

Sensory experiences in
a virtual reality architecture exhibition

The Forest in the House

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Abstract

This master thesis investigates how are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality (VR) architectural exhibition. The study proposes that to be able to make sensory experiences relevant *for* visitors we need to understand 1) how visitors make *their* sensory experiences relevant 2) how others can support in the process 3) what the study results mean in relation to designing *meaningful* VR environments. To answer the research question, this study utilizes the data gathered in a research project *The Forest in the house*, where study participants explore a large VR installation set in the National architecture museum in Oslo and describe their sensory experiences in an interview conducted after the exploring. *The Forest in the House* had a diverse set of museum visitors. Participants' ages varied from children to seniors, and they had different levels of expertise from non-experts, to architecture students, and professional architects. Together 18 pairs were recruited and partners in each pair took turns to explore the VR installation and acted as a guide to their partner. The data analysis was conducted with thematic analysis and looked for five main themes. The *first* theme was how participants construct new meanings and utilize learned meanings when verbally sharing sensory experiences. The *second*, *third* and *fourth* themes were: what presence, imagination and meaningful engagement mean in relation to participants' sensory experiences in VR. The *fifth* theme was how feelings relate to making sensory experiences in VR relevant. Taken together, the theory and the results of the study show, that sensory experiences are made relevant for visitors to a virtual reality architectural exhibition by 1) taking feelings into consideration when reflecting the VR experience, 2) comparing the sensory experience with previous sensory experiences, 3) understanding stimuli from different senses as intertwined, 4) concentrating on the sensory experience and communicating it verbally, and 5) reflecting what is meaningful and how to regulate presence. The study concludes that communicating sensory experiences in VR requires deliberate practice in utilizing language to describe sensory experiences.

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1. Introduction

Immersive virtual technology (VR) is a young yet rapidly growing field. Applications in VR are many, including virtual classrooms, training programs for health care professionals and patients, games, artworks, historical places, buildings, and scientific visualizations. In the context of museums, VR enables creating new experiences for museum visitors, investigating and communicating collections in a new way. For example, in Philadelphia's Franklin Institute museum visitors can be immersed in the ocean, outer space or even inside the human body (The Franklin Institute, 2019).

The National architecture Museum in Oslo had a large VR installation at the beginning of 2018. This VR installation, an architectural model, was utilized in a research project *The Forest in the house*, with Atelier Oslo, Notam, University of Oslo and The National museum as stakeholders. *The Forest in the house* explores how virtual reality can use light, space and materiality to communicate qualities of architecture and visitors' experiences of for example on movement, sight, touch, and hearing in architecture exhibitions. *The Forest in the House* contributes to creating new experiences for museum visitors and mediating understandings of architecture in architecture exhibitions (Internal working document).

This master thesis studies the process of making sensory experiences relevant after visiting the VR architectural model in the project *The Forest in the House*. It builds on the research design in *The Forest in the house* and on the data collected in the project. To identify elements that affect the process of making sensory experiences relevant, this master thesis approaches visitors' sensory experiences in VR architectural model from several theoretical perspectives. The master thesis describes how sensory experiences in VR relate to presence (for example, Schubert, Friedman and Regenbrecht, 2001), meaningful engagement (Hovhannisyan, Henson & Sood, 2019) and emphasizes

that visitor's personal history, actions, and goals impact sensory experiences in VR. It also describes some challenges related to creating meaningful sensory experiences in VR such as communicating the materiality of reality (described by Pallasmaa, 2005) or integrating sensory stimuli from different senses to create intended experiences in VR (Anderson, 2009; Roskies, 1999; Pallasmaa, 2005) and implies that failing to create integrated sensory experiences can result in stressful or surrealistic experiences. In addition, this master thesis discusses some challenges of how we intuitively understand perceiving (Merleau-Ponty, 1945, p. 5) and make meaning of our sensory experiences (Suthers, 2006; Rudie, 1994). As a conclusion from both the theory and study results, this master thesis proposes that one of the main challenges in making sensory experiences relevant for visitors in VR is the difficulty to describe (multi)sensory experiences with language. This master thesis aims to answer the following question:

How are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality architectural exhibition?



Picture 1. *A scenery inside the virtual reality architectural model*

2. Literature review – multisensory experiences in virtual reality

The literature review starts with defining VR from a technological point of view and then proceeds to the perspective of the visitor in VR. It then identifies presence and meaningful engagement as central aspects of the subject's VR experience. Finally, the literature review discusses how presence, learned associations, sensations, perceptions, and (multi)sensory experiences relate to VR.

2.1. Defining virtual reality

One often defines Virtual reality (VR) by the technology involved, such as head-mounted displays, computers, headphones, and gloves that sense motion (Coates, 1992). The technical definition of VR is not sufficient, though, from the perspective of software developers, policy and regulation creators (Steuer, 1992). To be able to develop VR applications that create the effect one intends them to create, one needs more understanding of how visitors experience VR. Therefore, this literature review aims to reflect some central aspects of how to define VR as a relevant sensory experience from the visitor's point of view. The perspective of making meaningful VR experiences, which the literature review also discusses, is relevant for both the designers and the visitors.

It is necessary to describe shortly the technical aspects of VR also because they affect the visitor's experience in VR. Although VR can comprise all kinds of environments that a computer either generates or mediates, in recent years, the rapidly developing technology has increased the immersion in VR affecting the visitor's experience in VR essentially (Floridi, 2004). Floridi (2004) emphasizes that rather than just simulating places either in real or imagined worlds, immersive VR aims to create a physical presence in a non-physical world often relying on more advanced technology than non-immersive VR. In an immersive VR experience, technologically created features seem so real that the technology "vanishes" as a mediator creating a strong sense of presence (Lombard & Ditton, 1997). Sounds and images in highly immersive virtual realities respond to body movements as

in the real world. Input devices track the user's reactions and movements to create consistency between a person's head and eye movements through appropriate responses and changes in perception. Although it is still challenging technologically, some argue that by involving all the five senses creates a completely immersive VR (Freina & Ott, 2015). However, several studies have demonstrated that technologically immersive virtual environment does not necessary guarantee that it creates *a psychological experience of being present*, which depends also on interactions between VR and subject's psychological features, such as goals and associations to what is sensed (Slater, Steed, McCarthy & Maringelli, 1998; Schubert, Friedman and Regenbrecht, 2001; Hovhannisyan, Henson & Sood, 2019). This literature review approaches sensory experience from different theoretical perspectives to identify elements that affect the process of making sensory experiences relevant. The literature review identifies in the following sections meaningful engagement, presence, flow, emotions, sensation and perception, learning and associations as central aspects in the visitor's VR experience concerning (multi)sensory experiences.

2.2. Meaningful engagement and presence in virtual reality

Many elements affect if a sensory experience in VR increases or decreases presence and meaningful engagement. The following section aims to describe some central elements in presence and meaningful engagement. It emphasizes the visitor's role as active human being with a personal history and goals for actions. It also introduces some concrete features in VR design that affect presence in VR.

To have an immersive virtual experience, Hovhannisyan et al. (2019) propose, a *meaningful engagement* with the surroundings is required. They also propose that immersive VR experience cannot be defined merely by the physical sensory experience of reality-like VR surroundings. In meaningful engagement, according to Hovhannisyan et al. (2019), subject is not a passive receiver of the surroundings but makes perceptions, which enable functional action. They also emphasize that goals define which type of engagement and types of actions are meaningful in the environment. For example, professional VR designers would perceive a VR environment differently, if they would

want to evaluate the design or if they would want to concentrate on merely experiencing the environment. Goals frame the designer's perceptions and of course, in many occasions, make it challenging to experience their design from the user's perspective.

It can be proposed that an experience in VR is meaningful in reality for example when it enhances the performance of a necessary task by decreasing stress and enhancing learning that is relevant for the task. Hovhannisyan et al. (2019) propose that the optimal goal in designing virtual reality is not its experienced realness, but *the maximization of subjective immersion by developing virtual experiences that are able to reliably facilitate a flow state within users*. Flow occurs in task performance, where the requirements of the task meet the performer's capabilities creating an optimal, enjoyable and rewarding experience, which is motivating itself (Csikszentmihalyi, 1996). Subjective immersion that includes flow-like experience reminds the psychological experience of *presence* as defined by Schubert et al. (2001). Schubert et al. (2001) emphasize that a certain type of environment does not automatically create the experience of being present, although there might be different qualities in the environment and actions taken in the environment that have an impact presence.

Immersive VR aims to create the experience of presence in VR. In their factor model, Schubert et al. (2001) identify three separate factors of presence in virtual reality, which include *spatial presence, involvement, and realness*. According to the model, spatial presence is, for example, *a sense of being there, a sense of presence in and a sense of acting in the virtual space, instead of operating something from the outside*. They have also found that both the imagined and the actual possibilities to interact with a virtual reality increases spatial presence (Schubert, Regenbrecht & Friedmann, 2000). The experience of *realness* includes, for example, experiencing VR as a real environment. One should note, as Schubert et al. (2001) emphasize, that to be able to create an experience of presence the realness-factor might be especially relevant in virtual game environments because they as a starting point alternate the reality. Because experienced realness increases presence, content, and actions taken in VR that alternate reality and also take place in an unrealistic VR environment might decrease presence. The third presence factor in the model from Schubert et al. (2001) is *involvement*, which is defined as *a psychological state experienced as a consequence of focusing*

one's energy and attention on a coherent set of stimuli or meaningfully related activities and events (Witmer & Singer, 1994 as cited in Schubert et al., 2001). An individual can be involved only in limited aspects of the VR in one moment, perform some actions and make some perceptions due to the limited capacity of momentary attentional resources (See for example Morey & Cowan, 2004). As the model from Schubert et al. (2001) propose, when activities and events seem to form coherent reason-consequence relations, stimuli seem to have meaningful relations with each other, and an individual can experience involvement.

In addition to meaningful engagement, emotions affect presence. Referring to correlational studies, Diemer, Alpers, Peperkorn Shiban & Mühlberger (2015) conclude that the stronger the experienced feelings (such as fear compared to joy compared to relaxing or as the intensity of the participants' typical feelings) are, the stronger is the correlation between emotion and presence. They further propose that because strong feelings often include high alertness, the alertness created by arousal explains the correlation between strong feelings and both physical and mental presence, as alertness increases readiness to respond to stimuli (Freeman, Lessiter, Pugh & Keogh, 2005). According to a study from Freeman et al. (2005), arousing VR environment is personally relevant and significant, although they also highlight that personally relevant content need not be arousing and, on the contrary, can also reduce arousal.

Although one can regard presence as a psychological phenomenon, research has found that there are many features in VR design, which contribute to presence in VR and to how it is otherwise experienced. For example, seeing a wide horizon increases the sense of presence (Prothero & Hoffman, 1995). In addition to seeing a wide horizon, the amount of movement and whether or not the participant can touch objects, impact presence in VR. In their experiment, Slater et al. (1998) asked participants to perform a task in VR, which required them to move their bodies actively. The amount of body movement users had to make was positively associated with the sense of presence in VR. Also, being able to touch objects changes how the users evaluate them. In mixed reality conditions, where participants in VR can see an object and be able to touch it physically, these objects are eval-

uated as more realistic and heavier than objects participants are not able to touch physically (Hoffman, 1998). The physical sensory experience in VR affects presence and increases possibilities to interact with VR through sensing it.

2.3. The multisensory experience in relation to sensation, perception, and learning

To further identify which elements are central in the visitor's VR experience, this chapter discusses sensing and perceiving in relation to VR. Understanding and communicating human sensation and perception is challenging, also because it is difficult to describe (multi)sensory experiences with language. The difficulty to describe sensation and perception as to how we subjectively experience them makes it difficult to understand them.

A philosophy that approaches the direct description of our experience is valuable in demonstrating the comprehensive experience in VR. Phenomenological philosophy *tries to give a direct description of our experience as it is, without taking account of its psychological origin and the causal explanations which the scientist, the historian or the sociologist may be able to provide* (Merleau-Ponty, 1945, p. viii preface). The following quote from the French philosopher Merleau-Ponty (1945, p. 5) illustrates, how the direct experience and our understandings of the direct experience differ and problematizes the way we often understand perceptions and the process of perceiving.

We think we know perfectly well what 'seeing', 'hearing', 'sensing' are, because perception has long provided us with objects which are coloured or which emit sounds. When we try to analyse it, we transpose these objects into consciousness. We commit what psychologists call 'the experience error', which means that what we know to be in things themselves we immediately take as being in our consciousness of them. We make perception out of things perceived. And since perceived things themselves are obviously accessible only through perception, we end by understanding neither. We are caught up in the world and we do not succeed in extricating ourselves from it in order to achieve consciousness of the world. If we

did we should see that the quality is never experienced immediately, and that all consciousness is consciousness of something. Nor is this 'something' necessarily an identifiable object.

We make perceptions out of things perceived means that there is no “objective reality” in reach of any perceiver. The visual field (or the fields of other senses) is always more than the objects we can perceive (Merleau-Ponty, 1945, p. 5) and sensations are not limited to predetermined meanings. We perceive many sights, sounds and other sensations, which are never thought or expressed verbally. As a consequence, these sensations are never integrated into conceptual understanding. The perceiver always makes decisions about what to perceive, whether these decisions are conscious or not. Therefore, the sensory experience is different for every perceiver. The designer of VR can create sensory stimuli, but each visitor makes their perceptions. To explain this in other words, it helps to differentiate between sensation and perception. By referring to experimental studies, Goldstein (2001) describes in his book *Sensation and Perception* profoundly the psychological processes in perceiving and the following is an attempt to summarize the basic processes in sensing and perceiving based on Goldstein’s book. Sensation means that physical energy is detected from the surroundings and converted into neural signals. Perception is the process of organizing and interpreting sensations. Executive functions, commonly recognized as limited in their *momentary capacity* (also, for example, Morey & Cowan, 2004), direct the attention that receiving sensations and making perceptions “require”. What is sensed depends both on the physical environment and psychological processes and meanings that are given partly unconsciously already in the moment of sensing, though these meanings can change afterward as explained later in this master thesis in the chapter *Theoretical approach*.

Psychological processes in sensation and perception include for example keeping goals in mind, associating memories or using a plausible schema to direct attention (Goldstein, 2001). The meaning-making of sensory experiences is then an inseparable part of the sensory experience itself and cannot be conceived as a fully conscious, and controllable process. It is, however, important to highlight that the meaning in relation to sensory experience is not to be confused with meaning, that is

consciously reflected and organized with language. Associations between concepts, memories, and schemas influence in a rapid process, what is perceived (Goldstein, 2001). For this reason, *learning* has an essential role in sensing and perceiving. For example, an experienced architect can make perceptions in an architectural model, which knowledge in architecture enables. An inexperienced observer would perhaps apply more personal experiences or ideas and make “perceptions of perceptions” that are not consciously reflected in relation to knowledge in architecture. In the following quote, Merleau-Ponty (1945, p. 18) describes how “knowledge” is constructed by perceptions that we are used to connect, and the way words affect these types of perceptions.

Knowledge thus appears as a system of substitutions in which one impression announces others without ever justifying the announcement, in which words lead one to expect sensations as evening leads one to expect night. The significance of the percept is nothing but a cluster of images which begin to reappear without reason. The simplest images or sensations are, in the last analysis, all that there is to understand in words, concepts being a complicated way of designating them, and as they are themselves inexpressible impressions, understanding is a fraud or an illusion. Knowledge never has any hold on objects, which bring each other about, while the mind acts as a calculating machine, which has no idea why its results are true. Sensation admits of no philosophy other than that of nominalism, that is, the reduction of meaning to the misinterpretation of vague resemblance or to the meaninglessness of association by contiguity.

I interpret this quotation from Merleau-Ponty as a description of how knowledge that is based on unreflected perceptions connects automatically to other perceptions, often not following any logic but rather associations based on experiences. This means that making meaning of sensations and perceptions intertwines with prior experiences. With other words, sensory experiences form connections with prior sensory experiences and meanings given to them without requiring conscious learning or reflection. Further, what is experienced in the past affect perceptions already at the moment of sensing, which makes it difficult, probably even impossible to understand why certain meanings

are given to certain sensations. These experience-based connections between concepts affect sensing and perceiving and play a central role when understanding the meaning-making of sensory experiences. When we, for example, hear certain music that we associate with a cozy atmosphere, and have often experienced cozy atmospheres in beautiful surroundings, we can suddenly perceive visual surroundings in the given moment more esthetic compared to how we perceived the surroundings just a short moment before. The associations between music, atmosphere, and esthetics changed the perception of the given moment. We use words to structure our perceptions, and these words are associated with other words. As the quotation from Merleau-Ponty (1945, p. 18) suggests, words construct meaning to sensations and perceptions, and as a consequence, these sensations and perceptions partially change because words add and reduce meanings, which in turn can change where we focus our attention (see also Goldstein, 2001). Not only the associations between music, atmosphere, and esthetics but also concepts, which activate in our minds, change the perception of the given moment. Also, an architect can associate a visual sensation (such as lightness) with a theory in architecture (for example how different materials relate to lightness) and then notices additional elements in the visual scenery relevant to the associated theory. Because meanings previously associated with a physical sensation affect how we experience physical sensation in the present moment, it is difficult to separate physical sensations from *learned* meanings, which are given to them.

2.4. Creating integrated multisensory experiences in virtual reality

This chapter illustrates how people form an integrated sensory experience in reality and how challenging it is to create meaningful sensory experiences in VR. The field of perceptual psychology has examined how sensory experiences develop and this section introduces some relevant studies. Though this section does not as a whole inform the analysis in this thesis, this section reviews key findings from this field to make it easier to understand the analysis on a deeper level. One central challenge is to understand how sensory stimuli from the five senses (taste, touch, smell, sight, and hearing) are integrated, which is, however, important when aiming to design for example realistic, esthetic or relaxing multisensory experiences in VR and when making visitors sensory experiences

relevant for designing new sensory experiences. Also, if the visitor fails to integrate sensory stimuli in VR, the resulting experience might be unintended, for example, stressful or surrealistic sensory experience. Also, the meaningfulness of the VR experience can suffer if the subject's experience differs essentially from the design goals.

According to Anderson (2009), information from the senses is processed parallelly, not serially and this processing is coordinated by prior experiences and information from the long-term memory. Parallel processing means that sensations happen at the same time through different senses and affect each other, for example, auditory sensations can change the visual sensations. This is illustrated in the chapter *The multisensory experience in relation to sensation, perception, and learning*. We integrate many of the perceptions that we make in a natural environment multisensory, which means that we combine and differentiate information from several sensory modalities (Calvert, Spence & Stein, 2004 as cited in Chen & Spence, 2010). The challenge of how we can combine information from the surroundings and form an integrated perceptual experience is called the binding problem (Roskies, 1999). For example, when walking outside, we most often hear the sounds of our steps and other sounds near and far, feel the ground underneath our shoes, see the changes in the scenery as we walk, feel the temperature and the wind in our skin. For us to be able to structure a coherent understanding of the environment, we have to integrate information from the senses as belonging to the same object and differentiate them as belonging to separate objects (Spence, 2011).

Structuring a coherent understanding of the surroundings in VR can, therefore, be challenging because any disintegrated stimuli violates a coherent understanding. The perceiver has to bring together, for example, auditory and visual sensations that belong to the same source to execute multisensory integration. In addition, information from different perceptions needs to be integrated for example based on how close in time they appear to each other (Calvert, Spence & Stein, 2004 as cited in Spence, 2011). For example, sounds serve a function when forming an understanding of size and other qualities of a space and echoes can even be used to navigate in space when not being able to see it (see for example Cotzin & Dallenbach, 1950). It follows that multisensory integration is "broken" if for example auditory and visual sensations conflict with each other or their timing is

inaccurate. A classic example, the “McGurk Effect” illustrates the consequences of ambiguities between different sensory modals. In the context of heard and visually observed talk, it shows that if we hear the word “bows” but see the mouth forming the word “goes” the perception is “doze” or “those” (Mc Gurk & MacDonald, 1976 as cited in Goldstein, 2001). Also, in VR conflicting visual and auditory stimuli can create unintended perceptions. According to Spence (2011) the tendency to correspond information from different sensory modalities might suggest a structure in our cognitive system or it might be that information has been coded near to each or otherwise (arbitrary) associated together in the brain. The same type of arbitrary associating is perhaps suggested by Merleau-Ponty (1945, p. 18) when he says *sensation admits of no philosophy other than that of nominalism, that is, the reduction of meaning to the misinterpretation of vague resemblance or to the meaninglessness of association by contiguity.*

Challenges to bind different sensations together and to create an integrated sensory experience in VR can cause unsuccessful “communication” between senses. Parallel communication between sensations enables necessary adapting to the environment. For example, perceptions can cause motor reactions and tendencies to move (see for example Goldstein, 2001, p. 260-262) demonstrating that information from the senses and movement are also tightly associated with each other. The parallel processing and communication between senses can also indicate why architecture can be experienced in the whole body, as Pallasmaa might mean when he says that the multisensory experience architecture enables a space for being, *frames, halts, strengthens and focuses our thoughts, and prevents them from getting lost* (p. 45). The experience of being framed or strengthened by architecture might be understood through how senses function in an integrated and parallel matter.

2.5. Multisensory experience of architecture

As mentioned in this literature review, memories affect the meanings given to sensations and perceptions and the physical sensory experience. This section gives some additional concrete examples of how sensory experiences and meaning-making of sensory experiences are culturally and individ-

ually conditioned. It describes the multisensory experience in architecture and illustrates how difficult it is to describe multisensory experience with language and how multisensory experience includes different senses. This section also describes that even though sensory experiences “make meaning” in a seemingly illogical process, they are also the basis of our bodily existence and are sensible in their way.

A Finnish architect Juhani Pallasmaa has tried to conceptualize the multisensory experience of architecture. He stresses in his book *Eyes of the skin* (2005) that we sense architecture through all our senses. Although previous research acknowledges the nature of multisensory as a holistic experience, research tends to overly appreciate visual perceiving over other senses (Howes 2005). Also, Pallasmaa (2005) criticizes the over valued role of gaze in architecture and illustrates the importance of other senses than vision. He says that *the eye surveys, controls and investigates, whereas touch approaches and caresses. During overpowering emotional experiences, we tend to close off the distancing sense of vision; we close the eyes when dreaming, listening to music, or caressing our beloved ones* (Pallasmaa, 2005, p. 46).

To illustrate the role of sounds, Pallasmaa (2005, p. 49) says that removing a soundtrack from a film, it becomes less plastic and loses its *sense of continuity and life*. Although architectural theories appreciate the gaze over other senses, Pallasmaa (2005, p. 37) presents that there is a growing trend to appreciate the more sensual experience of architecture that includes also other senses than vision and gives a *strengthened sense of materiality and hapticity, texture and weight, density of space and materialized light*. Materiality constructed by multisensory experiences can be difficult to communicate through VR, which is still based on strongly on visual stimuli (Floridi, 2004). The poetic language Pallasmaa uses illustrates the difficulty to use precise language when describing when experiencing architecture.

Every touching experience of architecture is multisensory; qualities of space, matter and scale are measured equally by the eye, ear, nose, skin, tongue, skeleton and muscle. Architecture strengthens the existential experience, one’s sense of being in the world, and this is essentially a strengthened experience of self (Pallasmaa, 2005, p. 41).

This quotation describes how the body and all the senses mediate the multisensory experience of architecture implying that strengthened experience of self through architecture also affirms the existential experience, which can also be called *the sense of being in the world*. Sense of being in the world reminds of the description of spatial presence from Schubert et al. (2001) *as a sense of being there, a sense of presence in and a sense of acting in the virtual space*. Pallasmaa (2005) does give multiple examples of such an experience. In the following quotation, Pallasmaa (2005) describes the cross-modal communication between vision and touch: *our eyes stroke the distant surfaces, contours and edges, and the unconscious tactile sensation determines the agreeableness or unpleasantness of the experience*. (p. 42). In addition, memories have a role in experiencing architecture. Pallasmaa says: *distance and spatial depth would not be possible at all without the cooperation of the haptic memory which provides sense of solidity, resistance and protrusion* (Pallasmaa, 2005, p. 42) and *the body is not mere physical entity; it is enriched by both memory and dream, past and future* (p. 45). According to Bloomer and Moore (as referred in Pallasmaa, 2005) architectural theory recalls reflection of what makes architecture to retain in our memories and strings together bodily experiences, imagination and the environment by creating associations and by awakening imagination.

Associations between sensed stimulus and meanings given to them, such as odors and emotional atmospheres can give a lively example of how experiencing architecture involves memories and imagination. A study from Ayabe-Kanamuura et al. (1998) compared the evaluations of odors between Japanese and German participants and found that sensations and associations to sensations from the past impact how sensory experience is formed in the present. They found that pleasantness and intensity of odors are culturally conditioned, and one evaluates odors that are unfamiliar in one's own culture as more intense. Because sensory experiences are culturally conditioned, Classen (1997) suggests that to understand how people sense their environment, one has to understand the culturally dependent meanings people give to their sensory experiences. According to Classen (1997) sensing and making meaning of the surroundings is not merely a physical process but an anthropological one and we make social agreements of how the reality is and how to frame perceptual experience. However, according to neuroscientific research people live in different sensory worlds and

for example, the sensing of different flavors is highly individual (Breslin & Huang, 2006) indicating that sensing is not only culturally but also individually conditioned. Social agreements of reality and social framings of perceptions cannot alone explain how meaning is created from sensory experiences. Then again, social framings do have an essential part in meaning-making, because meaning-making depends on the use of language, which contains social agreements of how reality is. To communicate individuals sensory experience in the social process of meaning-making is therefore dependent on the appropriate use of language. The individual has to find words to describe sensory experiences in a socially understandable way. As discussed in this literature review, finding the right words to describe sensory experiences is a challenging task.

2.6. Summary

To be able to create meaningful VR experiences, it is essential to understand how to make visitors' sensory experiences in VR relevant. Both to understand how visitors make their own sensory experiences relevant and how others can support in the process, can help designers to create relevant VR experiences. However, both studies on human sensation and perception indicate that understanding and communicating sensory experiences is complicated because it is difficult to describe (multi)sensory experiences with language. This master thesis study approaches sensory experience from several theoretical perspectives to identify different elements that affect making sensory experiences relevant. The following chapter adds a sociocultural perspective to the philosophical and psychological perspectives and describes how sensory experiences are made relevant through communication and the use of language. The sociocultural perspective illuminates the impact of culture, learning and social relations to sensory experiences and is especially important in the analysis of the results of the study and in aiming to understand how subjects make their sensory experiences relevant in a collaborative meaning-making process.

3. Theoretical approach

This chapter explains the sociocultural aspect of how participants communicate in VR and after visiting VR and how this communication is related to making sensory experiences relevant. The challenges in conceptualizing and communicating sensory experiences are discussed further in this chapter in relation to the research design. The theoretical approach and the literature review together form the theoretical lenses which are used in the data analysis. *First*, this chapter starts with describing the use of language when sharing sensory experiences and the difference between an individual's sensory experience and the "socially constructed sensory experience". *Second*, it proceeds to other aspects of the social meaning-making process: the use of previous experiences and imagination when constructing "a socially informed sensory experience". *Third*, this chapter describes how presence in VR affects how sensory experiences are made relevant in the interview. *Fourth*, the chapter describes the relevance of a mismatch between previous sensory experiences and current sensory experiences in VR. *Fifth*, the theoretical approach shortly describes the difference between the meaning-making of reality and the meaning-making of VR. *Sixth*, finally, this chapter describes the role of feelings in the process of making sensory experiences relevant.

3.1. Constructing new meanings to sensory experiences through verbally sharing them

The social sharing of sensory experiences depends on how we manage to communicate them. As discussed in the literature review, it is, however, difficult or impossible to construct the richness of one's sensory experience with words. Therefore, communicating or understanding one's own or especially others' sensory experiences through language is challenging. Of course, one can use others articulated observations to imagine their sensory experiences and to construct a new "sensory experience". One can use others' articulated sensory experiences, for example, to mentally rotate images one has seen (more about mental rotation in Shephar & Metzler, 1971). However, the physical sensory experience *as how it has happened in the moment of sensing* cannot change afterward. One

cannot, for example, *see* an object afterward from several perspectives merely by using imagination. The constructed sensory experience is a sophisticated guess of how the object might look like from the perspective of another. However, *the memory of the sensory experience* can change because of the guesses and new meanings the sensory experience gets in the social meaning-making process. A subject can *remember* seeing the object from different perspectives, although these perspectives are merely sophisticated guesses. Therefore, the subject's sensory experience and the socially constructed understanding of the sensory experience always remain two different things. The grade of sophistication of the "socially constructed sensory experience" could be proposed to depend on *empathically listening* and *imagining* different point of views, and possibilities to *socially share* and *form understandings* of sensory experiences.

Because memories of sensory experiences can change in the social meaning-making process, one can understand learning (of sensory experiences) as Suthers (2006) suggests *group activity that results in individual changes*. However, as explained, there is always a difference between a lived sensory experience and socially constructed sensory experience by using imagination. This master thesis, therefore, understands the meaning-making of sensory experiences as a combination of social and subjective processes and focuses on the process of making sensory experiences relevant through discussion. However, although at some amount people can relate to each other's sensations, even feel them by empathically imagining them, intersubjective meaning-making can be challenging, when people cannot understandably verbally share the sensory experience that mediate the meaning-making. Sensory experience is difficult to translate to words and to be able to make meaning of it; one has to be able in some amount to verbalize the sensory experience. Otherwise, it is something else one talks about.

Sociocultural theory highlights the need to understand human action in a culturally and historically situated setting mediated by signs and tools (Vygotsky, 1978). The notion from phenomenology that we make perceptions out of perceptions and the fact that we are not capable to communicate the pure stream of consciousness creates a challenge when we try to understand the meaning-making of multisensory experience and especially when we are trying to communicate it. According to

Vygotsky (1978), signs are psychological tools that are used in higher-order thinking and to affect behavior. Vygotsky (1986) emphasizes that language is the primary tool for meaning-making. In the present study, participants are not using words primary to higher-order thinking but to describe sensory experiences, which is assumable a different type of linguistic process. To be capable to negotiate social meanings for sensory experiences, individuals must first be able to describe their own sensory experiences with words. Describing sensory experiences can affect behavior, such as aiming for more precise perceptions, but it does not necessarily do that. Describing sensory experiences can also merely make the experience more visible and easier to relate to.

3.2. Making learned meanings visible and forming an integrated sensory experience

From a sociocultural perspective, sensory experiences in VR can be relevant for example when VR makes previously learned meanings visible. Visitors in VR can learn about their associations to contents in VR when some elements of a perceptual schema are missing. Visitors can learn about their memories when they try to make the experience in VR relevant. As suggested in the literature review sensory experiences are often “bound” with each other when they appear near to each other in time or space (Calvert, Spence & Stein, 2004 as cited in Spence, 2011) or through an association between concepts (Merleau-Ponty, 1945, p. 18). For example, for some people, the word “vacation” is automatically associated with the word “relaxing” as other people can associate the word “vacation” to “fun”, some people even to “stress” etc. Therefore, the meaning-making of sensory experiences is not purely an objectively logical process but includes gaining awareness of prior associations and attempts to organize sensory experiences with concepts. For example, if the visitors in VR associate their summer cottage with the VR environment, they can compare these with each other and notice missing or excessive elements in VR and draw conclusions of how real the VR seems to be. Or if the VR feels unreal, the visitors might start to wonder why and become aware of what makes reality feel real. The meanings given to the VR experiment, therefore, depend on the visitor’s previous sensory experiences and meanings given to them.

Because VR is not quite as reality is, at least at the moment, the meaning-making of VR is meaning-making of a new experience, for most of us. Ingrid Rudie (1994) defines the meaning-making of a new experience as a creative process of *appropriating new information and reconciling it with some pre-existing pattern of logic or sensibility*. Because sensory experiences do not follow any other logic than how humans sense the world through their senses (as explained in the chapter *The multisensory experience in relation to sensation, perception, and learning*), “the sensibility of a sensory experience” depends on comparing the new situation with previous experiences. It makes meaning, for example, that the air feels a certain way at the skin depending on the wind, humidness and temperature of the air. It makes meaning, that when the wind blows with certain strength, branches in the trees move tuned with the strength of the wind. It would not make meaning if we would suddenly feel a strong wind at the skin and could not see movement in the trees. According to Rudie (1994), the meaning-making process includes adapting our actions to suit the situation at hand and producing a suitable explanation for others’ actions or in the example, things that happen around us. We might think the trees are further away than we thought, and the wind does not reach them to give meaning to our observations. What we cannot sense in the situation, we compose, which follows, as Rudie (1994) underlines, that understanding can also become misunderstanding. The wind might just blow towards us, but not the trees. In relation to sensory experiences, this could mean imagining sensations in VR, that do not take place VR to give meaning for other sensations in VR.

As suggested in the literature review, meaning-making of sensory experiences happens already in the moment of sensing, when prior experiences affect the directing of attention. This is not, however, the same as the collaborative meaning-making process, where “meaningful” is meaningful socially. When visitors explore the VR model, they associate prior experiences with their sensations and perceptions to make meaning of what they experience in VR. This part of the meaning-making process might not be fully conscious, as participants might not reflect consciously and actively their prior experiences in this phase, because their limited attentional resources (as defined for example by Morey & Cowan, 2004) are in the features of the VR. However, when the participant afterward

discusses the exploring of VR, participants comments might reflect these attempts to give meaning for sensory experiences already in the moment of sensing VR.

3.3. Being present in virtual reality

The literature review identifies presence as a central theme in the visitor's VR experience and several aspects which affect presence, such as the elements in the VR design, feelings, goals, prior experiences, and imagined alternatives for acting. Presence in VR has also several consequences for the process of making sensory experiences relevant afterward. The way we can discuss experience depends on the way we have paid attention to it. Because humans' momentary attentional resources are limited (for example Morey & Cowan, 2004), visitors can concentrate only on limited features in VR experience. Distracting stimuli, for example, sensory stimuli deriving from reality uses the same attentional resources that can be directed to stimuli in VR. Also, goals that direct attention to certain aspects in VR can make other aspects "less sensed". Social engagement while in VR decreases focusing on the "VR experience", if they are understood as separate. Focusing on different nuances in the emotional or bodily experience or the details of the auditory and visual surroundings reduces attention given to other aspects, such as imagined possibilities to act in VR.

On many occasions, a flow experience in VR can be relevant and support achieving goals such as communicating ideas and creating effective experiences. However, the subject, who visits a VR environment does not always prefer to be present in the VR environment, although presence would feel comfortable or create flow. The visitor does not always welcome strong feelings, such as excitement or uncertainty as a part of the VR experience. Of course, full focus in VR is not always wished. For example, visitors have to be able to move safely in VR and if there are mismatch between the physical environment and VR, subject's focus is distracted. Also, even though sharing the experience verbally while in VR can serve for example designer's interests, who can use the verbally described experience as feedback, the visitors cannot be present fully in VR if they actively describe their experience with words.

3.4. Enjoying dreams and phantasies

In reality, making social agreements enable creating structures and rules that are essential for functional action. Assumable it is easier to consider VR more as a play and dreamlike environment than reality, decreasing the importance to evaluate activity in a socially agreeable matter. It is also challenging to create many details of actual reality in VR. Sensory world in VR is artificial and different from the sensory world in reality and sensory stimuli in VR lack many features from sensory stimuli in reality, such as how different materials relate to light, sounds, air and wind or scents. The lack of “natural” associations in VR might leave more “space” to imagine and alternate meanings given to sensations in VR. Therefore, meaning-making in VR probably lacks some rapid associations that we make in actual reality. As a consequence, sensory experiences in the VR might be an essentially different process than experiencing actual reality. The study from Antonietti and Cantoia (2000) illustrates the difference between experiencing VR and actual reality. They studied the difference between meaning-making in traditional instructional situations and immersive VR situations. In their study, they divided university students into two subgroups. The first group sat down and reflected a painting in front of them. The second group experienced the same painting in VR on a guided tour and were able to walk *in* the painting and observe it from different points of view. The study concluded that the students in the first group thought about *what* they were facing whereas the second group in VR condition reflected *why* or *how* something was in front of them. Antonietti and Cantoia (2000) conclude that in the VR condition students seemed to take freer and more imaginative perspectives compared to the group who were observing the picture in front of them.

As the study from Antonietti and Cantoia (2000) suggests, the meanings and causality that takes place in actual reality, might not take place in VR. Therefore, the process of making VR sensory experiences relevant might include a more open investigation of the rules and features of the particular VR environment, and lean less to learned meanings, rules in logic and sensibility. Stanovsky (2004) emphasizes that it is the social sharing of the virtual environment, which separates experience in a

virtual environment from private dreams and phantasy thus making the experience more real. However, it is plausible that people do not always prefer to make their experiences more real, but rather enjoy their dreams and phantasies. People can deliberately view VR as “a playground”, where meanings from reality do not gain an important role. It follows that the social negotiation of meanings is not as important in VR as in reality. VR is not real, and people are aware of that. Therefore, the need to make social agreements of how reality is might not apply to VR experience.

3.5. Setting goals for meaningful engagement

As explained before in this master thesis, the subject’s goals affect motivations to frame perceptions. An architect, who wishes to evaluate different aspects of the VR architectural model, observes the model with different knowledge frames than an architect who wishes to relax in VR. It also affects sensory experience whether people aim to communicate with another person what they perceive. The visitors in VR direct their limited attentional resources (see, for example, Morey & Cowan, 2004) to what is relevant or irrelevant from the perspective of the goal. If they decide that the goal is to communicate the experience to others, perceptions and actions would aim for the utilization of tools, such as evaluating the surroundings verbally. It follows that when the utilization of tools, such as words affect perceiving and perception changes because words are associated with other words and as a consequence change what is perceived. This is illustrated in more detail in the chapter *The multisensory experience in relation to sensation, perception, and learning*. Based on the previewed theory, this master thesis study proposes that communicating sensory experiences requires deliberate use and practice in utilizing language as appropriately as possible to catch essential features in the sensory experience.

3.6. Focusing on feelings when evaluating sensory experiences

This study expects that it is a part of the process of making sensory experiences relevant that participants aim to understand how they feel towards their VR experience. Based on experimental studies,

Pham (1998) suggests that an evaluator uses feelings in decision making more likely if the evaluators process their observations in a sensory manner. Because in the present study sensory experiences are in a central role, it is expected that feelings are regarded as important when evaluating the VR experience. In addition, Strack (1992) proposes feelings have more likely a role in human evaluation if people consider their feelings as representative of the evaluated target, or as Pham (1998) formulates it: if the evaluator perceives feelings as genuine affective responses to the evaluated target. Pham (1998) also proposes that evaluators use feelings in evaluating the target more likely if they think that the target is valuable for its own sake and not primary as an instrument to achieve something else. In the current study, participants do not have any reason to give an instrumental role to the VR architectural model and it is to be expected that they consider that the VR experience has intrinsic value. However, although we make conscious decisions of whether or not feelings are a reliable source of information, feelings also spread among people, making the “emotional dynamics” more complicated as socially influenced. Feelings are contagious especially with people who are close to us and in groups who share a common task (Parkinson, 2011; Barsade, 2002).

4. Methods

This chapter describes the research design in this master thesis and as suitable from *The Forest in the House*, data collection in *The Forest in the House*, data analysis, validity and reliability, ethics and my research procedure.

4.1. Research design

To answer the research question, *How are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality architectural exhibition?*, this study uses the data gathered from the exhibition *The Forest in the house* where participants explore a VR architectural model and describe their sensory experiences in an interview conducted afterward the exploring. During the interview study participants are encouraged to describe their sensory experiences in VR. The main source for analysis consisted of interview transcriptions and to a minor degree, summaries of participants' exploration of the exhibition.

It is not known a priori how participants make their sensory experiences relevant after visiting an architectural model in VR. Therefore, this study wishes to form the codes, themes, and categories inductively from the data gathered in *The Forest in the House*. The advantage of using a qualitative method compared with a quantitative method is that instead of presenting simple correlations, qualitative method can *comprehensively describe a specific phenomenon* (Mehan, 1979, p. 21 as cited in Silverman, 2014, p. 100). Comprehensive descriptions of sensory experiences in the interview enable analyzing the process of making them relevant. Comprehensive descriptions of the visitors' experiences in VR are also in line with the purpose of this master thesis, which is to understand the visitors' points of view.

The research design in this master study adopts some elements from *The Forest in the house* and it is both naturalistic and constructionist as it investigates social reality and gains to understand meanings, but these meanings are constructed not individually but in a social process (Silverman, 2014, p. 266). The master study investigates participants' experiences, which is typical for naturalistic studies, but the interview used in the study aims also to create an active construction of meaning in a mutual process, which is typical for constructionism (Silverman, 2014, p. 173). Silverman (2014, p. 168-169) highlights that interviews are interactive, and interviewers always have an impact on what interviewees say.

Asking about sensory experiences in an interview and how participants feel towards the experience in VR gives data about the meanings that are associated with the sensory experience and what participants consider relevant. It is important to notice, that making sensory experiences relevant *for* visitors is slightly another process than making sensory experiences relevant *by* visitors in VR. Making sensory experiences relevant *for* visitors includes somebody else than the subject who makes sensory experiences relevant. It can be thought that it is the social sharing and people who participate in it, which makes sensory experiences relevant. This study assumes that the process where the *visitors describe what is relevant for themselves* is important part of making the sensory experience relevant. Also, other members in the interview make these descriptions relevant by listening, confirming, etc. and thereby supporting the process of making the sensory experiences relevant *by and for* the visitor. According to the naturalistic conception of interviewing, both the interviewer and the interviewee are acting as subjects, where the interviewer creates the context for the interview and the interviewee accepts or does not accept how the situation is defined (Silverman, 2014, p. 179). Because this study analyses the process of making sensory experiences relevant in a context of an interview, where two interviewers ask open questions from a participant pair, such as "how would you describe your experience in VR?", analyzing both how sensory experiences are made relevant for and by visitors is possible. Notably, participants' sensory experiences in VR can be relevant to the participant's in many ways, such as learning more about VR. The data gathered in the study does not allow analyzing if the sensory experience in VR is relevant for the participants some other way than how the participants describe their sensory experiences in VR in the interview. This master study proposes that to be able

to make sensory experiences relevant *for* visitors we need to understand 1) how visitors make their sensory experiences relevant 2) how others can support in the process 3) what the study results mean in relation to designing meaningful VR environments.

The mere remembering in a dialog can reveal some aspects of what people have experienced as memorable and meaningful. According to Denzin (1991, p. 68) as cited in Silverman (2014, p. 182), the challenge in researching meanings through the use of language is that we use language in a culturally shaped matter, include cultural understandings in our use of language, and often fail to mediate the actual lived experience. However, to be able to design purposeful sensory experiences in VR it is important to get information from the actual lived experience. Therefore, this master thesis also discusses the tension between the actual sensory experiences and the meaning-making of the sensory experiences.

The data analysis of the master study aims to have a clear relation to the research question through the analytical concepts and frameworks that derive from comparing the gathered data with the literature review and the theoretical approach. The analysis looks for episodes, where participants aim to make their sensory experiences relevant and concentrates on verbal sharing, learned meanings, imagination, meaningful engagement, presence and feelings in the process of making sensory experience relevant. The gathered data is considered as a good example of the process of making sensory experiences relevant.

4.2. Data collection

This master study uses the data readily gathered in *The Forest in the house* where participants explore the VR architectural model in the National Museum - Architecture and describe their sensory experiences in an interview conducted after the exploring. *The Forest in the House* recruited a diverse set of visitors with different backgrounds and aims to have a representative sample on different types of museum visitors. The participants' ages varied from children to seniors, and they had different levels of expertise from non-experts, to architecture students, and professional architects.

Participants were recruited in pairs and took turns to explore the VR installation and acting as a guide to their partner. There were in together 18 pairs that participated in the study. The picture 2. shows the physical model used in the study.



Picture 2. *The physical model*

In the first phase of the participation, participants explored an installation that includes the physical model of the house (see Picture 2.) and a virtual reality scenery of the house and nature outside, where participants could not move (as there was no physical model for nature). Participants were given an introductory text written by the architect about the inspiration for the installation. They were asked to explore the installation and encouraged to talk about their experience as they were exploring the model. A video was recorded when participants explored the architectural model. Participants wore virtual glasses and hand and feet sensors to track movement and had to hold the sensors in their hands. Picture 3 shows the screen with a view inside the VR house.



Picture 3. *The screen showing a scenery inside the VR house*

The participant's partner, who was not in VR helped the participant who was in VR to move in the physical space. Participant with the virtual glasses could see the virtual sceneries and switch between nature and the house. Participant without the virtual glasses could see a video of what the participant in the VR was seeing in a screen projected on one wall of the space next to the installation (see Picture 3.). After both participants had explored the installation and guided their partner, they filled a survey on paper individually. In this master thesis, the survey is not included in the data analysis. At the final phase of the data collection, participants came back together for the group interview.

The interview guide in the project *The Forest in the house* directed the interviewers to ask open question of the three different research areas of the project, which are technical, meaning-making and museum/architecture exhibition. The way interviews were conducted in *The Forest in the House* shares many characteristics with interviewing focus groups. These similarities are for example participants sharing a characteristic (in this case a shared experience in the architectural model and most cases a relationship with each other), encouraging to informal group discussions and using earlier group discussion to structure the discussion at hand (Silverman, 2014, p. 206). Although the questions were open, the interview used in the study is semi-structured, which includes focusing on what is relevant for the aims of the project (Silverman, 2014, p.166).

4.3. Data analysis

To answer the research question, *How are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality architectural exhibition?* this master thesis studies how visitors make their sensory experiences relevant as well as how they feel towards their experience. The analysis of the data is looking for how participants construct new meanings and utilize learned meanings when verbally sharing sensory experiences, what presence, imagination and meaningful engagement mean in relation to participants sensory experiences in VR and how considering feelings relate to making sensory experiences in VR relevant. There are several possible methods to use to analyze the gathered data and this chapter aims to justify, and critically evaluate, the

methods that are chosen. This master study expects that participants make the VR experience relevant in a process, which is based on previous sensory experiences and meanings given to them and where the participants aim to describe sensory experiences with language. The focus of the analysis is in visitors' verbal meaning-making in interviews after they have explored the architectural model. When appropriate, some observations from the first phase, where the participants explored the VR model, are included in the analysis. Observations that are included from videos where participants were exploring the VR model, illustrate some central aspects of making sensory experiences in VR relevant.

Thematic analysis is an appropriate method to analyze the interviews conducted in *The Forest in the House*, because, as Braun and Clarke (2006) emphasize, it is a flexible method for finding different patterns from the data. This study considers finding different patterns in the data is necessary to be able to understand the process of making sensory experiences relevant. The present study wishes to analyze the data bottom-up, but it is also expected that after the first data analysis and literature review, flexibility in taking turns in interpreting data from the study and reading literature is required. Silverman (2014, p. 98-99) highlights that thematic analysis relies on the researcher's capability to find relevant themes, which can be a challenge for researchers at the beginning of their careers because they lack the skills to study different cases and compare their similarities. This study acknowledges this challenge and emphasis in the thematic analysis is therefore on reviewing the data as throughout as possible during the limited time for the master thesis. In addition, this study uses literature to interpret possible other factors related to those which can be derived from the data in the first analysis. Literature gives then better lenses to interpret the data in the final analysis.

Braun and Clarke (2006) present the different steps to thematic analysis recited here. First, it is important to become familiar with the data and form some initial ideas. Secondly, one should investigate the whole data and form initial codes, which capture interesting features. The third step is to form themes from codes and gather all data that is relevant for these themes. The fourth step is to analyze if the themes are suitable in relation to coded extracts of the entire data set and to form a

thematic map (or in the present study a document) of the analysis. The fifth step is to name the themes, define specifics of the themes, and form logical relations between the themes. The last step is to find concrete and interesting extracts for the report and to relate these to the analysis, research question and the literature. When analyzing video material, it is possible for different observers to look closer to and several times interesting and relevant phenomena (Derry et al., 2010).

Derry et al. (2010) propose that *inductive approaches apply when a minimally edited video corpus is collected and/or investigated with broad questions in mind but without a strong orienting theory*. In the current study, the research question addressed *How are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality architectural exhibition?* which one can consider as a broad question. This study does not use a strong orientating theory to conduct thematic analysis but aims to construct the final themes and other findings inductively from the data. However, the study acknowledges, as Braun and Clarke (2006) emphasize that all researchers are at least in some amount bounded to the background theories they use, which in this study come from phenomenology, cognitive psychology and sociocultural theory. In this study, these theories are chosen after conducting the first thematic analysis, and therefore the study does not consider being bounded to background theories being a problem for the inductive analysis of the data.

4.4. Validity and reliability

As demonstrated in the section *Research design*, this master thesis study aims to validity and reliability by forming a research question and by choosing methods that are aligned with the research design in *The Forest in the House*. Validity means *the extent to which an account accurately represents the social phenomena to which it refers* (Hammerslay, 1990, p. 57 as cited in Silverman, 2014, p. 90) and to meet this criterion, both the gathered data and the data analysis should have a clear relation to the research question (Silverman, 2014, p.81).

In the data collection of *The Forest in the house* cameras were placed so that they would capture the essential features when participants explored the architectural model, which increases the reliability

of data (Silverman, 2014, p. 88). There were no other visitors around because the installation was closed for the public during the time of the data gathering. Using a physical model with virtual technology in a relatively controlled setting, which increases the reliability of the results compared to a situation where setting would be “messier” or otherwise unreliable (Silverman, 2014, p. 316), for example if the environment would have been open to public, disruptions could have impacted participants’ behavior.

The themes that were found from the data were discussed in-depth with my supervisor, who is a researcher experienced in thematic analysis and an effort to confirm the findings was made. The relatively large number of participants enabled comparing findings from interviews with each other, which increases validity. All thought it requires time to analyze a large portion of data, a bigger data set is an advantage; it enables a more varied and closer analysis of the phenomena of interest (Silverman, 2014, p. 99).

In conducting the analysis and ensuring credibility, the thesis considers to which extent the chosen videos represent the phenomenon they are supposed to represent (Silverman, 2014, p. 79). When reporting findings from the data, this master thesis aims to present the context of an interview utterance to claim credibility (Silverman, 2014, p. 79). However, it is not possible to present where all the utterances derive from, and the summaries are aggregations of utterances. To gain credibility, it is also important to treat utterances as data that gain their meaning out of their local context. To increase credibility, Seale (1999, p. 148) as cited in Silverman (2014, p. 84) emphasizes that researchers should use concrete findings from the data instead of generating personal interpretations. This study aims to follow this advice. The present study aims to refer to concrete findings and minimize personal interpretations of the data. The discussion makes interpretations that rely on the literature review and the results from the study. In addition, the discussion poses some questions that take a critical stance on the underlying assumptions that are interpreted to take place in the ongoing dialogue about VR.

The study also asks, whether or not feelings are considered part of the process of making sensory experiences in VR relevant. In this study, feelings are understood in a broad sense. Everything the participants say they feel something towards, also the sensory experience of feeling something physically through the senses, is interpreted as a feeling. Although feelings could be researched from several points of view in the current study, the limitations of the research method, which rely on the interview after the exploring of the VR architectural model, does not allow nuanced investigation of feelings. The present study relies on participants' verbal expressions, which cannot be considered an accurate measure for what participants feel. Therefore, this study does not take a stand on commenting are the participants articulated feelings real. The current study limits the investigation of feelings to finding out whether or not feelings are considered part of the process of making sensory experience relevant and describing *how* participants verbalize their feelings in making the sensory experience relevant.

4.5. Ethics

The Forest in the House has taken care of many of the important ethical issues considering the master thesis study, such as the considerate treatment of participants in the data gathering. Such issues are, for example, to protect the interests of minor participants by involving a third party (Derry et al., 2010), ensure that participants are voluntarily involved and protect participants from harm considering their participation (Silverman, 2014, p. 148). It is also important to bear in mind that participants have given their consent only to a certain type of use of the gathered data, which limits the use of data (Silverman, 2014, p. 145, 153 & 155; Derry et al., 2010). In addition, even though *The Forest in the House* does not deal with sensitive information, it is important to protect the identity of the participants (Silverman, 2014, p. 145). This master thesis study makes data anonym and participants cannot be identified from extracts, where each participant is given a letter and interviewer is given a number. *The Forest in the House* has NSD approval (project number 57390) and this master's thesis work was approved within the project as well.

4.6. My procedure in analyzing the data

The analyzed materials included video material of visitors exploring the architectural model and the group interview in addition to transcripts from the exploring of the model and the interviews. Some of the project plans of *The Forest in the house* were also part of the analysis to be able to introduce the project where the data was gathered.

This master thesis study builds on the data collected in the project *The Forest in the House*. When the data gathering was conducted at the beginning of 2018 I participated in the study as a part of my studies and a practice period in Notam. At the time being, I was not aware that I was going to write my master thesis about the study. Being a participant in the study gave me a more concrete understanding of the participants' VR-experience and made it easier to categorize different elements of the VR experience in the thematic analysis. In the beginning, there were several possibilities to process the research data. I made the final decision about the methods after going through the data. A thematic analysis was considered as the most appropriate method to analyze the data. Because there was some individual variation in what the participants considered interesting and how they perceived the architectural model, it was necessary to investigate all transcripts of the interviews to specify the themes in data.

My supervisor Rolf Steier encouraged me to focus on themes, which I thought were central but also suggested some changes in the focus as the analysis proceeded. The analysis started with watching all the videos where participants explored the architectural model and the videos from the interviews, where participants reflected their experience in VR. After and during this, I read the transcripts and highlighted interesting comments about sensory experiences. I paid especially close attention to parts of dialogue that describe sensory experiences and meaning-making of the sensory experiences. I used the advice from Braun and Clarke (2006) that the codes and themes should grasp something essential about the data concerning the research question. I formed an understanding of the central themes in making sensory experiences in the VR architectural model relevant. The

initial set of themes are included in Appendix 1. The initial document included dates and group numbers, which later made it easier to identify the source of the findings.

In the second analysis, the literature search and analysis of data took place parallelly. I identified a theme from the data, searched for literature about the theme and identified additional aspects to look for in the data. In the process, I copied some interesting extracts from the transcripts for later use for the master thesis. I also considered if the formed themes and the literature were suitable in relation to “coded extracts of the entire data set”, which means if the themes appeared in the whole data or if participants described their sensory experiences in different ways. Afterward, I formed a thematic map of the analysis structuring the findings and examples from the data (Appendix 2). I actively wrote down themes, which repeated themselves in the videos and transcripts. The differences between participants in how they perceived the VR were considered interesting because it reflected how perceiving is not directly a consequence of the environment but contains subjective features. In the final phase, I related the interesting extracts from the transcripts to the analysis, research question and the literature review. After going through the whole data material and conducting an initial literature review, I chose presence and immersive experience as themes that narrowed down the material chosen to final analysis because presence revealed itself as a central theme both in the bottom-up analysis and in the literature review. Later, I considered presence more relevant than immersion because the focus of the study was, at this point, on meaning-making of sensory experiences, which includes the subject’s psychological processes and the sociocultural contexts. The focus slightly changed later in the study and became the process of making sensory experiences relevant. The role of previous experiences became a central theme and how learning changes the quality of attention when one senses and perceives surroundings. Utilizing technology and conceptual tools in meaning-making were first central themes but as the analysis proceeded, it became clear that the visitors’ experience in VR is not reducible to immersion understood as purely technologically produced. In addition, one could notice from the transcripts that the study participants struggled to communicate their experience with words. Therefore, the focus became the challenge and relevance of immersion and presence in VR and the challenge of communicating sensory experiences and making the VR experience relevant for the visitors.

The relevant literature was scattered in different, inconsistent themes, and practically no prior studies were found to analyze the making of visitor's sensory experiences in a VR architectural model relevant. My task became to connect the disconnected themes by finding the parts of theories and studies that combined them. My supervisor Rolf Steier recommended literature and in addition, I made searches with Google Scholar. I tried the search in the University of Oslo's library databases but noticed that I found the most relevant articles considering the findings from the data with Google Scholar, and from Academia.edu, which was very helpful. I used different combinations of search terms such as "sensory experiences", "virtual reality", "meaning-making" and "presence" to find more literature that was relevant. Several articles defined multisensory experiences only narrowly, and a need emerged to gain a wider understanding of what multisensory experiences are. I read about the philosophy of sensory experiences from Merleau-Ponty and sensory experiences related to architecture from Pallasmaa, both of which my supervisor recommended. I also used my degree in psychology to connect themes and literature in the review and to integrate disconnected parts in the theoretical framework to analyze the findings of the study. The additive process of the literature review utilized a snowball method, where I used the most referred articles in Google Scholar as a basis of the review and identified theory, questions and studies that were relevant for the present study.

5. Results

This master thesis aims to answer the following research question: *How are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality architectural exhibition?* To answer the research question, the master thesis studies the characteristics of the process, where visitors make their sensory experiences relevant after visiting the VR architectural exhibition. In the *Discussion*-chapter these findings are discussed in relation to other aspects of the research question. In this chapter, I will organize the findings by using five of the six themes described in the research design. The five themes in the results are verbal sharing, learned meanings, imagination, presence, and feelings in the process of making sensory experiences relevant. The sixth theme, meaningful engagement, is relevant especially for connecting the findings to the literature review and a larger context in the *Discussion*-chapter.

The chapter *Data collection* explains the used protocol when participants explored the VR architectural model. It was challenging to analyze the verbal meaning-making process of sensory experiences in the videos when the participants were exploring the VR because although encouraged to, most participants did not explain their observations actively. Therefore, the focus of the analysis is on the interviews and especially on the transcripts from the interviews. In the interviews the meaning-making of the experience involved for example describing sensory experiences, comparing the VR and reality, describing how easy or difficult the exploring of the space was, whether something was surprising, the meaning of having a partner beside and making wishes and suggestions for future design of VR. As mentioned in the *Methods*-chapter, the mere remembering of some parts of the experience indicates what people have experienced as meaningful. The analysis of results excludes suggestions for future design of VR because these are not in the central focus of this master study.

In the following sections, the transcripts are organized to the following sections: 1) communicating the sensory experience, 2) feeling the virtual reality, 3) presence, 4) aiming for an integrated sensory experience and 5) imagining actions in VR. In each section, there are several excerpts taken from the transcripts that describe the phenomenon in the section. Turns in the excerpts are numbered and if the pair talked Norwegian, the original Norwegian appears in parenthesis. Each participant has been given a letter from the alphabet (Participant A etc.) and interviewers are named Interviewer 1 and Interviewer 2.

5.1. Communicating the sensory experience

Important elements in communication in the VR were touch, moving and helping the one that was in VR. One can observe from the videos, where participants explored the VR, that they communicated with each other occasionally through touch, when the participant in VR was feeling insecure of moving in VR or the partner who was not in VR, interpreted that there was a need to direct the way of the partner in VR. In the interview, many comments that having the partner besides was important also because the partner physically guided them when they came to an uneven ground.

The one who experienced VR second felt safer and could more easily move in the VR because she or he had become more aware of the physical platform. The one who explored the VR first felt it was easier to guide the partner made it easier to relate to what the second participant in VR was experiencing since they knew the VR model better. The partner who was first in a guiding role had to rely on a screen replaced behind a distance and to the comments of the partner who was in the VR now. Several participants said in the interview, that it was difficult to discuss what the partner was seeing in the VR. They said, that although they could theoretically see what the partner could see in VR in a screen located some meters away from where they were standing, the contrast in the screen was weak and it was difficult to follow the screen in practice. During their exploring, participants posed some questions for the researchers who were standing beside the physical model.

Central themes regarding communication in the interview, were participants struggling and still trying to describe the sensory experience with words, the use of professional knowledge and literal language, expressing fascination towards details in VR, taking long turns to describe own experience, describing the size of the space and the experience of exploring it differently from each other, comparing the VR with reality and describing the sound as important part of the VR. Although the multisensory experience seems to be difficult sometimes to communicate in the interview, reflected by many participants searching for and losing words, participants do strive to describe their sensory experiences understandably to each other and use common language. One can notice the difficulty to describe the VR experience with language when participants use unclear and unfinished sentences in the interviews.

In the interview, several participants said that when they experienced the model they felt fascinated by the VR, observed many details and one participant directly said she felt motivated to explore the visuals closely and from different angles. One can also observe this from the videos, where participants are in VR, they focus their gaze long times in the same direction and occasionally comment on what they are observing. In addition, the attention paid to details one can detect in the interviews, where many can describe nuances in the visual and auditory scenery, which indicates that they have paid attention to these. Some participants comment that the changing light, shadows and other details in the visuals made the whole scene seem more real.

In the interview, knowledgeable participants use their prior understandings to explain their perceptions in the VR model, making references to architectural theories, literature, and art, and using factual knowledge such as how sounds make it easier to navigate in the place. Those participants who have architecture as a professional background use some concepts that derive from this background. These professional concepts function as tools, which make those participants' understandings and reflections of the architectural model qualitatively different from those participants' understandings, who do not have an architectural background. On some occasions in the interviews, one can describe the participant's use of language as literal, using many pictorial descriptions. In the following

Excerpt 1 Participant P searches for words to describe accurately how the light was in VR. This participant is an elderly person, which might explain the accurate perceptions of the details.

Excerpt 1. The entanglement of light

01 Participant P: It was, there was also, you become engaged with entanglement of light. First, the entanglement of light through the leaves. And then entanglement of light, what do you call it, not espalier, but
(Det var, det var også, du blir jo opptatt av filtringen av lyset. Først, filtringen av lyset gjennom trærne. Og så filtringen av lyset, hva kalles det, ikke espalier, men..)

02 Interviewer 2: Yes, it is some kind of grid.
(Ja, det er jo en sånn grid av noe slag.)

03 Participant P: Some kind of grid, that is true, so, which lets the light in, but not the warmth. It was something that talked to each other, I thought, which I thought was interesting.
(Grid av en slag, ikke sant så, som slipper lyset inn, men ikke varmen. Der var det noe som snakket til hverandre, tenkte jeg, som jeg synes var interessant.)

In Excerpt 1, the Participant P, an architect, describes that the different elements *talked with each other*, such as the light gleaming through the trees. The participant makes very accurate perceptions such as *Some kind of grid, that is true, so, which lets the light in, but not the warmth* and describes different visual elements as communicative, and notices that the visual elements affected each other, and changed in a dynamic relationship.

Summarizing all interviews, participants describe the visual experience often as esthetic, beautiful and including strong daylight. Some mention that the combination of the realistic house and unrealistic features in the nature made them critical towards unrealistic nature. Several participants comment that the quality of the visual influenced how real the place felt. For example, being able to see the pixels in nature made nature seem less real. In the nature scene, many describe that the wideness of the horizon was pleasant, and two participant pairs even comment that the experience of the view was much stronger than the experience of the architecture. In Excerpt 2, the participant pair describe the feeling of light.

Excerpt 2. Light that can cut

01 Participant Q: No, but, there were birches, which were white, at least according to what I saw.

(Nei, men, det var jo bjørketrær som var hvite, i hvert fall i det jeg så.)

02 Participant R: Yes, exactly.

(Ja, nettopp.)

03 Participant Q: They were white and that was the case also inside the house, at least. And a bit black, so it was like —, a simple contrast which made everything different than how the rest of the nature was.

(De var hvite og det var jo også dette indre i huset, i hvert fall. Og litt sort, så det var en så—, en enkel kontrast som gjorde det helt annerledes enn resten av naturen der.)

04 Participant R: But how the light was, that appears, appears strongest.

(Men det var behandlingen av lyset som står, står sterkest.)

05 Participant Q: Yes. It was that I connect with the whiteness. Almost too strong, the white, because light can cut, almost as it cuts.

(Ja. Det er det jeg forbinder med det hvite. Nesten litt for sterkt, det hvite, for lys kan jo være, nesten sånn skjærer seg.)

Excerpt 2 illustrates how the strong light feels excessive for this pair as the Participant Q says about the light *almost too strong, the white because light can cut*. Participants experience the strong light as a tactile stimulus, not only visual. This is interesting because many other participants associated the light with warmth. It can be concluded that in general in the interviews, participants associations differ from each other and they give different meanings to sensory experiences.

Most of the participants in the interview consider the sound space well designed and observed sounds as natural in the space. Many comments that sounds made the VR more relaxing, for example, the saxophone music and waves. One participant comment that if sounds were lacking the experience would have reminded *a grief poem with forceful movements but without sound*. Although most of the participants notice the waves, bees/insects, saxophone/jazz/music, some mention that they did not pay that much attention to the sounds. In Excerpt 3 participants discuss how they make their experience of sounds relevant.

Excerpt 3. Sounds integrate the different sceneries

01 Interviewer 2: The sound scenery?

(Lydbildet?)

02 Participant T: Yes, it was exciting because I think it was really essential when you were in the nature, then, that you experienced the nature and so when you were inside the house that you got the very feeling that you were still outside, that it in a way integrates everything, then. And in the corner where there kind of was jazz on, then, that made it kind of delightful to stand there, and you can in away see, for me then, it helps to, therefore, to create an atmosphere, then. So it was really relaxing and nice and, and so it stops in great amount other sounds that could be around, then. So you become a bit like inside that bobble. So I think it was really exciting.

(Ja, det var spennende for det tror jeg var veldig essensielt når du var i naturen, da, at du fikk den naturopplevelsen og så når du var inne i huset at du fikk den veldig følelsen at du fortsatt er ute, at det på en måte bringer alt sammen, da. Og så i det hjørnet hvor det på en måte var litt sånn jazz på, da, det gjorde det litt sånn deilig å stå der, og du kan på en måte se, for meg da, så hjelper det til å, altså, å sette en stemning, da. Så det var veldig avslappende og fint og, og så stopper det jo veldig mye annen lyd som det kunne vært rundt, da. Så du blir liksom litt mer sånn også inne i den bobla. Så det synes jeg var veldig spennende.)

03 Participant S: I think about the sound especially, then, I think that acoustic inside the house is very important in relation to which room you are in, you know. And that, the reverberation, or in a way, which locates itself in the walls, there you hear that the music comes from someplace, but you can hear it all the time. That I think was nicely done, which in away creates even greater assurance that you are there, then. And that is for sure, that is what the point is.

(Jeg tenker sånn på lyd spesielt, da, så synes jeg akustikken inne i huset er veldig viktig i forhold til hvilket rom du er inne i, ikke sant. Og at den, den etterklngen, eller på en måte, som ligger i veggene, der du hører at musikken kommer fra et sted, men du hører den hele tiden. Det synes jeg var veldig pent gjort som på en måte gir deg enda, altså det gir en større overbevisning om at du er der du er, da. Og det er jo sikkert, det er jo på en måte det som er poenget.)

04 Participant T: And that there is a room you can move in, that you in a way have, yes, as you say, move away from the sound. You know in a way that there is another room here, and if I turn around more, so even if you don't see it, it is there still, so.

(Og at det er et rom du kan bevege deg i, at du har på en måte, ja, som du sier, gå bort og lyden. Du vet på en måte at her er det enda et rom, og hvis jeg snur meg der, så selv om du ikke ser det så er det der fortsatt, da.)

In Excerpt 3 participants describe that sounds integrated the different spaces and sceneries. Participant T describes that sounds from the outside seemed to continue also inside and the jazz music created a cozy atmosphere also by muting the sounds coming outside the VR. Participant S comments

that acoustics made it possible to locate in which room one was in, and increased presence. Interestingly sounds made her sense that the room she had just looked at and turned away from was still there because she could still hear the music coming from that room. In this sense, music affected the sense of continuity of the room and the nature in the house.

In the interview, many participants comment that the sounds were an important part of the virtual experience as they made the experience more real and strengthened the participant's experience of being present in the place. The realness of sounds seems to be important for the participants. Some mention in the interview that sounds partly muted the background noise, which made the VR-experience more immersive. Several participants say that when sounds did not mute the background noise, VR felt less immersive. It can be interpreted that sounds from outside VR disturb the VR experience. The sound scenery is evaluated comprehensively, and some participants comment that they would have expected some sounds in the scenery, which were missing, as boat sounds in the sea and their steps, which would have made the VR even more immersive.

5.2. Feeling the virtual reality

Naming feelings and saying "I/it felt that/like..." is typical for participants answers in the interview. In the interview many participants mention that the house felt real, they felt relaxed, they were almost instantly present in the VR, the overall experience was pleasant and fascinating. While exploring the model many smiled. Participants seem to make both their own and their partner's feelings relevant in the interview when they describe and evaluate VR. Interpreted from participants' verbal and facial expressions, tone of voices, body movements and the way they describe the VR experience when exploring the architectural model and, in the interview, the experience provoked many emotions. These include for example happiness, contentment, surprise, and momentary fear or anxiety when participants did not feel secure to move in the VR. As mentioned in the *Theoretical framework*-chapter in this master thesis, emotions are contagious especially with people who are close to us and in groups who share a common task (Parkinson, 2011; Barsade, 2002). On some occasions, it

is difficult to differentiate if the participant's feeling is a reaction to the VR or the fellow participant's emotion. Most of the participants knew each other from before, they were either friends or partners and it is to be expected that they relate to each other's feelings spontaneously. In verbal communication, one can detect efforts to react compassionately to the other participant's emotional experiences and expressions. Pair members seldom directly confront or contrast each other's emotions, but usually, follow and confirm them.

On some occasions, in the interview, participants describe their sensation from one sense channel, as they perceived it with several senses. Especially the participants mentioned the light as a physical feeling at the skin. Participants associated their previous pleasant sensory experiences with the VR experience, such as relaxing, looking at the sea and taking a cold drink. Many mentioned that it was very light in the VR and that the lightness was a central feature in the model. The following Excerpt 4 demonstrates how stimuli to several senses at the same time strengthens presence.

Excerpt 4. Instantaneous, soothing feeling and looking from different angels

01 Participant D: I was quite, I was quite surprised that it was so instantaneous, because I thought it would take a few minutes until I felt like I was in the scene, but it was quite instantaneous, as I said, and was rather, were very soothing, and it was great that, I thought that the sound, and the landscape, and yeah, the architecture all reflected each other, so like, kind of the sense of vastness, and the wind, you could almost feel the wind, it was very, yeah. It was definitely like, I was gonna say out of body experience, but not really, because you kind of felt like you were in the scene, as well, so.

02 Participant C: True. I was just thinking about the word soothing, as well. When you (inaudible) said, it's like ah, it was so nice, like, the light was perfect, especially because it's winter in the real world, and it's cold. So, it was like, just for a second you can just, you know, shut off, shut out the whole thing, and just relax for a minute. And, I think, it was just, it wasn't, like just looking at nice pictures, but because you can move around and look at things from different angles and you know the steps were so far. It was like, yeah, made the whole thing perfect.

In Excerpt 4, the participant D is surprised that she was so quickly present in VR. Both participants describe that they felt soothed. The participant D describes the experience as a combination of different sensory stimuli *reflecting each other* and experience the feeling of wind as something one

can almost feel. Here the participant D describes *almost feeling a sensation* that physically does not take place in VR. The participant C comments that the experience was more than looking at pictures because one could move in the scenery and observe objects from different perspectives. The participant C describes how nice the VR experience was because in reality, it is winter and cold.

Most participants in the interview describe stimuli from different sense channels as intertwined and closely related. Some mentioned they enjoyed the presence of several sense stimuli, such as visuals, sounds, being able to move and touch. Many also wished to experience stimuli that did not take place, such as wind and scents, hear several sounds and be able to touch several things. Many participants mention that the combination of details in the visual, sounds and being able to move in the space created presence. The following Excerpt 5 illustrates the difference between expressing a learned idea and thoughts derived from feeling the sensory experience.

Excerpt 5. Cozy, dreamlike vacation

01 Researcher 2: You totally agree, yes. Can you find some adjectives, like, you find describing?

(Du er helt enig, ja. Har dere noen adjektiver dere har tilgjengelig, liksom, som faller dere, for å beskrive det?)

Participant A: Nice. Cozy.

(Fint. Kos.)

02 Participant B: Or dreamlike, but also like dreamlike in addition.

(Eller drømmende, men også litt sånn drømmende òg).

03 Participant A: It felt like a vacation. One was in a vacation; maybe one had hired a house for five days and was going to have it cozy. I talked to another person here; he said that people are only going to rent a virtual vacation in the future. Or just for couple of hours, or to relax, or a zen-room you can go in and just relax a little bit. It really functions, so that is quite interesting.

(Det følte litt ferieaktig ut. Man var på ferie, kanskje man hadde leid det huset for fem dager og skulle kose seg. Jeg snakka med en annen her, han sa at det kunne vel komme i framtida at folk bare leie seg inn på virtuell ferie. Eller for et par timer, eller avslapning, eller zen-rom du kunne gå inn i og så bare slappe av litt. Det fungerer absolutt, så det er ganske interessant.)

In Excerpt 5 participants describe that the overall experience of the VR architectural model was nice, cozy and dreamlike and one felt like being on a vacation. The participant A retrieves an idea he has heard earlier, namely that in the future VRs can be used for relaxation and vacations are made in virtual realities. Before this, Participant A comments that VR was nice and cozy but does not describe several sensory experiences in relation to being on vacation. This might indicate, that vacation in VR is a learned idea, not an association with the sensory experiences in VR. Participant B continues *or dreamlike* contrasting slightly the Participant A, but then the Participant B corrects, *but also like dreamlike in addition* affirming the partners comment and making the confrontation softer and less direct. In Excerpt 6 the participants talk about the sun as it was shining in VR.

Excerpt 6. The sun was shining

01 Interviewer 1: Can you talk more about the sound?

02 Participant B: Yeah, I think that was like giving, like more impression of being in the nature, being on the actual place, I mean. I think that was really important, to have the birds, and the ocean, and the, I mean, everything felt more real. When the sun was also like shi..., you know, I mean, it kind of made the sun warm, you know, in a way, so it's more these things.

03 Participant A: Yeah, it was good that the sound was from the big surroundings, not only the close ones, but the bigger ones. Then you got more sense of the space you were in, yeah.

Excerpt 6 is an example of some central features of the multisensory experience in VR. The interviewer asks participants about their sound experience in VR, but both participants end up describing other sensory experiences related to, associated, or intertwined with sounds. Participant B emphasizes that sounds gave an *impression of being in the nature* and *being on the actual place*. Participant B also describes that *everything felt more real* because there was input from several senses. Further, Participant B describes that the sun was shining in VR and then corrects that all the sensations together *kind of made the sun warm*. *The sense of virtual reality being a real environment* is an element defining the *realness* factor in the model of presence from Schubert et al. (2001). Participants' descriptions imply that they were feeling present in VR, and presence was strengthened by intertwined sensory experiences.

5.3. Presence

Being present in a reality-like VR seems to be valued among the participants. Many participants comment in the interviews, that the house scenery in the architectural model was more real than the nature scenery due to the precise physical response in the house scene. For example, many say in the interviews that the stairs in the VR felt real because they mostly matched the stairs in the physical model and physical response from them was precise. One can observe from the videos, that most of the participants tried to touch the surroundings, for example, the fences and leaves in the nature scenery. In the interview, many say, that the physical experience of touching the ground and fences with hands and feet felt convincing and that even though the fence sometimes seemed to pop-up suddenly, feeling the fence was important as it gave a sense of security. Some mention in the interview that not being able to touch objects made the nature scenery feel unreal (see Picture 3).



Picture 3. *Virtual hands reaching for the leaves*

When the physical response was not precise, VR felt less real, “weird” or surprising. In the interview, some mentioned they would have wanted to feel the place more physically, sit on the table or chairs and sleep on the bed. One mentioned that expecting that one can feel what one sees made her motivated to explore the place. Many comments in the interview that it was even a bit annoying, that things seemed real, but one could not touch them. For example, the leaves disappeared if one touched them. When interviewed, some of the participants considered it frustrating that the area one can explore is limited and one cannot explore the whole horizon. When the physical response was not precise, some experienced this as unsafe. This is understandable since by physically feeling that the objects such as the VR stairs matched with reality, participants were able to navigate in VR.

In the interviews, some participants comment that the room became smaller when one could physically feel its limitations, whereas others experienced the house scenery as spacy. Several participants comment that being able to move in the space made the experience more immersive. One participant says that being able to move in the space made the experience more real and *the sensory experience bigger* compared to the type of VR where it is not possible to explore the space by moving in it. In the following Excerpt 7 participants describe how they gradually and consciously accept immersion in VR.

Excerpt 7. Gradual and conscious immersion

01 Participant G: I am repeating what I answered in the inquiry, but I think it was very special and then move, and to get such a physical precise response to what you saw around you in the VR.

(Det blir jo litt å gjenta det jeg svarte i undersøkelsen, men jeg synes det var veldig spesielt og så gå og få en fysisk, såpass presis fysisk respons på det du så rundt deg i VR. Det er noe helt annet enn å stå på et flatt gulv, hvor du egentlig ikke beveger deg på samme måte, da, i VR. Det var jo veldig gøy.)

02 Participant H: Ja, for man er forberedt på at det ikke er, eller sånn, man merker veldig fort at det henger ikke helt sammen, men det er likevel veldig spennende å utforske det.

(Yes, because one is not prepared that it is not, or like, one notices very quickly that it does not really integrated, but it is anyway very exciting to explore it.)

03 Participant G: Yes, but in a way it is integrated.

(Ja, det henger nok sammen, på en måte.)

04 Participant H: You are like really tempted. Yes, you manage to, yes, you are emerged in it. I think, it felt really, really exciting to just be there and then, and then one accepts just how accurate it is, and then one starts to, yes.

(Du får liksom veldig lyst. Ja, du klarer å, ja, man lever seg jo inn i det. Jeg synes, det føltes veldig, veldig spennende å bare være der og så, og så aksepterer man bare hvor nøyaktig det er, og så begynner man å, ja.)

05 Interviewer 2: No, because there was something about the adjustments there, that I understood.

(Nei, for det var litt på justeringene der, det skjønte jeg.)

06 Participant G: But, one felt, it was quite easy to emerge oneself in it, quick i mean. One noticed like it most, when one took off the headset again, that it was quite peculiar to be here.

(Men, man følte, det var ganske lett å leve seg inn i det, fort altså. Men merka liksom det mest når du tok av deg headsettet igjen, at da var det litt rart å være her.)

07 Interviewer 2: Yes. Was there something that surprised you?

(Ja. Var det noe som overrasket dere?)

08 Participant H: I think perh.., I don't know, I think perhaps i was surprised how, that the, the world became so incredibly big, it felt like it did not end, or that it, yes, it became as, yes, it was a bit funny that, yes maybe that made one, that it was so easy to become emerged in it. That it quick.., that it became, it looked like it would just continue over. But then again the sound had a lot to do with it, that one, that it, it made it, that it was easier to forget where one was, or that it, it felt really like nice to be in the woods.

(Jeg tror kan.., jeg vet ikke, jeg tror kanskje jeg ble overrasket over hvor, at den, den verdenen ble så utrolig stor, den føltes jo som den ikke tok slutt, eller som den, ja, den ble litt sånn, ja, det var litt morsomt at, ja kanskje litt det som gjorde at man, at det var lett å leve seg inn i det og. At den fort.., at den ble, den så ut til at den bare fortsatte utover. Men så hadde det sikkert veldig mye å si med den lyden, at man, at det, det gjorde det, at det var lettere å glemme hvor man var, eller at det, det føltes veldig sånn fint å være i den skogen.)

In Excerpt 7 participants have a different type of overall experience of the VR model. The Participant G is surprised about the precise physical response of the VR model whereas the Participant H experiences the VR as enormous and endless. Even though participants have also different experiences on how integrated the sensory experience in VR was, both experience the VR model as highly immersive. It is interesting though that the Participant H first says that one notices quickly that elements in VR are not perfectly integrated. Her pair, the Participant G then says slightly confronting the Participant H, that she thinks the VR was integrated, and then the Participant H first says that

one is *tempted to* and then corrects that one *manages* to become emerged in VR. Then the participant H continues that it was exciting to *just be there* and *then* one accepts that VR is accurate. The participant H also describes that her experience of VR being endless and something that *looks like it would just continue over* made the VR immersive.

In the interviews, many participants comment that they felt present in their virtual body and being able to see the virtual body made them feel more present in the VR. Although some mention in the interview that it was difficult to touch things in VR because of the equipment, many do not mention this. Some mention they would have preferred to use gloves instead of the equipment to be able to touch things better. In Excerpt 8, the participant describes her experience of the virtual body.

Excerpt 8. Presence in the virtual body

01 Interviewer 1: Could you both talk about this, like the physical experience, what it was like with your feet and hands, and how that worked?

02 Participant J: Yes, I felt really present in the room, both with hands and with body which I could see the whole time. But there, and is it that it is fascinating because it is new, but anyway I was immersed with the figure I was, then. And at least with the legs, which one all the time, especially with stairs and that one could also feel the way forward. (Ja, jeg følte jo at jeg var veldig tilstede i rommet, både med hendene og med kroppen som jeg hele tiden så. Men der òg er det liksom om det er en sånn fascinasjon av det nye, men likevel så gikk jeg litt i ett med den figuren jeg var, da. Og i hvert fall også med beina som man hele tiden, spesielt med trappetrinnene og at man kunne føle seg frem og.)

03 Interviewer 2: Yes it looked like your body matched really well with...

(Ja, det så ut som din kropp stemte veldig godt med..)

04 Participant J: Yes.

(Ja.)

05 Interviewer 2: ...where you were.

(...hvor du var.)

06 Participant J: Yes. So I was really present physically.

(Ja, så jeg var veldig tilstede fysisk.)

In Excerpt 8 the Participant J describes the immersion to the virtual body and comments that she felt present in the virtual body because the virtual legs were mostly tuned with the movements of

real legs she felt present in the room. Participant J also emphasizes that it was important to see the virtual feet and feel the stairs with real feet to *feel the way forward* making her feel more present in the VR.

One can observe from the videos, that all participants walked carefully in VR. Some participants comment in the interview that because they had seen the platform in advance they were able to anticipate the physical experience in VR, which made it easier to navigate in VR. One participant raised an interesting reflection that the experience might be more immersive if one did not see the platform in advance. Probably not seeing the platform in advance permits experiencing stronger emotional reactions, such as uncertainty, which in turn enables surprise and excitement. In the following Excerpt 9 participants discuss the platforms and navigating in the VR.

Excerpt 9. Having to walk carefully increases presence

01 Participant K: It was really nice, I think, that you could come, that the fence popped up, so you could guide yourself around, to have an understanding where the room ended, and such. And, it was nice with all the platforms, so you had to be more present in where you were, had to be a bit careful when walking. I don't know, what do you think?

(Det var veldig fint, synes jeg, det at du kunne komme, at gelenderet dukka opp, sånn at du kunne guide deg selv rundt i, å ha liksom en forståelse for hvor rommet slutta, og sånne ting. Ja, det var fint med alle nivåene så at du liksom måtte være liksom tilstede i hvor du gikk hen, måtte liksom være litt varsom i å gå. Jeg vet ikke hva du tenker?)

02 Participant L: No, I agree. It really is, really livelier with the platforms. And so, it is good with these, these steps, but also, before I reached them, the room felt infinity. So those, or, I can imagine like that if one does not go clearly the whole passage, then it can, or for them, when I went the whole round I know very well what there is in the room, but it did not require much before I stopped on the way, and I would have been equally happy, but the room would have been much bigger.

(Nei, jeg holder med. Det skaper veldig, veldig liksom liv at det er de her trinnene. Og så, det er jo bra med de, de her stegene, men også, før jeg kom fram til dem så kjentes jo rommet uendelig. Så de, eller, jeg kan tenke meg liksom at om man ikke går klart hele gangen, så kan, eller for dem, når jeg har gått hele runden vet jeg veldig godt hva som er rommet, men det skulle ikke mye til før jeg stoppet på veien, og jeg ville vært like glad, men rommet ville vært mye større.)

The participant K describes in Excerpt 9 that the stairs and asymmetric platforms made her walk carefully, which she thought was nice and increased her presence in the architectural model. Participant L says that the steps and platforms with different shapes made the room feel bigger and gave it more life.

5.4. Aiming for an integrated sensory experience

When participants talk about their VR sensory experiences in the interview, they evaluate, how integrated the sensory experiences were. Participants make comments on features that decreased the presence in VR, such as sensory stimuli from the reality that did not correspond with elements in the VR. In the interview, many reflected that it was weird when they were in VR and heard the partner talk or felt them guiding but were not able to see the partner. One participant comment that being able to smell the rubber from the equipment, although there was nothing in VR that could smell like rubber decreased the presence in VR. In the following Excerpt 10, participants describe their difficulties to integrate sensory stimuli.

Excerpt 10. Unsynchronized VR and talking for both pair members

01 Participant Y: It was a bit weird, because it hang, it was like when you tried to touch something, you were touching it in the VR, but then you did not quite reach it in the reality. So it was a bit unsynchronized exactly then, but on got used to it, then it was fine.

(Det var litt rart, fordi det hang, det var litt sånn der at du prøvde å ta på noe, så tok du liksom på det inne i VR, men så kom du liksom ikke helt borti det liksom i virkeligheten. Så det var litt usynkronisert akkurat da, men man ble vant til det, så det gikk fint.)

02 Interviewer 2: Because a fence appeared, as you said, fence is following me, you said. But is was to look after you, of course. But it appeared in front of you, that you were able to touch. Did you do that?

(For det kom jo opp et gjerde, som du sa, gjerdet følger etter meg, sa du. Men det var nettopp for å passe på dere, selvfølgelig. Men det kom jo frem der, det kunne dere jo ta på. Gjorde dere det?)

03 Participant X: Yes

(Ja.)

04 Participant Y: Yes, we did that.

(Ja, vi kom borti det.)

05 Interviewer 2: And then you touched the stairs when you sat down? I don't know? You tried to touch the pillars and so on?

(Og så tok dere vel på trappetrinn når dere satte dere ned? Jeg vet ikke? Dere prøvde vel å ta på søyler og sånn?)

Participant X: Yes when we sat down, then it was, it felt much more real, because when we were walking around, as was already said, it was like, even though it was a bit uncalibrated it became less real, but when we sat down as only us and then it was like in the house. But when we changed to the nature we like hovering, and then it was like no, this is not real.

(Ja, når vi satt, så var det, så føltes det mye mer ekte, fordi når vi gikk rundt så var, som sagt, det var på en sånn, selv om det var litt ukalibrert så ble det liksom litt mindre ekte, men når vi satt så bare vi oss og da virket det som vi var inne i huset liksom. Men når vi byttet til naturen så svevde vi jo, og da var det litt sånn nei, dette er ikke ekte.)

In Excerpt 10, Participant Y says that it felt weird when VR was not synchronized and when one tried to touch something in VR but did not reach it in reality. The participant Y continues that it was fine when one got used to it. Another interesting thing happens when Interviewer 2 asks a question whether *you* as in plural touched the fence, pillars and so on. To this question, the Participant X answers that when *we* sat down, the VR felt more real, because when *we were* walking in VR, *we* could notice that VR was not integrated. This is interesting, because the Participant X answers as if both members of the pair had been walking and also feeling the VR the same way. The participant Y does not express disagreement, which indicates that she either experienced VR the same way or does not want to conflict with the Participant X's description of *their* experience.

In the following Excerpt 11 participants evaluate how harmonic they experienced their sensory experiences in VR.

Excerpt 11. Disharmony between sounds, sceneries, and other sensations

01 Participant U: Yes but, yes, because speakers one forgot when one was walking. It was like one tried a bit like that, here it is. But I mean yes, the sound, yes they were, they were quite, yes like at some point I would have kind of taken away the airplanes, wasps and the dogs barking in the background, so that was kind of, yes. Interesting. It helped, but I mean also one can question the motive in the video, the view and waves and like, it was almost as you could have one

such fans. Because, you know, maybe if one was located, in another place, in another context, in a street down town in New York, one would maybe be more compatible with the experience, here experience was missing like a scent of salt and the sea and.

(Jamen, ja, fordi høytaler glemte man at de fantes når man gikk. Det var sånn når man prøvde litt sånn å, her er det. Men jeg mener ja, lyden, ja de var, de var ganske, ja liksom på noen tidspunkt jeg skulle liksom ta vekk de fluene, veps og ja, og så var det hundene som bjeffet i bakgrunnen, så det var liksom, ja. Interessant. Det hjalp, men jeg mener også man kan stille spørsmål ved det motivet som var vist i videoen, liksom utsikten og bølgene og liksom, det var nesten sånn dere skulle hatt en sånn fan. Fordi ikke sant, det er litt sånn, selvfølgelig bestemte situasjoner forutsetter bestemte, også opplevelser. Så, for eksempel, kanskje hvis man hadde vært i, på et annet sted, i en annen kontekst, i en gate down town New York, så ville det kanskje vært mer kompatibelt med den opplevelsen, her opplev..., manglet litt sånn lukten av salten og havet og.)

02 Interviewer 2: (No, the scents are not.)

Nei, luktene er ikke.

03 Participant U: Yes, yes, I understand that, but we were in the house, therefore I thought okay well, I get, this will do, I am inside a closed architecture, and there is no wind here. So it was how it was, it had to do.

(Ja, ja, jeg skjønner det, men vi var inne i huset, så da tenkte jeg okay sånn, jeg får, dette her får passere, jeg er inne i lukket arkitektur, hvor vinden ikke dukker opp. Så det var sånn, det får passere.)

In Excerpt 11 the Participant U comments that one forgot the speakers, which might indicate that this participant paid even more attention to other aspects in VR than the sounds. However, this participant names several sounds, such as the airplanes, dogs barking and bees and criticizes that some of the sounds did not suit the visual scenery. The Participant U also comments that the scent of the sea was missing, but then says *it was how it was; it had to do* indicating that although he is missing many sensations in VR, he also accepts that VR gives “poorer” sensory experience than reality.

Some participants comment in the interview that when the technology was not working ideally, getting assistance from the partner to move safely was important. Interpreted from many of the comments from different participants in the interview, it seems to vary among participants if it is the realness or the experience of an artificial reality, which makes them want to interact and explore the place. It seemed important to many participants to compare the VR with reality in the interview as illustrated in Excerpt 12.

Excerpt 12. Discontinuing graphics and technology

01 Participant N: Yes, it was interesting, it was like I didn't try it before, I haven't tried this VR before, and so it was a bit more technology that you had to wear on it than I expected. But it was very like, yeah, you kind of got this kind of magical experience. The things that are not really there, they are suddenly there. And you get to walk around, and look around, and it felt also quite safe because there were always rails in the VR and you could see where the borders are. Yeah, it was kind of, it was not as realistic as I maybe expected, because the little leaves were like small, I don't know, circles and stuff. And I didn't get like the full experience that it was, I didn't, I kind of had to remember that I was in the VR, because of, because it wasn't completely like the real forest. But it was close enough.

02 Participant M: Yeah, I enjoyed it very much. I liked the fact that you can transition between environments, I thought that made it unique in a way. And you, it gives you control over. Also having it function on different levels is also a challenge in a way. You managed to match it very well, except for one part where it's a ten or twenty centimetres delay, which, which happens, but it's good that you have a guide for those, for those moments. Otherwise it's very nice, what we've talked about is that it, it becom..., it becomes at least for me, it becomes more immersive the more you experience it. The sounds play a very important role, I liked how there were different sounds in different areas that is very nice. I actually found the VR-set to be not as heavy, actually. I tried, I tried VR before and this was lighter than what I had experienced. Movement was quite easy, as well. So, it was, it was a great experience. And in the end when you could just sit down, and watch the waves, that was very relaxing. Great way to escape Norwegian winter.

The participants in Excerpt 12 seem to have a contradictory stance on whether they wish the VR to be unrealistic or realistic. The Participant M refers to the need to attend to technological equipment *but* experiences the VR anyway as *magical* even though the *unrealistic artistic leaves* seem to decrease the participant's presence in VR as *she kind of had to remember she was in VR* indicating she hoped to forget the fact that the VR was artificial. The Participant N tells that she has tried VR before and comments that the technology was *lighter than I expected*. Here the expectations derived from previous experiences affected the way the participant experienced VR. In addition, for the Participant N, being able to change between the environments and explore the model safely by walking around with the partner seemed to have given a feeling of control, which she experienced pleasant.

In the interview, many participants mention, that they were very concentrated on experiencing the VR and did not discuss that much while exploring the model. Some mentioned that they were feeling alone in VR. Many participants mention that they wanted to let their partner to concentrate on the VR experience without interrupting it. The following Excerpt 13 illustrates this.

Excerpt 13. Discussion as a distraction

01 Interviewer 1: Did you discuss the, the model, at all? The architectural features, or the natural features, or was it mostly about the, the safety?

02 Participant Å: We didn't really, we als., we got the impression that's why we were there. To, just to be kind of a safety guide, or not really, to have a conversation about it.

03 Interviewer 2: It was, you had them both, it could be both. You could be both, be a partner, to have a talk about the architecture, and then to be a safety guard. So, it's a very difficult position to be in.

04 Participant Ø: Yeah, I suppose we both took on the role of safety guide, and making it as smooth as if we were not there. So, I didn't really think about it, no.

05 Participant Å: But intuitively I thought that kind of not having any ext., not having any conversation, might make the experience somehow better, or stronger, yeah.

06 Interviewer 1: Because your voice might, like a disembodied voice might take it out.

07 Participant Å: Just a distraction.

In Excerpt 13, both participants express that it is difficult to pay attention both to guiding the partner and keep up a discussion illustrating the limited resources of momentary attention. Participant Å also emphasizes that he did not leave discussion to a minor role only because it was difficult to pay attention to several things at the same time but also because he consciously wanted to concentrate on the VR experience and give it full attention to it, be more present in VR and less present in the social interaction.

5.5. Imagining actions in virtual reality

Imagining experiences and stimuli that did not exist in the model seems to have an important role in both the process of making meaning of the experience and in making sensory experience relevant.

In the interview, many participants told that while experiencing VR, they imagined actions they associate belonging to this type of scenery. Some participants comment that there were elements, which were missing from virtual reality, such as sounds from footsteps, boats in the sea and scents, which can indicate that they imagined these in the scenery. Participants tell what they imagine doing in this type of place, or what they would normally do in a similar place. For example, the sea and the experienced warmth is associated with swimming in the sea. In Excerpt 14 participants discuss ideas, what they would want to do in VR.

Excerpt 14. Imagining actions

01 Interviewer 1: Did you find yourself looking at things from different angles? Was that interesting, or important?

02 Participant C: Yeah, yeah.

03 Participant D: Definitely, I even tried to touch, touch them with the fake hand. Then you're like oh, yeah, because you're almost expecting to be able to feel them.

04 Participant C: And, and try, like, you just wanted to continue, just go, go up the..

05 Interviewer 1: Like walk further?

06 Participant C: ..the stairs, and, and look at the view, like really look at things, like closely. And, you know, try to, you know, I wanted to sit at the table. That would also be, that would be fun, just, you know, just to sit at, as in like, a mutual table would be fun, yeah.

07 Interviewer 1: Yeah. Where you would feel like you're, I mean, sitting in a real chair that matched up.

08 Participant C: Yeah, absolutely. Like the bed, kind of thing, that would also be like a really great experience. So, if it was something comfortable that you could sit in, and then have that view, that would like, maybe I would fall asleep, or something. And, as I told Participant D (the name anonymized), like especially when the sun was hitting, and, and I just wanted to have something..

09 Interviewer 2: Was shining through the (inaudible).

10 Participant C: ..cold to drink and you know. Really just co.., like, really use all my senses, not only my ears and eyes, but..

11 Participant D: Maybe fake wind.

12 Participant C: ..everything. Yeah, I was thinking about that as well.

In Excerpt 14, the participants build on each other's ideas and imagine sensory experiences and acting in VR. Participant C says she wanted to sit on or beside a mutual table or a bed, which was not

possible in VR. She imagines sitting on something comfortable and looking at the view and falling sleep. She is also talking about the sun, drinking a cold drink and using all senses not only hearing and seeing. Participant D adds that there could also be a fake wind. Participants add to each other's imagined sensory experiences.

As described earlier in this chapter, participants mostly concentrated on their own experience in VR. However, in the in the last expert, Excerpt 15, where participants explore the architectural model (the excerpt is from exploring, not from the interview) one pair started to imagine what they could do together in the space.

Excerpt 15. Drinking and eating together

01 Participant B: Really nice [looks around]. Kind like Mediterrian architecture in Oslofjord.
(Kjempe fint [looks around]. Litt sånn middelhavs arkitektur midt i Oslofjorden.)

02 Participant A: Yes.
(Ja.)

03 Participant B: To relax here.
(Chill det her.)

04 Participant A: Can get comfortable there, can t you?
(Kan bli komfortabel der kan du ikke det?)

05 Participant B: Can indeed.
(Kan godt det asså.)

06 Participant A: Yes.
(Ja.)

07 Participant B: Especially in this weather.
(Spesielt i det været her og.)

08 Participant A: Mhm.

09 Participant A: You can get a bottle of whitewine.
(Du kan hente en flaske hvitvin.)

10 Participant B: Yes.
(Jæ.)

11 Participant A: Champain perhaps, isn't that what one drinks (laughs).

(Champagne kanskje, er det ikke det man drikker [laughs].)

12 Participant B: Some scrimps and white bread.

(Noen reker og loff.)

13 Participant A: Yes [laughs].

(Ja [laughs].)

In Excerpt 15, the pair is carried away imagining drinking champagne and eating scrimps and white bread in the VR scenery. The pair actively built on each other's comments. They add a sense of taste to the VR experience, which was not common among study participants. This pair also discussed actively in the VR and the one who was not in VR even pointed things to show where something located. In the interview, this pair said that it was enjoyable to share the VR experience together.

One participant comment that having another person besides even though one was not at the same time in VR made it possible to mirror each other's feelings and reflections making the experience richer. Some participants said in the interview that it could have been nice to be together in the VR. One participant mentioned in the interview that discussing with the partner what one was observing in VR made one feel less alone and the experience got a new dimension. It can be concluded, that the presence of another in VR is probably valued when the fascination of VR gets less, and the focus moves from observing the surroundings to taking actions in VR.

6. Discussion

This master thesis aims to answer the following research question: *How are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality architectural exhibition?* To answer the research question, this master thesis studies the characteristics of the process, where visitors make their sensory experiences relevant after visiting VR. The study proposes that to be able to make sensory experiences relevant for visitors we need to understand 1) how visitors make their sensory experiences relevant 2) how others can support in the process 3) what the study results mean in relation to designing meaningful VR environments. As the focus of this study is on how to make the participants' sensory experiences in VR relevant *for them*, *Discussion*-chapter wishes to give participants sensory experiences a central role but also reflect them in a larger context. This chapter focuses on answering the research question by summarizing the key findings and by discussing them in relation to the presented literature review and the theoretical approach.

The following sections answer the research question; Sensory experiences are made relevant for visitors by 1) taking feelings into consideration when reflecting the VR experience, 2) comparing the sensory experience with previous sensory experiences, 3) understanding stimuli from different senses as intertwined, 4) concentrating on the sensory experience and communicating it verbally, and 5) reflecting what is meaningful and how to regulate presence. The last part of the discussion presents the limitations of the study and gives suggestions for future studies.

6.1. Taking feelings into consideration

The results of the study show that reflecting feelings is a part of the process of making sensory experiences relevant. Most of the participants describe the exploring of the VR architectural model through their feelings and say that the exploring was pleasant, relaxing, fascinating and esthetic, although some also mention feeling alone in VR. Participants tell they enjoyed the stimuli for different

sense channels such as visuals, sounds, and music, being able to move and touch. They also wished to feel several sense stimuli, such as to be able to touch several things, feel the wind, hear several sounds and smell scents. In this study, feelings in VR seem to be meaningful and relevant for visitors, also without an instrumental value. As Pham (1998) proposes, people use feelings in evaluating an object more likely if they think that the target is valuable for its own sake and not primary as an instrument to achieve something else. In the current study, participants were asked to explore the installation and encouraged to talk about their experience as they were exploring the model, but they did not have any other task to perform in VR. As a starting point, participants did not have a need to use the VR for instrumental purposes.

Though participants do not have a strongly orientating task to perform in VR, they do give many of their feelings an instrumental value as mediators of how VR can be described. Participants experienced the house scenery as more real than the nature scenery because they could *feel* a precise physical response in the house scene, for example, the stairs in the VR felt real because they mostly matched the stairs in the physical model. This is an expected finding, as Hoffman (1998) has found that in mixed reality conditions, objects are evaluated as more realistic if participants in VR can see an object *and* be able to touch it physically. One participant commented that the expectation that one can feel what one sees made her motivated to explore the place. Exploring the place seemed to be motivating for many and some, for example, mentioned that they would have wanted to sit on the table or chairs and sleep on the bed. One participant commented that being able to see the virtual legs and feel the stairs with real feet, made her feel present in the virtual body and present in the room. She also commented these sensory experiences made her feel as she could *feel the way forward*. Physically feeling objects is considered relevant, because it helps to navigate in VR, whereas an inaccurate physical response makes participants feel unsafe. Feeling the fence was important for participants because it made them feel more secure. Ambiguities between stimuli from different senses regarding the same objects, such as not being able to touch objects in VR or getting an inaccurate physical response, make these objects feel unreal. Many commented in the interview that it was even a bit annoying, that things seemed real, but one could not touch them.

Although the stairs and asymmetric platforms made all participants prefer to walk carefully in VR, and one participant commented that having to walk carefully strengthened presence in VR. One possible explanation to this is, that feeling uncertain and perhaps even unsafe, intensifies the experienced emotions and therefore increases presence. However, Freeman et al. (2005) emphasize that although an arousing VR environment is personally relevant and significant, personally relevant content needs not to be arousing but on the contrary, can reduce arousal. Too much uncertainty can, therefore, lead to a decrease in presence.

6.1. Comparing virtual reality with previous sensory experiences

In the present study, participants evaluate how real the VR is compared to reality and their previous sensory experiences, they name “missing elements”, pay attention to difficulties to integrate the sensory experience and explain what these difficulties mean to them and why they are relevant. Considering the emphasis that participants give on experiencing the VR-environment as “real” and the critical evaluations they give to unreal features in VR, it is obvious that they consider realness as one of the most essential features in the VR architectural model. The results of the present study imply that realness makes participants experience VR as more immersive. Details make the VR seem more real and also more immersive, such as light shining through the leaves or reflections in the windows. Sounds were experienced as natural in the space, although some were critical towards some sounds, such as the dogs barking and the bees. In addition, natural dynamics between different sensory stimuli made the VR seem more real, such as changing light, sounds, and shadows. In the factor model from Schubert et al. (2001), the experience of *realness* increases presence and includes, for example, the experience of virtual reality being a real environment. Schubert et al. (2001) also emphasize that because experienced realness increases presence, content and actions taken in VR that alternate reality and also take place in an unrealistic VR environment might decrease presence. In the present study, features in VR that imply that VR is not a real environment, such as visible pixels or desynchronized features, decrease the realness of VR and as a consequence decrease presence in VR.

Sensory experiences in VR are made relevant often by comparing sensory experiences in VR with sensory experiences in reality. The new information is appropriated with the *pre-existing pattern of logic or sensibility* in meaning-making, according to Rudie (1994). This *pre-existing pattern of logic* would, in this case, be participant's prior sensory experiences. Participants do not only evaluate the realness of their sensory experiences when they make sensory experiences relevant. They also associate their prior sensory experiences with the ones they experience in the VR and "fill" lacking sensations, such as wind, sun or concrete things such as boats to the sea. In this manner, *the previous, real-life experiences enable experiencing the VR environment richer than it is*. Often participants in the study refer to their associations of how the sensory experience *should* be in the kind of place that the VR architectural model presents. When participants do this, they are critical towards the VR being a real place and demonstrate that the mismatch between their associations and the VR decreases their presence. Several participants commented that when they expected to perceive something, the incompatibility of expectation and perceptions in VR captured their attention and made the experience "weird" or "surprising". These expectations probably derive from prior experiences and associations fired by prior experiences. One participant commented that her history in following the constructing of the VR environment could have made the VR experience less immersive. It could, therefore, be assumed that when visitors get more accustomed to VR, they anticipate VR experiences, and "move" between VR and reality, which makes the VR get less immersive in time.

Participants make their sensory experiences also relevant by describing occasions, when it was difficult to integrate sensory stimuli in VR. When sense stimuli are challenging to combine, the VR is experienced as more unreal and participant's spatial presence decreases. In addition, involvement (as defined by Schubert et al., 2001), which presumes that sensed and perceived stimuli is coherent and the subject can create coherent reason-consequence relations, suffers when it is difficult to integrate sensory input. The results of the study indicate that disintegrated sensory experience draws the participant's attention to the oddness of the experience, reduces the presence and presumably decreases flow in VR. To be able to integrate perceptual experience and structure a coherent understanding of the environment, one has to combine information from the surroundings, overcome the

binding problem, integrate information from the senses as belonging to the same object and differentiate them as belonging to separate objects (Roskies, 1999; Spence, 2011). When activities and events seem to form coherent reason-consequence relations, an individual can experience involvement (Schubert et al., 2001). Structuring a coherent understanding of the surroundings in VR can, therefore, be challenging, because any disintegrated stimuli violates a coherent understanding. The results of the study demonstrate that when a participant, for example, hears the voice and feels the touch of another person, perhaps also can sense the scent of another person, but sees something else in the VR at the same place where sounds, touch, and scents derive from, participants experience lack of spatial presence in VR. The participant is automatically trying to integrate information coming from several senses but fails to do that. The sensory experience becomes less real and presence in VR decreases.

Ambiguities between sensory stimuli from different senses are made relevant in the interview as they interrupt flow in exploring VR. As explained in the literature review, sensory stimuli are processed parallelly and if the stimuli from different senses conflict with each other, such as the feedback from sound and the observed size of the space (see for example Cotzin & Dallenbach, 1950) the sensory experience becomes confusing and unintended. The results of the study indicate, that participants make the disintegrated sensory experience relevant in different ways. Although the mismatch between VR and physically felt reality made many participants feel insecure, others felt fascinated by the peculiarity of the experience. Many commented that they got used to and accepted disintegrated features in VR. The data also indicates that participants consciously decide to be immersed in VR and accept that their initially critical evaluation of VR becomes less critical. As suggested in the *Theoretical approach*-chapter VR is probably more readily accepted as a play and dream rather than part of reality making it easier to accept that it does not follow the pre-existing patterns of logic and sensibility. Several participants use verbs such as “accepting” in relation to observing disintegrated features of VR or “manage” in relation to being immersed in VR. This indicates that immersion to VR is probably a conscious psychological process, where participants let the VR to be immersive. Participants decide not to evaluate VR as critically as they could if they would want to.

6.2. Understanding stimuli from different senses as intertwined

It can be proposed that senses make meaning differently than logical thinking makes meaning. Associating and feeling the sun at the skin is not a learned idea, but a learned association. Some participants' comments imply that they did not consciously think that the sun *cannot* take place in VR, but they rather talk about the sun as if it had existed in VR. In this example, participants unconsciously “give meaning” for sensory experiences already in the moment of sensing VR as suggested in the *Theoretical approach*-chapter. The association to the sun is strong because without thinking about it consciously, the participants assume that for example hearing the waves and seeing a strong light, *must* mean that the sun is shining. This illustrates what Merleau-Ponty (1945, p. 18) might mean when he says *misinterpretation of vague resemblance or to the meaninglessness of association by contiguity*. One can argue, that logically it does not make meaning that people describe that the sun shined and could be felt at the skin in VR because we can expect that participants know it is not possible. But based on the (partly imagined) sensory experience, participants *feel* it makes meaning that the sun is shining in VR. Another process takes place when we make use of learned ideas to make meaning of sensory experiences in VR. The heard idea that in the future vacations are made in VR could have affected that one participant associated the feeling of being on a vacation with VR. These types of learned ideas differ from associations derived from previous sensory experiences, such as being able to feel the sun at the skin as a consequence of other VR sensory experiences.

Sounds are relevant for the participants as they make VR more lively and real and help to sense the space surrounding them. Sounds, which mute the potential background noise, make the VR-experience more immersive, which in turn might affect the spatial immersion, the sense of being and acting in VR. In the present study, participants discuss stimuli from different senses as intertwined indicating that in the direct experience senses are difficult to separate from each other. Based on both literature review and findings in the study, sounds help to locate where one is in VR and increase the experience of being present by indicating qualities, such as the size of the space around oneself.

One participant pair was especially observant towards the acoustics and one of them commented that the sounds made her sense that the room she had just looked at and turned away from was still there because she could still hear the music coming from that room. As mentioned in the literature review also Pallasmaa (2005, p. 49) says that removing a soundtrack from a film makes it lose its *sense of continuity and life*. To his pair, music strengthened the experience that the place continued its existence even though one could not see it longer and integrated the different spaces and sceneries. By muting the sounds coming outside the VR, music also made the atmosphere livelier and cozier. One participant describes that VR without sounds would be *a grief poem with forceful movements but without sound*.

In addition to sensory experiences in the present moment and retrieved sensory experiences, also the imagined sensory experiences affect what is experienced in the present moment. In the sensory experience, not only different senses are intertwined, but also the different time levels are mixed. The results of the study also indicate that both the perceived and the actual possibilities to interact with a VR strengthen spatial presence, which Schubert et al. (2001) define as the sense of being there and the sense of acting in VR. For example, several participants commented that being able to move in the space made the experience more immersive. Many described the house scenery as spacy and the wide horizon (which indicates that one can move further away) was experienced as pleasant. This was an expected finding, as a wide horizon increases presence (Prothero & Hoffman, 1995). Because one can move in the VR and observe objects from different angles, the experience is more than looking at pictures. Being able to move in the space makes the experience more real and as one participant said, *the sensory experience bigger*. As mentioned in the literature review, the amount of movement is positively associated with the presence in VR (Slater et al., 1998). In the present study, some commented that it was frustrating that the area one can explore is limited and one cannot explore the whole horizon.

6.3. Concentrating on the sensory experience and communicating it verbally

By communicating the experience to others in the interview, participants pay attention to their own sensory experience and make them relevant to others. As illustrated both theoretically and empirically in this study, it can be said that words cannot capture the richness of sensory experiences (see for example Merleau-Ponty, 1945, p. 5). In the current study, the participants' descriptions reflect difficulties to find appropriate words to describe the sensory experience. Participants give each other the possibility to explore and explain the experience without interrupting. This might reflect the partners understanding that it is difficult to find words to describe sensory experiences. Participants seem to understand that the partners experience is their own and the meaning of the experience is also something that the partner has to define themselves. In the interview, participants seem to verify each other's sensory experiences by, for example, saying "yes", although they do not always agree with the partner or even if their own experiences in VR differ from the partner's experience. In these occasions, participants seem to understand, that how sensory experience feels or what it means, is challenging to *negotiate* in a social process.

The results of the study indicate that to be able to be aware of the sensory experience, enough attention must be directed to sensory experiences. In the particular VR, the architectural model, deeper social engagement was not in a central role in VR. Participants said that it is difficult to experience the VR/guide the partner *and* keep up a discussion illustrating the limited resources of momentary attention (see for example Morey & Cowan, 2004). Participants need to *feel* the sensory experience in VR and not occupy their thoughts with something else than the sensory experience. In the interview, many participants mentioned that they wanted to let their partner to experience the VR without interrupting the exploring. Although Stanovsky (2004) emphasizes that social sharing of the virtual environment makes the experience more real, merely paying more attention to the experience might also make it more real. In the interview, the process of making VR sensory experiences relevant seems to include participants taking long turns in describing their own sensory experience and trying to use understandable language. Letting the partner to concentrate on the VR experience

seems to be an important part of making sensory experience relevant. Partners enabled each other to describe what they experienced in VR, by enabling concentration on the experience. When participants make their own and the partner's sensory experiences relevant, they do not argue, which of the experiences is more real.

Although participants often concentrate on describing their own sensory experience, they do also build on each other's comments and built "socially constructed sensory experience". These situations take place when participants are trying to remember details in the VR when they are describing their previously learned associations to the same type of scenery as the VR scenery is and when they are imagining "lacking" things. Especially when participants start to imagine taking actions in VR, they built on each other's imagined sceneries. In the present study, many participants associated actions with the lightness and summer scenery in VR and imagined what they would like to do in such scenery, such as relaxing, looking at the sea and taking a cold drink. One pair started eating shrimps and drinking champagne in VR, adding a sense of taste to their shared imagined experience. As illustrated in the study by Antonietti and Cantoia (2000), VR might stimulate freer and more imaginative approaches compared to observing a picture. As a consequence, VR is probably more readily accepted as a play and dream rather than part of reality and in VR one perhaps also accepts the violation of the pre-existing patterns of logic and sensibility. This is illustrated by the present study, where some participants "build a common dream" by taking part of each other's imagined worlds. When one participant is associating a relaxing sensory experience with the VR scenery, the other participant takes part in imagining elements that would make VR even more relaxing. In this way, *participants make each other's imagined associations relevant.*

6.4. Reflecting what is meaningful and how to regulate presence

The research question *How are sensory experiences (moving, seeing, touching, hearing) made relevant for visitors to a virtual reality architectural exhibition?* implies that sensory experiences are not necessarily automatically relevant for example for those who visit VR. The participants in the study do not have a strongly orientating common task that would have directed their attention to

certain aspects in VR, and they seemed to pay attention to different features in VR. Some participants pay attention to visual, auditory or other details in the VR, some emphasize the overall, on many occasions, emotional experience, and some start to imagine actions and sensations. This is an expected finding, as discussed in the literature review, goals define which type of engagement and types of actions are meaningful (Hovhannisyanyan, Henson & Sood, 2019). Without an orientating task that gives a framework for actions in VR, participants personal motivations and associations to VR experience seem to direct their attention.

Although the literature review suggests, that the physical sensory experience of reality-like VR surroundings is not sufficient to define immersive virtual experience, based on the data collected in *The Forest in the House*, the opposite seems to be possible. The results of the study indicate that the VR architectural model was intrinsically motivating experience and enjoyable itself. Based on the findings of the study, it seems that the subject's capability to wonder and enjoy the VR environment is enough to create flow and immersion in VR. As the participants task is to merely explore the VR architectural model, the VR experience in this study did not require many capabilities from the participant. However, subjects did seem to have an optimal, enjoyable, intrinsically motivating and rewarding experience, which is the definition of flow by Csikszentmihalyi (1996). Of course, this type of flow might pass when the fascination of the new experience is over. Sustaining flow or meaningful engagement in VR most probably requires creating other goals than merely wondering the VR experience because the surprising elements are not surprising forever. Only a few participants initiated a discussion about the instrumental role the VR architectural model can have in affecting the actual reality. In these cases, it seemed that the participant had some prior experience and knowledge of VR environments and possible ways to use VR.

This master study emphasizes that when one designs VR environments one should evaluate the visitor's responses to VR in relation to goals the VR wishes to achieve. Because the goals for VR differ, also the preferred sensory experiences differ. VR is supposed to meet some defined goals, such as modeling something (such as architecture), learning or relaxing in VR and relevant sensory experiences support achieving these goals. However, it might be on some occasions problematic to

transfer for example the learning in VR to using what is learned in reality as VR creates its own “reality”. In the context of architecture, for instance, VR lacks the materiality important in architecture. A VR environment, which designers wish to have an instrumental value and help building better architecture in reality, might instead fascinate visitors (such as nonprofessionals) and create an enchanting and magical experience. This enchanting experience might be emotionally appealing and therefore be considered meaningful and intrinsic. Nevertheless, if the visitors experience the particular VR as emotionally capturing they might be *less* interested in evaluating it critically. All though Hovhannisyan et al. (2019) propose that the optimal goal in designing virtual reality is *the maximization of subjective immersion by developing virtual experiences that are able to reliably facilitate a flow state within users*, being too present emotionally and perceptually in VR might jeopardize treating the model as a flexible tool. From the designer’s perspective, all sensory or emotional experiences that participants have in a certain VR environment are *not* relevant. In this example, the fascinating sensory experience in VR does not support the designer’s goal to create a VR environment, which helps to build better architecture in reality. As VR creates its own “reality”, there is a possibility that it departs from the meaningfulness experienced outside the VR. Afterward, when engaging with reality, the VR experience might become less meaningful.

Although VR cannot simulate the materiality of a real building it does not mean that VR cannot serve the goal of constructing sensory-friendly architecture. A professional architect might not expect that a VR model simulates architecture in a reality like matter but rather accepts that the model in VR can only represent some aspects of reality. Other aspects one has to imagine. Architects *expertise in possibilities and restrictions of creating architecture enable imagining realistic alternatives*. In addition, the expertise in real materials enables imaging of the architectural model in reality and gives opportunities to enhance the design in VR. However, the imaginative perspective and keeping reality in mind, might not be enough to transfer VR experience to usable learning for reality. The development of descriptive vocabulary for sensory experiences in VR is important, to be able to create, utilize and compare sensory experiences for example in learning *in, from* and *for* VR. When it is needed, managing to treat VR as a tool and not as a strongly immersive alternative reality permits the critical study of potential features of the model and contributes to creating new ideas

of how to change the VR model and on some occasions, reality. By being able to keep the goals derived from reality as the core motivation for designing and using VR, it becomes possible to use VR in a critical and productive matter *when enhancing actual reality*.

6.5. Summary

Drawn together, this study proposes that to be able to make sensory experiences relevant for visitors one needs to understand how visitors make their own sensory experiences relevant. One also needs to know how to utilize the gained knowledge in designing meaningful VR environments. The theory and the results of the study show, that sensory experiences are made relevant for visitors to a virtual reality architectural exhibition by 1) taking feelings into consideration when reflecting the VR experience, 2) comparing the sensory experience with previous sensory experiences, 3) understanding stimuli from different senses as intertwined, 4) concentrating on the sensory experience and communicating it verbally, and 5) reflecting what is meaningful and how to regulate presence. From the designer's perspective, visitors' sensory experiences are made relevant by reflecting what kind of presence is meaningful for visitors in a particular VR and using this knowledge when designing new VR. A major challenge is keeping the long-term goals that VR serves in mind when the short-term experience in VR creates a strong presence. Also, a great challenge in making sensory experiences relevant is being able to describe them with words.

6.6. Limitations of the current study

This study acknowledges that there are many themes, other than the ones in this study, that can describe the process of making sensory experiences relevant after visiting VR. The themes in this study are based on the readily gathered data, that could have been analyzed in several ways. Also, participants' sensory experiences can be made relevant for the participant's other ways than how participants think the sensory experiences are relevant for them. The data gathered in this study does not enable analyzing the relevance of the sensory experiences other than how participants describe their sensory experiences in VR in the interview. Because VR is new technology and there is

a lack of studies to compare the study results with, the analysis may, however, contain interpretations and conclusions that future studies correct.

If one or both partners would have discussed actively while one of them was in VR, this could have changed the perceptions made in VR as explained in the chapter *Theoretical approach*. Also, if the partners had discussed more actively in the VR, the focus of the study could have more naturally been in the collaborative meaning-making process. Because the participants mostly preferred to explore the model independently to be able to focus on the sensory experience, as they explained it, and only occasionally turning to their partner to gain guidance, the focus of the study became the process of making sensory experience relevant.

Making feelings relevant was part of the process of making the sensory experiences in VR relevant. However, the descriptions of participants feelings, which are based on their body language, cannot be interpreted as reliable enough evidence of what participants were feeling. Although feelings are reflected in the body language, the study used no framework to interpret feelings systematically. However, participants did describe their feelings in the interview the same way as their body language expressed the feelings while they were exploring the VR model. To emphasize that participants' words were not the only expressions of their feelings, some summarizing conclusions from their body language is shortly described in this master thesis.

6.7. Future studies

When designers are intentionally aiming to create certain sensory experiences, which support for example relaxing or a certain type of learning, they need to have a comprehensive understanding of how different visitors sense the VR environment. As discussed in this master study, communicating sensory experiences with language is challenging. In future studies, using pictures and videos from the visited VR can support the discussion of sensory experiences and make it easier to remember the accurate experience. However, explaining the experience also with words is important because verbal descriptions can enable using the gained data to develop VR applications. Also, considering

the importance for participants to express how they felt in the VR and towards the VR, feelings and bodily experiences do seem to be in a central role in the VR experience. Therefore, in future studies, participants' feelings as defined in this master thesis are probably a fruitful approach to the visitor's experience of VR.

In future studies, there are lots of opportunities to create VR experiences that serve valuable goals and make use of opportunities to study scientifically sensory experiences in VR. Studies can, for example, combine physiological measures with qualitative methods. Also, longitudinal studies can give more precise descriptions of the sensory experience and inform how to design meaningful VR sensory experiences.

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Appendix 1 Themes in the first draft

Overall experience

At the beginning people were more conscious of the surrealism of the VR-world, but many mention that the feeling faded gradually and they accepted the experience.

Feeling safe

The ones who guarded the partner first felt safe to move in the model

Feeling of the space, limitations, boundaries

Knowing where one is in the space

«.. så har man den tryggheten i at det er noen andre som, som er i virkeligheten»

3D experience near to “actual experience” (participants start to compare the experience with reality and imagine things that lack or what they would, could or like to do in the space)

Imagining living in a house like this, sleeping in the beds or sunbathing imagining/wanting swimming in the sea, falling/jumping from the cliff, seagulls flying, container ship

Critics that the nature is not that real/good, nature more real in the distance

Only some thought that the forest was realistic, detailed

Critics that the sound is not as it should be inside, “som det var bare et sted med tak, ikke (inaudible) vegger”.

Visual

Esthetic place

the light between the trees, the grid, something that communicated with each other

Beautiful place

Artistic leaves, nature does not look that real

Light

Many observed the light, how there was a lot of it how it came through the leaves Many mentioned that reflections in the windows made the VR more real

Some participants mentioned that there was almost too much light, «fordi lys kan ju være, nesten som skjærer seg»

View

Some commented that the experience of the view was much stronger than the experience of the architecture

Many experienced the wideness of the horizon as pleasant, «lett å leve seg inn i det»

Many mentioned wanting to explore both of the spaces, the house and the nature further than was possible but also accepted the limits of the spaces

Relationship between nature and the house

Notices (hill – stairs, søyler (?) – trees)

Nature and the house are the same

Being able to change the scenery quickly was observed as interesting

For an architect it was interesting to be able to change between reality and VR

“Kult” that one can change the scenery so quickly

“Når man bytter, så ser man liksom at søylene blir til trær”

Some experienced a close relationship between the nature and the house, while others did not

“ ... jeg tenker det (utsikt) inviterer meg til å gå ut, enn, mer at det inviterer naturen inn”

The forms of the steps varied in the physical model, which matched with the forms in the nature

Architecture disappeared to the scenery

Transparency of the house enhanced the feeling of the nature in the house

Virtual body

«Kroppen var en ustoppet dukke, men likevel alt fungerte»

For many it doesn't disturb that much that the VR body doesn't always instantly follow the actual movements the participant makes

Touch

Some mentioned that it is difficult to touch things because of the equipment, but many did not mention this, some mentioned they would have preferred using gloves to be able to touch things better

The stairs felt real because they matched the real stairs

For many it was disturbing (?) that things seemed real but one wasn't able to touch them, for example leaves disappeared if one touched them

The physical experience especially in the house was convincing for many, precise physical response

Challenging to notice that the location does not change though the scenery changes when pushing the button

Sounds

Most of the participant groups notice the waves, bees/insects, saxophone/jazz/music
 Sounds made the experience more real, some participants did not experience all sounds as real (the birds??)
 and some sounds were experienced as lacking (boats)
 Sounds made the experience more relaxing, saxophone
 Acoustics affect the understanding of the space, in which room you are in
 Sounds gave also realness for the experience of a wide horizon
 Several participants mentioned that hearing their steps would have made the VR even more immersive

Guiding

Some of whom were the first to try VR mentioned that they did not want to disturb the second one in the VR but instead wanted the second one to concentrate on their own experience
 Many experienced it important and pleasant to have someone who guided them
 «.. det var så rart, det bare, det var en hånd der hele tiden som passa på, liksom. Som var veldig sånn, den var der og gjorde det mye lettere, men så så man jo ingenting, men det var liksom greit.»

Sharing/not sharing the VR experience

Many said it was nice to share the experience,
 when being the second one to have the VR-experience and the first one could comment
 one pair started to imagine what they could do together in the space

Many mentioned feeling alone in the VR

Many thought that it was weird when being in the VR and not see the partner, who was guiding or talking
 Could have been nice to be together in the VR

The one who was the second to try VR uncertain how much the one in the VR can see Few of the ones who experienced the VR first, “pointed” to things in the VR-experience while the second participant in the VR was investigating the model, sharing made the other one feel less alone and the experience got a new dimension and became richer, the screen made the sharing easier

Some started to plan their actions together in the VR

Some participants talked about how things look like in reality not in VR

Many mention that they were very concentrated on experiencing the VR and did not discuss that much

Place

Some experienced that one was in Norway, others not

Sense experiences blend

The sound of waves and birds made the sun feel warm

Sounds added depth, sense of the space

Other sense experiences

Many experience that the place is warm because of the blue sea. However, some mentioned that the house was cold because everything was white etc.

Ideas for future use of VR

VR for visiting different places, also historical, not needing to travel

though one would lose the patina (feeling of time passed?), the concreteness, your body and the feeling of history

Ideas of an apartment or a house without needing to building it, possibility to change details for example the place of the staircase

Other

A bit of a boring experience, should be something to do (young person)

Many mentioned that being in the VR was an interesting, beautiful and “cool” experience, one was on a vacation, something new, esthetic, fun, dreamlike

For most of the participants it was difficult to answer the question about architecture, many answered something but not the question

Mostly the participants try to answer the question and seem to accept that they are describing something that requires searching for the right words

Some participants compare the installation to other forms of art,

For example how it would be without the sounds, «a grief poem with fierce full movements but no sound»

Appendix 2 The Results of the thematic analysis

Possible themes

Being present in VR/What makes VR more/less immersive

Pleasant/unpleasant sensory experiences in VR

Vacation, relaxing

Virtual reality as a social experience

Question 1) How do the participants describe the overall (sense) experience

- a) Most of the participants considered that the overall VR-experience was positive
 - i) Relaxing (referansebildene) Relaxing experience is formed by several sense experiences that happen at the same time (See referansebildene)
- b) Many mentioned that being in the VR was an interesting, beautiful and “cool” experience, one was on a vacation (referansebildene) something new, esthetic, fun, dreamlike
- c) Many mentioned that they were very quickly present in the VR
- d) At the beginning people were more conscious of the surrealism of the VR-world, but many mention that the feeling faded gradually and they accepted the experience.

Question 2) Which features of the sense experiences impact experiencing VR as real/unreal? What is the significance of being able to touch objects like stairs, railing or leaves, which one sees in the VR?

- a) Being able to touch the place and objects in it, getting a precise physical response. (see referansebildene and referansebildene)
 - i) The physical experience especially in the house was convincing for many, precise physical response, the stairs felt real because they matched the real stairs
 - ii) When the physical response was not precise, VR was experienced as less real or “weird” or surprising (See (referansebildene) In the nature scene some mentioned that not being able to touch the scenery made it unreal.
 - (1) For many it was disturbing (?) that things seemed real but one wasn’t able to touch them, for example leaves disappeared if one touched them. (see (referansebildene)
 - iii) When the physical response was not precise some experienced this as unsafe

- iv) For some the place was “familiar” which made the place seem more real (see referansekinden) -> sense experiences are compared to earlier experiences, if these match, what is experienced feels more real
 - v) Some mentioned that it is difficult to touch things because of the equipment, but many did not mention this, some mentioned they would have preferred using gloves to be able to touch things better
 - vi) Platforms and asymmetric forms in the house made the place feel bigger/more interesting (See referansekinden, referansekinden)
 - vii) Some commented that seeing the virtual body made them more present in the VR (See referansekinden)
 - viii) Many commented that they felt present in their virtual body (See referansekinden)
- b) **Movement**
- i) Being able to be present and move with the whole body make the sense experience more impressive
 - (1) The sense experience is bigger when being able to move with the whole body See referansekinden)
 - ii) Many mentioned wanting to explore both of the spaces, the house and the nature further than was possible but also accepted the limits of the spaces (20 G3)
 - iii) The one who explored the VR second felt more safe to move in the architectural model
 - iv) It was easier for the one who experienced VR first to be a guide for the partner (referansekinden)
 - v) The fence was important as it gave experience of the limitations (security) (See referansekinden), referansekinden)
- c) **The sounds** that suit the place match the size of the 3-dimensional space (some sounds were experienced as missing)
- i) Most of the participant groups notice the waves, bees/insects, saxophone/jazz/music (not 22 G5)
 - ii) Sounds made the experience more real (See referansekinden) Sounds in VR made the experience more immersive (see referansekinden), referansekinden))
 - iii) Some sounds were experienced as lacking. (See referansekinden)
 - iv) Many experienced sounds as natural in the space (See referansekinden)
 - v) Some participants experienced some sounds as unnatural/unreal (See referansekinden), referansekinden)
 - vi) Sounds made the experience more relaxing, saxophone (See referansekinden)
 - vii) Acoustics affect the understanding of the space, in which room you are in (?) (See referansekinden and referansekinden)
 - viii) Some participants did not notice the difference in sounds between the architecture scene and the nature scene (See referansekinden)

- ix) Sounds mute the background noise (see referansebildene)
 - x) When sounds did not mute the background noise, VR was experienced as less immersive (See referansebildene)
 - xi) When sounds were experienced as very real they weren't paid that much attention to (See referansebildene)
 - xii) Sounds gave also realness for the experience of a wide horizon (21 G3)
 - xiii) Several participants mentioned that hearing their steps would have made the VR even more immersive (See referansebildene)
 - xiv) Sounds added depth, sense of the space, How big the space is, In which room one is (See referansebildene)
 - xv) Sounds strengthen the experience of being present in the place (see referansebildene, referansebildene)
 - xvi) How it would be without the sounds, «a grief poem with fierce full movements but no sound» (comparison from another form of art). Reference: "When the soundtrack is removed from a film, for instance, the scene loses its plasticity and sense of continuity and life", s. 49 (Pallasmaa, 2005, Eyes of the skin)
- d) Elements and details in **the visual** VR (for example reflections in the windows)
- i) Quality of the visual, for example seeing the pixels in the nature (See referansebildene, referansebildene)
 - ii) Many experienced the wideness of the horizon as pleasant, «lett å leve seg inn i det» (See referansebildene)
 - iii) Many observed the light, how there was a lot of it how it came through the leaves referansebildene)
 - iv) Many mentioned that reflections in the windows made the VR more real
 - (1) The light between the trees, the grid, *something that communicated with each other* (See referansebildene, referansebildene)
 - v) Some commented that the experience of the view was much stronger than the experience of the architecture
 - vi) Esthetic experience, beautiful place
 - vii) Artistic leaves, nature does not look that real
 - viii) Combination of realistic house and unrealistic features in the nature made many critical towards the unrealistic nature
- e) Small details in the visual and sounds together make the experience more immersive (See

- f) Missing elements (for example footsteps, boats in the sea, scents (See referansebildene))
- g) Elements from the reality that did not correspond with elements in the VR (hearing people talking but could not see them), smell of rubber from the equipment, although there was nothing in VR that could smell like rubber) (See referansebildene)
- h) Being able to anticipate the physical experience when seeing the platform in advance (if not being able to see it, perhaps more immersive)
- i) Perhaps the incompatibility of expectation (expectation deriving from reality) and the experience of VR captured attention
- j) It seems to vary among participants if it is the realness or experience of artificial reality which make them want to interact and explore the place) See
 - i) For some frustrating when one cannot explore the horizon
 - ii) Invites to imagine sensations that did not exist in the VR (or in the surrounding reality)
- k) Prehistory in following the constructing of the VR environment can make the experience less immersive (referansebildene)
- l) **Ideas for future use of VR** VR for visiting different places, also historical, not needing to travel, though one would lose the patina (feeling of time passed?), the concreteness, your body and the feeling of history

Question 3) What is the role of imagining sense experiences/actions

- a) Participants imagine things (that lack) and what they would, could or like to do in the space (see referansebildene, referansebildene, referansebildene)
 - i) Many imagined touch experience (swimming in the sea, sitting on the table) or tried to touch (the leaves in the nature scene). (See referansebildene)
 - ii) One pair starts to plan what they would do together in the VR-space (See referansebildene)
- b) When the surroundings in VR is experienced as (partly) corresponding to reality, participants associate sense experiences that are not sensed VR, either to complement what they are perceiving and/or associating from their previous experience
 - i) Difference between those who have played computer games and those who haven't (at least that much)? (See referansebildene)
- c) What is experienced psychologically is not only what is physically experienced

- i) Imagined experiences can feel (almost) as real as actual experiences (the way participant talk about imagined experiences reveals this, they refer to these imagined sensations as if they were actually physically experienced (the warmth of the sun), although they do seem to understand that they did/could not physically experience the sensation) (See referansekinden, referansekinden, referansekinden)
- d) Some participants talked about how things look like in reality not in VR

Question 4) How do participants make sense of overlapping sense experiences (= when participants describe or make sense of something in the VR with several senses)?

- a) Light is experienced as a physical feeling
 - i) almost too much light, «fordi lys kan ju være, nesten som skjærer seg» (see referansekinden)
- b) The experience of warmth for some participants is a sum of several sense experiences
 - i) Many experience that the place is warm because of the blue sea .
 - ii) The sun felt warm (a lot of light and blue sea, the sun must be warm).
- c) Some mentioned that the house was cold because everything was white etc.
- d) For some the room became smaller, when feeling its limitations

Question 5) How did sharing/not sharing the VR experience impact the experience?

Some participants felt alone in the VR, many participants mention that they wanted to concentrate on the experience while other participants shared the experience when being in VR by discussing and pointing on things in VR

- a) Many said it was nice to share the experience
- b) The first one in VR could comment the partners experience
- c) One pair started to imagine what they could do together in the space (See referansekinden)
- d) Many mentioned feeling alone in the VR (See referansekinden)
- e) Many thought that it was weird when being in the VR and not being able see the partner, who was guiding or talking (See referansekinden)
- f) Could have been nice to be together in the VR (See referansekinden)
- g) The one who experienced VR first was unsure how much of the VR the guiding partner could see (See referansekinden)
 - i) It was difficult for the partner to see the detailed video of what the participant in the VR was seeing, because it was replaced behind a distance and it was light (See referansekinden)

- h) Few of the ones who experienced the VR first, “pointed” to things in the VR-experience while the second participant in the VR was investigating the model (See referanseilden) sharing made the other one feel less alone and the experience got a new dimension and became richer, the screen made the sharing easier
- i) Many mention that they were very concentrated on experiencing the VR and did not discuss that much
- j) Some mentioned that they did not want to discuss, because they wanted the partner to be able to experience VR in peace (See referanseilden, referanseilden)
- k) Many experienced it important and pleasant to have someone who guided them «.. det var så rart, det bare, det var en hånd der hele tiden som passa på, liksom. Som var veldig sånn, den var der og gjorde det mye lettere, men så så man jo ingenting, men det var liksom greit.»
 - i) Having another person beside oneself made the experience safer (feeling boundaries, being guided) (See referanseilden, referanseilden)
 - ii) The ones who guided the partner first felt safe to move in the model
 - iii) Knowing where one is in the space
 - iv) «.. så har man den tryggheten i at det er noen andre som, som er i virkeligheten»