RE-EMBODIED FEAR

Designing deep learning methods in virtual reality to unravel emotional body loops

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ABSTRACT

This thesis is an experimental research that theoretically examines the ontological nature of virtual reality (VR) and its possible implications to be used in designing new emotional learning environments and experiences. The focus is set on fear as an emotion that physically and mentally manifests itself as a specific phobia. The applications of using virtual reality as a psychological tool for treating negative emotions are questioned by making apparent the unanswered questions about our emotions and perception taking abilities.

Through different case studies related to the manipulations of our sense of embodiment in VR, the plasticity of our mind and body is researched and applied into emotion theories. The thesis examines how VR could be harnessed to reveal the phenomenal 'body loops' with the help of sensor technology (HRV) and ultimately, be designed to unravel the maladaptive loops. Hypothetically, it considers taking advantage of the virtual space design and our sense of embodiment by literally creating new perspectives for experiencing through virtual body manipulations. Through problematization and the ideology of ontological design, it is suggested that we should adapt more radical design in VR to overcome the existing scientific paradigms about emotional learning.

Keywords: virtual reality, emotion, fear, sense of embodiment, phenomenology, body loop, perception, deep learning, sensor technology, HRV, ontological design

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1. INTRODUCTION

> "All my knowledge of the world, even my scientific knowledge, is gained from my own particular point of view, or from some experience of the world without which the symbols of science would be meaningless."
>
> Maurice Merleau-Ponty (1945, Preface)

I will start with a quote by Maurice Merleau-Ponty for a couple of reasons. First of all, this famous author of phenomenology, who is also known from his theories of perception and embodiment, will appear several times in this Master's thesis. Secondly, one of the most important things I have learned during my years at the university is that all our knowledge is situated. Even though we aim to be objective, it can never be too much highlighted that we are all perceiving and understanding our environment through our own 'zero points'. In addition to its ideological appearance in this introduction, the so-called situated or embodied knowledge formed through a first-person perspective, and the very processes of its creation, is one of the main topics of my thesis.

The topic could be categorized under the field of 'affective computing' which is a part of media studies and computer sciences focusing on emotions, finding them fundamental to human experience and having an influence to our cognition, perception and decision-making. The field was established by Rosalind Picard (1995) who had the interest to build a robot capable of simulating empathy. Lately, affective computing has made its way into many different fields from artificial intelligence to economics and psychology. Moreover, as my approach suggests to see technology as a useful tool in designing our way of being and challenging the boundaries of our self, 'technoscience' introduced by a philosopher Martin Heidegger is a category I hope my work will also jump into. My contribution to these two subfields of media studies will be a unique combination of concepts, theories, inquiries and definitions with an aim to examine the theory of *phenomenal body loops*.

I will examine virtual reality (VR) both as a medium and a technology with a focus on its implications applied to psychological health research. I have framed my interest to consider how could we overcome our negative emotions and fears in virtual reality designed according to the ideology of deep experiential learning. By being loyal to the methodology of problematization[1], I am not only aiming to find 'right' answers for emotion recognition and treatment in VR. Instead, I seek to find and offer new questions and perspectives that could also help future researchers who have decided to tackle with the same challenge. These questions mainly arise from the multidisciplinary analysis of previously conducted studies in VR that are all somehow related to the sense of embodiment, emotions, perception taking as well as the ontological nature of virtual space and design.

The ongoing shift in affective computing has a new focus on *recognising human emotions* in addition to the previous aim of building emotionally intelligent machines for humans.[2] This interactional approach, if conducted in a user-driven way, namely aims to improve human-computer interaction (HCI). However, ethical questions cannot be neglected and we should ask from ourselves what is truly the aim of big tech companies, such as Facebook and Oculus, to build and design algorithms that are capable of recognising their users' emotions? Should we, as users or 'participants'[3] of virtual spaces, be concerned about the outcome where the machines are programmed to understand our emotions, and we are left 'blind' – becoming even more easily manipulable individuals in the machine-driven world?

I will begin by introducing the definition of virtual reality, which hopefully will help to understand why – in the current year of 2018 – it has become such a hype again after many years of ignorance. From its definition I will form a dialogue between the theories

[1] *Problematization* is a methodology used to challenge the underlying assumptions of existing theories (Davis 1986). As Alvesson and Sandberg (2011, 248) state, problematization differs from "gap-spotting" by aiming to challenge the whole theories behind existing literatures. However, also the methodologies of problematization should be carefully chosen and conducted to follow the scientific guidelines. In this thesis I am problematizing the existing paradigms in emotion research by identifying the literature domain as well as articulating and evaluating the existing assumptions based on them. Finally, also alternative assumptions are developed and evaluated in relation to the existing theories (Alvesson and Sandberg 2011, 260) which are open for recontextualisation.

[2] See for example *Affectiva*, a company with a "mission to humanize digital interactions by building artificial emotional intelligence", founded by Rosalind Picard and Rana el Kaliouby.

[3] I prefer to use the term 'participant' instead of an 'user' because it fits better to the ideology of ontological design.

of immersion and presence that are crucial for the sense of embodiment in virtual reality, and therefore, for it ever becoming ‘alive’. My theoretical overview about virtual reality is mostly based on the 1990’s philosophers and authors who all had a positive and opportunist approach to VR. The active reflectivist of technology, philosophy and culture, Richard Coyne, is chosen as a source for understanding the sensitive tension between technical and mental requirements in VR. The alternative point of views to VR is offered by Michael Heim and Frank Biocca who both are arguing for harnessing virtual reality to ‘reveal the truth’. The technoscientist approach introduced by Heidegger is supplemented by Jaron Lanier, a visual artist and one of the founding fathers of virtual reality, who critically contributed to the research of experimental research of embodied cognition already in 1980’s.

Chapter 3 examines the phenomenal nature of our embodied cognition and perspective taking, questioning the plasticity of our being through different case studies. The theory of phenomenology of embodied cognition and perception taking by Merleau-Ponty is introduced. Notably, his concept of ‘Objective Thought’ is more deeply analysed and linked to a different type of contexts, along with the cognitive therapy definition of ‘automatic thoughts’. The crucial statement of Merleau-Ponty is that perceiving an object is difficult because after the visual perception we also need to conceptualise it to become like an ‘Objective Thought’. This process leads to *the problem of perception* (Merleau-Ponty 1945) that designates the underlying attitudes towards an object which fails to reveal the originality of our perceptual intentionality (Jensen 2013). In relation to emotions and specific fears, Andrea Scarantino (2016), who is a philosopher of the mind, calls this as a *problem of intentionality* because emotions always relate to objects and “the aboutness of an object” causes a problem. In other words, our perceptions and emotions can easily lead us to ‘experiential blindness’ (Barrett 2017).

Explained by common terminology, the act of making representations out of things perceived also makes it hard to *recontextualise* or see them from another perspective. Therefore, changing the automatic thoughts – especially if they also involve our emotional memory – is sometimes very difficult. This phenomenon is also explained in social sciences either with a notion of ‘reality tunnel’ or ‘framing’. We tend to get used to perceive things in a certain way that later guides our action in the world (Fraga 2017b). The theory suggests that if our body is highly involved in this activity, we will create a ‘phenomenal body loop’ that do not necessarily demand us to perceive an object to trigger an emotional response but the automatic thought by itself is enough. The presented case studies are examples of embodied manipulations in VR that through ontological design could be applied to disrupt the reality tunnels and phenomenal body loops – finally saving us from the experiential blindness.

Chapter 4 is all about emotions. Because there is no universally accepted theory about emotions I need to make clear my preferences and the choice of different approaches with appropriate arguments. I will also focus on the methods of emotion regulation and fear learning, without forgetting the concept of emotional intelligence. In relation to affective computing, I will underline some challenges for emotion recognition through sensor technology and name the biggest obstacles for establishing a universally accepted theory and fingerprints of emotions.

The topic is confined to specific phobias instead of anxieties. Most of the given examples and explanations are made with spiders because *arachnophobia* is the most common and prevailing one in the world.[4] Exposure therapy is the most common treatment for phobias but it is also a very long and costly process. Recently, technological applications are studied to provide some new practical and effective solutions for phobia treatment. (Parsons and Rizzo 2008, Diemer et al. 2014.)

In fact, the ability of VR to simulate real-life situations and scenarios has made its way into neuroscience and psychological research. VR offers researchers new possibilities to quickly investigate, as well as manipulate human behaviour and cognition in a controlled environment. (Diemer et al. 2015.) It is important to highlight that every virtual environment relies on perceptual cues to activate affective reactions and all these phenomenal experiences are strongly related to the subjective experience of presence that is also proven to determine the ‘successful’ outcomes of psychotherapies conducted in VR (see, i.e. Wallach et al. 2011, Meehan et al. 2002). From the assumption that VR can evoke similar emotions comparable with real-life situations, I will consider different novel design methods and features to be applied in VR for new experiential learning.

[4] In https://www.fearof.net/ (Accessed 19 September 2018)

The benefits, as well as the limitations, of applying exposure therapy treatment into VR are examined by collecting some results from the previous studies of virtual reality exposure therapy (VRET), and other VR experiments related to the illusionary body manipulations. Even though virtual reality as a digital environment is providing a lot of opportunities for discovering interaction design, I am mostly interested about the challenge of helping the participants to change their *way of thinking* through recognising and then accepting, as well as questioning and recontextualising their perceptions and emotions. Of course, the sense of agency and the ability to interact in the environment is a necessary part of the learning process but changing the emotion through behavioural learning is another topic. I will focus on the cognitive behaviour ideology highlighting that we should be able to move towards our emotions in order to achieve long-term results in emotion regulation. (Parsons and Rizzo 2008, McNally 2007, Hirai et al. 2007.)

Finally, Chapter 5 will offer some answers to the problem statements. By supporting Stellan Ohlsson's (2011) 'Deep Learning Hypothesis' where *change* is seen as a constant feature in our environment together with Lisa Barrett's (2017) principle of *variation* as a norm in emotions, I will respond to the problem of:

> If the variation is the norm in emotions and change is the only constant in the environment, how can we design emotional environments in virtual reality to overcome fear that will ultimately override the mental representations and subjective phenomenal experiences of an individual that are regarded as 'maladaptive'?

It might seem that I am about to escape the whole topic of emotion research by actively supporting an individualistic and a constructivist approach, as well as believing in the vagueness of forming specific patterns for each emotion. As aforementioned, I also highlight that some experiences, and the actions applied to them mainly due to negative emotions, are considered as 'maladaptive'. By this I mean that all emotions should be seen healthy (for example, being and feeling angry) however, some of the cognitive states or behaviours attached to them can be regarded as maladaptive (such as expressing anger as shouting and throwing things out of the window). Most commonly, the ability to recognize, accept and control our emotions is called as emotional intelligence. On the contrary, if we let the negative emotions to modify our perceptions of the world they can be considered as maladaptive.[5]

My thesis will highlight the value and uniqueness of the sense of embodiment not only for understanding our cognition but also for considering it as a design feature in virtual reality. The hypothesis, which is built along this thesis, considers *changing or manipulating the embodied 'zero point' of the first-person perspective* in a fearfully emotional situation simulated in VR. It also questions if it could help the participants to become aware of and accept their own emotions, and finally unravel the fearful body loops. Therefore, the research question is:

> Could the ontological design ideology, together with the manipulations of our sense of embodiment, help us to develop new learning methods that will encourage us to bring the needed plasticity to our perception and ultimately, break down the fearful – phenomenal body loops?

The main idea of the design hypothesis, as radical as it sounds, is to make the participant to embody the feared stimulus by itself in VR. In particular, this experience could be carried through a change, by first simulating the familiar fearful 'real-life situation' in VR (i.e. perceiving a spider from a distance) that activates and 'affectively' involves the whole body of the participant, and then applying a new perspective with the help of storytelling and the unique interactive design features of VR, by ultimately turning into the feared stimulus (i.e. the spider). The curiousness for this type of embodied experiential learning came out as it has already been studied that manipulating the virtual avatar body can elicit behavioural and perceptual changes in the participants (see Fox et al. 2012).

The hypothesis questions if this type of embodied change would not only help the participant to question the illusory reality but also the occurring emotion and physiological changes in the body by itself. Because the hypothesis is grounded on subjective experiences, I find it necessary to base my theory upon phenomenology. Shortly, phenomenology is a philosophical research field that seeks answers on how

[5] In *Oxford Dictionary* 'maladaptive' is defined as an adjective of "not adjusting adequately or appropriately to the environment or situation" which I would like to modify a bit and extend as "not adjusting adequately or appropriately to the *change* in the environment or situation".

human consciousness and experiences are structured (Metzinger 2003, 37). As Don Ihde (2012) in his *Experimental Phenomenology* states, phenomenology is like "an investigate science, an essential component of which is experiment". Unfortunately, in this form of a written language, I am limited to offer only phenomenological thought-experiments for the reader. However, I do believe in the capability of phenomenology to find solutions in the form of experience-experiments, as highlighted at the end of my thesis.

I acknowledge that my approach is highly theoretical and probably fails to follow the conventional research methods by analysing the carefully collected research material and forming some 'clear' assumptions. However, I am referring to some experiments conducted in VR in relation to my theoretical analysis throughout the thesis. Besides, and thanks to my internship project in Amsterdam, I have some self-collected physiological data of measuring fear with a heart rate sensor, as well as empirical results about the meaning of colours as perceptual cues for triggering emotions (see Annex A).
With the help of my curiosity based on the ideology of 'research through design' and multidisciplinarity, I aim to offer a fresh perspective for emotion research and treatment in VR. I am very aware of the challenges of pursuing an interdisciplinary research and I need to admit that this writing process has been the one-of-a-kind puzzle. However, I wanted to take the risk because as John Dewey argues, our sensations, hypotheses and ideas "come into play to mediate our encounter with the world only in the context of active inquiry"[6]. Hence, more than representing a truth, if my thesis will manage to appear for the reader as one of those active inquiries, I have reached my goal.

Finally, I hope I will also manage to reify the new roles and career opportunities for media researchers in the future. Together with designers, artists and electrical engineers, among many others, I believe we could place ourselves more towards the productive cycle of media instead of the traditional role of working as critics for existing contents and products.

[6] *Internet Encyclopedia of Philosophy,* in https://www.iep.utm.edu/dewey/ (Accessed 12 September 2018).

2. BUILDING BLOCKS OF REALITY

Technologically, virtual reality (VR) is a 'computer-generated simulation' of a 3D and 360-degree technological environment that can be explored interactively.[7] As a highly sophisticated application of human-computer interaction (HCI), it allows the user to take all kind of projective transformations that are most commonly experienced from a virtually embodied first-person perspective (Coyne 1994, Rudrauf et al. 2017). The mechanical aim of VR is to "present *sensory information* and *feedback* with the intention of producing a convincing *illusion* that the user is immersed in an artificial world" (Coyne 1994, italics added). VR is often seen fascinating because it claims to open "new worlds to the senses", helping us to reveal different ways of how the space and reality around us are organised (Turkle 1995, 263). In fact, VR as a mixed reality stage is said to indicate "a space full of information" (Hansen 2006, 2).

In the 1980s, the notion of 'conversion moment' was used to describe the illusinatory or even a hallucinatory effect of virtual reality that makes us experience it as a 'real' world (Gonzalez-Franco and Lanier 2017). The previous boomtime of VR occurred in the beginning of the 1990's, but it ended almost as fast as it started. Instead of a seamless headset, it first appeared through 'pods' where one could enter into a pixel saturated reality. Back then, the very short exposure into another reality did not manage to entertain the targeted audience, who chose the more interactive and less clumsy video games over VR. (Fowle 2015.)

Sherry Turkle in her *Life on the Screen* (1995) interprets that the nature of virtual reality is relatively similar to the Internet, making us dubious about the relationship between virtual and real. In theory, the illusions that VR causes are typically divided according to *place*, *plausibility* or *embodiment* (Sanchez-Vivez and Slater 2005, Gonzalez-Franco and Lanier 2017). This thesis mainly focuses on the latter one.

The VR technology of the 21st century applies a set of different type of sensors, such as controllers and external cameras, to track the movements of our body motions. In a

[7] In *Digital Bodies*: https://www.digitalbodies.net/virtual-reality/ (Accessed 12 September 2018).

hypothetical extreme VR could be harnessed to measure almost anything from the human body (Bates-Brkljac 2012) and it often drives for complete synchronisation with our natural perception (Hansen 2006, 4). For example, to create a higher illusion of 'reality', it may integrate motion controllers for all our limbs and additionally, everything from eye-tracking technology to EEG measurements and thermal infrared imaging.[8] However, all of the trackings must be well aligned with our physical body movements to guarantee the immersion towards the virtual space. In the best (or the worst) case, the participants of VR will lose their sense of reality. This is due to the simple fact that also our mental construction of physical reality is based on those same type of embodied perceptions we can experience simulated in virtual spaces. (Heim 1993, Bates-Brkljac 2012, Gonzalez-Franco and Lanier 2017.)

The so-called 'philosopher of cyberspace', Michael Heim, defines virtual reality as "an *immersive*, *interactive* system based on computable *information*" where all of the three i-components are necessary for us to call the technology as virtual reality. According to Heim (1998), 'immersion' comes when the device manages to isolate our senses and make us feel present somewhere else. Most commonly, the head-mounted display completed with headphones also isolates the noises coming from our physical environment. 'Interaction' signifies the technological capability to simultaneously change the point of view and perspective according to the physical positioning and movement of the user. 'Information intensity' instead describes the entire "special qualities" virtual environments offer, such as constantly updated information about the surrounded objects. (Heim 1998.)

Heim argues it is mainly the information intensity of VR that creates the phenomenological experience of 'telepresence' towards a virtual space (Heim 1998). The term was first introduced by Marvin Minsky (1980) to describe the feeling that humans may have while interacting with teleoperation systems. Nowadays, virtual reality is said to be the most ultimate technology to create telepresence – the sense of "being there" in a virtual space. (ibid.) It could also be argued that in virtual reality there is no medium or *interface* because our consciousness becomes the medium simply by putting a headset on

[8] EEG is an abbreviation of electroencephalography that measures the electrical activity of the brain and thermal infrared imaging measures cutaneous and subcutaneous temperature variations of the body (Merla 2014).

(Milk 2015) and making us feel present in the *cyberspace*.[9] Hence, the participant is both the 'screen' and the viewer (Gonzalez-Franco and Lanier 2017), and in the best case, he or she will also become the active agent and the designer of the virtual space (Fraga 2017c).

However, there are different levels and stages of presence and for example, telepresence in VR is sometimes getting referred to as 'experimental presence' if it captures only the mental state of the user. In fact, another approach states that we should make a clear distinction between 'presence' and 'immersion' where presence demands the ability to *interact* in the space, whereas immersion describes the mere feeling of *being* in the space and having a deep mental involvement in something. (Diemer et al. 2015.) According to Heidegger (1977), immersion is only "a possibility of presence" and therefore, 'being there' should be broadened with the ability to 'do' there in order us to talk about the presence in VR. (Heidegger 1977, as cited in Sanchez-Vives and Slater 2005, Peperkorn et al. 2015.) In general, if we talk about immersion in VR simply as the mental state of the user, it can also be seen as an everyday phenomenon and "a basic property of normal conscious experience" (Seth et al. 2012 as quoted in Diemer et al. 2015).

Theories of presence can also be divided either into *descriptive models*, such as spatial and social presence, or *structural models* that describe how the presence is generated in mind (Lee 2006). Also, the way we come to define 'interaction' linked into presence is fundamental. For example, one claim is that the human access to presence is always interpretative and never direct. In fact, presence could also be understood as a necessary state of consciousness that "generates a mental model of an external space". (Biocca 1997.)

Frank Biocca (1997) argues that in cyberspaces presence is never stable and it travels between three places: the physical environment, the virtual environment and the imaginal environment.[10] In our physical environment, 'distals' as perceived objects are immediate, whereas in virtual environments distals are often mediated, and in imaginal environments there is only "a liminal attention to distal stimuli". (ibid.) Therefore, the definitions of

[9] See the terminological difference between an interface and a cyberspace further in section 2.5.
[10] Although, similar types of traveling and fluctuations of presence could be also observed within the physical spaces.

presence also come across with our understanding of VR either as a 'medium' or an interface, and how the distals come to appear for us. Anyhow, the process of generating a mental model of an external space can be seen dependent on our body, as to be argued later.

In order not to confuse the reader too much, I will now on use 'immersion' to describe the captivation of our mental states in VR and 'presence' only when I need to specify the involvement of action or embodiment towards a virtual space. Most importantly, we should understand both presence and immersion in VR as fluid mental states that are reprocessed and redefined by the participants (Donghee 2018). Even from the design point of view, *virtual realism* is not seen as a contributory factor to create immersion but instead, the multisensory feedback and other features applied to virtual spaces – such as sound, haptic feedback and body engagement – play a more crucial role. (Heim 1998, Sanchez-Vives and Slater 2004.) The so-called main design criteria for the users' to process the immersion is argued to be a transparent interface and a coherent virtual environment which demands that the physical laws, even if manipulated, should be consistent (i.e. Yanagida and Tachi 1994).

The notion of virtual reality is based on certain assumptions about our perception and mental states, as mentioned above. However, the definition of VR is also controversial in relation to the other, physical reality. In the early 1990s, the term *reality* got first replaced by an 'environment' or a 'world' that also changed the definition of VR (Heim 1993) before postmodernism arrived with its constructivists' arguments.[11] Recently, debates have been held between the data-oriented and constructionist approaches. According to the original data-oriented view, we need inputs to our senses to create a sense of the 'real'. (Coyne 1994.) On the other hand, the constructivist view sees that all our perceptions are constructed by ourselves with the help of our mental representations and those 'simple cues' gathered from the environment. However, both approaches are often seen related to each other (ibid.).

[11] Here I will use the term 'virtual reality' when discussing about the overall subjective experiences of the participants, however, in the cases when technical elements are specified, you can notice me using the term 'virtual environment' or simply 'environment'.

Biocca (1997) supports the constructivist approach and firmly states that our senses are portals to the mind and communication channels to reality. According to him, already before the 21st century the early virtual reality developers and designers supported J. J. Gibson's notion of 'ecological perspective taking' where the immersive environment is seen as activating our vision and senses (Biocca 1997, see also Coyne 1994). Besides, Biocca argues that we construct the world from "the patterns of energy detected by the body" and the body serves as a 'display device' for the mind.[12] Therefore, the same principle stating that our contact with the physical world is mediated through our body also prescribes virtual worlds.

In addition to our immersion to and presence in the space, we also must bring things around us into existence which often happens through our language by giving a some kind of meaning to them (Willis 2006). This cognitive interpretation as a way of constructing mental representations is also seen as an inseparable part of the ontological design process. In particular, because I am tackling with the challenge of treating fearful emotional experiences – that are represented in the mind as a form of a specific object and also stored in our body as a memory loop – I will question what are those 'constructed' features and emotions in virtual spaces that the participants of VR will bring into 'their world'. My curiosity also extends to concern how much the virtual experiences and perceptions will get considered as if they were real. What are the main building blocks of our reality?

2.1 Embodying the virtual reality

Virtual reality not only appear to us as an "analogy of our consciousness" (Damasio 1999, as cited in Hansen 2006, 4) but new immersive technological interfaces and cyberspaces are argued to 'reveal the role of proprioception in agency'[13] by reshaping the ownership of action and manipulating the whole sense of body location through *re-embodiment* (Dolezal 2009). In fact, the participants often create a virtual body of themselves in the virtual space as analogues of their own biological bodies. This type of a *sense of*

[12] As Marshall McLuhan would say, "all mediums are extensions of our senses", including both our mind and body. (McLuhan 1964, as quoted in Biocca 1997.)
[13] *Proprioception* is a term used to describe the information about how our limbs and body are positioned (Gallagher 2005, as cited in Dolezal 2009, 218).

embodiment (SoE), a full-body illusion towards a virtual avatar, is a common definition to discuss about embodiment within cyberspaces. (Lanier et al. 1988, Kliteni et al. 2013.)

Similar to presence and immersion, the sense of embodiment is also a fluid mental state but in addition, it considers the flexibility of the body. For Biocca (1997) the notion of *self-presence* defines the subjective level of embodiment in virtual environments. According to him, the mental model of the user's body is influenced when the physical body is referred to the virtual body, which furthermore may create a different meaning in comparison to the physical body (for example through its specific abilities to take action). Because of these overlapping processes Biocca argues that three different types of 'body' arise in virtual environments; the objective body, the virtual body and *body schema*, where the latter describes the mental and internal representation of one's body which is not stable. (ibid.) As an embodiment researcher Luna Dolezal defines, more than providing only an "observational access", re-embodiment in VR transfers our body schema and consequently, *perception* (2009, 220).

Body schema is then a concept that follows Biocca's theory of an agent traveling between these two worlds; virtual and real. In order to track the 'location' of the agent some methods have been developed that seek to measure the degree of self-presence in virtual environments, such as Ratan's (2012) concept of 'proto-self presence' which aims to analyze how virtual objects become as extensions of the body. Instead of solely relying on self-reporting, physiological measurements are commonly used to 'prove' the subjective experience of presence, such as the data mined from our heart or skin.[14] This data can also be read as our 'emotional data', even though it will demand using more specific and complex tools for translation, as will be discussed in Chapter 4 (Barrett 2017). By and large, it still remains difficult to find methods to measure presence and the sense of embodiment in VR that are universally reliable, valid, sensitive and objective enough (Meehan et al. 2002).

[14] See more in Chapter 4. However, some of the studies show that heart rate is more reliable and consistent in comparison to the skin conductivity, although some of the studies suggest the contrary. In general, most of the skin conductivity sensors are at least less sensitive and have a bigger delay compared to the common heart rate sensors. (Meehan et al. 2002.)

Body schema is a concept also used by Merleau-Ponty (2012) to separate the spatiality of the body from the spatiality of the environment. Unfortunately, most of the VR studies tend to emphasize the notion *body image* (which is nearly a synonym for 'the sense of body ownership') instead of investigating the body schema that also defines the body in terms of its capabilities for action, also referred to as 'the sense of agency' (SA). (Won et al. 2014.) More than body image, body schema is argued to describe the system of "motor and postural functions that operate below the level of self-referential intentionality" (Alain 2005, as quoted in Hansen 2006, 40). Hence, one could state that body schema as a concept has a potential to reveal new information about the unconscious processes of our perception.

Generally speaking, the constructivist approach that takes the individual sense of embodiment under the scrutiny of VR experience, has got only little attention in the commercial field of VR. Most commonly, the focus is kept on the visual 3D scenery even though it is already proven that virtual realism is not the main requirement for immersion towards a virtual space but rather, the degrees of physical and mental involvements are (Coyne 1994, Hansen 2006, 4). In addition, if we agree that (virtual) reality is accumulated upon different 'building blocks', applying the constructivist approach in VR design may help us to understand the "filtering processes" of our perceptions (Ihde 2009) and following, how do we come to develop a phobia at first hand.

2.2 Relativity

The peculiar relationship between virtual and the 'other' reality has made researchers to consider how much we could benefit from the technology and its simulations in order to understand how does the human mind works. The principle stating that reality is based on individual, internal, experience is often further described in terms of phenomenal, functional and physical property of certain system states. (Metzinger 2003.) The multidimensional structure of the mind demands to make interdisciplinary inquiries, as well as *relate* and critically reflect the findings.

It has been argued that without *relativity* there is no reality if we agree that reality is formed through a subjective point of view (Gura 2017). However, and instead of going now into the deepest questions of human life, I will use relativity and the concept of 'relativism' to separate our notions of virtual and real world. For example, Heim (1991, 30) actively requires more disjunctions and clarifications between the terms 'virtual' and 'real', arguing that "virtual world can be virtual only as long as we can contrast it with the real (anchored) world". He approaches the definition of virtual reality by asking, how does it differ from our real physical world which is also composed of "mere symbols"? (ibid.)

In order not to make us fall into 'irrealism', Heim has named different type of "reality anchors" we need in our real world in order to keep virtual worlds virtual. One anchor relates to the *temporal* dimension of our body (mortality and natality) and its vulnerabilities that are continuously, but often unconsciously, present when we act in our physical world. (Heim 1991.) On the contrary, in virtual spaces we are used to die, reborn and even kill other people without any harmful consequences to our physical body (Jensen and Moran 2013). Secondly, the dimensional carryover between our past and future is strongly present in our phenomenal experiences (Heim 1991). This is notable especially in those VR experiences that aim to simulate our real physical world or past experiences, like for example post-traumatic stress disorder treatments do. However, as Mark B. Hansen (2006, 2) notes, the human motor activity in general "hold a key to fluid and functional crossings between virtual and physical realms" which relates to the coherency of the virtual space in relation to our actions, and can make all of these anchors to disappear. Hansen has been theorising the role of technology in human agency, and his latest book, *Bodies in Code* (2006) collects the key arguments for combining theoretical and technical features for the design of virtual spaces.

According to the philosophical notion of relativism, there is no objective truth but each point of view builds its own truth – and reality (Gura 2017). In fact, virtual reality can be understood as a pleonasm because the mixed reality paradigm takes it "as simply one more realm among others that can be accessed through embodied perception" (Hansen

2006, 5). As Hansen defines (2006, 5), "the mixed reality paradigm foregrounds the constitutive or ontological role of the body in giving birth to the world ".[15]

2.3 Alternative reality tunnels

Because VR is a technology that directly allows us to create and simulate embodied perception and subjective experiences, we should get familiar with a concept of "reality tunnel". It can be defined as a subjectively perceived 'frame of reality', formed through an embodied first-person perspective that always entails some collection of assumptions (Leary 1988). Governing our ways of seeing and perceiving the world, these reality tunnels also guide our acting and moreover, they might appear as 'maps' to understand our inner states (Fraga 2016).

If VR is seen as a technology to fulfill human curiosity of exploring different realities (Bates-Brkljac 2012) it can be understood as another reality tunnel that aims to challenge our "baseline" reality tunnels (Fraga 2017b). As Heim argues, all cyberspaces should invite us to participate and have a design that evokes our imagination. Favourably, VR environment should be something more than the 'real' one because it helps us to leave behind the limits and anchors of our physical existence – as well as those baseline reality tunnels – that make us immerse into the virtual reality environment.[16] (Heim 1991.)

Moreover, by exploring different perspectives and representations in VR we can let the imagination nourish and even represent to ourselves those "events, objects and state of affairs that we firmly believe to be impossible" (Ohlsson 2011, 31). This is important because as Hansen (2006, 13) argues, even though external and sometimes mysterial (virtual) images would not be capable to "run a change in the organism directly, they can perform it *indirectly*, through the self-reorganisation".

[15] Moreover, our phenomenal being to the world is bound into 'analogically processed' experiences that gives more support for Hansen's statement of "all reality is mixed reality" (Hansen 2006, 6).
[16] As mentioned, Heim is also concerned that simulating the familiar 'real world' in virtual reality may turn into irrealism if the virtual world becomes indistinguishable from the real world (Heim 1991, 31).

The new theories of VR can turn out to be even more interesting if we consider the role of human emotions in shaping our reality tunnels, or what will happen to us when those baseline reality tunnels are “thrown off balance” (Fraga 2016) and when we are encouraged to reorganise ourselves within the virtual spaces? As a VR developer Daniel Fraga states, an alternative reality tunnel as a new experience always creates new ‘here and now’, literally changing how we perceive ourselves and the world around us. Nonetheless, the tricky question is “how does one open black holes in the fabric of meaning” that could ultimately manage to disrupt and shape our well grounded reality tunnels, by exploiting virtual reality? (Fraga 2016.)

According to Heim, we need new concepts to understand what the “esoteric essence” of virtual reality is. By citing David Zelter, Heim agrees that “*true* virtual reality may not be attainable with any technology we create” but perhaps the essence of VR lies in *art* as its highest order. (Heim 1993, 109-128.) Heim’s early metaphysical reading of VR makes him to describe it as a ‘Holy Grail’ of the research and moreover, he states that

> “the ultimate promise of VR may be to transform, to redeem our awareness of reality – something that the highest art has attempted to do and something hinted at in the very label *virtual reality*, a label that has stuck, despite all objections, and that sums up a century of technological innovation” (Heim 1993).

As introduced, VR can be seen as a technology and a medium full of boundless opportunities to challenge and amaze our affective mental states, constructed reality tunnels and existing representations. It can serve as a comprehensive “reality test for the body” (Hansen 2006, 5) and reveal the multiplicity of our mind, body and space (Turkle 1995, 263). What I am especially interested about is its capabilities of revealing the *plasticity* of our being (as to be discussed in Chapter 3).

2.4 Enframing the truth

According to Sara Murrani (2011), phenomenological theories have been adapted into technology and cybernetics already in Heidegger’s (1977) writings. Heidegger gave birth to the modern philosophy of technology, nowadays more frequently called as *technoscience* (Ihde 2009, 20-25). The empirical turn in the philosophy of technology started in the Netherlands during the 1990's when it applied a constructivist approach inspired and modified by Thomas S. Kuhn. Similar to the philosophy of science in general, the technological field also started to speak about the 'co-evolution' of technology and society. (Ihde 2009, 21.) Felix Guattari (1993) believes that "the relationship between human and machine has been a source of reflection since the beginning of philosophy" (as quoted in Murrani 2011, 276).

Heim (1993) was the first one to understand the ontological nature of virtual reality both as philosophical and metaphysical. However, he is concerned about the acceleration of language and information due to technological development of cyberspaces that makes us forget the very significance of information.[17] He argues that the language of VR is going to develop into a mere *hypertext*, causing only disorientation, mindless productivity and cognitive overload for humans. (Heim 1993, Phillips 2003.) On the other hand, the ontological dimension of technology understands virtual spaces as mediums for *revealing*, that can also move us to the other direction and help us to orientate in this world – depending on the applications.

In particular, Heim argues that if the ability of cyberspaces is to evoke our imagination, instead of only repeating the world already familiar to us, one should see virtual reality not only as a channel for reflection but moreover, it should be used to "make philosophy"[18] and to reveal "the alternatives" (Heim 1991). These statements are originating from Heidegger (1977) who adopts an ontological approach of seeing technology as revealing or enframing the truth.[19] In fact, Heidegger feared that the very essence of technology is to 'enframe being' which is exactly the same concern Gilbert Simondon mentions in his general phenomenology of machines (as cited in Murrani 2011).

[17] Heim names this phenomenon as *infomania* (Heim 1993).
[18] Coyne (1994, 65) highlights that virtual reality provides value for computer-aided design (CAD) by offering "a good test case for the applicability of contemporary philosophical thinking".
[19] Heidegger's definition of 'technological truth' (*Ge-stell*) is often translated into enframing (Heim 1991).

Also Hansen (2006, 12) highlights that the technological "power of imaging" can lead to internal observations of a human. He agrees that the novelty of a highly developed technology is not the possibility to experience new immersive illusory environments but rather, "the expanded scope they accord embodied human agency" (Hansen 2006, 3). Without doubt, also technologies shape humans' natural organization to the world (Noë 2015). Nowadays, the acceleration of technological language is experienced as nouns, abbreviations, emojis and short-lived pictures that are adapted to our everyday communication. Some of the authors strongly state this phenomenon will evidently change the meaning of our humanity and therefore, we should understand the importance of technological design as it automatically affects our ways of being. (Winograd and Flores 1986, as referred to in Murrani 2011, 269.)

2.5 Virtual reality as a tool

Due to its abilities to challenge our notions of reality, VR can be defined as a *tool*. However, the definition of 'toolness' is trivial because VR is also a space. This makes Heim (1993) to seek answers to the two ontological questions; the way how do we exist within cyberspaces and what is the ontological status of cyberspace by itself. According to Heim, this is important because the way we come to understand and define the structure of cyberspaces and virtual reality will also determine how distinct realities can exists in between them. (Heim 1993.)

In the fields of psychotherapy VR is merely seen as a technological tool for treating maladaptive emotions. Most commonly, the psychotherapeutic experiences conducted in VR are first validated with several user testings before their deployment, in order to be sure of 'successful therapeutic outcomes'. (Giuseppe 2005, Botella et al. 2004.) The design process then follows a very traditional method, by picking up a specific target group and listening to their needs in order to solve the defined problem with a well-designed, accurate and trustful tool.

However, ontological design ideology argues that tools should not be understood as mere objects having certain qualities but rather, the context or the *space* within they are used should be given more importance (Willis 2006). The very basic maxim of ontological design states that "as we design our tools, they design us in return" (Willis 2006).

Ontological design got first explored in the context of *practice* and it is mainly founded upon the works of Heidegger and Hans-Georg Gadamer.[20]

The aim of ontological design is to understand who we are and what we want to be in a modern world by characterizing the relationship between human beings and "our lifeworlds". It claims to be more pervasive and profound than the other design theories and it has also been favoured by philosophers and cultural theorists. Ontological design based upon *circularity* suggests that designing is fundamental to human nature. It is both an approach in design concerned on the nature and the agency of the design, as well as an argument or a method for particular way of doing design. (Fraga 2016, Willis 2006.)

The transparency of tools, which is a unique feature in cyberworlds, is told to reveal something additional or work as an anticipation of lifeworlds if carefully observed (Ihde 2009, 33). According to Heim, the relationship between an interface and a cyberspace is defined by the intensity level of how much we embody, immerse and therefore "own the system" itself in the form of being. Nevertheless, if both the 'tool' and the 'interface' of VR technology are made invisible it means that we can directly step into a *cyberspace* where "we feel ourselves moving through the interface into a relatively independent world with its own dimensions and rules". (Heim 1993, 79.) William Gibson (1984) describes this experience as a 'consensual hallucination' (as cited in Heim 1993, 79). As Heim defines, cyberspace itself can be seen as "a metaphysical laboratory, a tool for examining our very sense of reality" (Heim 1993, 83) but also warns that such an endless, imagined and infinite cyberspace can constitute an 'infinite cage' for the "finite incarnate human beings" (1993, 80).

When defining VR as a cyberspace instead of a tool, Heim (1993) raises a number of important questions, such can we assume causality in cyberspaces what comes to our affective human nature? Moreover, he is concerned about the design of cyberspaces by asking, who should be kept in charge of the design decisions that automatically entails some subjective intentions, prejudices and beliefs? Sherry Turkle had the same concern

[20] Ihde (2009) creates a link between technology and Husserlian perceptual or "praxical" experience that is grounded on Heidegger's ontological "tool analysis". Heidegger notes that in addition to a bare perceptual cognition we should be concerned those *manipulations* (of tools) that have their own kind of 'tacit knowledge' (as cited Ihde 2009, 32).

and she states that “Direct experience is often messy; its meaning is never exactly clear. Interactive multimedia comes already interpreted. *It is already someone else’s version of reality*” (Turkle 1995, 238, italics added). Nevertheless, at least VR the stories told in VR are always unique due to the active projections and agency of the participants.

The VR philosopher of the 21st century, Ray Kurzweil (1999), probably has the most optimistic approach to see the future of VR when he states that by encompassing all our senses it will facilitate interactions and enhance our perception, interpretation, memory and reasoning. Similar to Heim and Ong, also Kurzweil sees some kind of spirituality in technology and believes that machines will eventually “emulate humans in going to real and virtual houses of worship, meditating, praying, and transcending – to connect with their spiritual dimension” (Kurzweil 1999, 151-153 as quoted in Phillips 2003, 11). In align with the ideology of ontological design, and in relation to the language of technology, Phillips concludes that “we transform our symbolic environments and they transform us” (Phillips 2003, 12).

Hence, when creating ‘VR tools’ we should consider the agency of the participants and how much they are given the freedom to shape and modify the virtual spaces (Heim 1993, 83). Similar to Heidegger (1957), we should regard computers as *beings* and definite entities within the world, and the mind-versus-computer question should not be taken as ontological nor existential. Technology, and especially VR, should be considered as one mode of human existence – a component and an agent – that helps us to transform our relationship with the world (Heidegger as cited in Heim 1993, 60-64).

Unsurprisingly, there exist different interpretations for understanding the ‘toolness’ of VR but its philosophical notions remain quite the same. As Phillips (2003, 2) argues, “innovations in technology, the arts, sciences, and entertainment challenge us to ‘get real’ (virtually and otherwise), to see how we invent and reinvent ourselves through VR”. He sees that the ongoing technological revolution challenges us to see virtual realities through the new “electronic language” (Phillips 2003) that again comes align with Heidegger’s understanding of cyberspaces as tools for enframing the truth.

In this thesis, VR as a cyberspace is primarily considered as a tool for reorganising ourselves. Of course, in order to engage and immerse the participant to the environment, VR should also tell a compelling story. Virtual reality storytelling is a peculiar field, mainly because in VR *space* is both the story and the language. Interestingly, Fraga (2017b) sees that VR can help us to realise how all spaces around us are nothing more than "stories waiting to happen" and the very 'paradigm shift' in VR storytelling is the fact that it can be indistinguishable from our reality what comes to the feeling of spatial presence and immersion (Fraga 2017b).

From the perspective of media studies, this creates an analytical challenge also for understanding how much the designers of VR have an authorship to define the spaces appearing as 'stories'. In fact, Fraga (2017b) mentions that the "metamodern design philosophy" aims to form architecture of people *through the space* instead of focusing on the space by itself. This theory suggests that we should primarily prototype the experiences in VR instead of the technology (Hansen 2006, 33). The ideology of ontological design argues that VR as a cyberspace should be designed to tell a story within the participant becomes both the character and the agent in the virtual space. (Fraga 2017b.)

Emotions play a crucial role in the field of storytelling because even in traditional narrative research, the emotional identification with a character is seen as an effective mechanism for narrative persuasion (Hoeken and Sinkeldam 2014). Nevertheless, the negative side of the coin is that "being lost in a story" inside of the VR environment could transform the technology also as an "ultimate manipulation machine" that generously absorbs individuals with the help of a compelling story (Slater and Router 2002). All these multidimensional experiences capturing our attentional focus, narrative presence, emotional engagement and cognitive understanding are commonly described as processes of "narrative engagement" (Busselle and Bilandzic 2009).

Therefore, if the aim is to modify affective experiences in VR, the physiologically measurable arousal levels as 'windows'[21] could be applied to pilot new emotional experiences hidden in the form of a story, instead of the technological tool. For example, manipulating the sense embodiment of a virtual avatar – shifting from a human body to a spider – could take place according to the individual 'fear level'. It could mean that unless

[21] See Chapter 4, p. 55.

the participant is not afraid enough of the feared stimulus no change will occur, whereas, when the individual fear level is crossed the participant will switch from a human avatar to embody the feared stimulus in VR. As Turkle (1995, 263) argues, by playing with different perspectives the virtual space can "suggest the value of approaching one's 'story' in several ways and with fluid access to one's different aspects" (Turkle 1995, 263). The question would then be, will the emotion follow the re-embodiment and as a result, how do we reorganise ourselves and our emotions in that VR experience?

With the help of different case studies, I will next consider and question what the given extents of VR environments and stories for modelling illusions of embodied perceptions through virtual avatars are (Kliteni et al. 2012).

3. PHENOMENAL BODIES IN VIRTUAL REALITY

In this Chapter, I will first take a look into the most famous authors of the phenomenology of embodied cognition who all mutually believe the body is at the centre of our perceptual experiences and strongly involved in other conscious functions (Jensen and Moran 2013). I am about to argue that the formation of our mental representations as 'Objective Thoughts' (and the creation of 'feared stimulus') is not solely relying on our present visual perception but rather, on our memory from the past and expectations of future which are highly dependent on our *phenomenal embodied experiences*. These experiences not only help us to form the aforementioned reality tunnels but moreover, they create *phenomenal body loops* that guide our being and acting in the world.

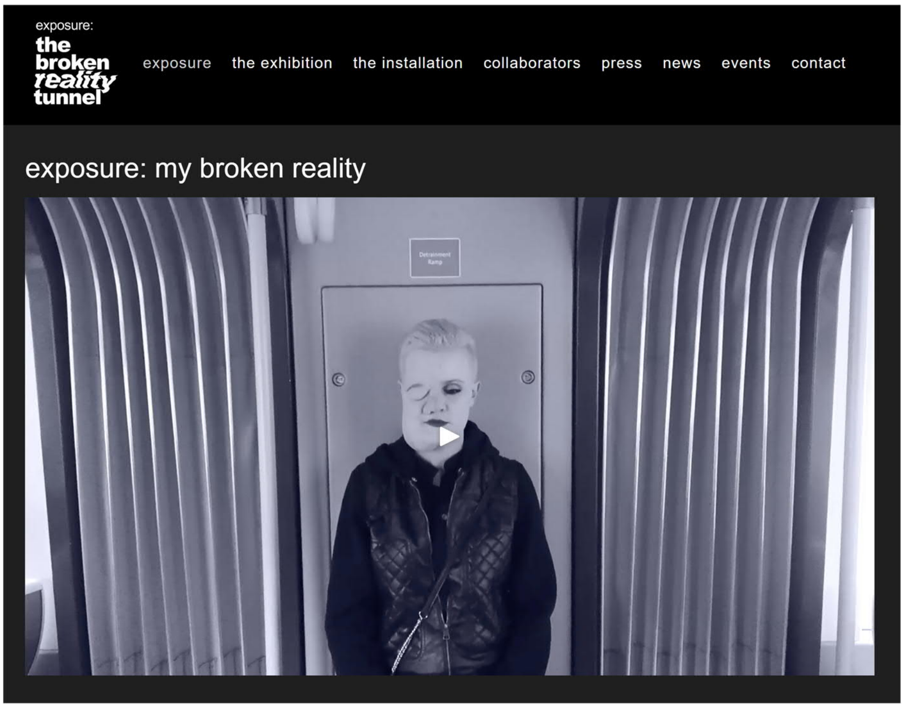

Image 1. 'Reality tunnel' describes the formed mental reality out of things perceived and imagined, but the concept of 'phenomenal body loop' also entails the body. See for example the work of Leigh de Vries who is an artist suffering from Body Dysmorphic Disorder (BDD), and how she represents the disorder as a self-

imagined ugliness of one's body. As a part of the exhibition, she has made a film "Exposure: The Broken Reality Tunnel" where she aims to visualise her own constructed and strongly embodied reality tunnel.[22]

To begin with, 'embodied cognition' is a definition used to describe the areas of research in cognitive science and philosophy of mind that focus on the holistic nature of our cognition where the body, mind and environment interact. As an opposite to the dualistic approach, no duality cannot be drawn in between them. (Bailey et al. 2016.) Following the constructivist approach, also from a phenomenological perspective the ability to interact with and perceive the environment from the embodied first-person perspective is taken as the one and only way to build our consciousness and reality.

As Hansen describes (2006, 12), phenomenology is a method of "absolute survey" that opens our access to the world. Due to the simulated illusions of embodied first-person perspectives the phenomenological approach may offer answers for how the participants represent, perceive and absorb themselves in multisensory virtual environments (Bailey et al. 2016). Phenomenology can investigate how do we 'come alive' in virtual spaces, and it suggests applying a comprehensively holistic approach to immersion. As Donghee (2018) argues:

> "Future research should see immersion as a cognitive dimension alongside consciousness, awareness, understanding, empathizing, embodying, and contextualizing, which helps users understand the content and stories delivered".

3.1 The problem of perception

Phenomenologically seen our perception is always active and bidirectional that occurs through the holistic interpretation of our body, mind and the space around us. It highlights the *interrelational ontology* where the 'human experiencer' is seen to be ontologically related to an environment or a world, within which both are also transformed through their relationality (Ihde 2009). Nevertheless, as most of the phenomenologists note, our embodied cognition is not embedded only in the present perception and action, but also

[22] See the project site http://mybrokenreality.com/ (Accessed 27 October 2018)

to our routines, memory, habits and skills (Jensen and Moran 2013, Husserl 1973, Merleau-Ponty 1945).

Even though these memories help us to orientate in this world, often making our lives easier, the conceptualization of all our experiences might cause problems because it makes us *intentional*. George Husserl believes human beings should be defined as embodied intentional agents, always “conscious of something” as without intentionality there is even no world for us (as cited Jensen and Moran 2013). The problem of intentionality is that our subjective and limited points of views (POV) always force us to see objects from a certain angle at a time (Ihde 2009, 12) and leave something unnoticed. This phenomenon called as *reduction* by Merleau-Ponty (1945), named as “framing” in social sciences, describes the framing of thoughts and reality between different actors. As introduced, the concept of “frame of reality” can be used to explain the intentionality and reduction of our perception based on a subjective point of view.

Because of the intentionality Merleau-Ponty states that perception is our central access to truth and “the world is what we perceive” (Preface, xviii), but paradoxically, at the same time perceiving is also something we achieve “against the background of our skills, knowledge, situation and the environment” (Noë 2015, xii). Therefore, even the phenomenological world is not about ‘pure being’ but through rationality our perceptions get blended and confirmed by each other. According to Merleau-Ponty, rationality is not a problem in phenomenological philosophy but rather *the created links between the world and reason* are as they always remain as ‘mysteries’ in the “unfinished nature of phenomenology”. (Preface, xxiii.)

Husserl also states that our consciousness is not merely founded on perceptual abilities but based on different ‘representations’ linked to our memory and symbolic thinking that make objects *present* in our physical world. For example, depending on the individual frame of reality and intentionality, seeing a cup on a table can make us either perceive it as a tea or a coffee cup. The interpretations often vary according to our current mood and needs. Husserl views that all objects we perceive are connected to their reference to being in the past or future[23], and strongly linked to our memory, imagination and perception. (Husserl 1973, as cited in Jensen and Moran 2013.)

Merleau-Ponty states that perceiving an object is difficult as after the visual perception we also need to conceptualise it to become like an 'Objective Thought' (Merleau-Ponty 1945). Similar to other mental representations, Objective Thoughts describe those underlying attitudes towards objects which fails to reveal the originality of our perceptual intentionality (Jensen 2013, 46). Merleau-Ponty's empirical model highlights the problem that the sense of the presence of an object is a poor impression related to previous contexts as well as to the expectations of future impressions (Jensen 2013, 48). And as he argues, this very 'experience error' make new perceptions out of things perceived, constituting our own reality (Merleau-Ponty 1945, 5). In phobic people this experience error commonly appears as a 'mystery link' that makes them to interpret the undangerous stimuli dangerous, causing irrational fear.

According to Merleau-Ponty, the acts of perception in general fail to "constitute an openness to the world that confronts us with the object itself *in person* rather than mere proxy which remains at a distance from reality itself", as Jensen (2013) well summarises. For Merleau-Ponty the problem of perception mainly correspond with the "problem of the presence of an object" as for him, natural perception forms in relation to existing objects in the *present* instead of our current mental representations (as cited Jensen 2013, 45). As the postmodernist approach argues, we tend to interpret the world more than perceive it (Turkle 1995, 264).[24]

Nonetheless, we need more information about the formation of mental representations and our emotions to understand how the phenomenal body loops arise, as well as what is in the core of maladaptive experiences. One answer is offered by Thomas Metzinger, who introduces a three-dimensional relationship of mental representations within an individual system. According to him (2003, 35), representation is "a process which achieves the

[23] In fact, the past and the future act in the present only through our representation of them (Ohlsson 2011, 31).

[24] The 'phenomenological fallacy' is a definition used to describe this kind of abstraction of representational process that makes us to forget the nature of phenomenal and temporal nature of our perception (Metzinger 2003). Merleau-Ponty names this as a "problem of perception" (1945) even though on the other hand, the human cognitive power is told to increase by our ability to form abstractions in the form of mental representations (Ohlsson 2011, 31).

internal depiction of a *representandum* by generating an internal state, which functions as a *representatum*", where the 'representandum' is the object of representation (i.e. a spider) and the 'repsentatum' describes the concrete internal state and a "vehicle" (body and mind) carrying information related to that object (i.e. spiders should be avoided). It is important to note that representatum is a dynamic and hybrid system that keeps changing in the processes of internal representations – or on the contrary – it keeps *looping* through our body.[25] (ibid.)

To conclude, the problem of perception suggests that we should also include direct phenomenal experiences into the research in order to understand and solve the formation of maladaptive Objective Thoughts and phenomenal body loops. As will be next argued more profoundly, VR is actually creating those direct phenomenal experiences. In addition, the research about the fluidity of our mind and body is relevant when the curiosity is set up to the methods of escaping those emotional body loops.

3.2 Intrinsic modulations and extrinsic inspirations of body schema

As introduced in the Chapter 2, the concept of body schema better describes the ambiguous and fluid nature of our body which is not always under our control, but represents the internal representation of one's body in contrast to the physical or virtual world. Like Hansen (2006, 26) notes, virtual reality technologies can extend and refunctionalise the power of the body to construct space and "stretch our body schema". According to him (2006, 20), virtual reality is capable "to stage a disconnection of the (fundamentally motile) body schema from the (fundamentally visual) body image", which is a phenomenon he names as a 'body-in-code'. Hence, for a generative approach, it could be recommendable to use the notion of body schema to describe our ability to adapt to the immediate sensory feedback in VR.

[25] Metzinger's suggestion of a three-dimensional nature of the phenomenal body loop is built upon the theory of "mental object" formulation which is argued to be a two-level process; one being the linguistic reference to the current phenomenal state and the second one constituting the phenomenal experience itself. According to Metzinger, the phenomenal experience can occur before and without the linguistic representation and therefore, one should take into account only the phenomenal level (Metzinger 2003, 38).

Interestingly, some studies also show that virtual avatars are even more flexible in terms of embodiment and merely perceiving a virtual body from a first-person perspective can create a 'body transfer' towards an avatar (Slater et al. 2010). Sanchez-Vivez and Slater (2014) use a notion of 'body semantics' to describe the ability of the brain to drive attitudes and behaviour according to the level of body ownership in contrast to the type of virtual body embodied. To align with the phenomenological approach, they argue that it is "through the body that we form and process all our perceptions, attitudes and behaviour". (ibid., 28.)

The definition of body semantics differs from 'Proteus Effect' by applying a psychological perspective that does not base itself on the common self-perception theory. Instead, body semantics can be seen as an approach that aims to find answers to *how can we embody an entirely different body from our physical one in virtual environments*, and where is this capacity of the brain arriving from. Sanchez-Vivez and Slater (2014, 28) suggest that these processes might rely on the statistical information we have gathered through our own social experiences. For example, every one of us has once been a child crawling on the floor, and hence, we can quickly get used to the sensory evidence of embodying a child avatar in VR. Another explanatory reason for body semantics is that some of our fundamental mechanisms can also encapsulate extreme associations between the type of the body and its behavioural capabilities. (Sanchez-Vivez and Slater 2014.)

In the field of neuroscience, human embodiment is shown to be flexible also in the case of severe injury caused by accident. Even after amputation, the cortical map of the injured limb might still make the patient feel illusory pain, but this problem can be solved by restoring the visual input of the plausible limb to the amputated one. This is one of the 'working proofs' that people can learn to alter their body schema according to the sensory input. (Won et al. 2014.)

From the virtual design point of view, Kasahara et al. (2017) divide the design to 'intrinsic' and 'extrinsic' according to the results of differently interpreted sensory conflicts about the sense of embodiment (see Figure 1). The *intrinsic modulation* will primarily occur after the sense of embodiment towards a virtual body is once established, proving that the mind is flexible what comes to the illusion of body ownership. Some of these types of unconscious gradual modulations are used for example in various physical rehabilitation treatments in VR (see Matijević et al. 2013).

The *extrinsic inspiration* instead describes the increased freedom of movement in contrast to the physical body, which can be felt for example as 'heightened' body sensation if the transformation is simultaneously visualised through a virtual mirror (Kasahara et al. 2017). Nevertheless, it has its limits as the results from the category 'discriminated' reveal (see Figure 2, p. 37).

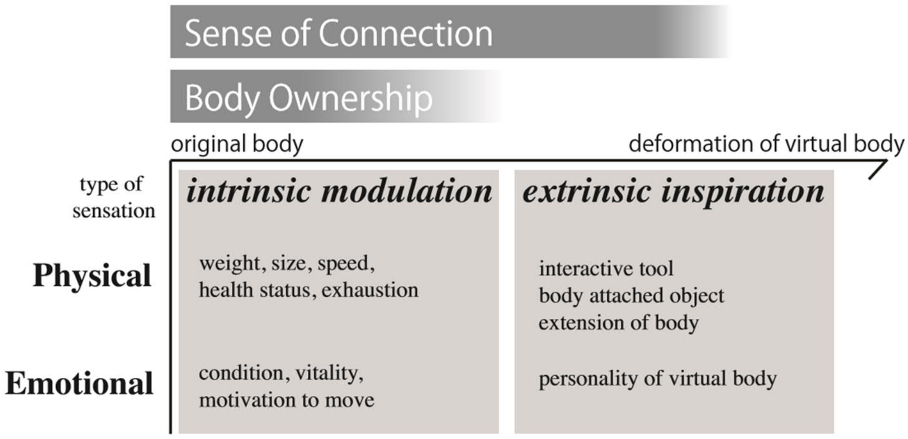

Figure 1. "Design space with virtual body deformation. It roughly consisted of two spaces: 'intrinsic modulation' and 'extrinsic inspiration'" (Kasahara et al. 2017). The study differentiates (a) intrinsic modulation and (b) extrinsic inspiration for virtual space design where the latter one relates to the perceptible body manipulations which, however, can help the participants to go through physiological or emotional changes.

On the other hand, some studies state that the manipulations of 1PP-locations and movement can also cause an intriguing "double-body" effect (Huang et al. 2017), making the participants feel that they have two bodies. In addition, during out-of-body experiences (OBE) subjects can feel their body-location is different from their physical one, which is the same than in experimental manipulations where the sense of IPP-location can be separated from the physical perspective taking point of view (Huang et al. 2017). Some studies show (see, i.e. Blanke and Mohr 2005) that during out-of-body experiences people seem to acknowledge that their zero point for perceiving is located outside of the physical body and "elevated". In VR this 'extrapersonal location' of the participants could give them a new 1PP-location which is dissociated from the sense of body-location. Therefore, Huang et al. (2017, 3) note that

> "if self-location is depicted *only* in terms of body-location, how to characterize OBE would become a problem. Hence, first-person perspective, more precisely, the *location* of 1PP, is important for specifying self-location, and its role is not the same as body-location."

These studies stating that 1PP-location and body-location are distinct also support the non-dualistic way of seeing our mind and body. Therefore, and instead of falling into Cartesian dualism, we might be even able to see a double-body effect in virtually manipulated environments. (Huang et al. 2017.)

By adapting the ontological approach to VR design, we might also be able to introduce some new design features upon the notion of re-embodiment. For example, what if the participants of VR could re-enframe their point of view by changing the sense of 1PP-location either embodying different virtual avatars or by simply escaping the body and 'travelling' in the space without a body? The question would then be, what are the extents of designing 'unrealistic' perspectives and actions attached to virtual avatars to maintain the sense of embodiment and self-location in cyberspaces, especially if those experiences are highly emotional?

3.3 From the sense of embodiment to homuncular flexibility

As introduced, comparing virtual reality to our basic mental processes of embodied cognition is acceptable if we are about to believe Coyne who argues that we can be immersed in, and embodied to "any environment, depending on our state of mind, our interest, what we have been taught to experience, our personal and collective expectations, and our familiarity with the medium" (Coyne 1994, 64). In virtual reality our bodily self-representation is driven by spatial attributes and most commonly, perceived from the first-person perspective (1PP) it makes us obey our intentions and have a sense of agency to the actions of our virtual and/or physical body (Kliteni et al. 2012). The first-person perspective together with the real-time motion capture of the participant's movements are said to be important factors to create the illusion of body ownership (Sanchez-Vivez and Slater 2014). Most commonly, the egocentric perspective embodied into a virtual body serves also as a sensory evidence towards one's self-location (Kliteni et al. 2013, Lee 2004). The role of perspective taking has also been studied in the case of threat responses, revealing that physiological responses towards an artificial body are higher from a first-person perspective than from a third-person perspective (see Petkova et al. 2011, Slater et al. 2010).

In fact, it is exactly the reliance on multisensory feedback in human perception that is argued to provide the needed flexibility to adapt to and control novel bodies, such as the virtual bodies located in VR (Won et al. 2014.) In addition, people are told to be "tool-users" and as the ideology of ontological design states, tools can alter or extend our senses[26] (Won et al. 2014, Phillips 2003, Willis 2006). For example, the movements of a virtual avatar may have an influence to our perception, and moreover, it has been studied that embodying a virtual avatar can perform a change in the way we feel and think (Sanchez-Vivez and Slater 2014). Biocca noted this phenomenon already in his "The Cyborg's Dilemma" (1997) where he states that if technology manage to change the appearance or affordances of the body, it will also change the self.

Hence, virtual reality not only enables people to inhabit bodies in the form of a virtual avatar that differs from their own but instead, it can also make them to feel as if it was their own (Won et al. 2014). As the famous rubber hand illusion (RHI) shows, our visual perception can trigger us to believe some of the body parts – or even a whole body – other than ours belong to us (see, i.e. Petkova et al. 2011).

The immersive virtual environments allow us both technologically and mentally to create the sense of body ownership and explore the limits of body manipulations in terms of its structure and size, and it can even change the egocentric visual perspective of the body that is not possible in our physical world. (Kasahara et al. 2017, 6439, Kliteni et al. 2012). To give an example, the winner of Sundance Festival shows how the world could look like through the eyes of animals in VR.[27] ITEOTA (*In the Eyes of the Animal*) is a 360 degree animated cinematic experience project that the artist themselves describe as a "hypnotic 3D world of swirling colours" which will introduce the viewer to "the science

[26] Here the 'tool' primarily signifies a physical or virtual object in space that can be used for interaction.
[27] See the project site: http://iteota.com/experience/welcome-to-the-forest (Accessed 12 September 2018).

of seeing”. The viewer can choose between a mosquito, an owl, a frog or a dragonfly, and perceive the world from a new perspective. For example, through the eyes of a frog one can see little particles floating around in the air, and the surface of the ground looks more like a surface of the sea.[28]

The idea of transforming ourselves through VR is not novel because already in 1980’s Jaron Lanier did some experiments and observed that people would quickly learn to adapt to different bodies in virtual world. He was especially interested about how much we could alter the virtual body before it would break the immersion that led to the most bizarre experiments with his colleagues in VPL research lab. They applied interaction to the experiments by tracking first the users’ body movements and then translating them into different and novel movements of the embodied virtual avatar. After making the participants to virtually embody different prototypes, from a flying bat to an eight-legged lobster, Lanier concluded that people can learn to inhabit and control virtual bodies that are quite different from their own. (Lanier and Biocca 1992.)

Lanier defines this ability as “homuncular flexibility” where the term *homunculus* refers to the idea of mapping the body in the brain (Won et al. 2014, Sanchez-Vivez and Slater 2014). Upon the notion of homuncular flexibility, also Sanchez-Vivez and Slater (2014, 26) introduced a paradigm called as the “Proteus Effect” to argue that the digital self-representation also has an influence to attitudes and behaviour in virtual environments. The term *proteus* refers to the mutability that makes us unconsciously to alter our behaviour according to the qualities of the embodied avatar. (Won et al. 2014.)

The whole-body multidimensionality of embodied experiences has been recently studied again in VR. The main question is not if we can feel virtual bodies as our own but *“to what extent we can experience the same sensations towards a virtual body in VR as towards our biological body”* (see, i.e. Kliteni et al. 2012). Unfortunately, the question remains yet unanswered. The reason might be that we do not fully understand what does a sensation or an emotion mean, nor how can we measure it, as will be thematized in Chapter 4.

[28] Imagine then how would the world look like through the eyes of a spider, if by looking up you would see a giant human? Maybe it could help you to change your perspective to the fear if you would feel scared of that human instead?

Questioning further the flexibility of the mind and body, a study conducted by Kasahara et al. (2017) tested a hypothesis of changing the sensations associated with the body by replacing the visual perception with a slightly deformed state in VR. They analysed how human movement physically changes due to the virtual body manipulations as well as how the participants "*feel* about the change in physical and emotional views of the body due to virtual body deformation". The study proved that spatio-temporal deformation does change the sense of body ownership and body image. They also argue that VR allows making perceptions of one's body more malleable. (Kasahara et al. 2017.) The investigations also covered emotional involvement together with the physical sensation of body ownership when the movement of the virtual body was delayed or accelerated in contrast to the physical body (see Figure 2, Kasahara et al. 2017).

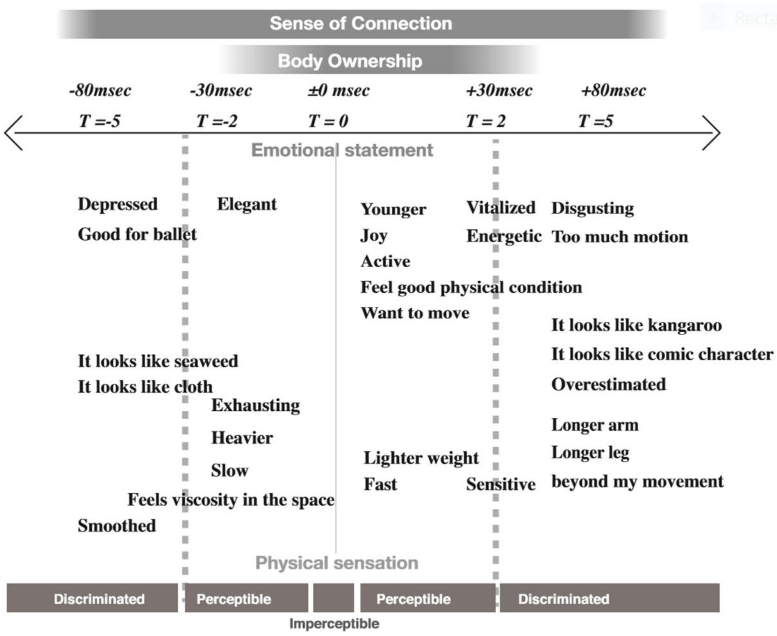

Figure 2. "Structured map from collected statements regarding sensation with deformed virtual body" (see Kasahara et al. 2017).

For example, the study suggests that a slightly delayed body movement of a virtual avatar can make the participant feel emotionally elegant but physically slower or heavier. On the contrary, the deformation towards the future creates an illusion of physically fast and light body, and emotionally active, joyful and energetic. (Kasahara et al. 2017.)

The research defined the category of "imperceptible" (a) as unnoticed manipulations of the virtual body, whereas "perceptible" (b) indicates that some manipulations were reported but the sense of body ownership was kept. The "discriminated" (c) category instead shows the limits of the sense of body ownership, revealing the moments when the participants were able to distinguish between the physical and virtual body. The differences between perceptible and discriminated were indicated in the self-reported feedback for example, either reporting as "*my* arm" or "*its* arm". Interestingly, the extrinsic factors got some of the participants to change and explore their physical movements that also caused some positive emotional effects. (Kasahara et al. 2017.)

Concerning the coherency of the environment, studies show that discrepancies between the action and the visual feedback negatively affect the sense of agency (SA). However, Gallagher argues that we might still be able to keep the sense of ownership (SO) even though we are not able to control our actions (Gallagher 2000 & 2014) because it only refers to one's self-attribution of a body which is influenced by both bottom-up and top-down factors.[29]

It is important to note that these type of manipulations of our embodied experiences might also become problematic and cause 'breaks in the presence' (BIP), especially if poorly executed in VR. The concept of BIP is defined by Slater and Steed (2000) to describe any event whereby the real world becomes apparent for the participant during the virtual reality experience. However, this feature could also be further studied in phobia treatments conducted in VR because *distraction* during the exposure therapy has shown to work as a facilitating feature in some patients (McNally 2007), even though it has a slightly different meaning to BIP. One of the deep learning hypothesis could form around the possibility of 'playing' with the breaks in the presence and reality anchors in order to reveal those alternative perspectives and question the existing reality and its tunnels.

To draw a conclusion, various research already show that changing the design of multisensory feedback in VR can lead to physiological, emotional and cognitive changes (see, i.e. Jauregui et al. 2014). Recently in cognitive neuroscience it has been validated

[29] Cognitive neuropsychology shows a strong dependence between bottom-up information that include all sensory information, such as visual perception, and top-down information referring to the cognitive processes (Metzinger 2003, 34).

that brain is surprisingly plastic regarding body representation, which of course is not a surprise if we look at the rubber hand illusion. (Botvinick and Cohen 1998; Sanchez-Vivez and Slater 2014.) Hence, advanced VR technology offers new opportunities to test different hypotheses about visuomotor adaptation and as Kasahara et al. (2017, 6440) conclude

> "Thus the way is now open for research into how sensations of one's body and its movements changes as the visual representation of the body is changed".

Next, I will go through few case studies related to virtual body manipulations in VR to consider the idea of more radical space design.

3.4 Case studies about the plasticity of being

Slater examines if the 'Proteus Effect' caused by the sense of body ownership towards a virtual avatar could also be applied as a method for implicit learning to run a change in the participants of VR. Especially one of the studies, that could be named as "Dr Sigmund Freud" (Osimo et al. 2015), is engaging in relation to the presented hypothesis of 're-embodying the fear' and changing the embodied 1PP in VR.

In this virtual reality experiment, the participants were asked to explain their problems to a virtual character by embodying a human avatar size of their own. The virtual character (named as "the Counselor") on the other side of the table was either a simulation of Dr Sigmund Freud or a copy of themselves. After 'the therapeutic session' the participants were shifted to embody the virtual Counselor to hear their self-reported problem again from "the other perspective", and in addition, they were also given the opportunity to respond back to 'themselves' (to their virtual avatar embodied previously). Moreover, after the "expert consultation" they shifted again to embody their virtual avatar body and listened the response of the Counselor (the one they have just given by themselves). This shifting process was repeated at least three (3) times causing a feeling of as if they were talking to themselves. (Osimo et al. 2015, see Image 2.)

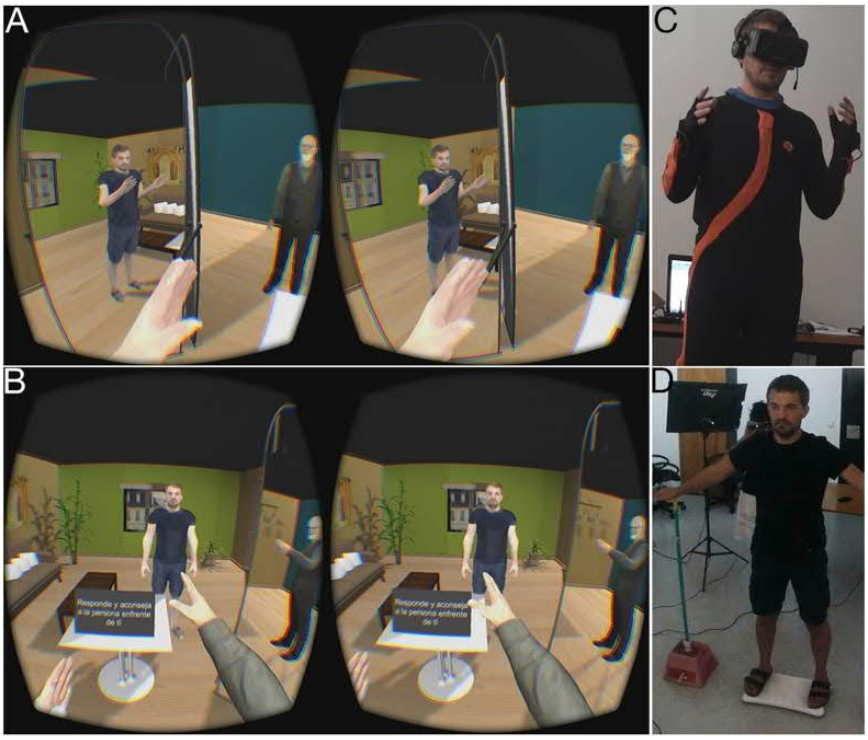

Image 2. The experiment setting (copied from Osimo et al. 2015).

The two conditions of this experiments differed by either embodying the virtual Counselor as Dr Sigmund Freud or as a mere copy of themselves. The test concluded that the best 'therapeutic' result was achieved when the Counselor was representing Dr Sigmund Freud, although all conditions showed at least little improvement in the participants' mood. Concerning the statement that embodying a virtual character from a first-person perspective can help to change our attitudes and behaviour, the researchers found out that simply the sense of body ownership towards the virtual avatar representing Dr Sigmund Freud gave the participants "more mental resources" to solve their problems. (Osimo et al. 2015, Slater 2017.)

Another study about these empowering effects of VR, conducted by Won et al. (2014), examined the effects of remapping movements in novel ways for virtual avatars. In one of their experiments, the participants were asked to control a three-armed avatar which resulted to a more effective way to comply the given task in comparison to the "normal" two-armed condition (see Won et al. 2014).

Behaviour wise, it has been studied that adults embodying a child-size body in VR make the participants overestimate the size of the objects and in addition, they tend to behave more ‘childlike’ (Slater et al. 2016). By comparing two experiences that differed only by the size of the embodied avatar (one being an adult and the other a body size of a 4-year-old child), the researchers were able to validate some previous data about virtual environments making us overestimate the size of the objects. In comparison to the baseline setting, where the participants needed to show the size of the objects by the distance between their hands, the estimation of object sizes through the child’s condition was overestimated almost by double (see Sanchez-Vivez and Slater 2014.)

To become more sure about the level of body ownership in novel virtual avatars, Sanchez-Vivez and Slater conducted another experiment where the avatar body moved independently of the participants’ real body movements. As expected, the tested participants reported a lower personal level of body ownership in these conditions. Hence, the authors agree that uncontrolled body movements extinguish body ownership and the sense of agency. (Sanchez-Vivez and Slater 2014, Kliteni et al. 2012, Kasahara et al. 2017.)

Few other studies, related to similar kind of manipulations of the sense of body ownership, show that embodying a different body can also cause us to feel empathy towards the virtual body (see, i.e. Nicola and Stilinović 2017, Donghee 2018, Milk 2015). In fact, the research field of empathy and mimicry is a fascinating but yet little discovered area in VR, even though it has been stated that “through avatar design and virtual scene changes, VR enables the study of non-conscious mimicry and personality altering effects with a reduction of unknown environmental variables” (Gonzalez-Franco and Lanier 2017).

Nonetheless, Slater states that changing the embodied first-person perspective in VR can only cause an implicit change in the participant (Slater 2017, 30) which is still a very different process from implicit *learning*. Hence, and to define the experience in VR as learning, the careful adaption of user interaction and agency through space is demanded which will be explained in Chapter 5.

One concern about manipulating our embodied experience relates to emotions. Like Sanchez-Vivez and Slater (2014) question, could the experienced pain or discomfort in VR be compared to the similar real-world scenario? Some studies do confirm this, as various phobia treatments in VR aim to show. However, the authors themselves believe that VR could primarily be harnessed to encourage us to experience the world from *a different point of view*, which can also make us feel a whole new range of mixed emotions that we are not able to feel in our physical environment. (ibid.)

In summary, phenomenology gives us new concepts to understand embodiment in virtual reality, such as the definitions of the sense of ownership (SO), sense of agency (SA), body schema and the sense of self-location (Gallagher 2014). Most of the research indicates that a fundamental morphological similarity with the real body parts is needed, but it does not matter whether they are seemingly real or virtual.[30] It has been studied that the sense of ownership (SO) can be present in whole artificial bodies, for example in avatars (Slater et al. 2009) but a self-reported scale of intensity towards a virtual body is always needed as a measurement of SO. The combination of physiological or behavioural affective responses can often reliably tell us whether a person is embodying the virtual body or not (Slater et al. 2010), which will be further explained in the next Chapter.

The next chapter will also seek to explain the nature of emotions and their role in our perspective taking in the space and meaning-making of the world. An excellent theoretical understanding of emotions is especially important if the aim is to design something related to emotional learning in virtual reality.

[30] Although, some research do highlight the importance of photorealistic avatars for the sense of embodiment (Won et al. 2014, Fox et al. 2012).

4. EMOTIONAL BODY LOOPS

To begin with, there lies no universally accepted theory about emotions, and it has been acknowledged there are almost as many theories about emotions as there are authors (Prinz 2014, Barrett 2017). In media studies, the topic is often avoided by a notion of 'affect' that describes the affective state of a media consumer in general, and do not necessarily try to assume the media content to trigger any specific kind of an emotion (Goldberg 2012).[31]

Undeniably, emotions play a central role in our everyday life, but only recently they have been taken more seriously into account in the multidisciplinary research fields of cognitive science and affective computing (Prinz 2014). Most of the research focusing on emotions often agrees to name some standard features of emotions, such as evaluation, subjective experience, physiological changes, bodily expressions, behavioural responses and different mental processes (Scarantino 2016, 5). According to the most popular view, emotions are deeply involved with our bodies' conditions (Minsky 2006), and therefore, they are often referred to as "affective states" in psycho- and physiology (Barrett 2016).

In this Chapter about emotions, I will introduce different theories and methods that can be chosen to study emotion recognition when the aim is to design psychotherapeutic experiences in VR, as well as analyze the effects of embodying virtual avatars. I will start by mapping the physiological nature of our emotions based on William James (1884) and contrasting it to its philosophical notions. Some of the authors follow a neo-Jamesian approach in emotion research with a strong focus on the body (see, i.e. Damasio and Prinz) whereas some have focused more on the constructivist side of James' theory with a focus on the mind (see, i.e. Russell and Barrett).

Upon the 'basic' emotion theory also the sensor technology developed to detect our emotional states is examined, with a focus on fear as an emotion. From the premises of

[31] On the other hand, the study of media contents can be approached from the perspective of perceptions which, of course, is a meaningful contribution to the study of perceptual cues in triggering emotions. However, the research methods of humanistic sciences are most commonly relying on self-reporting that faces its own challenges for 'trustful' analysis and further application.

comparing emotion to perception, I will end up highlighting the importance of emotion regulation instead of toleration when treating negative emotional experiences.

4.1 Searching fingerprints for emotions

The first attempt to develop a fingerprint and a theory of emotions was introduced by Charles Darwin, who in his book of *The Expression of the Emotions in Man and Animals* (1872) argues there is a universally common pattern for facial expressions. Later Paul Ekman (1972) tested Darwin's hypothesis and formed 'six basic emotions'; anger, fear, disgust, surprise, sadness, and happiness. Till today this theory validated by facial expressions is considered as the "golden standard" method in emotion recognition even though it also continues to face criticism because of its high reliance on human judgment and close relation to the behavioural, social conditioning. (Barrett 2016.)

In neuroscience, our emotions are told to be processed through the limbic system, which is situated behind the neocortex part of our brain. The neocortex part deals with conscious thoughts, and on the contrary, the limbic system is studied to be illogical, irrational and unreasonable. From a physiological perspective, emotions are said to occur when the autonomic nervous system (ANS) and our organisms are 'engaged', simultaneously triggering bodily reactions. (Freeman 2000.) Due to this assumpted nature of emotions, they are highly seen dependent on and originated from our body – similar to other phenomenal experiences. Nowadays emotions are often measured through physiological body changes, such as from our heart rate or skin temperature. In the physiological study of emotions, it is common to use 'regions of interests' (ROI's) to extract information from our affective nature with an aim to form some universal patterns from the data recorded. Only in rare cases also behavioural responses are said to reveal the physiological nature of emotions. (Cardone and Merla 2017.) When collecting emotional data, reliability and validity are generally used to measure emotion 'performances'.[32]

[32] Reliability measures "the degree to which our observations about a phenomenon are consistent", whereas the validity of an annotation is "the degree to which the annotation construct measures of the phenomenon we claim to measure". (Yannakakis et al. 2017, 250)

William James (1884) was one of the first philosophers to consider the physiological causes of emotions. He aimed to find "generative principles" of emotion research instead of following the individualistic approach supported by modern philosophers. According to James (as quoted in Scarantino 2016, 11)

> "the bodily changes follow directly the PERCEPTION of the exciting fact and our feeling of the same changes as they occur IS the emotion".

This means that a somehow conscious interpretation of our body is needed in order for us to *define* an emotion. The most important notion by James is that emotions do not cause bodily changes but *emerge* from them. (Scarantino 2016, 11.) Russell (2015, 432) agrees with James, stating that emotions are "internal entities with certain powers, such as the power to cause their own components" (as quoted in Barrett 2017). As an emotion researcher Lisa Barrett (2017) defines, emotion is a "category of instances" with a vast variety that is strongly depended on the given context and time. The context dependency creates a link to our perception which in fact, made James argue that without nothing in sight we cannot learn to feel (as cited in Scarantino 2016).

In addition to the changes in our autonomic nervous system, the neo-Jamesian approach also takes into account hormonal, neural and musculoskeletal changes of our body. Most importantly, neo-Jamesians make a clear distinction between emotions and *feelings*. (Scarantino 2016.) For example, according to Antonio Damasio (1994) emotions are "a collection of changes in body state connected to particular mental images", whereas feelings are experiences of previous emotional processes and have a role in practical reasoning (as quoted in Gustafsson et al. 2009, 54). The constructivist approach by James and Lange better describes this by naming feelings as 'psychic atoms' which are constructed out of basic ingredients (Scarantino 2016).

Scarantino (2016) argues that taking a look again at the history of the philosophy of emotions can reveal some new ideas related to emotion research. For example, he defines three separate definitions of emotions; *feelings*, *motivations* and *evaluations*, that is based on his reading of Aristotle's hybrid division. Finally, he suggests that the failures of accepting a universal theory of emotion can be overcome by changing the 'methodological presumptions' of emotion research (Scarantino 2016, 4).

The interpretation of emotions as mere 'mental images' makes Damasio define feelings as *somatic markers*, more commonly known as 'gut feelings' that are marked either as negative or positive in our memory (prefrontal cortex) to be later used to guide our actions. (Yannakakis et al. 2017.) The common approach in cognitive science states that our feelings as somatic markers do not only to have a crucial role in decision making but rather, they *interfere* the whole decision-making process (Scarantino 2016, Barrett 2017). Interestingly, Damasio's (1994) "somatic marker hypothesis" suggests that all irrationalities between perception and emotions are due to the inability to register options as positive or negative in the 'smart' prefrontal cortex (as cited in Scarantino 2016).

To overcome these paradoxes, humans tend to interpret everything they perceive, and emotions sometimes play a very crucial role in that process. The statement that emotions help us to form representations or 'have objects' is related to the intentionality of emotions. According to Bob Solomon (1973) emotions are similar to other mental states in their intentional nature, and they take objects beyond themselves at least in three different ways. For example, the emotionally affected mental representations can be either about *particular* objects (such as the fear towards a spider) about the *significance* or value of the objects (such as a threat of the spider) or directly, about the *cause* of the emotions that can also be separate from the object and its significance.[33] (Solomon 1973, as referred to in Salmela 2011.) Also many other cognitive theories state that emotions are almost identical to thoughts (Prinz 2014, 9). However, to what extent we could regard *emotions as perception* and what do they have in common?

4.2 Emotions as perception

Emotions role to perception has been found through other approaches and authors as well. In his *Society of Mind* (1986) Marvin Minsky proposed a system of K-lines (knowledge links) to connect different modules with different representations to study our perception.

[33] It has been criticized that this 'overintellectualist approach' taken by Solomon can lead to "the disappearing act" that make feelings disappear from emotions. (Deonna and Scherer 2010, Salmela 2011.) In addition, Solomon aimed to model emotion on perception because of their common feature of intentionality. But as Salmela (2011) asks, is the 'intentionality' enough to regard emotions equivalent to perception?

Later in his *Emotion Machine* (2006), he takes more into account the affective nature of our body and its meaning to perception. Minsky concludes that all emotions are simply different 'Ways to Think', as well as a driving force to activate the different modules and determine the goals to be achieved. (Minsky 2006, Sowa 2016.) According to Minsky, emotions are not different from the processes we define as 'thinking', and most importantly, they work as artefacts to increase our resourcefulness as well as all of those varieties of thinking we call as 'intelligence' (Minsky 2006).

Mikko Salmela, the author of the book *True Emotions* (2014), collects some key arguments that support the view of seeing emotions as one type of perception that arrive from emotions' noninferential structure, their epistemic role, as well as from phenomenology and perceptual system theory (Salmela 2011). He states that perceptual theories of emotions have become popular in the philosophical understanding of emotions, mainly because it falls under the categories of both cognitivism and noncognitivism. The noncognitive approach focuses on the affective nature of emotions processed through our body, whereas the cognitive theory emphasises the intentionality of emotions that affect our beliefs, thoughts and evaluative judgments – "strongly interacting with our reasoning" (Salmela 2011, Minsky 2006). Salmela concludes that by placing perception at the centre of emotion research is a way to get in touch with both intentional and phenomenal readings of our body (Salmela 2011).

The argument that prohibits emotions as a type of perception states that emotions have their own input system and neural pathways, whereas the phenomenological one discerns similarities in intentional, affective and perspectival nature of emotions and perception (Salmela 2011). Jesse Prinz (2014) strongly supports understanding emotions as one large perceptual system composed of both bodily changes and our mental representations. He only draws two distinctions; one between "elicitors of emotion" and "emotions proper", and the other for direct and indirect causes of emotions. Prinz's (2014) concept of *emotions proper* is coming from a noncognitive approach of seeing emotions as indirect perceptions of bodily changes. This could be further analyzed by the *real* and *nominal contents* of emotion, where the real contents represent the mental representations and nominal contents those bodily changes of an emotion. (Prinz 2014 as referred to in Salmela 2011.)

Instead, the ‘elicitation file’ is a notion describing a specific mental state that is capable of internally trigger an emotion when encountered with those previously formed mental representations, without the need of feared cues in sight for example (Prinz 2014, Salmela 2011). In a phobic scenario this would mean that if the elicitation file of fear contains both memories of previous perceptions of the phobic stimuli (i.e. seeing a spider) and the mental representations attached to them as ‘calibration files’, such as danger (i.e. spiders should be avoided), it can cause an affective response in our body by itself. This theory is in align with Metzinger’s (2003), who names the elicitation files as mental representations carrying the information as ‘representatum’ (see Chapter 3).

However, Salmela (2011) argues that emotions can also be seen composed of perceptions of bodily changes alone because those calibration files of mental representations are only causes and not “constituents of emotion”. Hence, for the definition of emotion it does not matter if the affective body response comes from elicitation or calibration file because the *perception* of the phobic stimuli does not trigger the behavioural or physiological response but only the recognition of the content as *fearsome*. Salmela argues that if the definition of perception already entails the recognition of perceived stimulus, “examining the causal-functional role of perceptions and the elicitations files” might become more useful. (Salmela 2011, 9.)

Hence, the debate between the ‘elicitation and calibration files’ will throw us back to discuss the difference between emotions and feelings. The self-perception theory finds one type of phenomenal similarity between emotional feelings and bodily states by stating that we *feel* emotions when we express them (Salmela 2011, 24). As Salmela highlights, these bodily feelings do not enter into our experiences unless they are getting interpreted “as being about external objects or part of an emotion” (Salmela 2011).

Therefore, Salmela suggests that a notion of *emotion perception* should be used to describe how does the mind perceives itself. This process is similar to our visual perception, and more crucially, the real-time comparison between our immediate emotions with previous emotions can also define the ‘emotional intensity’ of our responses. (Salmela 2011.) Hence, the perception in emotional situations composes through the comparison of the occurring direct emotional experience with indirect, previous emotional experience. (Van Boven et al. 2009.)

A recent study tested a hypothesis in VR, asking what if the emotional experience is not triggered only by environmental stimuli, but the brain is playing a pivotal role in regulating emotional experiences based on the perceptions of bodily reactions in relation to the context and environment (see Dobricki and Pauli 2016). The experiment was designed with spatial manipulations in contrast to the sensory input while walking in a virtual environment. The findings suggest that people are not always “stimulus-response machines” but our emotions can be independent of the interactions between bodily and spatial cues. (Dobricki and Pauli 2016.)

Unboutly, the original nature of emotions is always partially involuntary and unconscious but as Greenberg states, the earlier view of seeing emotion fully as ‘post-cognitive’ is inadequate. He continues that emotion can precede cognition, but more importantly, it plays a crucial role in the information processing. (Greenberg 2004.)

Besides, even though we could be able to extract all physiological responses from the body, it is highly possible that the self-reflection of an individual does not correlate with the ‘emotional data’ (Cardone and Merla 2017). Emotions are often understood as tacit knowledge, something that inbounds subjective knowledge and is difficult to describe with words. However, if an individual manages to describe his or her emotions those can be easily named as feelings instead of emotions *per se*. Due to these methodological dissonances, emotions still appear somehow unfamiliar and unresolved for us. As Minsky (2006, 22) states, emotion is only one of those ‘suitcaselike’ words we use to “conceal the complexity of very large ranges of different things whose relationships we don’t yet comprehend”. Unfortunately, the topic cannot be entirely escaped because occupying this world as embodied subjects our affective nature certainly does have an effect on our perception and understanding of the environment, either virtual or real.

Considering the role of emotions for perception is important because as mentioned, also emotions take objects beyond themselves (Solomon 1973). Christine Tappolet notes that “emotions often misfire” every one of us at some point in our life and it does not appear only as a tendency of phobics (Tappolet 2012, 207). She considers if we could define emotions as perceptual illusions, arguing that *recalcitrant emotions* – emotions that conflict with our evaluative judgment – are one type of perceptual illusion (Tappolet 2012, 208).

Applying perception to emotion research in virtual reality may provide some new answers because in general, it does not require linguistic capabilities. As Salmela (2011) argues, we can perceive a propositional content *p* without asserting it through language, that is still both intentional and phenomenal. One exciting division between emotion and mere perception is that we cannot talk about perception without the intentionality as we always perceive *something*. Instead, emotion does not necessarily require intentionality and it can arise solely from our episodic memory. Hence, Salmela concludes that "emotion may allow an analogy with veridical and hallucinatory perception, as some perceptual theorists suggest" (2011, 3). Finally, he argues that even though emotion and perception can be analysed in the same context, emotions cannot be solely modelled on perception (Salmela 2011).

4.3 Fear as an emotion

Fear is often defined as one of the 'basic emotions' by consensus (Ekman 1994; Plutchik 1980). From a physiological perspective, fear is often associated with heightened arousal (as an opposite to valence) which is felt as an aversive subjective experience. It is also seen to be programmed into our limbic system, activating the amygdala region in our brain whenever a person is exposed to a threat. (ibid.) Aristotle defines fear in his *Rhetoric* as "pain or disturbance due to imaging some destructive or painful evil in the future" which is a definition that entails both the evaluative and the constitutional dimension of fear definition (as quoted in Scarantino 2016, 6).

One of the challenges to detect fear comes from its close relationship to anxiety. The philosophical approach states that the difference between fear and anxiety lies in their relation to an object (Ahmed 2014). According to Sara Ahmed, fear has an *object* whereas anxiety has not. Also, the sudden temporal dimension of fear appears when were are exposed to a threat that "projects us from the present into a future". Affective signs from our body, such as sweating, increased heart rate and unpleasant intensity of the whole body prepare us to either flight-freeze-or-fight. (Ekman 1994.) Hence, fear is felt as an intense bodily experience of the present. Ahmed (2014) concludes that we fear when an object approaches us and we anticipate it to hurt us. Therefore, fear as an emotion is often closely related to our intrinsic memory.

The ways of measuring fear vary because as Barrett argues, it does not take only one physical form. For example, a wide-eyed face can be seen as more of a created facial expression that is used as an "instrument of social communication" (Barrett 2017, 11) rather than a sign of fear. Rather than behavioural responses, the activation of the basic biological mechanisms and hormones (i.e. amygdala and hypothalamus) in our sympathetic nervous system enable *thermal observations* of the affective nature of our body, and it is taken more reliable and valid method to measure fear (Cardone and Merla 2017, Yannakakis et al. 2017).

Nonetheless, even after multiple tests with functional magnetic resonance imaging (fMRI), Barrett has not been able to find a correlation between brain regions and fear.[34] She comes into the conclusion that brain operates by "the many-to-one principle of degeneracy, and instances of single emotion category, such as fear, are handled by different brain patterns at different times and in different people"[35] (Barrett 2017, 23).

Barrett in her book new book of *How Emotions Are Made: The Secret Life of the Brain* (2017) even questions the old notion of seeing emotions universal and processed through specific brain regions. She argues that emotions are constructed in a moment "by core systems that interact across the whole brain, aided by a lifetime of learning" (2017, preface). Barrett (2017) also criticises that emotion researchers have been trying to form an objective 'fingerprint' of each emotion that could apply to every individual and cross-culturally. Most importantly, she focuses on highlighting that all common emotion theories combining physiological and behavioural responses ultimately fail to correlate with experimentally collected emotional data. (ibid.) If all of this is true, what could we say about emotions?

[34] fMRI is kept as one of the most accurate and reliable technology for neuroimaging (Williams et al. 2001).
[35] Finally, Barrett escapes from searching fingerprints for emotions and defines them as a 'myth'.

Nevertheless, if we examine fear from the phenomenological and physiological approaches one can be sure of that fear is located in the body, and so is the embodied memory of it. This bodily memory of fear guides our relational perspectives to the environment and plays a crucial role in forming mental representations out of things perceived (Froese and Izquierdo 2018). Moreover, if we agree that also fear is constructed through instances that build up those emotional body loops, it would also mean that it could be broken down through reorganising of our perceptions and mental images attached to them.

4.4 Methods for emotion regulation

Emotions are often seen as useful from the evolutionary point of view. The only risk is that they can turn dysfunctional if they also endure in the circumstances where not especially needed, by taking over our conscious control. (Ekman 1994.) Uncontrolled or misdirected emotions can be a source of irrational behaviour (Damasio 1994, 52 as referred to in Scarantino 2016) and in extreme cases; the affective dysregulation can lead to disruptions that appear as psychological disorders (Parsons and Rizzo 2008).

Hartley and Phelps (2010) state that for healthy and adaptive human function the ability to respond emotionally to “salient cues” in our environment is critical. Affective engagement is said to enhance our perception, facilitate action readiness and decision making, as well as guide our intention and perspective taking (ibid.). Hence, emotional involvement in virtual spaces is important simply for the motivation and curiosity to explore those virtual environments. Moreover, because the feeling of “spatial presence” is an affective emotion by itself, it has been stated that technological engagement already creates a certain kind of emotional experience[36] (Peperkorn et al. 2015). Some studies

[36] During the project in MediaLAB Amsterdam me and my colleagues were conducting an experiment in order to collect heart rate data while the users were playing a scary videogame. The two different conditions were a totally dark room (p=6) and a color-lighted room (p=6) where the colours were changing according to the scaled heart rate changes. The after questionnaire searched to gain knowledge about how the participants felt immersed within these two environments (the room and the game) and did the colours make any difference to the self-reported level of immersion (see Annex A).

also show that virtual reality experiences can increase emotional responses and enhance our perception taking abilities (see, i.e. Estupiñán et al. 2014).

Nevertheless, stronger emotional involvement in virtual spaces can cause a challenge for reading the physiological measurements if we cannot be sure of what is truly the cause of arousal – is it the fear of a perceptual cue or an 'excitement' of the new technological environment? Are the participants more afraid of the technology or the virtual content by itself? On the other hand, the intense feeling of a spatial presence (especially if appearing as an excitement) may show up useful for some mental health applications that aim to modify problematic emotions because at least it shows a positive and opportunistic attitude towards the treatment (Peperkorn et al. 2015).

In addition to the ability of showing 'emotional availability', the capability to regulate our emotional responses is seen as equally important. The notion of *emotion regulation* refers to those regulatory processes that help us to control the physiological, experiential and behavioural components of our affective states. (Hartley and Phelps 2010.) It is also used to describe the individual ability to recognise and guide their own emotions and emotional experiences instead of being a 'victim' to them (Kappas 2013).

Emotion regulation is often contrasted with the notion of 'emotional intelligence' even though neither of them can be learned solely from the books. However, and as we can predict from the definition, the very process of 'regulation' can be suggested to involve our cognition. The interest to study emotion regulation in virtual reality (if not emotion recognition *per se*) is especially important in order to help those individuals who cannot control their own emotions. The individual ability to recognise one's emotions 'accurately' is called as *emotional granularity* that generally develops through inconspicuous practice in our everyday life (Barrett 2017). One of the problems related to emotion regulation might be that we do not experience and *practise* the full scale of emotions anymore in our daily life. For example, we might not need to encounter fear by fighting for our survival in the jungle, but luckily we can live it through by watching a horror movie. This applies to other emotions as well, although the question remains to what degree we can compare the emotional experiences lived through cyberspaces to our physical 'real life' experiences?

It has been studied that several parts of our brain are involved in emotion regulation (Philippot and Feldman 2004). As Hartley and Phelps (2010) highlight, the involvement of individual *mental strategies* to modify the fear response is a part of cognitive emotion regulation. The most common emotion regulation techniques for fear include extinction, cognitive regulation, active coping and reconsolidation. For example, by using the extinction technique fear is diminished through a change in the representation of previously threatening stimulus that will no longer signal danger. (Hartley and Phelps 2010.) Active coping as a method regulates the performance of behaviours that are usually supported by other individual coping strategies. The emotion regulation may happen through automatic forms of regulation by learning to change stimulus-outcome contingencies or through intentionally deployed techniques.[37] Most commonly, all of the techniques apply an instrumental learning process to some degree although only a small number of research has considered fear regulation solely through action. (ibid.)

The reconsolidation method is most strongly supported by the active working memory. During the learning process, the past memory gets disrupted when less fearful information is provided to block the reinforcement process that can lead to 'unravel' the phenomenal body loop with new information (Hartley and Phelps 2010). Because the memory trait is fragile immediately after learning, it is possible to efficiently disrupt the underlying memory link and label new memory during a specific time window. In general, the manipulation of the reappraisal process is taken as a key to alter emotional responses (Hartley and Phelps 2010). These "windows of disruptions", either related to the virtual embodiment or cues in the virtual environment, should be somehow adapted when developing emotional learning environments in VR.

Extinction-based exposure therapies are used for those anxiety disorders which involve dysfunction in some parts of the neural systems kept responsible for fear learning (Hartley and Phelps 2000). Exposure therapy has proven its efficacy, and it is the most common method used in phobia treatment (Hirai et al. 2007, Knapp and Beck 2008) that has also been applied into VR (Parsons and Rizzo 2008). In the famous Pavlovian fear

[37] As Hartley and Phelps (2010) note, even though we might conduct studies in animals considering the neural links of emotions, the emotion regulation is an unique process in large parts for humans because it demands the use of cognitive strategies (such as reappraisal, selective attention and suppression).

conditioning paradigm[38] the previously neutral stimulus (also referred to as conditioned stimulus CS or *cued fear*), such as a tone, acquires emotional significance by pairing with an aversive stimulus (the unconditioned stimulus US or *contextual fear*). After a few repeated pairings, the CS is capable of eliciting a conditioned fear response (CR) by itself (i.e. hearing the tone without seeing the fearful stimulus). Extinction learning, therefore, describes the gradual decrease in fear response with the absence of the aversive stimulus, only when the cued fear is presented (Schafe 2014).

The learning in exposure therapy occurs by forming novel stimulus-outcome associations (Hartley and Phelps 2010). Unfortunately, as we cannot know what are the individual thought processes involved in this change a lot remains a mystery what comes to the individual coping strategies. Highlighting the uniqueness of virtual spaces again, a recent study about experiencing fear in VR conducted by Lin (2017), is offering a fascinating alternative for resolving some of these mysteries. By focusing on individual coping strategies, the experiment found a new coping strategy of "self-talk" that the participants widely applied in virtual spaces by cuckooing *"this is not real"* (Lin 2017, 353). The worth of studying would be if this is a characteristic coping technique especially in cyberspaces, and how it is related to the notion of relativism and Heim's reality anchors (1991) between the virtual and real?

Because the brain is a "supersystem of systems" composed of many networks, it is no doubt that emotions are seen as disrupting our reasoning most of the time. As Damasio states, we easily see emotion as "a supernumerary mental faculty, an unsolicited, nature-ordained accompaniment to our rational thinking" (Damasio 1994, 52 as quoted in Scarantino 2016). Therefore, the ability to understand one's own emotions and separate them from 'rational thinking' – or even become *aware* of them at first hand – can be seen as an enigmatic miracle by itself.

To summarize, emotions are not notably different from other 'cognitive operations' that are also supported by several other mental states. The interpretation of our affective bodily responses (such as the sense of butterflies in the stomach) is often represented in mental images (my attraction to a person) (Philippot & Feldman 2004) that in general

[38] Also referred to as 'classical fear conditioning' to study associative learning in mammals (Schafe 2014).

helps us to make sense of the world, but sometimes can also lead to maladaptive experiences.

4.4.1 Fear toleration or reduction

Virtual reality exposure therapy (VRET) is nowadays one of the 'novel' treatments for different anxiety disorders and specific phobias (Parsons and Rizzo 2008, Diemer et al. 2014, Ougrin 2011). For example, one project under PsyTech has created an augmented reality tool called PHOBOS for mental health professionals developed by psychologists[39], that aims to offer a low-cost and user-friendly treatment for phobias also through mobile technology. Their VR environment for phobias is currently under development and it has an open source code for researchers. It already includes a wide range of different phobias, from social and context-based to a specific type of phobias.

The traditional method of exposure therapy puts the patient face-to-face with the fearful stimulus until the maladaptive responses (either perceived as behavioural, physiological or cognitive) are gone. Most commonly, the treatment can either follow a gradual process named as 'graded exposure', or by making the patient confront the fearful situation directly as "its worst possible", which is called as 'flooding'. (Lang et al. 2000.) Another less known method is called as 'systematic desensitization' where the exposure trials are paired with relaxation techniques (Ougrin 2011).[40] As already mentioned, using distractions during the therapeutic session have proven to be effective for some phobias (McNally 2007) and hence, instead of trying to generate one method for exposure therapy we should study when the distraction hinders the progress in exposure therapy and for what kind of phobias it might facilitate it (Foa and Rauch 2006).

Exposure therapy often works when we get used to to the previously fearful situation (Knapp and Beck 2008). From a phenomenological perspective, this habituation process can also mean that we only need to "learn to endure" and tolerate the fear felt in our body. Due to this feature, exposure therapy has also received criticism because it is presumably a very long process. Moreover, by merely adapting to a fearful situation might not tell us

[39] See more on the website: http://psychologicaltechnologies.com/

[40] This could be set under the same category with distraction techniques and windows of disruption, but note that breaks in the presence (BIPs) have a slightly different meaning.

anything about the cognitive efforts of the patient. New cognitive associations applied to the learning process remain unresolved and we cannot guarantee that they are strong enough to prevent the long-term prevalence once treated. Hence, is the *fear toleration* instead of *fear reduction* valid enough to indicate the successful outcome of exposure therapy? (Parsons and Rizzo 2008.)

As an alternative to exposure therapy, Foa and Rauch (2006) suggest an "emotional processing theory" (EPT) for treating dysfunctional fear, within the change in emotional experience in VR can be seen to happen through the following path:

1. Activation of the maladaptive experience by creating those specific elements and features in the VR environment that triggers fear.

2. Challenging the maladaptive beliefs by offering new ways for self-experiencing which can then be integrated into the existing negative experience. This phase could include some methods taken from the cognitive therapy that are adapted into the VR exposure therapy treatment. For example, because most of our fears are irrational, giving the patient time to reflect and *take new projections in his or her projective transformations*, the maladaptive experiences processed through our embodied cognition could be changed.

3. Accessing the adaptive emotions (i.e. curiousness) and bringing them into contact with the maladaptive emotions (i.e. fear) can help to transform or undo the maladaptive schemas. VR offers the opportunity to bring the adaptive emotions into the same context with the maladaptive emotions, by applying different contexts and elements to the environment. (see Foa and Rauch 2016.)

Some anxiety disorders and specific phobias have been treated with the help of VR by eliciting subjective and physiological reactions similar to real life situations (Diemer et al. 2015). Unfortunately, consistent documentation of the long-term outcomes after the exposure therapy treatment sessions in VR is often neglected. Even though VRET provides some advantages compared to in vivo exposure therapy, such as its reliance on the sensory input instead of mere imagination and greater acceptance among patients, it too often takes its premises for granted. (Garcia-Palacios et al. 2007.) For example, from a meta-analysis consisting of 21 articles related to VRET, Parsons and Rizzo (2008) concluded that common variables are needed in order to indicate the treatment efficacy in multi-centre studies. They highlight that more than the outcome, also the optimal type of virtual reality environment should be documented more in detail for further studies of VRET (Parsons and Rizzo 2008, 258).

4.4.2 Capturing the plasticity of emotions

As aforementioned, VR could be harnessed to measure almost everything from our body and lately, 'emotion sensing' has become a hot topic in the field. For example, the motion tracking cameras have been accompanied with a different type of sensors that send data for artificial intelligence algorithms, which is then translated into our "emotional data". (Pultarova 2016.) The data can be then used to develop our engagement with the virtual space, or as one of the leading companies *Emteq* names their mission – "to enable people to understand their emotional responses".[41]

Physiologically fear is defined as a sympathetic arousal. Therefore, a compelling solution for treating specific phobias and maladaptive emotional experiences with the help of sensor technology can be found from measuring heart rate variability (HRV) (Liu et al. 2013, Nardelli et al. 2015). HRV has been widely used as an indicator of stress since the 1960s and during the past two decades, various studies have shown its potential also to indicate the individual ability for emotion regulation. (Shaffer and Ginsberg 2017.) HRV tracks the neurocardiac functions of our body, which are constantly affected by heart-brain interactions and the processes of our autonomic nervous system. Instead of the basic beats per minute (BPM) measurement, heart rate variability indicates the changes of time between the interbeat intervals (IBIs), caused by sympathetic increases. (Shaffer and Ginsberg 2017.)

HRV might also tell us something about emotions in general because emotions can be viewed as a reflection of "the status of one's ongoing adjustment to constantly changing

[41] In https://emteq.net/ (Accessed 12 September 2018).

environmental demands" (Frijda 1986). Higher HRV is studied to signal "the availability of context- and goal-based control of emotions" (Thayer et al. 2012). Moreover, it is associated with a smaller negativity bias, more rapid extinction in an interoceptive fear conditioning paradigm and willingness to take a positive approach (Shook et al. 2007). Similar to our heart, also our emotions are forced constantly change according to the environmental conditions. It has been stated that a healthy heart is not a "metronome" but rather a "mathematical chaos" of interbeat intervals (Shaffer and Ginsberg 2017).

On the contrary, lower HRV can indicate some degree of 'laziness' in the emotion regulation system. Studies show that people with low resting HRV also have delayed recovery from psychological stressors in comparison to those with higher levels of resting HRV. (Liu et al. 2013, Thayer et al. 2012.) Hence, higher HRV might be a critical system to help us to adapt to the environmental and physiological changes (Shaffer and Ginsberg 2017), and some even argue that HRV tells us more about the state of *mind* than the state of the heart (Thayer et al. 2012).

Even though HRV might offer us some information about individual abilities for emotion regulation, it could be recommendable to also search different methods to measure the level of self-presence and immersion towards the virtual space. For example, for the treatment of a specific fear which is assumedly specified also by the subjective self-reporting[42], the eye-tracking technology applied to the VR headset could probably give additional information value about the feared cues.

Unfortunately, as Barrett's carefully conducted meta-analysis shows; currently none of the existing computational emotion models manages to prove their coherency when physiologically tested with the help of different sensors (Barrett 2017, 14). Hence, I will not claim that fear could ever be recognized solely by physiological measurements (also due to its close relationship with anxiety). Instead, I do believe sensor technology could be integrated into emotional experiences in VR to collect data and information about

[42] However, Metzinger do not support self-reporting in emotions because we do not yet know how does the personal-level ownership of one's subjective experience appear, nor "how one can conceive these representational states in the brain as being, at the same time, object-directed and subject-related" (Metzinger 2003, 34)?

those ‘emotional windows’ for disruption of the previous memory and enhancing new learning.

To summarise, it is not recommendable to blindly trust any sensor technology developed in VR for emotion recognition. Even though the most advanced devices can track almost everything from our affective nature, the ‘architecture’ of emotions is too complex and differs individually preventing to form reliable universal “fingerprints” of emotions (Barrett 2017). However, as Barrett (2017) argues, from the collection of instances together with machine learning techniques there might be a possibility to form *individual fingerprints* for emotions – depending on the given time and effort.

4.5 Looping of the body and mind

According to Barrett, also emotions take mental representations as *emotion concepts* when they are getting registered into our memory. She argues that a describable emotion is “brain’s creation of what your bodily sensations mean, in relation to what is going on around you in the world” (Barrett 2017, 31), which something we learn to describe as words. Upon the constructivist approach, Barrett develops the *theory of constructed emotion* which states that emotions are not reactions to the world and individuals are not passive receivers of sensory inputs. Instead, everything is constructed. Due to this reason, if we want to “grasp the origin of emotions” everything needs to be broken down step by step.[43] (Barrett 2017.)

As she (2017) highlights, if we genuinely want to understand emotions, we must take *the collection of instances* seriously. Only immediate emotional experiences can be considered as truly phenomenal because they are directly experienced and perceived. At least, immediate emotions quickly capture our attention and for example, we tend to detect emotional stimuli more rapidly than neutral stimuli. (Van Boven et al. 2009.)

[43] Therefore, also the challenge of emotion recognition gets a new formation by stating that emotions and emotion theories cannot follow a linear, “cause-and-effect storyline”. On the contrary, variation will always be a norm in emotion research. (Barrett 2017.)

However, this often leads to "immediacy bias" which argues for the bigger intensity of immediate emotions in contrast to the previous ones which are often felt more salient, highly involving our cognition and giving emotional information. Bechara et al. (2000) state that once the emotion is learned it is possible to experience it again with a *fainter* image of an emotional body state that forms an "as if body loop". Therefore, even though the somatic signals are integrated into the structures that appear as physical states, they do not necessarily need to originate from the body (Damasio 1994).

In order to better understand the relationship between phenomenality and constructivism, Kreuter and Moltner (2014) aim to examine "the phenomenology of adapting or not adapting well to stimuli" by suggesting new strategies and key concepts of schema-focused therapies for individuals suffering from maladaptive schemas. They define *schemas* as psychic structures that are playing an important role in maintaining our mental states, and which manifest themselves through our memories, emotions and perceptions. A *schema* in cognitive science describes the "structure, theme, or pattern of cognitive content" or a blueprint of subjective experience. "Maladaptive schemas" then are schemas that are seen to cause cognitive or behavioural dysfunctions, such as exaggerated fear reactions. (Kreuter and Moltner 2014, 7.) Nonetheless, because schema is a notion used to describe our mental processes the definition of body loop would better highlight the phenomenal, yet still constructed, embodied nature of our schemas.

To understand from where the emotional body loops arise is especially problematic when we try to regard emotions as perceptions in *dysfunctional* situations of emotional system. The dysfunctions in perceptual systems can be either caused by failures in the "hardware" (i.e. due to physical brain damages) or as more commonly, by the misconnections in emotional "software" (the phenomenal body) which is the typical case in phobias. (Prinz 2014, Salmela 2011.)

The failure in the software is caused by those 'calibration files' but as Salmela notes, they "can be changed through *learning* and *experience*, which brings some degree of plasticity and normativity to our emotional lives, as we are responsible for our emotions to the extent we can control them" (Salmela 2011, 6, italics added). As presented, in specific phobias where the fear is somehow (consciously or unconsciously) getting marked to the perceived stimulus, it will automatically trigger an emotional body loop whenever a person is confronted with the fearful stimulus. The question remains then how we should design new learning methods in VR that encourage us to bring the needed plasticity to our perception, in order to break down the looping?

In conclusion, we can state that only *immediate* phenomenal emotional experiences have the potency to modify previous emotional experiences. Another interesting notion is that not even all perceptual failures are caused by “hardware” dysfunctions like some visual illusions show us (Gura 2017). The underlying question related to perception goes then back to the previous consideration about should we be enforced to think all reality is a mere illusion, constructed by ourselves? And moreover, are emotions enhancing or preventing us from seeing the alternative realities in virtual environments?

In the next chapter, I will argue for harnessing virtual reality for deep experiential learning in fearful situations. Because only through direct emotional experiences we can run a change and possibly break the individual emotion concepts and body loops, VR is as a unique environment full of opportunities for modelling new ‘cognitive designs’ of learning. I have chosen to focus on Stellan Ohlsson’s *Deep Learning Hypothesis* together with the ideology of ontological design. In addition, I am also about to refer to Thomas Kuhn and his notion of “structure” and paradigm shifts approached from the context of VR.

5. DESIGNING VIRTUAL REALITY FOR DEEP LEARNING

This thesis has formed a few assumptions and statements about our emotions, perceptions and embodiments, and in general about how do we adapt and habituate ourselves into the technological world. First of all, the constructivist approach understands perceptions and emotions as individual constructs where variation is seen as a norm. Secondly, emotion and perception are not independent mental states but instead, they are overlapping with each other and also highly involved with all other mental processes through the most complex imaginable ways possible. Thirdly, humans are embodied creatures within spaces and everything we experience should be grounded on the phenomenological understanding of our cognition. Upon this framework, I have also questioned the flexibility of our mind and body that could help us to overcome the mental, physical and emotional boundaries – and unravel the phenomenal body loops in virtual environments.

Finally, as a major of media it makes no sense to go more deeply into the theories of cognitive neuroscience, psychology or behavioural science to highlight the most relevant aspects for virtual space design. Instead, I aim to form some new perspectives upon the phenomenological and philosophical understanding of technology that are applicable especially when we consider VR as *a cyberspace* instead of a mere interface or a tool. Expanding the ontological nature of VR, I will argue in this chapter how virtual reality could be harnessed to form new emotional experiences through *deep experiential learning*.

5.1 Cognitive architectures

The balanced relationship between perception, emotion and presence is told to identificate the most relevant aspects for designing emotional experiences and experiential learning moments in VR (Diemer et al. 2015). As introduced, the physiological arousal state of our body is a trackable dimension indicating our affective experiences and it could also be modelled to measure the degree of our involvement in cyberspaces. For example, by tracking the arousal state with the help of sensor technology, we could measure the most 'strongest windows' for emotional experiences in virtual spaces and apply it to the space design (Peperkorn et al. 2015).

Moreover, because perception has a crucial role on eliciting emotional reactions, also the relationship between perception and *information as perceptual cues* on emotional experiences should be taken for more profound analysis during the design process (Diemer et al. 2015). This means that human consciousness cannot be understood by solely tracking and breaking down the core systems of the brain because all those brain processes also involve the presence of things in the *space* (Pepperell 2003, 13). Luckily, VR is offering a platform where we can easily limit the intensity of information in the space so that our perceptions become more analyzable in comparison to the physical world. For example, with the help of eye-tracking technology, we can gain more information about the perceptual cues that trigger emotional reactions.[44]

Of course, there remain some concerns considering the space design, such as the individual contextualization of events (see Chapter 3 and the concept of reality tunnel). Fuchs (2007) also states that our implicit memories constitute a "relational field" that works like a filter through which we relate ourselves to things and to people. Heidegger already highlighted that this does not only apply to the physical objects and our coherence with those objects within we live, but we should look at our engagement with the world in a referential context or preferably as a *referential whole* (as referred to in White 2018, 132). This referential whole includes the sounds, smells, temperature and texture of the spaces, among others. For example, researching the role of perceptual cues to trigger

[44] During the past few years, many VR companies (i.e. *Tobii*) have been trying to develop working models for eye tracking technology. However, many ethical questions arise from its applications such as biased moral decisions (see more in Pärnamets et al. 2015).

emotions one of the leading companies in the field, *Liminal VR*[45], has been investigating the role of colours and music in emotional experiences. Hence, in the design phase one should remember that all the spaces around us – either virtual or physical – are never objective or neutral.

The design of virtual reality could be argued to be mainly about the design of our cognition. In modern cognitive science the well-established definition of "cognitive architecture" was first introduced by Allen Newell that got later developed by John Anderson (1983) who defines it as a theory of "the basic principles of operation built into the cognitive system" (Anderson 2007). Hence, a deep understanding of systems is the core ideology of *architecture.* As Brooks (1962) describes*,* architecture is "an art of determining the needs of an user of a structure and then designing to meet those needs" (as quoted in Anderson 2007). Unfortunately, due to this imperative definition, it does not fit into the ontological design approach where the designed structure of the cyberspace changes directly when we step into it, simultaneously changing also ourselves and our needs.

In addition, if architecture by definition means as trying to fix a problem of how a structure achieves a function (Fisher 2016), the complexity of the neurological architecture of our cognition (referred to as *degeneracy* in neuroscience) still leaves many questions about our cognition unanswered. Like Barrett and Minsky would agree, the different building blocks as *core systems* simultaneously contribute to many different mental states, including thinking, feeling, seeing, remembering and experiencing. (Barrett 2017, Minsky 2006, Nasoz et al. 2003.)

Instead, the notion of 'Post-Architecture' could be more suitable in this context to describe the fluid and continually adapting structure of (virtual) spaces. According to a VR developer Daniel Fraga, Post-Architecture is an ontological design method that "measures ontological creativity" (Fraga 2016). For him, the main objective of Post-

[45] The main objective of Liminal VR is to develop virtual reality experiences and environments where the participants can take conscious control over their emotions. In http://www.liminalvr.com/ (Accessed 12 September 2018).

Architecture is to create intimate and personal heterotopias[46] that will set our "baseline reality tunnels" in crisis (ibid.).

Post-Architecture is fundamentally a holistic approach within the individual appears as a *Gesamtkunstwerk* – a universal artwork. Fraga agrees with Heidegger stating that virtual reality should be harnessed and designed to make us question the baseline reality tunnels by immersing the participants into 'disruptive reality tunnels' where they "can undergo a change through their own mental states". (Fraga 2016.) This implicit change can occur with the help of well-designed artefacts in VR that the participants could use to affect their constitution of reality "by means of space-related choices". (Fraga 2016.) The ideology of Post-Architecture does not demand a well-structured understanding of our cognitive systems, but instead, it relies on and accepts the fluidity and active agency of the participants.

5.2 The learning paradox

> "We live in a world in which change is no illusion. Adaptation to this world requires cognitive capabilities over and beyond those implied by the traditional view."
>
> Stellan Ohlsson (2011, 4)

According to Stellan Ohlsson, learning to adapt to the changing environment and live in a 'turbulent world' is not like "figuring out how a clock works" but more like "playing Meta-Chess" where every single move also changes the rules of the game (Ohlsson 2011, 18). Heidegger already realized that when reality changes so does our thinking, which made him to connect *being* with time (Heim 1993, 56) and understand that the individual reality consists of only here and now. In addition, Kolb (1984, 1) highlights that human survival depends on our *ability to adapt* "not only in the reactive sense of fitting into the

[46] *Heterotopia* is a concept brought by Foucault (1990) used to describe "a place of otherness" showing us how a society is structured. According him, heteropias are neither concepts nor 'things', but "as places which get their significance from discursive practices dealing with the 'things' and human beings". (as cited in Kraus 2016, 24.)

physical and social worlds, but in the proactive sense of creating and shaping those worlds".

Moreover, Ohlsson argues that if change is the only constant and thoroughgoing, also the rules that execute the change must themselves be changing (Ohlsson 2011, 21). For him it is not a surprise that all emotion researchers, as well as many other laboratory scientists, have failed to "conform to the rules of the clockwork game" and find fingerprints for emotions. He argues that even in our everyday life all complex and unpredictable systems are pervasive, whereas clockwork systems are rare (Ohlsson 2011, 19). As already mentioned, even a healthy heart is not a metronome so how could be our emotions?

The traditional method of exposure therapy only teaches us to adjust to fearful situations and tolerate the unpleasant emotions. Hence, the learning process of exposure therapy demands that the participant needs to go through a change because the reality by itself will not change. Nevertheless, Ohlsson criticises that as long as we regard change as *an illusion*, where the environment and reality are always understood by the clockwork mind-sets, we can only learn "by accumulating experiences, analyze them to identify the regularities, project those regularities onto the future and act accordingly" (Ohlsson 2011, 16). The cognitive capabilities needed for this type of learning include the activation and use of our active *episodic* memory, which is the very same one that help us to form abstractions, concepts and generalizations (Ohlsson 2011). But is this kind of learning, based on building new concepts and 'Objective Thoughts' driving us any further towards a balanced emotional life?

As aforementioned, this kind of adaptation or fear toleration as a 'learning process' does not reveal anything about our mental processes expect the involvement of our episodic memory. Therefore, the different type of individual coping methods and mental strategies used in order to "magic" the feared stimulus as non-fearful stimulus will remain as a mystery.

Nonetheless, Ohlsson notes that if we would like to follow the clockwork approach all of our past experiences are useful for the general knowledge that also controls our future experiences. From the past information built into our memory, we tend to 'predict' the future and what is happening around us. This process is generally called either as a transfer, an induction or *a projection*. (Ohlsson 2011.) Not surprisingly, for Ohlsson this process of mental projection can be seen as a problem when treating specific phobias (2011, 20) however, it is still needed to bring us back to the original context of the fear before the *change* can happen.

Therefore, the paradox we need to overcome in VR is the fact that our prior experiences are the only source of expectations and guide to the future (Ohlsson 2011). This *learning paradox* could be understood similar to the 'discovery paradox' because discovering as a process also demands to absorb conceptually more complex structure by using previous knowledge (Paavola 2001). Learning is a holistic process but as Kolb states, the *experience* is the key:

> "Immediate personal experience is the focal point for learning, giving life, texture, and subjective personal meaning to abstract concepts and at the same time providing concrete, publicly shared reference point for testing the implications and validity of ideas created during the learning process" (Kolb 1984, 21).

Experiential learning can be contrasted with *implicit learning method* within the learning process of complex information is argued to happen unconsciously by gaining abstract knowledge (Reber 1989). For example, the learning processes of basic human functions from walking to language, are told to happen implicitly with a stronger involvement of our working memory and attention than in explicit learning (Slater 2017, 25). Our implicit memory is influenced by our whole history of engagement with the world and interactions with others that unconsciously guide all our actions. Because those experiences in the world are formed through the body, we could also name it as a *body* or *'intercorporeal' memory.* (Froese and Izquierdo 2018.)

To overcome these paradoxes of learning and discovery, Ohlsson (2011, 21) suggests *deep learning* to override those predominant misleading experiences based on the act of considering "actions other than those suggested by the projection of that experience on to the situation at hand". The main idea of his 'Deep Learning Hypothesis' is that we also need *non-monotonic* learning mechanisms to override experiences, which for Kuhn is known as the "essential tension" (1977).

Ohlsson's explicit statement about 'The Deep Learning Hypothesis' goes as follows:

> "In the course of shifting the basis for action from innate structures to acquired knowledge and skills, human beings evolved cognitive processes and mechanisms that enable them to suppress their experience and override its imperatives for action." (Ohlsson 2011, 21.)

For Ohlsson, the process of adapting to the changes in the environment (learning) and the "deliberate inition of change" (creativity) have a strong connection. The Deep Learning Hypothesis by itself does not offer any solutions for changing behaviour or phenomenal experiences but rather, it offers a new perspective for running a cognitive change. (Ohlsson 2011, 23). By neglecting direct experiences, or simply interrupting them with 'rational reasoning', affects how we will relate to the changes of the world around us (Ohlsson 2011).

Hence, before adapting ourselves to deep learning mechanisms we should consider how fully are we exposing ourselves directly to new experiences without interfering them with 'rational reasoning' or conceptualisation. Are we be able to let ourselves experience and perceive the world and forget the interpretation processes for a while? If not, could we at least learn to adapt to more creative perception takings through VR?

Slater (2017) names a few reasons why VR could be used for educational learning which also apply to some extent in experiential, emotional learning. First of all, VR can transform the abstract into concrete experiences and perceptions. Especially in logical fields, such as in mathematics, the complex and abstract systems can be learned more easily in "virtual playgrounds" (see, i.e. Hwang and Hu 2013). Secondly, the participant of VR is most commonly *doing* instead of observing, thus enabling "hands-on training". Thirdly, all those things that "previously seemed impossible" turn out to be practical, such as travelling around in virtual worlds – or embodying different bodies and perspectives that we do not yet have a previous intercorporeal memory from. (Slater 2017.)

In addition, in VR the participant can travel beyond reality and explore different manipulations of it (Slater and Sanchez-Vives 2014) which can also enable developing new experiential learning mechanisms. For example, Slater (2017) mentions that manipulations of the parameters of reality, such as Einstein's theory of relativity, could be modelled and experienced in VR. She criticises that we often see only the technological advantages of VR, forgetting the new pedagogical affordances when designing new virtual learning environments. Finally, she questions if the learning experiences conducted in VR could deepen our understanding through exploration and encouraging us for journeys of discovery? (Slater 2017.)

Related to the art of recontextualisation, Anja Kraus (2016) integrates the question of *"What do the things show us?"* to a learning context where we commonly supposed to have definite answers. As Kraus highlights, the common ideology of learning may limit the spectrum of possible answers and strengthen the existing social power structures. Consequently, the concepts difficult to describe or those that are continuously perceived differently are providing more than only one answer and can leave us in doubt. Hence, Kraus suggests an *explorative learning method* and adapting a displacement strategy in order to get used to perceive the things from different angles where 'situatedness' naturally is the key. According to Kraus (2016), the perspective on the 'things' and the 'order of the things' is not determined by their material qualities but primarily by their socio-cultural significance.

Upon this theoretical background, Kraus introduces a displacement theory developed by Christiane Brohl (2003) who implies an art-didactical strategy and a form of learning. As in the case of arts, when we displace the 'things' into another location we free them from their original contexts through recontextualisation. The displacement makes us reflect or question the 'things' in their familiar discourses that can help to form new understandings of the 'things'. Learning as a displacement can be described as

> "the dislocation of a well-known fact or 'thing' into another material or discursive context. By being relocated, the fact or 'thing' changes its meaning and significance. Displacement can be described as a researching learning in the situational context of locations, things and discourses." (Kraus 2016, 27.)

Kraus argues that by using displacement strategy, the intrinsic value of the 'things' eventually becomes visible (ibid.).

Virtual environments offer a playground for recontextualising both ourselves and the things around us. Depending on the creativity of the space design one could study for example, would the fear reactions diminish if the participant would see the fearful spider being drowned in the full glass of water? Alternatively, what if the virtual space would be first filled with full of spiders, exposing the participant to its worst possible, would the one spider in sight after be still able to trigger a fear reaction?

5.3 Hermeneutic circling – VR as a strange tool

"Create or be created, this is the name of the game"

Daniel Fraga (2017b)

I introduced a hypothesis of what if we could transform ourselves to embody the feared stimulus by itself in VR. Some of the concerns related to this phenomenal embodied change are already mentioned above, such as the level of the sense of agency, body ownership as well as the motivation of immersing ourselves to new environments for journeys of discovery. The yet unanswered question is if those 'manipulated' embodied first-person perspectives in virtual reality are capable of revealing that the body as an object only "belongs to a derivate ontological plane, one that emerges from the primordial subjectivity" (Hansen 2006, 11). Could the disclosure of the body as an egocentric perspective taking zero point help to understand the origins of our phenomenal body loops, and the meaning and importance of recontextualisation?

Radicalness seems to be the key as the case studies reveal. By designing highly sophisticated VR manipulations Sanchez-Vivez and Slater (2014) believe in using it as a practical tool in cognitive neuroscience to study the importance of embodiment in perception. Moreover, they argue that VR will help to uncover "the striking plasticity of the brain with respect to body representation" and encourage us to think and design phenomenologically. Align with Kuhn they state that only through the paradigm shifts we can find more information about how does our mind work. (Sanchez-Vivez and Slater 2014, 28.)

Merleau-Ponty points out that if we are to make sense of perception "as seeming to be a direct manifestation of the object itself" we need to have direct knowledge about such manifestations gained through our experiential life (Jensen 2013, 50). However, this is a partial paradox because we normally cannot gain a direct information in a phenomenal sense about the perceived object and therefore, it remains as a 'mere appearance' and similar to hallucination (Jensen 2013, 49). The primordial dimension of the living subject can only be "felt from within" (Hansen 2006, 12) that leads to Gura's (2017) conclusion of "the only way to know the thing is to be a thing". The hypothesis about embodying the feared stimulus by itself suggests that we could gain at least a new zero point for perception and hence, a new experience, which can be independent whether we feel embodied to it or not. Instead, the sense of embodiment towards the feared stimulus would then again argue that we get direct information about that object.

Even though virtual reality has been widely applied to psychological health research and seen as a 'tool' for treating psychological disorders, it should primarily be understood as *a channel for experiencing*. As White (2018, 130) argues, we can easily get a similar type of 'sense of different worlds' in virtual spaces than through the art. Similar to art, virtual spaces can shape and be shaped by the environment within they are created and received that builds up a so-called *hermeneutic circle*[47]. (Willis 2006.) As Heidegger (2003) states that "great art discloses a world in which we can live" (as cited in White 2018, 128) which furthermore makes Noë (2015) describe art as a 'strange tool'.

VR often manages to shake and shape our reality tunnels and 'worldhoods'[48] and therefore it provides a platform for the ontological design that we could also refer to as *worlding* (see Heidegger 1927). According to Willis (2006, 84), worlding accepts 'the circularity of being' by refusing to frame the human subject according to environmental determinism and instead, it understands 'human' and 'world' as the same entity. As she concludes, "ontological designing is a way of naming particular situated instances of

[47] According to Willis (2006, 83), "hermeneutic circle is a way of explaining a structural condition of being-in-the-world".

[48] *Worldhood* is a concept created by Heidegger that integrates his two notions of *Dasein* ('being') and *Welt* ('world'), describing the circumscribed, situated and multiple nature of our world(s). However, it cannot be contrasted with the individualised notion of "world view" but rather it means the "existential structure of Dasein" and "the final concept of world" – ontologically understood. (White 2018, Cavalier 2018.)

worlding" (2006, 84). In addition, because human beings occupy space through the embodiment and mental activity, "*space* could be considered as the product of an embodied mentality" (Willis 2006, 86).[49] Hence, everything around us is constructed through own perceptions and *designed to design* us.

Design is seen different from the science itself because design is brought to solve undefined problems, concerning "how things ought to be" whereas science keeps describing how things are. Therefore, design could be understood as "knowing-in-action" where we respond to things that emerge as "reflecting-in-action". (Willis 2006, 90.) According to Donald Schön (1983), reflection-in-action is to become a researcher in the context practised and construct new theories (as cited in Willis 2006). Willis argues that reflection-in-action also accumulates to situated experiences and pre-ontological understanding supported by Heidegger. (Willis 2006.)

The ontological approach to design takes into account our being-in-the-world as embodied and situated agents within the hermeneutic circle. In other words, this means design never ends because "worlded-ness is ever-present and is ever-animated by hermeneutic circling" (Willis 2006, 95) and design by itself designs, being much stronger than the claim of design to 'have an influence on' (ibid.). Moreover, the hermeneutic circle does not give primacy to objects, methods, strategies nor agents in the design process (Willis 2006). This means that the 'certainty of a particular outcome', defined according to the designers' intentions and validated through scientific experiments, fades away when we apply an ontological design approach and hermeneutic understanding to virtual spaces. Finally, reflection-in-action turns into knowing-in-action.

In conclusion, as a cyberspace for experiencing, virtual reality could be understood as a 'strange tool' – an interface for reorganising us as human beings and "making sense of the various ways we are organised" (Noë 2015, xiii). The successful outcome of VR is then if we manage to immerse and reorganise ourselves into the hermeneutic circle of worlding, start to question our established reality tunnels and challenge our concepts through recontextualization.

[49] Heidegger's *'Building Dwelling Thinking'* (BDT) also relates to the activity of humans to find and join spaces (see more Willis 2006, 87).

6. CONCLUSION

"If science was uncovering the 'truth', the 'reality' of the world, then it could for example be argued that scientific reason would provide the best guide to creating a human world that fitted the reality discovered by reason."

Schostack and Schostack (2012)

The primary objective of this thesis was to offer explicit thought-experiments of how could we benefit from the technological development and evolution in order to break the existing scientific paradigms. The focus was on virtual reality and human emotional experiences, examining the plasticity of our embodied cognition and perception. The need for active inquiries in the field of affective computing was highlighted because as Sherry Turkle (1995, 265) notes, during the era of machines – "when we start to feel fragmented as individuals" – human brains and computers together can "contribute to a larger evolving structure that try to put the world back together". The human agency in virtual space design was underlined in order to avoid cyberspaces to reduce us as "bodies-in-code" (Hansen 2006), appearing as mere information (Turkle 1995, 238) waiting to be created by machines (Fraga 2017b).

In the course of the writing process, I was privileged to get feedback from few people outside of the university, and even outside of this Western 'scientific bubble'. One of them, an Indian designer Vibhav Kamat, always managed to challenge my way of thinking with well-grounded arguments. For example, to overcome negative emotions, he commented:

> *"More the fear is entertained, the more it will grow. There is no way a person can be treated to become fearless by using toys. Fear will go away only when the person has no choice left but to deal with it in actuality and move on. It is ironic that as we are striving towards building a more secure environment, we are becoming more fearful than ever before. And we have reached a point where the majority of fears are figments of imagination, not genuine."* (Vibhav Kamat, 2 June 2018.)

Hence, if we take virtual reality as a technological tool for treating negative emotions for granted – without considering its ontological nature as Heim consistently does – it can result in very opposite consequences than expected. Although 'entertaining fear' is also a well-known genre in the general Western mass media outlet, yet no consensus can be drawn about its consequences. What could be sure of is that majority of our fears nowadays are mere "figments of imagination" and purely irrational, such as the fear and phobia of spiders.

In addition, while we were talking about the universality of emotions and emotional fingerprints, Kamat argued that

> *"Emotions cannot be isolated from the experiential context of the person and the person cannot be isolated from the ecosystem. Thus a theory of emotions if at all has to emerge, it has to be integrated with an understanding of the human ecosystem"* (Vibhav Kamat, 2 June 2018).

I find it interesting that Kamat is using the term 'ecosystem', although it comes to align with the theory of emotions as social constructs and ways of communicating in the given *context* and thereby involving also our cultural differences. However, if we consider virtual reality as a new ecosystem on its own, does it mean it will also drive us away from those emotions we experience in the physical 'real' world? In addition to those 'reality anchors' that are kept to divide these two worlds, do we also establish *emotion anchors* when we step into cyberspaces? As mentioned in Chapter 4, even the spatial presence in cyberspaces is argued to be an emotion by itself, and hence, the risk is to automatically relate the arousal states and emotional data of VR to the emotions studied in the physical world.

The methods of exposure therapy were criticised because most commonly the treatment does not aim to reveal those individual mental strategies used to deal with negative emotions but instead, it only cares about the 'successful outcome'. The counterargument stated that VR could, and should, be used to study more about those mental learning strategies by exploiting different space and interaction designs. The active agency also applies into emotions, and in order to build up emotionally healthy lifestyles we should be aware of, to tolerate and to regulate negative emotionality as well as enjoy positive emotionality (Frijda 1986). We could still define VR as a tool but it should not become the doctor.

Emotional knowledge and the awareness of an emotion can be understood in several different ways (Bechara et al. 2000) and by playing with time windows and fear related cues in VR we could more investigate the most fragile connections between our fear memories and embodied experiences. Even though one might always need to compromise and work only with harsh assumptions of emotions, at least trying to understand the participants' emotions within virtual spaces and detecting emotional availability through sensor technology could enable us to develop more effective learning solutions. Furthermore, new cognitive designs for learning in VR could also help to examine the plasticity of our mind and body, as well as enable to build a better theoretical framework between the sense of embodiment and the plausibility illusion (Lin 2017).

Many might disagree with my research method based on theoretical analysis and problematization, wherein the experimental results are appearing only as sample 'proofs' supporting the intertwined theories. However, Kuhn in his *The Structure of Scientific Revolutions* (1962) mainly focuses on explaining the dynamics between normal and revolutionary science and how paradigm shifts occur. For example, his notions of structure challenges the previous and 'traditional' way of seeing scientific knowledge build in a linear manner according to experimental results. Kuhn argues that scientific knowledge only evolves through *nonlinear* radical and complex new 'revolutions' that will replace whole systems confirmed by theories and concepts validated with experiments.[50] (Kuhn 1962, as cited in Kreuter and Moltner 2014, 8.)

As Paavola (2001) notes, the process of *discovery* has sometimes gotten more attention even in education and cognitive science than in philosophy. He argues that the curiosity to understand our modern knowledge society also forces us to conceive learning as "analogous to processes of active inquiry". Similar to learning, discovering has a paradoxical nature because it is arriving from the existing theories but on the other hand, it also involves sudden 'moments of insights' that result from creativity. First of all,

[50] Similar to Kuhn, also N. R. Hanson was looking for a logic of scientific discoveries during the 1960s, reaching a conclusion that all new scientific discoveries should be *conceptually* analyzable (Hanson 1972, as referred to in Paavola 2001).

overcoming these paradigms will demand us to avoid dichotomies and instead, “apply all our capabilities from insights, innovations and emotions to hard work, logic and tradition” (Paavola 2001). Therefore, we need the “essential tension” (Kuhn 1977) to combine both ‘divergent’ and ‘convergent’ thinking, in order to come up with innovations (as cited in Paavola 2001).

It has sometimes been hard to draw a line between the convergent and divergent thinking, mainly because most of the authors I have referred to have already successfully applied the methods of active inquiry and problematization. Heidegger’s notion of deploying virtual reality to reveal alternative truths, Barrett’s reading of emotions as individual constructs and Fraga’s concept of Post-Architecture in virtual design, are all hypothetical thought experiments not yet ‘proven’ by common science but fighting against existing theories and creating those essential tensions. Their importance cannot be neglected because by exclusively accommodating to the structures of conventional science and building mundane virtual environments that simulate our real world cannot be regarded as an anomaly, capable of breaking the existing paradigms.

The same applies to our emotions and understanding of reality. We need more radical design and disruptive reality tunnels, not only in cyberspaces but also in scientific research in order to understand the complexity of our humanity. Finally, we should understand the difference between virtual and real worlds and not compete with them but instead, try to get the best out of both (Turkle 1995, 238).

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ANNEX A: Fear arousal detected by a heart rate sensor and colours affecting the immersion

This experiment was conducted by me and my former colleagues, Agnetha Mortensen, Christiaan van Leeuwen and Yuijie Shan, during our VR project for Triple and MediaLAB Amsterdam. Only results relevant for this thesis are anonymously presented. See the full project site: https://medialabamsterdam.com/blog/project/vret/

Set up:
An isolated room with a computer, headphones and joystick. The task of the volunteers was to first watch a calming video (5-10 min) in order to set the baseline for the heart rate sensor and then play a scary videogame called *Slenderman* (10-20 min), either in a fully dark room or in a changing colour-lighted room. The heart rate sensors applied included MioLink and Garmin Forerunner 35, the latter one only serving as a comparison for the heart rate data collected. The baseline trial and the experiment session were fully recorded.

We got total amount of 12 people to participate in the experiment, 4 male and 8 female. However, the final number of valid data we took into account was 10 (4 male, 6 female) in division of 5 for both control groups (darkness/colours). The age of the participants varied in between 22-30.

Objectives and research questions:
a) Does color light feedback alter the immersiveness of the users?
b) What is the maximum heart rate BPM (in comparison to the baseline) when the users are exposed to fearful stimuli?

The individual test planning:

Time (mir	What	Tools
5	Introduction and instructions	Personal talk
5	Pre-survey and consent form	The survey + pen
5-10	Baseline trial: Watching a calm video	Soothing movie/ soothing experience
10-20	Experiment session: Playing scary game to get physiological data	Mio Link + RGB light with remote + recording equipment
5	Post-survey	The survey + pen

Total 35-45 minutes per person.

Playing a scary game in a color-lighted condition:

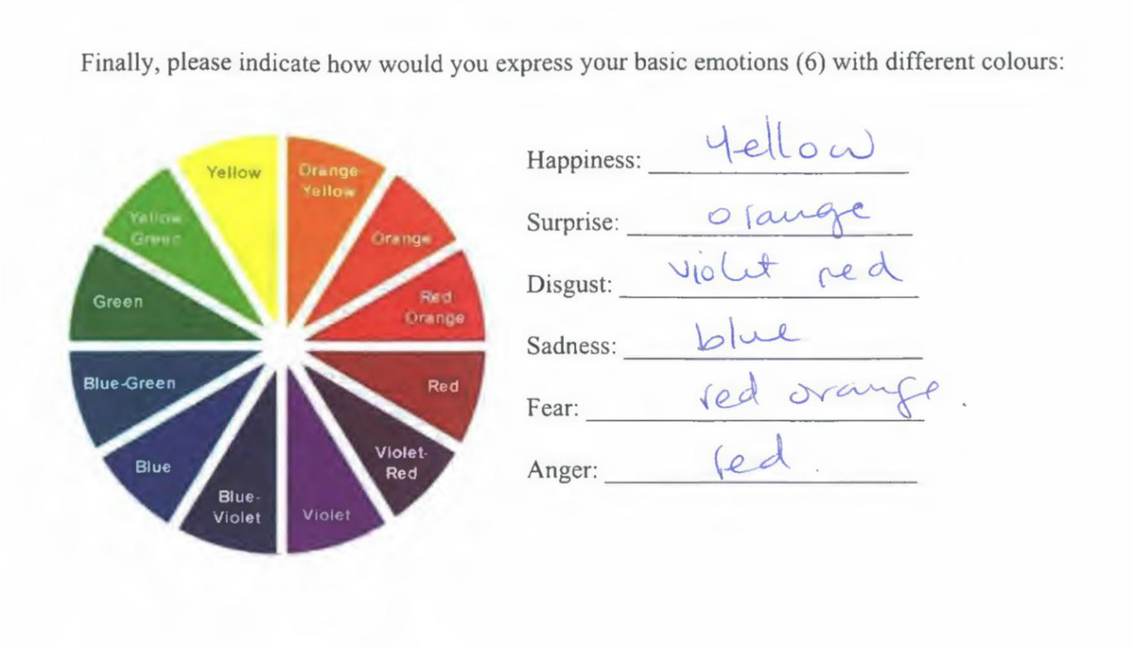
The color of the RGB light changed in the room with each change of 5 beats per minute. One of our pre- assumptions was the color change may change the heart rate of the user and/or alter the immersiveness. The colour change was designed as follows:

Baseline + HRV amount	Color	Approximate color
• 25	White	
• 20	Navy Blue	
• 15	Indigo	
• 10	Violet	
• 5	Lavender	
BASELINE	Pink	
• 5	Turquoise	
• 10	Ocean	
• 15	Baby blue	
• 20	Oxfam Green	
• 25	Forest Green	
• 30	Yellow	
• 35	Honey	
• 40	Pumpkin	
• 45	Apple Red	
• 55 and above	Cherry Red	

Findings:
The self-reported fear level did not correlate with the heart rate data (see Figure 3). After questionnaire, data and interviews with the volunteers suggested that a high arousal state can also indicate excitement instead of fear among the participants who are familiar with videogames. The data from MioLink is accurate enough to be used in a virtual reality to create more personal emotional experiences.

The interpretation of colors varied. For example, one of the participants reported in the after questionnaire that "The switching of colors just got me out of the game, effectively light colors like green, lightblue and yellow. Dark colors pulled me in the game (red/brown/purple/dark blue)" and another one stated that the colors distracted him from immersing into the game.

In the after questionnaire we also aimed to collect data about the universality of colors in order to design immersive and emotional virtual reality experiences (see Picture 3).


Finally, please indicate how would you express your basic emotions (6) with different colours:

Happiness: yellow

Surprise: orange

Disgust: violet red

Sadness: blue

Fear: red orange.

Anger: red.

Picture 3.

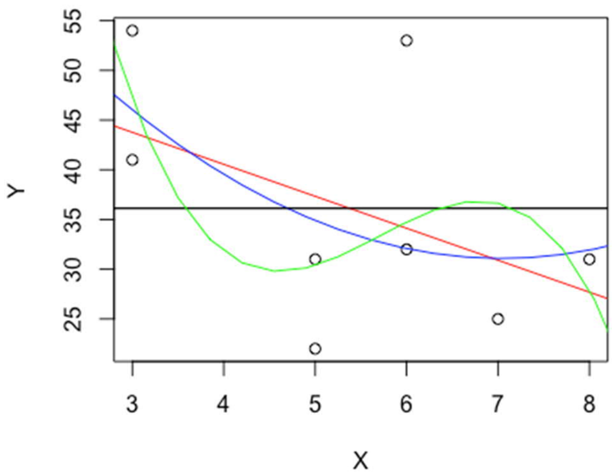


Figure 3. A graph of the model from the data recorded (*n*=8), where X indicates the self-reported fear level and Y the heart rate range varied during the experiment (calculated from the average baseline).

ANNEX B: LYHENNELMÄ

Tässä pro gradu -tutkielmassa käsitellään *virtuaalitodellisuus* käsitteen ontologiaa sekä sen teknologisia ominaispiirteitä uusien affektiivisten oppimisympäristöjen suunnitteluun. Tutkielma on rajattu käsittelemään yksittäisiä fobioita, jotka ymmärretään irrationaalisiksi pelkotiloiksi. Toisin kuin useimmat ahdistuneisuushäiriöt, fobiat ovat usein vähemmän riippumattomia kontekstistaan ja vaativat usein vain tietyn objektin havaitsemisen herättääkseen voimakkaita tunnereaktioita. Näin ollen niitä vastaavien pelkotilanteiden simuloiminen virtuaalitodellisuudessa on helpompaa ja virtuaalitodellisuudessa toteutettu altistusterapia onkin nykyisin yksi psykoterapiassa käytetyistä hoitomuodoista.

Tutkielmassa kuitenkin teoreettisesti kyseenalaistetaan virtuaalitodellisuusterapian perinteiset hoitomenetelmät altistumisterapian metodein tuomalla esiin huomioimatta jääneet kysymykset muun muassa virtuaalitodellisuuden luonteesta suhteessa 'fyysiseen' todellisuuteen. Lisäksi esille tuodaan teoreettiset kiistanalaisuudet koskien tunteita ja havainnointikykyämme, johon vastauksia etsitään ruumiillisesta kognitiotieteestä ja konstruktionismista. Korostettuna on myös sensoriteknologian käyttö osana virtuaalitodellisuutta ja käyttäjien 'tunteiden tunnistamista' sekä siitä juontuvat eettiset kysymykset koskien aktiivista toimijuutta.

Työn metodologia pohjautuu osittain problematisointiin sekä itse teorian että aineisto-analyysin osalta. Tieteellisesti vahvistettujen teorioiden ja olettamusten täydentämisen sijasta problematisointi metodologiana pyrkii haastamaan yleisiä tieteellisiä käsityksiä (Davis 1986) ja luomaan ikäänkuin näkemyksellistä tietoa. Tutkielma on monitieteellinen ja teoreettisesti eksperimentaalinen tutkimus, jossa kokeellisen teorian kivijalkoina ovat fenomenologinen ruumiillinen kognitiotiete (Merleau-Ponty 1945) ja teknofilosofia (Heidegger 1977, Heim 1993). Näihin linkitetään myös tunteiden teoriat (Barrett 2016, Minsky 2006, Damasio 1994, Scarantino 2016), ontologisen suunnittelun ideologia (Willis 2006, Fraga 2016) sekä viimeisimpänä syvän oppimisen metodit (Ohlsson 2011, Kolb 1984).

Teorian ja aineisto-analyysien avulla tutkielma tematisoi mielen ja kehon 'muovautuneisuutta' sekä muokkautuvuutta ympäristön muutoksiin vastakohtaisena affektiivisten tunnetilojen luomille fenomenomaalisille "silmukoille" (Bechara et al. 2000, Sanchez-Vivez ja Slater 2014), jotka linkittyvät havainnointikykymme 'ongelmallisuuteen' (Merleau-Ponty 1945, Metzinger 2003, Jensen 2003). Tutkielma ehdottaa, miten virtuaalitodellisuutta voitaisiin hyödyntää näistä *ruumiiseen koodattujen pelon silmukoiden* irti pääsemisessä tuomalla esiin muun muassa havainnollisten ruumiillisten manipulaatioiden eri tapaustutkimukset virtuaaliavaruudessa. Lisäksi tutkielma ehdottaa, miten sensoriteknologiaa ja erityisesti sykevälivaihtelua (HRV), voitaisiin hyödyntää tunteellisessa oppimisessa.

Laajan teoriakatsauksen ja problematisoinnin avulla haasteeksi nimetään;

> Mikäli variaatio on ominaista tunteille, asettamalla näin ollen mahdottomaksi affektiivisten 'sormenjälkien' tuottamisen teknologian avulla, ja ympäristön muutokset tulisi ymmärtää luonnollisina, miten virtuaalitodellisuutta voitaisiin hyödyntää oppimisympäristönä eri pelkotiloista eroon pääsemiseksi, jotka rakentuvat havaintojen, mentaalisten representaatioiden ja subjektiivisten fenomenomaalisten kokemusten kautta?

Tutkimuskysymyksenä sen sijaan on;

> Voidaanko ontologisen suunnittelun ideologiaa ja havainnollisia ruumiillisia manipulaatioita soveltaa osana uusien oppimisympäristöjen kehittämistä virtuaalitodellisuudessa, mikäli pyrkimyksenä on yksilön havainnointikyvyn laajentaminen ja irrottaminen ruumiiseen koodatuista 'pelkosilmukoista'?

Virtuaalitodellisuus teknologisena simulaationa fyysisestä todellisuudesta avaa uusia maailmoja aisteillemme, sillä se luo minä-muotoisia näkökulmia 3D ja 360-asteisiin ympäristöihin, joita käyttäjä voi tutkia interaktiivisesti. Illusiivisten efektien säilyttämiseksi teknologialta vaaditaan kuitenkin täydellistä synkronointia käyttäjän reaaliaikaisiin liikkeisiin (Bates-Brkljac 2012), jotta mentaaliset "ankkurit" fyysiseen todellisuuteen häviävät (Heim 1993) ja käyttäjä voi sulautua osaksi virtuaalista maailmaa.

Tätä ilmiöitä kutsutaan usein ”immersioksi” (engl. *immersion*), joka mentaalisena olotilana ei juurikaan eroa tunteistamme kuulua osaksi fyysistä ympäristöämme (engl. *presence*) (Diemer et al. 2015).

Ero fyysisen ja virtuaalisen maailman välillä voidaan nykyteknologian avulla saada tuntumaan pieneltä, joka on kannustanut eri alojen tutkijoita hakemaan vastauksia virtuaalitodellisuudesta liittyen ihmisluonteen ominaispiirteisiin. Useiden teknofilosofisten tai neurotieteellisten lähestymistapojen lisäksi esimerkiksi fenomenologia tutkimusmetodina pyrkii kokeellisten tutkimusten avulla etsimään vastauksia miten tietoisuutemme ja kokemuksemme rakentuvat. Fenomenologia korostaa ruumiin merkitystä, jonka takia se on yksi varteenotettavista lähestymistavoista mikäli tutkimuksen kohteena ovat fyysiset pelkotilat. (Merleau-Ponty 1945.)

Virtuaalitodellisuus on ainutlaatuinen teknologia, sillä esittämällä manipuloituja – mutta erittäin todentuntuisia – ympäristöjä se saa meidät kyseenalaistamaan ja horjuttamaan käsityksiämme fyysisestä todellisuudesta (Phillips 2003). Virtuaalitodellisuus mahdollistaa havainnollisten ruumiillisten manipulaatioiden toteuttamisen ja useat tutkimustulokset osoittavat, että ihmismieli on yllättävän muovautuva. Esimerkiksi vakavien fyysisten loukkaantumisten jälkeenkin pystymme omaksumaan uusia liikkeitä, tai jopa kokonaisia kehoja, erilaisten toimintojen toteuttamiseksi (Won et al. 2014). Tutkielmassa kootaan esimerkkejä erilaisista virtuaaliavaruudessa toteutetuista tutkimuksista, jotka liittyvät havainnollisiin ruumiillisiin manipulointeihin sekä niiden ajamiin mentaalisiin muutoksiin.

Altistusterapia on tunnetuin hoitomuoto erilaisille fobioille (Hirai et al. 2007, Knapp ja Beck 2008), jota on sovellettu nykyisin myös virtuaalitodellisuudessa (Parsons ja Rizzo 2008). Altistusterapia oppimismuotona kuitenkin vaatii potilaalta ainoastaan uusien havainto-merkitys -suhteiden muodostamista. Tämä on todettu yksilölliseksi prosessiksi, joka sisältää erilaisia mentaalisia strategioita uusien konseptien muodostamiseksi havaituista asioista (Hartley ja Phelps 2010). Altistusterapiassa nämä yksilölliset mentaaliset strategiat jäävät kuitenkin usein mysteereiksi, sillä hoitomuoto on kiinnostunut ainoastaan onnistuneesta lopputuloksesta (Parsons ja Rizzo 2008, 258).

Psykoterapiassa virtuaalitodellisuus onkin ymmärretty ennen kaikkea “työkaluna” erilaisten tunnetilojen hoitamiseksi (Giuseppe 2005, Botella et al. 2004). Ontologisen suunnittelun ideologia kuitenkin ehdottaa, että virtuaalitodellisuus tulisi ymmärtää pelkän työkalu-metaforan sijasta kanavana ‘itsemme uudelleen järjestämiseksi’, haastaen käsitystämme todellisuudesta ja omasta olemassaolostamme (Phillips 2003, Noë 2015, Heim 1993). Ontologisen suunnittelun ideologian mukaan kaikkea ei voida suunnitella, jolloin aktiivinen toimijuus on vahvasti korostettuna (Fraga 2016, Willis 2006).

Aktiivinen toimijuus näyttäytyy myös tunteellisessa oppimisessa, sillä universaalien sormenjälkien muodostaminen tunteista on osoittautunut lähes mahdottomaksi (Barrett 2017). Sensoriteknologioiden käyttö osana virtuaalitodellisuus kokemuksia on suositeltavaa, mutta niihin ei voida yksinomaa turvautua. Erityisesti pelkotiloihin ja havainnointikykymme mukautuvuuteen liittyen tutkielmassa käydään tarkemmin läpi mitä sykevälivaihtelu (HRV) saattaa paljastaa valmiudestamme omaksua uusia perspektiivejä sekä niistä juontuvia kokemuksia (Frijda 1986). Osa tutkijoista jopa väittää, että sykevälivaihtelu kertoo itse asiassa enemmän mielen kuin sydämen toiminnasta (ks. esim. Shaffer ja Ginsberg 2017).

Aktiivinen toimijuus käsittelemässäni kontekstissa myös tarkoittaa, että virtuaalitodellisuuden kautta käyttäjälle tulisi pyrkiä luomaan ja antamaan vastuu oppia itse havainnoimaan sekä ikään kuin korjaamaan omat irrationaaliset pelkotilansa sen sijasta, että teknologia olisi valjastettu tekemään se hänen puolestaan. Päämääränä on siis luoda käyttäjälle sekä valta että vastuu lukea ja arvioida omien tunnetilojensa ‘tarpeellisuus’ esitetyissä konteksteissa ja kokemuksissa, jotka osittain eroavat fyysisestä todellisuudesta. Hypoteesien ja esimerkkien avulla tutkielmassa esitetään muun muassa, miten virtuaalitodellisuutta voitaisiin hyödyntää tunteellisessa oppimisessa kirjaimellisesti ‘asuttamalla’ uusia perspektiivejä – hyppäämällä jonkun toisen, tai jopa oman pelkokohteensa saappaisiin.

Yhtenä ratkaisuvaihtoehtona tunteelliseen oppimiseen virtuaalitodellisuudessa ehdotetaan näin ollen syviä ja kokemuksellisuuteen perustuvia oppimismetodeja. Tarkasti kaavoitettujen virtuaalitodellisuus-ympäristöjen sijasta, jossa toimintojen oletetaan perustuvan havainto-merkitys -suhteiden muodostamiselle, ja jotka tunteellisesti värittyneinä saattavat luoda fenomenaalisia silmukoita, tutkielma ehdottaa ratkaisuksi ontologisen suunnittelun ideologiaan pohjautuvia metodeja havainnointikykymme laajentamiseksi (Ohlsson 2011). Kokemukselliseen oppimiseen liittyen Stellan Ohlssonin mukaan (2011) metodien ytimessä tulisi olla myös välitön kokemus, jossa muutosten havainnointi yhdistettynä *luovuuteen* auttaa kohtaamaan maailman eri näkökulmista. Tämä kuitenkin vaatii rationaalisesta ajattelusta luopumista, sillä jatkuvan tulkinnan ymmärretään estävän kohtaamaan asiat siten, kuten ne nykyhetkessä ilmenevät (Turkle 1995, 264).

Virtuaalitodellisuus tarjoaa suoria ja lähes välittömiä kokemuksia, joskin on yhä epäselvää, missä määrin voimme verrata näitä kahden maailman välisiä kokemuksia yhdenmukaisina tai onko se edes tarpeellista. Tutkielmassa kuitenkin todetaan, ettei virtuaalitodellisuutta yleisesti ottaen vielä käytetä sen täydessä potentiaalissaan negatiivisten tunnetilojen hoitamiseksi, sillä ainoastaan fyysistä todellisuutta jäljittelemällä on vaikea päästä eroon tieteellisistä paradigmoista (Sanchez-Vivez and Slater 2014, 28, Paavola 2011). Tutkielma ehdottaa radikaalimman ja luovemman suunnittelun omaksumista osaksi virtuaalitodellisuutta ontologisen suunnittelun periaatteita noudattamalla, mikä tarjoaa myös käyttäjälle aktiivisen toimijuuden muokata ja olla luontevammin osa ympäristöä.