Extrapolating Lessons for Future Cinematic Virtual Reality Creators by Looking at Current and Past Attempts at Creating Virtual Reality.

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Graduation Thesis, September 2018
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***Abstract* — The primary objective of this thesis is to formalize the formal lessons of the medium of Cinematic Virtual Reality (or CVR). In order to do so I first researched what makes CVR its own unique subsection of Virtual Reality (or VR). This was done by comprehending the history of the medium, and its current state. By doing so, we may definitively separate CVR as its own subsection of VR. Once this subsection is defined, we may extrapolate lessons from the advice of current CVR directors for future CVR directors to adhere to. As such, this thesis's first focus is on the history of VR. The second focus is on where CVR is currently as a medium. The third and final focus is on what current directors and content creators have learned from their experiences when creating for this medium, and what we can learn from it. With these three primary focuses, we may establish a basis for the very first CVR lessons. This thesis aims to begin constructing the formal rules of Cinematic Virtual Reality so that the medium can benefit from an inherit structure, as it has gained significant maturity in the last half century. By having these formal rules structured, the production process benefits from a clearer path to achieve narrative goals.**

I. Introduction: Art and Rules.

Cinematic Virtual Reality is a neoteric medium and art form. As such, it does not have the maturity that most other art forms have. With the passage of time comes experimentation that we can learn from. In theatre, actors are encouraged not to face away from the audience. This so that visual connection with the actor's face is never broken. The connection should not be broken because facial queues can be used to emote a character's state of mind even when not speaking. We know this because theatre has had over 2500 years of practice and study [41] In cinema framing has developed its own set of rules. When shooting a scene in which two characters are interacting, to maintain clarity, the director must imagine a line connecting the characters. The director must then choose a side of this same line, and shoot both shot and reverse-shot from that specific side of the line. This is so the audience is not disorientated as to where the characters and the conversation is happening. This rule is commonly referred to as the 180-degrees angle rule. We know this because cinema has over 110 years of practice and study. [42] Photography has transmitted many of its rules of framing to cinema. The most notable example is the rule of thirds. This rule urges cinematographers to capture their subject matter slightly close to the edge of the frame. This is so that the subject matter is displayed in an interesting and captivating way, as opposed to capturing it straight on in a more sterile fashion. In cinema, this rule is commonly used. [43]

It is only after experimentation that we can cleverly bend, or even out right break, the rules and canons to deliberate dramatic effect. Such as Stanley Kubrick breaking the rule of 180-degrees angle to purposefully disorientate his audience in The Shining and Eyes Wide Shut. Cinema was nearly a century old when Kubrick shattered rules. During the time that predated Kubrick, many artists had to experiment with the medium in order to figure out what to do and what not to do. (Georges Melies and George Albert Smith pioneered experiments when there were no such rules or canons.) Cinematic Virtual Reality does not have this maturity; and as such is still lacking rules for artists to abide by or shatter for dramatic and narrative effect. Therefore, this thesis shall stray from the technical portions, such as postproduction, and home in on how the canons creators from the medium should abide by.

In order to do so I must first isolate Cinematic Virtual Reality from other forms of Virtual Reality by its definition. Secondly, I must look at the mediums past and examine its evolution. This is because if I know where the medium is coming from, I will have a better understanding of where it is going. Thirdly, I must understand where it is now, by investigating how many people are consuming it, and what investments are being made. (We can do this by looking at sales numbers of Head Mounted Displays, the devices used to experience Virtual Reality.) Fourthly, I must look at the careers of creators and use their experience as a jumping off point to examine Cinematic Virtual Reality today. This is so that I guarantee that someone who has had appreciated and award-winning work shares the same opinion on the lessons for Cinematic Virtual Reality that I will extract. Thus, ensuring the thesis's credibility. Finally consume many examples of CVR to

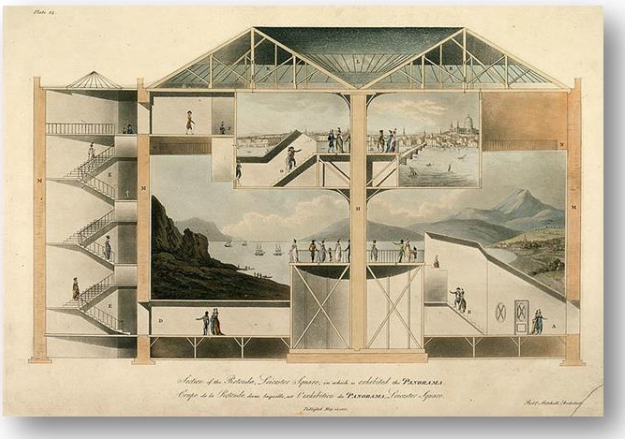
formulate theoretical lessons for the best way to communicate in the medium of CVR.

II. The first steps towards our modern definition of VR.

What exactly is Cinematic Virtual Reality? In addition, how does it fit into the medium of Virtual Reality? Let us start by examining our current definition of these terms and analyze attempts at communicating through this medium.

In order to understand the subsection of CVR we must first understand that it is an umbrella term. Moreover, we must know how we define it today. Today, VR is fully described as "an artificial environment, which is experienced through sensory stimuli (such as sights and sounds), provided by a computer and in which one's actions partially determine what happens in the environment;" according to The VR Book: Human Centered Design by Ph.D. Jason Jerald and Webster's dictionary. [1][2] If we use the first portion of this definition, "an artificial environment, which is experienced through sensory stimuli" and omit the latter part of "provided by a computer and in which one's actions partially determine what happens in the environment;" we can see that attempts to create artificial environments happened long before our current definition of VR. So, before I can start to examine current creators of VR and there work, I must first understand where this medium came from, and how past predecessors shaped the medium today. Only then can we examine current creations and what underlying rules they share in common. This is because attempts at creating artificial environments through sensory stimuli, what we call today VR, began as far back as 1787. [3] They began with Robert Barker's patent. [4]

Robert Barker began creating artificial environments by stimulating his spectator's vision. In order to create artificial environments, Robert Barker ingeniously used the means of his era, and created massive canvas paintings of up to 22 meters in altitude. After which he hung said canvases around the interior of his circular venue, the Leicester Square Panorama formerly situated in Cranbourne Street. [3] It is comparable to modern VR, because the enormous size of the paintings, and the fact they wrapped all around the walls of the venue, made Robert Barker's paintings engulf his spectator's vision in an artificial environment. This was as modern VR does today. The venue also had a specific point of entry in through which all participants started their experience on. Just as the point of entry of modern VR experiences. Robert Barker's intention was to have: "Observers, whatever situation, may wish they should imagine themselves, feel as if really on the very spot." thusly "creating an artificial environment through sensory stimuli." [3] Like the ones we aim to create today. Robert Barkers panoramas and modern VR have the same goal in mind. [10]



"Cross-section of the rotunda in Leicester Square in which panoramas were exhibited. Aquatint by Robert Mitchell, 1801" [3]

The similar features do not end in the theoretical realm. In practicality today, when we edit VR footage, we stretch into the form of a flat equirectangular panorama, distorting the image so that it may fit the two-dimensional screens of our computers. [5] The image is then reshaped by the head mounted display so that the user may experience the sensation of being elsewhere. Humankind is still creating panoramas; only instead of covering buildings walls with paintings, we cover the spectator's eyes directly through the use of a head mounted display. Yelena Rachitsky noticed these similarities and in her 2016 Marche du Film at Cannes and characterized it as "A form of virtual travel." [4] Virtual travel that took spectators into an artificial environment. This form of virtual travel is defined by having static imagery, and non-narrative content. In addition, Robert Barker's financials success lets us know that the public at the time had a genuine interest in this "form of virtual travelling."

Example of equirectangular 360 video [5]

The second renowned and notable endeavour to create an artificial environment was Sir Charles Wheatstone's stereoscope. [2] This apparatus is worth taking into account when studying VR because sight is the main stimuli used to achieve the sense of being in a virtual environment. The stereoscope fools the mind into thinking that a 2D image is in fact 3D and is fundamental, even today, to create the illusion of depth when experiencing VR. The stereoscope was invented in

1832 and was a double-lensed apparatus that showed two different images, depicting the same subject matter. However, since these images were slightly tweaked to cater to each different and individual eye, it created the sensation of depth and three dimensions. [2]

The stereoscope exceled at creating the illusion of depth. Therefore, images that had a clear foreground and background gained new life when looked at through the device, because it would accentuate the distance between the object in the foreground and the background. A technique inherited from stereoscopy, still used in the medium of VR today. This is because it aids in creating the sense of an artificial environment, which is a crucial part of the definition used for VR today. In the words of astrophysicist Sir Brian May, "it's achieved with two pictures, one taken for each eye. Slightly different because each of our eyes, has a slightly different view of the universe (…) the lenses sort it out, so that the left eye sees the left picture, the right eye sees the right picture. And your brain does the rest; your brain reconstructs the image." [6] Contemporary to Sir Charles Wheatstone, poet Oliver Wendell Holmes wrote on June 1859, about using the apparatus: "The mind feels its way into the very depths of the picture." [2] and more recently in 2015 Sir Brian May said, "It's so vivid, so clear, so solid, so 3D, that you feel you can walk in and talk to these people (...) the Victorian stereoscope has never been equalled giving you the completely immersive 3D experience".

On the right a stereoscopic, image of India (circa 1905). On the left a still frame of a lecture on VR (circa 2014).

This apparatus is in tune with Webster's definition because it strives to create an artificial environment through sensory stimuli. Because of this, we still use the principles of stereoscopy when creating VR with our modern-day head mounted displays (or HMDs). [10] Charles Wheatstone's stereoscopes sold half a million items by 1856 years and, like Robert Barker's panoramas, a financial success. [2] This lets us know that audiences at the time procured this form of medium. The stereoscope also shares with the panorama the similar characteristics of static imagery, and non-narrative content.

With this in mind, we can define the age from Robert Barker onward as the age of Pre- Virtual Reality. Because, although it does not fit our current definition fully, we cannot deny that these were deliberate attempts at creating artificial environments, which at the time were recognized with financial success. Letting us know today that there was an authentic interest from the public. As such this age should be considered a gestation period for the idea of VR. Moreover, we currently use elements of these inventions in modern day VR consumption and production. In the case of Sir Charles Wheatstone, we use stereoscopy in our HMDs to enhance our consumption of the medium, and in the case of Robert Barker, we still envelope our view with a two-dimensional canvas. Only now, we have the aid of HMDs. This was the age of VR fecundation. The full definition we currently have of VR comes much later, as of 1950's onward, because it is only then that we start using machinery to create artificial environments.

III. VR AS WE DEFINE IT TODAY.

Although humankind had achieved "an artificial environment, which is experienced through sensory stimuli (such as sights and sounds)," the means by which it provided the artificial environment were analogue. Not by a computer or a machine. By using the complete modern definition of VR, I have found that VR, as we define it today, began in the second half of the 20st century.

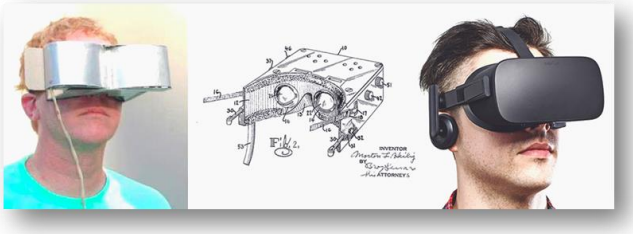
This began to happen in 1957 with the invention of the Sensorama by the hand of the 'father of VR' Morton Heilig. [2, 7] He is known by this nickname because he used machinery to transport his spectators into artificial environments. Just as we define VR today.

Morton Heilig intended his invention to be "the cinema of the future." [8] It was supposed to be "the cinema of the future" because it used four of the five senses to create an artificial environment. The Sensorama was an arcade style machine. It had 3D stereoscopic imagery with wide vision, motion and color, for sight, stereo-sound for hearing, aromas and scents for smell, and wind simulation, and haptic vibrations for touch. [9] The only unaddressed sense was taste.

Before submitting your senses to the Sensorama, the user was instructed to select between one of five films, thus determining what was going to happen in the environment. The films were Motorcycle, Belly Dancer, Dune Buggy, helicopter, A date with Sabina and I'm a coca cola bottle! [10] Two of them stand out for their experimentation with the diegetic spectator. (Diegetic Spectator is when the spectator is not just spectating, but also has a role in the narrative.) These two films 'A date with Sabina' and 'I'm a coca cola bottle', have the spectator be an element inside of the story. He experimented with story by having the user be the date with Sabina and placing the spectator inside the glass of the coca cola bottle. He brings the spectator into the narrative. Thus, giving us the first example of CVR using the spectator as a diegetic element of the story.

The second innovation Morton Heilig bestowed upon the medium of Virtual Reality was the very first HMD. [11] He patented it as the Stereoscopic Television Apparatus in 1957. Although, it did not have the head tracking mechanisms of modern displays, this apparatus uses 3D stereoscopic vision and full stereo sound, just like modern HMDs today. [7] So even when the spectator moved his head left or right he would still look at the same subject matter. [11] Even today, 61 years

later, the similarities between Morton Heilig's creation and our modern head mounted displays are uncanny. Both engulf the user's vision and hearing in an experience that aims to transport them to a virtual setting. Making their transportation to a virtual setting in an uncanny experience. It is uncanny, because it uses the sensory stimuli of sight and sound to fool the mind into thinking that is elsewhere. Virtually traveling into an artificial environment.



Side by side, comparison of Morton Heilig's 1957 Stereoscopic Television Apparatus and modern Oculus Rift released March 18, 2016. [7]

Morton Heilig contributions to the medium of VR were fundamental milestones in the progression of VR as a medium. The Sensorarma experimented with adding other senses to VR experiences; he upgraded static imagery to motion images and experimented with the role of the spectator in VR stories. By having, the spectator be a fundamental part of the narrative action of these pieces Morton Heilig ensured the believability of the virtual travel into artificial environments. Because spectators were no longer just traveling to an artificial environment, they were also witnessing a narrative in this artificial environment.

The Stereoscopic Television Apparatus is the precursor to the head mounted display, so it is a precursor to the apparatus we today use to consume the medium of Virtual Reality. Because of the inclusion of narratives in artificial environments and the invention of the apparatus we use today to consume the medium of VR, Morton Heilig's legacy in the birth of VR is undeniable.

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IV. The beginning of interactivity in the VR medium.

The second scientist instrumental in the birth of modern-day VR is Father of Computer Graphics Ivan Sutherland. Ivan Sutherland contributed to the medium of VR, with his invention 'Sword of Damocles', the fundamental way spectators interact with the artificial environment. By using the head's rotation and position, the HMD can now faithfully stimulate the sensory stimuli of vision into believing that they are looking at an artificial environment. It does this by mapping what the HMD displays to the spectator's vision to the artificial world, thus making it so that the head movement mimics looking at something else seamlessly. This is of particular importance because no matter where the spectator looks the artificial environment always engulfs his vision, creating the sensation of being in an artificial environment.

Ivan Sutherland had previously gained notoriety as the Father of Computer Graphics for creating the first interactive computer design interface. [12] This acclaimed project is known as the Sketchpad, and had the ability to place, rotate and draw 3D geometry. For his Sketchpad project, Ivan Sutherland was awarded the 1988 Turing award. [12,15] This fist instrument would aid in developing his contribution to the medium of VR, which is one that is still used in modern HMDs today. [13] His significant contribution for VR is the 'Sword of Damocles.' The Sword of Damocles was an HMD hung from the ceiling that used a computer system to determine the spectator's head rotations and positions. With the computer reading the spectators head movement, it sent back to the HMD a simple piece of 3D geometry that would be superimposed to the spectator's view. This piece of 3D geometry would rotate and position itself in accordance to the user's head movement by using the Sketchpad's project software. Thus, the user's actions dictated what was happening in the environment, bringing us closer to our modern definition of VR because now it is "provided by a computer and in which one's actions partially determine what happens in the environment;"

The head tracking technology is a fundamental part of modern VR, and the primary source of input given by the spectator in a CVR experience. This experiment was also the first instance of Augmented Reality (or AR). [15] Because if we compare it to Webster's dictionary definition of "an enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device (such as a smartphone camera)." We can clearly see Ivan Sutherland's invention fits this definition fully. Therefore, Ivan Sutherland's 1968 project, Sword of Damocles, is not only the first ever example of AR; it is also the first to employ head motion as means of communication between the spectator and the experience. Because AR, just like VR HMDs uses the positioning of the device to determine

where it will place the AR elements in the real world. Thus, Ivan Sutherlands work paved the way for how we fundamentally experience VR today, and its sister branch AR. Making this a catalyst moment in the birth of VR. If we consider that it was during Morton Heilig's and Ivan Sutherland's career that we began having apparatuses that fit our modern definition of VR, then we can make a distinction between the previous era of Pre-VR and call the era that began in the 1950's, the Birth of VR.

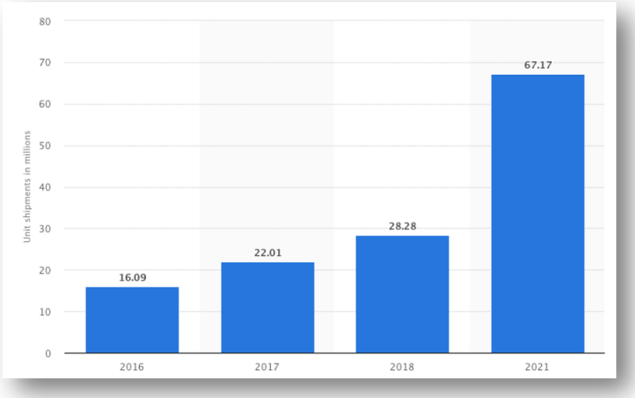
The distinctions do not just end at the definitions of the term VR itself. From 1950's onward VR acquired moving imagery and attempts at narrative content. Which is unlike the inventions of Robert Barker and Sir Charles Wheatstone. In addition, unlike Robert Barker and Sir Charles Wheatstone, Morton Heilig's and Ivan Sutherland's inventions were not met with economic investments therefore they never left the prototyping stages. [16] Nevertheless, all of their legacies live on, because we still use elements from Robert Barker, Sir Charles Wheatstone, Morton Heilig's and Ivan Sutherland's, inventions to make modern VR.

After the text edit has been completed, the paper is ready for the template. Duplicate the template file by using the Save As command and use the naming convention prescribed by your conference for the name of your paper. In this newly created file, highlight all of the contents and import your prepared text file. You are now ready to style your paper; use the scroll down window on the left of the MS Word Formatting toolbar.

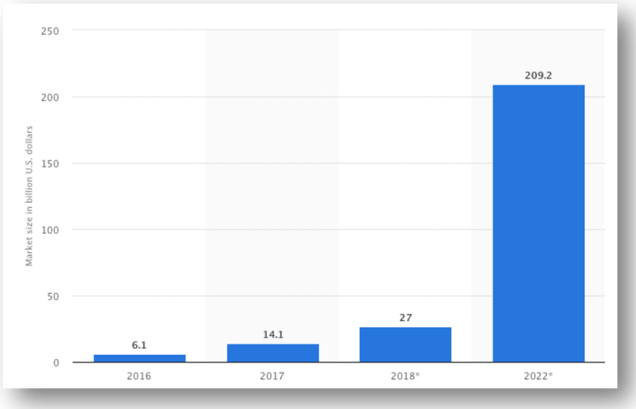
V. WHERE VR IS NOW.

With the definition of VR firmly established, it is becoming less and less a foreign concept not only to researchers and creators but also to the general public. Economically it is making waves and there is major interest in seeing its use become more widespread.

It is very likely that Palmer Lucky's Oculus reignited our collective interest in the medium of VR. This is because Oculus began as a Kickstarter campaign and it raised 2.5 million dollars. This attracted the attention of the world's most popular social network site. Facebook purchased the company for two billion dollars. [17] Unlike the era of the birth VR, in which Morton Heilig and Ivan Sutherland's had little financial backing, today the VR industry has a substantial financial backing from both consumers and investors. In addition, it is predicted that financial backing will improve. With all these economic incentives, we can extrapolate that the medium is growing. Both by having more creators and more consumers means that the medium will both expand on its means of production, and audience sizes. [18, 19]



Forecast unit shipments of virtual reality head-mounted displays worldwide from 2016 to 2018 and in 2021 (in million units) [18]



Forecast augmented (AR) and virtual reality (VR) market size worldwide from 2016 to 2022 (in billion U.S. dollars) [19]

Because of the huge economic boost given to VR recently, major companies are looking for ways to streamline access to HMDs. Samsung in 2016 shipped a free Gear VR headset with their high-end smartphones. (The company's take on an HMD.) [20] Google is trying to make VR HMDs accessible to everyone by making their HMDs out of cardboard, and affordable or only 30 dollars. [21] This kind of facilitation to the accessibility of HMDs grants the medium of VR a larger range of spectators.

With this newfound interest from both consumers and investors, and the easier access to the medium from either free or inexpensive HMDs, VR has started creating a VR Specific vocabulary. Because of this vocabulary we can determine where specific subgenres of VR fall based on how much or how little they follow the words in said vocabulary. The words in this vocabulary range from the VR creator oriented content of Virtual Reality Pop's VR Glossary by Robbie Tilton, interactive designer and VR researcher [22] or the VR user oriented content of The VR Glossary by Steve McCarthy. [23] Much like a baby becoming a toddler, from the 1950's until today, VR has managed to increase its mobility and vocabulary. It increased its mobility because of the economic

boost the industry has received recently. It also optimized the HMD, so that it can be an easily affordable item for anyone, and that the medium of VR is easily accessible to anyone with a smartphone. Since it is accessible to a much larger demographic, many more people have started discussing VR and an underlying terminology has emerged. Therefore, VR has started saying its first concrete words. Because of its recent economic success and the underlying vocabulary that the medium has developed to define its own terms, VR is in the position to become a prolifically established medium.

VI. Using terminology to distinguish forms of VR.

VR is expanding, both economically and terminologically. Because of this the medium of VR has begun dividing itself into sub genres, VR as a whole has become the umbrella term for all attempts at creating virtual environments. Since the VR industry has started saying its first own words, we can start to classify the different forms of VR by how much or how little they fit that specific word, and its definition. Just like, we did previously when dividing the ages of VR in accordance to our definition of it today. By using these terms, we can start dividing virtual reality into categories. This study will focus on one particular type of VR, Cinematic Virtual Reality (or CVR).

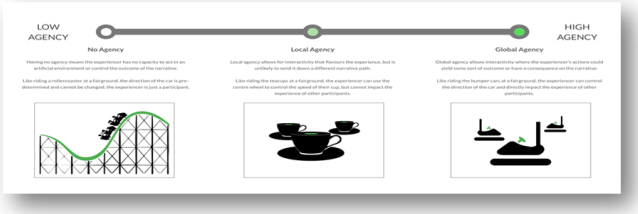
By studying glossaries and vocabularies we can define Cinematic Virtual Reality as being defined by the spectator's only means of interaction with an artificial environment being the spectators head rotation. Therefore, the spectator may choose what to witness and not to witness when experiencing said artificial environment. As an example, CVR is as if a film in which the spectators only means of participation is the choice of where to gaze. Such as the documentary 'Clouds over Sidra' in which the spectator is artificially transported to a refugee camp as a voice over explains where the spectator is in the artificial environment and what they are looking at.

Still from the award-winning documentary 'Clouds over Sidra'.

As opposed to interactive VR in which the spectator can use much more than just their head rotation to interact with the artificial environment. Like for example the video game archery in which the player is actively tasked to defend a castle from a hoard of invaders. The spectators are given two controllers, one for each hand, and their timing and positioning directly affects the outcome of the experience.

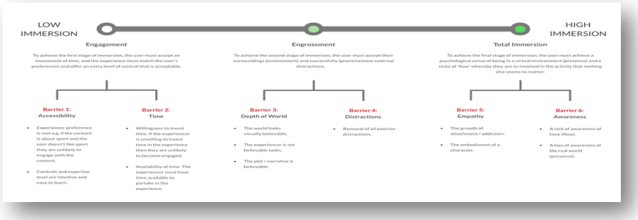
Still from award winning VR video game, 'Archery'.

As such, CVR will be compared to the definitions of "The Agency Scale: 'Agency' is the capacity of an entity to act in an artificial environment. It is a key contributor to enabling a state of presence in the experiencer." [23] In terms of Agency, CVR is closest to having low to no Agency. Because CVR spectators do not have the ability to "control the outcome of the narrative," CVR films are pre-determined. Although the spectator might be a diegetic element of the story, the spectator has no control over the outcome of the experience. The spectators only control their field of view.



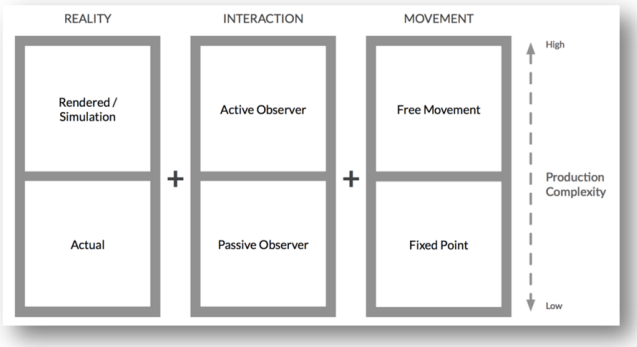
"The Agency Scale: 'Agency' is the capacity of an entity (a person or other entity) to act in an artificial environment. It is a key contributor to enabling a state of presence in the experiencer." [23]

In accordance to 'A Grounded Investigation of Game Immersion' by Emily Brown and Paul Cairns, [23] CVR is characterized by having high to total immersion. Because of the fidelity of 2K and 4K resolutions and stereoscopy, the visuals of CVR, trick the mind into believing that the image it is watching has depth and that it is present in a Virtual World. The suspension of disbelief is achieved, and the viewer is engrossed in the task of observing and absorbing the virtual world and its underlying narrative.



"The VR Immersion Scale: In their paper 'A Grounded Investigation of Game Immersion' Emily Brown and Paul Cairns, define three phases of immersion and six barriers of entry." [23]

CVR can either take place in an actual live action real world setting such as Ashes to Ashes [24] or an animated rendered setting such as Henry [25]. So regardless of production complexity, CVR may exist on both ends of the reality spectrum. However, in the Interaction and Movement it always sits on the low end of the spectrum. For interaction the spectator may only choose where to look, therefore he may only be a passive observer, and never an active one. Again, concerning the movement spectrum we need to place CVR on the low end of the spectrum. This is because, unless the CVR creator chooses to move the artificial world around the spectator, the spectator will be confined to a fixed point.



"The VR Experience Scale: Virtual Reality experiences can be mapped along 3 primary scales: reality, interaction, and movement. (As defined by human interface design and innovation company Punchcut)." [23]

With these spectrums in mind, we can classify CVR as having:

Low to no agency.

Total to high immersion.

Rendered or actual footage.

Passive observer.

Movement fixed point. (Unless a creator moves the camera for the spectator)

If we compare these spectrums to a traditional film, we can see that only one of the spectrums is changed. That is the immersion spectrum. Because film does not fool our mind into believing that, we are in an artificial environment the total to high immersion phenomenon no longer occurs.

Classification of traditional film:

Low to no agency.

Low to no immersion.

Rendered or actual footage.

Passive observer.

Movement fixed point.

However, if we compare it to interactive VR there are more differences. Since it is up to the player to interact with the environment, the sense of agency is much higher, and the observer becomes an active part of the virtual environment. This is because he can choose where to go in the virtual environment. The lighthouses take the position of the HMD and the controllers and place the spectator in the virtual world accordingly. (Lighthouses are infrared devices used to measure the distance between themselves and the spectator/player in order to determine where to put them in the virtual world.) Making the spectator unstuck from a fixed point. This adds a bigger array of possibilities of interaction between the player and the virtual environment, as opposed to the linear CVR experiences.

Classification of Virtual Reality:

High to total agency.

Total to high immersion.

Rendered or actual footage.

Active observer.

Free Movement.

Does this mean that studying CVR is useless? Quite on the contrary. Because, despite the linearity of CVR, (compared to interactive VR) the lessons learned from studying this branch of VR can be applied to all forms of VR. This is because all forms of VR communicate visually with the spectator, by using the head position to display different visuals. (In accordance to what the creator wants to show and what the spectator chooses to look at.) Therefore, the lessons learned from making film content in CVR can be used when making interactive content as well. Therefore, now that I know what CVR is, and how it fits into the larger medium of VR, I have to explore who is

creating CVR content, and what they are learning from their creations. This is so that afterwards I can compare it to my own findings.

VII. Creators of VR.

With a firm understanding of how to identify CVR in place, I can start examining different examples of CVR pieces and their creators. Thus, learning from the pioneering creators who have been successful in the medium, and recording their lessons for future CVR creators (and interactive creators) to acquire a basis to work off. This study focuses on three different pioneering CVR creators. They were chosen specifically because they are all award winners in the medium of CVR. However, each creator comes from a different country and field, thus insuring a wider range of views.

The first creator that will be discussed is Chris Milk. Chris Milk gives us the perspective of a traditional Hollywood filmmaker turned virtual reality creator. He is originating from Glen Cove, New York, but now resides in Los Angeles, California. He began making music videos for musicians such as: Beck, Bono, Modest Mouse, Gnarles Barkley, Kanye West, The Chemical Brothers, Audioslave, Jack White, Norah Jones and Arcade Fire. Chris Milk did this because "music makes everything have more emotional resonance (…) I thought if I added more layers on top of the music, I could make it more powerful, so I got into directing music videos." [28]

He has been quoted saying that he realized the limitations of the frame as a window, "is there a way that I can use modern technologies and developing technologies to tell stories in different ways? And tell different kinds of stories that maybe I couldn't tell using the traditional tools of filmmaking that we have been using for hundred years." Therefore, he began experimenting with interactive art installations and created the 'Treachery of the Sanctuary' and the 'Wilderness Machine'. [27] But after discovering a VR project from Nonny de la Pena at the University of Southern California, he could "taste the lightning" and started creating in this medium. [28] He created Clouds over Sidra, (2015) Evolution of Verse (2015) and Life of Us (2017). [28] He was awarded the Best Interactive Award of 2015 at the Sheffield Doc/Fest for his empathy generating CVR documentary 'Clouds over Sidra'. [26] Chris Milk's work is of a documental nature. He uses the medium to transport his viewers into war torn places, so that the spectator may empathize with the people in these precarious places and situations.

The second creator is Saschka Unsled. Sashcka Unsled uses the perspective of a 3D computer animator. He is originally from Frankfurt, Germany but is currently living in San Francisco. He began his animating career by starting his own studio under the name: Studio Soi. Pixar then hired Saschka Unsled. During his time at Pixar, he worked on the production of the major motion picture Brave. After which he directed his own short the The Blue Umbrella. [29] Well established in the animation industry, Saschka Unlsed was hired by Oculus Story Studios to aid in the creation of VR animated, rendered, and cinematic content. While working at Oculus Story Studios, he directed CVR film Lost and produced Henry in 2015. He later directed Dear Angelica in 2016 [29, 30] Henry is now an Emmy Award winning short, and Dear Angelica was part of the Sundance film festival selection of 2017. His accolades in the medium and experience in different assignments make him a good source of knowledge.

Saschka Unsled's knowledge is of significant importance in the medium of CVR because since he is using animation to create his projects, he has full control of the visuals of the project at all times. In animation all you have to do is redraw something if you do not like the way it turned out, traditional cinema on the other hand requires a full on reshoot. Because of this Saschka Unsled has the unique ability to mutate a project, even when they are in the final stages of the pipeline, to better suit his artistic vision. As such, although his projects take longer to make, he has a fuller creative control over the final product. Because he can alter his projects mid production, he learned valuable insights as to how to use character emoting to better make the spectator feel immersed in the virtual environment. Particularly in the film "Henry", where he learned the value of directly emoting to the spectator opposed to the traditional implicit emotion. (More information on this point in the psychological factor of empathy in the diegetic spectator rule. Pg 26.)

The third and final creator is Steye Hallema. Steye Hallema is from the Netherlands. He initially began his career as a musician. [31] From 2008, until 2015, he was a songwriter and composer at Dox Records in Amsterdam. Steye Hallema later moved to VPRO Medialab, from 2015 until 2016. In 2016 he began working at Jaunt VR as Creative Director in Amsterdam. He has made many projects in CVR ranging from music videos, to commercial projects, comedies and feature films.

He began making a CVR music video for his band Steye & the Bizonkid for the song What Do We Care 4. While he was working at VPRO Steye Hallema created the Dutch spoken CVR short film: Missie Aarde: de VR-film (2016). Missie Aarde places the spectator inside a robot sent on an outer space mission. After commencing at Jaunt, he made Inside Trump's Head, a satirical comedy that places the spectator inside the mind of the 45th president of the United States of America. In 2017, he co-directed Ashes to Ashes. He won Golden VR Award at the Dutch VR Awards for his work as a director on the CVR film Ashes to Ashes. [31, 32, 33] Steye Hallema's work is the most narrative out of the three chosen creators. Most, if not all of his projects have an underlying story.

VIII. The three Lessons extracted from listening to creators and experiencing their creations.

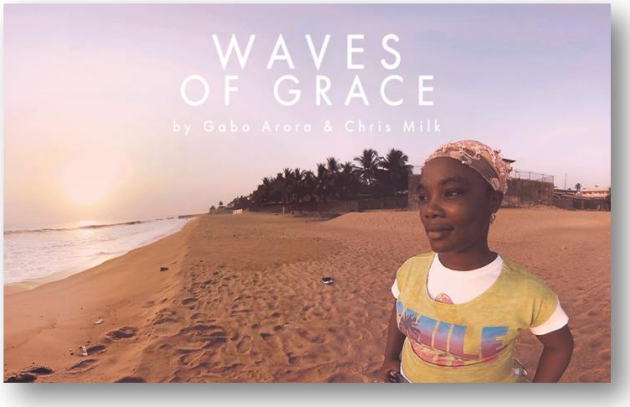
In order to distil the lessons learned I have studied four major things. What the creators say about their own creations, what they say they have learned from designing their creations,

and the psychological impact their creations and artificial environments had on me and other reviewers, and finally the creations themselves. By doing so I have learned that future CVR creators should take into account the following:

Lesson #1: Composition in VR is the spatial relationship between the spectator and elements of the virtual world.

Composition in VR should be treated as the spatial relationship between the spectator and the elements of the story. Therefore, proximity needs to be handled with great care, because according to the pioneering creators of VR: "Contrary to popular belief, there is composition in Virtual Reality, but it is completely different from film where you have a rectangular frame." – Steye Hallema. Because of the absence of the frame, the creators of CVR must consider that everything in the world must somehow revolve around the spectator's presence in the virtual world. This is because the viewer needs to be considered the centre of the artificial environment so that they may intake as much of the virtual environments as possible. In a well-made composition, the elements of the artificial world must rotate around the spectator and take their time in gaining proximity to the viewer.

As a practical example, in the documentary Waves of Grace, Chris Milk transport his spectators virtually to Liberia and experiments with composition in VR. In Liberia, the only constant thing is a woman and her voice over. Her voice over guides the spectator and connects what we are looking at. (Much like the style of his previous award-winning work 'Clouds Over Sidra'.) As we are transported from the different scenes, we hear her soothing voice explain not only Liberia, but also the underlying Ebola problem that torments the region. We see her in the virtual world but always at medium to far away distance. It is only in the final scene, when the credits start rolling that we are transported to a beach and our narrating companion is standing right next to us. This is of importance because we can learn that in order to approximate a character to the spectator we must also approximate them emotionally and build a bond between the two. Because beginning with an unknown character in close proximity to the viewer is an invasion of personal space and hinders the building of empathy between the spectator and the character.



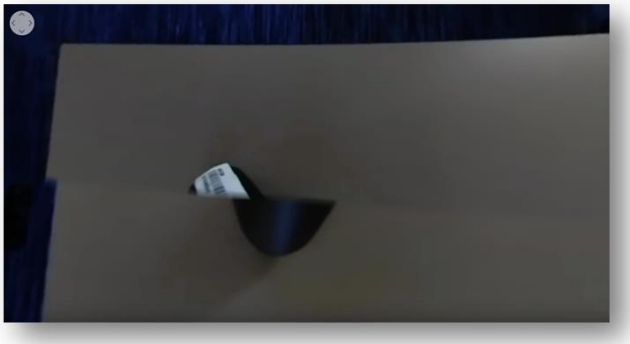
Still from 'Waves of Grace'. Since the only constant during the whole documentary is the voice and presence of the narrator, the spectator welcomes her close proximity at the end. As the spectator hears her closing remarks at the end of the documentary, both the spectator and the narrator share the view of the setting sun over the ocean.

"Composition is now where your consciousness exists and how the world moves around you. (…) we also see the changing role of the close up in virtual reality. A close up in VR means you are actually close up to someone it brings that character into your personal space. A space that we usually reserve for the people that we love." – Chris Milk [28]

Nevertheless, why is that this intimacy needs to be established before approximating characters in the virtual world? This is due to the fact that: "In VR there is no fourth wall." (Fourth wall is the acknowledgment that the viewer is witnessing the film through a 2D screen. As opposed to a CVR experience in which the spectator is stimulated to believe, he is in the virtual environment. As an example when Woody Allen addresses the audience by speaking and looking directly into the camera, in the film 'Annie Hall', he is breaking the fourth wall.) According to Saschka Unsled there is no such separation in the medium of VR. Therefore "if someone falls on their face next to you it's not funny (…) if you sit this close to someone when they are about to cry, that is not comfortable. But if the character sits back there in a corner and is about to cry, you actually have a lot of sympathy for them." – Saschka Unsled [30]

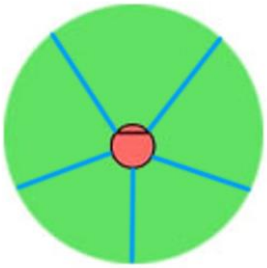
So now that we know this about composition how do we compose for CVR? The best way is to divide the artificial world into parts. In modern CVR the illusion of an artificial world is made by enveloping the viewer in a sphere, however this sphere is in fact a 2D drawing stitched together to fill the viewer's view, much like a cocoon. (Just like Robert Barker did many years before with his paintings.) Dividing the 360-degree angle of the sphere that envelopes the spectator into 5 parts makes the constructing of the artificial world easier. Because the creator can keep track of the elements of the artificial world that are revolving and approximating and going away from the spectator.

This is of double assistance because the process of wrapping the 2D image around the spectator is called stitching. This process (although very optimized over the last decade with software designed specifically to facilitate and automate this process) still leaves lingering visual artefacts in the form of cuts.



Still taken from the 360 recording of this very same thesis defence. If the spectator looks directly down, they can see this stitching artefact left from the stitching process very clearly.

Therefore, by dividing the 360 angle into sections the creator may hide this artefact in a more optimal way by making it so that the stitching hides better in the visual elements of the virtual world. Or in Steye Hallema's words: "In order to Pre-produce it is best to employ a matrix style script that takes into account five slices. (The five slices are the 72-degree angles that make up the full 360-degree experience. Creators divide them into 5 slices in order to keep track of action happening simultaneously.) It is then up to the creative to fill in said slices and even have them interact and overlay. Much like making a piece of pie. – Steye Hallema Paraphrased {B} {C} [40]



Graph of the divisions of the 360 sphere. The virtual environment in green, the spectator in orange and the divisions in blue. The creator may choose one of these lines to hide the cuts from the stitching and optimize the visual immersion of their creations. If a spectator notices the stitching, it immediately breaks the sensation of being in a virtual environment.

This study has found that composition in CVR is the spatial relationship between the portrayed elements that sculpt the virtual environment. The difference between traditional film and CVR, lies in the fact that the immersion of CVR, makes it so that the creator must now take into consideration the distance between the spectator and the elements of the story. If composition is done incorrectly, it will provoke uneasiness for the spectator. To bring something in too close too fast will cause discomfort, and to have something too far away will make it unimportant. The main lesson here is to use proximity very carefully as it might provoke discomfort in the spectator. This is because the spectator can feel like their personal space has been invaded. As such, we need to find a way to transition between spaces.

"The feeling of stereoscopy comes from proximity or lack thereof. Therefore, proximity is something to take into account. (…) – Steye Hallema.

Lesson #2: How to cut from scene to scene.

Steye Hallema discovered how to wipe (a transition between scenes in which the imagery wipes form one visual to another) through serendipity. He was wondering how to transition between one visual to another when someone form the props department walked by with a hula-hoop. His idea was that by using the consistent motion of a hula-hoop panning up and down the camera Steye Hallema could mask the transition to the next visual by hiding the transition in the motion of the hula-hoop. Since this is a fluid, consistently timed motion, it is not jarring to the spectators and acts as if the spectator walked through a tunnel or door into the next scene. Furthermore, since the viewer sees the hula-hoop coming at them before the transition happens the spectator can psychologically brace themselves for the transition. As if, they were waiting for an elevator door to open. Because of this, we can learn from Steye Hallema's work that transition can occur dynamically if properly timed and choreographed with the user's attention.

Still from Steye Hallema's music video 'What Do We Care 4'. On the far right and left, we can see the incoming hula-hoop that will transition the viewer into the next visual scene in a dynamic way. Dynamic, because it fits with what is happening in the virtual environment. It is also done on the edges of the frame (where the stitching cut occurs) to hide the stitching artefacts as much as possible.

"This was actually a very lucky find, because, I was thinking about progressing this experience in VR, in the music video, and there was just a hula-hoop there, and I was thinking about "how do you wipe in VR?" so I saw the hula-hoop, put it

over the camera and when I put my headset on, "Wow! This really works."" – Steye Hallema at VR Days 2016 [32]

The hula-hoop trick works because of two factors. The first factor is that it lets the viewer know that the transition is about to happen before it actually happens because they see the incoming hula-hoop. This makes the transition less jarring and more seamless. The second factor is that the hula-hoop acts like a door into the new visual. It breaks up the virtual environments because the viewer feels as if they had just passed through a door or tunnel into the new scene, although remaining in the same virtual environment.

"I felt like the pre-existing solutions to these problems were not explored sufficiently. Therefore a lot of experimentation occurred. During one of these experiments, serendipitously, I discovered that top to bottom wipes worked by panning a hula-hoop over the camera. Consistent experimentation is what the medium needs to explore new ways to evolve." – Paraphrased Steye Hallema {D} [40]

Nevertheless, this is far from the only example of a cut used to great effect in CVR. Let us look at the film: Miyubi, is the longest CVR experience currently available for the public. It is a forty- minute long experience. It places the spectator in the roll of a Japanese toy robot called Miyubi, living with a semi-dysfunctional family. It is noteworthy because it intelligently uses the powering off of the robot to switch between scenes. Therefore, when the characters switches off so does the spectator; the CVR experience transitions to black, and the next scene starts when the robot is reactivated. This acts like Steye Hallema's hula-hoop, because it acts like a telegraphed door between scenes, and it even it takes it a step further. Because Myiubi making the jumps between scenes is a diegetic element of the story centred on the spectator. The power off is both happening to the robot character and the spectator. If the spectator was not playing the role of a robot these cuts could not occur. This makes it so that the spectator is invested in the story, and curious about where the robot will be turned on next, continuing the story. [37] This form of interweaved storytelling, in which the spectator plays a part inside the virtual world, makes the spectator feel more like a part of the artificial reality. This phenomenon, hereby referred to as the diegetic spectator (when the spectator is a part of the narrative), happens because of three psychological factors.

Lesson #3: Diegetic Spectator is making the viewer an element or character of the story. They can be King Arthur's swords as the many knights try to pull it out of the rock unsuccessfully. Or alternatively a sailor on Ulises's ship in the Odyssey. This is because by making the viewer, a part of the story the narrative impact is augmented. It makes the spectator feel like they belong in the virtual world. This happens because of three psychological factors:

1. Embodiment, 2. Identity and 3. Empathy.

Let us go over each individual factor, and examine how they help the viewer feel that they are an element of the story.

Embodiment: In the Cyborg's Dilemma, Professor Frank Biocca states that: "The body is a representational medium for the mind." [35] Therefore, if the spectator has some form of physical embodiment in the narrative, the spectator will be more grounded by his presence in the virtual environment. As an example, in the Horror film 'Catatonic', the spectator is stimulated into embodying a patient strapped to a wheelchair being transported around a macabre insane asylum. Guy Shelmerdine, the director of 'Catatonic' does this with a simple trick. He places the camera a top of a wheel chair and makes it so that the point of view of the camera sees two prosthetic arms sticking out under the viewer's vision almost at all times (with the exception of looking directly up or backwards). Because of this the point of view from the wheelchair makes the viewer think that the arms are his.

The viewer is transported around the insane asylum being shown all kinds of atrocities, and while all of this is happening the visual of the arms is subconsciously imprinting into the viewers mind that the arms strapped to the wheel chair are his. [36] By the time they reached the mad doctor's office three minutes have passed. This seems to be enough time for the spectator to embody the patient. Because when the doctor character pricks the spectator's embodied arms with a syringe, the spectator reacts as if it was their own arm. The spectators usually pull their arm back and swat the doctor away.

Still from the award winning horror film 'Catatonic' 3:47 into the experience.

The embodiment phenomenon makes the spectator feel that the fake arms, under the spectator, are actually his or hers. Therefore, when a sinister doctor pricks the spectator's fake arms with his needle, the spectator retracts their real life arm, thinking that the virtual ones are actually theirs. Leonor Pacheco, lead animator at Easy Lab Animation said about the experience, "It really felt like I was there, so it was instinctive, I saw the needle coming towards the arm, and I had to move it out of the way." Catatonic uses the diegetic spectator extremely well, and really makes the user feel as if they are one of the patients of the insane asylum. [36]. By having the spectator, be one of the many disturbing patients of the insane asylum, the spectator feels even more uneasy at what they are seeing, and

the anticipation of what is coming next is greater. This is because they might assume that what is happening currently to the patients will happen to them next. Thereby enhancing the narrative impact of the whole experience.

Steye Hallema when asked about this phenomenon said the following statement: "As a storyteller I can give my spectator a body or not. This can either reinforce their sense of embodiment and presence or negate them to just being a spirit like presence in the virtual reality I am creating. These choices must come from what suits the story best." –Paraphrased from interview {E} [40]

Identity: Now that the spectator is embodying an element of the story, one of the first questions that comes to mind is "who am I?" This can either be omitted, like in the case of 'Catatonic', so that the spectator is more uneasy in the virtual environment. Or told explicitly like in the case of the opening of the film 'Missie Aarde,' to give the person a sense of belonging to the virtual world is created. This is because Identity: In A Conceptual Model of Multiple Dimensions of Identity by Susan R. Jones and Marylu K. McEwen is, "the aspect of self is assigned by other such as society, college student peers, or family." This quote is important because it lets us know that identity does not come exclusively from the person, therefore the virtual world must assign an identity to the spectator during their experience, in order to maximize their investment in the virtual world. Either implicitly (like the mental patient in 'Catatonic') or explicitly (like in the film 'Missie to Aarde') One of the major driving forces in spectator identity is the characters around him or her, and how they view him. This will be fundamental in the process of identity creation during the spectator's experience. [38]

Because of this Ashes to Ashes stands out as a primary example of how to create the identity of the spectator in the virtual environment in an ambiguous way. Letting the narrator decide who they are. This is because in this film, the spectator is told two different stories regarding their character and their identity in the story. The first story they are told is that they are an urn of a deceased grandfather. They are told this explicitly by a family of characters all gathered to mourn and decide what to do with the remains of the grandfather, the spectator. However, moments after, a Brechtian moment occurs (Brechtian is a technique used in theater to remind the audience that they are watching a play) and the set comes apart revealing the backstage, production and even wiring of the various lights and equipment. Thus reminding the viewer that they are in a virtual reality experience, and subsequently their real world identity.

During this entire film if, the spectator looks down they can see the camera and tripod used to record the film. So who is the spectator in the end? The remains of a grandfather, or a simple camera on a set surrounded by actors? Or are they perhaps their real world identities still? Since the whole point of VR is to transport the spectator into a virtual world, it is quite ingenious of the creators to let the spectator decide how much they want to be invested in the narrative by breaking it up with Brechtian incident's. Every time the viewer becomes invested in the story, they are quickly reminded that it is just a story and they are not actually there.

With all of this in mind we can see that giving the spectator an identity and making said identity a diegetic element in the story grounds the user in the experience. This is because regardless if the identity is ambiguous or not, a dependable way of getting the spectator invested in the story is by giving them an identity. Director Steye Hallema had this to say about 'Ashes to Ashes' and the usage of realism and how it relates to identity:

"In the narrative of Ashes to Ashes we wanted to overlay the different types of acting in accordance to the different realities of the characters. As such, the little girl acts in accordance to her make belief reality, which then contrasts with the rest of the cast's realistic acting. This leaves the spectator in this sort of limbo identity between the little girl's notion of reality and the rest of the casts" –Paraphrased from interview {F} [40]

Finally, in Ashes to Ashes the spectator is told that he or she is the ashes of the deceased grandfather of a family, fighting over what to do with the remains. This puts the spectator in the heart of the story as the central McGuffin. (McGuffin is a term in cinema invented by Alfred Hitchcock used to describe an object or character that sets the story in motion, such as the One Ring in the Lord of The Rings). Because all of the surrounding character's actions narratively revolve around you, the spectator. This makes the spectator emotionally invested through their identity in the virtual environment. Steye Hallema on Ashes to Ashes states: "Because there are two overlapping stories happening at all times this gives a level of engagement still not present in most VR films, and this is why I feel spectators are so drawn to it." {N} - Paraphrased [40] as such the spectator is immersed in the story because they have a sense of a goal and purpose inside the artificial world that they have been placed in by the creators.

Empathy: Recently it has been discovered that not looking at the spectator and not acknowledging their existence in the virtual environment, is a hindrance to the sense immersion. This is because the spectator feels invisible to the eyes of the characters, and since being invisible is not a relatable experience, it ruins the immersion of the spectator.

Saschka Unsled learned first-hand about acknowledging the spectator. In his cartoon, film 'Henry' the titular character never acknowledged the spectator's presence in the virtual world in the first drafts. This proved to be a strange experience with test groups. Because they were not acknowledged as being in the same world, the spectators felt that they were invading the personal privacy of Henry. As if they did not belong in Henry's house where the film takes place. With this in mind the film was remade this time with Henry taking

breaks form the main action to emote directly at the spectator what he was feeling. Laughing when something silly happened and frowning when something made him unhappy. Because of this acknowledgment, the spectator feels much more at ease in Henry's home. Therefore, we can learn from this that the spectator should be acknowledged in one form or the other so that they do not feel alienated from the virtual environment.

"We had an early build of Henry where Henry never looked at you, and this felt really strange because you know you are there. In addition, this character goes through all these things without even acknowledging that you are there. It felt right that Henry acknowledges you as the viewer, because you are actually there, and it's a moment were the story stops and he looks at you and he shares that moment with you." – Sashcka Unsled [30]

In 'Exploratory Investigations of Empathy' Ezra Stootland states about empathy that, "an observer's reacting emotionally because he perceives that another is experiencing or it about to experience an emotion." This quote is important because if the characters in the virtual environment emote directly at the spectator, by looking at the camera, they instil a visceral emotional reaction. As opposed to emoting indirectly and not looking at the camera. This is a driving force for investing the spectator emotionally, because it the character displays a certain type of emotion directly at the character; it will also elicit an emotional reaction from the spectator, grounding him emotionally in the virtual world. [39]

Still from Henry acknowledging the spectator's presence by looking directly in the spectator's direction. Thus, ensuring that they feel welcome and are not alienated form the virtual environment. ´

This kind of direct emotion is only possible in the medium of VR, because very few films and plays do so. This is because if actors in plays or films look directly at the audience, they risk reminding the spectator that they are watching a play or film ruining their immersion. The exact opposite happens in CVR. The more the spectator is looked at during a VR experience the more they feel like a part of the virtual world.

"VR makes us feel like we are a part of something. (…) I believe that we are still hardwired to care the most about the things that are local to us. In addition, VR makes anywhere, and anyone feel local, and that why it works as an empathy machine. Our film Clouds over Sidra takes you to a Syrian refugee camp, and instead of watching a story about people over there, it's now a story about us here." Chris Milk – [28]

From Interview: The most entertaining facet of creating Virtual Reality is discovering new ways to enhance the spectators experience dramaturgically. This comes from deciphering what techniques work with what stories. – Paraphrased {H} {I} [40]

Since Virtual Reality is trying to stimulate the spectator into thinking that they are elsewhere, by making the spectator play a role in the virtual environment their psychological presence in the virtual world is much more solidified. Because the spectator now has an identity in the virtual world that they are placed in. With this identity comes a sense of agency. With all of this in mind, one can clearly state that CVR productions will elicit a deeper emotional reaction from its spectators by the inclusion of a diegetic spectator. This is because a diegetic spectator provokes three psychological reactions that ground the spectator's experience: Embodiment, Identity and Empathy.

Is this lesson, that the diegetic spectator immerses the spectator more into the narrative used currently? Surprisingly it is already being used to accentuate the horror genre, children's animation and dramatic empathy towards main and side characters.

"We live in an age where we are locked up in our own ego, and something that can break us free is the medium of VR. This can be done and by exploring POV (Point of View) storytelling so that we may better empathize with our fellow human beings." – Paraphrased Steye Hallema {G} [40]

IX. Conclusion, where is CVR going?

Now that we know, where VR came from, and what it can learn from what has been created, inside the sub-genre of CVR, this study may conclude with pertinent information for future CVR creators to adhere to. This study concludes that VR is old enough to divide into time periods. Because from our first attempts at creating artificial environments up until now, the medium has evolved in fundamental ways. The age of Robert Barker and Charles Wheatstone was an age of precursors in which creators were trying to transport their viewers into artificial environments but did not have the modern mechanized and computerized methods of modern VR. Therefore, the intention was there but the means were not. This is the first age of VR. We owe this age the usage of stereoscopy to create the illusion of depth in modern VR. And we also owe this age the thought process of breaking down a virtual environment into a 2D image that can be wrapped

around the spectator's vision to mimic the visual sensation of being elsewhere.

Once Morton Heilig and Ivan Sutherland began using mechanized and computerized means to transport spectators into a virtual environment, the foundation of what we today call VR flourished. Because the work of Morton Heilig and Ivan Sutherland were the first apparatuses that fully fit the definition of VR today. Therefore, we can divide VR into ages by the definition we have of it today, and the means by which we stimulate the senses to fake the sense of being in a virtual environment. In Robert Baker and Charles Wheatstone age, it was analogue, and with Morton Heilig and Ivan Sutherland, the means became mechanized. Because of the usage of mechanized means, the imagery was no longer static, and characters and objects inside the virtual worlds could talk and move. This paved the way for story telling in the medium of VR.

By comparing the defining characteristics of these eras, I have separated and distinguished between them. With this perspective, I have noticed that technologies, dating as far back as the Pre-Virtual Reality era, (Robert Barker and Charles Wheatstone) are still used in modern VR today. The same goes for Morton Heilig and Ivan Sutherland. Morton Heilig created the HMD, the means by which we consume VR. Ivan Sutherland created the means by which HMDs communicate with the spectator, by using the head rotation of the spectator HMDs can faithfully stimulate the spectator's eyes and minds into thinking they are in a virtual world. Therefore, recognizing that attempts to make virtual reality stem far back in time, we can see how some of these fundamental aspects are still used in creating the sense of being in an artificial environment even to this day. It is only after the 20th century that we have digital machinery to aid us in this goal.

Because of this, we are currently leaving the early stages, of VR, and entering VR's maturity. And currently the medium of VR is gaining mobility by being accessible through very simple and affordable means. This economic incentive from both consumers and investors has VR on track to keep growing as a medium. This growth will make it so that multiple forms of VR emerge, and we must use pre-established terms and their definitions to distinguish between them. With these distinctions clear, we can identify separate VR genres by comparing them on a spectrum of how much they are in tune with a set of definitions. Thus, separating between VR formats. The particular form of VR that this study focuses on is CVR.

With this maturity, we have begun constructing a VR specific vocabulary. This is because there are elements of VR specific to the medium that need to be characterized, either based on the user or the creator. For this thesis, we have primarily used user vocabulary to pin point exactly how CVR fits into the medium of VR. It is the least the interactive, but the lessons learned by studying the subgenre of CVR can be used in other more interactive genres. The lessons learned in this thesis can be used to enhance not only non-interactive VR but also interactive VR as well. If the player has an identity, it gives the player a sense of a much more grounded experience as was seen by the usage of diegetic spectator.

What is also interesting about this medium is that it's current creators did not study their whole lives to communicate in this medium (unlike traditional mediums such as painting and music). Therefore many of the award winning creators do not come from a VR background but instead from somewhere else. This diversity ensures experimentation that we can learn from. And since many creators have experimented with the subgenre of CVR, by listening to what creators have to say about their experiences creating in this medium, we may find repeating lessons to extract from their experience; and as such benefit future creators of this medium. The lessons that were learned from current creators are as follows: Spatial placement is the new form of composing in CVR. Camera movement and edits may be used if done in accordance with the environment and optimally with the story. Because of this diegetic spectators are important to the medium of CVR and VR at large. Because they bring in the spectator's psychologically into the virtual world. Making their experiences with the medium much more powerful. This should be taken into consideration when making future VR projects. By placing the spectator in another's perspective, whether that be a prop or character, makes the experience much more impactful.

"I think we can tell stories from the perspective of people. We can tell stories and share experiences. I can maybe get closer to experience how it is to be you. (…) An old experiment is the gender swap experiment in which I as a person can experience how it is to be a woman and vice versa. (…) I think it would also be interesting to be an Afro-American getting pulled over by American cops." – Steye Hallema [33]

There are some modern creations adhering to these principles good effect. Such as Catatonic, Myiubi, Henry, Waves of Grace, Clouds Over Sidra, Missie Aarde, and Ashes to Ashes. By examining these creations, we can learn from what the future creators should do and not do depending on what they are trying to do. If it is the creators desire scare someone they should bring in objects into the spectators proximity abruptly. If not they should do it smoothly. If the creator wants to transition to another visual they should do it by having an element of the world act as a door into the other scene, or have it be a part of the story. In addition, if the spectator can be a part of the story themselves the experience will benefit by psychologically attaching the spectator to the real world. This was learned by experimenting and constructing multiple pieces by multiple artists. If future projects use these lessons when crafting their virtual worlds the stimulated the sensation of a being in a virtual environment will be much stronger in a user's mind.

Despite having a long road ahead, CVR has reached a point that it can learn from both its past and what is happening inside the medium today, so that in the future it may create the most

optimal narrative content. This study of VR was necessary because VR is fundamentally different from other mediums “Because now you (the spectator) are in the middle and you matter, and this changes everything, and I feel that we need some sort of design approach to do Virtual Reality right.” {O} [40]

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I. CONVERSATION #1 STEYE HALLEMA 10-7-2018

A. De Ruijterkade 1241011 AB Amsterdam *16:00*

Interviewer (or I): When did you first start doing Cinematic Virtual Reality?

Steye Hallema (or SH): We were doing 360 video in 2001. When one of my colleagues found a way to film a Chinese mirror ball, and with an SD camera. He de-warped it in After Effects and then, in Macro Media Director, the sort of predecessor of Flash he would sort of like make it interactive. So that's when we started thinking about, "Well, wait a second…" we can do this too. But then it sort of stopped you know? I've always been doing a lot of things in After Effects, and somewhere in 2007 it became 3D. So you had the camera, and I was testing it out and figuring out stuff with that, and there was a plugin in Trap Code called Horizon. That was a lot of help, when you had the camera moving through space, it would give you an environment. You wouldn't have to place huge solids everywhere. You could put a layer in it and it said layer, and I said: "Hmm… Could that be a panoramic video?" Because we were doing that already, so I put my SD camera on its side, and made a video panorama, of my living room, just by making pizza slices and putting them together, horribly stitched, but it worked! {A} And all of a sudden I could like move my camera around but in way better quality. After that in 2009 I made another which is pretty decent as promotion for my music, but it didn't work because no one understood it…

I tried again in 2011. I would say that people didn't understand it but one day before the project came out Apple pulled the plug from Flash so it didn't work. So I was done with it. But then I had a new album and a producer I had met said I should apply for a fund, a video-clip fund, a music video-clip fund in Holland at the time. And I had this sort of plan laying out a 360 video, but personally I was like "I've had it with 360 video no-one understands it, whatever." But nevertheless we wrote it (the music video for Steye and the Bizknoids https://www.youtube.com/watch?v=BufN_qkP58E) and we go it (the fund) and I was doing it I was testing it and while I was working on it I discovered that Oculus already did DK2. So I said "Wait a second, that's interesting!" So I ordered one and I got it and I managed to make it work on my computer and then I wasn't looking at my material I was standing in my own music video. And that is when my head completely exploded. I was in the middle of my own music video! It was so cool, instead of looking at it, I was in it. And because of the group that I was with, that was doing 360 video already, Pip slap, we had a couple of dogmas. And one of the dogmas was that we wanted to un-sheep the audience. Which has been basically one of the things I have been doing all my artistic life.

It just made sense, I had been walking a lot of roads at the same time and all of a sudden they came together forming a different stream. Because of this I redid the whole script, well not script, more like a film plan, for the music video. Because I felt like the edits and stuff just didn't work, and that is when I came up with the hula hoop thing as well. Which was Serendipity. I was trying wipes on the computer when my costume designer walks by with a hula hoop, and I say "Wait a second, this can be a wipe." That can be a transition. So, I tried it, I just put it over the camera. {D} A 360 camera, it was the yellowbird camera. It's based on the lady bird I think by Google. No, ladybug camera I think. It was one of the first 360 cameras that sort of worked, they built this bot that stitched for you, it was pretty neat.

When I discovered that I was in the music video, that changed everything and then I was gone because I was like "This is it." And I was very lucky that the music video got nominated for the music video awards in 2016. But it was only nominated. We were in the same ball game as Coldplay and Cee Lo Green, my own little band Steye and the Bizknoids, that even in Holland no one knows. So, that was good enough because the CTO of Jaunt saw it and said "I want that guy." And I was being flown over to the States and they offered me a job which was cool.

I: In the music video, we see the band over and over again, in different scenarios at the same time. How did you coordinate everything?

SH: The coordination in the end comes from a matrix script. Excel is your friend, and I knew that the camera was filming 5 sides. So I basically made 5 pizza slices, so you had time and you had slices. And you start to play around. We had this sort of weird story that you started with the band in the warehouse and they were bored, so then they started to think about stuff and the cool thing about a music video is that it doesn't matter. As long as it goes from A to B, and has a couple of surprises. So we built it from there, and I guess the arc was more dynamic here, as opposed to, let's say, a traditional story. Which is why we just started to fill in the 5 slices. And sometimes there would be one slice, and it was a lot of masking for me to figure out all the hula hoops. {C}

I: There is a particular scene in which the drummer appears and disappears in a mirror.

SH: I still want to make a film with this, and its actually an idea I sent to OK GO once. Because it is a beautiful philosophical thing, because you are in the same space. Looking at a different time, through a mirror. I made a test with that because, well, we tested so much we did three weeks of filming and testing so we could get the camera three times. So we had a lot of vocabulary to play with. So when we finally shot, we had already tested some stuff.

I: In the film Ashes to Ashes you reminded the viewer that they were watching a production unfold. Where did this creative choice come from?

SH: I'm trying to incorporate that in my talk because that is what I call acting versus staging. I think there is a problem in VR, please tell me if you've ever seen a VR film in which you thought the acting was really good. Because, I heard that some people like Miyubi, but I don't really like it so much. And there is Gomorra, an Italian one, I didn't see it but I would love to see it. {L}
http://monogrid-gomorra-master.s3-website.eu-central-1.amazonaws.com/#!/

First I thought it was the director or the actors not being good, but I don't think that is the case. I think there is no common knowledge yet, because in film we (contemporary society) have been watching films since we were 0. And mankind has been doing it for more than 100 years. So we have this common body of knowledge about how it works, so when we are on stage and we are talented and have a big imagination, we can sort of, fill everything in because this is how we think it should be. The directors know what to do and achieve and the actors know that as well. But in VR the rules are different. In VR one of the things is that you are feeling present and therefore I think you demand a higher level of acting you want really realistic acting. {M} But what happens on set is you mostly want to get one cut, because if you cut all the time it is disorientating. You do long shots, so what are you going to then? You are going to stage, like you would in a theater play. So the actors think "Ok, this is more like a stage so I'll project like on a theater stage." But I don't know what happens, so this is something I really want to test and how I solved it intuitively, before I even found the problem, is that I'm going to make a new type of deal with the viewer. Because in a film you make a deal with the viewer, in a theater play you make this deal with the viewer, we are going to act like this, and that, and you are going to believe that. This is the deal we make. And I think this deal is something we still have to work out in VR. How I've sort of found my way around this dilemma is by telling the viewer "This is the story we are going to tell you."

I think in another way, that's what I made with the music video which is just some freaky guys with weird costumes. For Ashes to Ashes we wanted a reaction of "Wow, this acting, what is this? And the surprise: "Uau! I'm on a film set." What we try to achieve is to have different levels of acting, because the girl still believes in the story but the actors don't. I think it somehow worked although the story is weird. {F}

We didn't write the story, we had to fix the story in that sense because again, someone form the film paradigm was asked to write the story. But the story really didn't relate to VR at all. I think she thought she had a really good find in making Grandpa an Urn but who are you then? Are you the spirit? There are so many questions that dramaturgically we were like: "Oh my god…" But people really like it more than most VR films because it is richer than the average VR film. More stuff is happening at the same time. There are two stories, there is the story of the actors and the little girl. And they sort go (under and over each other) so it's sort of like a dream, you find your way. {N}

I just wish I had the same budget for my next film.

I: Part of my thesis advocates for the usage of a diegetic spectator because of three psychological phenomena in VR. Namely: Embodiment, empathy and identity. In your next production is the viewer a more diegetic element of the story?

SH: I think that there is a lot of fun with finding and playing with that (diegetic spectator). The next film I am trying to make is the Imaginary Friend. You as the viewer are the Imaginary Friend, of Daniel an 8-year-old boy with extremely vivid imagination who has a friend who is namely you, the viewer. And he desperately tries to convince both his peers and parents that you exist. So I feel that I have found the perfect place for the viewer, and maybe in Cinematic Virtual Reality only. Or maybe a couple more ghost stories.

I am actually getting more skeptical about VR and the power of VR. When the wow effects disappear, I think a lot of people, including me, have been doing very relevant research in dramaturgical terms finding a place for the viewer. For example, you mentioned embodiment, the first thing I do is get the body out. Because if the body doesn't move like you do it's lame. {I}

I: Have you ever seen a movie called Catatonic?

SH: I did, and I thought it was the lamest thing. I really feel like it's really lame. Don't you? {J}

I: I like it because they used embodiment in a clever way. Since the spectator's character is strapped to a chair, if you move your arms, it's just like the story it won't impact anything. Once the spectator is accustomed to having the character being strapped to the chair, a doctor pokes the arm of the spectator with the syringe, and both me and the lead animator at Easy Lab experienced this phenomenon, but it might be a personal matter.

SH: Yes, it might be a personal thing because it gets me out way more than it gets me in. I've seen my body but that was when I was scanned by Kinect. And this was in a gamer oriented experience but I really loved it. But when it's nothing I always plan to take it out. But maybe it's a personal opinion. That's the annoying thing about getting all these things down, there all these personal opinions. {K}

When you have a body, for example in Imaginary Friend, I'm going to give you a body, or at least I will test it out first. So we can make you anything he wants basically. Or I can as a storyteller. It's make believe and it's make believe that he is making you up so, I'm going to give you a body and when you move slightly it will move with you to give you a clearer sense of embodiment. {E} So you move something you feel like "Hey, it's me!" I also want that body to move with the story. At a certain point you over here this from his mother "This imaginary friend is not good!" and you are someway in the back of a hallway and you see Daniel eavesdropping on them. And then he looks at you, and this changes you from being friendly to being dangerous. Because if your mother says something about your friends that's going to change your perspective of your friend.

I: It's intelligent that Daniel is the only one who can see you because it creates a very strong empathy between the spectator, the character they are playing, and Daniel.

SH: In my art I'm always trying to do something for everyone so that a dramaturge citric form the theater industry and a framer from a village would love it as well. That's always the strive, I guess.

It's hard but it also keeps you sane as well because it is so easy to fall into the traps of the critics and always wanting to please your peers. That's a dead end street always, it real is. I've been bumping my head in that dead end many times, and will do it many more.

I: As an artist how do your artistic creations usually begin?

SH: I've never started with writing stories. I was always the kid in school who could draw pretty well and play guitar. I've always loved both. When I went to art school, I was lucky, in the sense that I could find what I wanted which was Art and Science in The Hague form the Conservatory and the Arts Academy. So basically I didn't have to choose between music and image. And in the end it was well, I wish I had better teachers, and they were all good artists it was a special place, but yeah the young 18, 19, 20, 21 must be trained, with skills and drilled. A little bit more like army style, "C'mon just learn something!" So I've always trained myself. But I've always been doing both, I thought the art school was so artsy that I wanted to make corporate and company movies on the side to make some money to be able to buy equipment. But also to be able to do something in the real world, to relate to the real world, and I was always making music.

I did a lot of graffiti where I'm from, a city up north, and my designs became more and more like compositions like graphical notation. But I eventually saved some money and discovered that samplers existed. So I bought a sampler, and after that there was no more graffiti design anymore. I just made beats and made beats, but at a certain point, I was accepted to art school and started painting and it always went like this. And in the end, well there are only so many skills that you can learn so I made a real effort to learn making music, and really made an effort to make music videos and sort of image stories.

I became a songwriter after finishing art school but I tried and made an effort to graduate by making a story machine. I wanted to make a story machine, but I drowned, I couldn't do it, it was intellectually too hard. Or I didn't get the right help from my tutor's, but I wanted to make a machine that produced stories and I just let go because it was too hard. In the end I made an installation of 11 televisions hung up in a circle and I made this clip of this guy telling the other guy in the other television that "he was right, he was wrong." "You are right, he is wrong." "That's right I'm wrong"

In the end I made a composition of a conversation in a very artsy style, but in a way sort of cool, because it would reflect how people are talking on television and talk shows. Such as you interview someone, and then you interview someone with an opposing opinion. And that sort of became a composition, which I kind of like to do but I also thought it was a bit artistic. So it's always been going like this, and I've always been trying to find arching themes.

I've been trying to find arching themes in my own work, and one thing is that, because I'm always doing everything. I really like ideas. Because in the end you are always trying to find the clearest idea. Next to

that I'm starting to call myself a story designer. I've been working as a composer, as an inventor, as a director, but for these last couple years I'm calling myself a story designer. And I'm calling myself a story designer because the relationship between the story and viewer has changed. Because know you are in the middle and you matter and this changes everything, and I feel that we need some sort of design approach to do it right. That's why I like having this conversation with you because I felt in the emails that you sent a thoroughness that VR needs. {O}

With Smart Phone Orchestra it's the same thing. Although it is not someone on his own with a headset it's a whole audience, but still I am communicating via that phone with an individual. So again it's the same thing, and that's how I try to make it more cohesive. And then I have my own taste and tendencies. Musically I like it when it is funky, and I don't mean that it should sound like Parliament. I like music that makes you move and there is a simple thing, you have straights, and when something is not on that straightness and is little bit off, then from some sort of magical reason, our bodies react. And that's interesting.

And then I guess the lyrics I write on my music for my songs are I guess a little like abstract paintings in the sense that they should be coherent, but I don't try to tell a too clear story I sort of like to let you discover the story. In a story world. So everything comes together again.

* BREAK * Interviewer is shown work from Steye Hallema.

I: In this piece where you have yourself playing all the instruments of the band, how did you organize your shots?

SH: I have to make it as a matrix scenario because every shot I took had to have the same light. So what I did was put the drums into midi and routed that into a fader box for the lights, so the lights, when I hit the kick or the snare, it lights up. And I'm actually play backing because it is coming out of the computer. But because in every shot the lighting is the same it makes it feel that is all belongs together. It makes them all connect. These are the tricks and I really like to think like that but now it's not necessary anymore. But in the beginning this was our script. *draws on paper a grid* slice a, b, c, d, e, and this is the time. So if something is happening here and something is happening there you are going to try and find ways to connect to each other.

But now it's not necessary anymore with pre-built cameras, we have the insta 360 pro here. These work sort of ok. But the fact that I had to do this trained me in a way that makes me think of composition in a different way.

I: This is very valuable because when I was thinking about how to compose for Virtual Reality my cinematic training incentivized me to use story boards, but story boards no longer work, because now the spectator is in charge of framing with their field of view. So how do we Pre-Produce?

SH: I have to grab your attention, and I've discovered that people's attention is quite easy to grab. Ashes to Ashes is going everywhere, but now what I have done way more is fixed positions. What I do now mostly if this is the camera this will be the main action sort of going here and back, but you just have something happening here that if you miss it is fine but if you see it, it adds to the story.

What I will try to achieve with Imaginary Friend is that for example the drama is unfolding here, but since you are his imagination there are for example two of these standing in the sink, and what you he sees is dragon's fighting, so what the viewer sees is also dragon's fighting. This in essence becomes nonlinear story telling which is what I want to do a lot. But not in a traditional, branching, sort of way. Making it organic so whatever the viewer is looking at, is what is being told.

I: I agree because second viewings from the spectator are always welcome but if they can grasp the narrative fully the first time it's for the better. So in your opinion the first viewing should make the spectator aware of let's say 80% of the story.

SH: Yeah it should definitely be enough, but it doesn't really matter because ideally it's always 100% percent, but if you look again there is acutely 120%.

I: That is a better analogy. So the spectator will get the full scope of the narrative, but then if they want to see an element of story more profoundly, a second viewing is where the spectator will see it.

SH: Yes, I don't see why not, especially with story world building stuff. But this a spectrum, and there is so much involved I feel we need to feel our way in by doing and testing.

I feel I've been lucky with my intuition because I've done so much that a lot of things I make are well balanced but I want to have more money so that I can make more mistakes.

* BREAK * Interviewer is shown work in progress from Steye Hallema.

I: The spatial distance is used quite well between the character, the protagonist, and the protagonist's mother.

SH: This is also reinforced because the characters are talking in the third person, not at you but about you.

I: And the usage of peacock feathers to hide the rig gives you a feeling of flotation and disembodiment.

SH: Exactly, but it is really just a mockup, in the end result I want it to move with you.

I: Like an ethereal presence.

SH: Ethereal! That's the word. I want it so that if the spectator moves like this, it moves with him you know? So you really feel like it's moving with you.

I: Will the protagonist's drawings move as well?

SH: Yes, they will, and that's why we had this test shot so that we can work with them like mood boards and sort of make it so that it looks like this, and I was really happy when I got the chance to make a test shot. It was with the international theater in London they kindly donated their actors and their location. So we only had to borrow the camera and do the Post-Production. The only problem with this is that I don't like the acting. I like the kid protagonist a lot, and I was hidden the whole time under his bed here so that when we did the scene with the bird I had to make a bird sound and I wasted everyone's time of like half an hour, because everyone would laugh. It was so much fun. But I got the actors form the international theater so I couldn't really choose them, and the mother although she is a wonderful person, comes from a circus and theater back ground. Therefore, when starts walking she says, "I'm going to walk!" *exaggerated walk* and that doesn't work, it ends up being artificial. She projects all the time. Which has me thinking about working with amateurs, and amateurs that can take a queue would work very well.

We use our own 360 cameras, the Insta 360 Pro, it's a little bit grainy but for the price it is very competitive and we can finally test stuff and do stuff. Because I think my point is that it is important to have an iterative process. Go back and forth, and it's really good to have your won camera.

I was working with the Jaunt One camera, and it's like this big with 24 lenses, but it's so much work and its expensive. I think they tried to sell it for a while as a business model for about 70,000 euros or dollars, and the one I'm using cost 4,000. Because the quality level is not much different you know? While the price level is very different. The Jaunt is a really good camera, it really is, the dynamic range is amazing, the colors just pop but there is one problem. The stitching algorithm because it has 24 lenses, and how the stitching algorithm works it needs 3 and sort of calculates the distance and how it should stitch. This mostly works well. The thing is that we can't get closer than one meter, and I've boosted it to 70 cm and it sort of worked. But I really feel that the stereoscopy is moving in very close, because that is when you feel it the most. When it is 2 meters away, who cares? {B}

I: What is the dream VR project?

SH: In the end I would like to make story worlds. I'm really interested in making stories world. So it would be cool to make more gaming style world's. I would really like to make some sort of game.

Or maybe I don't want to make a game, game. I would more like to make it a psychological experience, something along the lines of a brainwashing machine to help people view the world. Because in the end what we are creating is a simulation of reality. Well maybe because I'm getting older, or maybe because I am meditating a lot I see people walking around this world who don't have a clue. If we talk about religion, at least religion gave people an anchor. That doesn't happen anymore, I think what we are doing now is definitely better than religion, but now we are locked up in our own ego. I think we can really expedite how we learn and understand with VR. {G}

I: In your VR days interview you said that one of the coolest things VR can do is swap genders or even place a person inside the skin of a minority, such as an African American getting stopped by the police.
https://youtu.be/qhVckryApiA?t=1m9s

SH: What I think I did less than most is research presence. Because presence is already there, and I went into talking the spectator along straight away because I also felt that presence is very fragile. In a VR game I'm doing it so I am there, as opposed to a story where I am just a spectator. I want to bring these closer together.

I: Brining closer interactivity and cinematic experiences?

SH: Yes, for someone who wants to get into this medium you need to make mock ups. And taming the technology to tell your Virtual Reality story, because in a way this is all a Virtual Reality.

I spent 4 days in a monastery and I showed some of the monks my work. And one of them said about my work "That is exactly what I am trying to teach you, take off the mask!"

So that would be my dream project, and in a way Smart Phone Orchestra. Is also a Virtual Reality because I want to make a play about social media. I think in the last century was when big geniuses were creating art, and that century is gone… I think art now is really about networks, as a musician I see music, well maybe because I am getting old, but I have the feeling that since the 90s there hasn't been much music invented. It's still branching out but in the 90s you had gangster rap, and techno and grunge you all these kind of raw and expressive flavors and you really don't have that anymore. Maybe because the music industry's distribution is now so effective and what is changing now is how we relate to music. I'm from a generation where I had to go to the record store, find something that really liked and then spend money on it. And a lot of money on it and they I had this 10, 12 maybe 15 songs that I would listen to over and over again.

Now we have Spotify, and I sort of stopped as a song writer when I got Spotify because as a musician, you are not competing with fellow musicians, you are competing with the whole world and all the music that has ever been made. Your chances are so small, why?

Ok, let's say that art, the only definition of art that upholds, is that, art gives you a way to see, and in see I mean feel, think, smell, experience in a different way. It's opening your eyes. So at this moment I think the most relevant artworks are networks and how we all relate to each other. You are probably like me a part of 100 WhatsApp groups. So wherever you are in world, as long as you have internet you relate to all these groups and they are not always active. But at least 4 or 5 are active at least every day in my life. So what is changing is that I am engaged with these people all the time and therefore networks are fundamentally changing. With Smart Phone Orchestra I can really show a network of people in a real room. And that's another dream project I have.

The way it works is that we hang speakers and every speaker has a different output so we can really create a sound field. So that every speaker is a sound source and you can really feel spatial sound. We are down to 10 parts because they are randomly distributed. SO IPhone or androids will be playing different parts. Because the operating systems are different the latencies are all over the place so we distribute sound accordingly. But we don't know the placement, and its not an app it's a website, so that anyone can spontaneously interact. With these 10 parts it is a cohesive piece but if we have more it becomes too random, because we want everyone to hear a different piece but within a limit. So in that sense it is creating a story world where everything is happening at the same time. For me there is a lot of parallels with Virtual reality and the smart phone orchestra. Because one is doing this (points to the inside) and the other one is doing that (points to the outside).