inside the physical artefact to touch the sphere because it felt like he put his hands in some creature’s body.

**Locating relations between Interaction attributes and Pleasures**

Based on the findings presented above, an illustration was made to pinpoint where different Interaction attributes that affected the Pleasures existed within the artwork (see Image 25).
Pleasures in time

As described in section 2.5, temporal aspects of interaction are important to address to understand their aesthetics. To analyse what significance time might have on the experience of Pleasures within the artwork, two previously mentioned notions were applied to the result presented in Image 25. The first notion, from section 2.5, was that a piece of art can extend outside of time by being accessed through people’s memories. This suggests that experiences with objects in different contexts could remind users of the interaction with the artwork which lets them partly re-experience the Pleasure they had with it. For example, users could potentially re-experience the pleasure of Captivation within the artwork in another context when they see something that reminds them of the Pleasure they experienced from the visual animations. Alternatively, they may remember the Pleasure of Sensation when touching another object with a texture that feels similar that of the artwork.

The second notion, as mentioned in section 2.4.2, was that pleasure can be both a driving factor for, and an experiential output of, interaction. This suggests that a desire to experience a certain Pleasure may also drive users to engage with the artwork, for instance as a result from its attractors or affordances. For example, before any interaction is initiated, the user may experience a desire to feel immersed by the visual elements from looking at...
the inviting animations, which would result in Captivation. Or they may experience the desire to touch a part of the artwork because it looks soft, imagining a pleasure of Sensation.

This analysis led to the increased relevance of the model illustrated in Image 11, which was then complemented with the idea of how the Pleasures could potentially be experienced in interactive art in and outside of the actual interaction with it (see Image 26).

![Image 26. Model of the experience unfolding updated with the idea that Pleasures may be experienced outside the interaction with the artwork.]

4.5.2 Insights

As described in section 1.4 and 2.4, both the computer system behind interactive art and experience is complex. From these evaluation sessions, it seems like the relations between Interaction attributes and Pleasures within this artwork are complex as well. With this artwork, some Interaction attributes clearly had a bigger impact on the Pleasures experienced than others. For example, the Direct interaction seemed to have a strong relation especially with Exploration, Sensation and Camaraderie because the participants experienced pleasure from feeling like being a part of the artwork. Fast and Delayed interactions seemed to reduce the Pleasures that were related to more imaginative experiences, such as Captivation and Camaraderie due to the feeling of reduced control, perhaps leading to
increased cognitive load in processing what was happening. But it seems to be difficult to put words on an experience as they are subjective and abstract, which may result in loss of knowledge on how these relations actually may work. As participants describe their experience with words, it may not always be easy to link back those expressions to an Interaction attribute within the artwork and find their relation to the Pleasures.

In addition to this, it seemed like the Interaction attributes within the artwork could change over time as well; from Diverging to Uniform and Incidental to Targeted as the participants’ experience of control over the interaction increased. This makes it important for the researcher to take notice of when the attributes change so that the relations identified are between the correct Interaction attributes and Pleasures.

5 Discussion

The workshop in this project was valuable for identifying experiences of different movements in interactions with objects. Although it might have shifted a little too much to the sensational experience of touching these objects instead of the feeling of the actual movement. The fact that it did not include interaction with digital objects may have resulted in loss of valuable information on how Interaction attributes in interactions with technology could be applied to Pleasures. Since the final artwork did include technology, perhaps the results of the workshop would have been richer and more clearly targeted to the design decisions of the artwork if it included interaction with digital objects. This because it cannot be assumed that an interaction with a physical object is experienced the same as with a digital object since they can react to human action differently. It may not be certain that all of the Interaction attributes are experienced the same in an interactive artwork as with, for example, rolling a sphere or stroking a furry scarf.

Using the Pleasure framework in the evaluation sessions worked very successfully for communicating with participants about experiences with the artwork as it served explanations of feelings that they could, or could not, relate to. Worth discussing is the inevitable bias of the setting in the evaluation sessions, which may lead to some Pleasures being experienced more or less than they would in the field of an actual public exhibition lab. In addition to this, it is explained in section 2.4.3 that users’ personalities can have an impact on their experience with an interactive artwork. This suggests that how the artwork is introduced and presented to the participants in these sessions will most likely also affect their experience in different ways as their response to the way in which information is communicated will be different.
In this project, the vision of the artwork may have had too big of an impact on my design choices regarding the design of it due to my great desire to accomplish that vision. When I changed course of the project to the broader scope of Pleasures, this vision was perhaps not as important for the research questions, but I could not completely let go of it since it would take too much time to ideate and create a new version of the artwork. To clarify, the vision may have affected the design choices in a way that didn’t always fully comply with the research questions, when they changed to a broader scope. However, the artwork had to take some physical shape and form to provide a platform for exploring the research questions and a conceptual idea for the artwork seemed necessary for it to be called an artwork.

The evaluation sessions showed that there may be many different relations between Interaction attributes and Pleasures. Nevertheless, they also point to the complexity of these relations. Again, referring back to section 2.4.3 and the importance of considering different personalities when experiencing Pleasures in interactive art, it was apparent that different people have different approaches to the interaction with the artwork created in this project. During the evaluation sessions, the participants had different attitudes towards the artwork; some, perhaps more technical-oriented, wanted to understand technical implementation behind the artwork’s functionality, whilst some had the aim to create all the different patterns possible or wanted to understand what meaning it conveyed through the visuals. This could potentially result in different Interaction attributes relating differently to Pleasures for different users, which means that the results in this project may not be definitive to other future work.

It is uncertain how valuable the two models presented in section 4.5.1 are for future work. I think the first one, which is locating where relations between Interaction attributes and Pleasures were experienced within the artwork created (Image 25), could help to understand how certain elements of an interactive artwork could be tweaked to experiment with further research on how Interaction attributes affect Pleasures within multisensory interactive art. The second model showed how Pleasures might be experienced with interactive art outside of the actual interaction with it (Image 26). I think this idea is interesting to address to gain more knowledge on how the aspect of time might affect Pleasures, however, it does not answer the question of how strongly these Pleasures can be experienced outside of the interaction with the artwork.

Addressing experiences is, as stated in section 2.4, fundamental for designing interactive art and other interactive systems. There are frameworks for communicating around them, but due to their subjective nature and ambiguity, they may be difficult to visualize and draw models of when ideating for the creation of artworks. From this, it seems like the creation of artworks can become a way to experiment with design to achieve a certain experience. Even though the relations between Interaction attributes and
Pleasures seem complex, I believe that understanding these better and being able to pinpoint what aspects of the interaction with the artwork evokes a certain Pleasure, and how, could help designers think around and concretise the intended pleasurable user experience within interactive art more clearly.

6 Conclusion

One fundamental aspect to address in interaction design is user experience. The interest in the interaction design community is shifting from the functionality of products to the aesthetics of the interaction with them, which raises the question of how to design interactions that bring pleasurable experiences to users. Pleasure can be both a driving factor as well as an experiential output of interaction, making it a relevant part of user experience to understand better to optimize the design of interactive systems.

Interactive artworks are one type of interactive system where the art itself is created when users engage with it, making them not only the spectator but also the creator of it. One way of engaging users with interactive art is through playful behaviour, that in turn can result in different pleasurable experiences, or Pleasures, emerging from the interaction. This interaction can be described as a conversation between the user and the computer behind the artwork through the exchange of input and output. Furthermore, this input and output can be characterized with Interaction attributes, resulting in a set of attributes that constitutes what the interaction with an artwork feels like in a functionality- and modality-free way. This creates the opportunity for the aim of this thesis, which was to explore how the specific set of Interaction attributes of an artwork may result in certain Pleasures that users experience with it. In addition to this, all interactions happen over time which points to the importance of also investigating the temporal aspects of interactions in relation to the Pleasures.

In this project, a multisensory interactive artwork was created as a platform to explore relations between Interaction attributes and Pleasures as well as how the temporal aspects of the interaction within the artwork can affect the Pleasures experienced. The analysis of the evaluation sessions showed that there can be many different relations between Interaction attributes and Pleasures, but they are complex as experiences are subjective and abstract. Because of this, experiences may be difficult to describe with words which can result in loss of information on how these relations actually work. The results also showed that Interaction attributes experiences within an interaction can change over time, along with the experience of certain Pleasures, which makes it important for designers to notice these changes to accurately analyse relations between them. Furthermore, this led to the analysis that the
Pleasures might also exist before and after the interaction with the artwork in users' imagination and memories.

Addressing exploration of these relations could potentially aid interaction designers' thinking around, and choices of, what Interaction attributes to use in the creation of interactive systems to design for certain Pleasures, and by that also contribute to the understanding of interaction as a medium in future design of interactive systems.

7 Future work

As referred to Saffer (2010) in the introduction, designers need to consider the consequences of their design choices as they have to be good. I believe that designing consciously for positive experiences, and namely pleasure, is one way of creating a bit of good in the world.

It would be interesting to add another level of interaction to the artwork created within this project, for example that it would react when lifting up the sphere, see how that would change the relations between Interaction attributes and Pleasures experienced with it. It could also be useful to design more artworks with a totally different set of Interaction attributes to see if the relations between them and the Pleasures identified with this artwork would be strengthened or opposed. This could potentially help determine how much the results from this project were biased by the vision of the artwork as well as how it was created and presented to the users in the evaluation sessions.

This thesis only addressed the pleasurable experiences that can emerge from the Pleasure framework. However, as the creator of it expresses, they can just as much create displeasures. This creates an opportunity for further exploration of how Interaction attributes can affect negative aesthetic experiences with interactive systems. This could expand the scope of knowledge on how Interaction attributes affect these experiences according to valence of aesthetic statements, and potentially also on how personalities can play a role in whether an aesthetic experience is positive or negative. As some experiences that by some people would be considered pleasurable could potentially cause displeasure for others, which leaves a big responsibility for interaction designers to be thoughtful and careful when designing for experiences.
8 References


