

VISITOR CURIOSITY THROUGH EMBODIED INTERACTIONS

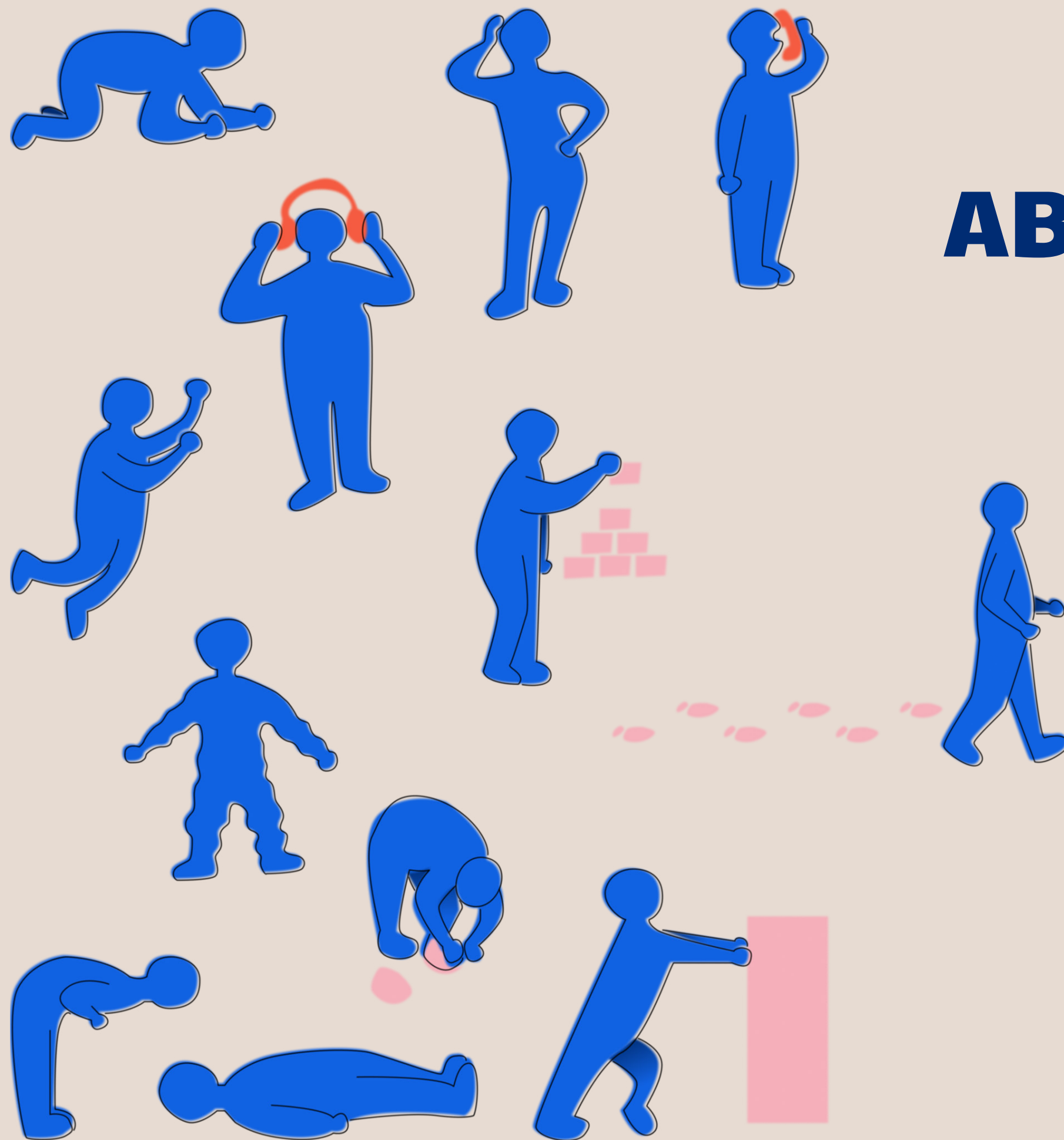
HOW EMBODIED INTERACTIONS IMPACT MUSEUM VISITORS' CURIOSITY

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ABSTRACT

Museums today are becoming increasingly focused on their visitors and how they can create educationally engaging experiences. Moreover, a current trend within museology is designing exhibitions in order to involve museum visitors and their bodies, giving them a more active role in their learning experience. Curiosity, which is closely linked to interest and engagement, is a natural driving factor in human development to target when aiming to engage visitors and ignite their interest. This thesis sets out to investigate the relationship between embodied interactions and curiosity in the context of museum exhibitions. The research is carried out with an inductive approach, where eight in-depth interviews were conducted to investigate how embodied interactions impact the curiosity of museum visitors between the ages of 18 and 29. Two layers of analysis have been applied to the results to first identify the level of curiosity eliciting from each exhibition experience, followed by an analysis of each embodied interaction type in isolation from the context of the respective exhibitions. The study found embodied interactions to have a significant impact on visitor curiosity and the general pattern was that the greater the amount of embodied interactions resulted in a higher level of curiosity. Furthermore, the analysis shows that some embodied interactions are more effective than others in evoking curiosity in museum visitors.

Keywords: *Embodied interaction, curiosity, museums, exhibitions, interaction design.*

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1

INTRODUCTION

- 1.1 RESEACH QUESTION
- 1.2 DELIMITATION
- 1.3 THESIS DISPOSITION

In recent times, the role of museums has been reimagined to keep up with the increasing need for attracting visitors, as the experience economy has expanded beyond museums and cultural institutions, resulting in more competition for visitor's time (Pine & Gilmore, 2007). This, in turn, affects how museums design their exhibitions. There is a vast amount of articles, scientific studies and books discussing the museum's adaptation to a world where the experience becomes increasingly important. Art historian Claire Bishop has described how museums change from being *"a patrician institution of elite culture to its current incarnation as a populist temple of leisure and entertainment"* (Bishop, 2013, p. 5).

In a study on engaging visitors in the museum setting, Basballe and Halskov (2010) empathises that *"(...) museums should strive neither to entertain nor to teach, but instead, to engage people in educationally enjoyable experiences."* (Basballe & Halskov, 2010, p. 83). As the quote suggests, museums should strive to be an institution where learning and experience go hand in hand. In the field of psychology, scientists have been looking at how curiosity contributes to people's ability to learn (Berlyne, 1960, 1967, 1971; Loewenstein, 1994; Kashdan et al., 2004; Litman, 2005). More recently, the concept of curiosity has become a subject of study for design related fields (Tieben et al., 2011; Wu et al., 2012; Houben & Weichel, 2013) as well as design within museology (Rounds, 2004; Ciolfi & Bannon 2002 & 2007; Roberts et al., 2018) providing a new perspective for understanding interconnected concepts such as interest and engagement (Arnone, 2003; Rounds, 2004; Arnone et al., 2011; Roberts et al., 2018).

In a publication by Louisiana, Denmark's most visited museum in 2018, they point towards a change from "spectator to user", where museums go from being collection-driven to focusing more on being audience-oriented (The Museum as a Place | From Study Archives to Experience, 2012). A current trend when museums develop with the modern time is activating the body of museum visitors. According to Howes (2014) *"perhaps the most salient trend in the new museology has been the rehabilitation of touch"* (Howes, 2014 p. 259). In order to understand how visitors use their body in museum exhibitions, e.g. through touch, there has been some research into the concept of embodied interactions (Tan & Chow, 2017; 2018). Based on studies referred to in Tan and Chow (2017; 2018) this study will define embodied interaction as an interaction between human and environment, in which the bodily movement or senses play a key role.

Even though there are multiple studies on curiosity, from different research fields, as well as embodied interactions, no study has exclusively been studying the connection between embodied interactions and curiosity. Therefore, this is the research gap this study will seek to fill.

1.1 Research question

This study will set out to investigate how embodied interactions in museum exhibitions can impact visitors' curiosity. In order to study the concepts of curiosity, embodied interaction, and their relation, the following research question has been formulated:

"How can embodied interactions impact visitor curiosity in museum exhibitions?"

With a basis in the theory on curiosity by Tieben et al. (2011), the goal is to gather data, analyse findings and ultimately contribute with an understanding of how curiosity relates to embodied interactions—in the context of museum exhibitions.

1.2 Delimitation

With the above mentioned research question, the scope for this research is limited to studying this phenomenon purely in the context of museum exhibition, with the sole target group of museum visitors. Moreover, the sampling conducted for the study has had no limitation in terms of nationality, but has chosen interviewees exclusively within the age group of 18 - 29 years of age. The sampling will be described more thoroughly in chapter 4.4.1: *Sampling*.

1.3 Thesis disposition

Chapter 2: Literature review

In this chapter research within the field of exhibition design is introduced, along with the two focus areas of the study; curiosity and embodied interactions. Each subchapter will include examples of other studies researching the specific subject, with different perspectives. Finally, the research gap is introduced.

Chapter 3: Theoretical framework

The following chapter offers an overview of the theoretical framework used in this study, and dives into the definition of curiosity by Tieben et al. (2011) and its application within interaction design. Here, the study's theoretical grounds, i.e. how this study interprets and uses the concept of curiosity, will be presented. Finally, the study's research contribution is introduced.

Chapter 4: Methodology

In this chapter the study's methodology is presented; the philosophy of science, methodological understanding of interaction design research, as well as the empirical work in the form of interviews. Additionally, the approach for sampling, conducting, and coding the interviews is presented, along with how the analysis was approached. Finally, ethical considerations and the quality of the research will be discussed.

Chapter 5: Results

The results chapter present the empirical findings in the form of interviewees' exhibition experiences. All results are presented in the form of summaries and quotes.

Chapter 6: Analysis

The analysis offers two layers; the first focusing on curiosity principles identified in each exhibition, and the second isolating each embodied interaction to understand what curiosity principles each of them induce. Both subchapters are followed by a subconclusion.

Chapter 7: Discussion

In this chapter, insights from the two analytical layers are discussed, where empirical findings are connected to the theoretical framework and studies presented in the literature review. Methodological considerations are also brought into the discussion to account for the validity of the contributions it provides to answer the research question.

Chapter 8: Conclusion

Finally, the conclusion aims to summarise the study's general insights in short and finally answer the research question.

2

LITERATURE REVIEW

- 2.1 EXHIBITION DESIGN
- 2.2 CURIOSITY
- 2.3 RESEACH GAP

The following chapter provides an overview of relevant literature within the field of exhibition design, embodied interactions, and curiosity. With a review of the literature the aim is to uncover similar projects and relevant research that can contribute to this study. Finally, the research gap within the field is presented.

2.1 Exhibition design

According to Dernie (2006) there are three major approaches to designing exhibitions; *narrative space*, *performative space* and *simulated experience* (Dernie, 2006). Narrative space exhibitions are structured around a story or narrative, to captivate the audience. Performative space can be seen as a kind of interactive theatre that recognizes *“that the body plays a fundamental role in communication and learning”* (Dernie, 2006, p. 46). Here, the spatiality of the exhibition is in focus, as well as the body and the temporality of the experience, allowing the individual visitor to actively affect the exhibition experience. Performative space exhibitions often involve playing, effectively enhancing learning, making this kind of exhibition great for engaging with children (Dernie, 2006). Finally, the simulated experience is an emergent approach to exhibition design and is yet more connected to practices from the theatre world by immersing the visitor in an experience that catches the visitor between the real and the fictional. This sometimes includes technology like augmented reality (AR) or virtual reality (VR), but other times *“nothing more than paint, lens and light”* is required to create an immersive experience (Dernie, 2006, p. 74).

2.1.1 Embodied interactions in exhibitions

“(...) bodily engagement plays a key role in facilitating meaningful experience, and giving rise to metaphorical meanings.” (Tan & Chow, 2017 p. 44).

One of the most eminent trends in modern museology is to bring back the element of touch and letting visitors physically interact with objects at the museum (Howes, 2014; Hale & Back, 2018). During the 17th and 18th century it was common practise for museum visitors to physically handle museum artefacts, as it was seen to benefit visitor learning, increase their enjoyment of the objects, foster a more intimate relation to the artist and have healing powers (Howes, 2014). However, these benefits were cast aside during the mid 19th century, and replaced by new ways of behaving and interacting at the museum—where visitors went from handlers to spectators (Howes, 2014). Nevertheless, a more tactile museum experience is re-emerging and physically activating visitors again, much in line with Dernie’s (2006) definition of performative space. Technology introduces a range of new ways to reintroduce touch in museums; through interactive screens, or even simulating the feeling of touching through 3D-models of museum objects (Roberts et al., 2018; Howes, 2014).

Sosnowska (2015) argues that sensory perception plays a key role in our

understanding of the world, and that every experience and human perception is based on the multisensory experience obtained through our senses. Furthermore, Sosnowska (2015) points to the importance of involving touch and bodily movement in interactions, since this sense is crucial in human perception processes. In fact, in the digital era, *“auditory and tactile experiences are becoming as equally important as sight in the process of communication, connectivity or perception.”* (Sosnowska, 2015 p. 65). Finally, Sosnowska (2015) emphasises the importance of engaging exhibition visitors’ physical body in the aesthetic experience, ultimately allowing them to *“perceive it in the most natural way with the aid of human multisensory properties, as well as by interaction between man and the machine”* (Sosnowska, 2015 p. 71).

Tan and Chow (2017) investigates the relationship between embodied engagement and meaningful audience experiences through an empirical study in public spaces. With the basis of theory on embodied interaction, ambient media and audience engagement, they prototyped the installation *“the Piano Staircase”*—an interactive staircase where each step corresponds to a piano key, giving off sound when stepped on. Based on video recordings and interviews they coded the findings and developed the model called *“An embodied engagement model”* (Tan & Chow, 2017). Here, the different types of responses have different intensities throughout the process of interacting with the prototype. Generally, the sensory and physical responses are intense at the same time—specifically in the adaptation and exploration phase, while the cognitive and emotional responses are intense during the anticipation and evaluation phase. Finally, they conclude that cognition and bodily responses are mutually associated (Tan & Chow, 2017).

In a subsequent article, Tan and Chow (2018) supplements their Embodied Engagement Model with a study contributing with a design approach on how embodied interactions can be designed for ambient media. Here, Tan and Chow (2018) points to the interplay between metaphorical meanings and bodily engagement, in order to design for meaningful interactions. Furthermore, they propose a Unified embodied engagement model that *“integrates engagement processes (temporal dimension) with affordance-based experience”* (Tan & Chow, 2018, p. 6). Here, they claim that it is a design’s affordances to spur embodied interactions that impact the audience engagement. Applying their embodied design approach they then developed ten design ideas, which were tested, analysed, and finally informed the study’s implications for design. In conclusion Tan and Chow (2018) present three guidelines for design, as a product of their theoretical study and empirical work.

In the book *“The Future of Museum and Gallery Design”* Hale and Back (2018) contributes with a chapter on the interplay between the body, museum objects and spaces, and how these affect visitor engagement and experience. Hale and Back (2018) presents a theoretical framework, which they suggestively name *“Interpretive exhibition design”*, consisting of *“the use of space, setting and the active engagement of the visitor in the creation of more meaningful and memorable encounters with museum objects.”* (Hale & Back, 2018, p. 340). Finally, they point to the role of a moving body in actively experiencing an exhibition—even in exhibitions where the visitors are viewing or reading, the

body is active (Hale & Back, 2018).

In a field study by Hornecker (2008) it is illustrated how an existing interactive table in a museum setting makes people employ various gestures to interact. However, most conversations around the table were technical and very few were about the content. Most visitors just passed by it, not noticing the interactivity, and the majority of the few people who did interact with the table did so briefly (Hornecker, 2008).

2.2 Curiosity

"Curiosity is one of the driving factors of human behaviour." (Tieben et al., 2011 p. 362).

Curiosity has long been a concept of study in the field of psychology, with several researchers contributing with their theory and understanding of the phenomenon (Berlyne, 1960, 1967, 1971; Loewenstein, 1994; Kashdan et al., 2004; Litman, 2005).

2.2.1 Curiosity in interactive systems

In 2011, Tieben et al. conducted a study on how five main principles of curiosity; *novelty, partial exposure, complexity, uncertainty and conflict* could be implemented in six interactive prototypes in order to trigger curiosity and change behaviour. These five main principles were based on prior contributions on curiosity (Berlyne, 1960, 1967, 1971; Loewenstein, 1994; Rauterberg, 1995; Garris et al., 2002; Vorst, 2007) and acted as Tieben et al.'s (2011) theoretical framework, summarised in the model *Five main principles for evoking curiosity*. All prototypes had audio output, programmed to react in different ways when people were passing or interacting with the speakers, mapping movement and distance with sensors to generate different audio outputs. The study was conducted at a school in a hallway, where they found novelty, complexity and uncertainty to be effective, although novelty had only a brief effect. Conflict and partial exposure was found to be less effective than other curiosity principles (Tieben et al., 2011).

In the article *"A curious learning companion in Virtual Learning Environment"* Wu et al. (2012) demonstrates how Berlyne's theory of curiosity and the computational theory of Fuzzy Cognitive Map (FCM) can be used to create a computational model of curiosity. Wu et al. (2012) combined the fuzzy logic with a more numerical inference inspired by neural networks to create the FCM. They worked with three different concepts that in total make up novelty; recency, frequency and similarity. In this article, the FCM of curiosity is implemented into a learning companion in the virtual learning environment (VLE), to help learners identify information to fit their knowledge gap. To test their hypothesis

an experiment was set up by giving users a simple learning task. The study found that implementing this into the learning companion did improve the user's learning outcomes in an VLE (Wu et al., 2012).

Another study uses curiosity to create an artifact that helps people overcome interaction blindness; the misconception that an object is not possible to interact with (Houben & Weichel, 2013). The curiosity object was based on the *"World's Most Useless machine"* (WMU machine), because it inhabits all five curiosity principles proposed by Tieben et al. (2011); novelty, complexity, uncertainty, conflict and partial exposure. A two day experiment was conducted, with a baseline set up on the first day (without the curiosity object), which resulted in no interaction from passers-by, and a setup with the curiosity object on the second day which resulted in 41 interaction instances.

2.2.2 Curiosity in museum exhibitions

In an article by Rounds (2004), behaviour patterns of museum visitors are presented with data showing that many visitors view exhibitions in a haphazard manner, straying from the devised routes, prepared by museum professionals. Rounds (2004) introduces the term *curiosity-driven visitor*, referring to the segment of visitors that constantly seek novelty to satisfy their curiosity. Researchers before Rounds (2004) have been deeming this behaviour unintelligent. Nonetheless, Rounds (2004) points to the exact opposite—that the picky and pleasure-seeking behaviour is not solely about obtaining new knowledge, as argued by Lowenstein (1994 in Rounds, 2004), but more about the pleasurable experience of curiosity seeking itself.

Ciolfi and Bannon (2007, 2002) have been studying the museum space in relation to designing interactive exhibitions. In 2002 they studied the existing exhibitions at the Hunt Museum as preparation for later exhibitions. Here a few elements were of particular interest to the museum visitors; the Cabinets of Curiosities, the Archaeology Workshop and the handling sessions. Each of these exhibition elements enabled visitors to explore hidden content and involved touching artifacts or exhibition objects like drawers. They concluded that it was important for visitors to be able to interact with the artifacts as well as other visitors both verbally and through gestures and to engage them through continuous surprise and discovery (Ciolfi & Bannon, 2002). In their article from 2007 they build on these and other studies in order to design the interactive museum exhibition *"Re-tracing the Past"* (Ciolfi & Bannon, 2007). Here they focus on the four dimensions of place; physical, individual, social and cultural, and how these aspects can be integrated when designing interactive museum exhibitions (Ciolfi & Bannon, 2007).

In their article *"Digital Exhibit Labels in Museums: Promoting Visitor Engagement with Cultural Artifacts"* Roberts et al. (2018) investigate visitor engagement around authentic objects using cognitive models for curiosity. The study takes place at a museum where three different screen based prototypes were tested against principles of curiosity and engagement. Data about capture- and interaction rate was gathered and summarised for each prototype and

conversations arising around the displays were recorded and were coded according to theory on curiosity. They found that visual prototypes were more curiosity enticing than the more text-based ones. However, the attention was at risk of being drawn to the display rather than the authentic objects.

2.3 Research gap

Going forward, this study will take its departure in the research gap left by the literature review. As it is evident in the state of the literature review, there is a lot of research about embodied interactions and many studies about curiosity, but none of them has investigated the relationship between curiosity and embodied interactions in a museum context. Hence, this is the research gap this study will attempt to fill.



3

THEORETICAL FRAMEWORK

- 3.1 **CURIOSITY**
- 3.2 **THEORETICAL GROUNDS FOR THIS STUDY**
- 3.3 **RESEARCH CONTRIBUTION**

This chapter presents the theoretical framework on which the study will base its definition, interpretation, conceptualisation and application of curiosity. Finally, the study's research contribution will be presented.

3.1 Curiosity

"Curiosity may be defined as a desire to know, to see, or to experience that motivates exploratory behaviour directed towards the acquisition of new information" (Litman, 2005).

Curiosity is a big factor in human development that drives us to learn more about the world around us. An academic interest in the subject can be traced back to antiquity in a quote from Aristotle's Metaphysics; *"All men by nature desire to know"* (Evans & Marr, 2006, p. 1). The term curiosity is closely linked with interest and engagement (Arnone, 2003; Rounds, 2004; Arnone et al., 2011; Roberts et al., 2018), where Arnone (2003, p. 1) claims that *"curiosity is a heightened state of interest "* and that the exploration involved in curiosity is in itself rewarding. According to Arnone et al. (2011), curiosity is interlinked with interest and engagement. Furthermore, they claim that one must look at how these three concepts are affected by personal, contextual and situational factors (Arnone et al., 2011). One of these factors is age, which has a big impact, since *"curiosity often decreases with age"* (Harter, 1981 in Tieben et al., 2011, p. 361).

3.1.1 Five main principles for evoking curiosity

As presented in the literature review, Tieben et al. (2011) developed a model called The five main principles of curiosity, which includes novelty, partial exposure, complexity, uncertainty and conflict (see figure 1).

Novelty refers to anything new to the particular person, a kind of sensorial experience and/or attention-drawing element. Partial exposure should be understood as hiding and exposing information and/or stimuli, then exposing it—sometimes gradually. A figurative example of this is strip tease (Vorst, 2007 in Tieben et al., 2011 p. 362). It could also mean the feeling of having incomplete information or a gap in knowledge. Complexity is, as the word indicates, ambiguous, and invites exploration and interpretation, prompting one to discover the meaning or workings of something. Uncertainty entails things or stimuli that one cannot predict with certainty, sometimes including an element of surprise as well as producing doubt in general. Finally, conflict is when something violates one's expectations completely, or generates conflicting experiences (Tieben et al., 2011).

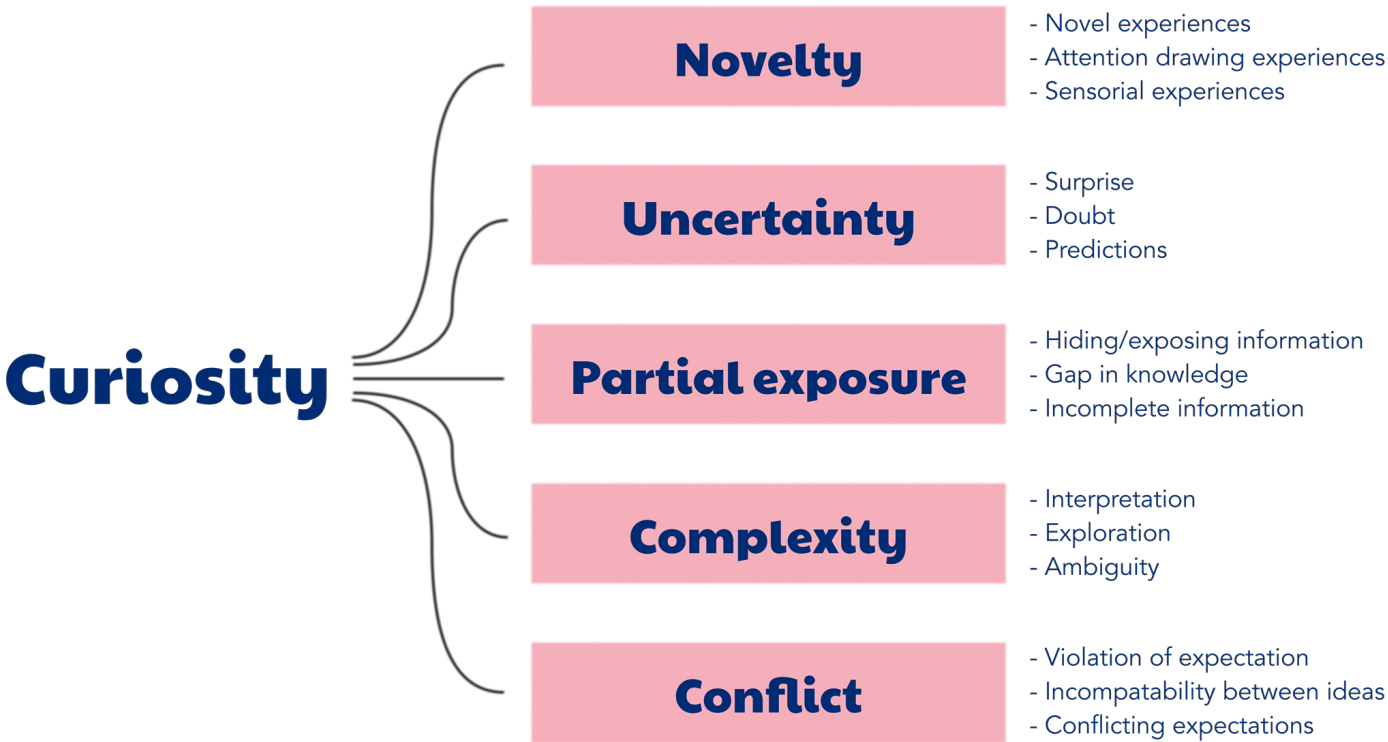


Figure 1: Five main principles for evoking curiosity and a few examples (Tieben et al., 2011 p. 362).

3.2 Theoretical grounds for this study

Thus, the theoretical grounds will be that of Tieben et al. (2011), defining curiosity based on a combination of the five principles for evoking curiosity; novelty, uncertainty, conflict, complexity and partial exposure. Furthermore, this study will articulate tendencies about the temporal aspect of curiosity by condensing it into three terms; *initial curiosity*, *sustained curiosity*, and *refrain*. Initial curiosity is defined as every encounter that led to interaction, whereas refrain refers to a situation where curiosity is not sufficiently high to make the interviewee interact. Finally, sustained curiosity refers to a prolonged and or repeated interaction. These temporal aspects have been included to add to the overall evaluation of curiosity in the analysis (see chapter 6: *Analysis*). For the remainder of this thesis, the concept of evoking curiosity will simply be referred to as curiosity.

3.3 Research contribution

Going forward, this study will take its departure in the research gap left by the literature review. By investigating the relationship between embodied interactions and curiosity in a museum context, the study will aim to contribute to the research community, both in regards to the context of museums and to the relationship between embodied interaction and visitor curiosity.

The study will base it's conclusion and implications for design on the theoretical framework above and empirical findings from interviews with people who have attended a museum exhibition where embodied interactions played a key role in the experience. Furthermore, the study will seek to answer the research question:

“How can embodied interactions impact visitor curiosity in museum exhibitions?”



4

METHODOLOGY

- 4.1 PHILOSOPHY OF SCIENCE
- 4.2 INTERACTION DESIGN RESEARCH
- 4.3 INTERVIEWS
- 4.4 RESULTS AND ANALYSIS
- 4.5 QUALITY AND ETHICS

This chapter describes the methodological approach chosen for the project, which is a design study dealing with research into design. The chosen methodology is qualitative using in-depth interviews and analysis hereof. Finally, quality and ethics is addressed.

4.1 Philosophy or science

This thesis is written with an inductive approach seeking to explore the concept of curiosity and embodied interaction in the context of museum exhibitions, through interviews with people who have visited one or several exhibitions, where their bodies were activated. Through these empirical findings, the thesis will attempt to generalise an answer about how embodied interactions impacts curiosity in a museum exhibition setting, thereby providing an answer to the study's research question (Birkler, 2011).

4.2 Interaction design research research

This study is conducted within the research field of interaction design, and will take departure in Fallman's (2008) definition of interaction design research. According to Fallman (2008) interaction design has *"three vital, external interfaces"*; the interface towards the industry, the interface towards academia and the interface towards the wider society (Fallman, 2008, p. 5). Each of these perspectives brings different traditions and concerns to interaction design research.

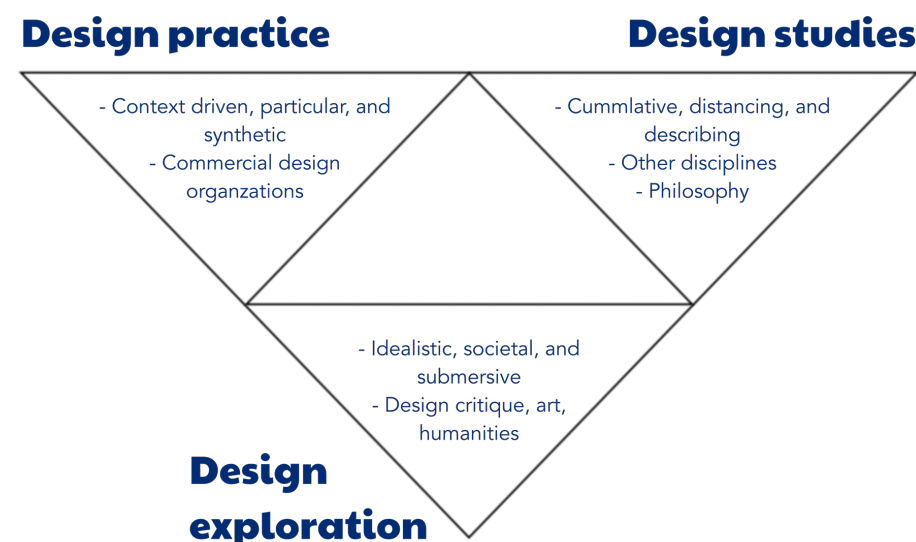


Figure 2: The interaction design research triangle (Fallman, 2008, p. 5).

With his model, depicted in figure 2, Fallman (2008) indicates that the interaction design researcher can benefit from changing between the different perspectives of the three design research activities are *design practice*, *design studies* and *design exploration*—to shift between roles and perspectives in the design process.

Design practice is concerned with hands-on creation of designs, often in collaboration within a team in the industry (Fallman, 2008). This is related to what Nelson and Stolterman (2014) calls the real. The real is concerned with the ultimate particular, not generation of the general, nor the ideal (Nelson & Stolterman, 2014). It is the application of know-how to real products, services or spaces. In this research activity it is important to take into consideration the context and a large number of stakeholders, especially that of a client (Fallman, 2008).

The perspective in the interaction design research triangle interfacing the wider society is design exploration. Here, the research activity is concerned with what is possible; what design can do without concern for the boundaries by academia or client requirements (Fallman, 2008). In accordance with Fallman's (2008) definition, design exploration is therefore free to transcend the existing traditions through its explorative nature—providing the interaction design "becomes a statement of what is possible, what would be desirable or ideal, or just to show alternatives and examples." (Fallman, 2008, p. 7). This research activity is similar to the concept of the ideal; what is desirable (Nelson & Stolterman, 2014). It *"(...) often aims to suggest alternatives, problematize, criticize the current state of affairs, and provoke."* (Fallman, 2008, p. 14).

Finally, the third part in the interaction design research model is design studies, which consists of activities similar to other traditional academic fields and often use both theory, practises and techniques from them in the design research (Fallman, 2008). Design studies are characterised by knowledge-seeking, focusing on the general, and contributing to theory and the academic research's cumulative body of knowledge (Fallman, 2008). Design studies are, like the other design research activities, related to a design inquiry term by Nelson and Stolterman (2014); the true. The true uses reason and logic to explain and find the universal. For the purposes of this study, the design activity is design study, taking a stance in curiosity literature from the field of psychology with the purpose of contributing to existing literature and understanding of curiosity, and how it can be viewed from an interaction design perspective.

Fallman (2008) argues that it is the combination of the three sides to interaction design, and the act of changing between these perspectives that differentiates it from other research fields, e.g. Human Computer Interaction (HCI). In this study the main focus will be on design studies, but if the study's result would be used as implications for design when designing exhibitions the other two perspectives would be included as well. This in turn naturally leads to further design explorations into the ideal way of designing to evoke curiosity in the context of museums.

4.3 Interviews

In order to understand how embodied interactions affect visitors' curiosity, the study uses qualitative methods as the foundation to answer the research question. Curiosity is something subjective, thus the need for an inquiry method that allows for qualitative data gathering and analysis. Eight in-depth interviews were held with a semi structured approach, due to the possibility to dive into what was being said during the interview and ask follow-up questions while keeping an overall structure to cover all theoretical aspects. The structure was built up with questions belonging to each of the curiosity principles, followed by questions about embodied interactions and questions related to curiosity stages and duration (see appendix 1). This structure served as a guideline for each exhibition mentioned in the interviews.

4.3.1 Sampling

Starting as a collaboration with Designmuseum Danmark, the study planned to conduct the empirical inquiry with the museum's visitors. In the initial plan, experiments with prototypes were supposed to investigate how curiosity elements gradually added to a new exhibition could increase the participating visitor's curiosity. That way, visitors would have the exhibition fresh in memory, and it would be possible to interact with exhibition elements in continuation of the interview. However, due to the COVID-19 crisis and the museum closing down, the study changed direction—staying within the same theoretical area and target group, but changing methodology.

To find respondents for the interviews, a convenience sampling strategy was chosen because of the short notice the researchers had to change the research design (Robinson, 2014). Had the research plan always been to conduct semi-structured interviews, researchers could have begun the recruitment process earlier. According to Jager, Putnick and Bornstein (2017) it is advised to choose a **homogeneous group** when doing a convenience sampling, in order to get a more generalised result for a smaller subpopulation. As a result, **the convenience sampling was combined with purposive sampling, based on the visitor statistics** from Designmuseum Danmark, and the group most represented among museum visitors (Robinson, 2014). At Designmuseum Danmark, 53% of all visitors in 2019 were under the age of 30 (Årsrapporter, n.d.). Due to convenience, the chosen respondents were at least 18 years old, so parents' permission didn't have to be given.

Since the museum has approximately 80% non-Danish visitors, it was decided that both Danish and non-Danish interviewees would be included to make it representative of the museum's visitor population (Årsrapporter, n.d.). Had there been a longer recruitment process, it might have been beneficial to include more international interviewees, to better match the main visitor of Designmuseum Danmark. The age and nationality of the eight interviewee are presented in table 1.

Anonymised name	Gender	Age	Nationality
TF	F	29	Danish
MF	F	27	Swedish
F	F	26	Danish
K	M	29	Danish
MM	M	29	Danish
W	F	20	Swedish
G	F	27	Swedish
TM	M	29	Danish

Table 1: An overview of the interviewees

The sampling of interviewees did not distinguish between the different kinds of museum exhibitions; art, history, scientific etc. since it can be argued that the interactions and the exhibition design is in focus and that practices from any kind of museum can be transferred to other museum types e.g. from art to the design museum in regards to curiosity and use of one's body. Instead, the only requirement was that the interviewees should have visited a museum exhibition within a year, where some sort of embodied interaction was included in their experience.

4.3.2 Conducting the interviews

The total number of interviews for this study was eight. Two of the interviews were conducted in person with audio being recorded. Six of the interviews were conducted remotely over the internet, through the web application Zoom, and recorded with the permission of the informants. When conducting interviews over videostream, one of the biggest challenges is to register all nuances in body language and facial expressions (Goodwin, 2009). By recording both audio and video, interviews could be looked at again to detect as many details as possible.

To start each interview, the researcher asked the informant to describe an exhibition experience where their body was activated in some way, and then inform them that the researcher would ask follow up questions along the way. During the interviews, the researcher conducting the interview used the interview guide to check if all the theoretical aspects were covered in the interviews. The questions were designed in a way as not to explicitly tell the informant that the interview was about curiosity. To avoid putting words into the interviewees' mouths, questions about curiosity focused on the five curiosity principles, rather than the concept of curiosity itself. For that reason the researchers didn't mention the word "curiosity" until later in the interview.

Even though only informants that had visited one or several museum exhibition experiences that activated their body within the last year were sampled it became clear that the interviewees remembered many details of experiences they had further back in time. Since these exhibition experiences were relevant for the study, they too were included. The strength of the interviewees' memory

justified the inclusion of these.

4.3.3 Transcribing interviews

Each interview was transcribed by the researcher who conducted the interview themselves. In effect, both researchers transcribed half of the interviews. A complete collection of the eight interview transcriptions can be found in appendix 2-9. All transcriptions were transcribed into the original language, either Danish, English or Swedish, and quotes used later on in the thesis have been translated into English.

4.3.4 Coding interview results

As this thesis sets out to investigate the concept of curiosity and how this relates to embodied interactions in the context of museum exhibitions, it is inherent that the thesis will ask questions about the semantics, in other words the meaning of the concept curiosity (Goertz & Mahoney, 2012). In qualitative research concepts consist of attributes, and the coding of data involves indicators of those attributes and/or the concept directly. The attributes of a concept cannot be separated from the concept, nor can it be linked to it in a causal or temporal relationship (Goertz & Mahoney, 2012). The connection between the concept of curiosity is defined by the five principles; novelty, partial exposure, complexity, conflict and uncertainty, as well as the temporal aspects to curiosity (initial, sustained and refrain) and indicators about interest or engagement, but there can be made no calculated weighed relationship between them. According to Goertz and Mahoney (2012, p. 208) *"indicators are optional, substitutable and not necessarily definitional."*

When coding the interview transcriptions for this thesis, the researchers have identified several indicators of the attributes and effectively, of the concept curiosity. Some of these indicators are grounded in the theoretical framework. Other codes are related to embodied interaction or cognitive response, e.g. by level of engagement or interest in the subject matter.

To code the interview transcriptions a digital tool called Epiphany was used (Epiphany, n.d). This tool enabled the researchers to add all transcriptions, then highlight elements from the transcriptions and give those highlights tags and categories. The researchers used the tags as codes, since it was possible to add multiple tags to one highlight. All tags would later be searchable in Epiphany, to find patterns across highlights in all of the transcriptions. Each highlight was also given a category with the name (or artificially constructed name) of the exhibition in question. That way each exhibition could be looked upon in isolation from the rest of the transcription in which it appeared. This also proved to be beneficial to gather highlights from multiple interviewees talking about the same exhibition. To sum up, the tool enabled the researchers to look at the collected qualitative data at different levels, in ways that would not have been possible if the coding was done manually; hereto the search function and the different levels consisting of "highlights" and "insights". Had the researchers

chosen to code the interview transcriptions manually these benefits might not have been obtained. Nevertheless, the codes might have been searchable if the manual coding was done on a computer, but there would still not have been the possibility to create an overview of these without more manual labour put into it.

Both researchers were involved in the coding of every interview transcript. Each researcher started coding the interview transcription they did not themselves conduct and transcribe, in order to get familiar with the all interviews. When those had been coded, the other researcher would go through the coded interview transcriptions and vice versa. That way, investigator triangulation was strengthened by having both researchers make codes (Flick, 2010). After the coding had been completed, the researchers would go back to some of the interview transcriptions to adjust or add some codes.

4.4 Results and analysis

In order to allow the reader the opportunity to review the points made in the interviews as objectively as possible a results section was added to the report. All interviews were included, but only the exhibitions that contributed to the later discussion of curiosity and embodied interactions were mentioned. All the exhibitions recalled by the interviewees were different, except the Night fever exhibition at Designmuseum Danmark that had been visited by two of the interviewees. Consequently, the study can not offer much comparison between different experiences from the same exhibition, something that could have contributed to the final analysis. All the museum visits recalled during the interviews are all subjective experiences and interpretations of the exhibitions. However, an exhibition, as with all experiences, will always be experienced subjectively, and qualitative methods such as interviews can be considered an appropriate method to go in depth with these subjective experiences. When looking at the results and the analysis one must account for the fact that interviewees visit different types of exhibitions; such as art, science, and history. This, however, gives the study a chance to investigate the relationship between embodied interactions and curiosity across different types of exhibitions and give a more nuanced result.

To subtract meaning from the interviews three analytical layers were made. The first layer focuses on the analysis of curiosity principles in each of the exhibitions—one by one. The second analytical layer focuses on the embodied interactions across the different exhibition experiences.

4.4.1 First analytical layer

When analysing the exhibitions one by one a fuzzy-set membership score (FMS) was given to each exhibition as an evaluation of how much it belongs to the theoretical concept "curiosity" (Goertz & Mahoney, 2012). The six-value FMS (see table 2) was chosen to assign each exhibition's FMS one of six values,

offering more nuanced scores than the alternative three- or four value FMS (Ragin, 2005). The FMS enabled the researchers to condense all the indicators of curiosity (curiosity principles, duration of the interaction, strength of the overall statements, level of interest or engagement, etc.) into a single number representing membership of the concept curiosity. The FMS given to each exhibition is therefore not based on a precise calculation, but rather a sort of interpretation that takes into account the weight of each indicator of curiosity. Each researcher went through the analysis of the indicators and agreed on the FMS given, strengthening the validity. Applied to the many exhibitions in the analysis, the researchers could then compare the exhibitions to each other, partly based on the FMS and identify which embodied interactions were involved in those exhibitions with a high FMS.

Six value fuzzy set	
1.0	fully in
0.9	mostly but not fully in
0.6	more or less in
0.4	more or less out
0.1	mostly but not fully out
0.0	fully out

Table 2: Six-value fuzzy set scale (Ragin, 2005).

4.4.2 Second analytical layer

Following the same theoretical models as in the first analytical layer, the second part of the analysis tried to collect insights across interviews and exhibitions. Here, the focus was on the embodied interactions that had been identified in the empirical finds. This analytical layer’s strength was to compare across exhibitions and experiences, to find similar or contradictory patterns that could help answer the research question. The reason for doing two layers of analysis is that since the first analytical layer maps how curiosity is stimulated in each exhibition, which could be attributed to a combination of embodied interactions and contextual factors, the researchers would benefit from analysing the embodied interactions in isolation. The second layer is therefore more critical to the specific influence of each embodied interaction on curiosity.

4.5 Quality and ethics

In this chapter the study’s validity and reliability will be evaluated, to inform the general quality of the research and its contribution to the research community. Additionally, the underlying ethical considerations of the study are discussed.

4.5.1 Validity and Reliability

When evaluating the quality of this study, Golafshani (2003) proposes looking at the concepts of trustworthiness, rigour and quality to determine its validity and reliability. Qualitative research, opposed to quantitative research, does not put the same amount of value in statistical and numerical measurements of a study’s results. Here, the focus is rather on the researchers ability to choose methods and techniques that allow them to collect qualitative results, like through in-depth interviews in this study, that help construct the understanding of a phenomenon—grounded in the real world (Golafshani, 2003). Through a transparent and well documented research process, where interview guides, transcriptions and codes are all provided in appendix, the transferability is increased along with the possibility for other researchers to recreate the study with the same conditions.

It can be argued that had the study been assuring a triangulation supported by additional methods, the validity had been strengthened further (Golafshani, 2003). However, the validity is strengthened by investigator triangulation, since the study was conducted by two researchers, who both went through each other’s codes and interpretation of the results (Flick, 2010).

Ethical considerations

4.5.2

In line with the recommendation from the Swedish Research Council (Good Research Practice, 2017), the study took the necessary precautions in order to increase the ethical accountability of the study. Since the study included qualitative research in the form of interviews, the main ethical concerns regarded the study’s interviewees. In this study the interviewees were assured anonymity as well as the option to not answer questions if they did not feel comfortable. In addition, the study focused on their museum experience and were not examining them on a very personal level, making it less intrusive for them as individuals. After the interviews had been conducted, each interviewee got their interview transcription sent to them by email, giving them the opportunity to look it through and make sure they felt that it was representative and correct. Here, the researchers informed them that if an informant found anything misleading, they could contact the researchers to rectify it. Finally, the Swedish Research Council (Good Research Practice, 2017) point to the ethical problems of withholding data from the research or concealing sources of errors. Therefore, the transparency of the study is prioritised, offering a well-documented record of all research activities and their results—either in chapter 5: Results or the appendix.

5

RESULTS

5.1 INTERVIEW WITH MM
5.2 INTERVIEW WITH TF
5.3 INTERVIEW WITH F
5.4 INTERVIEW WITH K

5.5 INTERVIEW WITH TM
5.6 INTERVIEW WITH MF
5.7 INTERVIEW WITH G
5.8 INTERVIEW WITH W

A summary of the different interviews containing the exhibitions used for analysis are given below. Common for all of them are that the exhibitions were located at a museum and that the interviewee involved their body in some way. Even though the analysis will not be focused on the exhibitions individually, the following summaries will function as a reference point for further analysis in chapter 6: Analysis, and an overview of what each exhibition included. To ensure anonymity, each interviewee has been given a code name consisting of their initial and, in case of two people with the same initial, an extra letter is given, indicating the gender of the interviewee, e.g. MF is female and MM is male. In each interview it is introduced what museums and exhibitions are referenced in the interview and in each exhibition it is introduced what type of interactions were involved during each exhibition. A majority of the exhibition names are constructed by the researchers based on the interviewees' descriptions, and will be used for the remainder of this thesis. Only the exhibitions that contribute to widen the understanding of curiosity or embodied interaction will be presented in this chapter. All interview transcriptions can be found in appendix 2-9 and all mentioned exhibitions with highlighted quotes and codes can be found in appendix 10. Throughout the rest of the thesis, all translated quotes included will be presented in corresponding footnotes in their original language.

5.1 Interview with MM

In the interview with MM, conducted in Danish and quotes translated into English, he accounts for several exhibitions and exhibition elements at Zoologisk museum, Experimentarium and an exhibition at a third museum (Appendix 2). In the following sections they will be summarised one by one.

5.1.1 Zoologisk museum

5.1.1.1 Cranium Cabinets

Embodied interactions: walking (through door), opening (cabinet)

The Cranium cabinets exhibition consisted of a construction of cabinet doors with skulls behind. Some of the skulls were placed behind transparent materials, while others were behind opaque materials—hiding them. Visitors were then able to open the cabinet doors at random to reveal what was behind, or to go through a door to the inside of the construction to see them all at once. MM recalled having seen that kind of exhibition at other museums, but liked it all the same and even went back to it a second time. He liked that he could “go in depth with the details”¹ (Appendix 2, p. 2) and could pick and choose what to focus on. He also found the presentation aesthetically pleasing and said that opening some of the cabinets made him want to open more (Appendix 2, p. 7).

¹ “at fordybe sig og gå lidt i detaljerne”.

5.1.1.2 Lion exhibition

Embodied interactions: seeing (to search)

In the Lion exhibition, a taxidermied lion and its prey are displayed behind glass in the middle of the room, surrounded by other taxidermied animals and painted animals on the walls.. A text in front of the display presented what types of animals were inside. Not all of those animals were in plain view, prompting the visitor to search for them and MM argued “it makes it more fun to have to fight for it.”² (Appendix 2, p. 5).

5.1.1.3 Beaver exhibition

Embodied interactions: pushing (button), seeing (to search)

At the Beaver exhibition there was a pile of wood and a button. When visitors press the button it lights up inside the pile of wood and the beaver’s silhuete is displayed. MM didn’t know exactly what the button was supposed to do, but he wasn’t completely uncertain as he thought that “the exhibition was built up so it was rather boring, so there ought to happen something when you pushed the button”³ (Appendix 2, p. 9).

5.1.1.4 Wall of Ice

Embodied interactions: touching, sensing (temperature)

At Zoologisk Museum there was a wall made of ice that visitors could touch. Its physical form was big, cold, and continuously affected by the many people touching it. MM described how there were markings where visitors had touched it, thinking it was “fun to see that you were forming the exhibition in a way”⁴(Appendix 2, p. 2). MM wondered how the museum had made it, since the room was rather warm and the ice didn’t melt.

5.1.1.5 Amazonas exhibition

Embodied interactions: crawling (into small space)

In the interview with MM, only a part of the Amazonas exhibition was recalled; a construction where the visitor had to crawl into some pipes and look out through glass boxes (Appendix 2, p. 5). Here the visitor could go “if you wanted the last pieces of information”⁵ (Appendix 2, p. 6), but since he regarded the exhibition element to be mainly for children he did not himself crawl inside, partly due to the fear of getting stuck.

² “det gør det også sjovere at man bliver nødt til at kæmpe lidt for det.”

³ “udstillingen var jo bygget op, så den måske var lidt kedelig, så der måtte jo ske et eller andet, når man trykkede på knappen.”

⁴ “sjovt at man kan se, at man er med til at forme det her museet på en eller anden måde.”

⁵ “hvis du vil have de sidste informationer eller oplysninger”

5.1.1.6 Dinosaur room

Embodied interactions: touching, watching (video)

In the Dinosaur room the visitor was first presented with a name tag for the particular dinosaur, followed by its skeleton that could be touched, and finally with a video. MM argued that this process “makes you more interested in watching the video”⁶ (Appendix 2, p. 4) and recalled being “impressed with the sight of [the dinosaur] and then getting to make a bond with it by touching it.”⁷ (Appendix 2, p. 4).

5.1.1.7 Primary cranium exhibition

Embodied interactions: touching (physical object), putting together (physical objects like puzzle)

The Primary cranium exhibition consisted of various skeletons made out of plastic that visitors are allowed to touch. Some of the skeletons could be put together like a puzzle—an interaction that MM found appealing as a learning process (Appendix 2, p. 3).

5.1.2 Experimentarium

In his account about Experimentarium MM said that “you always get a little dirty from being there, because you are active and use your body” (Appendix 2, p. 11). The following sections will present the exhibitions he recalled.

5.1.2.1 Sense tunnel

Embodied interactions: Balancing, crawling, climbing, walking, groping the air, listening, sensing (temperature)

The Sense tunnel was a construction visitors went into, which activated almost all senses. Its exterior consisted of a rolling eye, traffic lights and surveillance camera footage showing people inside the Sense tunnel, that gave MM an idea of what to expect. Many people were queueing up, which made MM want to try it, since it looked popular. Inside, visitors went from room to room without knowing what would come next. First, there were black plastic strips hanging down disguising what came next, followed by a dark room with climbing stones, then a net that visitors could climb in different directions. Then visitors encountered a cold room with mirrors all around and a sound of the wind. The cold room was followed by a warm room with a sound of animals on the savanna, and a balance beam paired with an optical illusion trying to trick visitors into thinking they were out of balance, which almost made MM feel seasick (Appendix 2, p. 10). MM called it a “holistic experience”⁸ (Appendix 2, p. 11), since nothing but taste was missing from the sensorial experience. In the

6 “gør også at du er mere interesseret i at se videoen”

7 du bliver imponeret over synet her og får lov til at danne et bånd med det her ved at få lov til at pille ved det her.”

8 helhedsoplevelse”

Sense tunnel he said that “you almost feel like you are lost”⁹ (Appendix 2, p. 11) and compares it to an obstacle course, but the experience he had was not unpleasant (Appendix 2, p. 10).

5.1.2.2 Earthquake exhibition

Embodied interactions: Getting up on (plateau), being shaken, pushing (button), building (with blocks)

One of MM’s “favorite exhibitions” (Appendix 2, p. 12) at Experimentarium was the Earthquake exhibition, consisting of two parts. In the first part, visitors could construct something out of building blocks to be tested against the force of an earthquake. The visitor could push a button to activate the earthquake when ready. The second part, which MM tried every time he visited the museum, was a big plateau where one could stand and feel a simulation of an earthquake with one’s own body. Here, the earthquake was automated in coherence with video footage simulating the earthquake (Appendix 2, p. 12). The force of the shaking was gradual and MM ensured that it wasn’t dangerous, but “you are shaken thoroughly” (Appendix 2, p. 12). The exhibition did not affect MM much, but he thought that “you would think more about it if you experienced it in another country, where you had more earthquakes.” (Appendix 2, p. 13).

5.1.3 Pedagogue exhibition

Embodied interactions: Shoving (furniture), climbing (giant steps), putting on (jumpsuit)

The Pedagogue exhibition consisted of everyday items enlarged to make the adult visitor feel like a child. The exhibition “had a route, you had to walk through where you kind of got an aha!-experience”¹⁰ (Appendix 2, p. 10); the visitor had to crawl stairs, shove around furniture to get up to look over counters, and dress themselves in big jumpsuits (Appendix 2, p. 9). MM thought it was an exciting experience that “put things into perspective”¹¹ (Appendix 2, p. 10), but throughout the exhibition he recalled feeling frustrated but apprehensive to the difficulties of a child.

5.2 Interview with TF

In the interview with TF, conducted in Danish and quotes translated into English, she accounts for an exhibition element at ARoS called Olafur Eliasson tunnel (Appendix 3).

9 “Man føler lidt at man er faret vildt.”

10 “var en rute, man skulle igennem. Hvor man ligesom fik en aha-oplevelse”

11 “Den satte også igen tingene i perspektiv.”

5.2.1 Olafur Eliasson tunnel at ARoS

Embodied interactions: Walking, seeing vaguely (through fog), groping the air, sensing (temperature)

TF stated that the Olafur Eliasson tunnel was “one of [her] strongest museum experiences”¹² (Appendix 3, p. 7). She was originally attracted to the tunnel because there were a lot of people around it, but said that she thought she would have noticed it anyway due to the size of its exterior. TF did not recall ever interacting with anything like it. Her “curiosity was stirred all the time, because it was also a process.”¹³ (Appendix 3, p. 3), which consisted of a long tunnel filled with fog, changing lights, colors and temperature, where the visitor could barely see and needed to explore the abstract space by walking slowly and groping the air with their arms and legs. She compared the experience with playing computer games, since the visitor affected the exhibition in a way. Even though the exhibition was static in itself—it was the walking through the different colors, lights, etc. that created the experience. This made the experience “much stronger and more personal”¹⁴ (Appendix 3, p. 5). Even though there were a lot of other people interacting in the tunnel at the same time, TF felt that “it was pretty clear that everyone had their own intense individual experience”¹⁵ (Appendix 3, p. 4) that was hard to communicate to other people.

5.3 Interview with F

In the interview with F, conducted in Danish and quotes translated into English, she accounts for several exhibitions and exhibition elements at Tøjhusmuseet, Nikolaj Kunsthal, GL STRAND, Louisiana and Arbejdermuseet (Appendix 4). In the following sections they will be summarised one by one.

5.3.1 Exhibition at Louisiana

Embodied interactions: Placing (sticker on wall), walking, listening (to music)

Before arriving at Louisiana, F had already heard a lot about the exhibition on social media and in newspapers. She described how visitors could walk through many rooms with different lightning and sound. In one part of the exhibition visitors could place a dot-shaped sticker on the wall, which F did, even though she was somewhat critical to taking part in forming the exhibition, since she thought it felt “forced”¹⁶ (Appendix 4, p. 1).

¹² “Det er måske en af mine stærkeste museumsoplevelser.”

¹³ “jeg synes hele tiden min nysgerrighed den blev sådan pirret, fordi det også var et forløb.”

¹⁴ “den bliver meget stærkere og mere personlig”

¹⁵ “men det var ret tydeligt at man hver især havde haft en intens individuel oplevelse”

¹⁶ “forceret”

5.3.2 Afghanistan exhibition at Tøjhusmuseet

Embodied interactions: Walking, seeing, enacting with body, pushing (buttons), listening (to sounds), holding (physical object)

The Afghanistan exhibition consisted of a series of rooms visitors walked through, simulating different locations in the life of a soldier stationed in Afghanistan. The first room simulated the room of a boy signing up to be a soldier, then the following rooms simulated different places in Afghanistan where the soldier might be. Lastly, the final room simulated the airport in Copenhagen where the soldier is welcomed home. Throughout the exhibition sound effects were used to strengthen the simulation, where F was especially affected by the sound of military planes flying over her (Appendix 4, p. 2). At different stations screens with buttons were located, showing videos. Visitors were also invited to physically enact some tasks a soldier might be faced with, for example to hold a rifle or figure out a strategic way to cross a simulated river without setting off a landmine. F reflected that “if the body hadn’t been in it, I don’t think it would have made me conscious in the same way”¹⁷ (Appendix 4, p. 8) and also talked about the empathy she felt for the soldiers, whose environment the exhibition tried to simulate.

5.3.3 Leonard Cohen exhibition

The Leonard Cohen exhibition was splitted up between two locations; Nikolaj Kunsthal and GL STRAND, but will be described without consideration to what part of the exhibition were held where.

5.3.3.1 Screen room

Embodied interactions: walking (behind curtain), listening (to sound and music)

This part of the exhibition was split into two rooms, where the first one only consisted of a screen revealing a few older men humming, confusing F because she could not see the point of it. F recalled being very confused about this room and went outside to read on the door, which told her that she had to continue behind the screen and through some curtains, where the exhibition would continue. As she continued behind the screen and walked through a curtain, she found a large room with 20 full-body screens, arranged in a half circle. On each screen there was a man, singing and dancing to the music, revealing to the visitor that the humming men from the first room were actually part of the background music for the song playing. By moving between the big screens, the sound from each man became louder the closer F got to that specific screen. Sometimes a sudden sound would appear from some of the screens, nudging F to walk over there and explore it further. F mentioned that this was her favourite part of the exhibition (Appendix 4, p. 10).

¹⁷ “Hvis kroppen ikke havde været med, så tror jeg ikke det havde kunne blive bevidst på samme måde.”

5.3.3.2 Things hanging from the ceiling

Embodied interactions: Listening (to people talking through headphones), talking (into microphone)

In a delimited area of the exhibition, there were microphones and headsets hanging down from the ceiling, that visitors could hold, listen or talk into. F mentioned how it was unclear what the purpose was, until she tried it a second time. She described how the devices were connected to a website where people from all over the world broadcasted when they were playing a Leonard Cohen song. F described how this interaction made her feel a connection to these people she could hear, creating a sort of shared experience, but only because she felt it was the purpose of the interaction. In reality, she *“forced it rather a lot. And that ruined [the experience] a bit.”*¹⁸ (Appendix 4, p. 9).

5.3.3.3 Depression room

Embodied interactions: Lying down, listening (to music)

F also talked about a section of the exhibition that she chose not to visit, where visitors were supposed to go into a room, lie down and listen to some of the more depressing music by Leonard Cohen. F recalled how there was a long line to enter, but how she desisted to go inside since she felt it was too obvious what feelings she was supposed to get out of it. For F, extracting her own experience is important; *“no one should tell you what experience you are going to have”*¹⁹ (interview with F, p. 13). If the exhibition tries to, they often *“make the expectation of it greater than the experience.”*²⁰ (Interview with F, p. 13), in F’s opinion.

5.4 Interview with K

In the interview with K, conducted in Danish and quotes translated into English, he accounts for exhibitions and exhibition elements at Copenhagen Contemporary and Louisiana (Appendix 5). In the following sections they will be summarised one by one.

5.4.1 Circus room at Copenhagen Contemporary

At Copenhagen Contemporary K recalled an exhibition consisting of various elements. All of the elements, except for the Mirror rooms, are placed in the same room, giving it a playground feeling, where you could *“interact with everything without knowing what it did in advance”*²¹ (Appendix 5, p. 7).

18 “jeg forcerede det ret meget. Og det ødelagde det også lidt”

19 “Der er ikke nogen der skal fortælle én hvilken oplevelse, du skal til at have.”

20 “forventningen til det bliver større end oplevelsen.”

21 “man kunne interagere med alting alligevel uden at vide hvad, det gjorde på forhånd.”

5.4.1.1 Mushroom

Embodied interactions: Shoving (with entire body), listening (to sound)

One of the exhibition elements K remembered most was a giant mushroom of approximately two meters that stood and quivered, indicating that he could interact with it. When the mushroom was shoved, it emitted a sound like a bell. K had to experiment through trial and error, which made him wonder things like; *“How much should it be pushed to give a sound? And which sound will it say when I push it this much? Can I overturn it completely?”*²² (Appendix 5, p. 10), which made him interact with it a bit longer. Overall, he thought it was a fun and unique interaction, since you had to use your entire body to shove it (Appendix 5, p. 11).

5.4.1.2 Carrousel

Embodied interactions: Sitting, jumping on/off, going round (in the carrousel)

Another thing that caught K’s immediate attention in the room was the carrousel, due to its size. It was a big carrousel with balloon swings which turned around more slowly than K expected. He thought it was fun and liked that *“you are up in the air”*²³ (Appendix 5, p. 8). However, he did not find it interesting to stay on the ride, since nothing new happened along the way other than just going round and round.

5.4.1.3 Phone

Embodied interactions: Picking up (phone), dialing (number), talking

One of the things in the Circus room that really made K wonder was a phone hanging on the wall. He was quite uncertain whether the phone *“was for him to use or just for the staff”*²⁴ (Appendix 5, p. 7). No matter what, the phone worked, so he used it to do prank calls, which he thought was really fun (Appendix 5, p. 6).

5.4.1.4 Box with holes

Embodied interactions: Crawling, taking off (shoes), look out (of holes)

One thing in the room that K did not interact with was a sort of box with pipes to crawl into and holes you could look out from, which was not something he had seen at a museum before. It was completely dark inside, so K did not know where he would end up, even though he looked inside. He thought the exhibition element was very childish and a bit cumbersome, since he had to take off his shoes, so in the end he did not try it.

22 “Hvor hårdt kan jeg skubbe den? Hvor meget skal den skubbes før den siger en lyd? Og hvilken lyd siger den, når jeg skubber den så meget? Og kan jeg vælte den helt?”

23 “man kommer op i luften”

24 “Er det noget jeg skal bruge eller er det bare noget til personalet?”

5.4.1.5 Mirror rooms

Embodied interactions: Walking (through sliding doors), seeing (own reflection in mirrors)

Mirror rooms were several (maybe seven) mirror covered rooms separated by motion-detecting automatic sliding doors—also covered in mirrors (Appendix 5, p. 6). Visitors walked through the rooms and “*you [were] just watching yourself stand there waiting until the next door opens*”²⁵ (Appendix 5, p. 6). K did not recall feeling lost or thinking about anything in particular other than it was rather fun.

5.4.2 Video in ceiling exhibition at Louisiana

Embodied interactions: Lying (in bed), watching (video), listening (to sounds and music), taking off (shoes)

At Louisiana K experienced an exhibition consisting of a dark, quiet room with beds and a video projection in the ceiling. The hallways leading up to the room were very dark, and “*suddenly there is something that lights up. It was rather magical in a way.*”²⁶ (Appendix 5, p. 2). When he first entered the dark room he had no expectations of the experience and he could not see the video in the ceiling, only the light coming from it and the beds. He saw other people taking off their shoes before getting into bed, which he wondered the necessity of.

He recalled the experience as being “*sort of sensorial all of it. [He] felt that you were lifted into another world.*”²⁷ (Appendix 5, p. 1). K had never experienced anything like it. Especially the feeling in the room made him think that he was not really allowed to talk, which was a new museum experience to him, seeing as he usually talked to people about the artworks. However, the opportunity to lay down and look up he did not feel was very novel, but “*that the entire interaction allowed you to withdraw a little. Because there was made room for reflection in a way.*”²⁸ (Appendix 5, p. 2). Because it was such a dreamlike and comfortable experience, he laid in the bed for approximately fifteen minutes.

5.5 Interview with TM

In the interview with TM, conducted in English, he accounts for several exhibitions and exhibition elements at Designmuseum Danmark and Moesgaard museum (Appendix 6). In the following sections they will be summarised one by one.

²⁵ “Og du ser bare dig selv stå og vente indtil den der dør åbner.”

²⁶ “pludselig er der noget, der pludselig lyser op. Det var ret magisk på en måde”

²⁷ “Det var meget sådan sanseligt det hele. Jeg følte lidt at man blev løftet ind i lidt en anden verden”

²⁸ “hele den der interaktion gjorde, at man ligesom trak sådan lidt tilbage. For der opstod et rum for refleksion på en eller anden måde.”

5.5.1 Night Fever at Designmuseum Danmark

Embodied interactions: Dancing, listening (to music through headphones), seeing, sitting (in a reconstruction), touching (reconstruction), bending (under half wall)

At the Night fever exhibitions, visitors could explore club culture from the 1960’s until modern time. With a focus on aesthetics, information is presented in the form of text, video and audio in addition to design artefacts and physical recreations of for example night clubs. The exhibition was enhanced with light effects and interior design details. TM remembered a reconstruction of a famous Copenhagen night club, and how that gave him a whole other experience than just reading about it. According to TM, being able to touch and feel the environment of the night club strengthened the experience and “*[his] senses are more invoked. It’s more a whole body experience, you could say. So it’s both more interesting at the time and I also remember it way better*” (Appendix 6, p. 7). TM explained how one could also listen and dance to different music genres in a silent disco section, where the music only was available to the person wearing the headphones. Before entering the dance floor section, TM remembered seeing feet of people dancing, the rest hidden by dark screens covering half of the wall. Seeing other people interacting made TM eager to try it himself, an experience he described as shared with other visitors at the dance floor but at the same time an individual experience.

5.5.2 Viking exhibition at Moesgaard museum

Embodied interactions: Walking, placing (physical object), seeing, listening (to information)

In the Viking exhibition, TM recalled that visitors start by choosing a token—a physical object that they bring with them throughout the exhibition. Each token was representative of a specific character in the viking era, and by choosing a character’s token the visitor got a personalised experience that followed a journey of their chosen character. Around the exhibition room screens are stationed, with an interactive zone for visitors to place their token, ultimately activating information about the life of their chosen character. A side from walking around and placing their token, visitors could both read, listen and look at information on the screens. To TM, this museum exhibition gave him “*the most complete museum experience [he] had ever had*” (Appendix 6, p. 3). The main reasons he mentioned were the control he had over the information flow and how he accessed the information gradually by placing his token on interaction points, the feeling of personalised content and how it was presented to him in a narrative way.

5.6 Interview with MF

In the interview with MF, conducted in Swedish and quotes translated into English, she accounts for several exhibitions and exhibition elements at Ripley's believe it or not museum and Designmuseum Danmark (Appendix 7). In the following sections they will be summarised one by one.

5.6.1 Ripley's believe it or not museum

This particular museum was divided into many small exhibition parts, both following the adventures of an explorer and his travels around the world, combined with Guinness world record facts.

5.6.1.1 Tallest man

Embodied interactions: Holding (physical objects), seeing

On the exhibition's theme of Guinness world records, one part displayed a model of the world's tallest man where visitors could use their own body to put into perspective how long he actually is. Additionally, MF remembered how visitors could try to fit as many plastic eggs as possible in their hands, and compare it with the amount the world's tallest man could manage. Through the act of interpreting with her body, by trying to compare how many eggs she could hold to the world's tallest man, she claimed that it resulted in a better understanding of the facts the museum was trying to convey, and gave her a more memorable experience.

5.6.1.2 Mirror/window section

Embodied interactions: Mimicking, walking, seeing

In this part of the exhibition, MF described how visitors encountered something that appeared to be a mirror in the beginning of the exhibition, where a screen next to it showed facial gestures and tricks from Guinness world records. MF explained how visitors were supposed to mimic the videos, while seeing themselves in the mirror. However, towards the end of the exhibition visitors passed the mirror from the other side and could see that it actually was a window, displaying the visitors trying to mimic the videos reflecting themselves into what they were thinking was a mirror. MF felt tricked, but it gave her a fun experience that according to her, tied the start and end of the exhibition well to each other..

5.6.1.3 Storm room

Embodied interactions: Seeing, feeling wind

In the Storm room, visitors encountered a strong wind and could see how objects

in the room were partially broken or cracked, and hear strong sound effects of a hurricane. Not until they had passed through the room, out into a new one, did they get information about the storm Katrina, making it clear that the prior room was supposed to portray an environment affected by the storm in a simulated experience. By dividing the simulated experience and information about the phenomenon into two rooms, MF says that it made her curious to find out why it was stormy and things look broken when she was in the first room.

5.6.2 Night Fever at Designmuseum Danmark

Embodied interactions: Walking, dancing, listening (to music through headphones), seeing, bending (under half wall)

Like TM, MF also visited the Night fever exhibition at Designmuseum Danmark. She recalled headphones placed around the exhibition, as well as over the dancefloor with silent disco, which she had never tried before. MF also mentioned that to access the dance floor, visitors had to bend under a half wall screen, where there were four rows of headphones, each row playing different songs. At the dance floor she remembers dancing and listening to different music genres, surrounded by strangers doing the same, giving her the sense of a shared experience. MF thought *"it was really cool and it had a lot of interaction. It was fun, partly because you got to do things individually."*²⁹ (Appendix 7, p. 7).

5.7 Interview with G

In the interview with G, conducted in Swedish and quotes translated into English, she accounts for one exhibition and several exhibition elements at the Swedish History Museum (Appendix 8). In the following her museum visit will be presented.

5.7.1 Timeline exhibition at the Swedish History Museum

Embodied interactions: Walking, listening (to sound and information), seeing, pushing (buttons), touching (physical objects)

In the Timeline exhibition, visitors got to walk from the beginning of the exhibition, portraying the year 800, until the end of the exhibition, leading up to the second millenium. Throughout this journey through time, the visitor encountered different historical aspects from the different ages, and could for example listen to accents from different geographical locations by pressing buttons. G explains how there were objects visitors were allowed

²⁹ "den var jättehäftig och den hade ju jättemycket interaktionsmoment. Det var kul, dels att man fick göra saker enskilt"

to touch, for example a boat and tools from the viking era, contributing to a fun experience. In addition to this, there was a lot of informational text and some videos, along with a reconstruction of the environment from certain time periods. G described how having buttons to press in order to reveal information or actively doing something helped her to regain focus.

5.7.1.1 Hole to crawl into

Embodied interactions: Crawling

In one of the sections in the Timeline exhibition, there was a hole that visitors could crawl into to get more information. G understood it as being for children so she did not interact with this part of the exhibition for the fear of getting stuck.

5.8 Interview with W

In the interview with W, conducted in Swedish and quotes translated into English, she accounts for one exhibition at the Killing fields museum of Cambodia (Appendix 9). In the following her museum visit will be presented.

5.8.1 Killing fields museum of Cambodia

Embodied interactions: Walking, listening (to stories), seeing, pushing (buttons), holding (digital device)

Embodied interactions: Outside Phnom Penh, the capital of Cambodia, a historical landmark and mass grave called the Killing fields is located—a museum that was created in memory of the victims and survivors of the Khmer Rouge holocaust. Here, visitors got to walk around the historical site while listening to an audio guide, consisting of the history leading up to the events of the holocaust, it's aftermath and stories from survivors. Visitors could access the information either through a portable tape machine that they control themselves, or by following a guide around the museum grounds. The tape was recorded and split into sections, where different chapters correspond to a physical location at the museum location, where visitors could see additional pictures and information from the events. W explained how the fact that she was present at the actual location made her experience much stronger, by allowing all her senses to take in and experience it. W also mentioned how the personal control over the information flow facilitated her intake of information. At first she followed the prescribed route step by step and listened to audio corresponding to each station, but in the end she just listened to the stories at random. Wearing her headphones she felt like she *“was in [her] own world”*³⁰ but at the same time had a connection to the visitors she passed by (Appendix 9, p 5).

³⁰ “var i sin egen värld.”





ANALYSIS

- 6.1 CURIOSITY INDICATORS IN EACH EXHIBITION
- 6.2 SUBCONCLUSION OF THE FIRST ANALYTICAL LAYER
- 6.3 CURIOSITY INDICATORS IN EACH EMBODIED INTERACTIONS
- 6.1 SUBCONCLUSION OF THE SECOND ANALYTICAL LAYER

The following chapter will analyse the key findings from the interviews, with focus on curiosity and embodied interactions and how these have affected the interviewees' museum experiences. The first analytical layer in chapter 6.1: *Curiosity indicators in each exhibition* aims to identify what curiosity principles each exhibition included. However, the analysis of the level of curiosity and embodied interactions can be hard to analyse in isolation, since the exhibition elements, in general, will have contributed to the level of curiosity. It is with this in mind, that the analysis will see how the embodied interactions have contributed to the interviewees' curiosity. The second analytical layer in chapter 6.3 will analyse how different embodied interactions evoked curiosity.

6.1 Curiosity indicators in each exhibition

In the following sections each exhibition experience from the results will be analysed individually. Each exhibition will be evaluated through the indicators of curiosity, and finally, given a fuzzy membership score (FMS) of 1.00 to 0.00, where 1.00 represents an ideal curiosity case with a high level of curiosity and 0.00 represents the worst curiosity case, with a nonexisting or low level of curiosity.

6.1.1 Cranium Cabinets

Embodied interactions: walking (through door), opening (cabinet)

Cranium cabinets hide and expose bits of information (i.e. craniums) through the physical form and therefore enable the visitor to expose more information through the interaction gestalt—both opening and finally, to get all information exposed at the same time by walking through the door. Through this combination, Cranium cabinets build on partial exposure. The individual control the exhibition entails lets the visitor explore on their own, which is an indication of complexity. There did not, however, seem to be any indication of neither uncertainty nor conflict in MM's recollection of the experience. Since MM did not recall the physical form of cabinet doors as a new or unique thing to this exhibition, it does not indicate a high level of novelty. However, he did find it aesthetically pleasing, which can be interpreted as an attention-drawing experience, indicating novelty. Finally, MM said that *"some of [the cabinets] make you want to open more"*¹ (Appendix 2, p. 7), indicating sustained curiosity. All things considered, as three of the curiosity principles are prominent and curiosity is sustained, the Cranium cabinets can be argued to have a FMS of approximately 0.6.

¹ "nogle af dem får du lyst til at åbne flere af"

6.1.2 Lion exhibition

Embodied interactions: Seeing (to search)

Just as the Cranium cabinets the Lion exhibition primarily builds on partial exposure. The visitors need to look for the hidden animals and gradually get information on their own initiative. This also includes uncertainty to some extent due to the fact that the visitor cannot be sure where the animal is hidden. Complexity is somewhat ensured due to the exploration made through looking, but the exploration is limited as well as the interpretation. MM does not mention novelty or a violation of expectations either, the latter indicating a lack of conflict. All in all, with only complexity being dominating and only three curiosity principles active in total, the FMS of the Lion exhibition can be argued to be approximately 0.1.

6.1.3 Beaver exhibition

Embodied interactions: Pushing (button), seeing (to search)

Pushing a button to turn on a light, cannot be argued to have a very novel appeal. As MM argued, since the exhibition was quite boring something was bound to happen when he pushed the button, indicating a low to mid-level of uncertainty. He didn't seem surprised about the effect of pushing the button either, and the expectations were therefore not violated; i.e. no conflict. The possibility to explore was highly limited, neither did the exhibition make him interpret what he saw or interacted with in any way, indicating a nonexisting complexity. The button did, however, enable the visitor to reveal some information otherwise hidden, indicating partial exposure. Since partial exposure is the only dominant curiosity principle, the experience does not amount to more than a FMS of approximately 0.1 in total.

6.1.4 Wall of Ice

Embodied interactions: Touching, sensing (temperature)

Uncertainty is one of the primary curiosity principles in this interaction, due to the way MM was wondering about how it could stay cold in a room so warm. This could also be interpreted as a sort of incompatibility between ideas, indicating conflict. The interaction of touching it directly and having that physical sensation, is a kind of sensorial experience (novelty). One might argue that the experience is not very complex, nor does it hide or reveal information. The FMS for the Wall of ice is approximately 0.4 based on the three curiosity principles activated, however none of them were very strong.

6.1.5 Amazonas exhibition

Embodied interactions: Crawling (into small space)

Novelty was nonexistent, due to the fact that MM had seen it before in other places. The interaction would, however, had MM interacted with it, allow

him to explore, which indicated complexity. As MM said in the interview, this exhibition indicated that the last pieces of information were to be found inside this construction, which can be interpreted as partial exposure. Finally, the recollection of the experience did not indicate any significant level of uncertainty or conflict. As only two curiosity principles were relevant the exhibition is given a FMS of 0.1.

6.1.6 Dinosaur room

Embodied interactions: Touching, watching (video)

The structure of the sequence can be interpreted as partial exposure, since the exhibition exposes information in bits and pieces. MM recalled being impressed by the sight of the dinosaur, which can be interpreted as an attention-drawing experience, indicating novelty. In addition, touching an object generated a sensorial experience, which strengthens the novelty principle further. Through exploring the dinosaur skeleton by directly touching it, one could argue that it made the experience somewhat complex. MM did not say anything that would indicate any uncertainty or conflict in the experience. However, the fact that he (and the children he was with) watched the video of approximately 10 minutes indicates sustained curiosity. Since three curiosity principles were dominant and the curiosity was sustained the FMS of the Dinosaur room can be argued to be approximately 0.6.

6.1.7 Primary cranium exhibition

Embodied interactions: Touching (physical object), putting together (physical objects like a puzzle)

Being a sensorial experience the exhibition was novel in some sense. One could speculate that uncertainty can be included as well, since the visitor would continuously predict how the different pieces fit together and might be surprised by how it ended up looking (uncertainty and conflict). However, MM does not utter these words explicitly. The visitors' gap in knowledge about how these pieces fit together as well as the inherent hidden qualities of the exhibition, indicates partial exposure. Due to exploration through the assembly of skeleton pieces, the experience is rather complex. Since uncertainty and conflict was not directly mentioned in the interview and the three other curiosity principles were prominent it is argued that the FMS is approximately 0.6.

6.1.8 Sense tunnel

Embodied interactions: Balancing, crawling, climbing, walking, gesturing, listening, sensing (temperature)

As indicated in the interview with MM, attention was drawn by the exterior of the Sense tunnel, which is an indication of novelty, even though the exhibition was not new to MM. It is also a very sensorial experience, since all senses but taste were engaged, another indicator of novelty. Uncertainty was ensured by

the constant uncertainty of what came next; i.e. he did not know what was in the next room. This is largely due to the sequentiality of the tunnel indicating partial exposure. Complete uncertainty was avoided by the use of surveillance cameras showing videos on the outside. It can be argued that the visitor must interpret on a continuous basis what they experience and explore it, especially in the dark areas, where one must feel the way—indicating complexity. There is nothing in the interview that indicates conflict, even though one could argue that conflicting experiences might present themselves in an exhibition with that level of uncertainty and constant need for exploration and interpretation. MM also mentioned that he often stayed in there a long time, indicating sustained curiosity. Based on the analysis above with a strong presence of at least four of the curiosity principles and sustained curiosity the exhibition experience is given a FMS of 0.9.

6.1.9 Earthquake exhibition

Embodied interactions: Getting up on (plateau), being shaken, pushing (button), building (with blocks)

The sensorial experience of the second part is indicating novelty, even though—just like the Sense tunnel—this exhibition was not new to MM. Quite the reverse, MM tried it every time he visited the museum, indicating sustained curiosity. It can be interpreted that the pushing of the button as a way of revealing whether or not the construction you built out of building blocks would hold was a kind of partial exposure. This act of wondering could also be an indication of uncertainty. Also, if the construction would hold without the visitor expecting it or vice versa, the visitor would experience a violation of expectations, indicating conflict. MM did not mention a conflict in the interview though. He did however say that there was no uncertainty involved in predicting what would happen when you got up on the plateau. Finally, by building something out of blocks the visitor was exploring or experimenting, indicating complexity. The overall evaluation including four more or less dominant curiosity principles amounts to a FMS of 0.6.

6.1.10 Pedagogue exhibition

Embodied interactions: Pushing (furniture), climbing (giant steps), putting on (jumpsuit)

As the experiences and the information was given in a sequence of rooms, partial exposure is a big part of the exhibition, which was strengthened by the inability to see things until stepping up on a box to see over a table, for example. Complexity was ensured through the ability to explore the elements of the exhibition and the interpretation MM experienced; e.g. the empathy towards children. MM recalled a sort of "aha moment", which can be interpreted as surprise, indicating uncertainty. He also seems surprised by how it feels to experience the world as a child, which indicates that he probably expected it to feel different; i.e. violation of expectations, indicating conflict. Novelty is indicated as the experience is sensorial by involving touch, crawling and climbing. As all five curiosity principles were activated in this experience it is

given an FMS of 1.0.

6.1.11 Olafur Eliasson tunnel at ARoS

Embodied interactions: *Walking, seeing vaguely (through fog), gesturing, sensing (temperature)*

What first attracted TF to the tunnel was the fact that many people *"were interacting in a different way over there"*² (Appendix 3, p. 2), indicating novelty. She also remarked that this made her expect that something special was happening in there (uncertainty). If there had not been many people around the tunnel, TF still thought she would have noticed it, due to the sheer size of the tunnel, that didn't indicate what was inside (partial exposure). Inside the tunnel the visitor was exposed to a sensorial experience, indicating novelty. Along the way, the visitor was exposed to sensorial stimuli in a serial manner (partial exposure), and TF did not know what was going to happen, which led to surprise (uncertainty) e.g. when the temperature changed. She kept trying to make predictions about what would come next, but failed and had to constantly adjust her expectations (conflict). Gesturing of limbs to explore the space indicates a presence of complexity to the experience. This is strengthened by the individual and ambiguous interpretation TF recalled, when accounting for the difference in her own experience and that of her companion. TF described the experience as a very emotional one and she *"had not predicted that [she] would get that feeling she came out with in the end"*³ (Appendix 3, p. 4), indicating conflict. She also said that she was surprised (uncertainty) by the complexity of the experience and that it was something she was not used to experiencing (novelty). After the first interaction with the tunnel TF went back to interact with it again (sustained curiosity) only to find that the effect had worn out, indicating a lack of novelty for repeated interactions. All in all, with all of the curiosity principles mentioned, and almost all of them strong, the experience TF had with this exhibition is set to **FMS 1.0**.

6.1.12 Screen room

Embodied interactions: *Walking (behind a curtain), listening (to sound and music)*

Partial exposure is at the root of the concept for this exhibition, since it deliberately tried to hide the biggest part of the exhibition behind a curtain. The first room was confusing (uncertainty) to F and made her wonder what this room could possibly have to do with Leonard Cohen (conflict). This confusion led her to seek an answer and find the rest of the exhibition. When listening to the singing men on the screens in the second room, F recalled being drawn (novelty) by her own senses from one screen to the next feeling surprised (uncertainty) by a new sound. This was mirrored in her statement that *"you always felt there were new things to observe"*⁴ (Appendix 4, p. 10), indicating sustained curiosity. According to F, the experience she and her companions had

² "mennesker der ligesom interagerede på en anderledes måde der over."

³ "Det havde jeg ikke forudset ville få mig til at få den følelse, jeg kom ud med til sidst."

⁴ "Man følte hele tiden, der var nye ting at observere."

and their individual interpretations (complexity) probably differed a great deal from each other. As curiosity was sustained and involved all of the curiosity principles, the FMS amounts to 1.

6.1.13 Things hanging from the ceiling

Embodied interactions: *Listening (to people talking through headphones), talking (into microphone)*

F was instantly attracted by the vision of this exhibition (novelty) and she wondered what it was, but did not understand it. This led to her giving up at first, possibly indicating too much uncertainty. However, after seeing her mother interacting with it and seemingly *"she got something out of it"*⁵ (Appendix 4, p. 8), F went back to try it again, but she felt that she had to strain herself in order to get something out of it herself. Eventually F understood the point of the exhibition, indicating sustained curiosity to fill her gap in knowledge. The experience was perhaps not that complex, since F felt it was predefined what she was supposed to get out of the experience, indicating no ambiguity or individual interpretation. Conflict was definitely present in F's experience, but not in a good way, since she had high expectations for the experience, which were not met. Due to a too high level of uncertainty and a negatively experienced conflict, the fact that novelty was present and curiosity sustained puts the FMS at 0.4.

6.1.14 Depression room

Embodied interactions: *Lying down, listening (to music)*

F did not interact with the exhibition, both due to the long queue, but also due to her feeling that the experience was too obvious in regards to what she was supposed to get out of the experience.

*"Now you have to go in and feel depressed. Wonder what that might do to you? I can probably figure out that I am going to be a little sad."*⁶ (Appendix 4, p. 13).

This indicates a lack of uncertainty and maybe too little complexity. It was however, a sensorial experience (novelty), that had the possibility to surprise (uncertainty) and/or violate F's expectations (conflict), but she refrained from interacting with it. With most of the curiosity principles low or unknown the resulting FMS is **0.1**.

6.1.15 Phone

Embodied interactions: *Picking up (phone), talking)*

Due to this perfectly normal-looking phone being placed in this exhibition,

⁵ "hun fik noget ud af det"

⁶ "Nu skal du ind og føle, at du bliver deprimeret. Hvad mon det gør ved dig?" Det kan jeg godt regne mig frem til, så bliver jeg nok lidt trist."

where K interpreted (complexity) that everything could be interacted with, he was doubting (uncertainty) whether it was for him to interact with or just for the staff. This indicates ambiguity (complexity) and incompatible ideas (conflict), but can also be interpreted as incomplete information, since there were no instructions for use (partial exposure). Since K expressed positive feelings about the exhibition element and it involved three curiosity principles the FMS is set to 0.6.

6.1.16 Box with holes

Embodied interactions: *Crawling, taking off (shoes), look out (of holes)*

The Box with holes entailed a lot of curiosity principles. Uncertainty is present in the form of K not knowing what is inside, due to the total darkness within. It can also be argued that this is a way to hide (partial exposure) some exhibition elements that would only be revealed if he entered. The many holes indicates the visitor's ability to explore (complexity) at will. In the interview K did not recall ever having seen anything like it at a museum (novelty), though it looked similar to constructions on playgrounds, i.e. another context. Even though K refrained from interacting with it, the exhibition experience is given a FMS of 0.6 due to four curiosity principles present in the exhibition.

6.1.17 Mirror rooms

Embodied interactions: *Walking (through sliding doors), seeing (own reflection in mirrors)*

Mirror rooms used both partial exposure and uncertainty with its construction. When K was inside each room he did not know (uncertainty) what was behind the next set of doors or how many rooms he had to go through, indicating a knowledge gap (partial exposure) that would be fulfilled when walking through them. Conflict might have arisen due to violation of expectation of how long it would go on. It was not mentioned in the interview whether the experience was new to K. The exhibition does not allow for much exploration or interpretation, which indicates a lack of complexity. Not much can be concluded from the duration of the interaction, since it was a section that led K from one exhibition to the next, but he did enjoy it seeing how he mentioned that it was fun several times during the interview. All in all, three curiosity principles are dominant in this exhibition and the overall experience was positive, which gives the experience a FMS of 0.6.

6.1.18 Video in ceiling exhibition at Louisiana

Embodied interactions: *Lying (in bed), watching (video), listening (to sounds and music), taking off (shoes)*

Before K entered the room he did not know what he was going to experience (uncertainty). Since the hallways leading up to it were dark, he was surprised (uncertainty) by the light coming from the video in the ceiling. This can be argued to be an attention-drawing experience (novelty), as he called it magical

(Appendix 5, p. 2). The silence in the room violated his expectations (conflict), since it did not correlate to the experiences he usually had with museum exhibitions, where people would talk about the artworks. This also indicates novelty, which is further strengthened by it being a sensorial experience. The fact that the video was somewhat hidden for the visitors when they came into the room indicates partial exposure. When faced with the task of getting into bed, K experienced doubt (uncertainty) about whether he should take off his shoes. A lot of interpretation was required for the individual to understand what was on the video (complexity). K ended up spending approximately fifteen minutes in there, indicating sustained curiosity. Since all curiosity principles were active in this exhibition experience, since K expressed positive feelings about it and since he interacted with it for a long time, the FMS is 1.

6.1.19 Night Fever at Designmuseum Danmark

Embodied interactions: *Dancing, walking, listening (to music through headphones), seeing, sitting (in a reconstruction), touching (reconstruction), bending (under half wall)*

The fact that the exhibition included simulations of nightclubs that visitors could sit in and feel, suggests that it offered them a sensorial experience (novelty). Dancing in an exhibition was also something that TM had never tried in an exhibition before (novelty). In the silent disco section of the exhibition, there were several rows of headphones hanging from the ceiling. Each row of headphones played different music, letting them explore and try the different ones (partial exposure & complexity). Seeing the feet of people dancing in the silent disco sections induced an attention-drawing experience (novelty), but since only the feet of the people could be seen this indicates partial exposure. However, there is no mention of this leading to any conflicting experience. On the contrary, seeing people dance made it clear to them what to expect, indicating a lack of uncertainty. Furthermore, MF mentions that the placement of headphones around the exhibition helped her sustain her curiosity and she felt like she wanted to try one after the other. TM points to his interest in the subject and the well-portioned information (partial exposure) as contributing factors to his sustained curiosity. There is no mention of uncertainty or conflict from either TM or MF. The FMS could be argued to be approximately 0.6.

6.1.20 Viking exhibition at Moesgaard museum

Embodied interactions: *Walking, placing (physical object), seeing, listening (to information)*

The Viking exhibition had many curiosity principles contributing to TM's positive experience, the main one being that of partial exposure of information. By gradually displaying information through his own control curiosity was sustained throughout the exhibition, and even after he exited the museum. TM called it *"the most complete museum experience [he had] had"* (Appendix 6, p. 3) (engagement) and said that it felt like being in a movie or book; something he had never tried before (novelty). Initially, TM was not sure what the tokens would enable him to do (uncertainty), but through exploration (complexity) he

learned how to interact with the system and found it very intuitive. There was no mention of any conflict during his museum visit. Due to continuously sustained curiosity, high engagement and four curiosity principles present, the FMS is argued to be 0.9.

6.1.21 Tallest man

Embodied interactions: Holding (physical objects), seeing

When looking at the curiosity principles this exhibition mainly builds on complexity, by letting visitors interpret the meaning of facts displayed there, through embodied interaction. MF also mentions wondering (uncertainty) if she can hold as many eggs as the world's tallest man. When trying she was surprised that she could not, which indicated a violation of expectations as well (conflict). All in all, due to only three curiosity principles being dominant, the FMS is set to 0.4.

6.1.22 Mirror/window section

Embodied interactions: Mimicking, walking, seeing

The fact that MF does interact with the mirror in the beginning indicates that it is an attention drawing experience (novelty). Some exploration could be argued to be involved in mimicking the grimaces indicating complexity. Due to the surprise MF experienced when finding out it was actually a see-through glass, the interplay between the curiosity principles uncertainty and conflict that were most apparent here. By placing the "mirror" and the reveal of the window so far from each other was according to MF also affecting the intensity of the surprise (uncertainty), since she had almost forgotten about the "mirror". She did not expect it to be a window, but simply a mirror, indicating a violation of expectations (conflict). Also, one could argue that the true nature of the mirror was hidden in the exhibition indicates partial exposure. Seeing how surprised MF was, it could imply that this type of exhibition element was something new to her (novelty). There is no direct mention of sustained curiosity. Finally, due to all of the curiosity principles being relevant, the FMS could arguably be set to 0.9.

6.1.23 Storm room

Embodied interactions: Seeing, feeling wind

Being an exhibition that involved feeling, one could argue that it was a sensorial experience (novelty). Once MF had walked through the Storm room and through a door, she got informational text about what the exhibition had tried to show her, and why, which is an indication of hiding the information at first and then exposing it (partial exposure). She described how she initially did not understand what she was seeing (uncertainty) but understood when she got the information in the next room. This initial information gap (partial exposure) contributed to her sustained curiosity, as she wanted to find the explanation to what she was experiencing in the first room. There is no explicit mention of a

violation of her expectation, but the fact that she was surprised could indicate that there was at least a small curiosity conflict involved. One could argue that there was complexity involved in the exploration of filling the knowledge gap, but since the exhibition route had taken her into the next room anyway, this complexity is low. In total, there are many curiosity principles at stake in the Storm room exhibition, giving it an approximate FMS of 0.9.

6.1.24 Timeline exhibition at the Swedish History Museum

Embodied interactions: Walking, listening (to sound and information), seeing, pushing (buttons), touching (physical objects)

Primarily the exhibition builds on partial exposure, both revealing information when the visitor walks from one section to the next, but also by pressing buttons to activate new information. According to G, the Timeline exhibition was not very novel to her, seeing how she compared it with another similar museum. However, she was allowed to touch some of the objects, and also noticed the light design and how these two elements resulted in a sensorial experience (novelty). There seemed to be little uncertainty and complexity. On the contrary G mentioned that it was clear what was expected of her and that she did not feel like there was much room for exploring or a need for figuring out what to do or what the elements meant (complexity). Since she recognised this type of exhibition from another museum, and felt no hesitation on what to do, it can be interpreted that there was no conflict in her museum experience. Nevertheless, G mentions that she was curious enough to go through the whole exhibition, to some extent due to her personal interest in history, indicating sustained curiosity. As only two of the curiosity principles—novelty and partial exposure—were dominant in the Timeline exhibition, but sustained curiosity was ensured nonetheless, it gets a FMS set at 0.4.

6.1.25 Hole to crawl into

Embodied interactions: Crawling

Including a hole visitors can crawl into to find out more is a clear example of partial exposure, since some of the information is hidden within the hole. Secondly, uncertainty is at stake here, due to the fact that visitors cannot know what to expect down there, bringing with it a need for exploration (complexity). One could also argue that the visitors might have expectations of what to experience in the hole that could be either confirmed or violated, the latter indicating conflict. However, the exhibition element did not produce enough curiosity for G to actually enter the hole (refrain). At least three curiosity principles were active, which sets the FMS to 0.4 in spite of the refrain from entering.

6.1.26 Killing fields museum of Cambodia

Embodied interactions: Walking, listening (to stories), seeing, pushing (buttons), holding (digital device)

In terms of curiosity, the audio part of the exhibition was mainly centered around partial exposure as visitors navigated through audio files to get more information. W had never visited a similar exhibition before (novelty) and felt that the sensorial inputs (novelty) of being present in the environment made it feel more real. Apart from controlling the MP3 player and walking around the area, there was not much more interaction and W did not experience uncertainty, except with the first encounters with the MP3 player where she had to understand how to use it—expecting to mess it up. These expectations were violated however when she did not have problems using the device (conflict). Through the audio files she got explanations on what to expect next, probably decreasing the level of uncertainty and conflict. One might argue that the stories being told and the things to look at required some sort of interpretation (complexity). W listened to all audio files available, which took over an hour according to W (Appendix 9, p. 3), suggesting a high level of sustained curiosity. With sustained curiosity enabled by three dominant (novelty, partial exposure and complexity) and two less-strong curiosity principles (uncertainty and conflict) the FMS is set to 0.6.

6.2 Subconclusion of the first analytical layer

The table on the right shows an overview of all exhibitions, their identified embodied interactions, induced curiosity principles and the FMS; dark blue illustrates a strong curiosity indicator, whereas light blue illustrates a weak one. Exhibitions where the interviewee refrained from interacting are marked with beige.

It is important to note that in table 3 the exhibitions are grouped into their respective FMS, meaning that exhibitions belonging to the same FMS are not ordered. Therefore, the exhibitions should be viewed as groups, e.g. all the exhibitions with FMS of 1.0 share the highest scoring.

In general, most exhibitions in the results had a high FMS (with an average of 0.6), which indicates that exhibitions that include embodied interactions evoke curiosity. Additionally, the exhibitions with a FMS of 0.0-0.1 had an average of 2 embodied interactions, the exhibitions with FMS of 0.4-0.6 had an average of 2.9 embodied interactions and the exhibitions with a FMS of 0.9-1.0 had an average of 4 embodied interactions. This indicates that the exhibitions with a lot of different interactions tend to have a higher FMS, which suggests that embodied interactions do in fact have an impact on curiosity (see table 2). However, this is not always the case—in the Mirror/window section and the Storm room, for example, each have two to three interactions listed, but have FMS of 0.9. Even the Screen room with a FMS of 1.0 only has two interactions.

Exhibition	Embodied interactions	Nov.	Unc.	Par.	Com.	Conf.	Sust.	FMS
Olafur Eliasson exhibition	Walking, seeing vaguely (through fog), groping the air, sensing (temperature)							1.0
Afghanistan exhibition	Walking, seeing, enacting with body, pushing (buttons), listening (to sounds), holding (physical object)							1.0
Screen room	Walking (behind a curtain), listening (to sound and music)							1.0
Video in ceiling	Lying (in bed), watching (video), listening (to sounds and music), taking off (shoes)							1.0
Pedagogue exhibition	Shoving (furniture), climbing (giant steps), putting on (jumpsuit)							1.0
Sense tunnel	Balancing, crawling, climbing, walking, groping the air, listening, sensing (temperature)							0.9
Viking exhibition	Walking, placing (physical object), seeing, listening (to information)							0.9
Mirror/window section	Mimicking, walking, seeing							0.9
Storm room	Seeing, feeling wind, walking through (to the next room)							0.9
Cranium Cabinets	Walking (through a door), opening (cabinet)							0.6
Dinosaur room	Touching, watching (video)							0.6
Primary cranium exhibition	Touching (physical object), putting together (physical objects like a puzzle)							0.6
Earthquake exhibition	Getting up on (plateau), being shaken, pushing (button), building (with blocks)							0.6
Mushroom	Shoving (with entire body), listening (to sound)							0.6
Phone	Picking up (phone), talking							0.6
Box with holes	Crawling, taking off (shoes), look out (of holes)							0.6
Mirror rooms	Walking (through sliding doors), seeing (own reflection in mirrors)							0.6
Night fever	Dancing, walking, listening (to music through headphones), seeing, sitting (in a reconstruction), touching (reconstruction), bending (under half wall)							0.6
Killing fields	Walking, listening (to stories), seeing, pushing (buttons), holding (digital device)							0.6
Wall of ice	Touching, sensing (temperature)							0.4
Things hanging from the ceiling	Listening (to people talking through headphones), talking (into microphone)							0.4
Tallest man	Holding (physical objects), seeing							0.4
Timeline exhibition	Walking, listening (to sound and information), seeing, pushing (buttons), touching (physical objects)							0.4
Hole to crawl into	Crawling							0.4
Lion exhibition	Seeing (to search)							0.1
Beaver exhibition	Pushing (button), seeing (to search)							0.1
Amazonas exhibition	Crawling (into small space)							0.1
Depression room	Lying down, listening (to music)							0.1
Carousel	Sitting, jumping on/off, going round (in the carousel)							0.1
Exhibition at Louisiana	Placing (sticker on wall), walking, listening (to music)							0.0

Table 3: Overview of exhibitions sorted after FMS from highest to lowest. (Nov. = Novelty, Unc. = Uncertainty, Par. = Partial exposure, Com. = Complexity, Conf. = Conflict, Sust. = Sustained curiosity.)

As can be seen in the Screen room analysis above, all five curiosity principles are evoked and F interacts with the exhibition during an extensive amount of time. One can therefore argue that more interaction elements does not always induce a higher amount of curiosity, but the quality of and relevance to the exhibition can be more or less curiosity evoking.

The exhibitions with FMS of 1.0 have all five curiosity principles in some way—most of them even show indications of sustained curiosity. Exhibitions with 0.9 either have all five curiosity principles to some extent or sustained curiosity based on all the curiosity principles except for conflict. In general, conflict is the curiosity principle that appears most rarely. One could speculate that this is due to the fact that the interviewees did not always mention their initial predictions or expectation, when describing their experiences, making it difficult to detect conflict. Walking, listening and sensing temperature are interactions that appeared often in the exhibition experiences with a FMS of 0.9 or 1.0. This might indicate that the exhibitions where the stimuli are coming from the outside without the active manipulation of the visitor has a great effect on curiosity. However, there are also examples of more active interactions like pushing buttons, climbing and placing a token, in the high FMS exhibitions.

The exhibitions with a score of 0.4 and 0.6 can be argued to be the most imprecise, due to the ambiguity of the results; the exhibitions neither belong completely to the concept of curiosity nor are they completely lacking curiosity. Partial exposure, novelty and complexity appear in almost all of the exhibitions with a FMS of 0.4 or 0.6. Uncertainty and sustained curiosity are relevant in some of them and conflict appears rarely. The second lowest ranging FMS—0.1—only involves one or two curiosity principles; sometimes partial exposure and complexity, and in one exhibition novelty and conflict. The only exhibition with a FMS of 0.0 had no curiosity principles at all.

Just because curiosity principles are being used in an exhibition, it does not necessarily mean that the visitor will interact with it, which is a sign of refrain and a lack of curiosity. This is the case for four of the exhibitions described in the interviews; Box with holes, Hole to crawl into, Depression room, and the Amazonas exhibition (all marked with beige in table 3). The interviewee refrained from interacting, but curiosity principles have still been identified in the analysis. On one hand, this can be seen as an indication of the limitations of the current theory on curiosity, i.e. there is a mismatch between the refrain and the FMS. Some exhibitions with a lower FMS than Hole to crawl into or Box with holes (e.g. Beaver exhibition) are interacted with. On the other hand, it can be argued that it is not the lack of curiosity that leads to refrain from interacting, but rather an obstacle grounded in something else. One possibility could be that in three of the four cases, the required embodied interaction (i.e. crawling) was interpreted as intended for a different age group than themselves. In Timeline, G even mentioned a fear of getting stuck, thus this fear might have conquered the knowledge gap. In the fourth, Depression room, one could argue that all of the curiosity principles were weak, primarily due to the lack of uncertainty and complexity.

6.3 Curiosity indicators in each embodied interactions

In the following sections all the identified embodied interactions will be analysed across the exhibition experiences one by one. The purpose is to see how each embodied interaction has affected the experience of curiosity. However, the analysis is carried out knowing that there can be other variables affecting the feeling of curiosity.

6.3.1 Full body

6.3.1.1 Walking around



In almost every exhibition walking around to navigate the exhibition space was a common practise. When walking around the body uses its senses to interpret the surrounding environment which will be explained further in chapter 6.3.3: Intangible embodied interactions.

In the Afghanistan exhibition, the focus was not on the movement of the body, but on the sensorial experience the body enabled when walking around the exhibition (novelty). F felt like she *“had come to another place”*⁷ (Appendix 4, p. 2) and that the experience impacted her more than if she were to learn about the subject through reading a book or watching a video. She also points to the fact that had she not been in this simulated environment and been able to pick up things *“(...) then I think I would have forgotten the experience faster.”*⁸ (Appendix 4, p. 8). The possibility to pick up something and use her body, made her remember the exhibition. W also mentions how the act of walking around made her experience at Killing fields more real. Through the activation of all senses when walking around W felt *“as if you experienced it all. (...) You almost felt like you were there.”*⁹ (Appendix 9, p. 8). Furthermore, F mentions how it was the impressions picked up by her senses that lead her around the Screen room, another indication of a sensorial experience (novelty). The interplay

7 “Man følte rent faktisk at man var kommet et andet sted hen.”

8 “så tror jeg at jeg havde glemt oplevelsen hurtigere”

9 “Det var ju nästan som att man upplevde allt. (...) man kände ju verkligen att man var där.”

between walking and listening is interesting in the Screen room. Had the screens not been so far apart, requiring F to walk from one place to the other when she heard a sound, the sound might not have appeared as interesting, because every sound would have been equally close to her and therefore probably mixed with other sounds.

Walking is also an important part of the visitor experience in the Mirror/window section, as a part of the information is hidden at first to be revealed later (partial exposure), so walking is used to sort of control or predefine the amount of information given at a specific time. Walking can also be used to give the control to the visitor. Distributing information spatially (partial exposure), making visitors move around in the room to access more information is an embodied interaction that both MF, G, and TM mentions as a contributing factor to the feeling of controlling the information flow. This in turn helped decrease MF and TM's sense of information overload in Ripley's believe it or not museum and the Viking exhibition. G does not mention if it helped her decrease information overload in Timeline, but argued that it helped her stay active.

To sum up, the embodied interaction of walking around mostly induces partial exposure, but can also be a way to gradually gather sensorial experiences (novelty).

6.3.1.2 Walking through something



Walking through something is here referred to exhibitions where visitors have either walked through a bigger space, eg. a room or tunnel, or walked through either a drape or door.

In the Olafur Eliasson tunnel, Mirror rooms and Sense tunnel the whole exhibition was centered around the visitor walking through it. The Screen room and the Storm room were also dependent on the visitor walking through from the first room to the next.

All five exhibitions were inducing a strong sense of partial exposure. TF mentioned how *"it can only be presented by me doing something about it [moving through the exhibition]"*¹⁰ (Appendix 3 p. 5) and that this embodied interaction generated a stronger experience, than if she would simply be a spectator. K also encountered partial exposure in the Mirror rooms when moving through one automatic door after the other, not knowing what to expect (uncertainty). In the Sense tunnel, MM had to explore (complexity) his way through the dark tunnel while not sure what to expect (uncertainty), experiencing a variety of other embodied interactions along the way (partial exposure).

¹⁰ "det kan kun blive præsenteret ved at jeg gør noget ved det."

For F the application of partial exposure in the Screen room was vital for her experience. By moving from the first room, feeling confused (uncertainty), through a pair of drapes into the second room and revealing the intent of the exhibition as a whole resulted in a surprise (uncertainty) that violated her expectations (conflict). It can be interpreted that the knowledge gap in the first room sustained F's curiosity to make sense of the exhibition by going behind the screen to the second room. MF had a similar experience in the Storm room, where the first room confused her (uncertainty) and she *"wanted to find out why they had built that [the first room]"*¹¹ (Appendix 7, p. 6), indicating sustained curiosity. By walking through to the next room (partial exposure) MF found the meaning of the former, violating her expectations (conflict). In all seven exhibitions the act of exploration (complexity) was also integrated in the embodied interaction of walking through the exhibition.

As an alternative to walking through a room or in TF's case—a tunnel—three of the exhibitions added a physical barrier visitors had to walk through to. In Video in ceiling and Screen Room, the visitors walked through drapes, hiding the next part of the exhibition (partial exposure and complexity). In the Cranium cabinets visitors have to walk through a door, if they want to reveal the complete exhibition behind it, instead of opening each cabinet separately (partial exposure).

To sum up, the most prominent curiosity principle in this embodied interaction is partial exposure. However, both uncertainty and complexity also affect the overall experience, and in F and MF's cases, there was a violation of their expectations (conflict) when their knowledge gap had been filled. Additionally, walking around is associated with sustained curiosity.

6.3.1.3 Dancing



Dancing was an embodied interaction found in the Night fever exhibition and was paired with the embodied interaction of listening to music through headphones.

According to the statements from TM and MF it seems like this embodied interaction had made a big impression on them both. Initial curiosity was aroused by seeing others on the dancefloor (novelty) and neither of them had ever tried this interaction in a museum before, also indicating novelty. However, the dancing itself did not induce other curiosity principles, but rather the combination of dancing together with listening to music. It can

¹¹ "ville ta reda på varför de hade byggt upp det här."

therefore be interpreted that dancing only induced the curiosity principle novelty, through the attention drawing experience and being a novel experience. It did however still affect TM and MF's level of engagement, and based on their interviews it can be understood that they spent quite some time at the dancefloor, which indicates sustained curiosity.

6.3.1.4 Balancing



Balancing refers to an embodied interaction only mentioned in the Sense tunnel, where visitors are invited to walk on a beam, while an optical illusion tricks them into thinking they're about to fall off. This is an example of a sensorial experience, indicating novelty. MM also mentioned that even though he had his balance, the circle spinning around made him feel like he was losing his balance (conflict). The balancing element does not induce any curiosity principles by itself. Instead, it was the optical illusion influencing MM's sensorial experience (novelty) and the feeling of conflict.

6.3.1.5 Bending under something

Bending under something has only been identified in the Night fever exhibition, where there was a half-screen exposing a dancefloor on the other side that visitors needed to bend under to access the dancefloor.

This particular embodied interaction is centered around partial exposure, where the exposed part generates an attention drawing experience (novelty). However, since MF and TM could see other people dancing on the dancefloor on the other side of the screens, there was no mention of uncertainty or complexity, nor conflicting experiences when bending under the half-screens and exposing the whole dancefloor. Contradictory, TM does not recall bending under, but rather *"walking around [the half-screens] to get there"*. This might indicate that the embodied interaction was not memorable by itself, but rather what was on the other side—since dancing (as described above) is an interaction both TM and MF remembers well.

To sum up, bending under something in the particular example from Night fever mostly induces the curiosity principle partial exposure, and a certain level of novelty seeing how the part being exposed draws the visitor's attention.

6.3.1.6 Lying down



Lying down refers to lying down on a bed, since this embodied interaction has only been identified in Video in ceiling exhibition and Depression room. In the former, laying down was paired with the interaction of watching a video in the ceiling. In Depression room, it was combined with listening to music.

Since F did not go into the Depression room, little can be concluded about the effects of lying down in this particular case. In Video in ceiling, however, K recalled lying down for about 15 minutes, indicating sustained curiosity. However, it is hard to say whether this sustained curiosity is due to the embodied interaction of lying down, or rather the interactions of watching the video sequence in the ceiling and listening to the accompanying sound. According to K, *"the entire interaction made the visitor retreat a little. Because a room for reflection occurred in a way. So you could lie back and let your thoughts flow."*¹² (Appendix 5, p. 2). K also mentioned that the embodied interaction of lying down was not something very novel to him, but rather the whole atmosphere in the exhibition. Nevertheless, lying down was an interaction that allowed him to relax and give in to what was happening around him, which could be interpreted as a sensorial experience or as an interaction that supports sensorial experiences induced by other exhibition elements, indicating novelty. The fact that curiosity was sustained in the Video in ceiling was partly due to the embodied interaction of lying down.

To sum up, lying down sustained curiosity—at least when combined with other embodied interactions—and induced novelty in the form of a sensorial experience.

6.3.1.7 Climbing



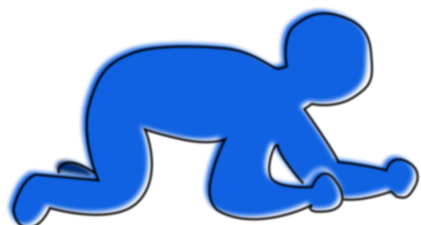
Climbing refers to the interaction of climbing a net or climbing a flight of stairs, and has been identified in the Pedagogue exhibition and the Sense tunnel.

In the Pedagogue exhibition, MM had to climb a flight of stairs with giant steps that helped him realise (conflict) why children can sometimes be slow. In the Sense tunnel, MM had to climb a net, all the while feeling a little lost (uncertainty). Although, it can be interpreted that the feeling of confusion is affected by the darkness in the Sense tunnel, thus the impaired visibility.

To sum up, it is difficult to pair climbing with specific curiosity principles. It is rather the specific context that influences whether climbing induces conflict or uncertainty.

¹² "hele den der interaktion gjorde, at man ligesom trak sådan lidt tilbage. For der opstod et rum for refleksion på en eller anden måde. At man sådan kunne ligge tilbage og lade tankerne flyde."

6.3.1.8 Crawling



Crawling refers to the act of crawling into something, and has been identified in the Amazonas exhibition, Box with holes, Holes to crawl into and the Sense tunnel. In the first three exhibitions there has been some sort of hole for visitors to crawl into, in order to reveal information (partial exposure). All interviewees refrained from this type of interaction and pointed to the fact that it was mainly aimed at children.

*"I think it became very childish in a way, I think. Yes, I don't know why. I got that playground feeling; Then you could crawl inside a black pipe and then you would think that was fun. It just didn't appeal to me so much, I think."*¹³ (Appendix 5, p. 8).

In the quote above, K indicated reluctance to engage in an exhibition element, where he was supposed to crawl into a pipe. He seems to think that the experience he would get out of it, would not be interesting enough. Additionally, G and MM were afraid of getting stuck themselves, due to the fact they understood it as being for children. Neither MM nor G were surprised to see that kind of interaction at an exhibition, since it was a quite usual thing to see at a museum with exhibition elements for children.

In the Sense tunnel however, MM did not describe in detail what the interaction entailed, but just mentioned seeing people crawling in. Here, MM did not seem to have any refrain from crawling, seeing how he never mentioned something negative about it and that the exhibition scored a FMS of 0.9. It can therefore be interpreted that crawling can in some cases be an embodied interaction that is acceptable. Although, not much more can be said about the exact reasons why.

In the three other exhibitions it could be interpreted that the interviewees did not feel uncertain about what kind of experience the interaction element would generate indicating a low level of uncertainty. This particular type of interaction was not something novel to these interviewees, a factor that might have influenced the low level of uncertainty and effectively the low participation rate.

Based on the findings, it can be argued that crawling was not curiosity evoking enough for the majority of the interviewees. However, this embodied interaction induced partial exposure, and

¹³ "Jeg synes det blev meget barnligt på en måde, tror jeg. Ja, jeg ved ikke hvorfor. Jeg fik den der legepladsfølelse; Så kunne man kravle ind i et sort rør, og så synes man det var sjovt. Det sagde mig nok ikke så meget, tror jeg."

6.3.1.9 Stepping up on something



Stepping or getting up on something has been identified in the Earthquake exhibition, where visitors can step up onto a plateau, which simulated the sensation of an earthquake, and in the Pedagogue exhibition, where the visitors have to step up onto a box to see the exhibition. There is no mention if this particular interaction induces any curiosity in the Earthquake exhibition, but rather the subsequent shaking did. One could argue that visitors might try to predict what will happen and how it will feel, indicating uncertainty. Following that argument, there would then be a knowledge gap on what one will experience (partial exposure). In the Pedagogue exhibition, the embodied interaction of stepping up is a way to reveal more information, indicating partial exposure. To sum up, getting up on something can be argued to be a way to reveal information, indicating partial exposure.

6.3.1.10 Being shaken



Being shaken refers to the Earthquake exhibition described above, as an extension to getting up on the plateau visitors can experience the sensation of an earthquake shaking you. For MM, this interaction was something that he always tried when there, indicating sustained curiosity. Since the body and senses were involved in the interaction, it generated a sensorial experience (novelty). Moreover, MM did not experience any uncertainty, complexity or conflicting experiences. All and all, being shaken mainly induces a sensorial experience (novelty) engaging enough for MM to try it repeatedly (sustained curiosity).

6.3.1.11 Shoving



Shoving refers to pushing something with one's entire body and has been identified in Mushroom and Pedagogue exhibitions. In the Mushroom exhibition, shoving was induced by wondering (uncertainty) and experimenting (complexity), since K had to try pushing it more and less hard, to explore what sound it would generate. K said that the interaction of shoving was very memorable and a *"very fun interaction"*¹⁴ (Appendix 5, p. 9)—not something he had seen before (novelty). In the Pedagogue exhibition the act of shoving a block was somewhat related to exploration (complexity) and novelty in the form of a sensorial experience.

¹⁴ "meget sjov interaktion"

To sum up, shoving something induced uncertainty, complexity, as well as novelty. One could also argue that partial exposure is a product of the exploration and wondering occurring subsequently evident in the continued shoving of Mushroom.

6.3.2 Object oriented

6.3.2.1 Putting on something



Putting something on refers to two things in the findings; putting on a jumpsuit in the Pedagogue exhibition and putting on headphones in Killing fields, Night Fever, Timeline and Things hanging from the ceiling.

Whether the act of putting on something is curiosity inducing or not is not mentioned explicitly in the interviews. Especially in the case of putting on a jumpsuit, little was said about the experience of it. In general it can be argued that many things factor in, but when faced with headphones hanging from the ceiling for example, the interviewees generally felt intrigued by it. The hanging headphones suggest that there is something (music, sound or information) to be revealed when wearing it, indicating partial exposure. The sound initiating from these are inherently sensorial in nature, indirectly indicating novelty. As this can be interpreted to invite predictions about what the output might be, both uncertainty and conflict could be induced. This in turn can lead to surprise or conflict when revealing the output. For MF the headphones hanging down were contributing to a feeling of exploration (complexity), probably due to the large number of headphones hanging in the Night Fever exhibition. In the case of Killing fields the headphones made up the primary part of the exhibition. However, when asked what sustained her curiosity, she did not mention the headphones being a contributing factor, but rather the subject. However, headphones enabled the visitor to have a personal experience alongside strangers, which could indicate complexity in the form of exploration or interpretation.

To sum up, putting something (usually headphones) on makes people curious because all curiosity principles can play a role. Partial exposure and complexity are the primary curiosity principles, while conflict, uncertainty and novelty are less prominent.

6.3.2.2 Taking off something

Taking something off refers to the act of taking off shoes in the exhibition Box with holes in and in Video in ceiling.



The fact that the exhibition required K to take something off made him refrain from interacting with the Box with holes in, which was partly due to the act of crawling, but also said that he thought *"it was a little cumbersome that day [to take off his shoes]"*¹⁵ (Appendix 5, p. 8). In the Video in ceiling exhibition K did interact, however—and not just briefly—indicating sustained curiosity. The fact that the same interviewee described two exhibitions where he was required to take off his shoes where the outcomes were so different; refrain versus sustained curiosity, questions whether the embodied interaction is curiosity evoking or inhibiting. In neither of the exhibitions the act of taking off his shoes was the primary driver for his curiosity, but it might have been the primary inhibitor in the Box with holes in. One might argue that the curiosity K felt in the Video in ceiling exhibition was large enough to overcome the obstacle posed by this embodied interaction.

Therefore, taking something off can, according to the findings, at best be interpreted as a neutral embodied interaction when it comes to curiosity, at worst an obstacle.

6.3.2.3 Opening doors



Opening doors or other kinds of lids entails exposing or accessing what is behind. In the interviews the act of opening appeared in the exhibition Cranium cabinets.

When describing Cranium cabinets MM explained how he found it *"(...) lovely, that you can adjust the level according to how much you can take in at a time. (...) it is nice that you are allowed to go in depth with the details and (...) that you don't have to take it all in at once."*¹⁶ (Appendix 2, p. 2). Inherent in the act of opening a cabinet door is the curiosity principle partial exposure and complexity due to the exploration it requires. Opening something entails that the visitor is interested enough to see what is behind it, therefore this embodied interaction is related to walking through something mentioned above, which indicates interest, interlinked with curiosity.

To sum up, opening doors sustains curiosity and induces partial exposure and complexity in the experience.

6.3.2.4 Pushing buttons

¹⁵ "det synes jeg var lidt besværligt den dag."

¹⁶ "dejligt at man kan justere niveauet efter hvor meget man kan tage ind ad gangen. (...) så er det også at man kan få lov til at fordybe sig og gå lidt i detaljerne og (...) at man ikke skal rumme det hele."



Quite a few exhibitions had some sort of button, which the visitor could press; the Afghanistan exhibition, the Earthquake exhibition, Timeline, the Beaver exhibition and Killing fields.

In almost all of the above mentioned exhibitions the buttons were integrated into the surroundings and in Killing fields they were integrated into a handheld device. All of them entailed partial exposure, as the pushing of a button revealed information or stimuli otherwise hidden. Like in the case of e.g. putting something on, the output might surprise (uncertainty) the visitor or in any case, the visitor will undoubtedly make predictions (uncertainty) about what the button might do. One example is the Beaver exhibition, where MM had assumptions about what might happen when he pressed the button. Again, the actual output might contradict (conflict) these predictions.

The embodied interaction of pushing a button will inherently induce partial exposure, uncertainty and maybe conflict.

6.3.2.5 Holding objects



In four of the exhibitions in the findings the visitors were invited to hold objects. In the Afghanistan exhibition the visitor could hold a rifle, in Tallest man the visitor could hold eggs, and in Killing fields the visitor needed to hold the digital device controlling the audio.

In the Afghanistan exhibition F is critical towards holding the rifle, but the act of doing it helped her understand the subject matter better (and empathise with them), which F interpreted to be the point of the exhibition. In the Tallest man exhibition holding objects also increased understanding of the subject matter by being able to compare oneself to the exhibition. Here the interviewee experienced uncertainty and conflict. The increased learning and empathising would only be increased in exhibitions where the embodied interaction fit with the subject matter. One might argue that it would have been pointless to hold a rifle in an exhibition about something other than warfare, for example. In Killing fields, the visitor had to—so the holding was a means to an end.

Even though a few of the exhibitions invite the visitor to hold something, it can be hard to say anything about how it evoked curiosity. What can be said is that in the examples above holding something is connected to uncertainty and conflict.

6.3.2.6 Building



A relatively active form of embodied interaction is building something, which only appears in two exhibitions; by building

6.3.2.7 Placing objects



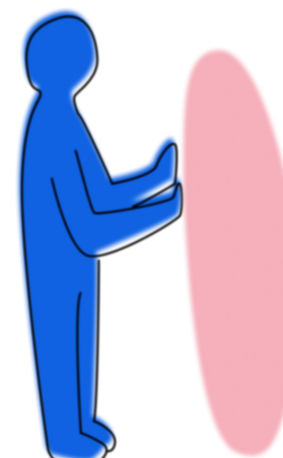
with blocks in the Earthquake exhibition and by putting together skeleton pieces like a puzzle in the Primary cranium exhibition. In both of these exhibition experiences uncertainty and complexity were relevant in the form of exploration. One could argue that partial exposure was involved as well, since the information as a whole is not presented until the visitor has finished building.

The act of placing something in the exhibition is only mentioned in two exhibitions; the Viking exhibition and the Exhibition at Louisiana. In both cases, the thing to be placed is provided by in the exhibition, but the experiences are quite different.

In the case of the Exhibition at Louisiana, F recalled feeling that it was a bit pointless that she placed something and the experience did not induce any curiosity at all. Here, there was no outcome of her placing a sticker other than the growing amount of stickers. In the Viking exhibition however, the placing of the token had varied outputs according to which token the visitor had chosen and where the visitor placed it. In this case, the placing of the token revealed information (partial exposure), so the visitor felt in control and *“made [his] experience way more interesting, because it was personalised”* (Appendix 6, p. 3). As can be seen in the analysis section of this exhibition the placing of the tokens also entailed uncertainty and exploration (complexity).

Based on the examples above, it is clear that the embodied interaction of placing something must have a sort of output in order to induce curiosity, which is the case of the Viking exhibition. If done so, it might entail partial exposure, uncertainty and complexity.

6.3.2.8 Touching objects



One might argue that all of the sections above entail touching something, but the embodied interaction touching objects only encompass exhibition experiences where the act of touching were in focus. Examples from the interviews are the Wall of ice, the Timeline exhibition, the Primary cranium exhibition, the Dinosaur room and the Night Fever exhibition.

A prominent example is the Wall of ice since touching is not merely a means to an end, but the main focus of the exhibition. When touching something is in focus, it is a sensorial experience, which indicates novelty. A majority of the interviewees can agree that when posed with the opportunity to touch elements or artefacts in an exhibition, it makes their experience more interesting. G mentions that one usually is not allowed to touch objects in

exhibitions, so when given the opportunity it makes the experience more engaging. Even touching by pushing buttons contributes to increased engagement, since it helps activating herself. K mentions something similar, and to *“touch something (...) make everything a bit more interesting”*¹⁷ (Appendix 5, p. 10). When talking about the Dinosaur room MM even argued that touching something can contribute to a strengthened bond between visitor and the object.

*“The fact that you are allowed to fiddle with it, then you sort of get another connection to the artifacts, right?”*¹⁸ (Appendix 2, p.4).

Touching something can also entail uncertainty in the form of predicting how it might feel or surprise about the sensation. In a way, the ability to touch something also closes a gap in knowledge about how it feels (partial exposure). To sum up, objects will inherently induce curiosity in the form of novelty and sometimes uncertainty and partial exposure.

6.3.3 Intangible embodied interactions



6.3.3.1 Groping the air

The embodied interaction of groping the air should be understood as gesturing with arms and/or legs, e.g. to find one’s way. This appears in two exhibitions; the Sense tunnel and the Olafur Eliasson exhibition. In both of these exhibitions, groping the air is used to navigate while being visually impaired due to darkness or fog. One might argue that the visitor is exploring by groping the air, which indicates complexity. Both exhibitions with this embodied interaction scored a high FMS and induced sustained curiosity.



6.3.3.2 Sensing temperature

In three exhibitions temperature played a key role in the experience; the Sense tunnel, Olafur Eliasson exhibition and the Wall of ice. Sensing temperature is inherently an embodied experience and is argued to be an embodied interaction, as it entails the interplay between cognition and the physical body, in interpretation. Sensing temperature is inherently a sensorial experience (novelty) and often involves surprise (uncertainty) in this study’s findings.

¹⁷ “røre ved noget, (...) gør bare det hele lidt mere interessant på en eller anden måde.”

¹⁸ “det at man får lov til at pille ved det, så får man ligesom en anden connection til tingene, ik?”

6.3.3.3 Listening



In several of the exhibition experiences listening was a major contributor to the interviewees feeling curious. The sound consisted of different audio; music in Night Fever, the Exhibition at Louisiana and the Depression room, singing voices in Screen room, stories being told in Killing fields, information in Viking exhibition and Timeline exhibition, voices saying something in Things hanging from the ceiling, a bell in Mushroom and sound effects in Afghanistan exhibition, Storm room, and in Sense tunnel. Finally, ambient sound in Video in ceiling exhibition.

As music was a part of three exhibitions with very different FMS, the act of listening to music is neither completely curiosity evoking or inhibiting. In the case of Night Fever, music was the subject matter, and this probably contributed to the overall positive feeling towards the exhibition. In Video in the ceiling, listening to ambient sound had a big impact on K’s experience, contributing to sustained curiosity. Since the Exhibition at Louisiana scored 0 on the FMS scale and the Depression room was not interacted with, listening to music did not contribute to curiosity in these instances. Related to this is the Screen room, where F listened to singing voices, which was related to the subject area. Here, listening encompassed surprise and attraction to different areas of the exhibition indicating uncertainty and novelty. She also mentions how constantly hearing something sustained her curiosity and continued her interacting.

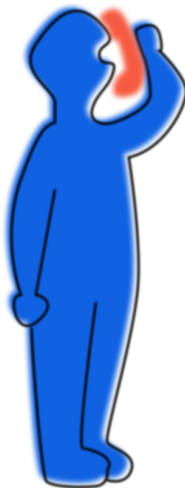
In four of the exhibitions the act of listening was focused on voices saying something; Killing fields, Timeline, Viking exhibition and Things hanging from the ceiling. The purposes of the voices were very different. In Killing fields the voice told a story, which sustained W’s curiosity. The format of a story exposed information to W in a gradual manner, indicating partial exposure. In Things hanging from the ceiling listening to the voices required a great deal of interpretation, indicating complexity (even though there was a description text in the exhibition instructing visitors on what to do). In the two other exhibitions, the act of listening enabled the visitor to learn new things and encompassed partial exposure.

Except for taste, all the senses were involved in the experience W had in Killing fields—which is what made the experience seem real. However, listening was the most prominent embodied interaction, since the museum experience in question was simply walking around and listening to an audio guide.

In the Afghanistan exhibition and in Mushroom, the visitor could hear a sound or sound effect. This sound came as a surprise (uncertainty) in both cases and contributed to the feeling of curiosity. In the case of the Mushroom curiosity was sustained since

K tried to understand how he could affect the sound (complexity) and in the Afghanistan exhibition the sound “made the biggest impression” (Appendix 4, p. 5), contributed to the simulated environment and made her feel uneasy.

According to our findings listening will induce four of the curiosity principles; novelty, uncertainty, partial exposure, and complexity. The curiosity effect of listening largely depends on the relevance to the subject area and the curiosity principles involved depends on the type of output the visitor listens to. In some cases it induces partial exposure, in others complexity. Listening is often connected to sustained curiosity and is inherently a sensorial experience, indicating novelty.



6.3.3.4 Talking

In two of the exhibitions the embodied interaction talking is a part of the exhibition; in Things hanging from the ceiling and the Phone. As the Phone enabled the visitor to talk in it like a normal phone, it might be interpreted as inducing sustained curiosity, due the plurality of the prank calls made. However, one could argue that it was rather the act of doing something K was not sure he was supposed to that resulted in his uncertainty and sustained curiosity. Talking was also an option in Things hanging from the ceiling as there were microphones, but F did not say anything about whether this option made her feel more curious.

6.3.3.5 Seeing

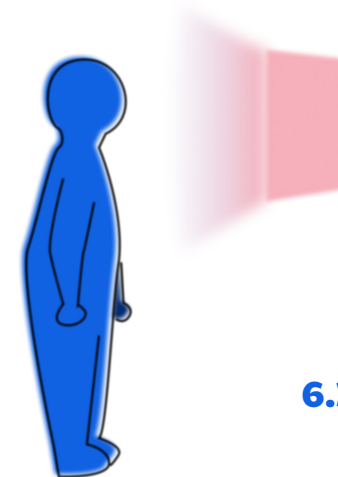


As seeing is an inherent part of every exhibition, it will only be described briefly in this section. The sections below will analyse the specific cases of watching and searching using sight, but this section will focus on more general findings.

Often, the attention drawing experiences (novelty) were dependent on sight. This was evident in the cases of e.g. Carrousel and Mushroom, where K noticed them due to their size. Seeing something might also make the visitor wonder (uncertainty), like when MM saw the Wall of ice or when MF saw the broken objects in the Storm room. In some exhibitions seeing was impaired due to either darkness or fog, resulting in the embodied interaction groping the air. Apart from novelty and uncertainty, one could argue that seeing often is an embodied interaction in the act of interpretation (complexity).

To sum up, seeing is closely related to the curiosity principle novelty and can also induce other principles like uncertainty and complexity.

6.3.3.6 Watching



This embodied interaction refers to the act of watching videos, and was found in Video in ceiling and Dinosaur room. In both cases curiosity was ensured for a long time indicating sustained curiosity. In Dinosaur room the act of watching the final video shows a willingness to close a knowledge gap (partial exposure). In the Video in ceiling exhibition watching the video included complexity, since it was not clear what the video footage depicted. To sum up, watching a video sustained the visitors' curiosity, which entailed either partial exposure or complexity.

6.3.3.7 Searching by seeing



In two exhibitions the visitor is invited to search for something using their sight; the Lion exhibition and the Beaver exhibition. Parts of the information were deliberately hidden, so that visitors had to actively search for this missing part. Here, the exhibition makes the visitor aware that there is a gap in their knowledge, prompting them to search for information to close that gap. In both exhibitions the act of searching is related to partial exposure and exploration (complexity), both contributing to sustained curiosity. In the Lion exhibition MM clearly stated in the interview that he found it engaging to have to search for something, instead of it just being presented to him in plain view. To sum up, searching entails partial exposure and complexity.

6.4 Subconclusion of the second analytical layer

To give an overview of each embodied interaction and what curiosity principle they induced (if any), table 4 was created (see below). The order in which each embodied interaction is presented has no impact to it being more or less curiosity evoking. As in table 3, the darker colored squares indicate a higher level of a certain curiosity principle, than the lighter colored ones.

Embodied interaction	Nov.	Unc.	Par.	Com.	Conf.	Sust.
Walking around						
Walking through something						
Dancing						
Balancing						
Bending under something						
Lying down						
Climbing						
Crawling						
Stepping up on something						
Being shaken						
Shoving						
Putting on something						
Taking off something						
Opening doors						
Pushing buttons						
Holding objects						
Building						
Placing objects						
Touching objects						
Groping the air						
Sensing temperature						
Listening						
Talking						
Seeing						
Watching						
Searching by seeing						

Table 4: Overview of embodied interactions and the induced curiosity indicators.

When looking at the embodied interaction in the first theme—full body interactions—it can be hard to point to a specific embodied interaction’s impact on curiosity, since they usually blend together to create a complete experience for visitors. Walking around and lying down are examples of this, as these

embodied interactions often include e.g. watching something or listening—sensorial interactions that contribute to the complete experience and indicate novelty.

Taking off something, climbing, balancing and partly stepping up on something are all examples of embodied interactions that do not by themselves induce much curiosity. Rather they are supplements to other interactions that are more curiosity evoking. Climbing did induce conflict in the Pedagogue exhibition, and uncertainty in the Sense tunnel, but both these curiosity principles arose partly due to external elements, such as darkness. Stepping up on the plateau in the Earthquake exhibition is not curiosity evoking by itself, but because of what follows—being shaken. Finally, one embodied interaction in this theme does induce curiosity in itself; stepping up on a box in the Pedagogue exhibition enables the visitor to see everything, clearly inducing partial exposure.

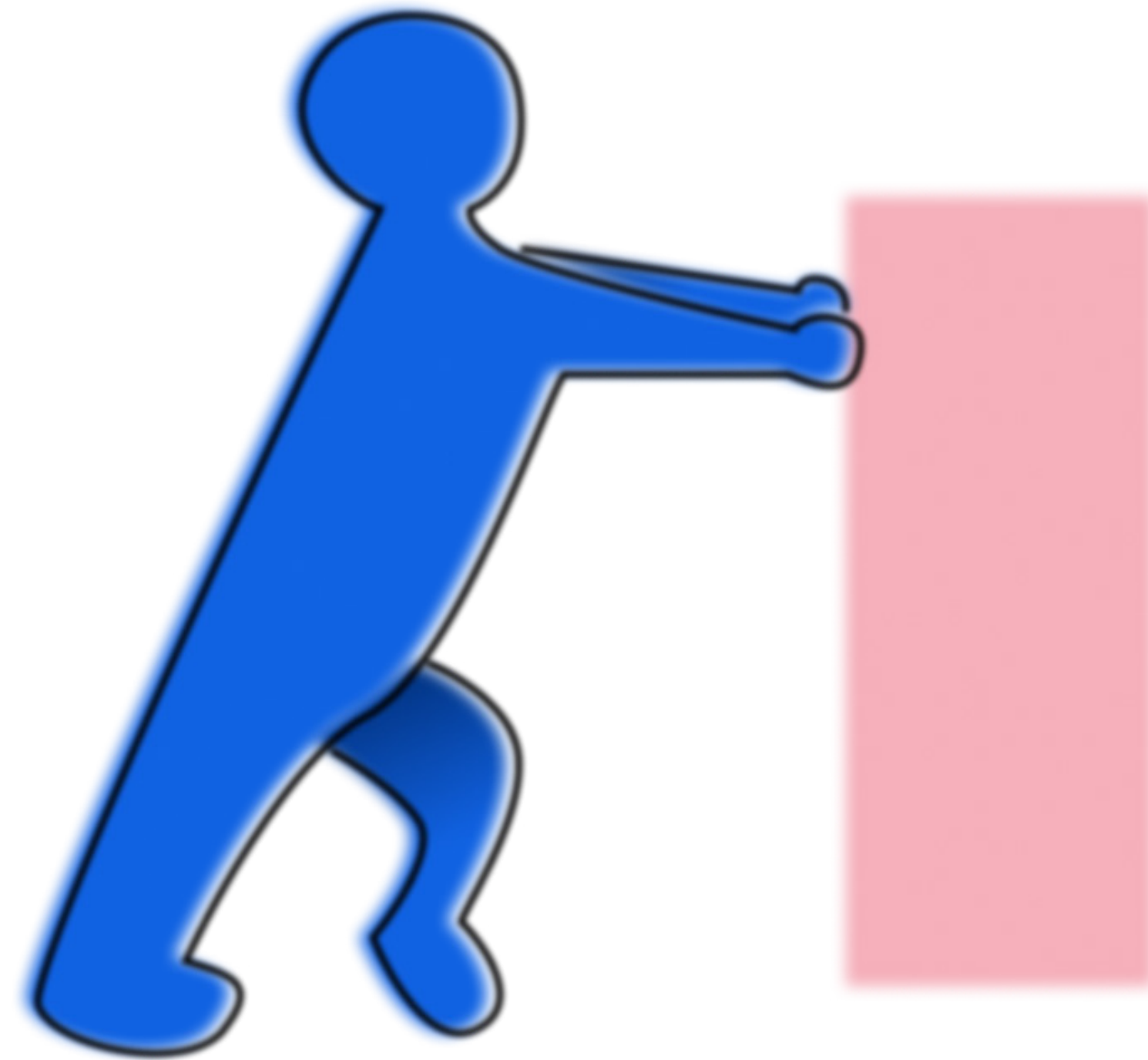
Partial exposure was also the curiosity principle induced in the most embodied interactions, e.g. opening doors, pushing buttons, bending under, walking around, and walking through something; either by gradually accessing new information or by revealing something initially hidden. Building, shoving, seeing, and listening on the other hand, were more connected to the curiosity principles of complexity and uncertainty. Usually these two curiosity principles were connected in these embodied interactions, since they encompassed some sort of initial doubt or prediction, followed by exploration and interpretation, in order to find the answer. It can be interpreted that this also induced partial exposure, since there is a knowledge gap to fill through the exploration.

Looking at embodied interactions more centered around objects, there are generally more curiosity principles induced, than in the full body embodied interactions. Most common are a combination of partial exposure, complexity and uncertainty—sometimes resulting in a conflict. Opening doors, pushing buttons, placing objects, building things, and putting on something are all embodied interactions that let visitors reveal hidden information through an active interaction. Since they initially do not have the whole picture it is the act of exploration (complexity), linked with doubt and predictions (uncertainty) that mainly arise when trying to fill the knowledge gap. As stated before, these predictions can sometimes be violated, resulting in conflict.

Finally, the intangible embodied interactions usually induces a sensorial experience (novelty) e.g. through sensing temperature or listening to audio. Sensing temperature, seeing something, etc. are more often interactions that contribute to attention drawing experiences (novelty), which can be interpreted as evoking initial curiosity. Listening, talking, lying down, dancing, opening doors, groping the air, and watching are on the other hand more linked to sustained curiosity.

Apart from the embodied interactions, there are also some cases where it is hard to say whether it is the interaction itself or rather the subject that engages the visitors. One example is Killing fields, where W points to her interest in the subject being a reason for sustained curiosity. However, she does mention that having someone telling the stories and historical facts contributed to her

overall experience, together with the sensorial experience of being present at the actual Killing fields. In the case of Killing fields the headphones made up the primary part of the exhibition. However, when asked what sustained her curiosity, she did not mention the headphones being a contributing factor, but rather the subject.





DISCUSSION

7.1 IMPLICATIONS FOR DESIGN

In the following section it will be discussed how embodied interactions impact visitors' curiosity in museum exhibitions. Apart from summaries and quotes on the interviewees' experiences in the specific exhibition, there were some more general points made on the importance of embodied interactions in museum visits, which are presented throughout the chapter.

In the analysis it is clear that the curiosity principles are intertwined. According to Tieben (2011) *"All principles have a powerful influence on people's behaviour, depending on the specific application and context."* (Tieben et al., p. 369). In this study, *uncertainty and conflict often go hand in hand*, for example when the visitor tries to predict something (uncertainty), but the predictions turn out to be untrue (conflict). Uncertainty is also often identified together with complexity, in interactions requiring exploration. *Other curiosity principles go hand in hand as well, in fact, most of them appear together*, as is evident in table 3 in chapter 6.2: *Subconclusion* of the first analytical layer. According to Tieben et al. (2011) eliciting curiosity will become more powerful when principles are combined. This was also evident based on this study's results. It could therefore be interpreted that the first analytical layer, looking at each exhibition, shows a higher level of curiosity than when isolating each embodied interaction. One example of this is the embodied interaction of lying down. The exhibition experience it belonged to had a high FMS in layer one, but layer two showed it wasn't really lying down that made K curious but rather the complete experience by watching the video, light effects, listening (to music and the silence), the atmosphere, and the feeling of something magical.

Complexity is the most prominent of the five curiosity principles in the exhibitions. As is clear from the empirical findings, the majority of the exhibitions and exhibition elements include some sort of element for visitors to interpret or explore, in order to understand the meaning behind it. One could argue that this behaviour is common practise within a museum setting, where the goal of museums is to offer educational experiences. For the exhibitions described in art museums, one could argue that art in itself often has an ambiguous nature that leaves room for visitors to interpret the subject on display. Hence, this might be the reason why complexity is the most common curiosity principle.

In Tieben et al. 's (2011) study they too found that complexity was a prominent curiosity principle in their experiments, together with uncertainty and novelty. As well as in this study, conflict proved to be less effective. A big difference between Tieben et al.'s (2011) study and this one, however, is the effectiveness of partial exposure, which is prominent in both layers of analysis in this study but proved to be less so in the study by Tieben et al. (2011). In this study, partial exposure was the second most prominent curiosity principle, as it appears most often in relation to the embodied interactions in different variations. In a museum setting visitors usually encounter a large amount of information and impressions, where too much might lead to information overload. The study's empirical findings show that partial exposure is an effective way of decreasing this information overload, sustaining curiosity and generating more engaging experiences. This might be due to the intuitive way it is manifested when spreading out information spatially, but can also be enhanced through design decisions. For example in Cranium cabinets, the fact that MM can adjust the

level of information is a way partial exposure can be applied through the use of *hiding information behind cabinet doors*. A similar opinion is expressed by G, about the advantage of decreasing information overload by partially hiding some information in Timeline, TM in the Viking exhibition and MF in Ripley's believe it or not museum. In all these three exhibitions the information is spread out spatially and enforced by letting the visitors actively request information, e.g. by *pushing a button or placing a token* onto interactive areas in the exhibition.

In literature, there are multiple examples on partial exposure of exhibition content, that require visitors to actively do something in order to see the content, has resulted in increased levels of curiosity and engagement (Howes, 2014; Ciolfi & Bannon, 2002). One example is *The cabinets of curiosity*, where visitors can open drawers to reveal museum artefacts mounted behind glass (Ciolfi & Bannon, 2002), and can result in a more *intimate relation* between visitor and museum artefact, as well as increase engagement (Howes, 2014). According to *Howes (2014)* the experience of *opening drawers* is almost like touching the objects and gives the visitor a more *intimate relation* to the objects. The specific interaction of opening drawers is somewhat mirrored in the Cranium cabinets, where MM opened cabinet doors. Here, the partial exposure *"to actively do something sometimes or like taking part in your learning process or experience, it is very important"*¹ (Appendix 2, p. 2). The more intimate relation to the objects brought on by touching them was also found, as MM recalled feeling more connected to the skeletons he touched in the Dinosaur room.

One could argue that partial exposure is the curiosity principle most closely linked to embodied interactions, since this principle appears in most exhibitions and the visitors usually move their body or touch something in order to reveal hidden information. Furthermore, complexity is also a vital principle, since exploration and interpretation often involves sensing with and moving your body. It might seem obvious that embodied interactions often will be included to some degree within exhibitions. What is more interesting here though, are the exhibitions that actively include these embodied interactions into the design, deliberately evoking e.g. partial exposure to support the visitors' ability to adjust the intake of information.

The general pattern in the analysis is; *the greater variety of different embodied interactions, the higher the FMS*. Exhibitions scoring 0.0 - 0.4 had one to three embodied interactions, except for Timeline which got an FMS of 0.4, even though five embodied interactions were involved. It could be argued that it is due to the fact that *Timeline has not been separated* into that many exhibition elements, but rather described in its entirety, with the exception of Hole to crawl into. However, the *Afghanistan exhibition* got a FMS of 1 and had six embodied interactions, but following the same argument, this exhibition might also be more accurate if divided into more exhibition elements. The majority of the exhibitions where embodied interactions have been a central part of the experience has an average FMS of 0.6, which means more or less in—belonging to the concept of curiosity.

¹ "at man aktivt skal gøre noget nogle gange eller ligesom tage del i din læringsproces eller oplevelse, det har stor betydning."

As mentioned briefly above, it can be argued that some of the exhibitions would have received a different FMS if the researchers had split the exhibitions differently. Some exhibitions might have received a higher FMS due a holistic view of an exhibition rather than an analysis of each component of the exhibitions separately. For instance, if the exhibition elements under the Circus room at Copenhagen Contemporary (e.g. the Mushroom and the Carrousel) were analyzed as a whole. Since the Circus room would then include a greater variety of curiosity principles, the FMS would inevitably have been higher. Yet other exhibitions might have received a lower FMS if the exhibition had been divided into smaller parts, for example if the Pedagogue exhibition had been divided into e.g. pushing furniture, putting on the jumpsuit and climbing a flight of stairs. One could imagine how each of these exhibition elements would include fewer curiosity principles on their own. It is therefore important to take into account the scope of each exhibition when analysing, and a great deal of effort went into dividing the exhibitions into a reasonable size to analyse.

As is evident in the difference in experience recalled by MF and TM about the half-screen in the Night fever exhibition, people remember things differently. One might argue that had other exhibitions been recalled by more than one interviewee, the memory of the experience could have varied between interviewees. However, since it was each interviewee's subjective experience that was in focus, both accounts (although contrary) are valid in themselves. Besides, the curiosity principles (and the FMS) are a result of what interviewees said, and since one interviewee might explain things in great detail while another might explain things more briefly, the exhibitions the latter interviewee visits might be regarded less curiosity evoking, simply due to lack of description. To avoid this, the interviewers made sure to ask as many follow up questions about each exhibition as possible during the interviews. Furthermore, the openness to curiosity and/or embodied interactions seemed to vary a great deal from interviewee to interviewee. For example W mentioned that "as a person [she is] already curious"² (Appendix 9, p. 5) whereas F seemed critical to most of the exhibition elements presented to her.

In regards to the temporal aspect of curiosity, all embodied interactions—except those interviewees refrained from—can be argued to initiate curiosity. However, some embodied interactions had greater success of sustaining curiosity; Listening, talking, watching, walking through something, dancing, and lying down are examples of those. That those embodied interactions are related to sustained curiosity might not come as a surprise, however, since these activities are usually done for a long time; watching a video or listening to a story, for example. It can be argued that since all of these embodied interactions are sensorial experiences, novelty plays a central part in sustaining curiosity as well, not just evoking it.

Finally, the empirical findings point to the connection between curiosity, engagement and interest that Arnone et al. (2011) empathises, demonstrating that using one's body in an exhibition can result in more than just curiosity evoking experiences. All of the interviewees commented on how embodied

interactions contributed to an increased engagement or maintained interest. Being able to actively affect or do something when interacting with an exhibition is found to be a way that embodied interactions in different forms can lead to increased engagement, or a tool to help sustain interest (from interviews with MM, TF, TM, G, MF, and K). TF explains how the possibility to affect her exhibition experience made "the response [she] got back so much stronger"³ (Appendix 3, p. 5). According to K, "using your own body and your own senses (...) involves you more, than if you would just look at it"⁴ (Appendix 5, p. 4). Both F in the Afghanistan exhibition, W in Killing fields, and TF in the Olafur Eliasson tunnel, point out that experiencing a place through one's senses results in a successful experience, increasing their engagement and interest. In other words, embodied interactions can impact visitors' curiosity, as well as increase their engagement and interest.

7.1 Implications for design

The findings in this thesis can be used by curators and exhibition designers to evoke and sustain the curiosity of young museum visitors, by designing exhibitions that activate their bodies. As curiosity is a driver for engagement and learning, the findings could be used outside of the museum world as well, by a wide array of professionals such as event managers, interaction designers and teachers, to benefit from curiosity eliciting embodied interactions.



³ "den respons jeg får tilbage den bliver så meget stærkere."

⁴ "At man bruger sin egen krop og sine egne sanser (...) involverer én mere, end hvis man bare sådan kigger på det."

² "Som person är jag redan väldigt nyfiken av mig."



8

CONCLUSION

The following chapter will seek to answer the research question:

“How can embodied interactions impact visitor curiosity in museum exhibitions?”

To answer the research question one must both look at the embodied interactions in the context in which they appear as well as in isolation—perspectives the two analytical layers have contributed to. Below, the most important findings regarding embodied interactions and their impact on curiosity in museum exhibitions will be described.

In this study it is found that embodied interactions are closely tied to the principles of curiosity. In other words; using one's body when interacting in museum exhibitions evokes curiosity. Being able to sense with your body (e.g. listening and seeing) is associated with novelty and attention drawing experiences. Many of these sensorial embodied interactions are in addition to novelty related to uncertainty, mainly due to surprise. The movement of the body from one place to another (e.g. walking around, walking through and bending under something) has been closely linked to partial exposure through searching for hidden information and being exposed to information gradually throughout the movement within the exhibition. These embodied interactions usually appear alongside sensorial embodied interactions such as listening and sensing temperature, in exhibitions that induce a high level of curiosity such as the Olafur Eliasson exhibition, the Afghanistan exhibition, and the Sense tunnel.

Embodied interactions such as dancing, being shaken, touching objects, and lying down are mainly related to novelty. The exhibitions where these embodied interactions appear are mainly quite curiosity evoking, evident by a high FMS; e.g. Video in ceiling and Screen room with the FMS 1.0 and Sense tunnel with 0.9. Crawling is the embodied interaction most often resulting in refrain—either due to it being cumbersome, childish or too predictable. Balancing, climbing, and taking something off evoked no curiosity principles, even though the overall exhibition experiences these embodied interactions belonged to gained a high FMS, which was obtained due to the other embodied interactions at stake.

Stepping up on something is vaguely related to partial exposure, just as placing objects is, along with vague attributes of uncertainty and complexity. Shoving something is related to both uncertainty, complexity, novelty and to some extent partial exposure. Building is related to uncertainty, partial exposure and complexity. Listening, watching and searching by seeing are all related to complexity and uncertainty. Finally, groping the air is the only embodied

interaction that is exclusively related to complexity.

Holding objects and talking both evoked a low level of uncertainty, where talking sustained curiosity and holding objects resulted in conflict. In the object oriented theme, putting on something, opening doors, and pushing buttons all built on partial exposure. Putting on something evoked all curiosity principles, however novelty, uncertainty and conflict only vaguely. Pushing buttons evoked uncertainty and somewhat conflict, in addition to partial exposure, while opening doors rather evoked complexity and sustained curiosity.

In general embodied interactions proved to have a great influence on visitor curiosity in many cases due to the fact that the same experience could not have been obtained without the inclusion of the body. Conclusively, embodied interactions can impact curiosity in museum exhibitions, and there is a slight tendency that exhibitions with a higher amount of embodied interactions score a higher FMS.





BIBLIOGRAPHY

Arnone, M. P. (2003). Using Instructional Design Strategies to Foster Curiosity. 5.

Arnone, M. P., Small, R. V., Chauncey, S. A., & McKenna, H. P. (2011). Curiosity, interest and engagement in technology-pervasive learning environments: A new research agenda. *Educational Technology Research and Development*, 59(2), 181–198. <https://doi.org/10.1007/s11423-011-9190-9>

Årsrapporter. (n.d.). Designmuseum Danmark. Retrieved 10 January 2020, from <https://designmuseum.dk/om/tal-fakta/>

Basballe, D. A., & Halskov, K. (2010). Projections on museum exhibits: Engaging visitors in the museum setting. *Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction - OZCHI '10*, 80. <https://doi.org/10.1145/1952222.1952240>

Berlyne, D. E. (1960). Conflict, arousal, and curiosity. McGraw-Hill Book Company. <https://doi.org/10.1037/11164-000>

Berlyne, D. E. (1967). Arousal and reinforcement. *Nebraska Symposium on Motivation*, 15, 1–110.

Berlyne, D. E. (1971). *Aesthetics and psychobiology*. Appleton-Century-Crofts.

Birkler, J. (2011). *Videnskabsteori: En grundbog*. Munksgaard Danmark.

Bishop, C. (2013). *Radical Museology or, What's 'Contemporary' in Museums of Contemporary Art?* Koenig Books.

Ciolfi, L., & Bannon, L. J. (2007). Designing hybrid places: Merging interaction design, ubiquitous technologies and geographies of the museum space. *CoDesign*, 3(3), 159–180. <https://doi.org/10.1080/15710880701524559>

Ciolfi, L., & Bannon, L. J. (2002). Designing Interactive Museum Exhibits: Enhancing visitor curiosity through augmented artefacts. 7.

Dernie, D. (2006). *Exhibition design*. L. King.

Dillon, C. (2003). Understanding Reliability and Validity in Qualitative Research. 10.

Epiphany—The Best Product Discovery Platform for Teams. (n.d.). Epiphany. Retrieved 1 June 2020, from <https://app.getepiphany.com/#/account/login>

Evans, R. J. W., & Marr, A. (Eds.). (2006). *Curiosity and wonder from the Renaissance to the Enlightenment*. Ashgate.

Fallman, D. (2008). The Interaction Design Research Triangle of Design Practice, Design Studies, and Design Exploration. *Design Issues*, 24(3), 4–18. <https://doi.org/10.1162/desi.2008.24.3.4>

Flick, U. (2010). Triangulation in Qualitative Research. In E. von Kardorff & I. Steinke (Eds.), *A companion to qualitative research* (repr, pp. 178–184). SAGE.

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Sage Publications*, 33, No. 4, 441–467.

Goertz, G., & Mahoney, J. (2012). Concepts and measurement: Ontology and epistemology. *Social Science Information*, 51(2), 205–216. <https://doi.org/10.1177/0539018412437108>

Good research practice. (2017). Swedish research council.

Goodwin, K. (2009). *Designing for the digital age: How to create human-centered products and services*. Wiley Pub.

Hale, J. A., & Back, C. (2000). Architecture, movement and meaning in the museum. In *Building ideas: An introduction to architectural theory* (pp. 340–351). John Wiley.

Hornecker, E. (2008). 'I don't understand it either, but it is cool'—Visitor Interactions with a Multi-Touch Table in a Museum. *IEEE International Workshop on Horizontal Interactive Human Computer System (TABLETOP)*. Hornecker_2008_visitor interactions with a multi touch table in a museum.pdf. (n.d.).

Houben, S., & Weichel, C. (2013). Overcoming interaction blindness through curiosity objects. *CHI '13 Extended Abstracts on Human Factors in Computing Systems on - CHI EA '13*, 1539. <https://doi.org/10.1145/2468356.2468631>

Howes, D. (2014). Introduction to Sensory Museology. *The Senses and Society*, 9(3), 259–267. <https://doi.org/10.2752/174589314X14023847039917>

Jager, J., Putnick, D. L., & Bornstein, M. H. (2017). II. MORE THAN JUST CONVENIENT: THE SCIENTIFIC MERITS OF HOMOGENEOUS CONVENIENCE SAMPLES: DEVELOPMENTAL METHODOLOGY. *Monographs of the Society for Research in Child Development*, 82(2), 13–30. <https://doi.org/10.1111/mono.12296>

Kashdan, T. B., Rose, P., & Fincham, F. D. (2004). Curiosity and Exploration: Facilitating Positive Subjective Experiences and Personal Growth Opportunities. *Journal of Personality Assessment*, 82(3), 291–305. https://doi.org/10.1207/s15327752jpa8203_05

Litman, J. (2005). Curiosity and the pleasures of learning: Wanting and liking new information. *Cognition & Emotion*, 19(6), 793–814. <https://doi.org/10.1080/02699930541000101>

Loewenstein, G. (1994). Psychology of Curiosity: A Review and Reinterpretation. *American Psychological Association*, 116. No. 1., 75–98.

Nelson, H. G., & Stolterman, E. (2014). The design way: Intentional change in an unpredictable world (Second). MIT Press.

Pine, B. J. I., & Gilmore, J. H. (2007). Museums and Authenticity. Museum News.

Ragin, C. C. (2005). From Fuzzy Sets to Crisp Truth Tables.

Rauterberg, M. (1995). About a Framework for information and information processing of learning systems. 54–69.

Roberts, J., Banerjee, A., Hong, A., McGee, S., Horn, M., & Matcuk, M. (2018). Digital Exhibit Labels in Museums: Promoting Visitor Engagement with Cultural Artifacts. Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems - CHI '18, 1–12. <https://doi.org/10.1145/3173574.3174197>

Robinson, O. C. (2014). Sampling in Interview-Based Qualitative Research: A Theoretical and Practical Guide. Qualitative Research in Psychology, 11(1), 25–41. <https://doi.org/10.1080/14780887.2013.801543>

Rounds, J. (2004). Strategies for the Curiosity-Driven Museum Visitor. Curator: The Museum Journal, 47(4), 389–412. <https://doi.org/10.1111/j.2151-6952.2004.tb00135.x>

Sosnowska, E. (2015). Touch, Look and Listen: The Multisensory Experience in Digital Art of Japan. Journal of Science and Technology of the Arts, 7(1), 63. <https://doi.org/10.7559/citarj.v7i1.147>

Tan, L., & Chow, K. K. N. (2017). Facilitating Meaningful Experience with Ambient Media: An Embodied Engagement Model. Proceedings of the Fifth International Symposium of Chinese CHI on - Chinese CHI 2017, 36–46. <https://doi.org/10.1145/3080631.3080638>

Tan, Liang, & Chow, K. (2018). An Embodied Approach to Designing Meaningful Experiences with Ambient Media. Multimodal Technologies and Interaction, 2(2), 13. <https://doi.org/10.3390/mti2020013>

The museum as a place | From study archives to experience. (2012). Louisiana. <http://www.kunsteder.dk/en/themes/the-museum-as-a-place>

Tieben, R., Bekker, T., & Schouten, B. (2011, July 1). Curiosity and Interaction: Making people curious through interactive systems. Proceedings of HCI 2011 The 25th BCS Conference on Human Computer Interaction. <https://doi.org/10.14236/ewic/HCI2011.66>

Vorst, R. (2007). Nieuwsgierigheid: Hoe wij elke dag worden verleid (in dutch),.

Wu, Q., Miao, C., & Chen, Y. (2012). A curious learning companion in Virtual Learning Environment. 2012 IEEE International Conference on Fuzzy Systems, 1–8. <https://doi.org/10.1109/FUZZ-IEEE.2012.6251362>

