Virtual Reality in the Healthcare Sector of Today

Gaining Allies or Making Adversaries through Immersive Virtual Environments and Technical Decisions

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Preface

This Master's Thesis has been devised in the period of January 2018 to June 2018 and is based on the use of virtual reality in the Danish healthcare sector. We would like to take this opportunity to thank all the people who have contributed with their time and made this Master's Thesis possible. Likewise, would we like to thank our supervisor, Christian Baron, for supporting us throughout the whole process. We would also like to thank our families for their words of encouragement during the long months of Thesis work.

Summary

I dette kandidatspeciale undersøger vi Virtual Reality (VR) indenfor sundhedssektoren. Tre forskellige lokaliteter er taget i brug som casestudier, for at konstatere konsekvenserne ved at introducere VR og Hovedmonterede Displays i en børn- og ungdomspsykologisk klinik ved navn Cool Kids, og i to afdelinger på Rigshospitalet; Videnscenter for Børnesmerte og Ungdomsmedicinsk Videnscenter. Hvert sted har forskellige målsætninger med at bruge VR i deres felt. Cool Kids ønsker at bruge VR til at behandle børn som lider af fobi for hunde (cynofobi), ved hjælp af kognitiv adfærdsterapi til at gradvis eksponere børn for hunde i et kontrolleret Virtual Environment (VE). Videnscenter for Børnesmerte ønsker at bruge VR til at formindske eller eliminere smerter under smertefulde procedure som involverer nåle. Ungdomsmedicinsk Videnscenter vil gerne hjælpe børn som er isolerede på grund af et svækket immunforsvar, til at få oplevelser uden for hospitalet gennem VR, på trods af deres isolation. De forskellige lokaliteter er forbundet gennem deres fælles interesse i VR og deres forbindelse til en VR applikationsudvikler ved navn Khora som har udviklet applikationerne som de tre forskellige aktører gør brug af. For at kunne studere VR fænomenet i disse varierede lokationer, brugte vi antropologiske metoder som deltagerobservation og interviews for at få en forståelse for vores felt og de ”indfødte” som huserer der. Ved at bruge begreber fra Aktør-Netværks Teori (ANT) og især The Key to Success In Innovation af Madeleine Akrich et al. (2002a, 2002b), er vi interesserede i at beskrive de socio-tekniske miljøer som findes i vores tre casestudier. Vi vil også bruge det framework som Mel Slater og Sylvia Wilbur’s (1997) har udviklet vedrørende Immersive VE’s og Utility of Presence. I vores brug af Slater og Wilburs (Slater & Wilbur, 1997:8) begreber konkluderer vi at den aktuelle software applikation brugt i Cool Kids er umulig at bruge til psykologiske behandlinger. Vi argumenterer for at software applikationen, der er lavet til at behandle cynofobi ikke besidder et Immersive VE. Subjektet der oplever VR’en i Cool Kids kan derfor ikke transferere viden fra VE’et over til den reelle verden. Derudover gør vi brug af Akrich et al. (2002a, 2002b), til at udvikle en analyse af associationer hvormed aktører der har et netværk af allierede, og som kollektivt forhandler VR, er dem der står tilbage med de bedste resultater med deres applikation. Implementeringen af VR hovedmonterede displays indenfor sundhedssektoren betyder også at de tekniske beslutninger som blev taget baseret på at det hovedmonterede display blev brugt i hjemmet bliver problematiske i den nye kontekst. Men VR har også evnen til at etablere allierede indenfor afdelingen Videnscenter for Børnesmerte som et interessement device der formår at forføre doktorer, sygeplejersker og børn til at bruge apparatet på grund af dens evne til at fjerne tilknytningen til smerte indenfor netværket.

Abstract

This Thesis explores Virtual Reality (VR) in a healthcare setting, Three sites are used in a case study to ascertain the consequence of introducing VR and Head Mounted Displays into the Psychological clinic Cool Kids and in two departments at Rigshospitalet The Pediatric Pain Knowledge Center and the Youth Medical Knowledge Center. Each site has different goals with using VR in their field. Cool Kids want to use VR to treat children who are suffering from phobia of dogs, by gradually exposing them to dogs in a controlled Virtual Environment (VE). The Pediatric Pain Knowledge Center wants to use VR to decrease or eliminate pain during painful procedures involving needles. The Youth Medical Knowledge Center wants to help youths who are isolated because of their decreased immune systems, to have experiences outside of the hospital through VR, despite their isolation. The sites are bound together through their shared Interest in VR and their connection to a VR application developer called Khora, who have developed the applications which the three fields use. To study the phenomena of VR in these varied locations, we used the anthropological methods of Participant Observation, as well as Interviews to gain an understanding of our field and the actors inhabiting it. By using concepts from Actor-Network Theory (ANT) and especially: A Key to Success In Innovation by Madeleine Akrich et al. (2002), we seek to describe the socio-technical environment of our three case studies. We also use Mel Slater & Sylvia Wilbur's (1997) developed framework on immersive VEs, and utility of presence. While relying on the concepts from Slater and Wilbur (Slater & Wilbur,1997:8) we found that the current software application used at Cool Kids is impossible to use for psychotherapy. The argument is that the software application made for treatment of cynophobia, does not have an immersive VE. The subjects experiencing the VR, can therefore not transfer knowledge from the VE to the real world. Additionally with Akrich et al. we develop an analysis of associations in which the actors who have the network of allies, and collectively negotiate VR are the ones who stand with the strongest result. Implementing VR HMD's in the healthcare sector also means that technical decisions based on home usage become problematic. But VR also have the ability to establish allies in the Pediatric Pain Knowledge Center and as an interessement device manages to seduce doctors, nurses and children using the device because of its ability to disassociate pain within the network.

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List of terms

360 degrees camera: a special camera that is used to record video in a 360 degrees format.

VR Game: A type of VR application. VR Games are developed by 3d graphic designer.

HMD: A head-mounted display (HMD) is a type of computer display device or monitor that, as the name implies, is worn on the head or is built in as part of a helmet.

Innovation: a term originating from economics**.** Making things functional in practice = economically viable (=successful)

Software: Built-in software that comes with the HMD

Virtual Reality Application: a 3rd party software that does not come with the VR system, i.e. the VR video at Cool Kids or the VR game at the PPKC

Virtual Body (VB): Having a virtual body (also known as avatar) in the VE. VB is used in our Thesis due to our theoretical choice.

Virtual Environment (VE): the environment in the virtual world

Virtual Reality (VR): a computer-generated scenario that simulates experience through senses and perception

Virtual Reality Device: VR device like VR system, but only strictly hardware, thus software is not talked about when using this term

Virtual reality exposure: Exposure is a commonly used method in psychotherapy. VR Exposure is the same type of method but used with VR.

Virtual Reality Videos: A type of VR application. A VR Video is filmed with a special camera that can simultaneously film everything in a 360 degree field of vision.

Introduction

Virtual Reality (VR) is a developing technology with a lot of anticipation behind it, and solutions involving VR is being established for a variety of fields. VR currently encompasses locations such as, but not limited to: the entertainment industry with videogames and film, the healthcare industry, the tourism industry, the advertising industry, building facilitation (engineering) etc. VR is seen as a new way of seeing and playing film and videogames, as it gives a new potential for increased immersion and interactivity. In tourism, it enables one to see and explore a tourist destination before one actually visit it physically, and gain an understanding of what is available (VisitCopenhagen, n.d.). In the advertising industry, it is possible to create stronger brand storylines through curated VR stores (Larsen, 2016). VR enables engineers and architects to show in greater detail how a building looks and better illustrate where to position the interior. A hospital for example used a VR studio to give a better sense of the building project. It also enabled the staff and users to come with input to where to specifically place things and test how the placement would work in terms of flow and wayfinding within the hospital (Tygesen, 2017). And in healthcare evaluations, some of which this project specifically looks at, VR is being used in treatment of phobias, pain relief situations, or as a way to combat isolation. Other uses in healthcare could for example be to better train staff in difficult procedures (Højer, 2017). In psychotherapy, VR has also been used to treat pedophelia (Renaud et al., 2011) and post-traumatic stress disorder (PTSD) (Rothbaum et al., 1999).

It would appear that VR has a lot of possible applications, which are in the process of being put into practice, while some already have been. With the somewhat recently released VR Head Mounted Displays (HMD), it has opened the door for many to purchase and use VR for research or practical applications in order to realize the possibilities of the technology. There are a great number of expectations of what the technology is capable of and some come to fruition as the boundaries and barriers are being tested of the technology.

In this Thesis, we have chosen to write about VR in healthcare with specific relation to projects at Cool Kids at Vesterbro, Peadiatric Pain Knowledge Centre (PPKC), Youth Medical Knowledge Center (YMKC), where PPKC and YMKC are under Rigshospitalet. We have spoken to actors involved in the projects about how their interest and investment into VR came about, how they use it and how successful it is. Additionally, we have spoken with other actors, such as the developers of VR applications from the company Khora, about the specific difficulties of developing VR based programs. We have also conducted participant observations by participating in an event about VR in the healthcare sector by CopenX and Khora, as well as observe the usage of VR in a session at Cool Kids. We want to, with this Thesis, analyze the different Actor-Networks that are embroidered

together between the different actors in our field, and we want to decipher what problems materialize when VR and the HMD's, are put into practice at the healthcare sector. Specifically, we want to look at how the hardware from Samsung Gear VR, and the different applications from Khora, are used as an interessement device in the three cases we study in the healthcare sector. Furthermore, we will look at how Samsung Gear VR successfully manages to gain allies or how it fails to do so, using the framework from Akrich et al. (2002a, 2002b) on The key to success in Innovation part 1&2 . By doing so, we hope to shed some light on how non-human actors can influence a network and create allies, adversaries and sceptics because of the technical decisions which were made by the developers of the technology.

Motivation

Our motivation for this project came from personal and professional place. We have been interested in VR for some time since when we wrote a report on VR and its use in treatment of pedophelia and PTSD as part of the curriculum for our course on emerging and cutting edge technology. Additionally, one of the writers of this project wrote about the history of the Virtual Boy as part of a different semester course on the history of technology.

VR is interesting to us, because it is in the stage of real world implementation and it has a history of rising and falling in terms of popularity and usage. It is also a technology which seems to interest many and are applied to a large quantity of different fields. Which is also why we initially wanted to understand the practical usage of this technology within one of these fields. We chose to work within the healthcare sector, as it seemed to be the one with most current applications being developed that also added a societal value to the technology, which was more interesting to us than VR in the entertainment industry.

Problem field

VR technology is still trying to establish its role in our society and has often been associated as a gadget for playing video games, and VR is often also promoted as such. But VR is not only a gadget for playing games. Over the past few years, it has been utilized well within the field of healthcare. Additionally, the VR seems to only get better and better as technology advances further. Our field is limited to the Danish healthcare sector and the organizations located in Copenhagen, specifically Cool Kids, PPKC, and YMKC. Khora is the company that develops and facilitates VR while Cool Kids, PPKC, and YMKC are the organizations that uses VR for respectively: treatment of phobia, pain-related procedures and escaping the feeling of isolation at hospitals. We decided to look at how Cool Kids, PPKC, and YMKC try to adopt VR as a solution to some of their problems, and why they did so. In our Thesis then we are going to look at the

network, the actors and relations that which are involved in the process of adopting the VR in the specific field of healthcare in Denmark. We have seen from a variety of studies that there is a potential for VR to be a successful actor in the healthcare sector and it can be supportive and effective in some specific types of treatments such as exposure treatments for people with specific phobia. We are interested in what it takes to develop a successful VR, and how it can be developed in a way that makes VR with immersive VEs. This leads us to the research question.

Research question

How does virtual reality become adopted as a solution to the problems of three different locations within the healthcare sector?

- What network of relations is established when VR is implemented in the healthcare sector?
- How can immersive VEs accommodate the interests of actors in the healthcare sector?
- What problems emerge when virtual reality is incorporated into the field of healthcare?

Field Boundary

In this Thesis we focus on three different locations within the healthcare sector. This means that we will not be looking at other sectors that use VR, nor will we be looking at VR used in the home or VR applications used online and their online communities. We will also not be going into the economic details in the Thesis, related to the cases described herein. We have also mostly concerned ourselves with one specific HMD: The Samsung Gear VR, as it is the HMD which is being used in all three of the locations which we describe. We do go examine some technological aspects of VR. However, we do not dig into programming. Neither will we go into any details on psychological or biological aspects of the impacts of VR.

Brief Introduction to the history of VR

In this chapter we seek to define what “Virtual” means as well as give a brief introduction to the history of VR.

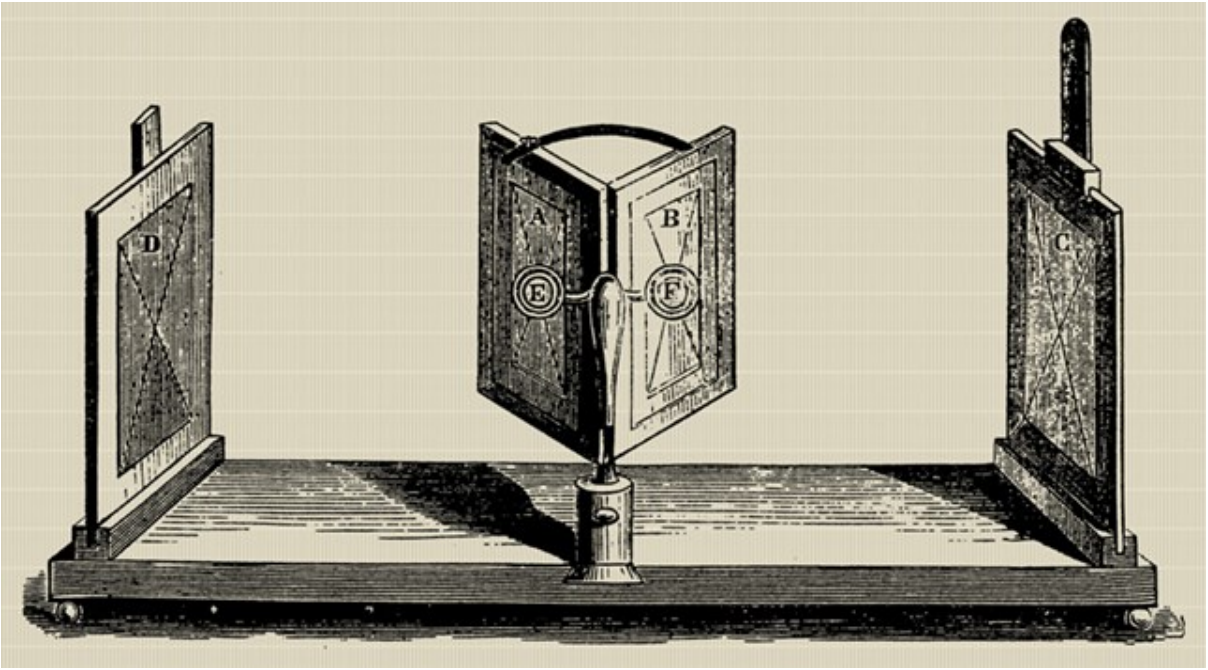
The noun virtual stems from the latin Word virtus, which means strength or power and during the medieval period virtualis came to be known as being something of “virtue” (Shields, 2003:2).

Shields argues in the text that much can be gained from looking at historical cases related to the virtual, and that the virtual has existed in the form of rituals and in architectural fantasies and environments (Ibid.:4). He argues that virtual worlds are simulations which can diverge into two, either through the realization that no virtual world can be complete, or as a prized representation of the world, free of the messiness of the real (Ibid.:4).

Virtual reality has historical threads that go a long time back in history. Cave paintings could be said to be depictions of an analogue VR (Jerald, 2016:15) and in ancient Greece Plato developed the philosophical allegory of a cave (Gendler, 2015). People who would be chained in a cave their whole life, would see the world as the shadows reflected on the cave wall, and would take that as the real world in which they were situated. They would see it as their reality. A more current philosophical idea of a VR, is the brain in a vat: we are all brains in a vat, hooked up to a large computer, which is creating a virtual world which we inhabit with our virtual bodies (VB) (Hickey, n.d.). Current proponents of this theory is among other silicon valley software developers who have said it is increasingly likely as technology develops, that any advanced civilization would have already developed capabilities to simulate the world. One popular proponent of such theory is Elon Musk (McCormick, 2016)

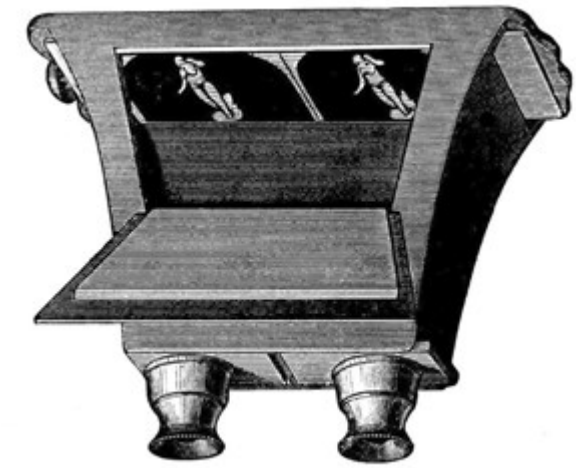
The brain in a vat scenario was also brought into popular culture by the film The Matrix, which uses the idea as the basis plot point for the film (The Matrix, 1999).

While the concept of the virtual has been developed for a long time throughout history, the first technological developments within VR happened around the 1800s. In this time period, some of the technological developments were the first stepping stones toward VR of today. In 1832, Sir Charles Wheatstone invented the stereoscope, a device which used angled mirrors at 45 degrees, which reflected images into the eye (Jerald, 2016: 15).



PICTURED: A DRAWING OF THE WHEATSTONE MIRROR STEREOSCOPE (ALGORRI ET AL., 2016).

In the 1850s David Brewster would use lenses to make a smaller stereoscope which was handheld, and thus did not require the same amount of space and was more portable compared to the stereoscope of Wheatstones. The stereoscope worked in the same way as Wheatstones, by having two of the same pictures to each lens; it enabled pictures to have three-dimensional properties. According to Brewsters estimations, by 1856 he had sold over half a million of his stereoscopes (Jerald, 2016:15).



PICTURED: BREWSTERS STEREOSCOPE (YOUMANS AND YOUMANS, 1882)

In 1928, the first flight simulator was developed. A fuselage-like device with the ability to sit in a cockpit, which also produced the motions and sensations of flying (Jerald, 2016:19). The simulator was at first sold to amusement parks, as the military was not interested, at least not initially.

During the early 20th century, technological advancement was rapidly developing, and as such science fiction and questions pertaining to the real and virtual began to be popular. Pygmalion's spectacles, a book by Stanley G. Weinbaum released in 1935. The story is about an alternative world seen through a set of eyeglasses that replaces real-world stimuli with artificial ones. In that world, one can speak to characters who does not actually exist and they reply, and the story revolves around oneself in the virtual world (Norman, n.d.), (Jerald, 2016:20).

In the 1950s Morton Heillig designed a head-mounted display (HMD) as well as a world fixed display. The world fixed display was called the Sensorama and *"[…] the Sensorama was created for immersive film and it provided stereoscopic color views with a wide field of view, stereo sounds, seat tilting, vibrations, smell, and wind"* (Jerald, 2016:21). Similar ideas were developed around the time: the Smell-o-vision was a device, which would be used in a Cinema, and would pipe scents related to what happened on the onscreen movie out to public watching. It was an attempt to introduce cinema to the additional sense of smell rather than just sound and vision (Cultureandcommunication.org, n.d.)

In 1968 a HMD was developed and demonstrated, called the Sword of Damocles by Ivan Sutherland. The head mounted display could use head tracking and computer-generated imagery (Jerald, 2016:22). In 1985 the first commercially viable stereoscopic head-tracked head mounted display called the VIVED: Virtual Visual Environment Display was developed (Ibid.:28). The VR headset could be produced at a relatively affordable price, which then enabled the VR industry to begin to take form. As the 1990s began, VR exploded in terms of market research and development. With industry taking note, it seemed like VR was on the rise, and hype began surrounding the technology, which inevitably resulted in a peak in 1996 and decline in 1998. In the 2000s, VR continued to grow outside of the public sphere, mostly in corporate, government, academic and military research laboratories (Ibid.:27). Eventually however, VR would start to be developed for commercial use, as Oculus Rift was funded in the crowdfunding platform Kickstarter in 2012 and eventually acquired by Facebook in 2014. Other commercial VR headsets developed during that time includes the Samsung Gear VR, Sony Playstation VR and HTC Vive VR headsets. In 2018 a new HTC Vive Pro was announced for pre-order, which will feature an upgraded

resolution and an improved design (Vive Team, 2018), as well as the new Oculus GO HMD a cheaper all in one HMD compared to the Oculus Rift (Oculus.com, n.d.).

Future

As things stand however, there have yet to be a “killer application” which necessitates the need for the technology of VR. Those applications are in the process of being made, but it is yet to be seen if they will have the impact which is expected of them by their developers.

Gabe Newell, founder of Valve, Steam, and HTC Vive partner said recently in an meeting filmed by the press, that VR has not yet made it to the mainstream audience (Gilbert, 2017). And it shows. Only about 0.2% to 0.4% of steam users have acquired and registered a headset on the platform (Valve, n.d.). So in terms of amount of adopters of VR for video games there is much to be desired when looking at the broad picture.

A “killer application” could obviously also come from the healthcare sector. There are several applications being made and researched. We will, and have mentioned some cases. However this still does not necessitate a revolution in the acquirement of VR headsets to the average person.

We are also far from the sort of transhumanist future which have been discussed in science fiction and philosophy. We are not close to implementing VR and AR as implants within people, to achieve extraordinary sight. There is work being done to work towards technologies like AR wearable glasses. The future could hold wearables which increased the ability to track and discern the facial features and emotions of a person's avatar in virtual environments (VE). Technology such as this is already in use in other domains, such as live streaming (Alamares, 2018) and in China facial recognition technology is starting to be used by police (Schmitz, 2018).

The technology behind Virtual Reality

There are two different strands of ‘reality’ changing technologies: Augmented Reality (AR) also known as mixed reality and Virtual Reality (VR). AR is the version which augments the already existing reality. What one sees in the real world is also visible through a smartphone or AR glasses, but are enhanced by them also, by showing things only visible through the technology, but that are not actually present in the real world. A popular example of AR in recent years has been the Pokemon GO application for mobile phones. The application works by showing the player, through the camera on the mobile phone, the pokemon in the environment which the player are currently inhabiting. The player must ‘catch’ the pokemon in the vision of the camera, and then the player can throw pokemon balls at them in order to catch them. The reality of the world is augmented by the pokemon which come to inhabit it through the smartphone screen.

VR is the all-encompassing field of view of a different world, differentiated from AR by being either a video or programmed application. None of the assets which you see in VR are real life, but have been generated through a computer, by programming, filmed through a 360 degrees camera or modeled in 3D. VR is thus a different world from the one you would see if you took the headset off, even if the VR world is representable of the world you see without the headset on. Because the headsets show a whole world with many 3D or filmed assets, the technology needed in terms of hardware is also much greater than the one needed for AR (Hall, 2016).

The Virtual Reality Market

Current popular technologies within VR that is commercially available, such as the HTC Vive, Samsung Gear VR and the Oculus Rift, are differing in a variety of ways from each other. Other well known headsets include the Google Cardboard and Sony's Playstation VR. We will explain as we go along, what VR is and the technology behind it, while also describing the ways in which these technologies are similar and different to each other by pointing out their specifications and abilities.

VR headsets are generally made up of a body, that is, the headset itself is made to enable a comfortable viewing session. The body connects the various other parts together. A headset like the Oculus Rift or the HTC Vive, also have lenses which bend light to enable viewing through the built in displays (Jay, 2016). While the Samsung Gear VR also uses lenses, it does not have the same kind of way of displaying as the Rift or Vive, but uses a smartphone as its way of presenting the VR. Samsung Gear VR is thus also "powered" by the smartphone device connected with the headset, while the HTC Vive and Oculus rift use computer power to display images. This gives the Oculus and Vive some technical advantages, since the computers needed to power the devices, will enable higher graphical settings and more well developed worlds in terms of looks, details, frame rates and resolution. This is despite the fact that the Samsung Gear VR technically enable higher resolutions (Shanklin, 2017). This increase in power comes with the price of being tethered through cables to a computer, while the Samsung Gear VR is untethered – wireless. The HMD uses sensors to track motions of the one wearing it. For example, the headsets also feature headtracking. Head tracking enables the wearer to look around in the VE. As the wearer turns their heads, so does their VB within the VE (MITK12Videos, 2016). Some of the VR devices, the HTC Vive and Oculus Rift in particular, also have full room tracking. Room tracking not only enables one to look around in a VE, but within a predetermined space, it also enables walking around in the real- and virtual environment simultaneously. There is also eye tracking being developed (Tobii.com, n.d.) for the HMD's and the HMD's also have controllers, through which one manipulates VE, and the menus in the software.

The currently available VR gear for consumers can be divided in three main categories:

1.PC-based immersive VR headsets such as HTC Vive, Oculus Rift, Samsung Odyssey, and Playstation VR plus various additional control devices

2. VR headsets that requires a smartphone (Samsung or Google)

3. Standalone VR headsets, which do not require a separate computing device such as Oculus Go , HTC Vive Focus and Samsung Gear VR

(Muikku & Kalli, 2017)

According to a VR market report by Digital Media Finland (Ibid.) conducted in late 2017, the development of the VR gear market for consumers has been a disappointment, so far, compared with the earlier expectations especially in the field of immersive VR (Ibid.). Some of the challenges for the consumers are the high prices, requirements of expensive computing devices, motion sickness (we will go through this later), ergonomics, and the chicken-and-egg-situation with development of gear and content (meaning content either has to be captivating enough or VR gear needs to be much more easy accessible). As a result, the most used VR gear for consumption has been the ones with smartphones (Ibid.).

One of the most common problems with VR usage is motion sickness (also known as cybersickness) as a result from prolonged VR usage, and also due to unstable scenes that are portrayed when using VR. Motion sickness contributes to physical fatigue, which is also another cause of discomfort when related to VR. Physical fatigue can be caused by multiple things, such as weight of the VR equipment, unnatural poses when using VR, and navigation techniques that require physical motion over an extended period of time (Ibid.). Content presented by using VR gear reacts to user actions, whereas content presented in traditional media, e.g. computers, is mostly independent from user actions. These negative health effects have resulted in most available VR content products being designed to have a limited duration or designed to be used only for shorter periods of time (Ibid.).

COMPANY	Q2/2017 SHIPMENTS VOLUME (IN THOUSANDS)	Q2/2017 MARKET SHARES
1. Samsung	568.0	26.7%
2. Sony	519.4	24.4%
3. Facebook	246.9	11.6%
4. TCL	106.4	5.0%
5. HTC	94.5	4.4%
Others	594.8	27.9%
TOTAL	**2130.0**	**100%**

VR MARKET SHARE AS OF Q2/2017 DEPICTED IN THE VR MARKET REPORT BY MUIKKU & KALLI, 2017

As of 2017, according to International Data Corporation (IDC) , the biggest global market share holder is Samsung leading with 26,7%, while Sony trails behind with 24,4% and further down we see popular brands like Facebook (who owns Oculus Rift) with only 11,6% and HTC (Vive) with a small 4,4%. It is surprising that HTC is trailing so far behind on the global market share. We assume this to be the case because HTC primarily offers PC-based VR where the consumer needs a strong computing device in order to fully experience their VR gear, meanwhile Sony has developed their VR for their Playstation 4 which is a computing device that is much more accessible for a reasonable price in comparison with a high-end computer, and is a device which has already sold 75+ million units (Gilbert, 2018). Samsung has been pushing their VR gear commercially and is much cheaper in comparison to the other brands. A search on pricerunner.dk shows that Samsung VR costs ~650DKK (~4000DKK total including their Samsung Edge smartphone) , while Oculus Rift goes for ~3500DKK and HTC Vive ~5000DKK (a computer with minimum hardware requirements costs ~6000DKK)(last checked 05/31). The Samsung Gear VR only needs their own respective smartphone in order to fully function, while Oculus Rift and HTC Vive additionally needs a high-end computing device in order to be optimally functional which will go way above the price of Samsung Gear VR.

TABLE 1 Comparison of VR Systems

	PC-Based VR		Mobile-Based VR			Console-Based VR	Stand-alone	
System	Oculus Rift	HTC VIVE	Samsung Gear VR	Google Cardboard	Google Daydream	PlayStation VR	Allwinner VR	Snapdragon 820 VR
Cost, US$	599	799	99	10–50	69–149	399	99–249	399–450
Hardware requirements (US$)	High-end PC (>1000)	High-end PC (>1000)	High-end Samsung phone (>600)	Middle or high-end Android phone or iPhone (>299)	High-end Android phone (>499)	PS4 (299) or PS4 Pro (399)	None	None
Resolution	2160 × 1200	2160 × 1200	2560 × 1440	Depends on the phone (minimum 1024 × 768)	Depends on the phone (minimum 1920 × 1080)	1920 × 1080	1920 × 1080	2560 × 1440
Refresh rate	90 Hz	90 Hz	60 Hz	60 Hz	90 Hz minimum	120 Hz	60 Hz	70 Hz
Field of view	110°	110°	101°	from 70°	96°	100°	90°	92°
Body tracking	Medium or high: head tracking (rotation) and positional tracking (forward and backward)	High: head tracking (rotation) and volumetric tracking (full room size is 15 × 15 ft for movement)	Medium: head tracking (rotation)	Medium: head tracking (rotation)	Medium: head tracking (rotation)	Medium or high: head tracking (rotation) and positional tracking (forward and backward)	Medium: head tracking (rotation)	Medium or high: head tracking (rotation) and positional tracking (forward and backward)
User interaction with VR	High (by using a joystick or controllers)	High (by using controllers)	Medium (by using gaze, a built-in pad, or a joystick)	Low (by using gaze or a button)	Medium (by using gaze or a joystick)	High (by using a joystick or controllers)	Medium (by using gaze, a built-in pad, or a joystick)	Medium (by using gaze, a built-in pad, or a joystick)
Software availability	Oculus store	Steam store	Oculus store	Google Play or iOS store	Google Play	PlayStation store	Google Play	Google Play

PC, personal computer.

Table that shows the specifications and prices in US dollars for the different VR brands (Parsons et al., 2017)

The table above shows the specifications for the HMD's. The prices are displayed in USD but we have already searched for the prices in DKK. One of the big downsides with Samsung Gear VR is that it does not have a full body tracking feature, it only comes with head tracking where it tracks the user's head movement. It seems a if the more functions the VR gear has, the more expensive it is.

To sum it up we will make a small pros and cons list of Samsung Gear VR, HTC Vive and Oculus Rift:

Samsung Gear VR:

Pros

- Max resolution: 2560x1440. Higher than HTC Vive and Oculus Rift.
- Cheapest of the three

- Wireless and Mobile HMD in comparison to HTC Vive and Oculus Rift
- Does not require an expensive computer

Cons

- Requires Samsung's top-of-the-line smartphone (does not function with other brands)
- Only head tracking
- Lower field of view (101 degree)
- Lower refresh rate (60hz) (number of times per second your device can redraw the screen. The higher the refresh rate, the more fluent the content is displayed)
- Lower user interaction: using gaze or built-in pad on the HMD or a joystick

Oculus Rift:

Pros

- Higher refresh rate (90hz)
- Higher field of view (110 degree)
- Cheaper in comparison to HTC Vive
- Positional tracking (back and forward) and head tracking
- High user interaction: joystick or controllers

Cons

- Requires a high-end computer
- Needs proper space for positional tracking
- More expensive than Samsung Gear VR
- Max resolution: 2160x1200. Lower resolution than Samsung Gear VR

HTC Vive

Pros

- Higher refresh rate (90hz)
- Higher field of view (110 degree)
- Full body tracking: volumetric tracking
- High user interaction: controllers
- Uses Steam, the largest largest digital distribution platform for video games

Cons

- Requires and high-end computer
- Needs a lot of space for optimal tracking (5x5m for movement)
- More expensive than Samsung Gear VR
- Max resolution: 2160x1200. Lower resolution than Samsung Gear VR

(Parsons et al., 2017)

Virtual Reality as an Alternative Treatment Method

VR as an alternate method of treating psychological disorders is nothing new. A simple search on google will give tons of results regarding the topic. A case study from 1999 by Rothbaum et al. (1999) presents the results of the first Vietnam combat veteran with PTSD to have been treated with virtual reality exposure (VRE). The patient was exposed to two VEs, a virtual helicopter flying over a virtual Vietnam and a clearing surrounded by jungle. The patient experienced a 34% decrease on clinician-rated PTSD and a 45% decrease on self-rated PTSD. Treatment gains were maintained At 6-month follow-up (Rothbaum et al., 1999).

Another case study by Difede & Hoffmann (2002) treats a survivor of the World Trade Center attack of 9/11 who had developed acute PTSD with VRE. The patient failed to improve with traditional imaginal exposure therapy, which they then resorted to VRE with greater success in comparison with the traditional treatment method. Over the course of six 1 hour VR exposure therapy sessions, Difede & Hoffmann gradually and systematically exposed the PTSD patient to virtual planes flying over the World Trade Center, jets crashing into the World Trade Center with animated explosions and sound effects, virtual people jumping to their deaths from the burning buildings, towers collapsing, and dust clouds. VR graded exposure therapy was successful for reducing acute PTSD symptoms. Depression and PTSD symptoms as measured by the Beck

Depression Inventory and the Clinician Administered PTSD Scale indicated a large (83%) reduction in depression, and large (90%) reduction in PTSD symptoms after completing VR exposure therapy (Difede & Hoffmann, 2002).

Through our research, we have stumbled upon a systematic review on controlled research on the effectiveness of VR distraction for reducing pain (Malloy & Milling, 2010). In order to be included in the overview, studies were required to use a between-subjects or mixed model design in which VR distraction was compared with a control condition or an alternative intervention in relieving pain. They identified 11 studies. The results showed that VR distraction is an effective method for reducing pain, as well as discomfort associated with burn injury care (Ibid.). The use of more sophisticated VR technology capable of fully immersing the individual in a VE was associated with greater relief. Overall, controlled research suggests that VR distraction may be a useful technology for clinicians who work with a variety of pain problems (Ibid.).

Furthermore, Malloy & Milling (2010), provides a table of studies of VR distraction for reducing pain and the characteristics of the studies.

Study	Sample	Virtual environment	Interventions	Summary of key findings
Experimental pain				
Hoffman et al. (2006)	77 students 18–23 years	*SnowWorld*	HT—high tech VR helmet LT—low tech VR helmet C—no VR distraction	HT reduced pain more than LT.
Patterson et al. (2006)	103 students 18–40 years	*SnowWorld*	VR—VR distraction H—hypnosis VR + H—VR plus hypnosis AC—attention control	VR reduced pain regardless of suggestibility level. Suggestibility moderated effect of H and VR + H.
Dahlquist et al. (2007)	40 children 5–13 years	*Finding Nemo* "Jellyfish Race"	ID—Interactive distraction PD—Passive distraction ND—No-distraction	ID increased pain tolerance and threshold more than PD and ND.
Dahlquist et al. (2009)	41 children 6–14 years	*Free Dive*	VR—VR helmet NVR—no VR helmet C—no intervention	VR increased tolerance more than NVR and C in older children; VR and NVR increased tolerance more than C in younger children.
Chronic pruritus				
Leibovici et al. (2009)	24 patients 18–84 years	*Air Lock*	VR—VR distraction NVR—Non VR distraction	No difference in pain between VR and NVR.
Port access and IV placement				
Nilsson et al. (2009)	42 cancer patients 5–18 years	*The Hunt of the Diamonds*	NVR—Nonimmersive VR SC—standard care	No difference in pain between NVR and SC.
Gershon et al. (2004)	59 cancer patients 7–19 years	*Virtual Gorilla*	VR—VR distraction NVR—Non VR distraction C—no-treatment control	VR reduced pulse rate and nurses' pain ratings more than C. No difference between VR and NVR.
Wolitzky et al. (2005)	20 cancer patients 7–14 years	*Virtual Gorilla*	VR—VR distraction C—no-treatment control	VR reduced pulse rate and observer pain ratings more than C.
Gold et al. (2006)	20 pediatric patients 7–12 years	*Street Luge*	VR—VR distraction SC—standard care	VR reduced parents' ratings of how much intervention reduced pain more than SC.
Burn Injuries				
Hoffman et al. (2008)	11 burn patients 4–40 years	*SnowWord*	VR—VR distraction C—no VR distraction	VR reduced pain more than C.
Mott et al. (2008)	42 burn patients 3.5–14 years	*Hospital Harry*	AR—Augmented realty SC—standard care	AR resulted in less pain than SC, especially for long dressing changes.

Overview of VR pain reduction treatments by Malloy & Milling (2010:3)

We see that the effectiveness of VR varies between what type of pain the patient has. What is up for discussion is the technology used at the given time. In our day and age, VR has come a long

way and the technology differs from what was used in 2004-2009. Nonetheless, it seems like VR is an efficient tool to reduce and distract the pain that the patient has, according to previously conducted studies and researches.

Introduction to the field

When we first started our Thesis about VR, we did not have a specific field as such. Therefore, we took a very explorative approach, trying to find a gatekeeper. In practice, this meant sending many emails in various directions, to people and companies that we thought might give us access to their field. One of them was the VR company called Khora, located in the Meatpacking District (trans. Kødbyen). Through a google search we managed to find the co-founders, Simon Lajboschitz and Peter Fisher, on their own webpage and we contacted them via email. After a few days they responded that they did not have time to speak with us, but if we wanted to we were welcome to visit the company and speak with Mia who worked as a shop assistant at Khora. We quickly responded, and suggested a day where we could drop by. The following week we arrived at the location. We were there two hours early, in order to find a nearby café where we could plan a strategy for the day. After collectively figuring out what outcome we would like from the visit at Khora, such as what questions we wanted to ask and what kind of contacts we would like to have, we headed towards their shop/lab. When we entered Khora, we were met by two people, Mia, whom we had an appointment with, and Benjamin another shop assistant. Mia and Benjamin were both standing near the front desk. Mia was the one to greet us first, and even if she slightly had forgotten that she had invited us over that day, she smiled and quickly stopped what she was doing before we came up to her. Behind the front desk, there was a door open into the big lab/office where most of the employees at Khora spent their working hours. We did not enter the lab/office at this point, as only Mia and Benjamin had time to speak with us. The three of us quickly split up. One of us was talking with Mia about our Thesis, what we would like to do, what projects Khora has done before, and not least which companies/organizations they have cooperated with. Benjamin invited the other two group members to try the VR HMD standing near the entrance and the front desk. Everyone can drop by Khora and try the VR at the front desk free in 15 minutes. No customers were waiting to try the VR after us, and since we visited Khora as students, and as invited guests, we were allowed to try many different games that Benjamin introduced us for and

TAM TRYING HTC VIVE AT KHORA

talked us through. Mia did tell us about many interesting projects done by Khora in collaboration with external partners. Most of the projects she told us about was VR within healthcare. Some of them were completed, but interestingly many of them were still ongoing. One of the projects she told us about is a project at a psychological clinic called *Cool Kids.* She did not have much information about the project but gave us the contact information to Cool Kids. Mia, the shop assistant, gave us the idea of attending an event called CopenX (Appendix, CopenX:60), which was about VR in healthcare later that evening, and we took on the opportunity of attending it, as an event of such will give us more knowledge about the usage of the technology and will in most cases help us connect further with important people within the field of VR in healthcare.

LUCAS TRYING HTC VIVE AT COPENX

The event gave us the opportunity to come in direct contact with important project managers in the VR healthcare sector and doctors at Rigshospitalet.
Furthermore, they even also gave us insight into the technology, about how VR is being utilized in the healthcare sector. We got in contact with Thomas Saaby Noer, Head of Healthcare for Khora. He is responsible for all the projects that Khora has in relation to healthcare and is additionally in charge of the product designs. During the CopenX event, we also met Kristian Bluff, a business consultant, who connected us with Søren Walther-Larsen, chief consultant at the Paediatric Pain Knowledge Center at Rigshospitalet(PPKC) (Appendix, CopenX:60).

A couple of weeks after, we got in contact with Søren Benedikt Pedersen from Cool Kids, who utilizes VR to treat cynophobia. As the name, Cool Kids, allude to, they primarily work with children who they offer cognitive treatment and therapies to. Cool Kids have two offices; one located at Vesterbro in Copenhagen and one in Roskilde. The office that we visited was located at Vesterbro in Copenhagen and not far from the central station. In the beginning as part of our field work for the Thesis we would visit Cool Kids. Here is an account of the visit:

We arrived at Søren Benedikt's office early in the morning. The entrance was very subtle, it just looks like any other entrances to a normal private apartment. We quickly noticed that the entrance to Cool Kids was overshadowed by a jewelry store and a clothing store. It would be hard to notice the entrance had we not known the address of our destination. In order to enter the entrance that leads to Cool Kids office, we had to ring on the doorphone next to the entrance door in order to be able to get inside. As we got access and got on the other side of the door, we could see that the entrance hallway was old. The office was located on the third floor. We took the elevator upstairs, which was also old and nothing like those fancy and shiny elevators that Aalborg University CPH have. Again, there was another door that we had to ring on the doorbell to make it inside. This door was different, it looked old and grey. If there was no sign that said Cool Kids, we would have thought that it was an apartment where someone lived. Søren Benedikt was the one who came to receive us at the door and took us inside. The Cool Kids office looked like a normal living room. It was noticeable that the place was built as an apartment but was now being used as an office. To our surprise, another employee from Cool Kids also attended the meeting. Her name was Johanne Studnitz Jørgensen. The meeting was informal where we discussed our plans and how we could be involved, and also their expectations for a project together. The duration of the meeting was not long and we were told that there were no children undergoing a treatment with their VR at that time and this was something that they were trying to put into process. Furthermore, they told us that, so far, only one kid has tried the VR treatment for cynophobia and the results were underwhelming and not to their liking. They wanted to try the VR treatment again on another kid and would update us when they had found one, but could not guarantee us anything at the current time. To our luck, Cool Kids managed to find a kid with cynophobia who were willing to use VR as a treatment method and we were also allowed to join and observe how the treatment was being conducted. In order to understand how Cool Kids were using VR for cynophobia treatment, we tried the VR device and watched the videos that Cool Kids had made. None of us have cynophobia and we were not startled or intimidated by the videos in any way, but this gave us a good understanding of how the applications were made, how it was filmed and the plot developments of the videos. There were 11 videos and the treatment starts at number 1. The videos are ranked in a "scary"-order, where 1 is easy and nice to look at and the higher you go up in the number, the more "scary" it is. As said, we had the chance to observe a child who underwent the treatment, which will be

describing in detail later in our Thesis.

COOL KID'S OFFICE AT VESTERBRO IN COPENHAGEN

0.1 TAM TRYING COOL KIDS' VR

0.2 TAM AND LUCAS AT COOL KIDS' OFFICE FOR AN INTERVIEW

Later in our process, we were at Rigshospitalet as we had an interview with Søren Walther-Larsen. We had to meet Søren Walther at department 4013, hallway 4, 1. floor. Upon entering Rigshospitalet, we noticed straight away that it is a busy place, as we had expected, after all, it is the largest hospital in Denmark. The floor that we went to was busy as well. Parents and children were in queue for their appointments. We felt lucky that we managed to get an interview in such a busy environment. The office that the interview took place in was very small with shelves that were stacked with folders, probably documents on patients, and the office was shared with three other doctors. The three of us sat there with Søren Walther and it felt a bit crowded because of the size of the office.

US ARRIVING AT RIGSHOSPITALET FOR AN INTERVIEW WITH SØREN WALTHER-LARSEN

We also got in contact with Per Frederiksen, psychologist and project manager at the Youth Medical Knowledge Center at Rigshospitalet (trans. Ungdomsmedicinsk Videnscenter Rigshospitalet). Though under the same organization as Søren Walther, Per Frederiksen utilizes VR for another purpose and also had the help from Khora but we found and got in contact with Per Frederiksen through our own research. The interview was not a physical meeting at Rigshospitalet, it was conducted through a phone call. Even though the interview was not conducted at Rigshospitalet, we already knew how the environment is there as we have been there during the interview with Søren Walther.

Description of Khora

Khora is a VR production house, a VR store and hub for innovators. Khora has a defined store space in Copenhagen, where one can visit and try out a variety of VR HMD's and applications. The aim and vision of Khora is stated on their website as: *"Virtual reality is a new communication medium that can revolutionize the world in which we live in under many aspects. Khora wants to discover its potential, and use it for exciting and valuable projects."* (Khora-vr.com, n.d. a).

Khora has developed a large variety of software for a large variety of clients. For example they have developed software in the areas of: refugee migration, tourism, education, and healthcare.

The two projects they have worked with, which we have been particularly interested in, has been in relation to VR and anxiety in children with Cool Kids and VR in relation to anesthesia at the PPKC

The applications Khora makes ranges from 360 degrees video productions to interactive 3D applications, consisting of both VR and AR.

Khora also hosts events and workshops to give people insight into the technology, as well as to understand the developments on the technological front.

Cool Kids

In our Thesis there are several different actors which we have situated our research around. One of them is Cool Kids, an anxiety treatment program for children which through Cognitive Behavior therapy and group work introduces children and parents to concrete methods and strategies that can be used in everyday situations (Cool-Kids.dk, n.d.). It is based on two decades running program from Australia (Macquarie University) which have then been used at Aarhus University by CEBU, the Center for Psychological Treatment of Children and Young (trans. Center for Psykologisk Behandling til Børn og Unge). The CEBU results show that after the participation in the program, children have increased their presence in school, increased confidence and heightened belief in their academic performance and ability to socially interact. As well as lowered their concern, shyness and anxiety (CEBU, 2018).

The program is primarily for 7-14 year olds and the duration is between 8-10 sessions of 2 hours.

What is interesting to us is their co-development of a VR application which is being made in collaboration with Khora. The current software is made, as a treatment in conjunction with the therapeutic group work, to treat children with dog anxiety and phobia. The child wears a VR HMD with a smartphone attached, and then views a video of a large field, where dogs are roaming around. The child will go through different stages of 1-11, and the dogs come closer or all the way up to the participant as the niveau increases, which ideally should result in a higher provocation of the anxiety. Through the increased anxiety with seeing and being around dogs in a virtual environment(VE), the patients will be able to talk about their experiences with the psychologist to put the intangibility of the phobia into words.

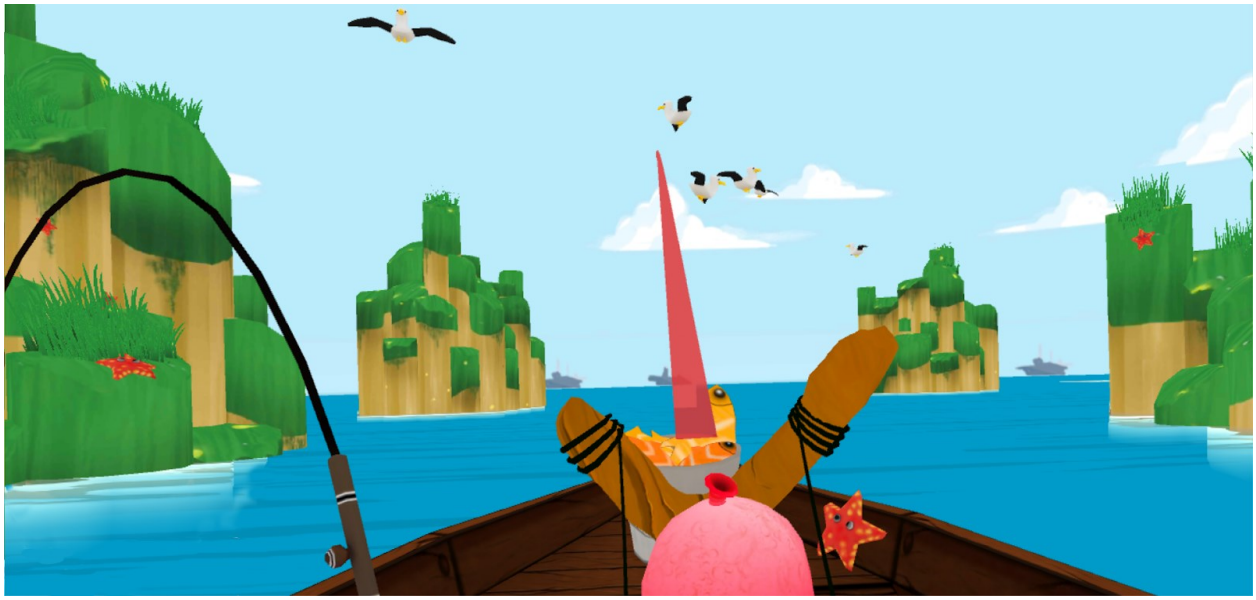
STAGE 11 OF THE CYNOPHOBIA VR TREATMENT VIDEO THAT COOL KIDS USES

Stage 11 of the video being used for cynophobia (fear of dogs) (Khora, n.d. b: Video).

At this stage, the software application is relatively new and underdeveloped which also means that the video might not have the intended effect in decreasing anxiety yet which is something we will be describing in the analysis.

Rigshospitalet

Rigshospitalet (english trans. Kingdom Hospital but is usually not translated) is the largest hospital in Denmark and is located in the heart of Copenhagen (Hermansen, n.d.). The hospital has a long history and it goes about 250 years back to Denmark's first real hospital, known as "Det kongelige Frederiks Hospital" at the time. Rigshospitalet was established to treat and care impoverished patients free of charge in Copenhagen (Hermansen, n.d.). Rigshospitalet is specialized in many different areas. The department that we have focused on in our Thesis is the Paediatric Pain Knowledge Center (trans. Videnscenter for Børnesmerter). Together with Khora, they have developed a VR video game that enables the doctors to treat the children with ease as the VR game keeps the children calm and distracts them from the pain that they might feel. We have met and interviewed Søren Walther-Larsen, the chief physician and project manager for the VR usage at the Paediatric Pain Knowledge Center (PPKC), where we also tried the VR game (Appendix, PPKC:64).



THE VR GAME, 'TROUBLE ON THE BATHING JETTY' (TRANS. BALLADE PÅ BADEBROEN), THAT THEY USE FOR PAIN DISTRACTION AT RIGSHOSPITALET, PAEDIATRIC PAIN KNOWLEDGE CENTER (MUNK, 2018).

The game is simple but effective. Above is a picture that illustrates how the game looks like when one puts on the HMD. The game takes place on a small boat and you are equipped with a slingshot that has water balloons as ammunition. The goal is the prevent the birds from stealing your fish in your bucket that is right in front of you, and by doing that, you shoot the birds with your slingshot. The game is developed as an application for mobile phones, specifically Samsung VR, which makes it easy accessible without having to use powerful computers. One just need to mount the phone onto the VR HMD, the Samsung Gear VR and it will work; it is a plug and play design.

THE SAMSUNG VR DEVICE THAT IS BEING USED AT RIGSHOSPITALET, PAEDIATRIC PAIN KNOWLEDGE CENTER (SAMSUNG, N.D.).

The Samsung VR has a controller, which in this case, is being used to aim with the slingshot. An important element in the design of the game is that the children do not get startled or scared, and last but not least, do not get nauseous. An important prerequisite for the game to function in the hospital situation as both topic of discussion, distraction and entertainment is that the nurse or the person who has to interact with the child during the procedure knows the game and knows what is happening (Munk, 2018).

The next step for the PPKC at Rigshospitalet and Khora is to document the effects of the VR game. The plan is to conduct a comparative research study on groups of children with other treatment methods that they use at the PPKC such as music, smartphones or tablets, and other kinds of distraction methods. If the effect appears to be as good as expected, the PPKC hopes to spread the method nationally, and also globally, so other hospitals and children can get a better experience in a difficult situation (Munk, 2018).

Another person which we spoke to from Rigshospitalet was Per Frederiksen, a psychologist. He was working in a different department called Youth Medical Knowledge Center (trans. Ungdoms-medicinsk Videnscenter). As the name indicates, it is mainly young patients, around the age of 12-

24, that he is working with (Appendix Per:37). The VR at this department does not have the same purpose as Søren Walter-Larsen's department. Per tries to create a better experience for youths that has to be at the hospital for prolonged periods (Jónasdóttir, 2016). The circumstances for each youth is different, but loneliness is a big problem as some might be isolated because of risk of infection, thus unable to join social gatherings at the hospital or getting visitors. Per thinks that VR might be the solution to this problem, that VR might be able to give the patients the feeling of not being isolated at the hospital, but also to have experiences that they can remember in their transformative years as young adults.

We have now detailed a variety of actors which we have had the ability to talk to, or participate in sessions with. We will be using interviews and observational notes from our fieldwork, to give a general idea of how these actors relate to each other, and what role VR plays which we will use later in the analysis. Now we will however go into detail regarding which methods we used for gathering our empirical research material and describe our involvement with our field of study.

Methodology

We will in this part of the Thesis describe the variety of methods with which we accumulated our empirical material. We will also be describing our involvement in the field, how we participated in and gained information about, our informants. The empirical materials gathered through the Anthropological Methods detailed in this part of the Thesis, laid the groundwork for the analysis and the shape of the Thesis itself.

Triangulation

A single method is often not sufficient to shed light on a phenomenon. Using multiple methods will help facilitate a deeper understanding of a subject matter. Using multiple methods is also commonly referred to as triangulation. Triangulation is frequently used when the field of study is difficult, demanding or contentious. Triangulation techniques are helpful for cross-checking and used to provide confirmation and completeness, which brings 'balance' between two or more different types of research. The purpose is to increase the credibility and validity of the results in the research. Often this purpose in specific contexts is to obtain confirmation of findings through convergence of different perspectives (Turner & Turner, 2009). Triangulation should be understood as a means of extending our knowledge of the research issue. There are several different ways of doing triangulation:

- **Data Triangulation**: obtaining data from different sources, or at different times or under different conditions, but would not include studies where these comprise the independent variables in an experiment. That being said, data triangulation is commonplace in presence research although rarely explicitly commented upon.

- **Methodological Triangulation:** involves using more than one method to gather data. Most common approach is to combine qualitative and quantitative measures.

- **Investigator Triangulation:** When it comes to observing a phenomenon, two researchers often observe in their own way. A research project consisting of more than one person will allow the research to gain multiple perspectives on a phenomenon. Each individual of the research group have a multiplying effect on the research; each one adds more than just his/her presence to the knowledge that is gained about the situation under study.

- **Theory Triangulation:** Involves using more than one theoretical framework in the interpretation of the data. This form of triangulation is uncommon in presence research. However, the results of studies adopting this form of triangulation are generally rigorously discussed and produce rewarding conclusions.

(Turner & Turner, 2009)

We have used three different types of triangulation in our Thesis, namely data-, methodological-, and investigator triangulation. For the data triangulation, we have interviewed and observed different people from different organizations; Khora, Cool Kids, PPKC and the YMKC. And all these people who contributed with their time for an interview have different professions and backgrounds, but, nonetheless, still the same interest as each other i.e. VR. Additionally, we have also gathered data on the internet about VR; the technical aspects of VR and usage of VR. This means that we have obtained our data from different sources. Methodologically, we have used different types of ethnographic methods: participant observation, field notes, and interviews. These methods combined complement each other and may, or may not, verify the validation of the data that we have gathered. The investigator triangulation is at place when all three of us are at place at an interview or observation of an event. If only one of us was at place during an interview or observation, it would not have been an investigator triangulation. We find that it was beneficial for us to be three as we all three have different views and we notice different things during an interview or observation. Like Turner & Turner (2009) states, each of us have a multiplying effect on the research. For the interpretation of our data, we have only chosen a single theoretical framework, thus, that part of our Thesis is not a triangulation. If we were to use more than one

theoretical framework, we would have to re-gather all data for our Thesis, as the data that we have been gathering are through the Akrich et al.'s (2002a, 2002b) methodological framework, which we will specify in the Theory Section of the Thesis.

Desk Research

In this Thesis we have conducted desk research. This means that we have conducted research on virtual reality with our computer. This is to gain a knowledge about what kind of research has been made already, on the topic, and more knowledge about the technology - what is it capable of and what has it been used for so far. By knowing more about the technology and the field it is being used in, will also help us facilitate questions that we otherwise might not think of. Desk research gave us an initial overview of the field. We tried to ascertain what was already written on the topic of virtual reality and what projects was currently ongoing. We especially looked towards projects within a Danish context, and actors engaged with VR. We found that there were several projects related to the healthcare sector which had concerned themselves with VR. We then took contact to some of the actors that we had come to know of through the research, and we were able to conduct interviews and Participant Observation because of them.

Literature search

Our literature search consisted of searching on keywords in google and on the AAU literature database Primo. We have used a variety of key words that we thought would give good search results. The initial google search was done to give a general understanding of the field. It has also helped us in finding some key gatekeepers and institutions, which we could ask for more information.

After the initial google search, we used primarily the AAU database, which give access to several publications. In it, we searched for some of the same key words as with the google search, but we were less general with the search terms.

For the google inquiry, the key words which we used during our searches were: Virtual Reality, VR, Virtual Reality AND Denmark, Virtual Reality AND Rehabilitation, Virtual Reality AND hospital.

For the AAU database inquiry, we used the same key words as above as well as others such as: Virtual Reality AND history, Virtual reality future, VR AND AR. Head Mounted Device, VR AND Healthcare, VR AND HMD. VR AND Specifications. VR treatments

We also asked a professor from Aalborg University CPH who is expert in VR, Jon Ram Bruun-Pedersen, whether they he of interesting literature that was worth knowing about and reading. This

led us to some specific articles on Immersion. Additionally, we asked our supervisor for his guidance on finding specific articles with search words we would want to find more articles about, but which were also of a specific standard.

Interview

Interviews are one of the ethnographic methods that we have used for gathering empirical data for our research topic. Our interviews are based on a ready-made interview guide that focuses on particular issues of interest, and possible questions (Appendix, interviewguide;3-7) (Kvale & Brinkman, 2009:45). Furthermore, they were constructed to be conducted in a semi-structural manner. This means that we have a set of specific questions related to our research topic, but they are reformulated to make the interviews more like a natural conversation. During the interviews when we ask the questions, they are not fixed, so it is possible to ask questions that are not in our interview-guide going with the flow of conversation, which might lead to interesting things that we might not have taken into considerations. The interview situation thus becomes more fluent and follows different themes and subjects, that might not from the outset seem to have any empirical value, but which can prove to be particularly insightful into the subject matter and world view of the informant. The interview is thereby shaped by not only us but also the informant. The strength of a semi-structured interview lies in its ability to be an informative conversation with the ability to produce new insights that were otherwise not clear beforehand to the interviewer. The interviewer and informant might get sidetracked by issues and information, but this information can be supportive to the research and lead to deeper insight into a topic of interest to the informant through which we can achieve a greater understanding of the worldview of the informant.

Anonymizing

During this Thesis we talked to various high standing and outwardly public people. The people we talked to, because of their public persona, chose not to be anonymized for this Thesis. We did however also have interviews with other people who were not in public media, and we have asked them in the specific instances if they would prefer to be anonymous. However, they gave us consent and permitted us to use their names in our Thesis, thus anonymization of these informants are not necessary. But one of our informants was a child and we chose to anonymize him out of courtesy.

Transcription

Our interviews were conducted in Danish as all the informants are Danish and so are all three of us. Therefore, our transcriptions are also in Danish as this will avoid potential misunderstanding when translating from Danish to English. However, when we quote and use the interviews in our analysis, it will be translated carefully to English in order to avoid misunderstandings or

misinterpretations of the real meaning of what the informants have said. Furthermore we have chosen not to include filler-words like eh, oh, ah and so forth in our transcriptions. This is to achieve more fluent sentences when transcribing and also to contribute to an easier reading of the transcription.

Fieldnotes in Ethnographic Research

When conducting ethnographic research in the field, the researcher strives to understand the activities and everyday experiences of other people. This is typically done by getting close to the daily rounds of people's lives and activities; the field researcher must be able to take up positions in the midst of the key sites and scenes of other's lives in order to observe and understand them (Emerson et al., 1995:1). This method of participating in the daily routines of this setting, develops ongoing relations with the people in it, and observes all the while what is going on, is also called participant observation in the world of ethnography. Ultimately, it is often not enough just to participate and observe, the ethnographer also has to produce some sort of written account for what they have seen, heard and experienced in the field. There will be many times where writing down fieldnotes will not be as simple as it appears. If the ethnographer is too busy with writing down notes, he or she might miss important ongoing activities, however, there is no one correct way of writing down fieldnotes. As Emerson et al. (1995:11) states, different ethnographers, and the same ethnographer at different times, turn experiences and observations into written texts in different ways. There will be times where an activity requires the ethnographer's full attention, in which, writing down fieldnotes will be postponed in order to be fully immersed in another social world (the observed field). And there will be times where an activity that enables the ethnographer to observe and write notes as the activity does not require full attention. However, in this situation, the ethnographer has to be concerned with "getting into place" to observe interesting, significant events in order to produce a detailed written record of them (Ibid.:11). In the experiential style, writing may be put off for hours or even days, until the field researcher withdraws from the field and, relying solely on memory, sits down at pad or computer to reconstruct important events. The most common method of writing down notes are by doing short brief notes, also called jotting. Again, there is no single correct way of how jotting should be, rather the ethnographer has to be aware of the circumstances and situations that he or she is in. It is time consuming and difficult to write out every word fully, and many fieldworkers develop their own private systems of symbols and abbreviations. Some even learn a formal transcribing system such as shorthand or speedwriting (Ibid.:12). Ethnographers must also decide when, where, and how to write jottings. Far from simply mundane matters, such decisions can have tremendous import for relations with those in the field (Ibid.:13). For instance, if the researcher is experiencing interesting scenes or conversations in the research field, pulling out a notepad and starting to write jottings might result

in distrust from participants as they may now see the ethnographer, or field researcher, as someone whose primary interest lies in discovering their secrets and turning their most intimate and cherished experiences into objects of scientific inquiry (Ibid.:13).

We had no difficulties in jotting while observing as we are a group consisting of three people. We have some advantages to our number, for instance, one could write jottings while the others could pay attention to the details in our observations. During interviews, one person would be focusing on asking questions, while the others would observe and write down anything interesting. We record our interviews, but listening to them can only do so much; you cannot see the expression of the informant, you cannot see their body language, anything visual while at the place is something you cannot comprehend and is difficult to imagine, when listening to an interview - that is, of course, unless the interview is in a video format. But in our Thesis, only the sound is recorded. It is important to have written notes of hand gestures and body language in general, or if something was said in a specific tone of voice, have notes which reflect that. It helps decipher what the informant was saying after the transcription of the interview has taken place, and gives a more real account of the interview process.

The downside to that we are three in our group is that it might attract too much attention and make participants feel uneasy of our presence. This could, in some cases, result in shallow information as they feel intimidated and unwilling to share.

Participant observation

Participant observation is a type of method within the field of ethnography that is commonly used to collect qualitative data. Furthermore, participant observation provide us with ways to check for nonverbal expressions of feelings, grasp how participants communicate with each other, and check for how much time is spent on various activities. This method also gives us the opportunity to observe events that informants may be unable or unwilling to share when doing so would be impolitic, impolite, or insensitive, and observe situations informants have described in interviews, thereby making them aware of distortions or inaccuracies in description provided by those informants. When doing participant observation, one's own body is being used as an instrument when investigating and observing, as it is a necessity to become a part of the field. The more one can participate in a given field, the more one will understand the culture they live or work in. To achieve this, it is important to understand the tacit knowledge within the field, including its norms and practices, and this is exactly where the part of using one's own body as an instrument is a necessity (Malinowski, 1922:25). While it is ideal to conduct a large amount of fieldwork, and as

detailed as possible, we must also be realistic with our opportunities and access to the field. As Jacob Krause-Jensen (Krause-Jensen, 2010:26) writes, *"Organizations are environments pervaded by instrumental means-ends thinking, and consequently we would expect business organizations to be sites of efficiency and bottom-line logic. From this perspective, organizations are not very inviting places to do ethnographic fieldwork, as such means-ends rationality runs counter to some fundamental ideas of what ethnographic research is all about."* (Krause-Jensen, 2010: 26). The healthcare industry is not an exception; in fact, it might be a more challenging field as there is patient confidentiality and other kinds of data that can be sensitive which one has to take into account. This means the kind of full participation within the culture of the 'natives' isn't possible. A way of gaining a better vantage point then is to gather materials from different sites and previously conducted case studies, which can help shed light on the field, like we have done in our Thesis with Khora, Cool Kids, and Rigshospitalet. Our field of study then takes on some of the multi-sited facets of ethnographic research, where the researcher travels between different sites which are connected by the same cultural rationales and technological artefact. George E. Marcus writes about multi-sited ethnography as: *"Strategies of quite literally following connections, associations, and putative relationships are thus at the very heart of designing multi-sited ethnographic research."* (Marcus, 1995:97). In our Thesis we followed VR and the associations between actors which connected them to one another and the technology.

Generally speaking, when conducting participant observation, the ethnographer has to engage in the field physically using their body as an instrument. We have involved ourselves in an event from Khora & CopenX, observed how a child underwent a VR treatment for cynophobia and also done observations of the three fields; Rigshospitalet, Cool Kids, Khora. In relation to the participant observation, we refer to James Spradley (1980) who was a professor of Anthropology who has written about how to conduct participant observation. As participant observers, we were all three outsiders. We had no prior relations to the field nor to any of the people involved in our Thesis, as such we were newcomers to the domain within which we wanted to enter.

Our role in the field has been academic researchers. We were simply interested in doing academic research on how VR is being utilized in the Danish healthcare section. This might have made it easier for us to gain contacts and interviews as the informants will get some form of recognition in our project. Though there are still data and stuffs that we could not gain access to. For example, we did not gain access to observing children at PPKC, when they use VR for pain distraction. Neither did we do observations at the Youth Medical Knowledge Center at Rigshospitalet. This might be due to some of the patients are being isolated, thus making it risky for, not only the patient, but also us if we were to observe them. We also did not observe how the designers and

programmers at Khora work, we only got the chance to interview one of the designers behind the game that they use for pain distraction on children at PPKC. Because of our role in the field, we gained limited access to Khora, how do they plan their designs, how do the designers or programmers work? These are some of the things that we did not gain access to. Things might have turned out differently if we were interns and not some students who suddenly show up at their doorstep with some interest in VR. Neither do we have any first-hand observation on how the children are reacting to the VR game. This is due to patient confidentiality and the uncomfortable feeling that the kid and his or hers parent might have if we were to observe them on the sideline. Must of our information concerning Rigshospitalet is from interviews and journalistic articles. But we did gain access to observing one child at Cool Kids, where we learned how VR was being used as a supportive tool in treating cynophobia. We were lucky enough to have a small interview with the child, who was accompanied by his mother. Which was lucky, especially if we consider the facts that this child has been diagnosed with a couple of disorders, such as ADHD.

Our position to Khora, Rigshospitalet and Cool Kids is not close, hence, we are outsiders, which is why we are limited to some information. There is, most likely, sensitive information that Khora does not want to give out because of the competition in the market. One could imagine, if we were for example interns, that we might have had larger access to information about design processes and that they have made spent more resources on us. We have in previous semesters conducted a research on VR, which means that we, to a certain extent, already know what VR is capable of.

Thick description

Thick description is often used to explicate and describe a field or a phenomenon that is being observed. Clifford Geertz, whom many consider to be the primary author and proponent of thick description, asserts that an anthropologist's task is to explain an incident, event, environment or culture with thick description (Geertz, 1973). This form of method identifies and outlines many details, conceptual structures and meanings that sometimes are neglected and overlooked. The opposite of thick description is thin description, which is a method of facts without deeper explanations and reflections of the facts. Thin description, according to Geertz, is inadequate when studying a phenomenon and it is also misleading (Geertz, 1973). An ethnographer must be able to present a thick description consisting of data with detailed descriptions and interpretations and reflections on the culture being observed. These are important aspects to an adequate thick description, at which it should be an interpretive ethnographic study. The raw observational data and material collected by an ethnographer is not sufficient if we are to conduct a thick description of a given phenomenon. Thus, social discourses are an important element in the interpretation, and an ethnographer has to take into account extroverted expressions as well. Data collection and

interpretations are therefore often limited to what the informants can tell us and what we are able to observe. Our thick descriptions and observation notes are in written form are depicted in our appendix (Appendix:60-64)

Observations at Cool Kids

Once again we arrived to the Cool Kids clinic at Vesterbrogade. During the first two hours we first interviewed Søren, the psychologist, followed by a small meeting which served as a preparation for the VR session with Mikkel. The VR device was tested, and we were allowed to watch the cynophobia treatment VR videos Søren Benedikt then asked us if we could recommend some VR applications that are fun for children, and said; *"I am not the savviest guy when it comes to using this technology"*. He had promised Mikkel that he could try other applications after the therapy was done. At 2:30PM Mikkel came to the clinic with his mother. Before they entered the consultation room we had already arranged ourselves at a table a few meters away from the round table with three chairs where sessions take place. Mikkel was briefed about our presence in advance, and when he, and his mother, entered the room he seemed curios and quickly took the initiative to reach out and say hello to us. After shaking our hands, he ran to the round table to take ownership of the chair he clearly knew Søren usually sits in. This upset his mother a bit, but Søren said it was okay and that Mikkel could sit wherever he wanted to.

Once they all sat down around the table, Søren asked Mikkel if it was okay with him that we stayed in the consultation room observing him experience the VR session. Mikkel responded that it was completely fine, and that he had already been interviewed many times before. Søren then asked Mikkel how he has been since the last session of treatment with VR. Mikkel expressed that he is not as afraid of dogs as he was before. His mother does not agree with the statement though, stating that he has not yet showed any signs that he is less scared of dogs now. Mikkel mentioned a situation right after school where his mother was not there. Supposedly, a man with a dog walked just past him, and the dog even sniffed him. In this situation, Mikkel was not quite as scared as he usually would have been he told them. The mother still seemed a bit skeptical of the story, but did not take the discussion any further. Mikkel then told Søren that he received a reward after the last VR treatment, because his mother thought he did so well. He was allowed to have an ice cream at the local ice cream shop in Søborg right after the session. At the same moment, Mikkel noticed the jar with candy at the table, and asked if he could have it. Søren told him, that he could pick one now, and then one more after he has watched another few VR videos taking him a few steps closer to finalizing his treatment with VR. When the initial catch-up between Søren and Mikkel was done, Søren asked if Mikkel was ready to try the VR again, which he was. Mikkel and Søren switched

seats because Mikkel needed more space before him, as it allowed him to get up from the chair and experience the VR standing instead of sitting down.

It took a few minutes before Søren and Mikkel had adjusted the headset so it sat properly. This initial challenge of making it fit properly is primarily because the headset is made for adults, not children. Once it was adjusted to Mikkel's head, a new challenge occurred. It took three to four minutes to find out which stage (video) Mikkel had reached. Clearly, Mikkel was not afraid to try a stage higher than he had actually reached, as he claimed that he had “already seen video number five”. At Cool Kids there is no monitor or screen outside the HMD with which Søren can see what is displayed in the VR space. Thus, Søren needs to ask Mikkel what he sees, instead of just follow it on a screen himself, which would have enabled Søren to take control and guide Mikkel through, not the other way around. Eventually Søren, Mikkel and even his mother too, agreed on what video Mikkel should start with for today’s session. He gets to start at level 7, a compromise which is higher than the stage he had actually reached (number 6), but lower than what Mikkel wanted to do himself. At the first session, which we did not observe, Mikkel was “not at all scared by the dogs” in the VR videos he saw. Nevertheless, Mikkel showed great enthusiasm towards today’s VR treatment, as if he almost looked forward to it. Once the Video, stage 7, started he really did make an effort to immerse himself into the VE. He stood up from the chair, pointed at the floor as if dogs were walking around in the room, and he said “the treats are over there come on…It is right there can you not even see them?!”. Only a few seconds later, he stopped being critical towards the dogs, and instead he became rather critical towards the VR experience. He would say “okay now I am just looking down at the camera stand”, referring to the stand of the 360 degrees camera that filmed the video he was watching. A short moment of silence and concentration from Mikkel while Søren spoke to him, was followed by even more critique. “You really do not scare me with this video, if that is what you are trying”. Once the video was done, Søren and Mikkel sort of helped each other take off the HMD from Mikkel's head. Now Søren had a few more questions to ask Mikkel. “on the worry scale from 1 – 10, how worried were you during the video?”. Mikkel quickly responded “one on the scale”. He then waited a few seconds before he corrected himself, “well okay, maybe 3 or something like that”. When Søren asked Mikkel to explain himself why he was not more scared, he said “Because they are on a leash…and I almost could not see them because they were far away, and also because I could barely hear them at all. They did not bark”. At this point Mikkel seemed proud of himself because he did not become scared, but he also seemed a bit frustrated by the fact that the VR experience was less immersive, thus, the dogs less frightening, than what he seemed to have expected. A few times he mentioned that the videos had until now been a tad boring. Søren reacted to the feedback from Mikkel, by allowing Mikkel to skip a few stages(videos) and watch video number 11 as the next one. However, before giving Mikkel the

HMD back on, Søren introduced what was going to happen at stage 11, which is the final and most frightening of all the cynophobia treatment VR videos made for treatment at Cool Kids. Søren said that at stage 11 the dogs run around him without leash or an owner controlling them, they will, however, play with toys and look for treats.

When the HMD was back on Mikkel's head and he started the video, once again he got up from the chair in order to immerse himself to the VE, by being able to look around in 360 degrees. "Oh there you are, I could not see you before", Mikkel said, because some of the dogs were behind him where he could not see them at first. "I can barely hear anything from the video". Søren did not respond to that, and instead he asked Mikkel what he saw in the VE. 10-15 seconds later, after persistently trying to concentrate on the video, Mikkel repeated: "now you really have to turn up the volume, I cannot hear anything". Søren tried to turn up the volume, but seemingly, it did not help much. The challenges in relation to sound seemed to be a combination of things, and we base this statement on our participant observations (trying the HMD and seeing the videos ourselves) and our observations of Mikkel trying the HMD. First, it is worth mentioning that it seems as if the 360 degrees VR videos were recorded with a poor microphone, making it difficult to provide the VR video with a high quality sound. The VR videos really seemed to lack the sound from 5, or more, meters away, which made it a challenge when the dogs were far away from the 360 degrees camera and microphone. Instead of sounds of dogs, the sound of the wind hitting the microphone seemed to be more prominent. Secondly, when watching the cynophobia treatment VR videos at Cool Kids, the sound is provided by the small speakers on the side of the HMD and not from headphones attached to the HMD. This, in itself lowers the quality and quantity of the sound. The exclusion of headphones also meant that Mikkel could easily hear noise from the room, as there was nothing on his ear to create a small sound block. Not only did Søren speak to Mikkel while he tried to focus on the VE, but during the VR session other noise appeared too. One thing is the consistent traffic noise from Vesterbrogade, which to some extent might have been realistic to the VE Mikkel experienced in VR, but during the session the doorbell rang four or five times.

When stage 11 was done, Mikkel quickly took of the HMD saying, "it was nice to get it off, my hair annoyed me". Søren asked Mikkel again how worried he was during the video, from 1-10.

"3 again, because I knew they would not do me any harm, the owner was right there too. It is more when the owner does not have control over the dogs." Then Mikkel again took a brief moment to reconsider his answer. "okaaaay, maybe a liiiitle bit more [worried, edited], maybe a half more on the scale". Even if Mikkel did not get that worried, or scared, of the dogs, he was proud that he had seen all the cynophobia treatment VR videos. "I think that I did well, I can be proud, pat myself on the shoulder". Mikkel did physically pat himself on the shoulder, and then Søren patted him on the

shoulder as well, saying “yes, you did really well”. After the evaluation of the final dog video, Søren initiated an evaluation of the overall VR treatment, by asking what Mikkel would think about watching the videos again. Mikkel was not exactly thrilled about the idea of going through the stages one more time; he even said “it would be boring to watch the videos again”. When Søren asked Mikkel to elaborate why it would be boring to watch the videos again, he thought about it for a few seconds before answering “Because now I have already seen it, and I [would, edited] know what is going to happen. It was already a bit boring to watch it the first time, but it would be even more so to watch it again. It is kind of like going to the cinemas, it is boring to watch the same film over again”. Søren showed his understanding, saying that he was aware the cynophobia treatment VR videos were not frightening enough. However, he also said that Mikkel was at 3 on the worry scale, and if he experienced the stages again he might end at 1, which is in some ways the goal with the treatment. Nevertheless, it was not decided while we were there, whether Mikkel should experience the videos again or not. Mikkel got to choose one more piece of candy from the jar on the table, before Søren left the room, and Mikkel joined us at the other table in the room. Now it was time for us to interview Mikkel about his experiences.

Subsidiary conclusion

We have now gone over some of the methods through which we conducted our field work and took notes, how we made our interviews and transcribed the material. We also gave a thick description of a particular observation in the field, which we will be using as part of the empirical material for the analysis. We will now go through the theoretical part of the Thesis, where we will describe the theories which we used during the fieldwork which influenced the questions we asked and what we look for in our observations.

Theory

We will now describe the theoretical perspectives used as a foundation for our analysis and field work during our Thesis.

ANT

Actor-Network Theory or ANT, is a theoretical and methodological approach to social theory initially developed by Michel Callon and Bruno Latour. It was established as a response and critique to the Social Construction of Technology, which was deemed too limited in its scope, focusing on relevant social groups but forgetting or ignoring non-human actors and their ability to influence a network. The networks are heterogenous which are constantly performed and vigorously debated (Callon, 1986).

Embedded in ANT is the focus on non-human and human actors and their equal treatment, called generalized symmetry. Generalized symmetry is a commitment to explaining human and nonhumans in the same terms, and not presupposing any differences between them unless generated within the network of relations. Free association, no a priori distinctions between what is natural and what is social – if any distinctions are made they are made by the actors, and Agnosticism: analytical impartiality between actors, human or nonhuman, within a controversy (Callon, 1986).

In this chapter we will go over some of the common themes of ANT, while relating to the specific texts written by Madeleine Akrich, Bruno Latour and Michel Callon as starting points. We will then describe some of the critiques of ANT and after that we will go over our primary theoretical and methodological text which we will be using for the analysis.

Translation

"For ANT, as we now understand, the definition of the term is different: it does not designate a domain of reality or some particular item, but rather is the name of a movement, a displacement, a transformation, a translation, an enrollment. It is an association between entities which are in no way recognizable as being social in the ordinary manner, except during the brief moment when they are reshuffled together." (Latour, 2005:64-65).

A common thread within ANT is the central concept of translations, in which strong actors capable of creating a network that involves other actors, which have their voices translated to fit within the network. Callon defined four moments of translation in his paper on scallops in St. Brieuc bay (Callon, 1986): problematization, interessement, enrollment and mobilization.

Problematization is where the strong actors seeks to define the nature of a problems of other actors. The strong actors become indispensable to the other actors, and suggests ways in which their problems could be solved, if they are willing to negotiate and go through an 'obligatory passage point' which the strong actors have defined. In Callons text, the strong actors are the researchers who sets out to involve various human and non human entities within their research programme.

Interessement is the second moment of translation which Callon has defined. It is a series of processes and the way in which strong actors lock other actors into positions that has been proposed for them. For the strong actors seeks to impose and stabilize the identities of other actors defined through the problematization. The actors need to be seduced or solicited as they might be part of other networks or problematizations already in place. In Callons text, the scallops are

‘seduced’ by towlines by the researchers, an interessement device which allow for better anchorage for the larvae of the scallops.

Enrolment is the third moment of translation. It is a set of methods which strong actors use to define and interrelate roles which they had set for other actors. Enrollment is successful if the roles that strong actors have defined of various other actors is accepted. Callon writes that: *“To describe enrolment is thus to describe the group of multilateral negotiations, trials of strength and tricks that accompany the interessements and enable them to succeed”* (Ibid.: 10). In the case of the Scallops, successful enrollment is for the scallops to anchor themselves to the interessement device of the towline collectors.

The last moment of translation is the mobilization of actors. The methods in which strong actors ensure that spokesmen for various collectives in the network is correctly representing those same collectives. Mobilization is rendering the immobile mobile. *“To mobilize, as the word indicates, is to render entities mobile which were not so beforehand”* (Ibid.: 14). In Callon’s article, an amount of Scallops anchor themselves to the towlines, which then speaks on the behalf of other scallops. These Scallops are through a series of displacements, transformed from scallops to larvae, to numbers, and visualized through diagrams of curves and tables which are transportable and reproducible. All of the scallops of St. Brieuc bay can then be mobilized by the researchers through these visualizations. In Callons article, the fishermen and the scallops betray the researchers.

Latour also describes translation in his book on The Pasteurization of France, where in his notes he writes that: *“First, translation means drift, betrayal, ambiguity. It thus means that we are starting from inequivalence between interests or language games and that the aim of the translation is to render two propositions equivalent. Second, translation has a strategic meaning. It defines a stronghold established in such a way that, whatever people do and wherever they go, they must pass through the contender’s position and to help him further his own interests. Third, it has a linguistic sense, so that one version of the language game translates all others, replacing them all with “whatever you wish, that is what you really mean.””* (Latour, 1988:253). The language of Latour is quite antagonistic and militaristic, in that it describes a power relation and struggle in relation to strong and not so strong actors, and their relation to one another. Who speaks for who and what obligatory passage points actors must go through, defined by other actors. This is something that ANT has been criticized for as we will describe later in this chapter.

In our report we will relate to some of the translation processes mentioned here, but specifically look at the process of innovation.

Script And De-Script

In the anthology Shaping Technology/Building Society – Studies in Sociotechnical Change, Madeleine Akrich contributed with a chapter on The De-Scription of Technical Objects. In the chapter, she describes how designers often script various moralities and usages into the design of a technology, but when the technology comes into the hands of the users, they de-script the technology. She writes of designers as inscribing various visions into the technical content of an object. She writes about scripting that: *"Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science and economy will evolve in particular ways. A large part of the work of innovators is that of "inscribing" this vision of (or prediction about) the world in the technical content of the new object. I will call the end product of this work a "script" or a "scenario"."* (Akrich, 1992:208).

In Akrich's view, technological artefacts are built by someone, with others in mind. As such, in the technicalities of that object lies various visions of how to use the technical artefact, and how it will function within society. Consciously decided to meet the needs of a market. However, users can also resist the script within a technical object, which Akrich terms as de-scripting.

The de-scripting is then, when the users start using the technologies in unexpected ways, in ways that are counter to, or unexpected by the designer.

Akrich says that we must be more in tune with the way in which users use the things that designers make. She writes that: "Thus, if we are interested in technical objects and not in chimera, we cannot be satisfied methodologically with the designer's or user's point of view alone. Instead we have to go back and forth continually between the designer and the user, between the designer's projected user and the real user, between *the world inscribed in the object* and *the world described by its displacement.* For it is in this incessant variation that we obtain access to the crucial relationships: the user's reactions that give body to the designer's project, and the way in which the user's real environment is in part specified by the introduction of a new piece of equipment." (Akrich, 1992:208-209).

What is interesting to Akrich is the way in which users adopt and redefine their needs through the technological object, the de-scription of the technology in comparison to how designers initially thought of how the technology would be used. It is to show that technological objects are not necessarily going through a linear process and have one interpretation, but that a network of users can redefine the way a technological object could be used, that goes against the intentions of the

designer. She also points out that if we are to study innovation, we need to study the constantly performed network of technical objects, designers and users in their engagement with one another.

What is interesting about these various conceptions within ANT is that they focus on the heterogenous networks of a multitude of human and non-human actors, which are performing said networks. In our Thesis, we will be using the theoretical and methodological perspectives of ANT, in special relation to Bruno Latour, Madeleine Akrich and Michel Callon's article on the The key to success in innovation, which we think is very relevant to the ongoing developments within Virtual Reality and healthcare, as it is a new and continuously developing field. The theories and concepts we have chosen to highlight here is then a contextualization for the article which Latour, Callon and Akrich wrote about The Key to Success in Innovation.

Akrich et al., the key to success part one and two

We have already established some key elements of the ANT approach, as well as introduced the authors of our chosen framework: *The key to success part 1&2– by Madeleine Akrich, Michel Callon and Bruno Latour* (Akrich et al., 2002).

This framework is of course founded on many of the same ideas and concepts developed earlier by the authors, such as *heterogeneous networks*(Latour), *translation*(Callon), *in-scription/de-scription* and *attachment* (Akrich). In this framework though, the concepts are brought together and applied on specific examples, describing what to account for when striving for success in innovation.

The key to success in innovation part 1: The art of interessement

Already at the beginning of this text, it is made clear that Akrich et al. (2002a) wants to offer a perceptual change of looking at innovation processes. The idea that one individual (entrepreneur) alone can bring an innovation into being, must be replaced by the idea of a collectively held innovation process. This is what Akrich et al. (Ibid.:188) sees as moving on from the Schumpeterian model where innovation is the result of a single individuals' sense of intuition, screening and selecting. Instead it must be acknowledged that the understanding of the market/environment in which the innovation is (about to be) implemented in, is a collective activity (Ibid.:188). The change was further elaborated by stating that *"The individual qualities of insight, intuition, sense of anticipation, quick reactions, skillfulness, must all be reinvented and reformulated in the language of the organization. They are no longer the property of an individual, but become collective virtues, during the emergence of which the art of governing and managing play a key role."* (Ibid.:189).

Making innovations collective processes instead of individual ones, surely also brings some new dimensions to the processes. Suddenly the “inventor” does not have monopoly anymore. Instead, doing innovation is a process of negotiations, discussions and adaptations. All the related actors in the network of making the innovation succeed, which of course contains both human and non-human actors, can be seen as one united macro actor trying to find the right solution on a collective challenge. The actors involved in the process of making an innovation succeed, not only concerns the team of developers, but also the environment. The view Akrich et al. (Ibid.): thoroughly stress, is that the environment is not just a receptor of, a new technology for example, the environment is an associate since the technology is in search of allies. This idea is exactly in opposition to the model of diffusion, which assumes that once the general needs of the users are understood, and a product which accommodates those needs are introduced to them, then “*By virtue of its own qualities the product, launched on the market or more generally offered to users, ends up spreading throughout society via its demonstration”* (Ibid.:203). Akrich et al. argues that such a model offers a limited perspective, and does not explain innovation failures. Various cases are used to illustrate how innovation projects, based on the diffusion model, turned into sudden failures when certain things not accounted for changed what otherwise looked to become “certain successes”. The various innovation cases are described in order to arrive at the model proposed by Akrich et al., namely *the art of interessement.* Innovation is created by instability and unpredictability, therefore a simple model, such as the diffusion model, can not be used to describe all innovations. It can be difficult to know a priori, what will be important later in the innovation process, which is why minority opinions must be taken seriously as well. An example of the unpredictability of an innovation is the French company that implemented robots(Ibid.:196). In this case, the implementation of robots initially seemed to be most cost-efficient, as the robot would eliminate two machine operators. However, the implementation did not go as planned, technical breakdowns occurred as actors (technical ones) behaved different from expected. The plan about the robot to make economic growth within two years did not happen. Rather, the robot forced the company to make more investments, including the rehiring of the two machine operators. Eventually though, several years later, the whole work environment had been fully adjusted (adapted) in order to make the robot automation possible. Only then, the robot implementation led to economic benefits (Ibid.: 197). The example shows both how important the environment is when introducing innovations – making it an ally not a recipient and it also tells us something about how unpredictable an innovation process can be. One could ask how obstacles, whether technical or social, are to be dealt with beforehand or along the way, instead of retrospectively. According to Akrich et al. *“follow the market, follow the users and you will win”(*Ibid.:197) - is easier said than

done, as it is a big challenge to even identify the relevant actors, and there is no single technique showing how to do so, as every innovation case is different and changing all the time.

Even innovation cases like “Porvair” (Ibid.: 199) where the environment was investigated more carefully than in the case of the robot implementation, it proved difficult to foresee the trajectory of the project. The company producing Porvair had patiently studied the shoe and leather market, in order to know when and how to overtake the market with their artificial leather product. Their well-performed analysis even included interactions between different stakeholders on the market who potentially could have an influence on the innovations’ success. South American breeders, the policy of OPEC, and the fashion market, are all examples of such stakeholders that were closely monitored by the company before releasing their product on the market. Yet, even if the innovation plan worked perfectly at first, by hitting the market at the right time, suddenly adversaries occurred. The actors in form of *fashion* and *the petrol market* proved to be *“fluctuating actors”,* which made the innovation collapse. One might ask how it could happen since the company had made an analysis of these actors beforehand. But as Akrich et al. (Ibid.:189) stress, it is not sufficient to simply describe the current situation, one must try to be fluid, and ready for any possible situation. *“This collective actor must be able to react to all fluctuations, it must be in a position to seize all opportunities. Rigid and mechanical models, overly precise task and role definitions, constraining programmes, must all be avoided in order to innovate”.* Thus, the company had not foreseen the fluctuations of the fashion market and the petrol market, which made their innovation collapse.

Next step from Akrich et al. (Ibid.: 199-201) is to examine innovation cases in which the customers seems to be “pre-given”. The example used by Akrich et al. (Ibid.:200), is a company producing a new type of coal dust burner. At first hand such cases might seem easy, as they exclude the searching for relevant actors. The simple approach of conversations with the customers about their expectations and challenges towards the product, might look sufficient. In reality, the task at hand is more complicated than that. Akrich et al. underline that it is difficult to know whom to trust when doing innovation. “*Who is to be believed? Who is telling the truth? The intermediary, like market research, has no reason to be trustworthy. Innovation more often resembles a liar’s game rather than a game of truth”* (Ibid).: 200). Additionally, the customers that seemed to be a single pre-given entity, whom all had the same perspectives towards the innovation, proved to be the exact opposite. There is not just a single representative, spokesperson, for all the customers, there are many different and the same goes for the number of opinions towards the product. This leads to a variety of different conflicting points of view. But as difficult as it may make the situation for the innovator, this sudden situation of uncertainty is what *“trigger beneficial reorganisations”* (Ibid.:200).

The initial mess and uncertainty of an innovation, is exactly what innovation according to Akrich et al., is all about. The art of interessement (Ibid.:202) is the model trying to deal with these kinds of uncertainties and reorganizations. Instead of the classical way of analyzing an innovation case through the inventory of "*its advantages and disadvantages"* (Ibid.:202), such as resources spent, productivity and the like, the art of interessement offers an alternative. The art of interessement is less concerned with the inventory of an innovation(materials and resources spent), while still acknowledging its importance, but strives to analyze the adoption of an innovation, which goes through a chain of steps. The environment, an associate of innovation not a receptor, consists of various different actors, and *"The evaluation of the disadvantages and advantages of an innovation is entirely in the hands of the users: it depends on their expectations, their interests, on the problems which they raise."*(Ibid.:202). Each property of the innovation attracts interest from actors in the environment, who eventually will end up either refusing the innovation, or *"take it up, support and diffuse it" (*Ibid.: 204). Actors in the environment, users for example, can intervene in the innovation process at any point and stage, and, interestingly, the producer of the product is not to be considered manager of the relationships between the product and the users. Instead, the producer must be considered the allocator of interessement devices. *"[Technologies', edited] Characteristics correspond to technical decisions which contribute to defining the social groups concerned, setting some up as allies, others as adversaries or sceptics. A technical device distributes the forces which will support or resist it. It is in this sense that it can be analysed as an interessement device."* (Ibid.:205).

The importance of technological choices made are therefore crucial, as the technological characteristics are part of what sparks certain interests into being, they are what will make the user attach or de-tach themselves to/from the product. What Akrich et al. suggest with their framework, is to keep the part of doing technological analysis. However, the analysis of the object per se must not be distinguished from the sociology of the environment in which it is supposed to thrive, and vice versa. The art of interessement therefore is a socio-technical analysis aiming to set up all of *"the actors who seize the object or turn away from it and it highlights the points of articulation between the object and the more or less organized interests which it gives rise to."*(Ibid.: 205).

The case of the photovoltaic kits (Ibid.: 202) is a perfect example of what happens when in-scripted forces does not accommodate with the actual needs and interests of the actors in the "receiving" environment. Basic initial market research established a need for photovoltaic kits in Africa: Children were using streetlamps to do homework, and many people around villages exploited the light from public televisions for different purposes. Having established a need for the product, the only task remaining was to produce the right product. Wrongly though, the innovator of the

photovoltaic kits employed "*the old maxim from the 1933 Universal Exhibition held in Chicago: Science discovers, industry applies and man follows"* (Ibid.:202). Thus, the prototypes during the development of the product were only tested for their technical feasibilities, and not whether it would be adaptable to the needs of the users. In other words, they made the mistake Akrich et al. (Ibid.:205) tells us not to make: making the technological analysis (development) per se, and not paying attention to the environment in which it searches for and obtains allies. When the product was launched on the market in Africa it did catch attention, however the device was not used as intended by the innovators: *"they fight over it, they kidnap it, they divert it but in order to make it something other than what was intended"* (Ibid.: 203). Eventually, the disinterest in the device progressively raised in villages near Zambezi in Africa. The failure of the device was not directly connected with technical breakdowns; rather it was the lack of understanding that an innovation requires the support of actors in the network. A socio-technical analysis of the case shows exactly some of the dynamics and concepts already described. It is evident early on that the technology distributes underlying forced in-scripted by the innovators. Actors in the network will either attach or de-tach themselves from these forces. As with any other case of innovation, there are many different actors in the network of the photovoltaic kit. This also means that actors are not concerned with the same technical properties, and as such different interests occurs. Moreover, the actors will try to use and transform the characteristics of the device so that it satisfies *their own* needs. Akrich et al. also stress that there is "no kit but in name"(Ibid.:204), which is exactly due to the fact that the device means different things to different actors, who are concerned with different characteristics and forces ascribed to the device.

For instance, the kit is designed in a way that makes certain allies in the network, such as the French and African public administrations. These allies are attached to the device because of the solar cells, which accommodates their interests. On the other hand, some technical properties of the device make adversaries in the network. Wires are of a fixed length, and the batteries requires one exact type of fluorescent tube (Ibid.:204). These technical characteristics makes for a device that is difficult to adjust, transform and adapt to the specific needs of the users. For example, the short wire makes it impossible for many people to install the solar cells on the roof. The result of these technical choices makes adversaries in the network, actors who could have been allies if the technology had been designed differently. Additionally, the battery regulator was protected from intervention by a sealing that only the manufacturers could open. If a technical breakdown occurred, the only solution to the problem would be to send the device back to the manufacturers in France. The sealing, together with the only option of using 13 watt fluorescent tubes, meant that local electricians and other maintainers were completely cut-off and eliminated as potential allies.

The innovators of the photovoltaic kits were so determined on avoiding the device to be turned into something different from the intended design that it became the downfall of the innovation.

The key to success in innovation part 1 (Ibid.:187) gives us some important concepts and ideas for our analysis. Worth mentioning is the idea of perceiving innovation as a collective task where actors in the environment are allies instead of receivers of a technology. This idea leads towards the art of interessement, which has been described with the case of the photovoltaic kit.

The key to success in innovation part 2: The art of choosing good spokespersons

In the key to success in innovation part 2: The art of choosing good spokespersons, the example of the photovoltaic kit is again used. Again the importance of negotiations and what Akrich et al. calls *"to adopt is to adapt"*(Akrich et al.. 2002b:208) is stressed. To adopt is to adapt means that mutual transformations and compromises of the technical and the social has to be allowed for the innovation to succeed. We already mentioned that the design of the kits, making the device rather inflexible, made adversaries in the network. Akrich et al. builds upon this observation, and describe what must be done in order to make allies.

"In order to take advantage of these allies who were as powerful as they were unforeseen, it was clear that a redefinition of the kits had to be accepted: to make provision for many small lighting tubes, to increase the power, to no longer make the length of the filaments impossible to modify. The concept of the object had to be changed in order to establish a satisfying compromise between its characteristics and the demands of the users. The social "material" and the technical "material" are both relatively malleable and the successful innovation is the one which stabilises an acceptable arrangement between the human actors (users, negotiators, repairers) and the non-human actors (electrons, tubes, batteries) at the same time. The particular strength of the innovator is to permanently play with both registers, to treat nature and society symmetrically." (Ibid.:210)

In the quote Akrich et al. once again stress the importance of negotiations in innovation cases, which sometimes eventually reshapes the device, but possibly also the social material into stabilized arrangements. Innovations spark opinions into being when launched, therefore the environment is produced at the same time as the innovation it is going to judge (Ibid.:211).

These socio-technical adaptations and negotiations can be described through the whirlwind model (Ibid.:212). The whirlwind model is proposed, by Akrich et al., to substitute the linear model which only describes innovation cases as, accordingly, going from stage to stage in a chronological order that can not be interrupted. Instead, the whirlwind model does, contrary to the linear model, acknowledge that innovation cannot be described by a model as simple as the linear one, because

innovation rarely follows a chronological path. Rather, the whirlwind model aims to describe the socio-technical negotiations that gives shape to the innovation. Thus, the whirlwind model pays attention to the "trials" that any innovation is submitted to (Ibid.:213). These trials, interessements, are what will shape the stabilized socio-technical (re-)organizations.

Another important concept of the framework, and for Callon in particular, is the spokesperson. In the mentioned phrase about a *"powerful and unforeseen ally"* (Ibid.:210) it refers to the allies in form of muslims using the photovoltaic kits in mosques in Africa. If it is described as a "powerful" ally, it is because it is a spokesperson, which speaks on behalf of many underlying actors. The name of this spokesperson could also have been a macro actor. A spokesperson is an actor who translates the interests of the whole underlying heterogeneous network he/she/it speaks on behalf of. Thus, a spokesperson can be broken down to a network of micro actors of which it represents. The importance of choosing the right spokespersons is dangerous to underestimate, as it can jeopardize the whole innovation. Akrich et al. describe Edison's project about revolutionizing America's electrification, to pinpoint the importance of spokesperson.

One of the first things Edison did during his innovation project was to make use of public opinions. His way of sparking a public into being, was by letting his intentions out there. Next thing was setting up his lab, which he did very carefully. Being the smart innovator he was, he recruited spokespersons who each came to represent the field of their expertise. He needed to recruit spokespersons from the fields of mathematics, physics (Upton and Jehl), mechanics, a *"confirmed bench scientist"*, a lawyer, transmissions and generators (Ibid.:216). Edison's recruitment of course also consists of technical devices such as machines, tools and not least a well set-up library, up to date with all the relevant literature and newest research and journals within the field of his innovation. By making all these choices and preparations, Akrich et al. argue that Edison goes beyond being an innovator in the shape of an "organizer" or an "able manager" (Ibid.:216). In fact, what Edison does is research, due to his *"strategic scientific and technological choices"* (Ibid.:216).

All the actors recruited by Edison, both human and non-human, are spokespersons speaking on behalf of each of their fields. The mathematician, for example, is obligated to speak on behalf of the whole field of mathematics, which is to translate everything it stands for truthfully. Does the mathematician, or any of Edison's recruited spokespersons for that matter, make a mistake it would have big consequences for the innovation. A mistake by a spokesperson would mean that they lie, so to speak, on behalf of not only themselves, but also the whole heterogeneous network that they speak on behalf of, and whose interests they translate. *"if he forgets the good journals, if he bypasses a promising technology, then his project is questioned. But if, to the contrary, he makes good choices, then it is on the right trajectory."* (Ibid.:216). As evident in the mentioned

quote, if Edison should be unfortunate and choose wrong spokespersons it could call the innovation into question. Conversely, choosing the right spokespersons is what puts the innovation on the right trajectory.

Edison's awareness about spokesperson is what indirectly gives him the idea of Menlo Park, or at least spokespersons are what enables him to set up Menlo Park. For Menlo Park, Edison recruited spokespersons that altogether represented every aspect concerning the innovation. Thus, Menlo Park was a microcosm in which all the relevant actors (human and non-human), and forces from real life America at the time, were represented. Little did the scale matter as long as all the chosen spokespersons in the project represented those they spoke on behalf of truthfully. This goes both ways, of course, the represented actors (from real life society) could at anytime betray their spokesperson, which likewise would jeopardize the innovation. Last mentioned situation would occur if, say, the users in America suddenly acted in a different way than they had first told (translated) their spokesperson, hence "lying" to their spokesperson about their interests.

"The fate of innovation, its content but also its chances of success, rest entirely on the choice of the representatives or spokespersons who will interact, negotiate to give shape to the project and to transform it until a market is built. Change the recruitment, forget the library, install other equipment, and it is at best a different innovation which sees the light of day, and at worst no innovation at all" (Ibid.:217).

As mentioned in the quote, spokespersons are those who ultimately gives shape to the innovation. The constitutional forces of the network are therefore stressed once again. This, however puts a huge responsibility on the recruitment of the right spokespersons. Make a mistake, chose a wrong spokesperson and it will at least make it another innovation. Innovation is a matter of negotiations, and choosing the spokespersons (human and non-human) to collaborate with is what will make or break an innovation. Who are *"the protagonists that are mobilized"? (*Ibid.:217). "*Will Upton and Jehl be in time to mobilize, among the most recent scientific knowledge? That which is unquestionable?"* (Ibid.:217).

At Menlo Park, Upton and Jehl were, respectively, spokespersons for math and physics. If they did not mobilize in time, then the networks that they represent will not feature in the innovation. In other words, math and physics would not have been a part of Edison's electricity case, which of course would make the innovation impossible.

Any innovator who, like Edison, brings in spokespersons (macro actors) to collaborate and negotiate with, allows their own ideas to, potentially, be reshaped. Instead of being protective of one's own ideas about how the innovation ought to be, one needs to acknowledge the fact that

innovation succeeds when it is carried out collectively. However, the tricky part is that one can never be completely certain to have chosen the right spokespersons beforehand. A spokesperson can always be refuted by all those *"in whose name they claim to speak"* (Ibid.:218). Nevertheless, those who have a chance of succeeding in innovation are the ones that carefully and successfully choose their spokespersons. Ultimately, choosing spokespersons is a social thing to do, it comes down to a sense of trust and taking a chance.

"No innovation, no invention develops without this initial bet, without this act of elementary trust, which defines our relation with others, and which leads to regarding the spokespersons with whom you prepare to negotiate your innovation project as legitimate" (Ibid.:219).

Immersion – Mel Slater and Sylvia Wilbur, 1997

VR can be divided into hardware and software. In our analysis we will look at how the VR hardware in form of specific technical choices, turns some actors into allies and others adversaries. As such, the Key to success – Part 1&2 is ideal to look at the hardware. We also strive to understand how VR by its different software applications and the HMD's, can be used as an interessement device by Thomas(Khora). In order to do so, we wanted to understand how the different technological characteristics of VEs make up immersive experiences that increase the subjects' feeling of presence in the given VE. Of course, there is a close connection between a VE and the VR HMD. A well-developed, immersive VE needs to be supported by a good HMD, and vice versa.

Mel Slater and Sylvia Wilbur has made the framework we have chosen to use for our understanding of what makes up immersive VEs. We first heard of Mel Slater during our meeting with Jon Ram Bruun-Pedersen, who works as an assistant professor at Aau-Cph. Jon Ram Bruun-Pedersen has a PhD in VR Rehabilitation(Personprofil.aau.dk, n.d.) and can therefore be regarded an expert within the field of VR, especially in relation to healthcare. Jon Ram Bruun-Pedersen advised us to look at some of Mel Slaters publications. We quickly realized that Mel Slater is one of the protagonists, when it comes to research on Immersion in relation to VR. We chose to use the specific framework called:

A Framework for Immersive Virtual Environments (FIVE): Speculations on the Role of Presence in Virtual Environments (Slater&Wilbur,1997)

We have probably all had the experience of being on the "outside" of another "world". Whether it be outside the Computer Room, or sitting in a car separated from the outside world by the window. The moment one enters the Computer Room, or roll down the window, one becomes part of that other reality, or world. This is where Mel Slater and Sylvia Wilbur (Ibid.: 2) begins. But, how is it then possible to enter the world of a virtual environment (VE)? That is, to have the feeling of being

present in the VE. According to Slater and Wilbur (Ibid.: 3) it must be separated into two concepts *Immersion* and *Presence*.

Immersion is something that concerns the technicalities. More specifically, Slater and Wilbur propose that the degree of immersion can be objectively assessed, as the characteristics of a technology (Ibid.: 3). Immersion is an important concept, as it is a description of the technology that will provide an *"inclusive, extensive, surrounding and vivid illusion*" (Ibid.: 3) of reality to the senses of the human experiencing the VE. Whether a VR technology is *inclusive* or not, has to do with the extent to which the real, physical, reality is being shut out. In other words, if the goal is to be included in the virtual environment, one must be excluded from the physical world as much as possible. This also means that, optimally, the HMD would be weightless, as it would limit the perception of the physical world. However, it is important to mention that all these dimensions of immersion has so called "associated scales" which indicate their degree of realization. Therefore, a weightless display is the ideal situation, but less can do as well. *Extensive* indicates the sensory modalities, such as sound for example, included in the VE. *Surrounding* means that the VR must be panoramic rather than a narrow field of vision. Again, how "surrounding" a VR is, will in reality vary. It could be *"delivered by a small external screen at one extreme and a wide field of view HMD, or a CAVE system at the other"* (Ibid.:4) Naturally, a more surrounding VR will have a positive effect on the immersive VE. Vivid concerns the resolution and fidelity of the display. It is also mentioned that this includes the energy simulated on the display, such as "visual and colour resolution"(Ibid.:3). The aspect of vividness calls the quality of the given display into question, such as; from wireframe to photorealism, and pixel resolution. In short, it is a description of the pictorial realism.

In addition to the aforementioned four factors, which all concerns *"display of information"* (Ibid.:3), Slater and Wilbur mentions two more elements that must be taken into account when making an immersive VEs, namely *matching* and *plot*.

According to Slater and Wilbur, immersion requires a self-representation in the VE, which is a virtual body (VB) (Ibid.:3). *Matching*, in this regard, means that there must be *"match between the participant's proprioceptive feedback about body movements, and the information generated on the displays"* (Ibid.:3). When the participant moves in the physical world the VB should move the same way, and the better match between the two "bodies" the better the immersion will be. The VB represents the participant in the VE. Therefore, the VB has two functions, it is both part of the environment, perceived by the participant, and at the same time, the VB represents the participant making it the medium for perception. The visual perception in the VE is centered on the position of the VB, more precisely from the viewpoint of the eyes of the VB. This is called egocentric as

opposed to exocentric by Ellis (Ellis, 1991; in Slater & Wilbur, 1997:3), and explains why the matching of the VB and the participants movements is so important in an immersive VE.

Lastly, Slater and Wilbur mention *plot,* which is very important too in an immersive VE. The plot is closely related to the other mentioned aspects of immersion, as many of the aspects depend on each other. An immersive VE needs to have its own storyline, which is distinct from the one in the real world. This includes a self-contained dynamic and unfolding of events. Furthermore, the subjects and objects in the VE must have what Zeltzer (Zeltzer, 1992, in Slater & Wilbur, 1997:4) calls *autonomy,* which is the ability to have one's own independent behavior in the VE. This includes that actors and objects in the VE respond to the actions of the participant. In practice, if playing a game where the participant shoots an actor in the VE, the actors must respond by dying or getting injured. Zeltzer (Slater & Wilbur, 1997:4) calls this *interaction,* and it basically concerns the capability of the participant to influence unfolding of events in the VE. In short, plot is yet another aspect that, if performed comprehensively by the designers, potentially can play a part in "removing" the participant from the physical world, in order to take part in an alternative world with its own drama, which the participant can influence (Slater & Wilbur, 1997:4).

While immersion concerns technicalities, making it an objective and measurable size, *presence* on the other hand, must be considered more of a subjective figure. Presence is a "state of consciousness", it is the psychological sense of being in the, in this case, VE. Presence induced by a technology-based immersion, is therefore to be seen as an illusion. The general idea by the many scientists (Ibid.:4) who have studied presence, is: when feeling highly present in a VE one should *"experience the VE as more the engaging reality than the surrounding physical world, and consider the environment specified by the displays as places visited rather than as images seen"*(Ibid.:4).

As already described earlier, matching is an important part of an immersive VEreal, and naturally the same goes in relation to presence. Presence requires that the participant can relate to, and identify with, the VB in the VE. Here again, matching is vital. The movements in the physical world must correlate with the movements of the VB in the VE, as this will increase the feeling that the VB is the body of the participant, which will add to the feeling of being present in the VE. Presence is a more subjective figure than immersion, but in fact it can be divided into both a subjective and an objective part. Describing presence, is a description of a participant's state in relation to the given environment. Thus, the subjective description concerns the evaluation of the participant's feeling of "being there", to what degree do they feel present in the VE. In line with the feeling of being there, the Subjective evaluation also includes the participant's view of the VE. In other words, does the participant find the VE "place like" (Ibid.:5).

The objective description of presence is a description of *"an observable behavioral phenomenon"* which is a comparison between how the participant behaves in the VE compared to how they would behave in a similar environment in the real physical world. The extent to how the participant behaves the same way in the VE as in the real environment, describes the psychological sense of being present in the VE. The more they behave the same in the VE and the real world, the more present they feel in the VE.

Another important aspect of presence is to understand that it cannot simply be seen as an increasing factor of immersion, as several aspects are important to consider. Firstly it must be stated that the display aspects (Inclusive, Extensive, Surrounding and Vivid) is mediated through what Slater and Wilbur calls "two filters"(Ibid.:5): *"the application or task context"* and *"the perceptual requirements of the individual"* (Ibid.:5). The first filter refers to the fact that it depends on the specific situation, what elements of the display aspects that should be most developed. If the application or task requires that the participant must clearly hear the sounds, then naturally extensiveness has to be focused on when developing the immersive VE and maybe vividness can be downsized during the development. The second filter concerns individual differences. This refers to the fact that it is different from individual to individual, which of the modalities they prefer to receive information from. For one individual it might be crucial that the sound (extensiveness) of the VE is successfully constructed, while for another individuals it would be barely noticed.

Lastly, Slater and Wilbur mentions another hypothesis in regards to presence in VE. As mentioned, the plot line is important when trying to displace the participant from the real world into a virtual one, a world which contains its own dynamics and dramas. The more the plot removes an individual from the real world, the greater the chance of feeling present in the virtual world. But accordingly, there is a subjective aspect to the displacement of a participant as well. The more a person in general is susceptible to displacement of their sense of reality, the more likely it is that they will feel present in the VE. And something could, according to Slater and Wilbur, even suggest that there might be some correlation between an individual's degree of susceptibility to hypnosis, and their feeling of presence in a VE (Ibid.:5). Therefore, whether an individual is capable of feeling present in VE, might be measured by their degree of susceptibility to hypnosis.

It is also important to describe the relation between Immersion and Presence. One could say that Immersion comes before presence, as it is a necessity to have an immersive technical apparatus in order to succeed with VR i.e., to make the human participant feel present in the VE. On the other hand, as mentioned above, some hypotheses suggest that whether a participant will feel present in the VE or not, can also be a question of subjectivity.

Slater and Wilbur name various examples of earlier research projects focusing on how the factors of immersive VEs exactly influence the human experience.

In relation to *inclusive*, Slater and Usoh (Slater and Usoh, 1992 in Slater & Wilbur,1997:6) made an experiment, in which they aimed to find out if there "*were any circumstances that especially decreased the participant's sense of really being there*" (in the VE) (Slater & Wilbur, 1997:6). Some of the participants mentioned the experimenters voice as something that decreased their sense of being in the VE. Even more participants found the poor screen, such as high lag and low resolution, to be something that decreased their sense of being there. Interestingly though, in the same study, when a loud incongruous noise was made outside the VE, such as dropping a glass on the floor for example, it had different effects than the voice of the experimenter. For the participants who reported the highest feeling presence, the outside interference of a sudden noise, was incorporated to the VE. Slater and Wilbur here draws a parallel to Sigmund Freud's observations of dreamers, who pull in outside events into their dreams *"Maury's famous dream about being guillotined as being prompted by something falling on his neck while sleeping"*(Ibid.:6). It seems that when a participant has a high sense of presence, then not only will the events in the VE feel real, but also the outside events will be weaved into the VE, making the experience even more inclusive.

Moving on, it is further elaborated how sound from the HMD's speaker can provide an inclusive experience. Patel (Patel, 1994 in Slater & Wilbur, 1997:6) carried out an experiment in which subjects were divided into four groups, based on the type and quality of sound they received. One group wore a HMD without sound, hence they listened only to the sounds from the real world such as non virtual sounds from the laboratory. The rest of the groups all received sound from the HMD speakers with one group receiving *white noise*, another group receiving *non-directional sound*, and the last group receiving *spatialized directional sound* (Ibid.:6). Results showed that white noise provided the most inclusive experience for the subjects in the experiment. The white noise generated by the HMD speakers seemed to isolate the subjects from the real world. Not surprisingly the biggest contradiction was the group of subjects who received no virtual sound, they experienced the least inclusion of all the groups.

As mentioned, vividness concerns the photorealism of VEs. This could be shadows, which according to Slater and Wilbur is an example of a high level vivid detail (Ibid.:6). Studies have shown that there is a correlation between subjects' reporting of presence and the pictorial realism presented to them, such as in a driving simulator (Ibid.:6). The field of view has also been studied. It has been concluded by Hendrix and Barfield presence (Ibid.:6) that stereopsis and a wide geometric field of view has positive effects on the subjects' feeling of presence.

Another study focused on exactly the mentioned vivid detail of shadows, showed that shadows do have an impact on the feeling of presence in, in this case, a VR shooting game. The experiment was carried out by asking subjects to pick up and fire a projectile at some target. An independent factor in the game/task was the dynamic shadows, which varied in extent of occurrence while the task remained otherwise remained exact the same for all the subjects. The results were methodologically found in two different ways. The first way was through questionnaires given to the subjects of the experiment, and the other was through behavioral observations. The latter was an attempt to measure the aiming angle, done by the subjects. Both methods showed that dynamic shadows has a positive influence on the subjects' feeling of presence in the VE. In relation to vividness, physical laws seems to also have an impact on making the experience feel more alive and realistic, which ultimately makes the experience more inclusive. Slater and Uno (Uno,1997 in Slater & Wilbur,1997:7) made a study in which they exposed 18 subjects to different combinations of elasticity, friction and collision response, in a VR bowling game. The study showed that the more realistic the dimension of friction was in the experience, the greater was the reported degree of presence sensed by the subjects. On the other hand though, accurate simulations of elasticity and collision did not show a correlation with the subjects' reported sense of presence (Slater & Wilbur,1997:7).

In 1996 Welch et al. (Welch et al, 1996, in Slater, 1997:6) made a research in which they studied the importance of pictorial realism and proprioceptive matching in a driving simulator. We have already stressed the importance of pictorial realism, but in this study it is used as a comparative dimension in relation to matching. They found that the smaller the delay was in the driving simulator, the greater the reported sense of presence. The delay refers to the time it takes between the participant's movements and the feedback from the simulator. Thus, the faster the VB in the VE makes the same movements as the person in the real world, the greater feeling of presence. The study also showed that the dimension of matching was more important than the pictorial realism of the driving simulator, in relation to feeling present. Another study, made by Hendrix and Barfield (Hendrix and Barfield, 1996a, in Slater, 1997: 7) found head-tracking to drastically increase the reported sense of presence. Furthermore, head-tracking made *"subjects becoming more animated in the use of their bodies, such as standing on a chair, bending down, leaning forwards and backwards, and turning around."* (Slater & Wilbur, 1997:7).

Lastly, a study by Slater, Usoh and Steed (Slater et al., 1995, in Slater, 1997: 7) showed that subjects who walked in a VE using a "walking in place" reported a higher sense of presence than subjects who navigated around the VE with a pointing device, such as a controller. Walking is an example of a high level matching dimension, and according to Slater et al., its positive effects is

due to its great matching between *"optical flow and proprioception for the walking technique compared to use of a hand held pointing device for navigation"(Slater & Wilbur, 1997: 7).*

Hendrix and Barnfield (Hendrix and Barfield, 1996b, in Slater, 1997:7) carried out another study, this time to examine the effects of sound (Extensiveness) on subjects' reported sense of presence in VE. Methodologically, they made two experiments. The first one was where spatialized sound was introduced for some subjects in a visual VE, and for some subjects it was not in what was otherwise the same visual VE. In the second experiment, some subjects experienced a VE with non-spatialized sound and other subjects experienced, again, the same VE but with spatialized sound. Both experiments indicated that spatialized sound had better effects than no sound and non-spatialized sound, in relation to sense of presence.

There has not been done many studies examining the impacts of plot on reported presence, according to Slater and Wilbur (Slater & Wilbur, 1997:7). However, Welch et al. (Welch et al.,1996, in Slater & Wilbur, 1997:7) made a study to understand the impacts of interactivity in a driving simulator. Interactivity in this regard, is whether the subject experiencing the simulator is part of the VE, by driving the vehicle, or simply observing the VE. Surely, this has something to do about matching too, which we have already examined, but it also has something to do about the plot of the VE. The study showed that interactivity had a positive effect on the reported sense of presence. Thus, making the plot for a VE experience, it might be worth keeping in mind that it has an impact whether the subject experience the VE is part of that world or merely just observes it.

Utility of presence

One could ask why it is so important to study presence in relation to VE, and as such, VR. According to Slater and Wilbur, there are many reasons as to why a feeling of presence is so important when a subject experiences VR. Some of them are even closely relevant for the cases studied in our Thesis.

Firstly, it is mentioned that the *"distinguishing feature of immersive VEs, compared with exocentric desktop display systems, is that they afford a sense of presence"*(Slater & Wilbur, 1997:8). This is an important distinction to make, as it tells something about why VR is used in the first place: to give a sense of presence in the VE.

Presence is important because *"the greater the degree of presence, the greater the chance that participants will behave in a VE in a manner similar to their behavior in similar circumstances in everyday reality. Hence if a VE is being used to train fire-fighters or surgeons, then presence is crucial, since they must behave appropriately in the VE and then transfer knowledge to corresponding behavior in the real world."*(Ibid.: 8). Accordingly, having a sense of presence in the

VE is crucial if it is used in contexts where the subjects experiencing the VR are to gain some sort of behavioral knowledge from the VE. Not only does this apply to training of fire-fighters and surgeons, but also for patients treated with VR in psychotherapy. In fact, Slater & Wilbur (Ibid.: 8) state that *"without presence the psychotherapy would not be possible".*

Sociology of expectations

Visions and expectations are significant aspects of science and technology development. In the beginning of a science and technology development, visions and expectations are often high, but they change over time as the development goes on and limitations and possibilities are being unfolded. As Borup et al. (2006:286) states, *visions drive technical and scientific activity, warranting the production of measurements, calculations, material tests, pilot projects and models*. This means that visions and expectations not only functions as a goal, or milestone, for the development, but it also plays a central role in mobilizing important resources and actors together at the macro-, meso-, and micro-level. Although expectations and visions have always been important elements of science and technology development, they are not historically constant and it may even be argued that hyperbolic expectations of future promise and potential have become more significant or intense in late and advanced industrial modernity (Ibid.:286).

The general conception of the future, and accordingly the structure of expectations, has changed over the decades, with the advancement and progress in our technology. Our expectations are often portrayed in the genre of science-fiction where there is a tendency to reflect our present day concerns and hopes. Star Trek: The Original Series (TOS) by Gene Roddenberry, is a science-fiction television series that was broadcast from 1966-1969, represented many concerns that took place at the time. Most of the technologies that were presented in the series are not "science fiction" anymore in our day and age. The handheld communicator that they used in the series is now what we call mobile phones, automatic doors are everywhere, and the portable computer (Personal Access Data Devices, or PADDs) is what we call a tablet computer (Brandon, 2015). Expectations as an important element in the shaping of specific artefacts have been analysed in relation to the role and function of 'leitbilder' or 'guiding visions' (Borup et al., 2006: 286). Economy is another driving factor in expectations and visions in science and technology development. Investor's behavior is typically based on the rational risk-return considerations, and is also influenced by expectations and perceptions of other investors' behavior. Economics also plays a significant role in the context of technology diffusion. We must also distinguish between traditional approaches to expectations in economics, particularly rational expectations, and the more constructivist position taken in Science and Technology Studies (Ibid.). Rational expectation relies

on the assumption of a realist distinction between people's expectation and the real underlying fundamentals. In rational expectation, when hype occurs around a technology, it does so because people invest in expectations and not the fundamentals. A crash occurs when the dissimilarity between real and artificially inflated values becomes undeniably obvious (Ibid.:288).

Expectations commonly have a temporal patterning over time. This is frequently manifested in alternating cycles of hype and disappointment. This phenomenon of early promise/later disappointment suggests that while expectations are essential to mobilizing effective interest, an early surge in hype is necessary in order to get a hearing (Ibid.: 290). The initial promises for a specific artefact are set high in order to attract important and necessary actors, such as financial sponsors. While it is necessary to raise the profile and attract allies. Disappointments are also likely because of the specific structure of expectations. (Ibid.: 290) Early technological expectations are in many cases technologically deterministic, downplaying the many organizational and cultural factors on which a technology's future may depend. In this way, expectations of technology are also seen to foster a kind of historical amnesia—hype is about the future and the new—rarely about the past—so the disjunctive aspects of technological change are often emphasized and continuities with the past are erased from promissory memory (Ibid.: 290).

We have now outlined the theoretical material we use in this Thesis. We have laid a foundation of early ANT conceptions. Then we described the main theoretical perspective of the Thesis with A Key to Success In Innovation, which will be our primary theory for analyzing our empirical material. We also outline the concept of Innovation, which we also will be using, to describe our field and to give a more wholesome socio-technical analysis of VR in Healthcare. At last, we also write about the conceptualisations of expectation and hype which we will be using later in the discussion.

Analysis part 1

We have now described the technology and field which we have chosen to research, that of VR in the healthcare sector. We have also gone over the methods we have used to gather empirical data for the Thesis. We have introduced concepts from ANT and introduced Akrich et al. article on how to articulate a socio-technical analysis of technological innovation through the model of interessement. We have also introduced the concept of Immersive VEs. We will now use the empirical data gathered, and analyze it through our theoretical perspectives, by identifying the associations and relations between actors, and see how alliances and adversaries are made as a product of aggregated interests through decisions related to the technology. We will describe the environment within which VR spreads and effects and the technical decisions made with the technology and how they shape each other. We see VR - the software used and the hardware as

an interessement device, which is something we will describe in our two part analysis. Additionally, we will use the concept of Immersive VEs to give a better understanding of how actors influence the technology and network as they are part of decisions about VR technology which will give a better understanding of effects those relations and decisions have on the socio-technical milieu.

Identifying the actors and their relations

The first part of our analysis is where we identify the important human and non-human actors in the network we investigate. This includes a closer look at how alliances are made, why certain actors might become adversaries, and who becomes spokespersons. Given our theoretical orientation, we will pay attention to non-human actors, as well as human actors. As we will elaborate later, there are many examples throughout our Thesis where non-human actors have agency. To look closer at the technological components of VR, we use Mel Slater's framework of Immersion. This will aid us in our socio-technical analysis to seek an understanding of how exactly the various technological components can have agency in the network(s).

As is often the case when doing an ANT project, it starts out messy. Our fieldwork went in many directions, and as such, there were no chronological order, we simply visited whomever had time to speak with us first. However, from all the mess we will try to find some order.

In the end of this part of our analysis, we will be capable of creating a visual representation of the network that we pay attention to, which will be helpful for the rest of our analysis and, not least, for answering our problem formulation.

We will start our journey of identifying the actors, where it chronologically began; by exploring what VR is. As a result of that exploration, we identified a variety of VR technologies. Our own interest in VR in the contexts of healthcare, is what led us to begin our research. We quickly found out that, just like there is no single fixed form of the photovoltaic kit in a Key to success (Akrich et al., 2002a:204), there is no single fixed form of VR but in name. In the text, what Akrich et al. means by saying that there is no fixed form but in name, is that actors who seize the photovoltaic kit have their own perception of the technology. Every actor wants it to fulfill their interests, and use it in their own way. Later in our analysis, we will also look at VR in that regard, namely whether it accommodates those interests or not. First however, we must find out who the actors in our Thesis are, and the relations between them. As mentioned, the first actor we identified is VR.

VR can be divided into hardware and software, but it can also be broken down into much smaller components than that. The hardware used in the cases we investigate is the same as they all use the Samsung Gear VR. The software is also the same, but the application, on the other hand, differs from place to place. Therefore, when we make the socio-technical analysis of the VR and

the network, in which it is supposed to make allies, be taken up and diffused, we will separate the different cases. This means that when we look at the relation between, for example, Søren Benedikt Pedersen and VR, we look at his relation to the specific form of VR used at Cool Kids. Thus, we analyze VR as a interessement device, which mediates relations between other actors in the network we investigate. To analyze VR as a device of interessement is to look at how technical decisions contribute to define social groups, setting some up as allies and some as adversaries.

After identifying VR as an actor, we wanted to explore a field where it has the role of a healthcare technology. We started to send a couple of e-mails in different directions, before we decided to visit Khora at the Meatpacking District (trans. Kødbyen), which proved to be a good idea. Here we spoke to Mia (Introduction to the field), a shop assistant at Khora, who told us about a few projects that might be of interest to us. The projects were all related to VR within healthcare, as we told her that this is the field we would like to focus on in our Thesis. The projects she mentioned were, amongst others, Khora's project with Cool Kids and Khora's project with a YMKC. When we a few hours later that day attended the CopenX conference about VR within healthcare, held at Khora, we met a new gatekeeper: Kristian Bluff (Introduction to the field). Kristian is the one who connected us to Søren Walther at Rigshospitalet. Kristian himself, does not have any experience with VR, he is a mediator between technology and different kinds of socio-economic environments. At the same time as one of us met Kristian, the other two of us got in touch with Thomas. Thomas is the head of healthcare at Khora, and we were lucky enough to arrange an interview/meeting with him. Being the head of healthcare, he is the representative of Khora that visits customers such as Cool Kids, the Paediatric Pain Knowledge Centre at Rigshospitalet (PPKC), and the Youth Medical Knowledge Center (YMKC) at Rigshospitalet. This makes him the spokesperson for the whole network of Khora. This means that he must represent all the interests of the rest of Khora, such as the Board of Directors for example, truthfully. Instead of perceiving him as a producer, or a manager in the different VR cases we investigate, he is, as Akrich et al. suggest, an allocator of interessement devices (Ibid.:205). As Cool Kids was the first place we visited to conduct an interview, we will start to look at the relation between Søren Benedikt and Thomas (Khora). At the beginning of the interview, Søren Benedikt told us a bit about his motivations and interests for working with VR at his psychological clinic. As a psychologist, he is first and foremost concerned with evidence-based methods, but he told us that it is also of his interest to be innovative. He believes that technology allows one to improve and find smarter solutions. Søren Benedikt sees VR as a technology that can *"make psychology different from usual"* (Appendix Søren Benedikt:8). At our follow up interview with Søren Benedikt, we asked him to elaborate why it is important to be innovative within his field of expertise. Clearly, it is related to the specific group of patients at Cool Kids. *"[…] it is especially important to be innovative when working with children and teens.*

Because with them [children and teens, edited] one needs to be a part of something, by using media and technology which appeals to them". (Appendix Søren Benedikt:13). Søren Benedikt has interests, expectations, and ideas of what VR must do at Cool Kids, it must be appealing for the patients, while of course, at the same time it is important for him that the technology he chooses to use is an evidence-based method. By saying that VR is of interest to his patients, he shows the capability of understanding the needs of his patients as defined by him. This understanding surely is important, as in the negotiations between Søren Benedikt and Thomas (spokesperson for Khora), Søren Benedikt is spokesperson for Cool Kids which includes all the patients, making him responsible of representing the children and teens truthfully. Later in our analysis, we will pay attention to whether the children and teens are represented truthfully or not by Søren Benedikt, which serves as an important socio-technical analysis of whether they will attach or de-tach themselves from the device, in other words: will they become allies or adversaries of the innovation.

By now, we can establish that Søren Benedikt already had the idea of being innovative in the form of using technologies for psychological purposes, before Khora came into the picture. Therefore, he naturally also had some ideas about what VR should be capable of e.g., be appealing and be an evidence-based method. He explains further what he means by VR being appealing for the children*. "I believe there lies a responsibility in trying to communicate psychotherapy and psychological knowledge at eye level and make it available. So of course, there is an ambition of making knowledge and anxiety telling (trans. angst fortælling) easy and available."* (Appendix Søren Benedikt:13)*.* Søren Benedikt wants to use VR to mediate psychological treatment in a new way which is more interesting for children, let alone children with special needs (Appendix, Søren Benedikt:13). Using VR as a mediator between himself and his patients, is again underlined as he mentions that *"[…] first off, I do not believe that the technology can replace humans, I mean, the psychologist or therapist, he does not become redundant, he needs to be here, because it is a process, an interaction. Instead it [VR, edited] is an aid in the therapy"* (Appendix, Søren Benedikt:13)*.* Throughout both of our interviews with Søren Benedikt, he stressed the importance of the VR as a technology to help him make the therapy more interesting for some children. Moreover, he also said that it is important for him to have control over the device, which again underlines his understanding of VR as an assisting technology. Control is exactly one of the important characteristics VR has, or at least must have, when using it for rehabilitating purposes, according to Søren Benedikt. *"I think it is essential to control the stimuli applied on the children, because control is some kind of trust. For example, trusting that you will not suddenly be pushed from the edge. Or that, when walking down the street meeting a dog, it either has to be something I decided beforehand so I can help him [the kid,edited] meet the dog. Or, like in real life we could*

walk down the street and meet a dog that I do not have control of, one cannot be prepared for that, because in real life one cannot know if it is a fighting dog. Thus, the big benefit with this [using VR, edited] is that we have 100% control, except when the technology breaks down" (Appendix, Søren Benedikt:15). When Søren Benedikt expresses his ideas and interests of how the VR ought to be in relation to psychotherapeutic, or at least treatment at Cool Kids, he represents both the children and the psychological field of expertise. It is, according to Søren Benedikt, of the children's interest that he as a therapist controls the stimuli the children receive. At the same time, Søren Benedikt, given his field of expertise, mobilizes the psychological science, just like Upton and Jehl in Edersons project are responsible for mobilizing the fields of math and physics (Akrich et al., 2002b:216). An example of psychological knowledge mobilized by Søren Benedikt, is the idea of gradually moving from stage to stage as an important part of rehabilitation, as opposed to, for example, running into a fighting dog when the kid is not ready for that stage yet.

Despite Søren Benedikts interests and ideas of being innovative, manifested in the form of using VR for rehabilitating purposes, he did not initiate any contact to a VR company himself. *"Khora contacted me, they had a technological student in an internship, I believe. And as part of that internship they [the student and Khora, edited] looked at companies with psychological perspectives. Therefore they contacted me, amongst others. Eventually we decided to use it for the purpose we do now: children with anxiety"* (Appendix, Søren Benedikt:8).

One of the first signs as to why VR is a device of interessement that creates a relation between Søren Benedikt (the whole network of Cool Kids) and Thomas (the whole network of Khora), is their common interest in *"using a modern technology for the benefit of people with psychological disorders. It is in itself a good ideal to have I think. That Khora takes interest in this area, or wants to contribute to mental healthcare. Thus, those working with the technology are not just somebody in the entertainment industry, that sometimes only thinks about profit."*(Appendix, Søren Benedikt:12). Clearly, it is important for Søren Benedikt to collaborate with a company with some of the same interests as himself, namely to focus on other dimensions than economy. However, as we will see later economy also plays a role in relation to what is possible. However, first, we will keep focusing on how the relation between the two was established.

Thomas also told us about the negotiations during the initial meeting, and how he and Khora generally gets in contact with companies and projects. *"Basically like we are sitting here [at Khora, edited], inviting people over for coffee meetings, and tries some VR with them. This is to get people to open their eyes for what the technology can do, what does it do to the body, and afterwards sit down and talk about: how could this be relevant for you? (Appendix, Thomas:23).* Thus, Thomas' and Khora's way of attracting new customers is by making a problematization: making people

realize how they can use VR as a part of solving their problems. Søren Benedikt already had an idea of being innovative, but he had not thought about using VR before Khora contacted him, and the idea of starting with an application for children with cynophobia also occurred after negotiations with Khora. There are therefore clear indications that Søren Benedikts interests has been translated by Thomas and Khora.

When they sat down and negotiated how the first application, a pilot project, should be. Both Thomas and Søren Benedikt told us that Søren Benedikt was the one who, given his knowledge about the children and the whole psychological field, was responsible for the storyline of the application, while Thomas and a cameraman recorded the video (Appendix, Søren Benedikt:9;Thomas:24). During the process, they first thought about making an application for children with claustrophobia, such as a small elevator. However, they decided to take a different path. *"I remember that we started to talk about making an application for children with claustrophobia. But then we thought that it might not be exciting enough to be in an elevator and look around, and there are not as good pictures in it, as the cynophobia treatment VR videos. Therefore we thought it would be better with cynophobia treatment VR videos."* (Appendix, Søren Benedikt:9). As Søren Benedikt mentioned in the quote, his initial thought was to make a video for children with claustrophobia, an idea that changed after negotiations with Thomas. This is despite the fact that the idea had not even been tried out, before it changed. While we cannot know it for sure, one could imagine that the change of plans was partly due to marketing reasons, as cynophobia treatment VR videos had better pictures than elevator videos. This interpretation suggests that the choice of making cynophobia treatment VR videos rather than elevator videos was for Khora to attract external actors with a *"video with good pictures in it".* On the other hand, the choice of making a video with good pictures could also be an attempt to make the videos appealing for the children at Cool Kids. In fact, it might be a combination of the two, both to be "appealing" for the children at Cool Kids, but also to make videos looking attractive for potential clients and partners. However, the fact that the actual children concerned by the videos were not involved in the negotiations leaves questions unanswered. They never really found out what worked better on the children, maybe it would have been possible to make a better video for children with claustrophobia. It is also worth questioning what is actually meant by "good pictures". When we asked Thomas and Søren Benedikt about the importance of immersion, they both agreed that it is fundamental in relation to therapy with VR. But when we asked Thomas to explain what Immersion is, he said *"[…] I think the best one to have described it [immersion, edited) is that guy Mel Slater. It is something about place illusion and plausibility illusion. About, yeah, whether the place you are [in VR, edited], is trustworthy or not. Which is, if the design and what is going on [in the VE, edited] is trustworthy. […] If one kind of imagines the world with all the senses,*

becomes enclosed in this small bell jar, and kind of forgets about the outside world, that is a sign of an effective immersion. […] It is the different production teams [at Khora, edited] whose competences that comes into play, because there are many, and we do not have like an "auto". Everybody at the design teams are educated in what they are doing. So for example those working on 3D graphics has their own principles, and theories about colors etc." (Appendix, Thomas:26). Based on the quote it is evident that it takes a whole team of designers to produce an immersive VE. One could draw a parallel to Edison's electricity project. Edison recruited several important actors, each responsible for representing and mobilizing their respective field of expertise, in order to make the microcosm called Menlo Park (Akrich et al, 2002b:216). The actors in the design team at Khora are each responsible for mobilizing their field of expertise, and as a whole (a collective process) it makes for an immersive VR application. On the other hand, Thomas and a camera operator, together with Søren Benedikts storyline, made the application with cynophobia treatment VR videos for Cool Kids. What then happened to all the principles and theories the design team brings into play to create immersive experiences? They were not there, due to a new actor we can now identify: Economy.

Thomas does not hide the fact that economy plays an important role as to what kind of VR application that is possible to make. First, he stressed the impacts of making a VR experience that allows one to interact with the VE. *"It gives a much bigger effect if one can do something, if one can interact with the [virtual, edited] environment, but one cannot do so in a video. But it is just much easier to record a 360 degrees video compared to 3D graphic experiences, and it just costs a lot more resources to make something in 3D compared to recording a video."* (Appendix, Thomas:25)

Clearly, Thomas acknowledges the fact that interaction with the VE has a big effect. Without saying how it has a big effect, one might suggest that it is in line with Mel Slaters concept of Immersion. As we have already established, Mel Slater refers to Immersion by using Zeltzer's *"notion of interaction"* (Slater and Wilbur, 1997:4). Here Mel Slater describes that interaction has to do with the participant's ability to have an influence on the events in the VE, such as cause changes in the VE. Interaction requires a technical setup providing a *"minimal lag between motor actions and the corresponding system response" (*Ibid.:3), which one could also describe as a match between the participant's proprioceptive feedback about body movements and the information displayed on the screen. Additionally, interaction also has to do with the plot of the VR application. The plot must have its own drama where the participant can interact, away from the everyday reality. For example, and very relevant in relation to the cynophobia treatment VR videos, Welch et al. (Welch et al., 1996, in Slater, 1997:7) made a study showing that participants controlling the vehicle in a

driving simulator reported a greater feeling of presence in the VE, than the participants who merely just observed the VE. Reflecting on the project at Cool Kids, as we have described in our participatory observations of the application, the cynophobia treatment VR videos allows a very limited degrees of interaction for the participant. In fact, it can be related to the group of subjects in the study by Welch et al, who basically just observed the VE. When we asked Thomas if he believe it would have worked better to make a 3D experience instead of the 360 degrees videos they made, he answered: *"Yes, definitely. It was a deliberate choice, because of the budget available. If we should have made it [the application for children with cynophobia, edited] as a 3D experience, it might have cost ten times more than it did, which is a big difference for a private company"* (Appendix, Thomas:26). Economy becomes an actor that had an impact on what it possible to make in terms of VR product. During our interview with Thomas, he said that, naturally, an interactive 3D application is not always the right solution, as, for example, a VR overview of Copenhagen is better captured with a 360 degrees camera, compared to a 3D experience. However, the application made for Cool Kids would have "worked better" (Appendix, Thomas:25) had it been a graphical 3D experience, as it would have been more interactive to use Thomas' words, which according to Mel Slater would have made it more Immersive than the current application.

The application at Cool Kids is a pilot project and expectations, from Thomas and Søren Benedikt, seems to have been relatively low before the application was even tried out on the children. Given Thomas' experience with other VR projects, and his awareness about the fact that a graphical 3d experience would have made for a more interactive VR experience, one might question to whether he believed that the application would have success, or rather be a great opportunity to learn something, even with a profit.

By now, we can already establish that the project of making the cynophobia treatment video at Cool Kids was not quite a collective process. The design team consisting of various actors, each capable of representing and mobilizing their field of expertise, were not a part of the negotiations and Thomas from Khora did not truthfully represent them as a spokesperson, since he does not bring their expertise into the development of the cynophobia treatment VR videos. As we have mentioned, Søren Benedikt was, during the negotiations, spokesperson for the psychological field as he made the storyline for the cynophobia treatment VR videos. He was also spokesperson for the children, as he was responsible for representing their interests. This is both due to his knowledge of the children, but also due to Thomas' lack of knowledge about the children at Cool Kids, which he also recognized (Appendix, Thomas:24).

Luckily, we had the opportunity to observe a child at Cool Kids receiving treatment with VR, by going through the different stages of the cynophobia treatment VR videos. After observing the child, Mikkel, trying the VR, we also had the opportunity to interview Mikkel about his experience. The observations of Mikkel, and the interview with him, serves as an opportunity to look at the relation between the VR and a user, which is another actor who is going to either "*seize the innovation or turn away from it"* (Akrich et al., 2002a:205). Besides looking at the articulation between Mikkel and the object, it is also an evaluation of how Søren Benedikt fares as a spokesperson for the children, or at least for Mikkel.

Søren Benedikt stressed the importance of VR being appealing for children at Cool Kids, and that it serves as a new and alternative way of communicating psychological knowledge, not to mention psychological therapy. Mikkel was chosen to try out the VR treatment for cynophobia, partly because Søren Benedikt had identified him to be curious about VR prior to the treatment.

Mikkel did seem to be excited about trying VR at Cool Kids, right from when he entered the clinic, and he also told us during our interview with him that he had been looking forward to try the VR application (Appendix, observations at Cool Kids:61-63;Mikkel:44).

However, one of the things appearing from both the observations of Mikkel experiencing the different stages of the cynophobia treatment VR videos, and the interview of him afterwards was that the cynophobia treatment VR videos were not frightening enough. The reason for this can be ascribed to both the articulation between Mikkel and the VR, and Søren Benedikt as a spokesperson for Mikkel. In relation to first mentioned reason, the technological specifications of the VR used at Cool Kids does not provide an immersive experience. Drawing on Mel Slaters concept of immersion, one can identify various reasons as to why the VR at Cool Kids does not provide an immersive experience. We have already established the lack of interaction the VR at Cool Kids provide. Another thing to account for is what Mel Slater calls inclusion, which has to do with the extent to which the real physical world is shut out from the VR experience. As observed (Appendix, observation at Cool Kids:61-63) there were several occasions where the HMD annoyed Mikkel. Other real world distractions occurred too, let alone Søren Benedikt who spoke *"too much" (*Appendix, Mikkel:46) to Mikkel during the experience. These are all obstacles preventing the experience from being inclusive. Furthermore, both Mikkel and even Thomas expressed that the VR experience at Cool Kids is not enough *"true to life" (*Appendix, Thomas:24). Mikkel even said that he *"could barely see the dogs' fur"* (Appendix, Mikkel:46)*,* and that in general *"the graphics is really bad in the videos"* (Appendix, Mikkel:44). The critique towards the "graphics" is what Mel Slater calls vividness. This concerns resolution and fidelity of the display, and as studies have shown, higher levels of vividness does correlate with greater sense of presence in the VE (Slater

and Wilbur, 1997:6). Another aspect of the technicalities of VR, which must be taken into account if one strives for an immersive VE, is extensiveness. Extensiveness has to do with the sensory modalities of a VR , such as sound for example. As established based on our participant observations and observations of Mikkel, the VR and HMD at Cool Kids does not stimulate one's sense of hearing, as it does not provide a high level sound experience (Appendix, observation at Cool Kids:61-63).

Mentioned technological modalities of the VR at Cool Kids are important to identify, as they are part of what will set actors in the network up as either *"allies, adversaries or sceptics"* (Akrich et al.,2002a:205). At least we can say that exactly those technological characteristics are what sparked Mikkel's interests into being. Furthermore, we have, based on Mel Slaters concepts, established that concerned technological modalities are part of what affects the extent to which the VR provides an immersive experience. An immersive VR is required in order to make the subject feel a high sense of presence in the VE. The case at Cool Kids indicates that when a VR does not make the subject, in this case Mikkel, feel present in the VE, it does not have the impact on the subject as hoped. More specifically to this case, the VR at Cool Kids does not make Mikkel feel a great sense of presence in the VE, and as such he was not scared of the dogs in the VE, which was the purpose.

As mentioned earlier, the observations of Mikkel and the interview with him, also calls Søren Benedikts role as a spokesperson for the children into question. As established, Søren Benedikt made the storyline for the cynophobia treatment VR videos, which, to use Mel Slaters terms, is the plot of the VR application. Doing so, he both represents the field of psychology, but also the interests of the children. By making the plot, it allowed Søren Benedikt to control the events and dramas in the VE of the VR dog application. In other words, he was the one deciding how frightening the events in the VE should be, such as how close the dogs should get to the subject experiencing the VR. As established through Mel Slater's concepts, a part of making the plot is to decide the extent to which the subject can interact with the VE. Of course, ones interaction with the VE has something to do with the technicalities of VR, but it also concerns plot. We tried out the VR at Cool Kids ourselves. Based on our experience and our observations of Mikkel, it was clear that elements that do not concern the technological limitations of the VR, lowered the degree of interaction (Appendix, observation at Cool Kids:61-63). For example, the dogs seemed to be very distant from the 360 degrees camera i.e. the eyesight of the subject experiencing the VR. In the VE, a woman had control of the dogs, by navigating them around the grass at different distances depending on the different stages. They were navigated with treats, and one could imagine that the degree of interaction would have been higher if the dogs, for example, were navigated really close

to the 360 degrees camera, or maybe even by getting them to look directly into the camera/eyes. This has to do with the plot of the cynophobia treatment VR videos, something Søren Benedikt was in control of and which he designed according to what he before handedly thought, to accommodate with the interests of the children. However, as we have established, the cynophobia treatment VR videos, even the last stage that is the most frightening, were not frightening enough for the children with phobia for dogs. As such, Søren Benedikt did not represent the children truthfully as their spokesperson.

Mikkel has cynophobia, therefore his interests towards the VR at Cool Kids is that it must be a device that helps him get treated for this mental disorder. The device can only do so by gradually provoking his phobia more and more in a controlled manner, through the different stages of cynophobia treatment VR videos getting gradually more frightening. A major part of how to provoke the phobia is to make the subject, in this case Mikkel, feel as high a degree of presence as possible. The VR at Cool Kids did not make Mikkel feel a high degree of presence in the VE, and as such he was not frightened by the dogs, thus his phobia was not provoked. Hereby, the VR at Cool Kids failed to accommodate Mikkels interests of being a device to help him treat his mental disorder.

Mikkel was not represented truthfully by his spokesperson Søren Benedikt, when the plot was made. Furthermore, technological choices made seems to cause a detachment of Mikkel, who could potentially become an adversary of VR at Cool Kids. The technological choices made was to some extent a result of the actors recruited for the negotiations of developing the project, or rather, the lack of actors recruited to negotiate with. The design team consisting of different fields of expertise were not a part of the negotiations, and nor was Mikkel or any other child. Economy proved to have some sort of constituting force, or agency, as it influenced the actors recruited to the negotiations, thus the technological outcome. Not only did a limited amount of money result in the absence of the design team, it also resulted in the lack of user/patient understanding. Thomas told us that he did not actually know much about the project, as he had not spent a lot of time at Cool Kids at all. One could therefore argue that the limited amount of money led to a limited involvement of users, like Mikkel for example, making the project a lot less collective overall.

VR at the Pediatric Pain Knowledge Center

During our Thesis, we also identified actors at other VR cases made by Khora. After conducting observations and interviews at Cool Kids, we went to Rigshospitalet. Here, we had arranged an interview with Søren Walther who is the chief physician at the PPKC. We already had some information on the VR project at PPKC, based on Søren Walthers presentation at CopenX and our brief talk with Thomas at CopenX (Appendix, CopenX:60). Nevertheless, the interview with Søren

Walther allowed us to know more about his interests towards VR at PPKC, his relation with Thomas (Khora) and not least it also gave us the opportunity to try out the VR and HMD used at PPKC.

From Søren Walther's presentation, we already had an idea of his interests towards VR at PPKC, but during the interview, he elaborated. *"One of the things we are really interested in, is what we call procedure-related pain, which is pain related to all these small procedures children are exposed to at the hospital. In form of blood tests for example"* (Appendix, Søren Walther:48). Søren Walther and his colleagues, which he in this case speaks on behalf of, have a general interest in ways of distracting patients during procedures. The interest stems from scientifically proven reasons. *"It has been proven that distraction helps on pain, because under normal circumstances [if not distracted,edited] there will be sent impulses from the body to the brain saying: here there is something that hurts. And distraction has proven to simply just block, popularly speaking, for some of those impulses, as the brain can not do both at the same time. So if the brain is occupied by for example virtual reality, or another kind of distraction, those impulses will not completely get to the brain in the same way, saying: it really really hurts, they will get suppressed on the way to the brain."*(Appendix, Søren Walther:48). Given Søren Walther's field of expertise, he is extremely concerned by methods that scientifically have proven to work, such as distraction. Later, Søren Walther said that it is natural to choose to use technology as a new and smarter way of mediating distraction to the children in pain. VR is according to Søren Walther the obvious choice when deciding what specific technology to use for distraction (Appendix, Søren Walther:48).

Søren Walther does not hide why he and his team at the PPKC were interested in VR; it is for the purpose of helping the children at the center in pain, by distracting them during procedures like blood tests and anesthesia. Distraction as such is nothing new, previous to VR Søren Walther and his colleagues have used, and to some extent still uses, storytelling and soap bubbles as other methods for distraction (Appendix, Søren Walther:48). However, as Søren Walther already said at the CopenX event when asked why VR is better than other ways of distraction, VR is more effective because it stimulates more senses than for example storytelling, or regular video games on a Playstation. Therefore, within the interest of VR being a device that helps children in pain by distracting/occupying their brains during procedural pain at the PPKC, lies another interest: VR at the PPKC must be capable of providing an immersive VE. Søren Walther says that VR is a new and smarter way of distracting his patients because it stimulates more senses than other methods of distraction. Without directly speaking about immersion, let alone Mel Slater, Søren Walther does speak about the same sort of experience VR must be capable of providing. It must be an

experience that stimulates on many different parameters, as it is the most effective method for the purpose at the PPKC – distracting children's brains while undergoing procedural pain.

Foundations in the form of interests for implementing VR at the PPKC were already there before Khora or any other VR company came into the story. Søren Walther and his team had already used VR for distraction for a few years, as it was the natural step to take at the time. However, the project of using VR took off when a donation was granted the PPKC. *"Something really happened, in a good way, when we received a donation from a company. They gave us an amount of money, and then we decided to spend it on VR. Then we got in touch with Kristian Bluff, and with Khora. And Khora is Thomas, if you have met him? He has been involved in a lot regarding VR within healthcare. Then, we got them [Khora, Edited] to make us some VR software."* (Appendix, Søren Walther:48).

Once again, economy influenced what was possible in relation to a VR project. Based on Søren Walthers statement, a donation was the catalyst that made the VR project at the PPKC even better. The donation enabled Søren Walther and his colleagues to take contact to new potential allies to negotiate with in the VR project at PPKC. The first person Søren Walther got in contact with was Kristian Bluff. Kristian Bluff has a consulting firm where he partners up companies, organizations or people, for different kinds of smart technological solutions. Kristian Bluff proved to be the link between the two spokesperson in form of Søren Walther who, in this context, represented the PPKC, and Thomas who represented the department of healthcare at Khora. Kristian Bluff had information about the project at the PPKC and as such knew about their interests and requirements. With this information, he advised Søren Walther to contact Thomas from Khora.

After a few meetings between Søren Walther and Thomas, they decided to bring in other protagonists to negotiate with in the project. Thomas said: *"the way we decided to do it was, when doing something to distract children at the hospital during procedural pain, then, instead of just start doing something [designing a VR application, edited], we found a game that already existed, something we just bought in app store, a fully developed game. We tried it on some of the children at PPKC, in order to see their reactions and we tried to learn from the experiences it gave us. Afterwards we built something [a VR application, edited] ourselves. This approach was taken so that we did not waste a huge amount of resources and development hours on something that might not work. So, yes we simply just bought a game for 5 dollars in appstore, and I went to the PPKC at Rigshospitalet and tried the game on the children. I believe five children or something like that tried it over two days. We learned some experience, such as what worked well and what did not work well. For example, it was important that nothing [in the VR application, edited] was behind the children, because they were not allowed to turn around, and one of their arms needs to be*

available for the pediatrician. And we learned that objects [in the virtual environment, edited] should not get too close to the subject, because then they get surprised and make sudden movements" (Appendix, Thomas:23).

Thomas made children try out a VR game at PPKC, in order to understand their needs. Thus, children were called upon to negotiate with during the development of the game. In other words, those who are going to seize the innovation took part in the negotiations, which allowed in-scriptions of their needs, in the application. One could say that including the children to negotiate with during the developmental stage of the innovation, is to perceive the children as allies in a collective task of making the innovation succeed, as opposed to perceiving the children as merely receivers and users of a the technology. Of course, only five children were part of the negotiations, making them spokespersons for all the children at the PPKC who are going to use VR. As we have learned from Akrich et al. (2002b: 216), a spokesperson is responsible for truthfully represent those he/she/it speaks on behalf of. The five children called upon to negotiate with, must therefore truthfully translate the interests of all children they speak on behalf of, if the innovation must succeed.

Some of the experiences from the fieldwork carried out by Thomas at PPKC were in-scriped in the application. For example, the application was designed in a way that objects in the application only appeared in front of the user in a 45 degrees of vision, as opposed to many other VR games, and videos. In addition, everything to interact with in the VE of the application, was distanced from the subject (child) experiencing the VR. The reason for this is not directly to the interest of the children. Rather, it is for the purpose of accommodating the medical practice that the children are subjects to while simultaneously playing the VR game. One could therefore say that the aforementioned in-scriptions are to prevent the doctors and nurses at PPKC from becoming adversaries of the innovation. Of course, in that sense the in-scriptions are for the children as well, as they permits the usage of VR while undergoing procedural intervention.

Thomas had information about the medical requirements, examples mentioned above, of the VR based on his own fieldwork where he observed the medical practice, as well as spoke to pediatricians and nurses (Appendix, Thomas:23-24). Moreover, Søren Walther during the negotiations with Thomas also mobilized his field of expertise into the collective innovation project of making the VR application (Appendix, Thomas:23-24).

Unfortunately, we did not get the permission to interview or observe any of the children at the PPKC. We did, however, ask Søren Walther about the children's experiences with the VR at the PPKC. For the children, VR is something that makes a painful and unpleasant situations a bit more

tolerable. It does so by distracting them, as it occupies their brains with other impulses than those of pain coming from the arm (Appendix, Søren Walther:48). As such, the children at the PPKC are interested in the VR to be as distracting as possible in order to reduce the procedural pain. Søren Walther says that VR is a new and smarter way of distracting, because it stimulates many different senses at the same time. There can be drawn a parallel to some of the dimensions mentioned by Mel Slater about making an immersive VR that increase the subject's feeling of presence in the VE. Søren Walther mentioned that most of the children does seem to feel a high sense of presence in the VR game at the PPKC. *"they [the kids, edited] get really occupied by it […] Immersive? Yes. They are completely gone in this, I mean really out there playing in that world"* (Appendix, Søren Walther:54). According to Søren Walther, the children are immersed by the VR as it sort of takes them away from the real painful world, and makes them become part of another one, with its own dramas, which they can influence.

The VR application at the PPKC is a game that allows the children to interact with the VE by aiming and shooting at seagulls. The children's proprioceptive feedback matches the one displayed on the screen. When the child makes a movement with the controller in the real world, the aiming angle in the VE responds by moving in the same direction. As such, there is a match and the plot is made to create an interaction of the subject and the VE.

Søren Walther, his colleagues, and the children at the PPKC had the interest that the VR application should be as immersive as possible, in order to distract the children as much as possible. Thomas wants to accommodate this interest by allocating a VR experience that satisfies those needs (Appendix, Thomas:31). But how can Thomas arrange negotiations that permits such an application? To make an interactive, inclusive, indeed immersive form of application, more actors than Søren Walther, Thomas and five children took part of the negotiations of developing the application. Thomas recruited a game designer, Gertrud. Gertrud has a degree in game art, design and development, and at the time she took part in the project at PPKC, she was in an internship at Khora (Appendix, Thomas:27;Gertrud:58). Given her field of expertise, Thomas recruited her to negotiate with in the project in order to get knowledge about game design such as colors, shadows, and game mechanics such as different kinds of rules, mobilized into the project of developing the application. As such, Gertrud becomes spokesperson for the field she represents; she is responsible for translating the "interests" of colors theory for example, into the application. Gertrud made some fieldwork at the PPKC where she came to understand the needs of the children, and the medical practice, but she also held meetings with Thomas. Hence, she both had a direct relation to some of the children, but Thomas also translated some of the interests of the children and the medical practice to her. In addition to Gertrud, other designers were recruited for

the development as well. When Khora develops an application in form of a VR game, a whole team of designers takes part in the process. The donation made possible the recruiting of the design team in the negotiations of how the application should be designed in order to accommodate the interests of Søren Walther, and the children at the PPKC. Amongst the protagonists in the design team, Thomas mentions that "*there are 3D graphic designers, they know a lot of principles, theories about colors, and how fog works in a space, which makes another experience. And our lead designer is a computer scientist, but educated in audio design, so how can one use audio to influence, and 3D audio, and spatial audio."* (Appendix, Thomas:26).

We did not have the opportunity to speak with the actors in the design team Thomas speaks of in the upper mentioned quote. However, based on Thomas' statement it is evident that actors in the design team each mobilizes their field of expertise, into the application. Moreover, the fields mobilized by actors in the design team, correlates with some of the important technicalities of an immersive VR stressed by Mel Slater and Wilbur (Slater and Wilbur,1997:3). Such as vividness: pictorial realism, and extensiveness: sensory modalities such as sound.

Contrary to the project at Cool Kids, the project at the PPKC was more of a collectively held process. Like the Edison project, many actors were called upon to negotiate with, and each of them were made spokespersons responsible for representing and mobilizing their fields and the interests of them.

Virtual Reality at Youth Medical Knowledge Center

The last actor we identify is Per Frederiksen from the YMKC. Per Frederiksen did not have time for a physical interview, instead we interviewed him on the phone. It also means that he did not show us the VR videos used at the YMKC. However, at the CopenX the VR device including the applications used at the YMKC had a stand (Appendix, CopenX:60). Therefore, we briefly had the opportunity to observe the device, try it out, and watch a few of the Videos.

The VEs, in form of videos, for the VR at the YMKC was recorded by Khora. We do not have much data on the relation between Per Frederiksen (YMKC) and Khora. We do, however, know that this project, too, was funded by a donation from a company (Appendix, Per:39). As such, economy also influenced what negotiations and alliances that were possible to make.

According to Per Frederiksen, the interest at the YMKC is to use VR to *"break the feeling of being locked up at the hospital. Can we [with VR,edited] eliminate this feeling that, when being at the hospital, the patients does not experience anything"*(Appendix, Per:34). Clearly, one of the concerns Per Frederiksen has, together with the rest of the YMKC team he speaks on behalf of, is the one of young patients feeling isolation at the hospital. Per Frederiksen is a psychologist, and

during the negotiations, that is, the development of the VR project at the YMKC, he mobilizes theories from his field of expertise. *"We want to try and do something about creating a sense of leaving the place [the hospital,edited]. We were interested by the psychological theory about experiences in youth. Thus, our Thesis was, and still is: can we create an experience with VR, which gives an extra experience while still being in the hospital room?"*(Appendix, Per:39). The interest about what VR must be capable of at the YMKC is founded in psychological theory. At the same time, Per Frederiksen is a spokesperson for the youth. Based on his knowledge about youth with chronological diseases, for example leukemia or cystic fibrosis(Appendix, Per:36), he understands their desire to be somewhere else than in the hospital bed. Therefore, Per Frederiksen translates the interests of the youth, which he represents, into an idea of what VR must be capable of at the YMKC.

To accommodate the interests of Per Frederiksen, which includes the psychological theory, the rest of the team at the YMKC, and the youth with chronological diseases, VR at the YMKC must be capable of "making the youth feel like they are at another place". As we have mentioned before, VR can be divided into hardware and software. The software, in form of applications, for the VR at the YMKC is something that was made by Khora. In other words, Khora are the ones that, by making an application which contains immersive VEs, can use VR as an interessement device translating the interests of Per Frederiksen. Unfortunately, we do not have much data on this matter, as it concerns the relation between Per Frederiksen (and the rest of the YMKC) and Khora. On the other hand, we do have data on the articulation between the hardware, made by Samsung, and the different actors concerned with the VR project at the YMKC. This articulation, which is part of the socio-technical analysis, is something we will take a closer look at in the next part of our analysis.

Subsidiary conclusion

In this part of the analysis, we created an overview of the VR cases we study in our Thesis. We found that Thomas, the spokesperson for Khora in healthcare projects, allocates different kinds of VR software applications, to accommodate the interests of the different spokespersons he negotiates with.

Søren Benedikt was identified as a spokesperson for the network of Cool Kids. This makes him responsible for representing, and mobilizing, interests and knowledge of: the children at Cool Kids (users) and the psychological field of expertise. Only Søren Benedikt and Thomas took part of the negotiations of the cynophobia treatment video. This proves to diminish the immersiveness of the VE, as a consequence of an absence of important actors: the children (who were not represented

truthfully) and the design team from Khora. As such, the application does not translate the interests of Søren Benedikt nor the children's.

From the VR case at the PPKC, we identified Søren Walther-Larsen as the spokesperson for the network of the PPKC. Hence, he represents the nurses, the children, and medical knowledge. However, contrary to the negotiations at Cool Kids, the development of the software application in this case, is more collectively held. The children (users) were recruited, and the same was the design team. As a result, important perspectives and knowledge became mobilized into the software application at the PPKC. This led to a software application with a more immersive VE, capable of accommodating the interest of distracting children and teens from pain during procedures.

In relation to the VR case at the YMKC, Per Frederiksen proved to be the spokesperson. Unfortunately, we did not have much data on how the software application, developed by Khora, was used as an interessement device in this case. However, we did found that Per Frederiksen translates the interests of the youth with chronological diseases at Rigshospitalet, to what the VE must be capable of: being immersive in order to make subject feel like they escape from the hospital beds.

Analysis part 2: Technical decisions that led to allies, adversaries or skeptics in the Danish healthcare sector

Akrich et al. Writes that: *"The Socio-technical analysis underlines that the movement of adoption is a movement of adaption." (Akrich et al. 2002b:209)*. In our Thesis we have seen that the technological artefact of VR headsets, is being adopted in the environment of healthcare, done so by a variety of actors which we have identified in the first part of our analysis. However, this also creates specific issues that in normal use situations, such as entertainment at home, would not be considered a major issue, but which in healthcare create problems which are much larger and severe. The problems consist of, but are not limited to, things such as price, specifications of the headset, movement, software updates, ergonomics, and other hardware choices that lead to problematic or frustrating situations. We will now go over some of the technical choices made with VR HMD's and we will describe the consequence they have in the practice of healthcare.

In terms of prize, the chosen HMD within healthcare praxis has seemingly solely consisted of one HMD: Samsung Gear VR. For a magnitude of reasons: Firstly, the headset itself is relatively cheap compared to its competition (Samsung Smartphone excluded) as we have established in the VR Market part of this Thesis report. Secondly, the headset is untethered, enabling a greater degree of movement and having no computer is both cheaper and more roomly. Thirdly, it was also one of

the first headsets on the market meaning that actors who have been working with HMD's for some years invested in them some time ago and have not upgraded since, especially true for the governmental sectors where technological diffusion is often slower. Fourthly, Samsung Gear VR offered YMKC within the network (Appendix, Per:35) to use their HMD's, as they would provide them to the project free of charge. The relative cheapness of the HMD comes at a prize, as the headset is not as good at rendering in high resolutions or as detailed or indeed in as high Frames Per Second as something like the HTC Vive or the Oculus Rift (as described in the VR market section). This technical decision is interpreted differently by the actors which we have interviewed during our fieldwork.

Technical Decisions and automatic updates

According to Akrich et al., *"Innovation is the art of interesting an increasing number of allies who will make you stronger and stronger"* (Akrich et al., 2002a: 205)

What this means in terms of our Thesis is that to speak of innovation, we must speak of which decisions, technical or otherwise, that have managed to or managed not to aggregate interest to virtual reality.

We will be specifically looking at the ways in which the Samsung Gear VR HMD is used. Using the technology in the healthcare sector comes with a series of problems but also with some perks, some we have already mentioned such as relatively lowered price, untethered for easy of use and so forth. Akrich et al. writes about how we can articulate and describe technological innovation as who can gather the most interest and allies. By articulating decisions which lead to either enrollment of allies or actors distancing themselves as adversaries or sceptics. In the article Akrich et al. writes: *"Their characteristics correspond to technical decisions which contribute to defining the social groups concerned, setting some up as allies, others as adversaries or sceptics. A technical device distributes the forces which will support or resist it. It is in this sense that it can be analysed as an interessement device." (Akrich et al. 2002a: 205)*

During our project, we have gathered information about the uses of the headset and some of the complexities and problems that arise when using the technology in a healthcare praxis. One of them relates to the technical choices made by the developers of the headset, which seems reasonable in the context of home use for entertainment purposes, but which is problematic when transferred to the site of the hospital. During one of our interviews, our informant talks about using the HMD in a session with a child which he has promised can try the headset:

"So there are partly some technical challenges, and that is annoying. For example, we had to use it [HMD, edited] today, then it [notification, edited] suddenly pops up saying that you have to go in

and upload something or whatever. And I could not do that because I was not on the internet, and I am standing with the child. [...] That is very annoying. And I have just promised the child that that is something that you will of course get to try." - Søren Walther (Appendix, Søren Walther:51)

When the session is supposed to start, the software on the HMD starts updating. While an updating software would only be a minor inconvenience in private use situations, it creates a lot of complications at the hospital. The child has been promised to try out the HMD, but is now denied any access and ultimately have a worse experience of the hospital visit. The doctor loses face and trust, as he cannot keep his promise to the child. As we can see, even such a minor inconvenience such as a software update, can have a major impact when it is transported to the site of the Hospital. There is not room for technological errors, but in this case, there is not room for normal technological actions of the object either. It is a technical decision to have the software update automatically since it is more convenient than manually updating, but because the technology is not part of the "normal" use case i.e. home entertainment usage, it creates some problems for the users. In this case the technology betrays the users: the child and the doctor. The doctor cannot be sure that it will not happen again, even under crucial circumstances such as during actual procedures causing pain.

Calibration

We also saw and were told of other technical decisions which have led and lead to complications when using the device (Appendix, Søren Walther:51). One of them is the complicated use practice when setting up the device in order for a child to play a game. The device have to be calibrated first to know the location and direction of where the user is looking with the headset. This is important, as the VR application which the PPKC use, itself have a 45 degree space of play (Appendix, Gertrud:59). If the headset is not calibrated correctly, as was pointed out to us by one of the designers, Gertrud, then the children who use the HMD's will have to look to the side to be able to see what is happening, which make them twist into an awkward position. The calibration is thus necessary to be able to look straight ahead in the VE and see what is happening (Appendix, Gertrud:59). This is also something Mel Slater has talked about in relation to immersion and matching the proprioceptive feedback of the users' body movements with what is happening inside VE. In this case if the children's movements with their body in the real world and the children's VB does not match up, for example if they lie on their side in the real world, while they are standing straight in the VE, then it will have a diminishing effect on their engagement and feeling of presence in the VE.

But the calibration itself can also be a barrier to easily use the technology. As a game designer we interviewed points out:

"But it is difficult to make it function again and again when they [children, edited] turns and twists and the controller is not calibrated correctly. Because it have to be reset every time they put a new one on, so in that way it is a bit inconvenient, and it is the nurses or the doctors responsibility to reset it before the children get the headset on." - Gertrud (Appendix, Gertrud:59)

Calibration is a feature of the HMD itself, and another technical decision to allow users to setup the HMD themselves. But in a hospital setting it is time consuming as one has to have at least practical knowledge of how to work the headset. In a private setting this can be tolerated, but if something goes wrong or takes too long, it becomes problematic when in a hospital context. During a conference where the game was being shown at the hospital, our informant the game designer Gertrud had to calibrate the HMD for the nurses, as they did not have a working knowledge of how to set it up properly. This can of course overcomplicate the procedure and waste time, a resource which is not abundant at a hospital. Technicalities such as this in regards to calibration can help dissuade actors from using the technology.

Isolation and Inclusion

Another problem that is related to the technical decisions of the HMD, is that of isolation. When one puts on the headset, it is an isolating experience, which does not extend to others watching. It can be hard to determine what is happening inside the headset at any given time. With HTC Vive and Oculus rift and indeed Playstation VR, one can watch on an auxiliary monitor, what is happening while someone is playing a game or watching a video with the headset on. With the Samsung Gear VR, it is possible to do so as well, but requires ressources and know how, which is not abundant. Neither is it a general feature of the HMD to be connected with a monitor, since it is powered by the smartphone. At PPKC there is not necessarily room for an external monitor (Appendix, Getrud:60), and with the limited knowledge of the nurses and doctors on how to work the technology it is also a far away solution. The benefit of having a mobile HMD, with the Samsung Gear VR, is also being dissolved if the technology needs to be tethered to a stationary monitor. A monitor which often weigh too much to easily transport it around, and which have wires that have to be accounted, not least making setting up the headset even more of a bother.

So in a way, the technology is isolating. It is also a strength of the technology itself. In order to feel presence in a VE, one of the principles for becoming immersed is that outside stimuli is minimised (Slater & Wilbur, 1997:6). When wearing a HMD, one are not able to see outside of the screen and it is indeed one of the reasons VR was chosen as a technology for alleviating pain during procedures with children, as it distracts from real world stimulus. As we have established, it is not possible for wearers of HMD to see outside the headset, but others cannot see inside either, at least not without adding an external monitor which is not used in the current practice at PPKC. In

the healthcare sector, when establishing the fact that it is an isolating experience where outsiders cannot see what is happening, some challenges and missed opportunities can arise. One of the aforementioned “missed opportunities” was at PPKC. The VR application there is meant to capture and engage users so that the pain that comes from procedures involving needles is negated through distraction. The Nurse or the Doctor who does the procedure cannot exactly know, what the child is doing and what is happening at any given time with the child in the VE because there is no auxiliary screen. If there was, the nurse or doctor would have an easier time, or more consistent idea of when children were the most engaged or immersed with the application, and would be able to sting with the needle at that time where it would be least noticeable.

While we were observing in a Cool Kids psychotherapeutic setting, the HMD was on one of the children, and he was watching a VR video. Søren Benedict had to ask what was happening in order to get a good sense of what Mikkel was doing and how far he was in the session. If he knew precisely what was triggering what at a given time, he could have a better understanding of what was frightening Mikkel, and he would be able to better discuss it during the session. Because Søren Benedict also had to speak to Mikkel while he was watching the VR video, it seemed to have an impact on His feeling of presence in the VE, due to real world intervention. As he told us: *"He [Søren Benedict, edited] interrupts me a little bit. I was sitting there now and saw it, and wanted to concentrate on it." - Mikkel.*

This might of course also just be a feature of the way in which one does psychology and the practice around it. Søren Benedict needs to create a dialogue in which Mikkel expresses himself so he can put words on his fears. However, it does clash with the immersive part of VE in VR when something on the “outside” interrupts. As we can see, the technology is in this case display features which are both wanted but also limiting in the practical setting.

The built in VR stores

Something that is inherent to the HMD’s is the ability to download and use software applications on the systems. This general feature which many technological devices have, can be a distraction when used in conjunction with the healthcare sector, as the software which were intended for the youths to use, is not necessarily the most interesting. One of our Informants, Per, talked about how some of the youths had been allowed to take home the HMD’s, and use it: *"We have loaned it out to a patient over a weekend, where we sometimes feel a bit stupid, because then there are downloaded games and things are being tried. So who cares about the films you have made, I will run something or other interactive Google Earth and I will show you where I come from and where I live [...] We had not thought about that so in that way we were surprised" - Per Frederiksen*(Appendix, Per:41)

It turns out that there had been installed other applications on the HMD's indicating a desire to try something different. It speaks to the adaptable nature of the HMD's and its ability to create interest which can be considered good and bad in this case. If the children at the hospital finds it interesting to work with, but uninteresting when aligned with the chosen application of the hospital, then it becomes problematic if what is already on the software stores is more interesting than the things that are being developed in the public sector, then PPKC and the YKMC obviously have a problem, as what they are contributing is something that is meant to be different and engaging. What is engaging then is the technology itself. This could be problematic as proliferation of the technology makes the HMD's more abundant and common.

Ergonomics

Another problem relates to that of ergonomics. The HMD's that have currently been made is one size fits all. When it comes to children wearing HMD's then, it can be problematic to the level of comfort which they experience. As we have talked about, HMD's are meant to encase the vision of the wielder to improve the experience, as outside stimuli is reduced. Which means that comfort is important to VR in particular, because decreased comfort can result in decreased levels of Immersion. As we have established through Slater & Wilbur (1997), outside stimuli diminishes the inclusion of the VR. If a HMD is too tight, or light enters from the corners, it does not create the optimal experience for VR. It is also important that a HMD is comfortable and fits easily in the healthcare sector, as putting on a HMD might take additional time otherwise, or the broken immersion can cause increased awareness of the painful procedures being carried out. (Appendix, Søren Benedikt:17)

Getting sick through applications

We have now talked about some of the difficulties in the hardware, but now we will touch upon some of the difficulties with and perks of the application specifically relating to nausea or cybersickness.

One of the main concerns when using VR, which can be a feature of the headset, is the problem with creating experiences which cause vertigo and nausea. In a hospital one enters with an expectation of getting treatment which will improve ones condition. As it was put by Søren Walther: *"[...] you can say, [it, edited] would not be acceptable, if one introduced a technology in a hospital which made the children sick."* (Appendix, Søren Walther:51)

But if the application is not made properly, or not made with this in mind, it can cause problems that are less tolerable in the healthcare sector. When one goes to a hospital you expect to become

healthy, or at least not for the hospital to make one sicker. It is then much more important for the software not to cause any nausea of any kind than it would be compared to using VR at home. This is also one of the reasons PPKC hired Khora to develop the application initially, as also stated in part one of the analysis, because it is possible for Khora to develop it for the specific needs of the department PPKC. As well as mobilize the knowledge Khora have in developing applications for VR.

Another project at Rigshospitalet, in the YMKC, who also use VR videos as a way to gain experiences and see things outside of the hospital rooms. YMKC had some acquaintances with VR videos, but as 360 degrees cameras became more ubiquitous because of a decrease in price, they chose to give out 360 degrees cameras for families to film in the home (Appendix, Per:36). But they also experienced some problems with using the technology. Families who made the videos was not necessarily trained in the kind of effects VR could have on someone when they wear a headset. So when they made their videos, they would not be aware of wobbling the camera, moving it too fast. This could cause vertigo and motion sickness, a side effect of badly implemented VR. Per Frederiksen proposed making workshops for properly using the technology as it was needed to deal with if the families of the youths were to make the videos (Appendix, Per:36). It is therefore important that one understands the effects badly implemented VR can have before using it. Otherwise it will have the opposite effect, and instead of one using the VR interessement device to gain allies, one might create adversaries to the HMD's or the specific software in question.

Gaining allies and adversaries

As we can see, the Samsung Gear VR HMD is able to as Akrich et al. describes: *"allow it to attach itself to, or conversely detach itself from, a whole series of social groups which will decide on its future." (Akrich et al. 2002a:204)* by the technical decisions which have a substantial effect on the users and the environment it inhabits.

Because the Samsung Gear VR is both relatively cheap compared to other VR HMD's, and because it is mobile and untethered, it makes for a great solution for the doctors and psychologists who are able to provide a different kind of new technology to an otherwise clinical place, but in doing so it also requires an understanding of the technology, and how it functions and that is not necessarily something which either the doctors nor the nurses possess. This mean that the nurses and doctors can have difficulties engaging with the users and technology, because the technical

choices of the developer of the HMD's in Samsung, render the headsets unusable or unintuitive which cost a lot of resources that might be scarce for the PPKC.

The low resolutions VR videos discourage or is uninteresting to the children in the YMKC, however the VR games (unrelated to the video game in PPKC) is exciting to play, at least within a certain age span: *"The wild roller coasters, which were cool at the start, they are already beginning to diminish in their effect, when we put them [HMD edit.] on the head of someone: "arh yes yes, that is very nice, but my mobile phone has double the amount of resolution" or something to that effect."* (Appendix, Per:38).

The VR games were also on a higher budget, and were better implemented with VR, being not as relient on resolution to convey a better imagery, since the VR videos have to show "real life" images. The real life images conveyed in a worse manner is not as immersive as could be, since people expect more from real life, it begins to border on the uncanny valley. A game set in a bright cartoon world like 'Trouble on The Bathing Jetty' (trans. Ballade på Badebroen) does not offer the same connotations to real life, but is a different world and in a way more believable because it does not purposely mimic real life (Appendix, VR Application at PPKC:64). The game is also interactive, and through that interaction engages the user more directly, as we also pointed out in part one of the analysis.

As we have seen, a lot of technical decisions have lead to some scepticism related to the use of VR technology. Regardless of the scepticism then there is still an interest in developing a solution that includes VR. Allies must be gained through some other technical decisions or intrinsic properties that influence the socio-technical landscape, and which are useful to apply to the healthcare and psychotherapeutic setting. VR is a technology which has become relatively cheap compared to the '90s, and which is now able to be bought by private households without too massive of an investment. This also means that it is easier for public institutions such as the hospital to better finance trial projects to see what is actually possible with the technology at hand. The decrease in cost has also meant that companies such as Khora can begin to work with and gain experience working with VR technology and VR solutions in practice. The understanding of what works and what does not work when creating software for VR experiences is thus already markedly increased compared to before the release of commercial HMD's (Barras, 2014). This means that when the department PPKC from Rigshospitalet, for example, wants to work with VR and contract Khora to make a VR game, the VR game itself will be more robustly made to fit into the context of a healthcare environment. An increased attention to things such as seasickness have undoubtedly benefited the software (Appendix, Søren Walther-Larsen:53-54).

Other than the practical network and knowledge exchange that happens with VR technology as it proliferates which makes for more robust solutions, there is the scientific evidence for use cases of the technology, like we have described in the chapter on VR as an alternative treatment method. Rigshospitalet is working with VR in pain distraction practices, and it have anecdotally strengthened that area within the hospital, as it seems to have had a beneficial effect in that it enabled nurses and doctors to do painful procedures with reduced harm to children, and with no drugs needed. The children were even interested in coming back to try out the software again, implying that the procedure was not painful enough for them not to want to return again. This has also been observed in another hospital in Denmark: the North Seeland hospital (Hansen, 2018). So it would appear that it is not just an isolated case within one hospital. In this way it could be said that the VR HMD has managed to gain allies within the healthcare sector. It seems that by allying with VR as an actor, together with experts such as Khora, to the network of pain relief in children at the hospital, the network has in turn distanced itself from drugs and the pain which is inflicted during the procedures. In some ways, this would not be possible without the HMD's. The technical decisions to encase the eyesight of the wielder has also made it more immersive, because outside influence is limited, at least through sight. This is especially important as we can ascertain here, because otherwise the procedure would be fully visible to the patient, and the immersion and engagement with the VR would be minimal. So in a way, the HMD's are well designed for shielding against the painful procedures, even if the initially thought behind the technical decision was to create a more immersive experience.

Other than pain relief during painful procedures with needles. It has also helped to give experiences to isolated patients which cannot leave the boundaries of their confinement, in the Youth Medical Knowledge Center. There is a difference between watching a television screen to watching and moving around in a confined space in VR. What VR contributes is the added immersive element of feeling like you are standing in a real space. The 'camera' is not as objective as in a film, but becomes subjective as you are the one controlling what is of particular interest. The subject control the field of vision and the 'camera'. This makes for potentially more powerful stories to be told. The general prospect of the idea is to empower isolated children to have the possibility of seeing things and giving them experiences they would not be able to have otherwise. That is a strong argument for making the project work, even if the technological device and specifications cannot satisfyingly fulfil that promise because of the contemporary HMD's relative weakness.

Additionally in Cool Kids, VR enables control, which is something to be sought after when trying to incrementally expose a person of their phobia. Søren Benedict of Cool Kids wants to have a

controlled environment in which it is possible to subject a person to their phobia, talk about it and then subject that patient to the phobia once again with increased level of intensity. Increased levels of exposure and intensity that Søren Benedict himself have decided through a storyboard. But VR enables this controlled environment. If it was real dogs in real situations, it could get out of control. It is not always possible to predict what is going to happen in real life situations. You can plan for it, but there will always be unknown factors. Søren Benedict talks of VR and phobia treatment, as slowly stepping towards and facing the real life with its known unknowns. So while the technology enables some sense of realism, it also enables some sense of control which in combination is a potential tool for Cool Kids to use.

It is hard to say what kind of impact these technical choices will eventually have. Since this is a early implementation of virtual reality, and our informants are early adopters of the technology, some of the problems that we have circled here will inevitably be resolved, such as low resolution for example.

The allies which are being discouraged in our field could be the doctors and nurses, who will give up using the technology if it turns out that newer generations of HMD's does little to alleviate the resources they have to spend on making the technology work in the context of the hospital. There is also the potential for the technology to become so common that it will not have the intended effect on the children it was made for. If VR is in every household, perhaps then it hold little interest or engagement, which discourages both the hospital staff and the patients. The VR used in this case, would not at least be as good at gathering allies, if every home have easy access to virtual reality through one of the other, and much stronger HMD's such as the Oculus Rift, HTC Vive, or Playstation VR. One of the main selling points is that the technology is relatively new and thus is interesting in and of itself, which makes for a good interessement device, at least initially. As the Game designer of 'Trouble on The Bathing Jetty' said in an interview with us: *"Even though there are problems with it, then they [the children edited] are all very engaged by it. So in that way there is still some hype and something newsworthy because there is so many that have not tried it before. It is also exciting in and of itself to try. It is maybe also what functions in the VR game now, that it is still new." - Gertrud* (Appendix, Gertrud:59). But a technology like VR cannot continue to be 'newsworthy' and eventually actual practical use have to come before the expectations that people have for the technology. The advancement will then be gradual. But we will discuss the expectations of VR and its effects on our network in the discussion. We will end the analysis on a question for our discussion. In the end will the Samsung Gear VR used in the healthcare practice also be able to interest and make allies in the long run?

Subsidiary Conclusion

In this part of the analysis we have looked at some of the technical decisions and seen how they lead to problems when applied to the healthcare praxis.

What we have seen is that the technology of VR is built around specific practices, in particular as a home entertainment system, and supplying that technology creates some unexpected problems in the healthcare sector as the technical decisions which were made was not made with the healthcare sector in mind. Things such as updates, the calibration of the headset, the 'isolatory' experience, software causing cybersickness, ergonomics and so on, have a bigger impact on the experience at PPKC and YMKC, because they are more than just minor inconveniences. An automatic update can mean that a child who has been promised to try the headset, cannot, which causes the doctor to lose trust. Having to continually calibrate the headset means that time and resources are wasted. If software is not specifically made for the purpose, it can cause sickness, which cannot be allowed at the hospital.

Still, some of these complications can be tolerated, as the technology is relatively new. The question remains as to what the future of VR will look like, and if the technology will enable better usage in the healthcare sector and gain allies through its use as an VR interessement device. If it does not, one could easily imagine that the technology would never amount to more than a curiosity. Just there for the children to play with for a while if they had never tried it before or did not have one at home. Our thoughts on the subject matter will be part of the discussion.

Discussion

Intro to discussion

We have now described the way in which our network relates to one another, how allies and adversaries are made through those relations and the technical decisions of the technological object. We will now discuss some of the things which we have had the chance to analyse. We will also look at the expectations which our actors have to of the technology, how it helped shape their ideas and effected their design decisions, and the hype surrounding VR in general. And in the last part of the discussion we will discuss and point out some of the more overarching themes of the Thesis.

Critique of Thomas and Khora

In the first part of our analysis, we criticize the VR project at Cool Kids for not being a collectively held process. More specifically, we dig into the absence of a representation of the children's

interests in the cynophobia treatment VR videos, and its impact on the application. The reason for the absence seems to be a question of Søren Benedikts failure as a spokesperson and Thomas' lack of fieldwork, in short: a poor understanding of the children's actual needs. However, one could ask if it is even possible to evaluate a pilot project in such a manner. Maybe the cynophobia treatment VR videos are more to be understood as trying to create a starting point for negotiations between Søren Benedikt, Thomas and the children who are going to be treated with VR at Cool Kids as part of their rehabilitation from psychological disorders.

Søren Benedikt arranged the VR session we were allowed to observe at Cool Kids, exactly in an attempt to understand how Mikkel experiences the VR. Our observations of the session is also something Søren Benedikt was curious about, as he wanted to hear what we noticed in the VR-session. Any project has to begin somewhere, and the pilot project in form of the cynophobia treatment VR videos at Cool Kids might be equivalent to the 5 dollar game from the app store try out at the PPKC, which was the way of doing a pilot project in that case. As such, the two different cases, Cool Kids and the PPKC, which are both places which Khora have developed products for. They are difficult to compare because the one at Cool Kids is a pilot project, while the one at the PPKC is more of a completed project. Nevertheless, as established in the analysis, Thomas told us that they did not want to *"waste resources and development hours" (*Appendix, Thomas:23) at the PPKC, developing an application that might not work, so they tried a 5 dollar game on the children before developing their own. Why was this procedure not the same at Cool Kids? Here, Thomas, a camera man, and Søren Benedikt made the cynophobia treatment VR videos based on their assumptions of what might work on the children. Even if Søren Benedikt calls it a pilot project, it did take development hours for Thomas to create. This might imply that Thomas hoped that he could get the application spot on in the first attempt, without thoroughly carrying out fieldwork. It is difficult to imagine that Thomas would spent the amount of *"time and resources"* as he did on the cynophobia treatment VR videos, if he only considered it a pilot project. Not least because the pilot project carried out at the PPKC was in form of a 5 dollar game, despite the budget in that project was bigger.

Being extremely critical and skeptical of Thomas, and Khora whose interests he represents, one might suspect that he takes advantage of Søren Benedikt and Cool Kids. As mentioned in the analysis (Pagexx), it is worth questioning Thomas' intentions about the project at Cool Kids. He does not hide the importance of acquiring experience from doing the project at Cool Kids, which is the first one carried out by Khora at a psychologist clinic. Sure, in itself, it is a valid reason for carrying out the project, but the question is whether Søren Benedikt agrees with that reason? It does not seem like Søren Benedikt would be content of merely acquiring experience from the

project. Of course, the purpose of the pilot project is to acquire experiences, but not the overall project. After all, Søren Benedikt is the one who spent money on the project. What is even more important, for Søren Benedikt the VR project must help his patients in rehabilitation of mental diseases. Rather than the project is used for experimental purposes, which Thomas and Khora can gain experience from, and use in other contexts.

Not only does Thomas and Khora gain experience from the project at Cool Kids, they also make profit from it. Being a VR company, it is surely in their interest that people and companies invest money in VR. In our analysis, we establish the problematization generally used by Thomas and Khora, when they attend business meetings with different entities: making people realize how they can use VR as a part of solving their problems. Even the formulation of that sentence implies that Khora wants to make entities realize a need they did not know they had. Maybe they actually does not have that need at all. In any case, based on the project at Cool Kids, it seems to be impossible at this point to make comprehensive VR for the budget available at the company.

Thomas said that the best solution at Cool Kids would have been to make a 3D graphical application instead of the 360 degrees videos (Appendix, Thomas:26). His argument is that it usually is ideal to be able to interact with the VE, which is also the case in the project at Cool Kids. Despite Thomas' awareness about the 360 degrees videos' lack of interactivity, he decides to make the application nevertheless. As established through the concepts proposed by Mel Slater and Sylvia Wilbur (Slater & Wilbur,1997:7) the dimension of interactivity has a huge influence on subjects' feeling of presence in the VE. One might ask, if it is even possible to use VR for psychotherapeutic treatment, when it does not make the subject feel presence in the VE? Studies mentioned in Slater & Wilbur (Ibid.::8) studied the importance of immersive VEs in relation to psychotherapy. In short, the studies showed that VR in relation to psychotherapy is impossible to use, if the subjects does not feel presence in the VE. The reason is that there must be a connection between behaviors in the real environment and the virtual one. Thus, presence enables the subjects to *"transfer knowledge to corresponding behavior in the real world"* (Ibid.: 8). In relation to our Thesis, if the patients at Cool Kids does not feel a sense of presence in the VE, they will not transfer any knowledge to the real environment. Put differently, Mikkel or any other child will not be able to transfer knowledge/experiences such as "the dogs are not frightening", from the VE to the real environment, because the VE is too different from the real life environment. Indeed, a non-immersive VEs might still be entertaining and as such viable for other context than that of psychotherapy. Nonetheless, relying on Slater and Wilbur, the VE in the VR application at Cool Kids is not possible to use for psychotherapy (Ibid.:8).

The project was carried out despite Thomas' awareness of the lack of interaction between the VE and the subjects experiencing the VR, before the application was made. There seems to be two possible explanations for this, or maybe even a combination of the two. The first explanation is that Thomas simply does not know about the importance of subjects' feeling of presence in VEs, and the other one concerns economy.

During our interview with Thomas, he said that in his opinion, immersion is less important in relation to the project at Cool Kids, compared to the project at the PPKC (Appendix, Thomas:31). The argument from Thomas is that at the PPKC *"the purpose is to make the subject crave playing the game as much as we possibly can, I mean by making it [the game, edited] as immersive as possible. While on the other hand, the project about phobia for dogs, the purpose is to frighten them [the children, edited] (Appendix, Thomas:31).* It is difficult to criticize Thomas for not knowing the right conception of Slater & Wilbur's framework on Immersive VEs (even if it really would apply to his job as the Head of Healthcare at Khora). On the other hand, Thomas does seem to have an idea about what immersion means in relation to VEs. Unfortunately, he misjudges when an immersive VE is important and when it is less so. This is not to deny the fact that an immersive VE is important in relation to the project about pain distraction, because it is. As we have already established in our analysis, it does make for more distracting VR when the VE is immersive.

Albeit, one could imagine that an immersive VE is even more important in a context of psychotherapeutic rehabilitation, where it is supposed to have some sort of cognitive impact, than in a context used for distraction for about 5-10 minutes. Truth is that both applications, the VR game at PPKC and the cynophobia treatment VR videos, must contain immersive VEs in order to accommodate the interests of Thomas' customers. Evidently, he understands that an immersive VE is what satisfies the interest of distraction at the PPKC. In relation to the project about cynophobia, he has understood that the videos should have been *"more frightening"*, but omits how to satisfy that interest. According to Slater & Wilbur, the key would be to make that VE more immersive too.

Thereby, Thomas seems to lack an understanding of the importance of immersive VEs in relation VR in psychotherapy. Yet, could economic ambitions also serve as explanations as to why the Cool Kids project was carried out by Thomas and Khora, despite the VEs lack of immersiveness?

It seems to be difficult to make an immersive VE at Cool Kids, for the budget available. As we mention in the analysis, it might be possible to make a more immersive VE than they do, by adjusting some dimensions of what makes up an immersive VE, without spending more money. An earlier user involvement, would probably have suggested that the plot should have been more

frightening. The absence of the children's representation in the negotiations of the development had a negative impact on the VEs ability to be immersive, and as such: the application did not accommodate the interest of being a device that helps the children treat their cynophobia. That being said, one can not be sure that the VE in the application at Cool Kids would have been immersive to the extent that it could have a psychotherapeutic effect, simply by involving the children at an earlier stage of the negotiations, and as such adjusting the plot of the application accordingly. Maybe the current technological capabilities with VR makes it impossible to create an immersive VE at Cool Kids with the budget available. And maybe what currently is possible with VR, or rather what is impossible with VR, is part of the explanation of why Thomas and Khora wants to make Søren Benedikt, and companies in general, invest in VR even if it is not completely capable of accommodating the interests of the customers. It is in the interest of Khora to make actors, whether companies, organizations or people, curious about VR, and make them have expectations about what the technology is capable of. Indeed, it is in the interest of Khora to create hype and expectations around VR.

Expectations and Hype

"The evaluation of the disadvantages and advantages of an innovation is entirely in the hands of the users: it depends on their expectations, their interests, on the problems which they raise." (Akrich et al. 2002a:202)

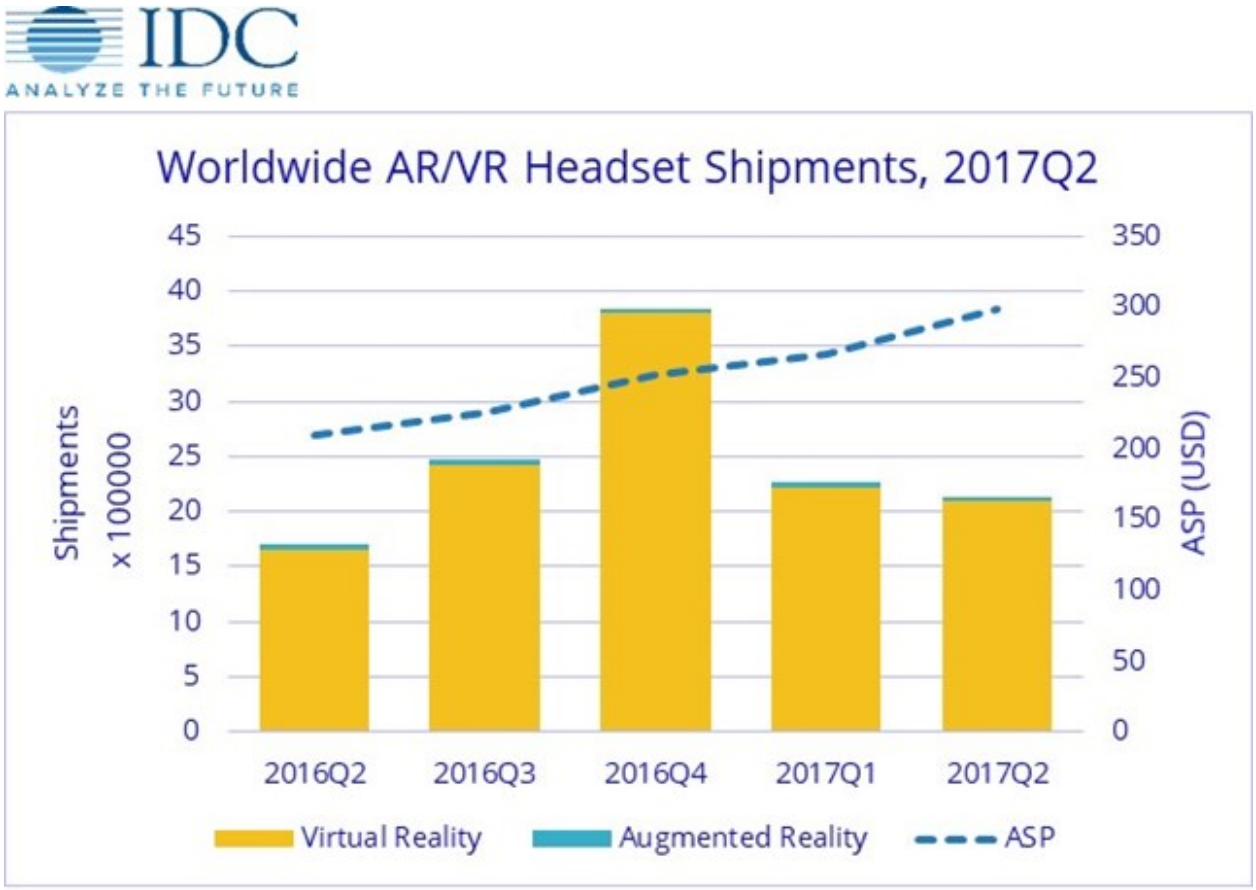
In our analysis we have looked at how our actors relate to each other in the field of VR in the healthcare sector, as well as seen how the VR technology is made up of technical decisions which shapes the healthcare sector as well as how these technological decisions makes other actors either attach or detach themselves to the Samsung Gear VR.

We will now discuss these findings, as well as take a broader look at the technology and the industry behind it, by deciphering whether VR technology itself is a hyped technology, and that the invasiveness of the technology within the healthcare sector can be contributed to a specific interest in the technology because it is new, and that the capabilities seems bountiful.

VR has been a technology which have already undergone a technological surge, only to fall down to a level of non-commercialization. In the '90s the technology rose and fell in popularity, and only recently have the public seen a resurgence of the technology (as we have written under the Intro to the history of VR). Because the technology then, relatively new to the general public, it becomes a tangible interest for us to see whether or not the technology then, is being hyped to be something that it is not, or cannot be. That the technology becomes included in every sector of the public and private sphere because it is the 'next big thing'. When self proclaimed innovators such as Søren

Benedikt begins to use VR as a form of treatment, or when PPKC and YMKC at Rigshospitalet start using it as part of procedures, is it then because the technology is hyped?

We have seen in the report by Digital Media Finland (Muikku & Kalli, 2017) that the VR has been a disappointment in comparison to initial expectations. Further research on this matter shows that the shipments for VR have been declining over the past year and half. We refer to the data that has been collected and visualized by IDC:



A CHART OF THE AMOUNTS OF SHIPPED VR HEADSETS FROM 2016Q2-2017Q2 (IDC, 2017)

The rise of the VR shipment in 2016 is due to the reason that Oculus Rift, HTC Vive, and Sony's Playstation VR was released this year (Kiss, 2016). The hype around it was huge resulting into a mass of higher expectations than what VR is capable of, thus leading to a disappointment. Furthermore, Samsung has sold significant more devices than HTC and Oculus combined in 2016 (Kamen, 2017). What happened? How can HTC and Oculus fall behind, with their superior specifications and functions compared to Samsung's VR HMD that has less features and functions? One of the reasons is that Samsung's VR is much more affordable in comparison to

HTC and Oculus for consumers. Furthermore, Samsung has pushed their VR commercially. For instance, one can/could buy their flagship phone and they will include their Samsung Gear VR. This kind of marketing move is much more expensive to do when it comes to PC-based VR. A good computer that is capable of handling VR costs from ~6000DKK, and that is just the computer, the headsets costs around ~4000DKK (which we write about under VR market). Not many people are willing to lay out the money, and the user would also need sufficient space and room size for movement. How many consumers are willing to have an empty room just for VR? The setup of HTC Vive and Oculus Rift is much more complicated and the not so tech-savvy consumer might not have the knowledge to set up a such advanced setting. We have observed that Søren Benedikt had a few issues with Samsung Gear VR because he was, as he also said to us, not so tech-savvy and it was relatively new for him (Appendix, observation at Cool Kids:64). While Samsung Gear VR is easier to use in comparison to HTC Vive and Oculus Rift, Søren Benedikt still had difficulties with Samsung Gear VR and one could imagine that it will be much more difficult for Søren Benedikt to setup and calibrate a PC-based VR like HTC Vive and Oculus Rift. This might also be one of the reasons for the declining sale of VR; it is simply too much of a hassle to set up and it is not worth it for the current price. Furthermore, the applications that are currently available for VR, at least for commercial, are simply underwhelming and does not pack a wow-effect. Needless to say, VR is not as underwhelming and disappointing in comparison to what happened in 1995 with for example the Virtual Boy, even if there is more to the failure of Virtual Boy than it seems at first (Boyer, 2009). VR has come a long way ever since, especially with the more advanced technology that we have in our day and age. Maybe it is not the VR that is the problem but that our expectations towards the technology is too high. Maybe we think that the VR is capable of the same things like the ones in the movies that are shown on TV (written under sociology of expectations). Maybe it is the consumers, the users, that is the problem and it is not the technology that is the problem. Like Borup et al., (2006) says in their Sociology of Expectations, when hype occurs around a technology, it does so because people invest in expectations and not the fundamentals.

In the case of our Thesis, hype also played a part in initially establishing the networks. In Cool Kids, the expectations of how the technology could be used as a treatment of phobia, played a part in initially using the technology, while Khora enabled these expectations of VR to come to fruition, as they made it possible for Cool Kids to finance the endeavor. This is because:

“The initial promises for a specific artefact are set high in order to attract important and necessary actors, such as financial sponsors. While it is necessary to raise the profile and attract allies. Disappointments are also likely because of the specific structure of expectations. Early

technological expectations are in many cases technologically deterministic, downplaying the many organizational and cultural factors on which a technology's future may depend." (Borup et al., 2006:290)

Khora was able to initially attract an ally in form of Cool Kids, partially because of the structure of the expectations. As it turned out, the actual implementation resulted in disappointment. The VE in the VR videos did not work as expected, as they were far too meagre and non-immersive in their presentation. This can be explained as a miscalculation on Søren Benedikt side. He expected the technology to cause more fear to the children with cynophobia, which might have been because he expected the technology to have more impact, to be more like real life. His expectations was more in line with what was possible to do in the real world. Some of the stages of the VR videos would be a massive undertaking to go through if this was a real dog in a real world scenario. After the realization that the VR videos were simply not scary enough, disappointment set in, but also a new understanding of the technological capabilities. As such, expectations were renegotiated and reduced. Søren Benedikt now understood, as well as Thomas, that in order to treat cynophobia with VR , it would simply need to be more frightening. We have questioned this in the analysis. Resolution and other technical decisions plays a part in giving the greater Immersive effect as well for example. But if Cool Kids and Khora had understood the effects the technology would have in the specific field of psychology, they would also have been able to better tailor their expectations, and create a product which would have had more of an impact.

At PPKC and YMKC at Rigshospitalet, there were also certain expectations related to the usage of VR. The initiative was formed with VR in mind, by Søren Walther and others at PPKC at Rigshospitalet. Clearly, they had something in mind with the technology. They wanted to have a VR solution which could help them make the lives of children undergoing various painful procedures easier. After receiving a donation, they took the project a step further. In order to do so, they got in contact with Khora through Kristian Bluff. Khora is a company capable of designing applications accomodating the needs of the users, which is one of the reasons why they were chosen to take the PPKC project a step further. For instance, Thomas visited PPKC a couple of times to understand the environment of PPKC in order to gain knowledge and ideas of how the application should be. They went out, spoke to the children and which tried out a game, to see what would work and what would not. As such, the expectations were already being put into a specific context of what can and cannot be done. They were better at adjusting their expectations to the field of healthcare, as they had also worked with it prior to this. Khora understood the practices and field of the healthcare sector to a larger degree partly because they had worked with it before, partly because Thomas had worked in the field himself. With the Cool Kids project, Khora

wanted to gain experience on how to make videos for the psychotherapeutic field, and Søren Benedikt was the main source of knowledge. In the project related to procedural pain, the knowledge was that of PPKC, but also on the side of Khora, and knowledge was gained through the fieldwork that they did. It also helped that PPKC had a donation to pursue something which would fit better with what they needed.

Escapism, Isolation and Pain

The question which we asked ourselves in the second part of the second analysis was whether or not the Samsung Gear VR would be able to gather interest and allies in the long run. Here we will discuss the prospects of the technology, the ethical problems and why we believe it will be continually used.

Virtual reality technology promises a variety of actors within the healthcare sector, to enable them to dive into another world for a time, to get away from the hard, clinically cold walls of the hospital, and be transported into a different world, for just a little time, forgetting the reality of their actual confines. In its ideal application, the children exposed to a healthcare procedure will be spared of pain, and the doctors and nurses will be spared of inflicting any. And in the psychological department in Cool Kids that we have also looked at, the technology will be able to help treat children of their phobias.

VR promises to transport the user into another world and spare them of the pain from the “real” world. But as we investigated other applications of VR in our field, we saw that there was a tendency to also use VR to indeed confront the real world. The opposite of escapism. In Cool Kids, VR is used to confront children with the anxiety of dogs, of their own fears in a safer, controlled environment than what is otherwise possible. Each level represents a “harder” scenario of dog interaction, and the end level which the participants works towards is the real world, with real dogs and unexpected scenarios of dog-human interactions.

What is at stake then, is not related to escaping through the virtual world, but to confront one's fears in the virtual, and then be able to deal with the anxiety in the real world. Contrarily, it could be said that PPKC at Rigshospitalet could be working in the field of escapism as they use VR to help their patients escape the confines of their room or the “operation”. A question that was asked during the CopenX Healthcare in VR workshop held at Khora was also related to the escapist role of VR in healthcare (Appendix, observation at CopenX:60). A participant asked whether or not it was possible that there could be legitimate reasons for patients to experience the painfulness of life in relation to a needle. That there was always pain in life, and shielding patients could only momentarily protect them, or that there would be certain “lessons” and knowledge to be gained

from such an experience. Søren Walther said however, that he would rather shield the child from the pain of needles, and make a hospital a less painful environment, than to have them suffer for a potential lesson in pain and subsequent knowledge gained. It also coincides with the ethical perspectives of the Virtual world. It is a means to an end in this case, but it also presents an ideal world for others. Some people could be afraid that VR would substitute the real world. In a campaign for Parents being the Best medicine during painful procedures of anesthesia for example (Munk, n.d.), it is made clear that parents can help make the process easier for the child going through the procedure. But would VR not be a substitute the parents and their engagement during the procedures? This could be a problematic thing, since the love of the parent is being shifted to the technology of the HMD. But it also frees up the parent. They are no longer part of the procedures in the painful form that they can take on their child. And if it is possible to take on a Virtual Reality headset which mostly negates the feeling of pain, then the children would surely want that as well. And that is the crux of it. Because in the end, if the technology can help reduce the pain from needles and drops, everyday procedures in Rigshospitalet, then the VR HMD's and software will continue to be used. Some of the technical decision which we have noted, have a large impact on the field, will maybe eventually become a non-factor, as technology advances and as the market increases. But the prime concern for Rigshospitalet is after all, not the resources spent, but the pain not dealt. That is also how allies have been gained, if the interessement device does what it has been expected to do which is to reduce pain during procedures, then both Doctors, Nurses, Children and Parents will follow.

Conclusion

In the first part of our analysis, we identified the important actors in the VR cases we study in our Thesis. First, we found that VR as an actor can be divided into hardware and software. Thomas, the spokesperson for Khora in Healthcare projects, allocates VR as an interessement device to translate the interests of the spokespersons he negotiates with in the different VR cases. The hardware used is the same in each case, Samsung Gear VR. The software applications however, varies from place to place. As such, we found that VEs represent what is malleable for Thomas. This is why different kinds of VEs are used to accommodate the different needs of the spokespersons he negotiates with. Thomas' way of attracting customers is by making a problematization: *making people realize how they can use VR as a part of solving their problems.* The spokespersons from the three cases we study have different interests of what the VR must be capable of. What is common to the three cases, is that Thomas (Khora), best accommodates the interests they each have, if the applications developed, contains immersive VEs. Immersive VEs are what makes the subjects experiencing the VR feel presence in the VE. We found that the

extent to which the VEs are immersive, is influenced by the recruitment for the negotiations/development.

At Cool Kids, the negotiations proved not to be collectively held. In fact, the development resembled what Akrich et al. (2002a:205) tells *not to do*: the technological analysis (development) was made per se, without paying attention to the environment in which it searches for and obtains allies. Consequently, important knowledge and perspectives were not mobilized to the application. On the other hand, the case at the PPKC resembles a collectively held innovation process. Here, the design team from Khora was recruited and the children were involved. As a result of this, knowledge from important expertises: gamedesign, color theories, and spatial audio was mobilized into the application. Moreover, the perspectives of the children (users) were mobilized into the application too. In each case, we identified that economy has an influence on which actors that are possible to recruit to negotiate with.

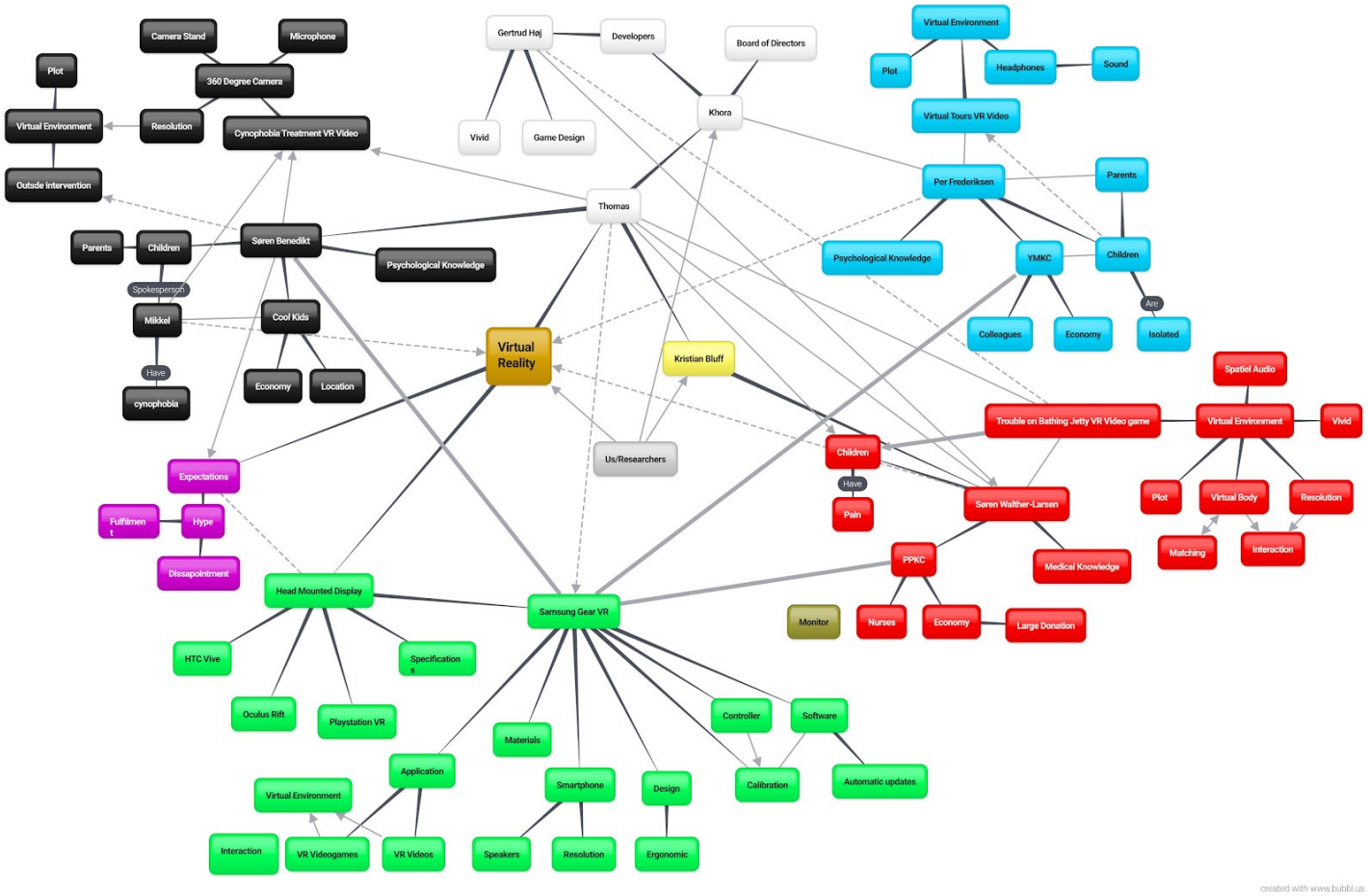
We also conclude, in the second part of the analysis, that using a technological object such as the HMD of Samsung Gear VR, has its share of problems. Technical decisions made with the HMD, have been made with the context of home usage in mind. However, when the HMD is transferred from the home, and placed into the healthcare sector, minor features can become large problems. If the HMD is automatically updating, it can cause the doctors and nurses trouble, if they have as we were told, promised a child that they would get to try the HMD during a procedure. Calibration can be a time consuming, and tedious experience if one have a limited knowledge of how to work a state of the art VR HMD. Software has to be made specifically with the HMD and the use context in mind, otherwise it can cause cybersickness to already sick patients. The HMD also lacks an auxiliary monitor which could've helped the doctors and nurses more in knowing when the patient undergoing a procedure was completely engaged with the VR video game. While the technology have been standardized for use in another field, which causes serious problems for the staff in the two departments at Rigshospitalet, it still manages to gain allies with the department of PPKC. One of the major reasons for this, is because it manages to disassociate a network. Interessement devices have the ability to gain allies through solicitation or seduction. By interesting the children undergoing procedural pain, through seduction and disassociating them to the pain they are experiencing, the HMD's as a interessement device is capable of gaining allies within the network. While the HMD's have technical decisions which could have made adversaries of the network, Doctors, Nurses and Children fall in line as the technology proves to create a less painful experience during a procedure for all of them.

Relying on the concepts from Mel Slater and Sylvia Wilbur (Slater & Wilbur,1997:8) we found that the current software application used at Cool Kids is impossible to use for psychotherapy. The

argument is that the application made for treatment of cynophobia, does not have an immersive VE. The subjects experiencing the VR, can therefore not transfer knowledge from the VE to the real world.

In the discussion we also comment on how there have been hype and expectations which have shaped the way in which the software have been made. In PPKC, as we point out, the VR Video game application was made with a team of developers, and with children who could speak on behalf of other patients being able to try out a prototype of the finalized application. The expectations for what was then possible was kept in line with the actual requirements of the PPKC and what the HMD was actually capable of producing. At Cool Kids however, the developers were not really engaged in the same way, and only when the product was completed was children made a part of the product. Inscripted into the application then, was the expectations of Søren Benedikt whose expectations exceeded that of what the HMD was actually capable of. That is to say, he believed that the cynophobia treatment VR videos would have to be moderately frightening in their presentation, since if the VR videos had been a real life scenarios, they would have been a large and intimidating step for a child with cynophobia to take. As it turned out, the VR videos were not very frightening at all, partially because of the expectations which Søren Benedikt had inscribed into the application.

Now that the actors and network relations have been analysed and discussed, we can also map out our field:



Map of the different actors in our field and their relation with one another.

As we have illustrated in our map with Virtual Reality as a starting point, Virtual Environment in the specific context of the PPKC (In red) have more associations with elements which provide a greater Immersive experience. Cool Kids (In black) have very few associations in connection to the Virtual Environment there, signifying a lesser Immersive experience. Actors such as the Samsung Gear VR and Thomas have large amount of associations, suggesting that they're strong actors within the network of VR in healthcare. The visualization also illustrates, that at the PPKC, important actors are linked to each other in the negotiations. The Children, The Development team, VR, Søren Walther-Larsen and Thomas, are all interlinked. As such, important perspectives and knowledge is mobilized into the development of the application.

Reflections

Post-phenomenology – Reflections on our choice of theoretical methodological perspective

In our Thesis we have chosen to use the theory of ANT and especially the article on the Art of Interessement. One could be tempted to ask why we did not choose to use the perhaps more obvious theoretical perspective for analyzing the VB relations in the VE and the technology which enables this with its complications and prospects. Mel Slater himself talks of Sensorimotor Contingencies, that is, “the actions that we know to carry out in order to perceive, for example, moving your head and eyes to change gaze direction, or bending down and shifting head and gaze direction in order to see something (O’Regan & Noë 2001a,b; Noë 2004 in Slater, 2009: 3550).

Since we see the technology as having agency of its own, and Immersion being a product of the technological limitations and possibilities, we believe we can explain the immersive something as a product of the technical decisions and specifications of the technology itself, and the sociological background, that is, the field in which the technology has been placed. It is also what we consider the socio-technical, which by and large is what we have tried to describe within the field of VR related to the healthcare practices.

While it was possible to research the same things in different ways, and come to conclusions that were similar with the different theoretical and methodological perspectives, it was also a choice we made because of the empirical material which we had access to. Our empirical material consisted of mostly interviews and desk research, as well as a observation at Cool Kids. We made the decision to choose an ANT oriented framework to analyse with, because of that. If we would have had more observational capabilities we would have to greater effect been able to look at how people using the VR HMD’s used their body and reacted to the stimuli within the virtual environment. It would then have made more sense to choose a phenomenological perspective to analyse with.

Further Research

In Cool Kids our research were centered on what amounts to a pilot project. It would therefore be interesting to see how Søren Benedikt would change the plot of the film to better gradually expose children to their cynophobia in the follow up project. Maybe the VR videos would then have a better outcome, rather than just being relatively boring for the viewer and not being usable as part of treatment. It would also be easier to decide how big of an impact the plot and the gradual increase of exposition to dogs would actually have, and how much of the feeling of presence the technology would allow one to experience.

In the PPKC department in Rigshospitalet it would have been interesting to see how the project continued, and evolved as technology became better and new generations of HMD's released. Would some of the problematic technical decisions inscripted in the design decisions of the technology no longer be an issue? Maybe a thing like calibrating the headset would be easier or automatically done by the HMD and there is the possibility that a HMD with an exterior monitor would be made, which would enable nurses and doctors to have a better understanding of what the child was doing at any given point in time, improving the success rate of painless procedures. It could also have been interesting to discuss a more closely the ethical issues with using VR in the healthcare sector and in the two departments in Rigshospitalet, in particular, if it is alright to 'cheat' children's brains, by making them believe they are someplace they are not, while a medical procedure is being performed on them. A question such as this lies unanswered by this Thesis.

In this Thesis we have specifically looked at VR in the context of healthcare. There is substantially more work being done in this field. We tried contacting nursing homes with patient with dementia, which used VR as a way to help them to train and have a better life (Weibel and Førby, 2016). It could be interesting to see what a techno-anthropological study with VR and dementia would look like: if there could be a way to improve the devices and what ethical dilemmas there probably are in such a field.

While we have focused on VR in the healthcare sector for this Thesis, there is also other sectors where VR has been used - we mention some of them in the introduction. If we talk about the entertainment industry for instance, it would be of significant interest to see if VR HMD's will become more of a mainstay in the future of in the private homes of citizens. We suspect that VR has been a technology full of expectations, and which have probably not lived up to those expectations. The question of future generations of HMD's will redeem the current generation of HMD's is left unanswered.

While it has only been a small fixture of this Thesis, Augmented Reality could also see a surge in usage as it matures. It could be interesting to study augmented reality technologies when they are part of a innovative network, and how they manage to gain allies or adversaries within this network.

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