Immersive Performance Environment: A Framework for Facilitating an Actor in Virtual Production

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BGIE, BFA (Hons)

Submitted in fulfilment of the requirements for the degree of

Doctor of Philosophy

School of Creative Practice

Creative Industries Faculty

Queensland University of Technology

2020

KEYWORDS

ABSTRACT

Virtual Production is a relatively new concept that covers a broad selection of approaches focused on combining physical and virtual content in real-time. Within the field of entertainment, Virtual Productions are beginning to dominate the industry when it comes to the creation of computer-generated imagery. However, Virtual Production currently has perceptual limitations that impact on an actor's understanding of the virtual environment during a performance. There is a growing discourse from professional actors surrounding this limited perception and its impact on their performance. The actors cited in this study have attributed this limited perception to the intrusiveness of the systems used in Virtual Production as well as the lack of stimuli during a performance. Actors are frequently called upon to take on the responsibility of overcoming this limited perception to meet the needs of the systems used in Virtual Production.

This study explores an opposing approach to this limited perceptual experience by minimising an actor's responsibility for the systems found in Virtual Production. Other research has attempted to address this challenge by developing new technology to create an immersive performance environment or adopting existing immersive technology into the rehearsal process. This study departs from a single technological approach by exploring several strategies that facilitate and mediate an actor's perceptual experience of a virtual environment during a performance. The research adopted an interpretive framework and followed a phenomenological paradigm to identify concepts with relevance to the underlying challenges associated with performing in Virtual Production. A practice-led methodology was adopted to enable the identification of these concepts through a series of experimental productions with several actors.

Overall, this study established three spectra of immersion for an actor in Virtual Production, which includes Bodily Immersion, Spatial Immersion and Perceptual Immersion.

These spectra provide a method for understanding an actor's varying experiences during a performance in Virtual Production. Furthermore, these three spectra of immersion were used to develop a conceptual framework for diagnosing and increasing an actor's level of immersion in a Virtual Production. The resulting framework provides a clear path for creating an immersive performance environment and provides enough flexibility to grow with the evolving landscape of Virtual Production.

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LIST OF FIGURES

LIST OF PUBLICATIONS

Material from this study has been submitted for publication as detailed below.

Creative Work:

- Bennett, J., Mohr, S. (2016). Powers Above Animation Exhibition. *Animation Fixation, Logan Art Gallery.*

Conference Paper:

- Bennett, J., Carter, C. (2017). Performance Capture: Split between the Fictitious and Physical World. Apple University Consortium (AUC) Create World.

GLOSSARY

The following glossary defines the various terms, abbreviations, and acronyms used throughout

the thesis:

AR	Augmented Reality: The process of supplementing elements of the virtual environment into a real environment.
AV	Augmented Virtuality: The process of supplementing elements of the real environment into a virtual environment.
BTS	Behind-the-Scenes: Revealing the inner workings and process used to achieve a creative outcome.
CGI	Computer-Generated Imagery: Imagery that is produced using computer graphic techniques.
DK2	Development Kit 2: An acronym for the Oculus Development Kit 2, which is a head mounted virtual reality system.
HMC	Head-Mounted Camera: A Motion Capture system that uses small cameras at the end of a tiny boom arm mounted to a helmet, which captures a user's facial movements and expressions.
HMD	Head-Mounted Display: A device worn on the head that uses a display or set of displays to stream data, images, and other information to a user's eyes.
iMoCap	in-Camera Motion Capture: A modified version of Motion Capture that uses specialised fractal MoCap suits and a small array of high-resolution video cameras to capture an actor's performance on location.
MoCap	Motion Capture: The process of digitally recording the motion and movement of objects or people.
MR	Mixed Reality: The process of merging the real and virtual environments seamlessly together as if they were one.
Performance Capture	The process of recording an actor's entire performance using Motion Capture technology.

RV Reality-Virtuality: An abbreviation used in the Reality-Virtuality Continuum, which describes the varying dimensions between a real and virtual environment.

RR Real Reality: An environment that has the quality or state of being real.

WoW Window on World: A desktop or screen-based Extended Reality system, that typically utilises conventional computer monitors to display the virtual environment.

VCS Virtual Camera System: A device that mimics the properties of traditional film cameras but provides a view of the virtual environment in Virtual Production.

Virtual Production A broad concept that covers the spectrum of real-time computer-aided productions in filmmaking and game development.

VR Virtual Reality: A simulated experience of an artificial or virtual environment that is commonly computer-generated.

XR Extended Reality: An Umbrella term used to describe the range of technologies or approaches that are used to supplement or merge the real and virtual environments.

STATEMENT OF ORIGINAL AUTHORSHIP

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: QUT Verified Signature

Date: 10/08/2020

ACKNOWLEDGEMENTS

Chapter 1 Research Introduction

1.1 BACKGROUND

In 2011, I had my first experience using Motion Capture (MoCap) and Performance Capture during research in the Vacation Research Experience Scheme[1] at the Queensland University of Technology. MoCap is the process of digitally recording the motion and movement of objects or people (Dyer et al., 1995). Alternatively, Performance Capture is a variation to MoCap commonly found in filmmaking or game development. Overall, Performance Capture indicates the process of recording an actor's entire performance (Fordham, 2005). An entire performance means that every element of an actor is captured, including their body movements, finger articulations and facial expressions. The experience of using MoCap and Performance Capture motivated me to pursue further research exploring the applications of these technologies in the entertainment industry.

This exploration led to research in Virtual Production, which adopts the use of MoCap and Performance Capture. Overall, Virtual Production is a new approach for working with Computer-Generated Imagery (CGI) in ways that are inherently similar to the approaches found in live-action productions (Autodesk, 2009; Morin, 2012). CGI is a term used to describe imagery that is produced using computer graphic techniques (Latham, 2012). The use of CGI has a rich history in filmmaking, initially emerging in the 1970s with productions like *Westworld* (Crichton, 1973), *Futureworld* (Heffron, 1976), and *Star Wars: A New Hope* (Lucas, 1977). These early films were the first to adopt CGI in their development (Okun &

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[1] The Vacation Research Experience Scheme provides undergraduate students an opportunity to gain research experience by working on a project for a period of at least six weeks before moving into postgraduate studies.

Zwerman, 2010, pp. 10–13). However, the focus of this study is on contemporary Virtual Production, which has shifted far beyond these early films and typically consists solely of CGI.

One of the most prominent contemporary Virtual Production's is the film *Avatar* (Cameron, 2009). In this film, the director, James Cameron, built upon the approaches used in *The Polar Express* (Zemeckis, 2004) to develop a new workflow that bridged the gap between physical and virtual filmmaking. This new production approach enables the director to see an actor's performance in a virtual environment in real-time, as seen in Figure 1. Using this approach enables the same level of interaction with a performance found in live-action productions, which allows the director to view, adjust, and change performances in real-time (Ng, 2012; Thacker, 2012a).

Figure 1. Viewing the Virtual Character in Real-time (Cameron, 2009)

Now, several years later, I have had countless experiences with MoCap, Performance Capture and Virtual Production as a MoCap Technician. A MoCap Technician's primary responsibilities focus on the physical and technical aspects of producing and processing MoCap data within a Virtual Production environment (Delbridge, 2014, p. 55). As a MoCap Technician, I have ascertained that Virtual Production focuses on bringing a high level of interactivity to a director during a performance. However, this focus in Virtual Production has

overlooked actors who depend on understanding and interacting in a virtual environment during a performance. This lack of interactivity for an actor is a persistent problem when performing in Virtual Production.

1.2 THE RESEARCH PROBLEM

Virtual Production currently has perceptual limitations that impact on an actor's understanding of the virtual environment because it is typically not visible or perceivable during their performance. This perceptual limitation of the virtual environment means an actor needs to memorise and imagine objects, obstacles, cues, and events in addition to delivering a performance (Kade, 2014, p. 4). This problem in Virtual Production has been a common area of discourse for professional actors commenting on their experiences in these productions. This study paid specific focus on comments from Valorie Curry, Jim Carrey, Ian McKellen, Benedict Cumberbatch, Brain Bloom, and Jamie Gray Hyder.

However, Valorie Curry provided the most explicit description of the problem associated with this perceptual limitation in a behind-the-scenes featurette for the short real-time film *Kara* (Cage, 2012), saying:

> More than anything for me, it was about being present in the space. Listening, smelling the room so [that] everything can be new in every moment. I think the challenge is just something inherent to the MoCap. There is obviously a lot of imagination because there is no set to work with, and I didn't get to talk to a face when I was doing it, and you know [there was] a million choreography things to remember. So, I have done a lot of theatre work, there are technical things to remember, but this was a whole different ball game… It was a lot to remember

while doing an emotionally intense scene, so it was challenging. (as

cited in Quantic Dreams, 2012, 2:26)

This comment connects the challenging nature of performing in a Virtual Production to the inherent nature of MoCap. The process of MoCap emphasises the recording of movement data over an actor's experience in a Virtual Production. This process distracts an actor's attention from the performance and forces them to take on additional responsibilities; thus, the actor must adapt to the needs of the systems and technology used in Virtual Production.

However, this is not to say that actors are unable to adapt to these environments. In fact, delivering a performance in challenging conditions is something actors have been successfully doing for decades. Andy Serkis has frequently commented on performing in MoCap, saying "There is no difference. Acting is acting. Performance capture is a technology, not a genre; it's just another way of recording an actor's performance" (as cited in Pizzo, 2016, p. 10). Andy contextualises this position further in another comment, saying:

Performance capture is just a technology that picks up everything you're doing, but in terms of embodying the role physically, mentally and doing all the research, you do that with any character you play as an actor. We are creatures of imagination and trick ourselves into believing we're murderers, lovers, etc. So, what you wear is just a superficial coating. I've never drawn a distinction between doing a motion-capture performance and one without motion-capture technology because it's just a different set of cameras. (as cited in Pizzo, 2016, p. 10)

This comment argues that there is no difference between acting with or without MoCap. However, the position of this thesis disputes the notion that there is no difference between

acting and MoCap acting as outlined by Serkis. While the acting process does not change for an actor when using MoCap, they are typically required to completely imagine the virtual content used in a Virtual Production, which creates a distinct difference from traditional acting. Furthermore, this requirement to imagine the virtual content increases an actor's cognitive workload and distracts their attention from the performance when compared to traditional acting (Bouville et al., 2016; Kade & Lindell, 2013; USA Information, 2018, p. 1783).

MoCap technology and its process are what cause this increased cognitive workload for an actor. MoCap technology usually requires an empty performance environment to minimise the occlusion of the MoCap cameras, thus ensuring the successful capture of an actor's performance. However, clearing the performance environment also removes stimuli for an actor, which is used to inform their performance. This study intervenes in this process and shifts the emphasis in Virtual Production away from the technology and back to the actor. The study achieved this intervention by establishing strategies that mediate or facilitate an actor's perceptual experience of the virtual environment during a performance in Virtual Production.

1.3   QUESTIONS, AIMS, AND OBJECTIVES

Pursuant to the research problem identified above, this research project responded to the following research question:

> *How can the technology or approaches used in Virtual Production be adapted to facilitate or mediate an actor's perceptual experience of the virtual environment during a performance?*

The primary aim of this research was to establish an immersive framework that can be used to address an actor's perceptual limitation to the virtual environment during a performance in Virtual Production. This study adopted the following objectives to achieve the research:

1. Examine current technologies and approaches adopted in contemporary Virtual Production and assess their impact on an actor's perception during a performance.

2. Identify the most relevant parties in Virtual Production that can address an actor's perceptual limitation to the virtual environment during a performance.

3. Conduct or collaborate on a series of experimental productions to investigate strategies or technologies that address an actor's perceptual limitation to the virtual environment during a performance.

4. Maintain the continued support of an actor during a performance in Virtual Production by avoiding strategies or technologies that hinder their acting process or increase their cognitive workload.

5. Analyse and interpret the actor's experiences of the strategies or technologies adopted during the experimental productions to assess their level of immersion.

6. Synthesise the findings of the study into an accessible framework that can be adopted by the relevant parties to diagnose and increase the level of immersion for an actor in Virtual Production.

1.4 RESEARCH APPROACH

This study takes a qualitative approach that was informed by a phenomenological paradigm and follows an interpretive framework. Phenomenology specifically explores an event, activity or phenomenon (Creswell, 2014, pp. 13–14). In this study, the phenomenon under investigation was an actor's perceptual limitation to the virtual environment during a performance in Virtual Production. In addition to this approach, the study adopted a practice-led methodology structured by action research (Gray, 1996; Kemmis & McTaggart, 1988).

This methodology was used to conduct three cycles of practice that included a series of experimental productions. These cycles were crucial to the research because they enabled the investigation of an actor's perceptual experience in Virtual Production. In these experimental

productions, I worked with several amateur, pro-amateur, and professional actors to explore several strategies that facilitated or mediated their perceptual experience of the virtual environment during a performance in Virtual Production. The adoption of the terms facilitate and mediate focused on illustrating the two key types of strategies used in this study. Facilitation strategies introduced information of the virtual environment into the real environment. Alternatively, mediation strategies focused on immersing the actor into the virtual environment, occluding the real environment. Furthermore, each cycle of practice built on each other but highlighted a specific element of Virtual Production, including the virtual character, the virtual environment and virtual perception.

Each cycle of practice was used to collect observational and interview data on the actors' experience of the various strategies adopted in the cycle of practice. The data collected from these cycles of practice were interpreted using the process and procedures associated with content analysis. The method of content analysis focuses on understanding the content or contextual meaning in textual data (Budd et al., 1967; Hsieh & Shannon, 2005). The findings that emerged from this analysis were used to form a conceptual framework for enabling an immersive performance environment in Virtual Production. An overall breakdown of the research approach adopted in this study can be seen in and a deeper discussion can be found in Chapter 3.

Paradigm

Phenomenology:
This study adopted a qualitative approach informed by a phenomenological paradigm. The phenomenon under investigation in this study focused on an actor's perceptual experience of the virtual environment during a performance.

Methodology

Practice-led:
This study used a practice-led methodology that was structured by action research to enable the exploration of the phenomenon by contributing to a series of experimental productions.

Methods

Experimental Productions:
Three experimental productions were conducted that explored strategies that facilitated or mediated an actor's perceptual experience of the virtual environment during a performance.

Cycle of Practice 1

Exploring the Virtual Character
Experimental Productions VIMMA Project and Powers Above.
Strategies Onboarding, Actor fatigue, and Character anatomy.
Creative Outcomes Behind-the-Scenes Documentaries and an animation.

Cycle of Practice 2

Exploring the Virtual Environment
Experimental Productions Deep Blue and the Perff Bots and Automancy
Strategies Onboarding, Physical Reference, and Floor Markers
Creative Outcomes Behind-the-Scenes Documentaries and an animation.

Cycle of Practice 3

Exploring Virtual Perception
Experimental Productions VIMMA Project and Powers Above.
Strategies Onboarding, Physical Reference, and Visual Immersion
Creative Outcomes Behind-the-Scenes Documentary and an animatic

Sample Selection

Amateur, Pro-amateur and Professional Actors
The participants selected for this study were a mixture of amateur, pro-amateur and professional actors with varying levels of experience with MoCap.

Data Collection

Interviews and Observations:
This study used a combination of interviews and observations as the primary methods of data collection to capture the participants experiences during the cycles of practice.

Data Analysis

Content Analysis
The interview and observational data collected during the experimental productions were analysed and discussed using process and procedures from conventional content analysis.

Outcome

Conceptual Framework:
The outcomes of this analysis helped form a conceptual framework that can be used to diagnose and increase the actor's level of immersion during a performance in Virtual Production.

Figure 2. Research Approach

1.5   SIGNIFICANCE AND CONTRIBUTION

This study contributes to the growing landscape of Virtual Production used in filmmaking and game development. These contributions include the discussion of literature surrounding the study, a series of experimental productions, and a selection of interviews detailing the actor's experiences performing in a virtual production. However, the study's largest contribution is a new conceptual framework that can be used to diagnose or increase an actor's immersion in a virtual environment during a performance in Virtual Production. While previous studies

informed the development of this framework, this study amalgamates and establishes a range of approaches for immersing the actor into a virtual environment. While this conceptual framework is a notable contribution in itself, its impact is reliant on its adoption into the process of Virtual Production. Therefore, this study is also significant because it identifies the most relevant parties for adequately adopting and adapting the conceptual framework into a Virtual Production. Overall, the primary aim of the conceptual framework focuses on minimising an actor's cognitive workload of imagining the virtual environment in a Virtual Production during a performance.

Currently, an actor is typically required to construct and imagine the virtual characters and virtual environments during a performance in a Virtual Production. Ed Hooks, the author of *Acting for Animators* (Hooks, 2013), highlighted the impact of Virtual Production on the acting process during an interview at FMX[2] in 2017, saying:

> I'm sitting here talking to you, and I'm thinking about, 'I'm talking to you'. I have to be aware of where the camera is; I have to be aware of all kinds of things. When you're doing a MoCap session, actors have to think about those things… You [have] to be very careful with facial capture. I see a lot of performances that have been captured this way… What they're doing isn't fitting the dialogue that they've got, because the actor actually is thinking about having to turn this way, and be their way, and do this way. You have to think about those things and then make it appear that you're not thinking about those things. So, an actor [using MoCap] has a double job to do. (as cited in Sarto, 2017, 6:51)

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[2] FMX is an annual conference held in Stuttgart, Germany, dedicated to animation, visual effects, games and immersive media. For more information about the conference, visit https://fmx.de [accessed November 2019].

This comment highlights that an actor performing with MoCap has a "double job to do", reinforcing that they have an increased cognitive workload in a Virtual Production. This research is significant because it addresses this increased cognitive workload by reducing an actor's need to construct and imagine the virtual environment during a performance. Reducing an actor's need to imagine the virtual environment during a performance means they can refocus on their primary responsibility in a production, their performance.

This research is also responding to the increased adoption of Virtual Production and how it is projected to become the standard approach to production in the future. David Morin, the chairman of the Virtual Production Committee[3], has commented on the adoption of Virtual Production, saying: "At some point, 'virtual' will be dropped, and [it] will just be considered production" (as cited in Giardina, 2006). These comments encourage the exploration of existing problems or challenges associated with the approaches found in Virtual Production because it will eventually become standard practice.

1.6   RESEARCH LIMITATIONS

Overall, this study suffered from a range of limitations, which guided the approach and design of the research. The first limitation was the lack of literature surrounding some areas of the research. Therefore, in some circumstances, the study had to rely on secondary sources. Additionally, the emergent nature of the research meant that the actors that participated in this study had limited understanding or vocabulary to describe their experiences. Therefore, an interpretative framework was adopted in the research design to address this limitation and

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[3] The Virtual Production Committee is a subcommittee of six organisations based in Hollywood, California. These organisations include the American Society of Cinematographers, the Art Director's Guild, the Visual Effects Society, the Previsualization Society, the Producers Guild of America and the International Cinematographers Guild (Giardina, 2006).

ensure the study's success. This framework enabled meaning to be derived from an actor's comments through interpretation if it was not already explicitly evident.

The second limitation was the sample size and profile of the actors that participated in the study. Ideally, the research would have benefited from engaging a large number of professional actors that have actively participated in Virtual Production. However, soliciting professional actors was outside of the scope of this study. Therefore, this study adopted a practice-led approach to expose any actors participating in the study to the process of Virtual Production and the perceptual limitation to the virtual environment during a performance.

The third limitation was the qualitative and experiential nature of the research. Overall, the study relied on anecdotal data through interviews and observations of the actors' experiences in Virtual Production. This limitation led to the adoption of action research to establish an iterative process to collect a range of data across various instances of the research. Furthermore, the resulting data from these instances were analysed and interpreted using content analysis as a method to establish a level of reliability and validity in the data. While the adoption of content analysis addressed this limitation, the interpretation relied on the researcher's personal experience and knowledge. This reliance was also considered a limitation of the study.

The final limitation was the accessibility to the equipment required to investigate strategies that facilitate or mediate an actor's perceptual experience of the virtual environment during a performance in Virtual Production. The only systems that were available or accessible for the study included an OptiTrack MoCap system and an Oculus Development Kit 2 (DK2) VR system. The OptiTrack MoCap system consisted of eighteen S250e cameras. While the system was adequate for conducting a Virtual Production, it was unable to capture facial or hand motion, which meant that the process of Performance Capture was not achievable in this study. However, this had little impact on the research because the actors were still required to

deliver a complete performance. Alternatively, the Oculus Rift DK2 VR system was an early developer prototype and was the only immersive technology that was readily available during the study. However, the Oculus Rift DK2 has limited capabilities when compared to contemporary VR technology available today.

Additionally, the Oculus Rift DK2 is known to cause simulator sickness, which restricted its use in the study. Simulator sickness is "similar to motion sickness, but can occur without any motion" (Kolasinski, 1995). The common symptoms of simulator sickness include general discomfort, apathy, drowsiness, headaches, disorientation, fatigue, pallor, sweating, salivation, stomach awareness, nausea, and vomiting (Feltham, 2017). It was essential to have techniques in place to avoid or minimise these symptoms and ensure the actor was comfortable. The following techniques outlined by Brown (2017) were adopted in this study to minimise simulator sickness. The first technique was warning the actor of the potential of getting simulator sickness and explaining the symptoms. The second technique focused on conducting short sessions in virtual reality that lasted no longer than fifteen minutes. The third technique ensured the displays were correctly adjusted so that the actor was comfortable and receiving a clear view of the environment through the VR system. The fourth and final technique immediately stopped a session if any symptoms from simulator sickness manifested (Brown, 2017).

1.7 STUDY STRUCTURE

Following this introduction, Chapter 2 details the literature and contextual review for this study. Overall, this review is by no means exhaustive, but it covers the various concepts and literature directly connected to the study. Furthermore, this chapter is categorised into three fundamental areas to provide structure to the review, which includes Virtual Technologies, Virtual Production, and Virtual Perception.

Chapter 3 details the theoretical groundwork surrounding the study's research approach, methodology, and methods. The chapter also provides insight into the research process, data collection tools, and data analysis procedures. This chapter builds on the research approach briefly outlined in Section 1.4.

Chapter 4 describes the three cycles of practice undertaken in this study. These cycles were instrumental for collecting data on the actor's perceptual experiences in a Virtual Production. Each cycle focused on a specific element of Virtual Production and investigated strategies for facilitating or mediating an actor's perceptual experience of the virtual environment during a performance. These elements included the virtual character, the virtual environment and virtual perception. This chapter also includes relevant data on the actor's experience and showcases the creative outcomes developed during this study.

Chapter 5 focuses on the critical analysis and interpretation of the data collected during the cycles of practice. This chapter follows the content analysis method and procedures outlined in Section 3.4.3. These procedures led to critical findings for the study, including the three spectra of immersion and a new conceptual framework.

Chapter 6 concludes the research by summarising the research findings from the previous chapters. Following this summary is the identification of future research that could build on the findings of this study.

Chapter 2 Literature and Contextual Review

2.1 INTRODUCTION

This chapter critically evaluates and contextualises the various concepts surrounding the research. The chapter primarily focuses on the three fundamental areas connected to this study and is by no means exhaustive. These fundamental areas include Virtual Technologies, Virtual Production and Virtual Perception. The first section covers the various systems that can be used to mix the real and virtual together in real-time. The subsequent section unpacks the various approaches and processes found in Virtual Production. The last section discusses the theory surrounding the perception and experience of reality, whether it is real or virtual. The review starts with MoCap, which is the underlying technology used to capture an actor's performance.

2.2 VIRTUAL TECHNOLOGIES

2.2.1 Motion Capture Systems

As briefly mentioned in Chapter 1, MoCap is the process of measuring and recording the data of an object's or persons position and orientation in physical space (Nogueria, 2011). The earliest form of motion capture can be dated back to the late 1800s when Eadweard Muybridge developed an approach for capturing motion by using photography to study human and animal locomotion (Dagognet, 1992; Liverman, 2004; Muybridge et al., 1981). MoCap technology has had several variations since this early form of MoCap, including technological innovations like mechanical and magnetic systems. However, more effective and efficient systems are prominent today (Trager, 1994). These efficient and effective systems include Optical, Inertial, and Markerless.

Optical MoCap uses a series of reflective markers, which are tracked by several cameras that triangulate the position of the markers in space. These cameras are calibrated to capture a

specific area called a 'digital capture volume'. The size of the volume is relative to the number of optical cameras used, the quality of the cameras, and the available physical space. Optical MoCap typically can capture facial movements, finger movements and multiple actors at the same time. There are no limitations to the objects it can capture, whether they are people, animals, or inanimate objects (Autodesk, 2009; Menache, 2000, pp. 17–21; Sharma et al., 2013).

Inertial MoCap uses small-scale inertial sensors to detect their position, rotation, and movement in space (Menache, 2000, pp. 29–30; Solberg & Jensenius, 2016). A number of these sensors are attached to the body, commonly around each joint of the subject, which is typically a person. Furthermore, these units are then set up to transmit their location in space to receivers in real-time. The benefit of this system compared with the optical system is its portability because it does not require specialised cameras or markers. Therefore, the system is not restricted by a digital capture volume, meaning it can be quickly set up in any location. The main disadvantage of the system is its restriction of capturing one actor at a time. Additionally, the system does not have a native ability to capture facial expressions, and some suits are unable to capture finger movements (Carter et al., 2013; Menache, 2000, pp. 29–30). Furthermore, Inertial systems are typically considered less accurate than Optical systems because they do not capture the absolute position of each marker. (Fleron et al., 2018; Seaman & McPhee, 2012; Solberg & Jensenius, 2016).

Unlike the Optical and Inertial systems, Markerless MoCap does not require specialised equipment or suits for capturing motion. These systems capture motion using multiple standard video cameras. The resulting video streams are analysed in real-time and focus on the changes happening between each frame to capture the motion. (Sharma et al., 2013; Shotton et al., 2011). Generally, Markerless MoCap is avoided over Optical or Inertial MoCap systems because it currently does not produce overly accurate motion data.

While each of these systems has its advantages and disadvantages, optical systems are the most widely adopted because of their accuracy and flexibility. For this reason, Optical MoCap systems have been used by most industries for over a decade, demonstrating that they are a suitable technology for just about any scenario (Okun & Zwerman, 2010). MoCap technology has a wide array of applications across several industries like entertainment, sports, medicine and computer vision (Lindequist & Lönnblom, 2004; Moeslund & Granum, 2001). However, this study focuses on the entertainment industry, more specifically filmmaking and game development. In this industry, MoCap is commonly used to record an actor's performance.

2.2.2 Performance Capture Systems

As briefly mentioned in Chapter 1, Performance Capture is used by the entertainment industry to describe the capture of an actor's emotion, not just their motion (Guerra-filho, 2005). This concept of capturing the emotion of an actor's performance is what separates Performance Capture from MoCap. Capturing an actor's emotion is achieved by completely recording their performance. Therefore, every degree of an actor's body needs to be recorded, including their body movements, finger articulations, and facial expressions. This approach was first employed in 2004 on the production of *The Polar Express* (Zemeckis, 2004) by the director Robert Zemeckis (Delbridge, 2014, p. 12; Kerlow, 2004).

Typically, Performance Capture utilises two separate MoCap systems to record the body and facial motion of an actor. Optical systems are commonly used to capture the body and fingers, but many productions are moving towards a Head-Mounted Camera (HMC) system to capture the face. These systems combine small cameras at the end of a tiny boom arm mounted to a helmet, which is worn by an actor to capture their facial expressions (A. Jones et al., 2011; Okun & Zwerman, 2010). The film *Avatar* (Cameron, 2009) provides an example of a Virtual Production that uses Performance Capture that incorporates an HMC. In this film, Sam

Worthington delivered the performance of Jake Skully, as seen in Figure 3. This film also used a camera system that could view the virtual environment during a performance.

Figure 3. Performance Capture in Avatar (Cameron, 2009)

2.2.3 Virtual Camera Systems

A Virtual Camera System (VCS) is a device that mimics the properties of traditional film cameras but provides a view of the virtual content used in Virtual Production. Typically, a VCS uses a tangible rig that is translated into the virtual environment using MoCap technology in real-time. Additionally, the tangible rig includes a display that can be used to view the virtual set instead of viewing the physical set, as seen in Figure 4. This system allows the production crew to shoot performances in ways that are inherently similar to live-action productions (Duff, 2011; Ng, 2012; Teo, 2010). While there are many different designs for virtual cameras, their objective remains the same, which is to replicate and extend the functionality of a live-action camera.

Figure 4. Example of a Virtual Camera System

There are three recent variations to the traditional VCS, called the 'Simulcam' and 'nCam'. The Simulcam is similar to a VCS but integrates a traditional film camera to enable a combined view of the live-action content and computer generated-imagery in real-time (Anderson-Moore, 2018; Götz, 2015, p. 31; Nerdeo, 2016). The nCam is a similar technology to the Simulcam but integrates Markerless MoCap technology into the system; thus, it is a self-contained camera that is not reliant on any other technology (Götz, 2015, p. 32). Recent developments of the VCS have adopted contemporary technology like tablets to create Smart VCSs. These systems utilise the tablet's inbuilt sensors to simulate the movements of a camera without the need for any specialised technology (Altman, 2014). While the VCS provides a view into the virtual environment, it is not the only way that it can be accessed.

2.2.4 Extended Reality Systems

Extended Reality (XR) is a relatively new umbrella term used to describe the range of technologies or approaches that merge the real and virtual (Liu, 2018). The Reality-Virtuality (RV) Continuum provides an example of the varying dimensions between the reality and virtuality found in XR, as seen in Figure 5. The continuum starts with the real environment denoting Real Reality (RR), which is the reality we perceive naturally in everyday life. Along the continuum is Augmented Reality (AR), a term coined in the early 1990s (Caudell & Mizell,

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1992). AR's primary experience is in a real environment, but the experience is supplemented with elements of the virtual environment (Azuma et al., 2001; Champion & Bekele, 2019). Additionally, along the continuum is Augmented Virtuality (AV), which flips the concept of AR. Therefore, an AV's primary experience is in a virtual environment, but the experience is supplemented with elements of the real environment. The continuum ends with the virtual environment denoting Virtual Reality (VR). Jaron Lanier is known for popularising the term VR in 1987 during a period of intense research activity into the technology, describing it as a computer-generated simulation of a virtual world generated in real-time (Latham, 2012, p. 148). Furthermore, VR is used to describe an experience where reality is occluded and replaced with a virtual environment (Champion & Bekele, 2019; Milgram & Kishino, 1994).
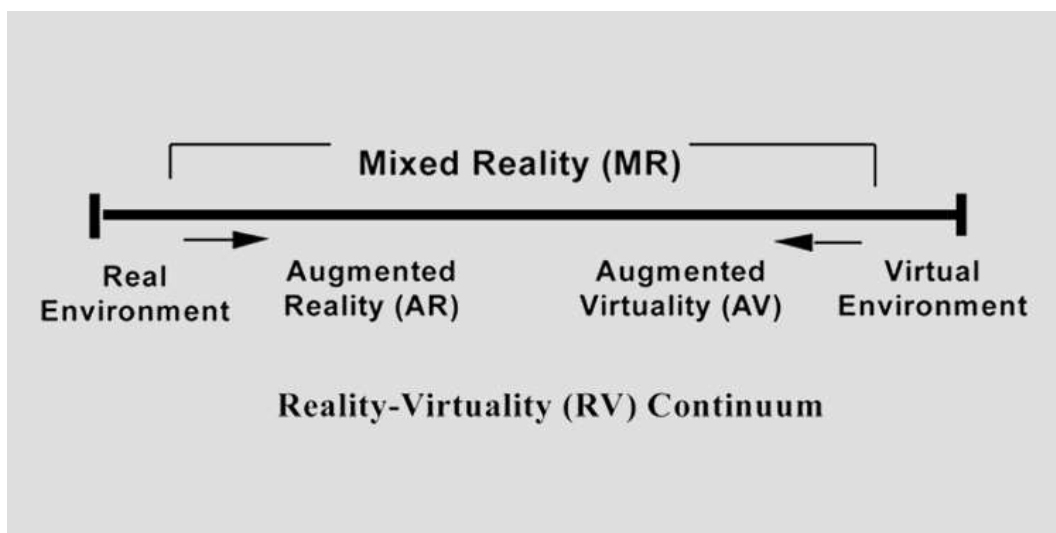
Figure 5. Reality-Virtuality Continuum (Milgram & Kishino, 1994)

Throughout this continuum, there is Mixed Reality (MR), which is a subclass of XR that involves merging the real and virtual environments seamlessly together. In some circumstances, AR, MR, and XR are confused with each other because they share a common objective, but there is a crucial difference between these terms. As indicated earlier, AR supplements elements of the virtual environment with a real environment. MR is a broader concept used to describe an approach that aims to seamlessly blend the real and virtual together as if they were the same reality (Champion & Bekele, 2019). Finally, as previously stated, XR

is an umbrella term that covers all areas of the RV Continuum. In addition to these dimensions found between the real and virtual, the continuum shows that there is a decreased awareness of RR and an increased acceptance of VR when progressing from the real environment to the virtual environment (Milgram & Kishino, 1994).

The concept of XR has a rich and extensive history dating back as far as the 1800s, but it was not until the 1930s that technology started to emerge with Stanley Weinbaum's short story called *Pygmalion's Spectacles*. This story described a vision of the future where a pair of eyeglasses along with other specialised equipment could be used to experience a virtual environment. One of the first technological developments in XR was by Ivan Sutherland in 1968. Sutherland developed the first head-mounted XR system called the 'Sword of Damocles', as seen in Figure 6 (Jerald, 2015, pp. 23–24). In addition to this development, Sutherland was the first to describe conventional computer displays as a window into the virtual world (Brooks, 1999). Today, Window on World (WoW) is used to describe desktop or screen-based XR systems. These systems typically use conventional computer monitors to display the virtual environment (Mazuryk & Gervautz, 1996).

Figure 6. The Sword of Damocles

XR systems have gone through many iterations since the development of the Sword of Damocles, and it even had a fleeting few years in the mid-1990s. However, it was not until the

start of the 21st century, with the release of the Oculus Rift, that XR systems started to gain momentum due to their sophisticated technology (Jerald, 2015, pp. 15–27). There are currently several high-profile XR systems that have launched over the past couple of years, including the Sony PlayStation VR[4], HTC Vive[5], and the Oculus Rift[6] (Huang, 2015; Leswing, 2017). Each of these systems falls into the category of VR on the RV Continuum because they replace a user's real environment with a virtual environment. There are other XR systems currently available that fall into other categories of the RV Continuum, but the technology behind these systems are only in the early stages and are not widely accessible. For example, the Microsoft Hololens[7] falls into the category of AR on the RV Continuum[8].

These contemporary XR systems typically employ a Head-Mounted Display (HMD) design to enable the experience of a virtual environment. While HMD's come in a variety of different designs solutions for accessing XR, this study adopted the use of VR HMDs throughout the research. VR HMDs typically consist of a helmet or set of goggles that have two small computer displays, one dedicated to each eye. The point of these displays is to create a perceptual experience where the virtual environment visually surrounds a user without the typical boundaries associated with conventional screens. While VR HMDs focus on the visuals, many include or support headphones to extend their capability to audio. The last element of an VR HMD is tracking technology, which tracks the head movements of the user to simulate the movements in a virtual environment. Generally, an VR HMD only tracks the head movement

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[4] For more information on the PSVR including specifications and capabilities, visit https://www.playstation.com/en-au/explore/playstation-vr/ [accessed July 2019].

[5] For more information on the HTC Vive including specifications and capabilities, visit https://www.vive.com/au/product/ [accessed July 2019].

[6] For more information on the Oculus Rift including specifications and capabilities, visit https://www.oculus.com/rift/ [accessed July 2019].

[7] For more information on the Microsoft Hololens including specifications and capabilities, visit https://www.microsoft.com/en-us/hololens [accessed July 2019].

[8] While this study aligns the Microsoft Hololens with AR, Microsoft commonly describes the device as MR technology.

of the user, but some systems can track the hand movement with specialised controllers (Charara, 2017; Moffitt, 2009).

Films like *Ready Player One* (Spielberg, 2018) and *The Lion King* (Favreau, 2019) have started to adopt XR technologies into their production pipeline. Overall, this adoption allows the director to be immersed into the virtual environment using an XR system in order to get a sense of the world and scout locations for filming in the virtual environment (Balakrishnan, n.d.; Jamie, 2018; Seymour, 2019). However, the adoption of these technologies currently focuses on the director's access to the virtual environment, overlooking the potential for using these technologies to immerse an actor. Therefore, this study placed a specific focus on the actor's experience of being immersed in the virtual environment using XR technologies before and during a performance in Virtual Production.

2.3 VIRTUAL PRODUCTION

2.3.1 Production Process

Virtual Production is a broad concept that covers the spectrum of real-time computer-aided productions in filmmaking and game development (Kadner, 2019). 'Real-time' in this study is used to describe the computer's ability to provide a quick rendered view of the virtual characters and virtual environments. Virtual Production employs a selection of virtual technologies to supplement or combine the real and virtual environments together, which leads to the creation of an AR, AV, or MR in a production. These virtual technologies were covered earlier in this chapter and include but are not limited to MoCap, Performance Capture, VCSs and XR systems. By using these virtual technologies, productions can view and manipulate virtual characters and virtual environments in real-time.

The virtual character is a concept used in this study to describe a virtual human, virtual actor, or virtual persona. All these terms represent a way to describe a computer-generated

character that is driven by an actor through Performance Capture. However, another concept used to describe a virtual character is a 'synthespian'. A synthespian is a specific kind of virtual character that focuses on the photo-realistic creation of a virtual character (Banks et al., 2015, p. 12). The primary aim of a synthespian is to be indistinguishable from real people. Another more contemporary form of a synthespian is a digital clone. A digital clone is a digital copy of a person that is typically indistinguishable from the real person. Within the contexts of Virtual Production, this is typically a digital copy of an actor (Ma & Huang, 2015). This study adopted the term 'virtual characters' over other terms because the study focused on providing a digital counterpart to an actor and not a digital copy or a character with a high level of realism.

The virtual environment is a concept used in this study to describe a computer-generated environment. However, virtual environments are synonymous with VR. Furthermore, virtual environments are considered a component of virtualisation, which is "the process by which a human viewer interprets a patterned sensory impression to be an extended object in an environment other than that in which it physically exists" (Ellis, 1995, p. 324). There are three levels of virtualisation, including virtual space, virtual image, and virtual environment (Furness, 1995, p. 25). Virtual space is the most abstract level in virtualisation and refers to the overarching perception of a virtual environment, which is similar to the interpretation of a map. Virtual image refers to the perception of space through an image, aligning with the WoW systems discussed in Section 2.2.4. Therefore, a virtual image is a screen display that provides a view of the virtual environment. Virtual environment refers to the perception of the environment without a frame, aligning with the XR systems discussed in Section 2.2.4. Therefore, this study adopted the term VR over the term virtual environment when considering virtualisation. This delineation of terms created a clear separation between a computer-generated environment and the perception of the aforementioned virtual environment using an XR system.

Virtual Production adopts the use of virtual characters and environments to create an interactive and iterative process that echoes through every stage of production. Virtual Production differs from traditional CGI in that the director is in control of the production and its outcome during a performance, as opposed to being passed on to other departments (Knopp, 2014; Peszko, 2007; Previsualization Society, 2010). This control facilitates decisions about the production during the early stages of development rather than waiting for the completion of CGI by other departments in later stages. Furthermore, it gives the director complete creative control over the production process, allowing them to make decisions and changes immediately during production rather than post-factum (Morin, 2012; Previsualization Society, 2010; Thacker, 2012b).

In addition to this creative control, Virtual Production delivers five improvements over traditional production, which include integration, iteration, interactivity, intuitiveness, and collaboration. Integration is used to describe the assimilation of all stages of a production pipeline with each other. This assimilation enables each department to take part and communicate their vision of the outcome during the production. Iteration is used to describe an iterative and nonlinear approach to the production pipeline. This iterative nonlinear approach is unlike the pipelines found in traditional productions, which are typically linear. Interactivity is used to describe the ability to make changes to virtual components in real-time. Intuitiveness describes the aspiration of Virtual Production to provide intuitive tools. The fifth and final improvement is the process of collaboration, which is used to describe the ability of each department to communicate and share their expertise during production. This collaboration enables the director to make informed decisions about their vision and direction for the production (Götz, 2015, p. 13).

Overall, Virtual Production aims to shift the linear process of filmmaking to a more agile and iterative approach. Furthermore, Virtual Production provides new approaches for working

with virtual characters and virtual environments. These improvements have shifted Virtual Production far beyond traditional production due to its adoption of an array of virtual technologies and virtual content. This adoption of virtual technologies has led to the creation of a new role in Virtual Production that focuses on managing the MoCap and Performance Capture processes.

2.3.2 The Motion Capture Technician

The role of the MoCap Technician, also known as the 'MoCap Coordinator' or 'MoCap Operator', is only sporadically and briefly mentioned in literature. For example:

> The motion capture technician sets a few details on the capture computer, the camera assistant records the slate (reference-code and take number), then [the] motion capture technician presses a button to start a capture. The performer does the required motion like running, jumping, and walking. Once finished, another press of the button stops the capture. The captured data is saved straight to a hard drive for the next use. (Izani et al., 2004, p. 364)

This description does not go far to explaining the various responsibilities of the MoCap Technician. While it is correct that the MoCap Technician presses a button to start and stop the capture, it diminishes the role by outlining one of the most straightforward responsibilities.

Another brief description of the motion capture technician can be found in research by Delbridge, where he provided more context to the responsibilities of the role, saying:

> The motion capture technician primarily maintains the camera array. The cameras can be refocused depending on the shoot undertaken, accounting for the size of the capture volume required and the sort of motion to be captured… The management of the capture software is

the responsibility of the studio technician. The use of pre-visualisation
and animation software is operated by the technician (or the animator),
but the capture director often determines its use. (Delbridge, 2014, pp.
55–57)

While this description dives deeper into the responsibilities of the MoCap Technician, it only provides a limited view of the role. It is important to note that these pieces of literature do not set out to describe the role and responsibilities of the MoCap Technician; they are merely providing context to their study. However, there is even little to no mention of the MoCap Technician in theoretical books dedicated to MoCap. These books include *The Animator's Motion Capture Guide* (Liverman, 2004), *A Practical Guide to the Art of Motion Capture* (Tobon, 2010), *MoCap for Artists: Workflow and Techniques for Motion Capture* (Kitagawa & Windsor, 2008), *Understanding Motion Capture for Computer Animation* (Menache, 2000), and *The Visual Effects Society: Handbook of Visual Effects* (Okun & Zwerman, 2010).

The only theoretical book that provides any information on the role of the MoCap Technician is *Motion Capture and Editing: Bridging Principle and Practice* (Jung et al., 2000), describing the role as:

…directly controlling the motion capture equipment, such as the
optical camera controller, managing calibration of the volume, etc.
With real-time systems, they're also ensuring the continuous
transmission of real-time motion data, and it's [*sic*] formatting with the
marker setup information from the performer. (Jung et al., 2000)

While this text is obscure and dated, it provides further context to the MoCap Technician's role and illustrates a few of their key responsibilities in Virtual Production. This text also provides

a background to the surrounding roles that are part of the MoCap process or sit in the hierarchy above the MoCap Technician role in Virtual Production.

These positions include the MoCap Supervisor, MoCap Director, and the Tracking Technician. The MoCap Supervisor oversees the MoCap process throughout production and is typically part of larger teams or projects. The MoCap Director is sometimes the supervisor but is typically the director of the production. The director works closely with the MoCap Supervisor and MoCap Technicians to ensure their vision of the production. The Tracking Technician, also known as the 'Tracking Artist' or 'Clean-up Artist', focuses on cleaning up the data (Jung et al., 2000). This role typically cleans and fixes any issues with the MoCap data collected for a production. While this text provides additional context to the MoCap Technician and outlines the relationship with other roles in the MoCap process, it still does not provide enough depth into their responsibilities.

Due to the lack of literature on the responsibilities of the MoCap Technician, the study relied on the best alternative resource for this information, professional job adverts. Ubisoft[9] describes the role of the MoCap Technician as "essential to ensuring that shoot days run smoothly and efficiently while ensuring high-quality data capture" (Ubisoft, n.d.). Monolith Productions[10] describes the role of the MoCap Technician as "responsible for setting up and maintaining the MoCap studio before, after, and during shoots" (Monolith Productions, n.d.). Industrial Light and Magic[11] have a slight variation on the title of the MoCap Technician, calling the role 'MoCap Technical Director'. They summarise this role as operating the

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[9] Ubisoft is a large international games production company that has developed and published several popular video games franchises. For more information on the company, visit https://www.ubisoft.com/ [accessed August 2019].

[10] Monolith Productions is a game production company owned by Warner Brothers Interactive Entertainment. For more information on the company, visit https://www.lith.com/ [accessed August 2019].

[11] Industrial Light and Magic is a distinguished visual effects and animation studio. For more information on the studio, visit https://www.ilm.com/ [accessed August 2019].

"motion capture system in a live-action shooting environment" (Industrial Light & Magic, n.d.). It is evident from these descriptions that the MoCap Technician's primary role is managing and maintaining the MoCap systems and data. However, each of these job adverts lists the specific responsibilities of the MoCap Technician, which provides more context to their role. These responsibilities include:

- Calibrating the capture volume as required (for example the systems, talent, actors, props and sets);

- Facilitating and conducting MoCap sessions as required by the production;

- Tracking and retargeting MoCap data onto the virtual characters and environments;

- Providing direction, feedback and assistance to actors and other roles on set when necessary;

- Ensuring the MoCap data has a high fidelity throughout the production;

- Ensuring the MoCap data has appropriate slate names and are in sync with time codes;

- Working with other production departments to fabricate reliable tracking props and sets;

- Maintaining the MoCap technology and studio equipment;

- Conducting initial clean-up of the MoCap data in preparation for the animation team;

- Contributing to the continued improvement of the MoCap process and pipelines within the studio; and

- Staying current with MoCap practices.

These responsibilities provide a holistic understanding of the role of the MoCap Technician in Virtual Production. Furthermore, these responsibilities illustrate that the MoCap

Technician is one of the most appropriate parties for addressing an actor's perceptual limitation to the virtual environment during a performance in Virtual Production. Other appropriate parties include the MoCap Supervisor or the MoCap Director because they have similar responsibilities as the MoCap Technician.

Overall, the most prominent responsibilities that enable this holistic understanding include facilitating the MoCap session, managing the various systems being used, supporting the development of the appropriate props, and assisting the actors or other roles on set when necessary. While other roles exist in Virtual Production, they do not have the same level of responsibility for an actor's experience during production. Therefore, no other role in Virtual Production has the same level of knowledge or accessibility to address an actor's perceptual limitation to the virtual environment during a performance.

2.3.3 The Performance Environment

As previously mentioned, the MoCap process typically emphasises data recording over an actor's experience in Virtual Production. This emphasis on MoCap has led to the removal of nearly every piece of stimulus for an actor during a performance, which includes make-up, lighting, costumes, set design, props, and even the actors themselves. This approach was used to minimise the occlusion of the MoCap cameras, thus minimising the time required to collect highly accurate MoCap data. 'Occlusion' is a term used to describe the obstruction of MoCap cameras, which affects their ability to capture a performance in the digital capture volume (Chen & Davis, 2000). This process of emphasising the data and not the performance is what leads to an actor's perceptual limitation to the virtual environment during a performance.

As previously mentioned in Chapter 1, an actor's perceptual limitation to the virtual environment increases their cognitive workload and distracts their attention from a performance because they have to construct and imagine the virtual environment. Furthermore, this increased cognitive workload is exacerbated when considering actors that are

inexperienced in MoCap because they are not familiar with the processes associated with the performance environment (Kade & Lindell, 2013; USA Information, 2018, p. 1783). This limited perception competes against acting theory and training, which commonly focuses on reacting fluidly and spontaneously with other actors and environments (Tanenbaum et al., 2014, p. 139). Jacques Lecoq describes this reaction, saying "reaction creates action" and "there is no action without reaction" (Lecoq, 2002, p. 89). An actor's performance is often a reaction to stimuli whether it is from internal motivations, another character, or the environment. However, as mentioned, a majority of the stimuli is removed from the performance environment in Virtual Production, which means there is nothing for an actor to react to during their performance.

In recent years, the performance environment found in Virtual Production has started to shift towards something more familiar to traditional production by reintroducing stimuli into the performance environment. This stimulus focuses on physical references and props, which are material representations of the virtual environment in the digital capture volume. Physical references are static objects such as walls, steps, trees and more. Alternatively, physical props are mobile objects such as weapons, tools, and more. It is typically not feasible to completely replicate the virtual environment because it is significantly time-consuming and costly. Therefore, physical references and props adopt the use of low-budget and simplified materials in their construction (M. Jones et al., 2008). In addition to the use of low-budget materials, physical references and props are typically designed to minimise occlusion. A wireframe design is often used during the construction of physical references to circumvent the occlusion of cameras. Behind-the-scenes featurettes of contemporary Virtual Productions commonly showcase the adoption and approaches to these physical references and props.

A short behind-the-scenes featurette from the film *Avatar* (Cameron, 2009) showcases the various approaches to physical references and props[12]. The first approach used on the production were physical props like a bow or gun. These props are used in a Virtual Production to inform an actor's performance and, in some circumstances, they are captured and translated into the virtual environment. The second approach was the use of modular scaffolding and flooring systems. These systems were used to replicate areas of the virtual environment and enable interaction with an actor during a performance. These interactions usually consist of simple interactions like walking through the environment. The third approach was the construction of a low-fidelity set. This approach was used for more complex interactions by developing accurate physical reference using low-budget construction material and landing mats. The final approach used on the production was the construction of low-fidelity vehicles. These vehicles used a metal cage combined with pulleys, wires, and levers to enable the vehicle to be pushed and pulled to simulate its movement. While this production showcases various approaches to physical references and props, it is not the only production adopting these approaches.

Generally, most contemporary Virtual Productions are starting to adopt the same or similar approaches. For example, the game development *The Last of Us* (Naughty Dog, 2013) showcases similar approaches to physical references and props in a behind-the-scenes featurette called *Grounded: The Making of The Last of Us* (Playstation, 2014)[13]. This featurette showcases the use of props, modular scaffold, flooring systems and low-fidelity vehicles.

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[12] A snippet of this behind-the-scenes featurette that showcases these various approaches to physical references and props used during the development of *Avatar* (Cameron, 2009) can be view here: https://youtu.be/P2_vB7zx_SQ [accessed November 2019].

[13] A snippet of this behind-the-scenes featurette that showcases these various approaches to physical references and props used during the development of *The Last of Us* (Naughty Dog, 2013) can be view here: https://youtu.be/LH18nGoIUKo [accessed November 2019].

While these productions showcase the various approaches to physical references and props, they do not explicitly articulate the benefit of these approaches for an actor.

However, Flueckiger has established a theory surrounding this approach, which she calls the "proxy approach". While her writings focus more on the proxy for a virtual character, she does mention that it also relates to terrain and props. The proxy approach provides on-set representations of a person or object, which enables physical interaction. In the research, Flueckiger identifies that touch is the best foundation for believability and presence for virtual characters (Flueckiger, 2011). Therefore, the adoption of physical references and props provides a higher level of perception to an actor in a Virtual Production because they can see the reference and, more importantly, they can interact and react to it.

2.3.4 Contemporary Experiences

There is a growing discourse by actors surrounding their experiences in contemporary Virtual Productions that typically focus on the challenging nature or limited perception associated with performing in a virtual environment. Valorie Curry commented directly on the challenges of Performance Capture, associating it with something inherent to the MoCap process as outlined in Section 1.2. However, Curry is not the only professional actor that has struggled with the perceptual limitation to the virtual environment during a performance. Jim Carrey, who performed in the film *A Christmas Carol* (Zemeckis, 2009), echoes some of Curry's comments by saying:

> The T-pose [is a challenge], which is a pose that you must do before they yell 'action'. It's how they log the data, and the computer recognises all the data… or that's what he tells us anyway! But personally, I feel like I hit the lottery. As far as challenges go, the challenges of the technique are that you have to create the world in your head… It really is a challenge in that regard because it's an odd thing

to stare at your acting partners and have these two prongs sticking out

of your head with four HD cameras this close to your face. There are

challenges, but there are also amazing benefits because you can do a

whole scene. You can do 20 scenes in a day. It's crazy. It's like doing

a play. You have to know it. It's the first time really that I've had to

know a script before I started. (as cited in Gomide, 2012, p. 56)

While Carrey points out the challenge of Performance Capture, he also mentions one of the

key benefits of working with Virtual Content. This key benefit is the ability to instantly change

the environment to a different location because of the virtual nature of the production.

The Hobbit: An Unexpected Journey (Jackson, 2012) provides another example of

comments on the perceptual limitation for an actor during a performance. During the

production, Ian McKellen was asked to perform separately from the other actors, who were

playing Dwarfs and Hobbits. This separation enabled the creation of a false perspective in post-

production, making him look larger than the Dwarfs and Hobbits in the scene. McKellen

described his experience of being separated by saying "…It was so distressing and off-putting

and difficult that I thought I do not want to make this film if this is what I'm going to have to

do". McKellen later added "It is not what I do for a living. I act with other people, I do not act

on my own" (as cited in Pulver, 2013). While this scene did not explicitly use Performance

Capture, McKellen still experienced a level of perceptual limitation during a performance

because he had no reference or understanding of the other characters in the scene.

In the sequel, *The Hobbit: The Desolation of Smaug* (Jackson, 2013), Benedict

Cumberbatch further established the perceptual limitation of the virtual environment during a

performance in the behind-the-scenes featurette of the film. Cumberbatch speaks about the

intrusiveness of a facial MoCap system and the imagination required by an actor during the

process of Performance Capture, saying:

This camera is really weird because it's right in your face, it's got a little circle of LED lights, so you're literally carrying around the actor's dream, you have your own little private keynote. It is really nice but actually, it's very, very weird [*sic*], and then you kind of have to forget it and imagine yourself into a vast creature [that is] in a huge space when you're really crawling around on a grey bit of carpet. (as cited in Jackson, 2014, 4:40)

These comments highlight the strange feeling the technology brings to a performance environment and how he had to ignore these feelings and imagine a large virtual environment while delivering a performance[14].

These comments from Cumberbatch are reiterated by Brain Bloom when describing his experience of Performance Capture in a behind-the-scenes video for the game development *Call of Duty: Infinite Warfare* (Minkoff et al., 2016). In this video, Bloom said:

…You've got essentially a movie crew hanging off your head, and it's always interesting to see how we keep that at bay and don't let it get in the way, and it doesn't always work. We have had some fun, you know, trying to kinda [*sic*] avoid locking horns. (as cited in Game Informer, 2016, 1:13)

Jamie Gray Hyder added to Bloom's comments in the same behind-the-scenes video saying:

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[14] The identification of challenge in Performance Capture and some of the comments made by professional performers were published as a separate paper: Bennett, J., Carter, C. (2017). Performance Capture: Split between the Fictitious and Physical World. *Apple University Consortium (AUC) Create World.*

…it's hard work [and] it requires a lot of focus. You've got your

camera here, and microphones here and you're all running around in

these silly suits, and there's all these distractions. But, everyone who

has worked on this game has brought such an integral performance to

everything. (as cited in Game Informer, 2016, 2:24)

While these comments do not provide anything new to the previously cited discourse

surrounding the actor's experience in Virtual Productions, it does reinforce previous comments

by other actors. Furthermore, these comments highlight that the challenging nature of

performing in Virtual Production exists across filmmaking and games development.

Overall, these various comments from professional actors illustrate the challenging

nature of performing in Virtual Production. While each actor was able to deliver their

performance under these challenging conditions, they all mentioned different elements that

impacted on their acting process. These elements include the amount of imagination required

while still doing the standard tasks of an actor, the distress an actor feels when performing in

isolation and the intrusiveness of the technology used for Performance Capture. While these

comments all have negative connotations, there are other, more positive comments connected

to the actor's experience in Virtual Production.

An alternate view of Virtual Production was provided by David Cage when he described

the experience as something liberating, saying:

Directing actors in performance capture is a very special job… It's not

like being a director on a set. It's probably more challenging even than

dealing with green screens. You rarely shoot an entire film in green

screen; here you shoot the entire game. So, the role of the director all

the time is to explain what's going on and try to recreate reality on set,

so the actor knows what to do. It's a very different experience for actors. On the first day you can read in their eyes 'what am I doing here? These people are crazy!'... On the second day, they seem to realize: wait a minute, I'm free. I don't know what these guys are doing, but actually, they don't give me any constraints. There is no camera, no lights, no marks on the floor, no wire of any kind. We don't need to take care of sound or anything, so I'm free to act. (as cited in Davison, 2013)

These comments start by highlighting the aim of this study, which is the need to recreate a reality onset. However, Cage goes on to describe the experience for actors in Performance Capture as "freeing" and later compares it to the sense of freedom found in minimalistic theatre (Davison, 2013). The concept of minimalistic theatre focuses on reducing the elements on-stage to emphasise the actor and their performance (Pavis, 1998). However, this comparison contradicts comments made by professional actors and overlooks two crucial factors in Virtual Production, the virtual character and virtual environment. These virtual elements are significant components of the production and should not be overlooked, which means an actor is not exactly free to act. However, they are free to act within the context of the virtual characters and virtual environments. While Cage's comments are misguided, Virtual Production can create a freeing experience for an actor, just in a different way.

Ruth Gibson and Bruno Martelli illustrated this difference in an interview where they describe MoCap technology as the new costume, saying: "Using MoCap to record movement was liberating as you did not have to be skinny or beautiful and you could become genderless" (as cited Chatzichristodoulou & Jefferies, 2016, p. 47). This comment highlights that an actor is no longer restricted by their body or location, which is what makes MoCap a powerful tool in contemporary productions. Therefore, an actor can perform as anyone, anywhere, at any

time, which is a freeing experience. Furthermore, these experiences are constantly transforming with the ever-changing landscape of Virtual Production.

2.3.5 The Changing Landscape

Clearly defining the changing landscape of Virtual Production has been difficult because the technology and approaches that they adopt are continually evolving. The company On-Set Facilities[15] provides one of the only examples for defining the landscape of Virtual Production by outlining the Virtual Production Spectrum. This spectrum has similarities to the Immersive Computing Spectrum presented during a VR keynote at Google I/O[16] in 2017 (Stein, 2017). Furthermore, both spectra have intrinsic links to the RV Continuum, discussed earlier in Section 2.2.4. Just like the RV Continuum, the Virtual Production Spectrum outlines the varying dimensions of productions moving from real to virtual, as seen in Figure 7. On the left end of the spectrum, is live-action, which denotes traditional productions situated in RR. In the middle is MR, which is used to describe approaches that combine live-action and computer-generated techniques. The end of the spectrum, is computer-generated, which denotes Virtual Productions situated in VR (On-Set Facilities, 2018).
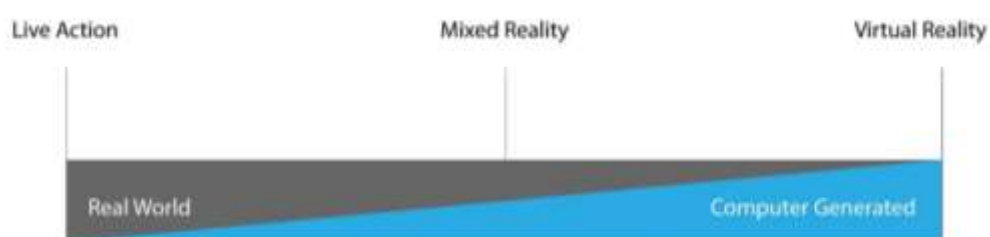
Figure 7. Virtual Production Spectrum (On-Set Facilities, 2018)

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[15] On-Set Facilities is an international company that provides hardware and software solutions for Virtual Production. For more information on the company, visit http://www.onsetfacilities.com/ [accessed September 2019].

[16] Google I/O is an annual developers conference held by Google in Mountain View, California. For more information, visit https://events.google.com/io/ [accessed November 2019].

This spectrum plays a crucial role in this study because it helps situate the investigation in the landscape of Virtual Production. The spectrum illustrates that an actor's perception of the virtual environment is limited when moving towards VR because of the adoption of computer-generated content, which an actor cannot naturally perceive during a performance. Therefore, this study focused solely on computer-generated Virtual Productions because it limits an actor's perceptual experience of the virtual environment during a performance. The other dimensions on the Virtual Production Spectrum situated in RR or MR were avoided in the study because an actor can naturally perceive the environment. This natural perception meant that an actor did not experience any perceptual limitation in these other dimensions. However, to bring further context to the Virtual Production Spectrum, a selection of films were explored and mapped to its varying dimensions.

Examples of productions that fall between RR and MR can be found in the recent *Planet of the Apes* film series, which includes *Rise of the Planet of the Apes* (Wyatt, 2011), *Dawn of the Planet of the Apes* (Reeves, 2014) and *War for the Planet of the Apes* (Reeves, 2017). These films adopted the use of active optical markers, which was a new technological approach for capturing a performance. The adoption of active optical markers removed the need to have a controlled environment (Failes, 2017). Before these films, the process of Performance Capture required a controlled environment to capture data accurately. However, this new approach enabled the accurate capture of data in any environment; thus, the digital capture volume could be moved out of the studio to a physical location, as seen in Figure 8. By capturing the performances on a physical location, the actors could perceive and interact with the environment and characters because they were real.

Figure 8. Planet of the Apes Performance Capture (Reeves, 2014)

In the film *Pirates of the Caribbean: Dead Man's Chest* (Verbinski, 2006), a similar approach for capturing an actor on a location was adopted, called 'in-Camera Motion Capture' (iMoCap). Industrial Light and Magic developed this new MoCap system[17] for use in traditional productions, unlike other MoCap systems. This system uses specialised fractal MoCap suits and a small array of high-resolution video cameras to capture an actor's performance on location (Failes, 2019; Frazer, 2006; Seymour, 2008). While this new production technique captures an actor's performance on location, it is unable to render the virtual character in real-time. This inability to render the virtual character in real-time separates this technique from Virtual Production and situates it clearly in live-action on the Virtual Production Spectrum. Therefore, live-action productions that only have a handful of virtual characters typically use this system. More recent productions that have adopted the use of iMoCap include *Teenage Mutant Ninja Turtles: Out of the Shadows* (Green, 2016) and *Beauty and the Beast* (Condon, 2017), as seen in Figure 9.

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[17] As mentioned previously, Industrial Light and Magic is a distinguished visual effects and animation studio. For more information on the studio, visit https://www.ilm.com/ [accessed January 2019].

Figure 9. in-Camera Motion Capture Examples

All the productions discussed in this section do not limit an actor's perception of the virtual environment during a performance because they use physical locations or characters. However, these strategies do not address entirely computer-generated Virtual Productions. These computer-generated Virtual Productions are typically unable to use physical locations or characters due to the fictional nature of the productions. As mentioned previously, this study focused on these computer-generated Virtual Productions and investigated strategies that facilitated or mediated an actor's perceptual experience of the virtual environment during a performance in Virtual Production.

2.4   VIRTUAL PERCEPTION

2.4.1 Perception

Perception or perceptual experience is concerned with the recognition and interpretation of sensory information, which is used to form a coherent and holistic view of the external world (Ciccarelli et al., 2009; Goldstein & Brockmole, 2009, p. 8). This study looks to facilitate or mediate an actor's perceptual experience of the virtual environment during a performance. Therefore, to enable this perception of the virtual, the study must consider how an actor perceives RR and how that perception can be facilitated or mediated into VR. One way of

understanding and interpreting perception is through the sensory systems found in the actor's body.

There are several types of sensory systems that contribute to an individual's external and internal perceptual experience of the world. External perception or exteroception is used to perceive the external world through the sensory systems of vision, audition, olfaction, gustation, and somatosensation. Vision or sight is the ability of eyes to perceive images of visible light, which generates an understanding of the space around us, including the varying colours, hues, and brightness. Vision is considered the dominant sensory system for understanding and interpreting the external world (Ciccarelli et al., 2009, p. 93; Davies et al., 2010, p. 95). Overall, this study focused on facilitating and mediating an actor's vision into VR because it is the dominant sensory system.

Audition or hearing is the ability of ears to perceive sound waves by detecting both the wavelength and amplitude of the sound. Hearing is commonly regarded as the second most dominant sense after the sensory system of vision (Ciccarelli et al., 2009, p. 100; Davies et al., 2010, p. 96). Olfaction or smell is the ability for a nose to perceive odours or scents floating in the air. This system integrates with the sense of gustation to form the perception of flavours (Ciccarelli et al., 2009, p. 107; Goldstein & Brockmole, 2009, p. 356). Gustation or taste is the ability of tongues to perceive flavours. (Ciccarelli et al., 2009; Goldstein & Brockmole, 2009, p. 366). Somatosensation or touch is a complex network of sensory receptors found all over the body. This sense includes the ability to perceive pain, pressure, tension, temperature, texture, shape, weight, contours, and vibrations (Ciccarelli et al., 2009, p. 108).

Additionally, somatosensation has a connection to internal perception or interoception, which includes senses of proprioception and equilibrioception. Proprioception or kinesthetic sense is the ability for a body to perceive the relative position of its limbs in space. Equilibrioception or vestibular sense is the ability for a body to perceive movement and

direction as well as maintain equilibrium and balance (Ciccarelli et al., 2009, p. 108; Goldstein & Brockmole, 2009, p. 330). Merleau-Ponty described this process of internal perception as the body schema, which is the body's intuitive understanding of its movement in space. Additionally, Merleau-Ponty argued that it is only through our lived bodies that we can access the physical world or what he describes as the "primary world" (Merleau-Ponty, 2013). In other words, without the body, there is no way to perceive the world, whether it is real or virtual. While sensory systems provide a way to understand and interpret how an actor perceives and experiences the world, it is not the only way we can approach perception and experience.

2.4.2 Phenomenology

Phenomenology is a common approach to research inquiry surrounding perception and experience. Modern phenomenology is credited to the German philosopher and mathematician, Edmund Husserl (Denzin & Lincoln, 2005, p. 484). Phenomenology focuses on exploring people's perceptions and experiences of the world and what it means to them (Langdridge, 2007). Therefore, phenomenology focuses on how people perceive objects and events. There are two significant schools of phenomenology called transcendental and hermeneutic.

Transcendental or descriptive phenomenology takes a detached approach to the experience and focuses on the descriptions of the phenomena. This detached approach uses a process called 'bracketing', which reduces or removes researchers' preconceived ideas or personal opinions from the study. Hermeneutic or interpretive phenomenology differs from transcendental phenomenology because it takes an attached approach to the experience. This attached approach focuses not only on the descriptions of the phenomena but also the interpretation of these descriptions by relating it to relevant features of context (Kafle, 2011). In this research, the focus is on an actor's experience, which means an actor intrinsically completed some level of interpretation. Additionally, preconceived ideas were what prompted the research to be explored, making it difficult to bracket. For these reasons, the school of

hermeneutic or interpretive phenomenology aligns with the circumstances of this research and, therefore, was adopted in the study's research design as outlined in Chapter 3.

When considering phenomenology, theory on the four existentials can be used to understand and interpret people's experiences of the external world. These existentials include lived body, lived space, lived time and lived other. Lived body or corporeality refers to our body or bodily presence in the world. Specifically, it is our subjective experience of our body and its interaction with the world. Lived space or spatiality refers to felt space or our subjective experience of space. Lived time or temporality refers to the subjective experience of time as opposed to the more objective clock time. Lived other or relationality refers to the relations we make or maintain with others. Our relations include the communications and relationships we experience with others through space and interactions we share and create with them. While these existentials offer specific points of focus, they are generally not separable; that is, they are interwoven and interact with one another in the exploration of experience (Rich et al., 2013; Van Manen, 1997). All four of these existentials heavily rely on our sensory systems to form an understanding of the world, which were discussed in Section 2.4.1.

While these four existentials provide a specific approach to understanding and interpreting an actor's experience of the external world, some have more weight in this study than others. Corporeality has a connection to an actor's experience of the virtual character because they are both related to the body. Spatiality has a connection to an actor's experience of the virtual environment because they are both related to space. Therefore, the investigations conducted in this research focused on the existentials of corporeality and spatiality. Using these concepts found in perception and phenomenology provided a means to explore, interpret, and discuss an actor's perceptual experience. However, this study also explored strategies to facilitate and mediate an actor's perceptual experience of the virtual environment during a performance, which has a deep connection with the concept of immersion.

2.4.3 Immersion

Janet Murray provides one of the more popular definitions of immersion, describing it as:

> A metaphorical term derived from the physical experience of being submerged in water. We seek the same feeling from a psychologically immersive experience that we do from a plunge in the ocean or swimming pool: the sensation of being surrounded by a completely other reality, as different as water is from air, that takes over all of our attention, our whole perceptual apparatus. (J. Murray, 1997, p. 98)

This definition uses a helpful metaphor of the ocean or swimming pool to explain the concept of immersion. It is the complete perceptual experience of being integrated into another reality. In this study, this other reality is virtual, which includes the virtual characters and virtual environments used in Virtual Production. However, immersion is not absolute and has varying levels of experience, depending on the strategies used to integrate a person into this other reality.

One of the more prominent strategies of immersion is the adoption of various virtual technologies that help mediate a person's perceptual experience into the virtual. One study explored this strategy by breaking immersive technologies into five capabilities, including inclusive, extensive, surrounding, vivid, and matching. Inclusive indicates how much of the RR is occluded. Extensive indicates the range of sensory systems accommodated through the technology. Surrounding indicates visual presentation, more specifically the amplitude of the field of view that ranges from limited to panoramic. Vivid indicates the resolution, fidelity, and quality of visuals delivered through the technology. Matching indicates whether the visuals of the technology accurately match the user's movements by updating the information affected by motion (Slater & Wilbur, 1997). Additional research builds on these five capabilities to establish three Levels of Immersion, including low, moderate, and high. Using these levels,

they consider how existing technology map to the capabilities. Furthermore, this additional research established a clear table that identifies the levels of immersion, as listed in Figure 10 (Miller & Bugnariu, 2016).

Level	Inclusive	Extensive	Surrounding	Vivid	Matching
Low	Numerous signals indicating the presence of device(s) in the physical world (e.g. use of a joystick or mouse to control the virtual environment)	Only accommodates one sensory system (e.g. auditory, visual, proprioceptive); stimuli are not spatially oriented	Computer monitor presentation with limited field of view	Low fidelity and visual/colour resolution; display may replicate features of the simulated environment, but not in a detailed or specific manner	No MoCap; visual experience does not match proprioceptive feedback
Moderate	Some signals indicating the presence of device(s) in the physical world (e.g. noise from a computer fan, weight and movement restriction from wearing a safety harness)	Accommodates 1–2 sensory systems (e.g. auditory, visual, proprioceptive); stimuli may or may not be spatially oriented	Large-screen projection with extended field of view	Moderate fidelity and visual/colour resolution; display replicates some features of the simulated environment, but some detail may be missing	Body segment MoCap (e.g. head, hand); visual experience somewhat altered to match proprioceptive feedback based on head or body segment movement
High	Limited signals indicating the presence of device(s) in the physical world (e.g. the weight of a head mounted display or an eye-tracking device)	Accommodates > 2 sensory systems (e.g. auditory, visual, proprioceptive); stimuli are spatially oriented	Head-mounted display or surround projection	High fidelity and visual/colour resolution; display closely replicates multiple features of the simulated environment in detail (e.g. correctly placed, dynamic shadows)	Full-body MoCap; visual experience altered to closely match proprioceptive feedback based on whole body movement

Figure 10. Levels of Immersion (Miller & Bugnariu, 2016)

Inside this concept of immersion are several other concepts that orient the different elements associated with perceptual experience. Two significant concepts exist within immersion, which includes presence and embodiment. Each concept has varying definitions and influence on each other but plays an essential role in clarifying immersion. It was important to unpack and define these concepts in the context of this study because immersion plays a pivotal role in facilitating and mediating perception.

Before discussing presence in the context of virtual environments, it is important to consider the concept in relation to non-virtual or real environments. Presence generally refers to the sense of being there (Skarbez et al., 2018; Slater & Usoh, 1993). Presence in any

environment occurs by processing sensory information through our external and internal sensory systems (Furness, 1995, p. 475). These sensory systems include vision, audition, olfaction, gustation, somatosensation, proprioception, and equilibrioception, which were discussed in Section 2.4.1. Alternatively, achieving a sense of presence in a virtual environment is a common goal explored in VR research. This calls for a dampening awareness of reality and a heightened awareness of virtual reality (C. D. Murray & Sixsmith, 1999). Therefore, presence in the context of a virtual environment refers to a sense of being there through the adoption of visual, auditory, or force displays generated by a computer (Sheridan, 1992). Overall, presence in a virtual environment or virtual presence is achieved by manipulating the sensory information received by our sensory systems using the virtual technologies discussed in Section 2.2.

Presence is a broad topic and includes various sub-components like telepresence and co-presence. Telepresence refers to the experience of presence through a remote machine (Minsky, 1980; Steuer, 1992). In other words, telepresence is the sense of being there even though the operator's perception may be through a machine in a remote location. Telepresence was avoided in the study because it is more interested in creating a sense of being there in a real environment. Co-presence refers to "a condition in which instant two-way human interactions can take place" (Zhao, 2003, p. 446). If we consider the concept of presence as being there, then co-presence is the concept of being there together (Schroeder, 2002; Skarbez et al., 2018). Exploring co-presence was outside the scope of this study due to the magnitude of organising productions and multiple actors.

Embodiment is a popular term that has been defined in multiple ways across literature (Wilson, 2002). However, this study is interested in embodiment as it relates to the perception of the world. Merleau-Ponty helps define embodiment in relation to the body and the world, saying "to be a consciousness or rather *to be an experience* is to hold inner communication

with the world, the body and other people, to be with them instead of being beside them" (Merleau-Ponty, 2013, p. 111). In other words, embodiment is the experience of the world through our body and its sensory systems. Overall, it is not possible to develop a perceptual experience without embodiment (Csordas, 1990). This notion is important for understanding embodiment in a virtual environment because it is founded on our sensory systems.

Embodiment in a virtual environment or virtual embodiment is achieved by manipulating the sensory information received by our sensory systems using the virtual technologies discussed in Section 2.2, which creates the illusion that the virtual character is the primary mode of perception. There are three aspects of virtual embodiment, which includes a sense of self-location, agency, and body ownership. The sense of self-location refers to the spatial experience of a person's body in the virtual. The sense of agency refers to the experience of being in control of the virtual character, specifically, how a person's movements translate to the virtual. The sense of body ownership refers to the person's self-attribution of the virtual character to their own body. Achieving these three aspects of virtual embodiment means that a person has accepted the virtual character as their new body (Gonzalez-Franco & Peck, 2018; Kilteni et al., 2012)

While using virtual technologies enables a sense of virtual embodiment, these technologies also interfere with this process. This interference is caused by the ability to sense the virtual technologies which anchors a user to the real environment. Its only through the transparency of these virtual technologies that this interference is removed, and virtual embodiment can be truly achieved. However, Merleau-Ponty's concepts on the body schema suggest that virtual technologies could become an extension of the body. He proposes that the body schema is not restricted to the internal perception of the body, it can be extended using various objects it interacts with. Merleau-Ponty gives an example of this extension, describing a blind man who uses a walking stick to aid his perception of the world. Overtime, the blind

man uses the stick as though it was an extension of his own body (Merleau-Ponty, 2013, pp. 175–177). Therefore, it is possible that overtime these virtual technologies will become an extension, leading to true virtual embodiment.

Both presence and embodiment are two distinct concepts that have a direct relationship with each other when considering immersion. Therefore, achieving immersion into VR requires a sense of presence and embodiment. Embodied presence is observable in VR when a user interacts and reacts with the virtual characters and environment as if they were there. This level of immersion in a virtual environment is not an absolute perceptual experience, it can be experienced in varying dimensions. However, for a user to be considered totally immersed into a virtual environment they should be able to grasp at virtual assets or develop a natural emotional response to the environment or characters (Schubert et al., 1999). This level of immersion can only be achieved using an ideal immersive system. An ideal immersive system enables the user to physically walk around objects and touch those objects as if they were real (Jerald, 2015). While this would be the recommended approach for a Virtual Production, a total level of immersion in a virtual environment has yet to be achieved. Therefore, this research looks to establish a multi-tiered approach that synthesises a range of strategies that aim to provide a high level of immersion.

It is important to note that embodiment is also embedded in concepts surrounding acting and performance. Andy Serkis helped illustrate the idea of embodiment, saying it's the process of "believing we're murderers, lovers, etc" (as cited in Pizzo, 2016, p. 10). Therefore, the primary aim for an actor is to embody the character to deliver a believable or authentic performance. The notion of an authentic performance is derived from the term authenticity, which refers to the ability to be genuine or to accurately reflect the true essence of something (Van Leeuwen, 2001, pp. 392–393). Therefore, an authentic performance is one that seems genuine, natural, or accurate. Alternatively, an inauthentic performance seems faked, forced,

or imitative (Henderson & Gabora, 2013). However, in many instances, an authentic performance is subjective. Therefore, it is common for a director to make judgments about the authenticity of a performance to ensure they have a desirable outcome for the production. Overall, the embodiment of a character is the gateway to an authentic performance. However, the process of embodiment in Virtual Production is disrupted for an actor during a performance because of their increased cognitive workload of constructing and imagining a virtual environment, which was discussed in Section 2.3.4.

2.4.4 Related Studies

Currently, there is a range of recent studies that have investigated an actor's perceptual experience using various virtual technologies in the context of Virtual Production. These studies have a direct connection with this research because they establish immersive approaches for an actor to experience a virtual environment during a performance. While these studies had a direct relationship, it was critical to build or diverge from these studies to provide a meaningful contribution to knowledge. These related studies included *Virtual Reality Rehearsals for Acting with Visual Effects* (Bouville et al., 2016), *Towards Immersive Motion Capture Acting* (Kade, 2014), *Historical Origins, Properties and Implications of Performance Capture* (Delbridge, 2014) and *Actors and Acting in Motion Capture* (Pizzo, 2016).

The study by Bouville, Gouranton, and Arnaldi (2016) looked at using VR technology to help actors when rehearsing scenes that include visual effects. The findings of the research revealed that VR trained actors operated at the same level as classically trained actors. Furthermore, it found that actors preferred VR rehearsals over traditional rehearsal (Bouville et al., 2016). While this study provided outcomes for creating an interactive and immersive environment, its primary focus was on immersing an actor during rehearsal. This study expanded on this approach by exploring an actor's immersion across a whole production.

The study by Kade (2014) played a crucial role in this study because it initially identified an actor's perceptual limitation to the virtual environment during a performance in Virtual Production. However, the findings of the research looked to address this problem by developing new wearable technology that immersed an actor during a performance. The outcome of the research was an initial prototype of a lightweight head-mounted projector, which visualised the virtual environment in front of the actor during a performance (Kade, 2014). While this new approach addressed the problem, it only provided a constrained perceptual experience of the virtual environment during a performance. This study, by contrast, adopted pre-existing technology or approaches and focused on creating an unconstrained perceptual experience of the virtual character and virtual environment. This unconstrained perceptual experience was achieved by adopting several strategies to facilitate or mediate the actors experience of the virtual environment. The strategies adopted included onboarding, actor fatigue, character anatomy, physical reference, floor markers, and visual immersion.

The study by Delbridge (2014) explored how an actor adapts to the technology used in Virtual Production. A series of experiments were conducted in the study to help actors situate themselves in a digital capture volume and deliver a performance with a limited perception of the virtual environment (Delbridge, 2014). While this study provided interesting approaches for working in a virtual environment, it emphasised the technology in Virtual Production over the actor. This emphasis is in direct contrast with the approach in this study, which looks to move away from emphasising the technology and shift the approaches used in Virtual Production back to the actor.

Pizzo (2016) identified that both studies from Kade and Delbridge stressed a lack of physicality for an actor in Virtual Production, connecting it to a flaw with the technology. Physicality is a concept that is used to describe the attributes of a person, their appearance, movements, and personality. Physicality concerning performance is described by Leach (2013)

as "the material presence of a body in space" (p. 183). Physicality is typically attributed to how an actor performs as a character, which includes movements, gestures, poses and facial expressions (Leach, 2013, p. 17). Therefore, physicality refers to the embodiment of the character and how an actor uses their body to deliver a performance. However, in Virtual Production, an actor is no longer performing for their body; they are performing for the body of the virtual character. This change disrupts the actor's process of embodiment, which impacts on their ability to develop a physicality for the virtual character.

While all these studies provide valuable approaches to addressing the challenges felt by an actor performing in a virtual environment, they do not entirely address the underlying cause of the problem. Overall, each of these studies focuses on a single technology or approach to address an actor's perceptual limitation to the virtual environment during a performance in Virtual Production. Therefore, this study departed from a single technological approach by establishing a multi-tiered approach to facilitate or mediate an actor's perceptual experience of the virtual environment during a performance.

2.5   CONCLUSION

This chapter highlighted the various literature and concepts surrounding the study by examining technologies and approaches adopted in contemporary Virtual Production. Additionally, this chapter placed the study in computer-generated Virtual Productions on the Virtual Production Spectrum discussed in Section 2.3.5. These productions enable the investigation of an actor's perceptual limitation to the virtual environment during a performance. Furthermore, this chapter identified the MoCap Technician as the most appropriate parties for addressing this perceptual limitation for an actor in Virtual Production. Therefore, the findings of this study were tailored for the MoCap Technician to encourage its adoption into the process of Virtual Production.

Chapter 3 Research Design

3.1 INTRODUCTION

This chapter outlines the research design adopted for this study to achieve the aims and objectives stated in Section 1.3. Overall, the chapter provides the theoretical groundwork concerning the research approach, paradigm, and methodology, including justifications on the relevance to the study. Additionally, the chapter describes the methods used to carry out the research such as the adoption of experimental productions that facilitated data collection, approaches adopted for collecting data during these productions, and procedures for analysing the collected data once the productions were complete.

3.2 APPROACH AND PARADIGM

This study adopted a qualitative approach informed by a phenomenological paradigm. Qualitative research is described as an inquiry that seeks to study and understand a phenomenon surrounding a social or human problem (Creswell, 2014, p. 4). Qualitative research was chosen for the study because it focuses on the experience and perception of participants rather than quantifiable variables. In the circumstance of this study, the phenomenon investigated focused on an actor's perceptual experience of the virtual environment during a performance. This focus on perception grounds the study within an interpretive framework required for qualitative research and the phenomenological paradigm. Phenomenology specifically explores an event, activity or phenomenon (Creswell, 2014, pp. 13–14). Phenomenology was discussed in detail in Section 2.4.2 and identified as an approach for understanding and interpreting an actor's perceptual experience in this study. The qualitative and existential nature of this study promoted the adoption of the practice-led methodology to enable the exploration and interpretation of an actor's experience in Virtual Production.

3.3 METHODOLOGY

The practice-led methodology is concerned with the process of practice and leads to new understandings about practice (Candy, 2006). Gray defined practice-led research as:

> …initiated in practice, where questions, problems, and challenges are identified and formed by the needs of practice and practitioners, that the research strategy is carried out through practice, using predominantly methodologies and specific methods familiar to us as practitioners. (Gray, 1996, p. 3)

Therefore, this methodology encourages the adoption of practice as a method to conduct the research. Gray went on to describe practice-led research as a form of "naturalistic inquiry, which places the researcher firmly within the research process, often as a participant" (Gray, 1996, p. 4). This naturalistic inquiry aligns with the interpretive framework used in this study, which encourages the researcher to take an active role in the research.

Additionally, a series of action research cycles were employed to enhance the practice-led methodology and provide structure to the investigation conducted through practice in this study. Schön described action research by stating "when a practitioner becomes a researcher into his own practice, he engages in a continuing process of self-education" (Schön, 1984, p. 299). Furthermore, Schön distinguished between two fundamental processes of action research, which include reflection in action and reflection on action. As these categories imply, reflection in action requires a practitioner to think about a situation and the actions taken while it is occurring. In contrast, reflection on action requires a practitioner to systemically and deliberately review the actions taken after each action is completed (Schön, 1987).

The combination of practice-led research and action research methodologies aligns with the approach of Kemmis and McTaggart (1988). Their approach builds off the contributions of

Schön by identifying the iterative process in the action research methodology. This iterative process is broken into four distinct stages, commonly referred to as a cycle of practice in practice-led methodologies. These stages include plan, act, observe, and reflect, as illustrated in Figure 11. The cycle begins with a planning stage, which involves designing an approach to the cycle. The completion of the planning stage leads to the action stage, which involves implementing the plan for the cycle. The observation stage is commonly integrated with the action stage and is used to document the effects of the action taken during its implementation. This documentation in the observation stage enables the use of reflection in action. The final stage of reflection is used to review all elements of a cycle after the action has been carried out. This reflection stage also enables the use of reflection on action. The outcomes of each cycle are subsequently used to inform the following cycle, feeding the iterative process found in action research (Kemmis & McTaggart, 1988).
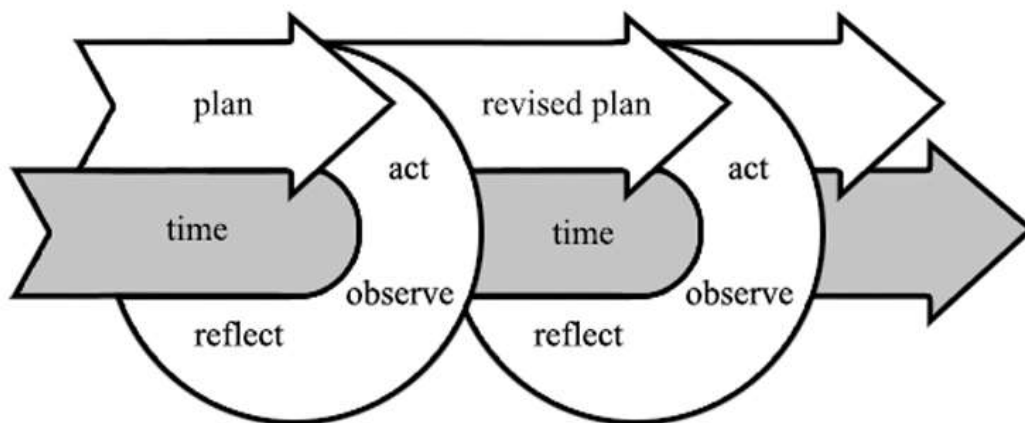
Figure 11. Action Research Model (Kemmis & McTaggart, 1988)

3.4 METHODS

The following methods were chosen for this study because they enabled a distinct approach for investigating strategies that facilitate or mediate an actor's perceptual experience of the virtual environment during a performance in Virtual Production. Additionally, these methods align with the research approach and methodologies adopted in this study. Furthermore, the research

problem and methods were validated early in the study through professional conversations with motion capture technicians during studio visits to House of Moves and Digital Domain located in Los Angeles. While these professional conversations were undocumented, it provided confirmation that the research was valid and relevant for the wider industry.

3.4.1 Experimental Productions

This study conducted a series of experimental productions through three cycles of practice. Each cycle focused on the development of an experimental production, which was used to investigate an actor's perceptual experience of the virtual environment during a performance. This investigation tested various strategies that facilitated or mediated an actor's perceptual experience of the virtual environment in order to reduce the cognitive workload of imagining the virtual environment during a performance. Each experimental production focused on the development of a short animated film and followed the production pipeline outlined by Isaac Kerlow. The pipeline consists of three typical production phases, which includes pre-production, production, and post-production (Kerlow, 2009, pp. 77–78). Using this approach benefited the study because the production phases align with the stages found in action research.

The pre-production phase aligns with the planning stage in a cycle of practice. This phase typically begins with the development of a script, storyboard[18], and animatic[19] for the film. The resulting storyboards and animatic were used to inform the design of the virtual characters and virtual environments, which were crucial for investigating an actor's perceptual experience in Virtual Production. Additionally, time was spent identifying the strategies that were adopted

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[18] A storyboard is a two-dimensional visualisation of a story that is usually produced as a series of thumbnail sketches. The storyboard sketches demonstrate essential information for the story like the performance, staging and framing of each shot in an animation (Kitagawa & Windsor, 2008, p. 15).
[19] An animatic uses the thumbnail sketches of the storyboards and turns them into a roughly animated video. The animatic demonstrates the performance, camera moves, special effects and sound of each shot in the animation (Kitagawa & Windsor, 2008, p. 15).

in the experimental production to facilitate or mediate an actor's perceptual experience of the virtual environment during a performance in Virtual Production. This phase also included short tests or explorations conducted separately from the development of the short animated film. Even though these tests were only used to inform the production of the short animated film, they also provided small outcomes for the research. These short tests were named minor cycles of practice', and the short animated films were named 'major cycles of practice'. These names clearly outlined the level of contribution to this study and their relationship with each other.

The completion of the pre-production phase led to the production phase in the pipeline, which aligned with the action and observation stages in a cycle of practice. The production phase comprised of a series of 'production sessions', which was a term adopted in this study to describe the time allocated for the Performance Capture process with an actor in the production. The number of production sessions scheduled was dependent on the length and complexity of the short animated film and availability of the actors and collaborators contributing to the production. These production sessions were a critical component to the study because it enabled the investigation and data collection on the phenomenon, which focused on an actor's perceptual experience during a performance in Virtual Production.

The first step in these production sessions was the construction and preparation of the MoCap technology to meet the needs of the production. These needs varied depending on the number of actors used in the production and the physical needs of the performance. The setup typically utilised an OptiTrack[20] Optical MoCap system that comprised of 18 S250e cameras. This camera array enabled the creation of a rectangular digital capture volume with a floor space of nine metre squared and a height of three metres. In addition to this MoCap system,

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[20] OptiTrack is a company that focuses on providing high end optical MoCap hardware and software solutions. For information on the company, visit https://optitrack.com [accessed November 2019].

each production used a WoW System, which was typically a large projection screen that could be used to view a virtual image of the virtual environment. Once these systems were set up, time was spent capturing the actor's performance and experience of the virtual environment.

Furthermore, these production sessions were designed to include a warm-up period, rehearsal takes, and recorded takes. The warm-up period enabled the actor to familiarise themselves with the various elements used in the production. This warm-up period also enabled the calibration and test of the MoCap and WoW systems used in the production to ensure it was ready before moving into rehearsal and recorded takes. The rehearsal takes were used to help the actor to develop an understanding of the performance in the shot, which included the exploration and adjustments of their performance as the virtual character. The recorded takes were used to capture an authentic performance that would eventually be adopted into the final animation.

The completion of the production phase led to the post-production phase in the pipeline, which aligned with the reflection stage in a cycle of practice. This phase began with the creation of a short behind-the-scenes documentary that collated and showcased a relevant selection of data streams from the cycles of practice. The documentary was designed to complement the experimental productions and showcase the intrinsic links between the theory and practice in this study. Furthermore, the creation of the behind-the-scenes documentaries encouraged the process of reflection on action. In addition to unpacking and reflecting on the production outcomes, time was typically spent supporting the completion of the short animated films and resolving any issues in the outcome of the animation. Chapter 4 includes a detailed exploration and description of these processes for each cycle of practice.

3.4.2 Data Collection

This study employed interviews and observations as the primary data collection tools during the production sessions of each experimental production. Interviews are the process of

conducting face-to-face, telephone, or video chat discussions where the researcher asks open-ended questions to encourage the participant to talk about their views and opinions around the research (Creswell, 2014, p. 190). There are three approaches to interviewing a participant, including structured, semi-structured, and unstructured. These approaches outline how many predetermined questions are used during the interview and the flexibility of the conversation (Bell & Waters, 2014, pp. 179–182). This study adopted the semi-structured and unstructured approaches to interview the actors who participated in the study. These interview approaches enabled an open and free-flowing conversation with the actors and allowed the use of pre-determined and organically formed questions during the practice and interviews. A selection of the pre-determined questions used in this study are listed below:

- What is your name?

- What is your performance background?

- Have you ever been in a virtual production or used motion capture before?

- What were your general thoughts on working in a virtual production?

- What are your general thoughts on Virtual Reality?

- What were your thoughts on the relationship between the virtual world and the physical world during your performance?

- Did you find physical props helpful in the production?

- Did you find projected reference of the virtual world helpful?

- Did you find being immersed with the Virtual Reality Headset helpful?

- Did you find anything limited your performance during the production?

- Are there any suggestions you could make to improve your experience of the virtual world?

- Are there any other thoughts you had about your experience in the production?

- Do you think immersing the performer into the virtual world will become common place in the industry?

- Would you be interested in working in an immersive virtual production again?

Each of these questions focused on collecting data on the actor's performance background or their perceptual experience participating in the experimental productions. Furthermore, additional questions outside of these pre-determined questions were used in this study, which organically formed during the cycles of practice. Overall, Unstructured interviews enabled a formative tactic during a cycle of practice to explore actions taken by an actor during a production session. Alternatively, semi-structured interviews enabled a summative tactic at the end of each cycle of practice to explore an actor's complete experience in the production. In addition to these interview approaches, this study also adopted observations as another method for data collection.

Observations are the process of documenting the behaviour and activities of participants involved in the research, which is commonly achieved by taking field notes (Creswell, 2014, p. 190). There are several different approaches to observations, which are dependent on the researcher's degree of involvement in the study. Spradley categorises these degrees of involvement as complete, active, moderate, passive, and non-participation. These approaches outline the level of involvement a researcher takes when interacting with the participants in the study (Spradley, 1980, pp. 58–62; Williamson & Johanson, 2017, pp. 413–414). This study adopted active participation as the degree of involvement when utilising the observation method.

Therefore, the role of the MoCap Technician was typically allocated to the researcher in this study to achieve this level of involvement, which firmly places them in the experience with the actors. Overall, this role enabled the direct observation of the actors during a production session and enabled the investigation of the various strategies being tested to facilitate or

mediate their perceptual experience of the virtual environment. Additionally, a MoCap Technician is one of the most appropriate roles in Virtual Production for addressing an actor's perceptual limitation to the virtual environment during a performance, which was identified in Section 2.3.2, encouraging the allocation of the role to the researcher. Furthermore, this role and its resulting degree of involvement in the study align with the phenomenological and practice-led methodologies.

In addition to these methods, this study also adopted secondary methods of data collection to capture the visual and audio spectra of each production session through multiple data streams. These secondary methods were a fail-safe to ensure the capture of each element of the actor's experience for reflection and analysis. Furthermore, these data streams aided the creation of short behind-the-scenes documentaries of the experimental productions, which were used to showcase the connection between theory and practice in this study. The various data streams include:

- MoCap data of the performances captured by the MoCap system;

- Screen capture data of the computers streaming the actor's performance;

- Video capture data of the digital capture volume;

- Video and screen capture data of the VCS when applicable; and

- Video or audio capture data of the interviews with the actors.

3.4.3 Data Analysis

The data collected from the cycles of practice through previously discussed observations and interviews were analysed using content analysis. Content analysis, also known as qualitative analysis or qualitative content analysis, focuses on understanding the contextual meaning in textual data (Budd et al., 1967; Hsieh & Shannon, 2005). There are three approaches to content analysis, including conventional, directed, and summative. The conventional approach is used

when existing theory or research literature on the phenomenon is limited. Using this approach, the researcher typically avoids using preconceived ideas and categories, instead they allow categories and names to flow from the data. Furthermore, if the data collected in this approach is primarily through interviews, then probes should be open-ended or specific to the participant's comments rather than to a pre-existing theory. The directed approach is used when existing theory or research literature is incomplete or would benefit from further description. The goal of the directed approach is to validate or extend a conceptual framework, theoretical framework, or theory in general. Using this approach, the researcher is guided by the existing research using the theory for initial coding categories. The summative approach begins with identifying and quantifying certain words or content in the existing theory. This quantification focuses on the usage rather than to infer any meaning. This quantified data is then interpreted to find broader or underlying meaning (Hsieh & Shannon, 2005; Mayring, 2004).

This study adopted a conventional method of content analysis due to the emergent nature of Virtual Production explored in this research. Furthermore, to facilitate this method of conventional content analysis, any preconceived ideas or categories in the research were avoided during the initial analysis; however, the existing theories of corporeality and spatiality from phenomenology were eventually adopted to help inform and focus this analytical process. The procedure undertaken to conduct this analysis followed the seven stages outlined by Spiggle, which include categorisation, abstraction, comparison, integration, dimensionalisation, iteration, and refutation (Spiggle, 1994).

These procedures for content analysis comprise of two overarching categories, including research tactics and fundamental analytical processes. Iteration and refutation are research tactics that ensure rigorous outcomes for a study. Iteration involves moving through data collection and analysis in reoccurring stages. Refutation involves deliberately subjecting the emerging inferences, categories, or continuums to empirical scrutiny. It involves purposely

exploring all aspects of these areas, whether positive or negative (Spiggle, 1994). The process of iteration and refutation were both used during the practice-led component of the study. This study achieved a process of iteration by using the action research methodology to structure the practice. Alternatively, this study achieved a process of refutation by purposely limiting an actor's perceptual experience of the virtual environment during a performance in Virtual Production. The remaining stages of categorisation, abstraction, comparison, integration, and dimensionalisation all focus on the process of analysis. They enable the construction of a coherent interpretation and explanation of the data. Chapter 5 includes a detailed exploration and discussion around these analytical processes. However, a short exploration of these stages concerning this study are covered below.

3.4.3.1 Categorisation

Categorisation is the process of classifying or labelling textual data (Spiggle, 1994). The process of categorisation is inherently related to a typical qualitative analysis process called 'coding', which was the process adopted in this study. Coding is the process of analysing textual data by breaking it down into delineating concepts (Creswell, 2015, p. 156). In the conventional approach to content analysis, an inductive method is encouraged during the coding process to enable meaning to emerge from the data. Additionally, this process of coding is repeated several times to ensure the categorisation of all aspects of the content in the data (Burnard, 1991; Elo & Kyngäs, 2008; Hsieh & Shannon, 2005).

3.4.3.2 Abstraction

Abstraction builds on the process of categorisation and focuses on identifying broader themes by creating general groups or conceptual classes from the categories found in the textual data (Spiggle, 1994). During this process, this study adopted the concepts of corporeality and spatiality from phenomenology to help connect the existential nature of the actor's experiences captured during the categorisation process. Before moving into the process of comparison, the

resulting conceptual classes from the abstraction process were assessed and scrutinised to identify their relevance to the study.

3.4.3.3 Comparison

Comparison explores differences and similarities across incidents within the data collected (Spiggle, 1994). During the categorisation and abstraction process, a level of comparison was completed implicitly to form the conceptual classes in this study. However, a process of more in-depth comparison was conducted to make these classes more explicit by discussing and comparing the data from each identified conceptual class across the cycles of practice. Furthermore, the relevance of each conceptual class was evaluated to ensure that the categorisations linked to each class during the abstraction process were appropriate. If the categorisations were not appropriate, then they were linked back to the other existing conceptual classes or disregarded from further analysis.

3.4.3.4 Integration

Integration is the process of connecting or building theories into the analysis that is grounded in data (Spiggle, 1994). This study achieved a process of integration by connecting the relevant existing theory discussed in this study to the conceptual classes identified during the initial analysis of the data. However, in some circumstances, new theories were introduced into the study to help clarify any unanticipated findings that formed during the initial analysis.

3.4.3.5 Dimensionalisation

Dimensionalisation involves identifying properties of the conceptual classes identified during analysis (Spiggle, 1994). Overall, the process of dimensionalisation is not an explicit requirement for content analysis. However, the nature of the study calls for this process because the actor's perceptual experience in Virtual Production is not absolute. They can have varying perceptual experiences between the real and virtual during a performance in Virtual Production. Furthermore, existing theory that explores the divide between the real and virtual commonly

uses a spectrum or continuum to illustrate their varying dimensions, which encourages dimensionalisation in this study.

3.4.4 Participants and Roles

The success of this study required access to actors to test and explore their perceptual limitation to the virtual environment during a performance in Virtual Production. Therefore, amateur, pro-amateur and professional actors were invited to contribute to the study as research participants. The terms amateur, pro-amateur, and professional actors are used to delineate the level of experience each actor brought to the study. Amateur actors had little to no experience in acting, pro-amateur had some level of formal training or some experience in acting, and professional actors had professional experience in the industry as an actor. The participating actors in this study included three amateurs, two pro-amateurs, and one professional. Furthermore, the professional actor was the only participant that had extensive experience in Virtual Production. However, all three amateur actors were familiar with the processes and technology associated with Virtual Production. While actors were crucial participants in the research, my role as a researcher was just as important when considering the interpretive nature of the study.

The roles I adopted in this study typically centred around the position of a MoCap Technician, as previously mentioned in this chapter. However, in the first cycle of practice, I took the role as an amateur actor. In both these roles, I was an active participant in the research during the production sessions in each cycle of practice. Furthermore, due to the numerous roles required for the development of each short animated film, multiple collaborators were required to contribute to the production of each film to ensure their completion. These collaborators were used to facilitate the development of the short animated films required for the study, but their contribution was not part of the research. Each collaborator had creative input into the production and acknowledged in the credits of the short film for their

contribution. In some circumstances, I took the role as a collaborator in a production to ensure their completion.

3.5 ETHICAL CONSIDERATIONS

This study was considered a negligible risk research project in which there was no foreseeable risk of harm or discomfort to participants. Any foreseeable risk was no more than an inconvenience as approved by the University Human Research Ethics Committee at the Queensland University of Technology (ref: 1500000023). However, several considerations were made to ensure that researchers and participants were comfortable when contributing to the study. These considerations included travel requirements for participants, an actor's comfort and safety during a production session, and attribution for creative contribution to a production.

3.6 CONCLUSION

This chapter outlined the research design and approach used to conduct this study. The chapter highlighted the research paradigm, methodology, and methods, which addressed the experiential nature of the study. Overall, the study took a qualitative approach, which was informed by a phenomenological paradigm and interpretative framework. It also included the adoption of the practice-led methodology, which was structured by action research. This methodology was used to conduct three cycles of practice to investigate an actor's perceptual limitation to the virtual environment in Virtual Production. These cycles of practice were used to capture data on the actor's experience of these strategies through interviews and observations. A detailed exploration and description of these cycles of practice are covered in Chapter 4. The resulting data collected during these cycles of practice were analysed using conventional content analysis, which led to the development of a new conceptual framework that can be used to diagnose and increase the level of immersion for an actor performing in

Virtual Production. A detailed discussion surrounding this analysis and the resulting framework is covered in Chapter 5.

Chapter 4 Cycles of Practice

4.1 INTRODUCTION

The following chapter details the creative practice conducted in this study. As mentioned in Chapter 1, these cycles of practice were crucial to the study because it enabled the investigation of strategies that facilitate and mediate an actor's perceptual experience of the virtual environment during a performance. The strategies that were explored in these cycles included onboarding, actor fatigue, character anatomy, physical reference, floor markers, and visual immersion. The onboarding strategy was used to facilitate the actors understanding of the virtual content by using a WoW or VR System. The actor fatigue strategy explored the impact of introducing a rising call for physically demanding performances on an actor. The character anatomy strategy explored how differing and divergent anatomies affected an actor during a performance. The physical reference and floor marker strategy was used to facilitate the actors understanding of the virtual environment by using objects and props to represent virtual content in the digital capture volume. Lastly, the visual immersion strategy was used to mediate the actors perceptual experience of the virtual environment during a performance using VR technology. Figure 12 shows a breakdown of these strategies in relation to the cycles of practice. Additionally, Further exploration and discussion of these strategies can be found throughout this chapter.

Cycle of Practice	Experimental Productions	Strategies	Creative Outcomes
Exploring the Virtual Character	• *VIMMA Project* • *Powers Above*	• Onboarding • Actor fatigue • Character anatomy	• Short BTS for *VIMMA Project* • Short BTS for *Powers Above* • *Powers Above* animation
Exploring the Virtual Environment	• *DeepBlue and the Perff Bots* • *Automancy*	• Onboarding • Physical reference • Floor markers	• Short BTS for *Automancy* • Short BTS for *DeepBlue and the Perff Bots* • *Automancy* animation
Exploring Virtual Perception	• Production test • *Lost for Words*	• Onboarding • Physical reference • Visual immersion	• Short BTS for the *Production Test* • Short BTS for *Lost for Words* • *Lost for Words* animatic

Figure 12. Cycles of Practice Breakdown

The structure of this chapter follows the action research methodology identified in Section 3.3, which includes plan, act/observe and reflect. Relevant findings for the study are detailed throughout each cycle of practice and include observations, semi-structured interviews, and unstructured interviews. Throughout this chapter a process of reflection in action and reflection on action was conducted. Reflection in action was achieved by collecting data on the observations and interviews conducted in the cycles of practice. Alternatively, refection on action was achieved through the creation of short behind-the-scenes documentaries. Any analysis during the reflection process in this chapter focused on informing and improving the subsequent cycles of practice. However, a detailed analysis of the data collected in this chapter can be found in Chapter 5.

4.2   CYCLE 1: EXPLORING THE VIRTUAL CHARACTER

The following section describes the first cycle of practice, where I collaborated on the development of the short animated film, *Powers Above*. This experimental production was used to explore strategies that focused on an actor's connection with the virtual character in Virtual Production. Initially, no direct approach or strategies were planned for this cycle of practice. Instead, the cycle focused on organically identifying strategies through practice that

emphasised an actor's connection with the virtual character. This connection included building a physical awareness of the virtual character and understanding their relationship with the virtual environment before or during a performance. The creative outcomes for the first cycle of practice are embedded below and include the *VIMMA Project* behind-the-scenes documentary as seen in Figure 13, the *Powers Above* behind-the-scenes documentary as seen in Figure 14, and the *Powers Above* animation as seen in Figure 15. Additionally, a complete list of the creative outcomes conducted as part of this study can be found in the Appendices.

Figure 13. VIMMA Project Behind-the-Scenes Documentary

Figure 14. Powers Above Behind-the-Scenes Documentary

Figure 15. Powers Above Animation

4.2.1 Plan

The planning stage started with the development of two virtual characters and a sci-fi-themed virtual environment. These virtual assets were initially developed by two artists collaborating on the production. The development of the virtual characters and environment were vital to exploring the connection between the actor and virtual character during the cycle of practice. Each character was designed with vastly different anatomies, as seen in Figure 16, enabling an array of different experiences for the actor during their performance. The first virtual character, named Mara or commonly referred to as The Enforcer, was an armour-clad female character with a standard human anatomy. However, the second virtual character, named Mondrak or commonly referred to as The Troll, was based on a vastly different anatomy. The Troll had a muscular torso, elongated arms, and short stubby legs, but still towered over The Enforcer virtual character. These vastly different designs were adopted as a strategy in the cycle of practice to explore how different anatomies affected the actor during their performance.

In addition to these virtual characters, a virtual environment was developed to enable strategies for facilitating an actor's perceptual experience of the virtual environment during a performance in Virtual Production. The virtual environment was designed as a sci-fi-themed

space station to complement the design of the virtual characters. This station was housed inside a giant asteroid and centred around one single large open room to emphasise a sense of isolation. The station was cluttered with boxes, dirt and a range of bulkhead doors to give it a military feel, as seen in Figure 17.

Figure 16. Virtual Characters Developed for Powers Above

Figure 17. Virtual Environment Developed for Powers Above

In addition to these virtual assets, storyboards and an animatic were produced to establish the story for the production with the support of collaborators contributing to the production. These story elements also enabled the exploration of the movements required for the performance. Therefore, during the design of the storyboards, opportunities were explored to

increase the actor's performance requirements in each shot. In the end, each shot was designed to be more physically demanding and complex than the last until the climax of the story. The structure of these shots and their physical demand on an actor were adopted as a strategy in this cycle of practice to assess the impact of fatigue on an actor during a performance. Towards the end of the planning phase, two production sessions were scheduled to test the previously identified strategies and capture the performances for *Powers Above*.

Before moving into the production phase of the first cycle of practice, I was recruited to be part of an international project. This project was called the *Virtual Intermedial and Mixed Reality Performance in Live Production and Creative Contexts Project*, abbreviated to the *VIMMA Project*. The project aimed to explore ideas around user-centred concepts and production solutions for MR and sensor-based performance in live productions (University of Tampere, 2014). The project held multiple workshops that expanded on areas around Performance Capture. I collaborated in one of these workshops, held at Aalto University in Helsinki, Finland. The primary purpose of this workshop was to explore various approaches to mapping two or more actors to an individual virtual character in real-time. While the *VIMMA Project* did not directly align with this study, it still provided an opportunity to explore areas of this study before moving into the production phase of the first cycle of practice. For this reason, the *VIMMA Project* was treated as a minor cycle of practice in this study and was used to inform the major cycle of practice.

During this minor cycle of practice, I took the role as one of the actors and discovered the benefits of exploring the various systems used in the production. Additionally, during this minor cycle of practice, a WoW system was used that enabled the participants to view the virtual characters. As an actor in this process, I found that having time to view and explore the virtual characters through a WoW system enhanced my understanding and confidence delivering a performance as the character. This approach had correlations with the concept of

onboarding, which is the act of bringing a novice into a system (Zichermann & Cunningham, 2011)[21]. In the context of Virtual Production, the concept of onboarding enables an actor to explore the systems and processes associated with the production before rehearsing or delivering a performance.

Therefore, the concept of onboarding was adopted as a primary strategy in the cycle of practice and integrated into the warm-up period of a production session. Overall, the onboarding strategy was adopted to facilitate an actor's understanding of the virtual content by engaging their external perception through their sense of vision before a performance. This perception was achieved using the WoW system, which enabled them to view a virtual image of the virtual environment and construct a physical awareness of the virtual character. The onboarding strategy was also used to allow an actor to get comfortable with the MoCap technology and experience the size of the digital capture volume before delivering a performance.

After the completion of the *VIMMA Project*, the last element of the planning stage required for the major cycle of practice was the recruitment of an actor. However, in this first cycle of practice, I took the role of the actor instead of recruiting one. This decision was encouraged by the direct insights gained from taking the role of the actor in the *VIMMA Project*. Furthermore, the practice-led methodology encourages naturalistic enquiry by firmly placing the researcher in the research. By immersing myself in the centre of the research as the actor, I was able to gain first-hand experience of the perceptual limitation to the virtual environment during a performance, which helped inform the approach and analysis of the research.

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[21] The concept of onboarding originated from the field of human resources where it is used to help a new employee adapt to a new workplace (Werner & DeSimone, 2011).

4.2.2 Action and Observation

The production phase started with a warm-up period, which enabled the implementation of the onboarding strategy identified in the minor cycle of practice. This strategy dedicated a short period of time to the actor to adapt to the various systems in the production and develop an understanding of the virtual environment and virtual characters, as discussed in the planning stage of this cycle. Overall, this strategy enabled me to walk around the empty digital capture volume while viewing my relationship with the virtual character and virtual environment using the WoW system. After the short warm-up period, I was prepped and directed to perform each shot as both The Enforcer and The Troll. Another strategy identified in the planning phase focused on actor fatigue and how it affected the overall performance. This strategy took a linear approach to the story by using a shot list that matched the order of the animatic and conducted multiple takes until the director was satisfied with the performance. Each of these shots started with multiple rehearsal takes where I was guided by the director. Once the director was satisfied with the outcomes of the rehearsal takes, we moved on to the recorded takes.

The first few recorded takes captured for *Powers Above* were simple to achieve, and there were no significant issues with the performance. As the story progressed, the shots became more demanding, both physically and mentally, which increased my fatigue as the production session progressed. As we progressed through each shot, more time was needed to achieve the performance because it had multiple queues, more exuberant movements, and stronger emotional requirements. After the completion of each shot, I observed that I became less focused and more disgruntled, even with short breaks and hydration. This lack of focus became especially apparent at the end of the production session where the most physically demanding shots were left to complete, and the gradual effect of fatigue had taken over. Therefore, a significant break was taken to refresh and overcome this lack of focus. After the break, it did not take long to achieve the remaining shots.

An observation I made during these performances was the time required to deliver an authentic performance as each virtual character. Achieving an authentic performance as The Enforcer was relatively easy and little to no time was needed to develop an understanding of the virtual character. Additionally, I found the performance to be straightforward due to The Enforcer's military background, which led me to perform with stiff, calculated, and confident movements to represent the characters formal military training. However, achieving an authentic performance for The Troll was more demanding when compared to The Enforcer. This demand was due to the design of the virtual character, which typically required movements to look heavier and more powerful to create an authenticity. Therefore, more time was needed to develop an understanding of the virtual character. In the end, I was able to hone my performance for The Troll through intense practice and by continually reviewing how my movements translated to the virtual character using the WoW system. This intense practice led to several rehearsal takes being conducted for each scene before moving into a recorded take, which was the performance used in the final production.

Another observation made during the production was the penetration of virtual assets, which impacted on the authenticity of the performance. As a result, further direction and rehearsal takes were required to overcome this issue. In some circumstances, penetration was unavoidable, and the director opted to fix it in post-production. However, towards the end of the production session, the director elected to introduce floor markers and physical references into the digital capture volume to help minimise the penetration issue. These physical references consisted of readily available makeshift material objects and were used to represent a selection of virtual assets in the virtual environment. After the production session, time was spent conducting a short interview with the support of the director. This interview was led by the director, who asked me questions about my perceptual experiences of the virtual character and virtual environment during the production session. By having the director lead the

interview I was able to focus on my answers to the interview questions. The transcripts of this interview can be found in the Appendices and further discussion and analysis can be found in Chapter 5.

4.2.3 Reflection

Throughout this cycle of practice, interviews and observations were conducted to capture data on the actor's experience of the strategies adopted in the production. This data was used to reflect on the outcomes of the cycle of practice and create a short behind-the-scenes documentary for the *VIMMA Project* and *Powers Above,* which are embedded in Section 4.2 or listed in the Appendices. The process of reflection only took a fundamental approach when exploring the data to inform the direction of the second cycle of practice. A more in-depth exploration of the data collected in this cycle of practice can be found in Chapter 5.

Reflecting on the data found that the onboarding strategy had the most impact on facilitating the actor's perceptual experience of the virtual character. While it did not provide a way to experience the virtual character during a performance, it did allow the actor to build a strong understanding of the virtual character beforehand. This strong understanding was achieved by enabling the actor to view the virtual character using the WoW System so they could develop a physical awareness of the virtual character. Alternatively, the other strategies of actor fatigue and character anatomy had little impact on the actor's perceptual experience, but they did hinder the actor's process. Therefore, additional time is needed to effectively deliver performance if an actor becomes fatigued or the virtual character's anatomy significantly diverges from the actor. The data from this cycle also showed that the physical reference was adopted almost instinctively by the director during the cycle of practice. While the use of physical reference was not a considered approach for this cycle of practice, it became apparent that it provided the actor with a perceptual experience of the virtual environment

during a performance. This perceptual experience of the virtual environment helped the actor to deliver a more authentic performance by minimising their penetration of virtual assets.

The completion of the first cycle of practice enabled the adoption of the findings from the reflection process into the second cycle of practice. Overall, the onboarding strategy successfully facilitated the actor's perceptual experience and understanding of the virtual character. This finding led to the adoption of the onboarding strategy in the second cycle of practice. Additionally, the instinctive adoption of makeshift material objects in this cycle of practice provided a clear direction for the second cycle of practice because they enabled the actor to experience the virtual environment in the digital capture volume. Therefore, the second cycle of practice focused on the actor's experience of the virtual environment and the use of physical reference.

4.3   CYCLE 2: EXPLORING THE VIRTUAL ENVIRONMENT

The following section describes the second cycle of practice, where I collaborated on the development of the short animated film, *Automancy*. This experimental production built upon the findings of the first cycle of practice and was used to explore strategies that focused on an actor's connection with the virtual environment in Virtual Production. This cycle of practice adopted the physical reference strategy due to its instinctive emergence in the first cycle of practice. The creative outcomes for the first cycle of practice are embedded below and include the *DeepBlue and the Perff Bots* behind-the-scenes documentary as seen in Figure 18, the *Automancy* behind-the-scenes documentary as seen in Figure 19 and the *Automancy* animation as seen in Figure 20. Additionally, a complete list of the creative outcomes conducted as part of this study can be found in the Appendices.

Figure 18. DeepBlue and the Perff Bots Behind-the-Scenes Documentary

Figure 19. Automancy Behind-the-Scenes Documentary
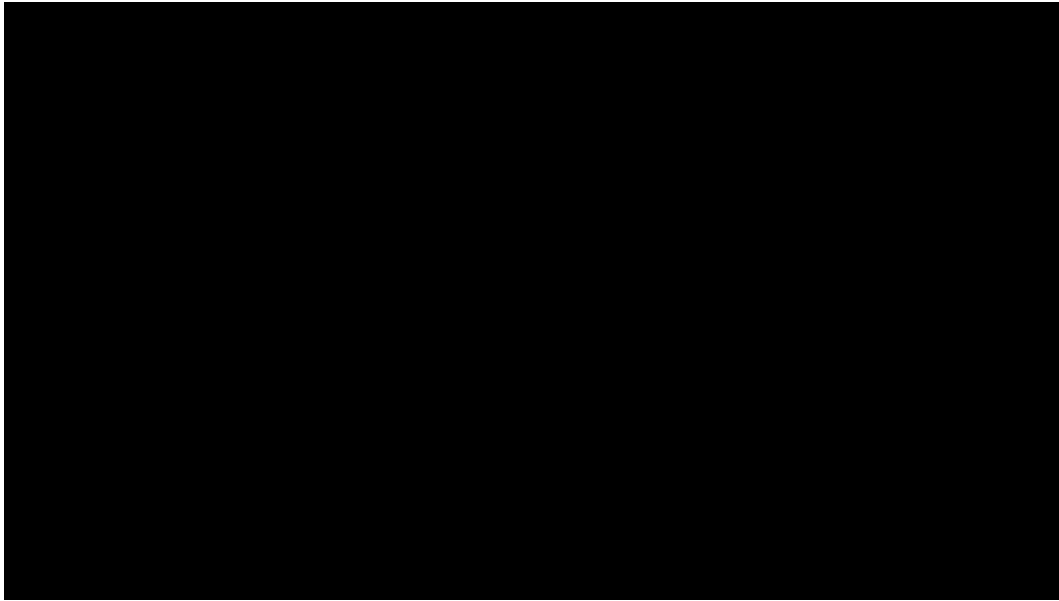
Figure 20. Automancy Animation

4.3.1 Plan

The planning stage for this cycle was shorter than the first cycle of practice because I had little to no involvement in the development of the virtual assets required for the production phase. The development of these virtual assets was completed by other collaborators that were leading the creative direction of the film. In addition to these completed assets, this cycle of practice adopted the identified strategies from the first cycle, which included the physical reference and onboarding strategy. The onboarding strategy allocated time to the actor at the start of the production session to adapt to the technology used in the production and develop an understanding of the virtual characters. In this cycle, the onboarding strategy was expanded to include the exploration and understanding of the virtual environment. The physical reference strategy provided an opportunity for the actor to externally perceive the virtual environment in the digital volume through their sense of vision and touch. With the completion of the virtual assets being covered by other collaborators in the production, time was spent planning any remaining elements needed to move into the production phase successfully. This process started by exploring the properties and design of the virtual characters and virtual environments developed for the production phase.

Overall, the virtual characters developed for the production phase were identical in their design. Both characters were designed with a standard human anatomy except for a long giraffe-like neck and were called 'Slenders'. While they were identical in design, variations were made to the Slenders' height and colour to create a differentiation between the two characters, as seen in Figure 21. The first Slender was shorter and coloured with a muted brown to symbolise his age and wisdom. The second Slender was slightly taller than the first and coloured with a vibrant green to symbolise his youth. The design of these characters included defined facial features, unlike the virtual characters from the first cycle of practice. While these virtual characters had facial features, they were not captured during the production session because the MoCap system utilised in the production was unable to capture facial movements. Instead, animators collaborating on the production crafted the facial performance by hand in post-production.

The virtual environment developed for the production was a small fantasy-themed room that complemented the design of the virtual characters and the story. The design of the room centred around an apothecary, which was tight and cluttered to meet the needs of the story. The room had a range of virtual assets that included seats, shelves, tables, books, and potions. While the room had a range of virtual assets, it was not quite complete at the time of the production phase. The environment was still missing texture or colour detail and some virtual assets, as seen in Figure 22. However, because the production only focused on capturing the performance, a completed virtual environment was not needed in the production phase.

Figure 21. Virtual Characters Developed for Automancy

Figure 22. Virtual Environment Developed for Automancy

With these virtual assets complete, it was now possible to identify opportunities to use physical references and props to enable the actor's perceptual experience of the virtual environment. Typically, this process of identifying physical reference would have been completed in tandem with the design of the virtual environment to encourage iteration, which is commonly found in Virtual Production. However, due to tight deadlines required for the production this iterative process was not possible, which led to a more linear approach to designing the environment and identifying physical references. Therefore, the identification of these references and props started with the analysis of the virtual environment and storyboards

after their completion to isolate virtual assets that had a substantial amount of interaction with the actor during a performance. These virtual assets were given an essential status to identify that they were imperative for enabling an actor's performance. In the end, only three virtual assets were deemed essential for the production session and had a high level of interactivity with an actor. The first essential virtual asset was the table centred in the middle of the room, which had significant interactions with an actor in nearly every shot. The second essential virtual asset was the shelves, which housed multiple items and had minor interactions with an actor in a couple of shots. The third essential virtual asset was a potion, which was housed on the shelf and had some significant interactions with an actor in a couple of shots.

The identification of these essential virtual assets enabled the procurement of material objects that provided physical references to the virtual environment during a performance. A crucial aspect to consider when sourcing these material objects was whether they were MoCap-friendly. MoCap-friendly objects aim to minimise occlusion of the MoCap cameras, so they always have a line of sight on the actor. Therefore, it was not possible to use a table as a physical reference because it would occlude a large area of the digital capture volume. In the end, the procured material objects included a selection of black pedestals and an industrial spray bottle, as seen in Figure 23. The black pedestals were considered MoCap-friendly and provided physical references for the table and shelf. Alternatively, the industrial spray bottle provided a physical prop for the potion.

Figure 23. Material Objects Used as Physical References and Props

With the material objects identified, time was spent recruiting actors for the production phase. However, there was not enough time available to do a call-out for acting talent. In the end, the animators collaborating on the production, which included Beth Liddle and Jongki Daniel Seo, volunteered their time to become amateur actors in the production. While both animators had a limited background in performance, their experience from developing the animation informed their understanding of the requirements of the production phase.

During the planning stages of this second cycle of practice, I was also recruited to support *Robotronica* by collaborating on the development of a short experimental animation using MoCap technology. *Robotronica* is a biennial event that showcases the latest innovations in the fields of robotics, technology and interactive design, and is held at the Queensland University of Technology (Robotronica, n.d.). The animation was a component of the 2015 closing performance of *Robotronica* called *DeepBlue and the Perff Bots*, which centred around an acrobatic performance that included a live orchestra and over 40 performing robots. While the closing performance did not directly align with this study, it enabled the early exploration and experimentation of the onboarding and physical reference strategies, which led to its adoption as a minor cycle of practice.

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4.3.2 Action and Observation

In the production phase, I took the role of the MoCap Technician and supported the director in capturing the actor's performance. The production session started with the calibration of the MoCap system, which mimicked the set-up in the first cycle of practice. During this period, Beth Liddle and Jongki Daniel Seo explored the virtual characters and environment using the WoW system. Furthermore, this period was spent setting up the physical references and props for the virtual environment in the digital capture volume. These physical references included the essential virtual assets identified during the planning stages of this cycle of practice.

The physical reference included three black pedestals that were used to represent the virtual table and shelf. The physical props included an industrial spray bottle that was used to represent prop for the potion. A comparison of the physical reference in the digital volume and the virtual environment can be seen in Figure 24. During the setup of these references, the actors were used to measure the accuracy and placement of the physical reference and floor markers in the digital capture volume by interacting with them as virtual characters. Additionally, floor markers were introduced to provide an additional reference of the table.

Figure 24. Physical Reference and Virtual Environment Comparison

With the physical reference and floor markers set up, the actors were provided time to explore the virtual characters using the onboarding strategy. This strategy helped the actors

develop an understanding of how their movements translated to their virtual counterpart and the various systems used in the production. During this exploration, I observed that the actors found it difficult to deliver an authentic performance due to the virtual characters' elongated necks. This difficulty was especially apparent when the actor accidentally penetrated the head of the virtual characters with their hand when trying to scratch their own head in thought. While there were several solutions to accommodate this issue, the director opted to continue the production session and encouraged the actors to use the anatomy of the virtual character to deliver their performance. Therefore, to overcome this issue and accurately portray this interaction with the virtual characters head, the actors had to imagine that their head sat above their own, as seen in Figure 25. Furthermore, the elongated head of the virtual character did not accurately represent the movements of the actor's neck or head. This inaccurate representation meant that any neck or head movement made by the actor was nearly unnoticeable on the virtual character. This inaccurate movement was an unanticipated issue with the design of the virtual character. While it would have been feasible to fix the issue, the director opted to continue with the production session and address the issue during the post-production phase of the animation. However, to minimise this inaccuracy the actors exaggerated their head movements during a performance to achieve an authentic performance.

Figure 25. Virtual Characters Head Interaction

After the actors had a clear understanding of the virtual characters, they were prepped and directed to perform each shot. The director took a leading role in this process, advising the actors on their performance. During these rehearsal takes, the director swapped between observing the actor's performance and the outcome of the performances applied to the virtual characters through the WoW system. In some circumstances, the director even played back the rehearsal takes to the actor to point out areas of improvement. Once the director was satisfied with the rehearsal takes, we moved on to recorded takes. These recorded takes were easy to achieve due to the rigorous approaches used in the rehearsals. After the production session, time was spent conducting a short interview with the two amateur actors and the director from the cycle of practice. During this interview, the actors and director responded to questions that focused on their perceptual experiences of the virtual character and virtual environment during the production. The transcripts of this interview can be found in the Appendices and further discussion and analysis can be found in Chapter 5.

4.3.3 Reflection

Throughout this cycle of practice, interviews and observations were conducted to capture data on the actor's experience of the strategies adopted in the production. This data was used to reflect on the outcomes of the cycle of practice and create short behind-the-scenes documentaries for *DeepBlue and the Perff Bots* and *Automancy,* which are embedded in Section 4.3 or listed in the Appendices. The process of reflection only took a fundamental approach when exploring the data to inform the direction of the third and final cycle of practice. A more in-depth analysis of the data collected in this cycle of practice can be found in Chapter 5.

Reflecting on the data reinforced the findings on the first cycle of practice and confirmed that the onboarding and physical reference strategy were successful at facilitating or mediating an actor's perceptual experience of the virtual environment during a performance. When

considering the onboarding strategy, it continued to have the most impact on facilitating the actor's perceptual experience and understanding of the virtual character. This trend continued with the physical reference strategy, which provided the actors with a mediated perceptual experience of the virtual environment during a performance.

The completion of the second cycle of practice enabled the adoption of the findings from the reflection process into the third and final cycle of practice. Overall, each strategy used in this cycle of practice successfully facilitated or mediated an actor's perceptual experience of the virtual environment during a performance. This finding led to the adoption of the onboarding and physical reference strategy in the third cycle of practice. However, these strategies only focus on an actor's external perception of the virtual character and virtual environment. Therefore, the final cycle of practice incorporated an actor's internal perception of the virtual character and virtual environment by adopting XR technologies into the pr.

4.4 CYCLE 3: EXPLORING VIRTUAL PERCEPTION

The following section describes the third and final cycle of practice, where I collaborated on the development of the short animated film, *Lost for Words*. This experimental production was used to explore strategies that facilitated and mediated an actor's perceptual experience of both the virtual characters and virtual environments during a performance. The cycle of practice specifically focused on using XR technology as a strategy to mediate an actor's perceptual experience in a virtual environment as the virtual character. Furthermore, this cycle of practice revisited strategies used in previous cycles to investigate their impact when used in conjunction with each other. Overall, this final cycle of practice was the most ambitious because it aimed to revisit all the findings from previous cycles of practice and address missed opportunities in this study. The creative outcomes for the first cycle of practice are embedded below and include the *Production Test* behind-the-scenes documentary as seen in Figure 26, the *Lost for Words* behind-the-scenes documentary as seen in Figure 27, and the *Lost for Words* animatic as seen

in Figure 28. Additionally, a complete list of the creative outcomes conducted as part of this study can be found in the Appendices.

Figure 26. Production Test Behind-the-Scenes Documentary

Figure 27. Lost for Words Behind-the-Scenes Documentary

Figure 28. Lost for Words Animatic

4.4.1 Plan

The planning stage of the third and final cycle of practice started with the recruitment of a professional actor. This recruitment was deemed a crucial component for the cycle of practice because it was considered a missed opportunity in the study because the previous cycles only employed amateur actors with little to no formal training in acting. In the end, Lorin Eric Salm opted to participate in the research and was an ideal candidate for the study. Lorin had an extensive history of performance within mime, theatre, film and television. Once Lorin was identified as the professional actor, time was spent collaborating on the pre-production for *Lost for Words*.

The pre-production for the film included the development of a script, virtual characters and a virtual environment. All these elements were required to adequately test the various strategies employed in this final cycle of practice. Two of these strategies were carried over from previous cycles of practice and included the onboarding and physical reference strategies. The third strategy focused on mediating an actor's perceptual experience of the virtual environment using XR technology. Therefore, a significant amount of time was spent to establish a way to integrate XR technology with the MoCap system used in this study.

In the end, this study integrated the Oculus Rift DK2 VR system[22]. This system was one of the most capable systems available on the market during the cycle of practice. The use of the Oculus Rift DK2 was adopted as the primary strategy in this cycle and named the visual immersion strategy. This strategy enables an actor's external perception of the virtual environment by immersing their vision into the virtual environment during a performance. Furthermore, this strategy enables an actor's internal perception of the virtual character providing a sense of embodiment. This sense of embodiment provides an actor with self-location, agency, and body ownership when immersed in the virtual environment using the Oculus DK2. Further discussion of embodiment concerning immersion can be found in Section 2.4.3. Overall, the visual immersion strategy enabled the actor to become the virtual character during a performance.

While the integration of the Oculus Rift DK2 was successful, it disrupted the process of Performance Capture. The leading cause of this disruption was the HMD design of the system, which occluded the face of the actor, thus restricting the ability to record their facial movements. Therefore, it was not possible to completely record an actor's performance when using the visual immersion strategy. In the circumstance of *Lost for Words*, the MoCap system adopted for the production could not capture the face, so there was no impact on the production. Additionally, there was no impact on the research because it focused on the experience of using the VR system and not on the outcomes of the MoCap data or animation.

After the integration of the Oculus Rift DK2, time was spent developing the various elements needed for the production. This process started with the development of an original story, a screenplay, character designs, storyboards, and an animatic. Several collaborators

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[22] The Oculus Rift DK2 is a discontinued VR system. However, more information can be found here https://au.pcmag.com/oculus-rift-development-kit-2-dk2 [accessed October 2019].

working on the production completed the development of these early concepts. Furthermore, these early concepts were used to inform the development of the virtual environment, which was vital for immersing an actor using the visual immersion strategy. I took the leading role in developing and designing the virtual environment, which started with the development of a café where a large portion of the story took place. The café was used to explore the overall look and feel of the environment with the input of the director. In the end, a bright and cartoon-like style was chosen to complement the early character concepts. The environment was expanded to the surrounding buildings using this style established during the development of the café, which led to the creation of a small town, as seen in Figure 29.

With the virtual environment created, time was spent developing the virtual characters from early concepts into virtual assets. These virtual assets were developed by a character artist collaborating on the production. The virtual characters were vital for enabling a sense of embodiment for an actor when using the visual immersion strategy. In the end, the overall design of the virtual characters was similar to the early character concepts, which was a simplified cartoon-style design, as seen in Figure 30. After completing the virtual assets, time was spent planning the production session for the production phase. The availability of relevant parties for the production phase led to the creation of a ten-day workshop. Additionally, a four-day testing phase was added immediately before the workshop to ensure its success.

Figure 29. Virtual Environment Developed for Lost for Words

Figure 30. Virtual Characters Developed for Lost for Words

This testing phase was considered a minor cycle of practice or pilot of the workshop and was named the *Production Test*. The purpose of this test was to ensure that the systems and strategies were ready before moving into the production phase with Lorin Eric Salm. However, to accurately test the systems and strategies, additional actors were required. While several different actors expressed interest in the testing phase, there were only two pro-amateur actors that were ideal participants for the study, Liam Soden and Maeve Hook. The last element explored during the planning stage was the structure and implementation of the strategies in the cycle of practice.

Matt Delbridge's doctoral study, *The Cooling Steam of The Polar Express: Historical Origins, Properties and Implications of Performance Capture* (Delbridge, 2014) used structured exercises that were relevant to this study. In his study, Delbridge established three exercises that helped the actor develop an understanding of the virtual environment, which included Walking Through, The Doughnut and The Characterised Avatar and Modelled Venue. The Walking Through exercise required an actor to navigate around three virtual assets that existed in the virtual environment but did not exist in the digital capture volume. Initially, the actor was able to use a WoW system to view the virtual environment and navigate around the virtual assets. However, the actor was eventually required to stop relying on the WoW system and navigate the digital capture volume with no reference. The Donut exercise extends on the complexity of the Walking Through exercise by replacing the three virtual assets with a torus-shaped virtual asset. In this exercise, the actor must pass through the hole of the torus without causing any penetration. The Characterised Avatar and Modelled Venue followed the same premise as the Walking Through and The Doughnut exercises but required the actor to deliver a performance as a virtual character in a virtual environment (Delbridge, 2014, pp. 139–142).

These three exercises provided a starting point for structuring the strategies in this cycle of practice. However, these exercises were adapted and built on so that an actor could experience the varying levels of perception between the real and virtual. The first stage was named the 'Invisible Reality' and replicated the three exercises from Delbridge's study. This stage focused on using the onboarding strategy to help an actor memorise the virtual environment before delivering a performance with a limited perception of the virtual assets. The second stage was named the 'Physical Reality' and focused on using the physical reference strategy to enable the perceptual experience of the virtual environment in the digital volume during a performance. The last stage was named the 'Virtual Reality' and focused on mediating an actor's perceptual experience into the virtual by using the visual immersion strategy. During

the third stage, a combination of all three strategies was tested, which included onboarding, physical reference, and visual immersion. Therefore, there was a total of nine planned exercises for the cycle of practice, which included:

- Stage 1: Invisible Reality
    - Exercise 1: Walking Through the Invisible
    - Exercise 2: The Invisible Doughnut
    - Exercise 3: The Invisible World
- Stage 2: Physical Reality
    - Exercise 1: Walking Through the Physical
    - Exercise 2: The Physical Doughnut
    - Exercise 3: The Physical World
- Stage 3: Virtual Reality
    - Exercise 1: Walking Through the Virtual
    - Exercise 2: The Virtual Doughnut
    - Exercise 3: The Virtual World

Conducting these stages and their exercises in order meant that an actor was able to experience the varying levels of immersion between the real and virtual. These varying levels of immersion enabled the actors to develop a baseline of experience in the Invisible Reality stage. Establishing this baseline meant an actor was able to compare their immersive experiences with minimal bias against previous stages as the investigation progressed. This approach also aligns with a process of refutation, which is part of the study's procedures for analysing data collected in these cycles of practice, as outlined in Section 3.4.3. Refutation involves purposely exploring all aspects of the research areas, whether they are positive or negative (Spiggle, 1994). While this research aims to address an actor's perceptual limitation

to the virtual environment during a performance, these exercises purposely explore an environment with little to no perception as a process of refutation.

4.4.2 Action and Observation

4.4.2.1 Production Test

During the testing phase, I took the role of the MoCap Technician and supported the actors in achieving the exercises outlined during the planning of the cycle of practice. The first day of the testing phase was devoted to testing the various systems needed for the production sessions. Once these systems were set up, a test was conducted to ensure that the digital capture volume was accurately defined to maximise the available space for performance, as seen in Figure 31. The second day of the testing phase was dedicated to a dry run of each system to ensure they were ready for the recruited pro-amateur actors, Liam Soden and Maeve Hook.

During this dry run, I assumed the role of the actor and discovered that virtual reference was required to represent the boundaries of the digital capture volume when immersed into the virtual environment using the Oculus Rift DK2. By adding virtual reference boundaries to the virtual environment, actors were able to remain confined to the digital capture volume where it was safe to perform. Without this virtual reference, actors could have run outside of the confines of the digital capture volume, which puts an actor in harm's way because their visual perception of the physical reality and its obstacles were occluded while wearing the Oculus DK2.

Figure 31. Production Systems and Digital Capture Volume

The third day of the testing phase was spent working with Liam Soden to test a few of the planned exercises. These exercises included The Invisible Doughnut, The Physical Doughnut, and The Virtual Doughnut. Before moving into these exercises, the onboarding strategy was used to enable Liam to build an understanding of the virtual environment. Once he had a confident understanding of the virtual environment, we moved into testing the various exercises. The first exercise tested was The Invisible Doughnut, which required Liam to pass through an invisible torus using nothing but his imagination. This exercise started with rehearsal takes where the actor could view of the virtual environment using a WoW system so they could build a mental construction of the virtual environment.

An interesting observation during The Invisible Doughnut exercise was Liam's approach to feeling out the torus in the digital capture volume. Liam mentally mapped out the torus by using the virtual characters arms as a measuring tool. This approach enabled him to construct a mental understanding of where the torus existed in the digital capture volume but took a significant amount of time. Once Liam felt confident that he had developed a robust mental construction of the torus, we moved on to recorded takes. During the recorded takes the WoW system was disabled and Liam had to rely entirely on his mental construction of the torus while

passing through the torus. However, Liam managed to successfully pass through the torus without causing penetration on his first attempt.

The second exercise was The Physical Doughnut, which introduced the physical reference strategy. This exercise focused on providing a makeshift physical reference of the torus into the digital capture volume during a performance. During this exercise, I observed that Liam had little to no need to mentally construct the torus because he could visually perceive its location using the physical reference. However, the makeshift design of the physical reference caused the actor to intermittently fumble during a performance because it was an inaccurate representation of the doughnut.

The third exercise was The Virtual Doughnut, which introduced the Oculus Rift DK2 to mediate the actor's perceptual experience of the virtual character and virtual environment. Before starting the third exercise, Liam was provided time to explore the virtual character when immersed in VR by using the onboarding strategy. Using this strategy meant that Liam could adjust to his experience of the virtual character in VR, which was vastly different from previous exercises. This difference changed the actor's view of the virtual character from a third-person view to a first-person view. This change meant the actor was no longer viewing the virtual character; they had become the virtual character. During this exploration, an impromptu exercise was conducted to help the actor form a trust for the environment in which they were performing, called the Volume Trust exercise. In this exercise, the actor was required to run from one side of the digital capture volume to the other. The idea behind this exercise was to get the actor to develop a trust for the virtual reference that was used to represent the dimensions of the digital capture volume in VR.

Once Liam trusted the virtual reference of the digital capture volume, we moved on to the third exercise. Initially, the physical reference from the physical doughnut exercise was carried over to this exercise. However, the physical reference became hazardous because

Liam's vision was occluded by the Oculus Rift DK2, which meant he was unable to see the physical reference in the digital capture volume. This occlusion caused Liam to fumble when attempting to pass through the doughnut, which raised safety concerns. Therefore, the physical reference was removed from the digital capture volume to ensure the actor's safety. Removing the physical reference meant that the actor had to purely rely on their view of the virtual environment in VR to complete the exercise. After the completion of the third exercise, another unstructured interview was conducted to compare the actor's varying perceptual experiences in the production.

The discussions in this unstructured interview inspired the creation of another exercise that enabled a higher level of immersion by animating objects movement in the virtual environment. Typically, it is challenging to create moving objects in a performance environment without a great deal of planning and development. However, in a virtual environment, movement can be quickly simulated by animating virtual assets. While there is a large selection of exercises planned for this cycle of practice, none of them specifically explored simulating the movement of virtual assets. The outcome of the new exercise situated the actor in the middle of a street in the virtual environment with an oncoming virtual car hurtling towards them. This exercise aimed to encourage the actor to jump out of the way of the virtual car, leading it to be named Dodging the Virtual.

The fourth and last day of the testing phase was spent with both Liam Soden and Maeve Hook and focused on the newly developed Dodging the Virtual exercise. At first, Liam took the role as the actor, and we moved straight into the exercise. During this exercise, Liam almost instantly accepted the virtual environment and successfully dodged the car. However, when Maeve took the role of the actor, she let the car pass right through her virtual body and did not attempt to dodge the car. On the second attempt, she had a delayed reaction to dodging the car and exaggerated her performance of being hit. The lack of commitment to the exercise was

attributed to the rushed approach to getting the actor ready for the exercise. Therefore, other exercises were explored instead of repeating the Dodging the Virtual exercise, which allowed Maeve to explore the virtual character and virtual environment.

The final exercise explored in the testing phase was the Virtual World exercise, which introduced a fully realised virtual environment and physical reference of a chair. This fully realised environment and physical reference mediated the actor's visual and somatosensation systems, enabling them to sit down on a virtual chair. Overall, the general approach for this exercise was successful. However, it was evident that providing a physical reference for the table would enable a higher level of immersion into the environment. At the end of the testing phase, semi-structured interviews were conducted with Liam and Maeve to capture their overall perceptual experiences of the virtual character and virtual environment during the testing phase. The transcripts of these interviews can be found in the Appendices and further discussion and analysis can be found in Chapter 5.

4.4.2.2 Lost for Words

The completion of the testing phase led into the production phase, which was a dedicated ten-day workshop with the professional actors, Lorin Eric Salm. During the production phase, I continued as the MoCap Technician and supported the actor in achieving the exercises outlined during the planning of the cycle of practice. The first day of the workshop was spent introducing Lorin to the workshop schedule, the research project, and the *Lost for Words* production. The second day moved straight into the production, which started with an introduction to the various systems used in the study. During this introduction, the onboarding strategy was adopted to enable Lorin to develop an understanding of the virtual environment and virtual characters. After the onboarding strategy, we moved into conducting the three exercises from the Invisible Reality stage.

This stage started with the Walking Through the Invisible exercise, which had three randomly laid out triangular pyramids for the actor to memorise. Overall, Lorin spent a large portion of time walking around the volume to develop a mental construction of the invisible pyramids. During this exploration, Lorin mentioned that it would be beneficial to have physical references of the pyramids in the volume, preferably the height of the pyramids. Lorin went on to say that he was choosing random things on the floor as markers to help memorise the location of the pyramids and thought placing markers on the ground would provide a more accurate representation of their location. These comments highlighted that Lorin would have preferred to have physical references to use as visual aid in the digital capture volume to help mentally construct the virtual environment. However, the purpose of the exercise was to do it without physical references, so Lorin continued to memorise the location of the invisible pyramids. After Lorin felt confident in his mental construction, we moved on to recorded takes where he was successfully able to complete the exercise. However, it was evident from Lorin's comments that he relied on random marks and scuffs on the floor as points of reference.

The second exercise conducted was Walking Through the Physical, which introduced physical references for the three pyramids to facilitate the actor's perceptual experience of the virtual environment. Completing this exercise was achieved almost instantly, and Lorin mentioned after the exercise that it required no time to memorise the environment because it was already there and visible, which made it easier to understand. The third exercise conducted was the Invisible Doughnut. This exercise was like the previously conducted Walking Through the Invisible. However, instead of walking around three pyramids, the actor had to pass through the centre of a virtual torus. Lorin started this exercise by feeling out and measuring the torus using the virtual character, which was remarkably similar to Liam's approach in the testing phase. Additionally, a dramatic performance was incorporated into the exercise to provide a higher level of complexity for the actor. This dramatic performance took the name of the

exercise and turned it literal, requiring the actor to pretend that the virtual torus was a giant edible doughnut.

The fourth exercise conducted was The Physical Doughnut, which introduced a physical reference of the virtual torus into the digital capture volume. This physical reference consisted of the rolling clothes rack used in the testing phase, but dowels were used to represent the hole of the torus accurately. Even though this new design was not an exact representation of the torus, it demonstrated the overall shape and location of the hole that had to be passed through by the actor, as seen in Figure 32. When conducting the exercise, the dramatic element established in the previous exercise was carried through to add a higher level of complexity for the actor. Overall, Lorin was able to complete the exercise almost instantly and no time was needed to memorise the location of the torus.
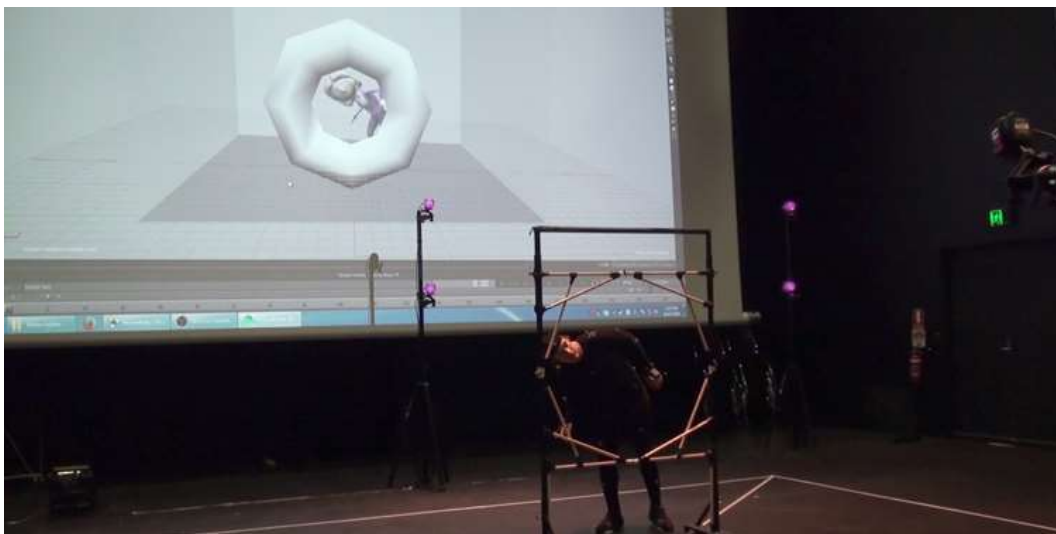
Figure 32. Physical Reference used in the Physical Doughnut Exercise

The completion of the Physical Doughnut led to the Invisible World exercise. This exercise required the actor to perform a shot from *Lost for Words* in a fully realised virtual environment. However, the shot chosen required the actor to sit on a chair that would not exist in the digital volume, which would be difficult to perform and was considered potentially unsafe for the actor. Therefore, the exercise was disregarded from the cycle of practice. Even

though the exercise was disregarded, it still highlighted that physical references enable an actor's performance to take place. For example, the lack of physical reference in this exercise meant an actor would have been expected to imagine and pretend they were sitting in a chair on top of delivering their performance, which would be challenging.

With this exercise disregarded, we moved on to the last exercise that did not use the visual immersion strategy, the Physical World exercise. This exercise had a similar approach to the Invisible World exercise except for the introduction of a chair and table physical references. The shot selected for this exercise was from early in the animation, and the animatic of the scene was shown to Lorin to help him develop an understanding of the performance. Overall, Lorin was able to achieve the performance in the first take with no practice. After the completion of this exercise, an unstructured interview was conducted to gather Lorin's thoughts on the exercises conducted throughout the day.

The following day of the workshop was spent exploring the exercises from the Virtual Reality stage. These exercises focused on mediating an actors perceptual experience of the environment using the visual immersion strategy. Overall, Lorin had little to no experience with VR, so the day started with an introduction to the technology, using the onboarding strategy. This introduction allowed Lorin to explore the virtual character and environment when using the Oculus Rift DK2. During this exploration of the character, the volume trust exercise was conducted to help Lorin develop confidence in the virtual reference of the digital capture volume dimensions.

Once Lorin felt confident in the Oculus Rift DK2, we moved on to the Walking Through the Virtual exercise. This exercise required the actor to navigate around the same three pyramids used in previous stages. However, in this exercise, the actor was immersed in the virtual environment through the visual immersion strategy. Overall, Lorin completed the exercise on the first attempt, quickly manoeuvring around the pyramids. While this exercise

seemed easy to achieve, I observed that the actor had to approach it differently than previous exercises. The most evident difference was his need to focus on the pyramids and, in some circumstances, look directly at them when manoeuvring around them.

This difference in the performance and the actors need to look directly at the pyramids was attributed to the limited capabilities of the Oculus Rift DK2. Specifically, the limited resolution and field of view of the system. This limitation affected the actor's peripheral vision, forcing them to look directly at the pyramids to see them accurately. However, this limitation of the Oculus Rift DK2 was compounded by the poor settings and placement of the point of view camera that was used to replicate the virtual character's vision in the virtual environment. Therefore, time was spent adjusting the point of view camera in the virtual environment to minimise this issue and help accurately immerse the actor's visual system.

Towards the end of the Walking Through the Virtual exercise, Lorin suddenly felt nauseous, which is a symptom of simulator sickness and considered as a limitation of the research, so we immediately stopped performing the exercises. It was evident from Lorin's mannerisms that he was feeling quite sick, so a substantial break was taken to help him recover from the symptoms. Once Lorin was feeling better, we cautiously moved on to the Virtual Doughnut exercise. During this exercise, a virtual environment from *Lost for Words* was introduced to try and provide some additional virtual reference to the actor into VR. This virtual reference was introduced to help reduce the chances of simulator sickness. While this virtual reference was intuitively adopted based off comments made by Lorin, it was later discovered that this solution aligned with existing research. This existing research found that the inclusion of a natural visual background reduced simulator sickness in a virtual environment (Lin et al., 2002). The location selected in the environment was outside of the café to provide a broader sense of space and a distant horizon. With the environment added, Lorin performed the same

dramatic component established in the previously conducted Physical Doughnut exercise. Overall, Lorin achieved the exercise almost instantly.

The Virtual Doughnut exercise was followed by the Dodging the Virtual exercise, established during the testing phase. This exercise had the actor dodge a virtual car that was speeding towards them in VR. Overall, the exercise was completed by Lorin on the first attempt, similar to the other exercises in VR. However, after conducting the exercise, Lorin mentioned that he felt no urgency to move because of the cartoon nature of the environment and that he could not hear the car approaching. While Lorin felt no urgency in the exercise, he still reacted to the visuals of the car speeding towards him in VR. However, it was evident from his comments that he had to rely on his formal training to deliver a sense of urgency in the performance. Furthermore, his comments suggest that realistic visuals and the accommodation of other senses like the audition system would bring a higher level of immersion. Therefore, additional unplanned exercises were added at the end of the ten-day workshop that explored the actor's experience of gravity in a virtual environment, the virtual environments level of realism, and the accommodation of other senses like the audition system.

The Dodging the Virtual exercise was followed by the Virtual World exercise, which used the same virtual environment introduced in the previous two exercises. However, to conduct this exercise, the location was changed to the interior of the café in the virtual environment. In this café, Lorin performed a scene from *Lost for Words*, established in earlier exercises. The chair and table physical references were used in this exercise because they closely aligned with the virtual assets in the scene. To start this exercise, Lorin felt and compared these physical references with the virtual assets while in VR to build trust between the real and virtual. Once Lorin felt comfortable, we moved straight into the exercise. Overall, Lorin completed the exercise successfully on the first take. The completion of this exercise brought the planned objectives of the cycle of practice to an end. Therefore, a semi-structured

interview was conducted to explore Lorin's perceptual experiences of the virtual character and virtual environment during the exercises. The transcripts of this interview can be found in the Appendices and further discussion and analysis can be found in Chapter 5.

The remainder of the workshop was dedicated to capturing the performances required for *Lost for Words* and pursuing other research goals unrelated to this study. However, at the end of the ten-day workshop, time was spent exploring additional unplanned exercises. These unplanned exercises focused on the actor's experience of gravity, the virtual environments level of realism, and the accommodation of other senses. Additionally, these unplanned exercises used the visual immersion strategy, which mediated the actor's perceptual experience of the virtual character and virtual environment using the Oculus Rift DK2. Furthermore, the actors perceptual experience of the virtual environment was increased by playing ambient sounds during the unplanned exercises to accommodate their sense of hearing.

Before starting these unplanned exercises, Lorin was provided time to explore the virtual character when immersed in VR by using the onboarding strategy. A slight change was made to this strategy by introducing a mirror into the virtual environment so the actor could view themselves as the virtual character from a first-person view or a third person view. While this was a minor change, it helped the actor develop an understanding of the virtual character because they could explore every facet of the design. After Lorin felt he had adjusted to the virtual environment and virtual character, we moved into the unplanned exercises.

These unplanned exercises were short and focused on skewing the virtual environment to assess the impact on the actor. This was achieved by changing properties of the virtual environment or virtual character. The changes made to the virtual character focused on altering its size, so the character was gigantic or tiny when compared to the virtual environment during a performance. The changes made to the virtual environment focused on re-orientating its position, so the environment was upside down or horizontal during a performance. Overall, the

actor had no problem adjusting to the altered size of the virtual character or re-oriented virtual environment. Furthermore, the actor's ability to adjust to the re-oriented virtual environment was associated with the actor's sense of gravity, which remained unchanged and constant during the exercises. At the end of these exercises, when Lorin removed the VR HMD, he commented that he lost his sense of location inside the digital capture volume, which indicates that he felt a higher level of immersion during these exercises compared to others. This higher level of immersion was connected to the level of realism in the virtual environment and the adoption of ambient sound. After the completion of these unplanned exercises a short semi-structured interview was conducted to explore Lorin's perceptual experiences of the virtual character and virtual environment during these unplanned exercises. The transcripts of this interview can be found in the Appendices and further discussion and analysis can be found in Chapter 5.

4.4.3 Reflection

Throughout this cycle of practice, interviews and observations were conducted to capture data on the actor's experience of the strategies adopted in the production. This data was used to reflect on the outcomes of the cycle of practice and create a short behind-the-scenes documentary for the *Production Test* and *Lost for Words,* which are embedded in Section 4.4 or listed in the Appendices. The process of reflection only took a fundamental approach when exploring the data collected, which followed the same process of the last two cycles of practice. However, this cycle marked the end of the practice conducted in this study, so the research moved into a process of critical analysis on the data collected during these cycles of practice, which can be found in Chapter 5.

Reflecting on the data confirmed that the onboarding, physical reference, and vision immersion strategies successfully facilitated or mediated an actor's perceptual experience of the virtual environment during a performance. The success of these strategies was explicit in

this cycle of practice because of the process of refutation. Refutation involves purposely exploring all aspects of the research areas, whether they are positive or negative (Spiggle, 1994). This process highlighted that actors preferred having any reference of the virtual character and virtual environment during a performance. Furthermore, it was evident that this reference also drastically reduced the time for an actor to deliver a performance.

4.5 CONCLUSION

This chapter presented three cycles of practice conducted as part of this study that included a series of experimental productions. These productions were crucial for investigating strategies that facilitated or mediated an actor's perceptual experience of the virtual environment during a performance in Virtual Production. Initial reflection on the outcome of these strategies showed that the onboarding, physical reference, floor markers, and visual immersion strategies successfully facilitated or mediated an actor's perceptual experience of the virtual environment during a performance. Alternatively, the actor fatigue and character anatomy strategies had little impact on the actor's perceptual experience and hindered the acting process. While these initial findings provide some insights into the strategies used throughout the cycles of practice, a detailed analysis on the outcomes and the data collected can be found in the following chapter.

Chapter 5 Analysis and Discussion

5.1 INTRODUCTION

The following chapter focuses on the critical analysis and interpretation of the data collected during the cycles of practice covered in the previous chapter. The chapter structure follows the content analysis procedure outlined in Section 3.4.3, which includes categorisation, abstraction, comparison, integration and dimensionalisation. The chapter starts with the categorisation of the data through a coding process. During this process, every segment of the resulting data collected from the cycles of practice was categorised using short descriptors. The resulting codes from the categorisation process were grouped into broader conceptual classes in the data through the abstraction process. Furthermore, during the abstraction process, theoretical concepts previously discussed in this study were emphasised to establish these broader conceptual classes. The comparison process debated the relevance of these broader conceptual classes by connecting them back to the actors' comments on their experience in the cycles of practice. The integration process linked existing theory to the conceptual classes that were deemed relevant to the study during the comparison process. These relevant conceptual classes were expanded further through the dimensionalisation process, outlining the varying experiences for an actor in Virtual Production. The findings of these analytical processes led to the identification of three spectra of immersion and the creation of a new conceptual framework for creating an immersive performance environment for an actor.

5.2 CATEGORISATION

The categorisation process started with converting the interviews and observations collected in the cycles of practice into textual data to enable their analysis. This process included combining the field notes collected into a holistic document for each cycle of practice and transcribing the audio or video recordings of each interview. The resulting data included five interview

transcripts and field notes from the three cycles of practice that covered commentary from several actors. The resulting data were categorised by labelling or classifying segments of the transcripts and field notes, as seen in Figure 33. Overall, no specific criteria were used on the data during the categorisation process. Instead every segment of the data was categorised to ensure it was explored, analysed, and discussed during the abstraction and comparison process. Furthermore, any preconceived ideas were avoided during this process to allow meaning to emerge from the data, which aligns with the conventional approach to content analysis adopted in this study. This process of labelling or classifying segments of data was repeated several times before moving into the abstraction process.
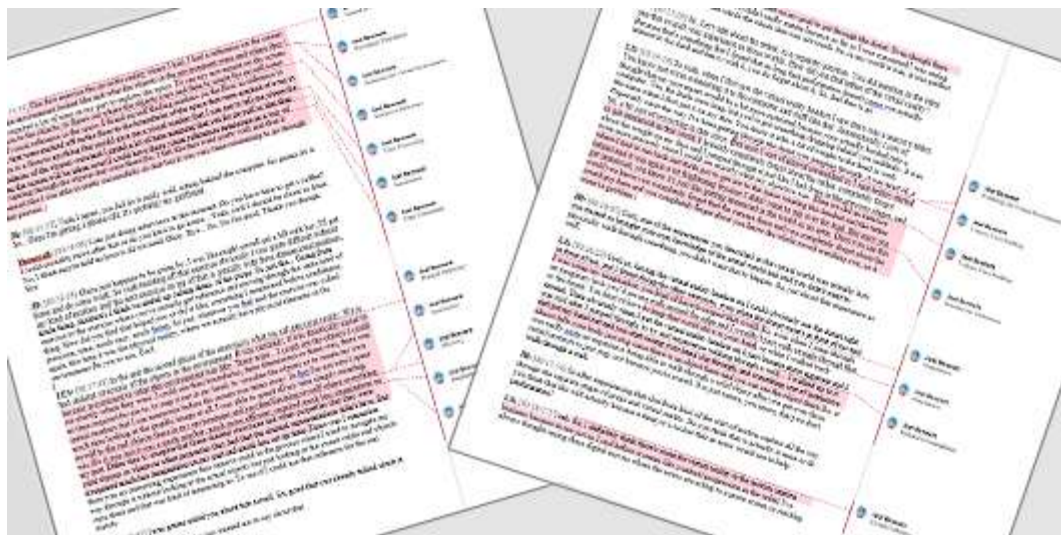
Figure 33. Data Categorisation Process

5.3   ABSTRACTION

The abstraction process started by exporting the classifications found in the data into a separate document. These exported documents emphasised the classifications from the categorisation process, making it easier to group them into broader conceptual classes. During this process of abstraction, concepts from phenomenology were adopted to help form some of the conceptual classes to link the actors' experiences to the existential nature of the study. These concepts included corporeality (lived body) and spatiality (lived space). The other broader conceptual classes were created by grouping common or repeating terminology or phrases together. The

resulting conceptual classes from the abstraction process were combined into a holistic table, as seen in Figure 34. The table includes the identification of twelve specific conceptual classes. However, only seven of these conceptual classes had a direct association with the study and the actors' perceptual experience of the virtual environment. These classes included corporeality, environment, imagination, immersion, performance, reference, and spatiality. These classes also have the highest frequency of documentation in the data, which further establishes them as relevant conceptual classes for the study.

Classes	No. Codes	Examples of Codes
Preparation	4	Setup, Setup Virtual Characters, Setting up Virtual Environment
Corporeality	59	Onboarding, Understanding the Virtual Character, Personality, Physicality, Exploring the Virtual Character, Movement Accommodation, Movement Translation, Becoming the Character, Play, Fun, Prosthetics
Environment	31	Technological Environment, Challenging Environment, Real-time, Ignoring Technology, Untrustworthy Environment, Trustworthy Environment, Inaccurate Reference
Experience	8	MoCap Experience, VR Experience, Performance Background
Imagination	21	Imagination, Pretend, Feeding Imagination, Motivation. Triggers Imagination, Illusion
Immersion	49	Immersion, Immersion Solution, VR, Virtual Production Convergence, Sensory Accommodation, Body Owner Ship, Virtual Acceptance, Virtual Evolution, Actor Reaction, Simulator Sickness
Performance	27	Forcing Performance, Performance Issues, Performance Fatigue, Enhanced Performance, Authentic Performance, Improv, Technology Restrictions, Creating a Baseline
Reference	31	Screen Reference, Reviewing Performance, Performance Playback, Performance Requirements, Forethought Performance, Split Attention
Research	4	Industry Example, Professional Example, Research Discussion
Self	7	Name, Employment, Study
Spatiality	38	Physical Reference, Place, Orientation, Physical Props, Physical Prop Fidelity, Realistic Reaction, Instinctive Reference, Time-consuming
Support	13	Supporting the Actor, Supporting the Director, Trust Building

Figure 34. Data Abstraction Process

5.4 COMPARISON

5.4.1 Corporeality

The conceptual class of corporeality included categories associated with an actor's experience of their body in the world. When comparing the conceptual class of corporeality across the instances of data, it became clear that every actor explored the relationship of their body to the body of the virtual character. I commented on this process in the first cycle of practice where I took the role of the actor, saying "…there were definitely benefits to it, obviously, being able to see the character, especially when we're setting up. That gave me time to play and explore and feel out the character". While other actors did not directly comment on this process, it was evident in the observational data from the cycles of practice that this process was carried out intuitively by every actor with little to no direction.

Another important finding of this conceptual class was the impact of external forces acting on an actor's body in the real environment during a performance in Virtual Production. These forces include but are not limited to gravity, air pressure, and temperature. Lorin commented on these external forces during the unplanned exercises when the virtual environment was flipped upside down, saying "I still feel that gravity is pulling me this way and I can walk along here, and those things just happen to be on the ceiling". In this comment Lorin is pointing out that flipping the world does not change his perceptual experience of gravity and that the virtual objects in the virtual environment just feel like they are part of the ceiling. While this may be an obvious outcome, the comment highlights that an actor will continue to receive some of their perceptual experience from the real environment when immersed in a virtual environment. Therefore, an actor's perceptual experience in the real environment should always be considered in Virtual Production.

5.4.2 Environment

The conceptual class of environment included categories associated with an actor's experience of the performance environment. When comparing this conceptual class across the instances of data, it became apparent that the class was a by-product of searching for direct answers to the research. Each of the categories had little to no association or connection with each other. This finding eliminated the conceptual class from any further analysis. However, this conceptual class included categories that were associated with the actor's trust in the performance environment, which did have some relevance to this study. Liam discussed his experience of building trust in the performance environment when immersed in VR in the third cycle of practice, saying:

> …we did an exercise where I had to run back and forth to get used to the space wearing this headset and the tether behind. It was a bit frightening because I didn't want to trip over the lead. But once you get immersed, it's just like getting immersed in the world as an actor. Once you see this world you completely forget that the camera is there, and you completely forget about the sound guy here, and you completely forget about the whole crowd watching you, so it wasn't a problem.

In this comment, Liam regarded the various technologies as something that could be ignored or forgotten. However, it was not until a later exercise that the importance of maintaining trust in the performance environment became apparent.

This later exercise required the actor to jump through a virtual torus while visually immersed in VR. Initially, the virtual torus was represented in the digital volume using an inaccurate physical reference. However, the actor was unable to see the physical reference because the VR technology occluded their view of RR. The only actor that experienced this

exercise was Liam, and he highlighted the confusing nature of misaligned realities and perceptions, saying:

> So, it was really sort of jarring just to walk forward and bump into an invisible object. That took me out of the process completely. It actually shook my trust a little bit as well in this virtual world because I suddenly became aware that there were completely different things happening outside of my control, and I couldn't see it. So, I tried to get through with the props there and VR headset on, but I was really hesitant. Joel decided to take the props away. Then once I re-organize myself, I found myself just again completely immersed and focused on my goal to get through the doughnut.

These comments illustrate the impact of misaligned realities and the lack of control felt by the actor. During this exercise, I automatically identified the risk associated with inaccurate physical reference when the actor was immersed in the virtual environment using VR technology. Therefore, the exercise was removed from the cycle of practice to ensure the actor's safety. While this incident was removed from the cycle of practice, it did identify the risks of using inaccurate physical reference when immersed in VR. Conducting any further investigation on the impact of misaligned realities was outside the scope of this study due to potential safety risks for the actor. While the untrustworthy performance environment was outside of the scope of the study, the findings were still used to inform the design of the conceptual framework.

5.4.3 Imagination

The conceptual class of imagination included categories associated with an actor's use of imagination to deliver a performance. When comparing this conceptual class across the instances of data, it became clear that imagination was employed continuously on some level

by an actor during a performance. However, most of the categories in this conceptual class had more profound parallels with other conceptual classes. This finding led to the complete reallocation of the categories in this conceptual class, which eliminated it from any further analysis. However, comments on imagination still had some relevance to the study. For example, how imagination was always required in a performance environment, even when providing stimuli through physical references. Lorin commented directly on this requirement of imagination in the third cycle of practice, saying:

> I don't feel like it would rob me of anything that I want to do or expect to be able to do, by being given what's being given. I mean as an actor, as a film actor, you work in a mostly real established environment, and there's still a lot of imagination that's required of the actor to make even an otherwise realistic style film look real. But a lot of it is done to make it as real as possible, even for the actor. So, that's just the nature of that kind of work... As an actor, it's part of the job and part of the joy of doing it, to bring a certain amount of imagination to it. Even with all of the givens; even given a virtual environment that the actor can completely see. I feel like there's still enough work left to do to give a believable performance within that environment.

This comment is significant because one of the objectives of this research is to maintain the continued support for the acting process by avoiding strategies that hinder an actor's performance. The comment outlines that an actor always requires some level of imagination during a performance, even when facilitating or mediating their perceptual experience.

5.4.4 Immersion

The conceptual class of immersion included categories associated with an actor's experience of being immersed in the virtual environment. When comparing this conceptual class across

the instances of data, it became clear that nearly every category in the data was representative of some level of immersion. However, this conceptual class and its connected categories paid specific focus on immersion using VR technology. Lorin commented on his experience of using VR technology and its potential adoption into the performance environment in the third cycle of practice, saying:

> I think VR has the potential to help make performance capture acting more believable... Without it, a lot more is required on the part of the actor to get to a point where they can start to give a believable performance. They have to use a lot more of their imagination and overcome other obstacles. Even VR right now has its limitations… You know the actor has to work around things that are either limiting or interfering with an otherwise natural acting process. So, I think the more the technology develops, the more it gets streamlined, the less it interferes with what an actor would do in a live acting situation either on camera or on stage. The closer it approaches that, I think the easier it will be on the actor and the closer an actor can get to do what they would otherwise be doing.

This comment suggests that there is a potential for actors to use VR technology in Virtual Production to achieve a believable performance. This concept of a believable performance is similar to the concept of an authentic performance discussed in Section 2.4.3. It means living in the reality of the scene, not pretending, not thinking, just performing (Comey, 2012). However, the comment stresses that VR technology hinders the acting process, which competes against one of the objectives of the research. Therefore, the adoption of VR technology into Virtual Production should only focus on facilitating an actor's understanding of the virtual environment until it has little to no impact on their acting process. Overall, the VR technology

used in this study had several limitations that impacted on the actor's ability to deliver a performance successfully. The most prominent limitation was the tether required to deliver the visuals to the VR HMD. Other limitations included the potential impact of simulator sickness, the weight of the device, its constrained resolution, and the restricted field of view. However, these were not the only comments made on the impact and potential of VR in Virtual Production.

Maeve reiterated the observations made by Lorin when commenting on her experience using VR technology during the third cycle of practice, saying:

> As far as applications of VR goes, I think there is definitely [a potential]. Like it could be incredibly useful. I think the way it works, as the technology furthers, I assume [it will] get smaller because everything does… I think it's always helpful to have something to play off, something to give your imagination… But if there's something physical like that, like the VR, then you do have something to play with, and I think that's always helpful. I don't think it's always necessary. And we see that now in films you can totally imagine things and totally imagine reactions, but as a tool for performers and for actors, it makes our job easier... It also could potentially make it more fun. There was that recent example with Ian McKellen breaking down on the Hobbit. But, so much of the actor's job is you know reacting with how the people are, reacting with environments and being open to all these things. Within film, in those computer-generated environments, you often don't have anyone to react off and if it's green screen or whatever. So, [VR] gives you something to play with, and it

gives you something more that can stimulate your imagination… It's

just another tool that I think could be really useful.

This comment strengthens the observations made by Lorin and reinforces that VR technology should be used to facilitate an actor's understanding of the virtual environment in Virtual Production. Furthermore, the comment suggests that more advanced technology could be used to mediate an actor's perceptual experience of the virtual environment during a performance. Additionally, these comments echo the performance theory from Lecoq discussed in Section 2.3.3, which says "reaction creates action" and "there is no action without reaction" (Lecoq, 2002, p. 89).

Overall, this study focused on mediating an actor's vision because it is the dominant sensory system, which was outlined in Section 2.4.1. While this study paid specific focus to mediating an actor's vision, it does not discredit the potential of mediating other sensory systems. This potential became evident in the Dodging the Virtual exercise where Lorin commented on the lack of immersion he felt, saying:

It was interesting, I think it's rendered in such a cartoony looking way,

that it didn't really create a sense of actual danger for me. Even when

it ran directly towards me… There was a sense of it going down as it

passed through me, not as if it was coming directly at me. I guess

because of the non-realistic nature of the way its drawn, it didn't really

give me a sense of real danger.

While Lorin's comment focused on the virtual environments level of realism, I also connected this lack of immersion to the unaccommodated sensory systems.

To confirm this hypothesis, I conducted a series of unplanned exercises that utilised a more realistic virtual environment and mediated the actor's visual system as well as their

audition system into the virtual environment. At the end of the exercises, when Lorin removed the VR HMD he commented on his acceptance of the virtual environment, saying "I'm not in the place in the room where I expected to be, when I took that off… Actually, you know it's strange, I really started to get the sense that I was in a much bigger room. I thought I was further away from you". Later, when Lorin was questioned further about this experience, he said:

> My sense of space had adjusted itself quite a bit to the virtual world and I felt like, I thought I knew where I was in the volume and it turned out I was in a pretty different spot than I thought I was… I had started to reassess space around me, and I also started to feel like I was in a much larger space [because] the virtual space I was in was representing a much larger room. And when I took off that headset, I was almost expecting to be in a room of equal size.... So, there was a little bit of a surprise to me. It was like just having someone spin you around and take off a mask and you suddenly have no idea where you were expecting to be.

These comments suggest that Lorin developed a sense of embodied presence in the virtual environment. This was the first and only time this level of immersion was achieved in the study and the outcome was linked to the adoption of a realistic virtual environment and the mediation of the actor's auditory system aswell as their visual system. Therefore, the level of realism in the virtual environments design and the accommodation of other sensory system outside of vision play a role in increasing an actor's level of immersion.

5.4.5 Performance

The conceptual class of performance included categories associated with an actor's experience of their body when performing. When comparing this conceptual class across the instances of data, it became apparent that these experiences had more profound parallels with the conceptual

class of corporeality. For example, the forcing performance category had a closer connection to the conceptual class of corporeality because it was connected to the actors experience of their lived body. Therefore, these findings led to the complete reallocation of the performance conceptual class to the conceptual class of corporeality.

5.4.6 Reference

The conceptual class of reference included categories associated with an actor's experience of screen reference. When comparing this conceptual class across the instances of data, it became clear that every actor used the WoW system to develop an understanding of the virtual character and virtual environment. However, this comparison also highlighted that these categories had a closer connection with the classes of corporeality and spatiality. This finding led to the complete reallocation of the categories in this conceptual class, which eliminated it from any further analysis. However, a WoW system was considered a vital tool for enabling these two classes of corporeality and spatiality. I commented on the experience of using a WoW system as an actor in the first cycle of practice, saying:

> The hardest thing was, when we were actually doing recorded takes, was trying to ignore that screen… I think it was because of my limited background. I always had this kind of pull, or this need, or this nudge at the back of my head that I always wanted to look, to see what my performance was acting like. But I was meant to ignore it and to purely focus on my performance. I think that got easier over time, but definitely, at the start, I was always like 'and what does that look like?'. Really, I should have been like 'well, it doesn't matter what it looks like because we can always play it back'. I should have just focused on what the actor is meant to do, which is to deliver their performance.

It was only until later in the research the distracting nature of a WoW system was associated with my limited background in performance because the pro-amateur and professional actors could easily ignore the WoW system during their performance. However, my comments highlight one of the benefits of performing in Virtual Production, which is the ability to playback a performance. By capturing the performance of an actor using MoCap, it is possible to watch it immediately after the performance. This process enables the actor to see how their performance translated to the virtual character. Furthermore, it enables a detailed process of review and critique on a performance.

Liam also commented on his experience of using a WoW system during an unstructured interview in the third cycle of practice, saying:

> I had to jump through a virtual doughnut that was projected on [a] screen, and I could see my body and movement, [which I could use] to try and make it through [the hole of the doughnut]… Honestly, it really started to get the imagination going. It was really fun to try and find my physical sort of proportions. [I used it] to try and figure out how big this doughnut was, how wide it is, how big this hole is and then try and solve the problem.

In this circumstance, using a WoW system was a requirement for the exercise. However, Liam's comments show that viewing the virtual character and environment through a WoW system can feed the imagination of an actor and motivate their performance.

5.4.7 Spatiality

The conceptual class of spatiality included categories associated with an actor's experience of space. When comparing this conceptual class across the instances of data, it became clear that every actor had a preference for physical reference to develop an understanding of the virtual

environment. Furthermore, some of the actors in this study would instinctively and intuitively create their own physical reference during a performance. Lorin commented on developing his own physical reference during the third cycle of practice, saying:

> I found myself finding markers on the floor in reference to things…
> Even using screws in the floor, to anything that would give me a visual
> marker that I could use to tell me where the boundaries of the objects
> [were]… I spend a lot of time mapping that out for myself. So, when
> the screen was taken away, I could have those visual references
> memorised as a way of navigating through the objects that were there…
> I felt like that went pretty well, and it seemed like I was able to pretty
> successfully do that, but it was very time-consuming to go through that
> process.

This exercise was a process of refutation, specifically looking at the impact of having no reference to the virtual environment during an actor's performance. The comment highlights that an actor instinctively uses any reference to construct an understanding of the virtual environment to deliver a performance. Furthermore, the comment also illustrates the time-consuming nature of this process because the actor is required to confidently remember a large amount of information to construct a mental understanding of the virtual environment.

These comments from Lorin were reiterated by Liam, who had a similar experience during the third cycle of practice, saying:

> So, I had to do an exercise where there was a virtual doughnut on
> screen, and I had to sort of make my way through the doughnut without
> clipping the edges. At first, I had the screen up there and I could see
> my model and where the doughnut was, and I had to try and get

through. After a couple of times of successfully getting through, the screen was taken away and I had to try and remember in my mind's eye where that doughnut was exactly, and where that hole was, and try and get through it without touching the edges. Obviously, when that screen first comes down, you feel a little panicked, but once you start remembering those physical actions [it becomes easier]... I [also used] physical references to where exactly the hole was. [In the end], I managed to get through without touching the sides [of the doughnut], and it wasn't too challenging. I could see how it would be possible to act with your imagination completely.

This comment highlights that Liam also created his own physical reference to maintain an understanding of the virtual environment. While I agree with Liam that delivering a performance could be achieved using only your imagination, the primary component that would enable this approach is time. However, time is a valuable resource in filmmaking and game development. Therefore, adopting physical reference during a performance is the recommended approach for mitigating the actor's need to construct a virtual environment in their imagination. Especially, when the actor is expected to navigate or react to virtual objects.

Lorin commented on the lack of time required to construct the virtual environment when physical reference is provided during the third cycle of practice, saying:

In fact, I'm not sure I spent much time looking at the graphic image at all. I was able to spend all my time simply orienting myself to the real objects there in my environment and just familiarising myself where everything was. So, it was a much quicker, much more efficient, [and] required much less imagination on my part. Other than to imagine that these skeletal structures had other properties that they were solid

objects or whatever other properties it didn't have. But it required much

less imagination on my part and much less set-up time.

This comment highlights that little to no time is needed to construct a mental representation of the virtual environment when using physical reference in the digital capture volume. Therefore, using physical references is quicker, more productive and requires less imagination, thus enabling the actor to focus on their performance.

Every actor's experience of physical references in this study was positive. Even my own experience as an actor in the first cycle of practice highlighted the importance of physical references when I said:

These physical references and physical props of the virtual spaces are

nearly one hundred percent necessary… It was a difference between a

fake performance and an authentic performance because I would be

physically touching and interacting with those things that existed in the

virtual.

These comments are supported by approaches in the industry and theory from Flueckiger on the proxy approach discussed in Section 2.3.3. Therefore, this early comment in the investigation led to the adoption of physical references as a strategy throughout each cycle of practice. During the second cycle of practice, the actors Beth Liddle and Jongki Daniel Seo commented on their experience of using physical references. The most significant comment during this discussion was when I asked whether they thought it would be harder to perform with no physical reference. They both responded to this question immediately and in unison, saying that it would be "definitely harder". This immediate response further confirmed that using physical references as a strategy made it easier for an actor to understand the virtual environment during a performance.

In the third cycle of practice, Liam expanded on the benefits of using physical references during a performance in an unstructured interview, saying:

> I definitely liked having actual reference… It just made it easier to lay something over the top… I think that's good because it was more precise than what I could have possibly had in my own mind and therefore I think the result [was] more precise as well. While I could do it without, I think the boxes definitely helped. Actually, you know what it added a level of excitement because when I was jumping over [the boxes] there was actually something underneath me and there was a bit of urgency… I just didn't have that sort of rush, I guess [without the physical reference].

This comment further highlights the benefits of using physical references and how it can help an actor deliver an authentic and precise performance. All these comments from the conceptual class of spatiality show the positive experiences of using physical reference in the performance environment.

5.5   INTEGRATION

The comparison process has specifically highlighted three core concepts that relate directly to the study, which include corporeality, spatiality, and immersion. All three conceptual classes had the highest frequency of categories, further validating them as core concepts in this study. Additionally, when considering the research question, each concept has a direct connection to the actor's perceptual experience of the virtual environment. Therefore, a process of integration was conducted to connect existing theory to these core classes. However, the core classes already have a connection to existing theory due to the adoption of phenomenology in the initial analysis of the data. This adoption led to the conceptual classes of corporeality and spatiality,

which focuses on an actor's experience of their body and space. However, corporeality and spatiality can be experience by an actor when performing in both a real environment and a virtual environment. Therefore, the integration process focused on extending these theories to create a delineation between the actor's experience of the real and the virtual.

5.5.1 Virtual Corporeality

Corporeality was a core concept that emerged from the initial analysis of the data and is based on the existing theory of phenomenology discussed in Section 2.4.2. However, this study has shown that an actor in a computer-generated Virtual Production is typically required to adapt their performance for the body of the virtual character. While they still achieve this performance using their own body, they must alter their physicality to align with the body of the virtual character. This process of performance is inherently disconnected because an actor would typically view the virtual character from a third-person perspective after a performance in Virtual Production. This process creates a misaligned experience for the actor because they have limited reference or view of the virtual character during a performance. Therefore, it is only through the use of MoCap and XR technology that an actor can embody the virtual character. Previous studies discussed in Section 2.4.4, inadvertently attempt to address this misaligned experience by re-orientating the perspective of the virtual character back to the body of the actor, so they have a first-person view of the character during a performance.

Most of these studies achieved this re-orientation by mediating an actor's visual perception of the virtual character and environment using XR technology, which was explored further in this study. However, this study demonstrates that the current limitations of XR technologies hinder the acting process. Moreover, this study did not account for how these technologies occlude the ability to capture the face of an actor, which is a critical component of Performance Capture. Overall, the identification of this disconnected experience suggests that the concept of corporeality is not adequate to cover the various experiences of an actor in

Virtual Production because corporeality is not inherently a disconnected experience. Its only through the introduction of virtual technology that a disconnect between the lived body and virtual body can occur.

Therefore, this study opted to create a delineation between the real and virtual surrounding the concept of corporeality by adopting the term virtual corporeality. So, if corporeality is the understanding and experience of a lived body, then virtual corporeality is the understanding and experience of a virtual body or a virtual character. These two bodily experiences work in conjunction with each other to immerse the actor into the virtual environment. For example, an actor develops a sense of proprioception through the experience of their lived body, but they develop a sense of body ownership through the experience of their virtual body. It is through the combination of these two experiences that immersion is possible within Virtual Production. Therefore, virtual corporeality is considered an extension of corporeality because the virtual body is only accessible by facilitating or mediating an actor's experience of their lived body into the virtual environment.

An interesting factor that is also connected to the concept of corporeality, but had limited exploration in this study, was the impact of the virtual character's anatomy on an actor's performance. When the virtual character's anatomy matched or was similar to the human form, it was relatively easy for the actor to develop a physicality for the character. However, when the virtual character's anatomy diverged significantly from that of the actor, it was harder to develop a physicality for the character. While the exploration of anatomy for virtual characters was explored briefly in this study, additional examples can be found in the industry. For example, the films previously discussed in this study demonstrate two notable approaches for achieving a physicality for a virtual character when their anatomy significantly diverged from the actor.

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The first example of physicality being developed for a divergent virtual character is evident in the film *Avatar* (Cameron, 2009), where actors deliver the performance for Mountain Banshees. Mountain Banshees are large bird-like aerial predators that resemble a pterodactyl, as seen in Figure 35. In this example, the actors held onto long poles to represent the wingspan of the Mountain Banshee, which helped them align their anatomy with that of the virtual character. This example demonstrates how actors can use prosthetics to deliver a physicality as a virtual character when their anatomies diverge significantly.

Figure 35. Developing a Physicality for Mountain Banshees (Cameron, 2009)

The second example of physicality being developed for a divergent virtual character is evident in the short video *How to Walk Like an Ape* (Tested, 2014). This video illustrates how actors developed a physicality for the ape virtual characters in the *Planet of the Apes* film series. In this example, actors used prosthetics that look like small stilts to extend their arms. This extension helped accurately align the actor's anatomy with that of the ape virtual character, as seen in Figure 36. Additionally, a movement coach was used to train the actors to move like an ape, which is vastly different from how humans move. Actors were able to achieve a realistic physicality for an ape using these prosthetics and training. Furthermore, the use of prosthetics can also be linked to the concept of a body schema discussed in section 2.4.344, which can be extended using various objects. Therefore, overtime the actors use of these prosthetics becomes

an extension of their own body and a part of their physicality. Overall, these industry approaches to using tools or prosthetics to align an actor's anatomy with a divergent virtual character further establish the core concept of corporeality and the adoption of virtual corporeality in this study.

Figure 36. Developing Physicality Using Prosthetics (Tested, 2014)

5.5.2 Virtual Spatiality

Spatiality was a core concept that emerged from the initial analysis of the data and is based on the existing theory of phenomenology discussed in Section 2.4.2. However, this study has shown that an actor in a computer-generated Virtual Production is typically performing for a real environment in combination with a virtual environment. When considering environments, a distinction between the real and virtual can be found in the RV Continuum discussed in Section 2.2.4. This continuum outlines a scale ranging between the real environment or reality and the virtual environment or virtuality. This continuum has direct relevance to this study because of its delineation between the real and virtual.

Therefore, this study opted to create a similar delineation between the real and virtual surrounding the concept of spatiality by adopting the term virtual spatiality. So, if spatiality is the understanding and experience of lived space or a real environment, then virtual spatiality

is the understanding and experience of virtual space or a virtual environment. For example, an actor develops a sense of gravity through the experience of lived space, but they develop a sense of self-location through the experience of virtual space. It is through the combination of these two experiences that immersion is possible within Virtual Production. Therefore, virtual spatiality is considered an extension of spatiality because virtual space is only accessible by facilitating or mediating an actor's experience of lived space into the virtual environment.

5.5.3 *Virtual Perception*

Immersion was a core concept that emerged from the initial analysis of the data and has a significant amount of existing theory, as discussed in Section 2.4.3. Immersion refers to the sensation of being perceptually integrated into another reality. In this study, several actor's external sensory systems were immersed in the virtual environment as the virtual character. These sensory systems are discussed in Section 2.4.1 and include vision, audition, olfaction, gustation, and somatosensation. This study emphasised vision and somatosensation sensory systems because they cover a high percentage of how we perceive the world. This emphasis on sensory systems pushed the concept of immersion closer to the concept of perception. Moving away from the concept of immersion and adopting perception emphasises an actor's perceptual experience. Therefore, perception was adopted over immersion to accurately illustrate how this concept focused on mediating an actor's perceptual experience of the virtual environment during a performance in Virtual Production. However, like the other concepts discussed in this section, perception can occur in a real environment or a virtual environment.

Therefore, this study opted to create a similar delineation between the real and virtual surrounding the concept of perception by adopting the term virtual perception. So, if perception is the organization, identification, and interpretation of sensory information to understand a real environment, then virtual perception is the organization, identification, and interpretation of mediated sensory information to understand a virtual environment. These two perceptual

experiences worked in conjunction with each other to immerse the actor into the virtual environment. For example, an actor develops a sense of smell or taste through the experience of their lived sense, but they develop a sense of vision and audition through the experience of their virtual sense. It is through the combination of these two experiences that perception is possible within a virtual environment. Therefore, virtual perception is an extension of perception because virtual sense is currently only accessible by facilitating or mediating an actor's experience of lived perception into the virtual environment.

5.6   DIMENSIONALISATION

The integration process identified the delineating experiences of the body, space, and perception felt by an actor in Virtual Production. However, these opposing experiences found in Virtual Production are not absolute. They can be experienced in varying degrees from the real to the virtual depending on the strategies adopted to immerse an actor into the virtual environment. Therefore, a process of dimensionalisation was carried out to help illustrate these varying experiences. This process of dimensionalisation is a common practice in existing theory when illustrating the varying dimensions from real to virtual. Examples include the RV Continuum discussed in Section 2.2.4 or the Virtual Production Spectrum discussed in Section 2.3.5. A similar approach was taken when considering an actor's experiences of body, space, and perception during the dimensionalisation process.

5.6.1 Bodily Immersion

The Bodily Immersion Spectrum illustrates an actor's bodily awareness of the virtual character in Virtual Production. This spectrum was created using the two dimensions of bodily experience identified during the integration process, which includes corporeality and virtual corporeality, as seen in Figure 37. This spectrum starts with the lived body or corporeality, describing an actor's bodily experience of performing with their own body in a real environment as typically found in traditional productions. Alternatively, the spectrum ends

with the virtual body or virtual corporeality, describing an actor's bodily experience of performing with a virtual body in a virtual environment, typically found in Virtual Productions. Between these two dimensions is mixed body, describing an actor's experience of performing with a mixture of both the lived body and virtual body.

Figure 37. Bodily Immersion Spectrum

This spectrum enabled the mapping of various strategies used or discussed in this study in order to understand their impact on an actor's bodily experience in Virtual Production. The primary strategy used in this study to enable virtual corporeality was onboarding. This strategy was used in this study to provide time for actors to explore the virtual character and develop a physicality for their performance. Onboarding only becomes a relevant strategy when virtual corporeality is the dominant mode of performance for an actor over corporeality on the Bodily immersion spectrum. This relevance is caused by the actor's need to view and understand the virtual character to deliver an authentic performance.

Another strategy that has relevance to an actor's bodily immersion is the use of digital clones, which was discussed in Section 2.3.1. Using digital clones in a Virtual Production falls under a mixed bodily experience because an actor's anatomy is identical to the digital clone. The last strategy discussed in this study that has relevance to an actor's bodily immersion is the use of prosthetics. This strategy uses various approaches to align an actor's anatomy to the anatomy of the virtual character. While prosthetics were not investigated in this study, industry

examples were discussed in Section 5.5.1. By using prosthetics, actors can maintain an understanding of the differences between their body and the body of the virtual character during a performance.

5.6.2 Spatial Immersion

The Spatial Immersion Spectrum illustrates an actor's spatial awareness of the virtual environment in Virtual Production. This spectrum was created using the two dimensions of spatial experience identified during the integration process, which includes spatiality and virtual spatiality, as seen in Figure 38. This spectrum starts with lived space or spatiality, describing an actor's spatial experience of performing within a real environment, typically found in traditional productions. Alternatively, the spectrum ends with virtual space or virtual spatiality, describing an actor's spatial experience of performing within a virtual environment, typically found in Virtual Productions. Between these two dimensions is mixed space, describing an actor's experience of performing with a mixture of both the lived space and virtual space.

Figure 38. Spatial Immersion Spectrum
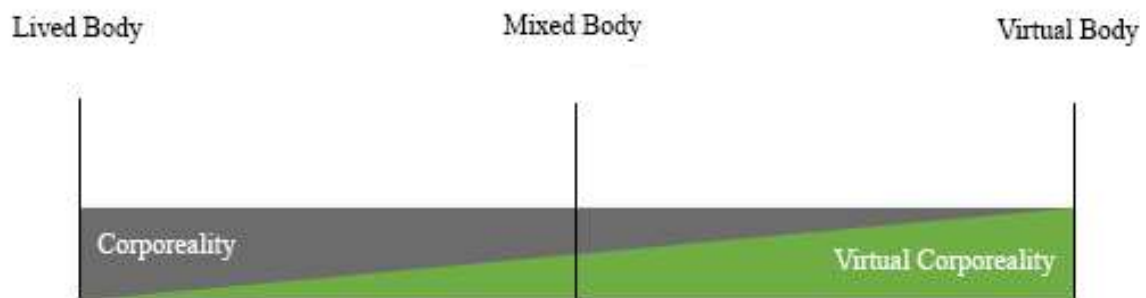
This spectrum enabled the mapping of various strategies used or discussed in this study to understand their impact on an actor's spatial experience in Virtual Production. The primary strategy used in this study to enable virtual spatiality was the use of physical reference. Physical reference is a concept used to describe physical representations of the virtual environment in

the digital capture volume, which is discussed in Section 2.3.3. The use of physical reference is a common practice within contemporary Virtual Productions because it enables actors to interact with the environment physically. During the third cycle of practice, it became clear that the accuracy of the physical reference directly impacted on an actor's experience of virtual space. This impact was associated with the actor's inability to see the exact dimensions of the physical reference when immersed in VR. Therefore, any major inaccuracies between the real and virtual references created a hazardous environment for a performance.

This suggests that physical references should be categorised into levels of accuracy. Therefore, this study adopted the use of three distinct levels of accuracy, which included inaccurate, semi-accurate, and accurate physical reference. Inaccurate references would be situated around mixed space on the Spatial Immersion Spectrum because they only provide minimal attributes of the virtual environment into the digital capture volume. Types of inaccurate reference used in this study included floor markers or random props. These references only had one or two attributes when compared to their virtual counterparts and were typically used as a guide during a performance. Semi-accurate references would be situated in between mixed space and virtual space on the Spatial Immersion Spectrum because they provide most of the attributes of the virtual environment into the digital capture volume. Types of semi-accurate reference used in this study included the three black pedestals, industrial spray bottle, the makeshift torus, the round table, and the chair. These references had most of the attributes of their virtual counterparts and were heavily used and interacted with during a performance. Accurate physical reference would approach virtual space on the Spatial Immersion Spectrum because they provide an exact representation of the virtual environment in the digital capture volume. Overall, this study did not use any accurate references, however, the table and spray bottle were almost an exact representation of their virtual counterparts. Ideally, every production should use accurate physical reference. however, as mentioned in

section 2.3.3, this is not always a feasible approach for every production because it is significantly time-consuming and costly to create an exact replica, especially when considering the size or complexity of the reference.

5.6.3 Perceptual Immersion

The Perceptual Immersion Spectrum illustrates an actor's perceptual awareness of VR in Virtual Production. This spectrum was created using the two dimensions of perceptual experience identified during the integration process, which includes perception and virtual perception, as seen in Figure 39. This spectrum starts with lived sense or perception, describing an actor's perceptual experience of performing within a real environment, typically found in traditional productions. Alternatively, the spectrum ends with virtual sense or virtual perception, describing an actor's perceptual experience of performing within a virtual environment, typically found in Virtual Productions. Between these two dimensions is mixed sense, describing an actor's experience of performing with a mixture of both lived sense and virtual sense.
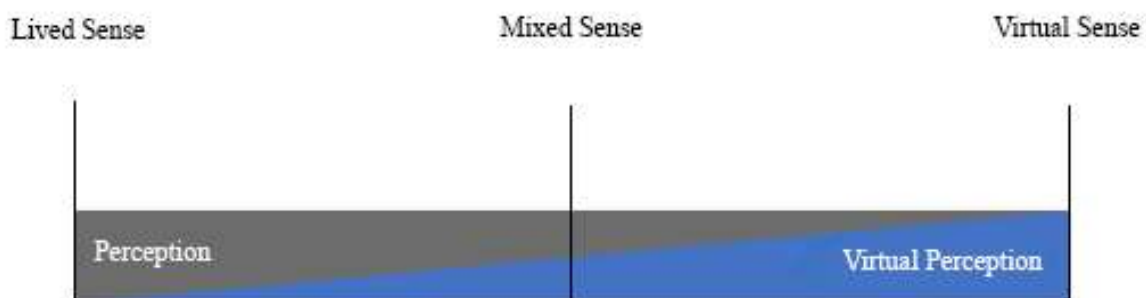
Figure 39. Perceptual Immersion Spectrum

This spectrum enabled the mapping of various strategies used or discussed in this study to understand their impact on an actor's perceptual experience in Virtual Production. The primary strategy used in this study that enabled virtual perception was VR technology. In this study, the Oculus Rift DK2 was used to immerse an actor's visual perception into the virtual.

However, limitations of the technology impacted on the actor's process of performance. Nevertheless, each actor recognised the potential of using this technology once these limitations are minimised or overcome. While the emphasis of this strategy focused on immersing the actor's visual perception, it does not diminish the importance of other external sensory systems. In fact, unplanned exercises conducted during the study showed the potential of immersing the actor's auditory perception as well as their visual perception. The other strategy used in this study was the WoW system, which has a connection to the actor's perceptual experience. This system uses conventional screens or projectors to show a view of the virtual character and environment in the digital capture volume. This strategy was vital for enabling the actors' understanding of the virtual characters and virtual environments. Furthermore, it had a direct impact on other strategies like onboarding, which was the primary approach in this study for informing an actor's understanding of the virtual characters and virtual environments. Without a WoW system, the onboarding strategy would be difficult to achieve in Virtual Production.

5.7 CONCEPTUAL FRAMEWORK

Analysing the data captured during the cycles of practice led to the identification of the three spectra of immersion for an actor in Virtual Production, which includes Bodily Immersion, Spatial Immersion and Perceptual Immersion. While these spectra take an essential step to understand an actor's experience performing in a virtual environment, they do not provide a clear and accessible way to adopt these new understandings into Virtual Production. Therefore, these three spectra were used to inform the development of a conceptual framework that can create an immersive performance environment for an actor in Virtual Production. The overall design of this framework focused on accessibility so it can be adopted and adapted by MoCap Technicians because they are the most appropriate parties for implementing this new framework, which was identified in Section 2.3.2.

The overall design of the framework took inspiration from the existing theory surrounding virtual perception discussed in Section 2.4. Additionally, the framework focused on addressing an actor's experience of the virtual body, virtual space, and virtual sense on the immersion spectrum. The resulting design of this framework provides suggestions for strategies used or discussed in this study that enable the experience of these virtual elements, as seen in Figure 40. However, these strategies are only suggestions and the framework is purposely designed to be flexible. This flexibility encourages a MoCap Technician to map their own or new strategies to the framework to diagnose and increase the level of immersion for an actor performing in Virtual Production. By providing the flexibility to use any strategy, the framework accommodates for the ever-changing landscape of the film and games industry.

	Low	Moderate	High
Bodily Immersion	Limited physical awareness of a virtual character. Strategies such as descriptions and discussions.	Moderate physical awareness of a virtual character. Strategies such as onboarding.	Exceptional physical awareness of a virtual character. Strategies such as digital clones and prosthetics.
Spatial Immersion	Limited virtual awareness of a virtual environment. Strategies such as inaccurate physical reference and floor markers.	Moderate virtual awareness of a virtual environment. Strategies such as semi-accurate physical reference.	Exceptional virtual awareness of a virtual environment. Strategies such as accurate physical reference.
Perceptual Immersion	Limited perceptual awareness of a virtual reality. Strategies such as WoW systems (screens). Immersion of 1 sensory system during or before a performance.	Moderate perceptual awareness of a virtual reality. Strategies such as WoW systems (screens, projectors, speakers). Immersion of 1-2 sensory system during or before a performance.	Exceptional perceptual awareness of a virtual reality. Strategies such as XR systems (HMDs). Immersion of 2+ sensory systems during a performance.

■ Real Reality (RR)   ■ Virtual Reality (VR)

Figure 40. Immersive Performance Environment Framework

As mentioned previously, the use of XR technology like VR HMDs was disregarded as a strategy because it impacted on the acting process. However, HMDs were left in this framework because every actor saw the potential of future advances in this technological area. There are also no clear strategies that could replace HMDs in the conceptual framework. While this means a high level of perceptual immersion is currently not achievable in Virtual Production, a relatively high level of immersion is still possible if the three areas of immersion are used together. If these areas are isolated, then the chance of achieving a high level of immersion is significantly diminished.

Furthermore, the design of the framework breaks the experiences and suggested strategies into RR and VR. This design decision illustrates the transition for an actor from RR to VR when accommodating the areas and levels of immersion. Furthermore, this design decision helps demonstrate a new concept called misalignment, which was extrapolated from the untrustworthy performance environment discussed in Section 5.4.2. The untrustworthy performance environment highlighted the disruption of an actor's trust when their experience of RR and VR are misaligned.

Therefore, the adoption of strategies should avoid crossing between the two realities represented in the conceptual framework. For example, a high level of perceptual immersion mixed with a low level of spatial immersion creates an untrustworthy performance environment, which was identified in the third cycle of practice. Alternatively, a high level of spatial immersion mixed with a moderate level of bodily immersion leads to the penetration of virtual assets during a performance. An actor's perceptual limitation to the virtual character during a performance typically causes this penetration, which was identified in the first cycle of practice. Finally, a high level of perceptual immersion mixed with a low level of bodily immersion is not necessary because the actor can see their virtual body when immersed in VR. All these examples cause a misaligned experience for an actor.

This newly established conceptual framework can also be used to diagnose the strategies used in previous studies or productions to assess their level of immersion. Therefore, the related studies discussed in Section 2.4.4 were revisited and assessed using the conceptual framework. As previously mentioned, these related studies only isolated a single technology or approach to enable the perceptual experience of the virtual. The study by Bouville, Gouranton, and Arnaldi (2016) looked at using VR to help actors when rehearsing scenes that include visual effects. Mapping this approach to the resulting conceptual framework in this study identified a moderate level of perceptual immersion, but no consideration was made for bodily or spatial immersion. Alternatively, the study by Kade (2014) established new technology that provided an actor with a view of the virtual environment using a wearable projector. Mapping this approach to the resulting conceptual framework also identified a moderate level of perceptual immersion, but no consideration was made for bodily or spatial immersion. This diagnosis reinforces that these studies only isolate a single approach.

The framework even has the versatility to cover Virtual Productions that are not computer-generated, which were situated outside the scope of this research. For example, the Virtual Productions discussed in Section 2.3.5, including the *Planet of the Apes* film series and *Pirates of the Caribbean: Dead Man's Chest* can use this framework to identify that they all have a high level of immersion. This level of immersion is achieved for an actor in these productions because they use a combination of prosthetics, accurate physical reference and accommodate two or more sensory systems because the productions are situated in a real environment during a performance.

5.8   CONCLUSION

This chapter illustrates the critical analysis and discussion of the data captured during the cycles of practice. The process of analysis led to the identification of three spectra of immersion felt by an actor in Virtual Production. These spectra include Bodily Immersion, Spatial Immersion

and Perceptual Immersion. These three spectra of experience were used to develop an accessible conceptual framework for creating an immersive performance environment. The primary purpose of this conceptual framework is to provide a clear path for a MoCap Technician to diagnose and increase the level of immersion for an actor during a performance in Virtual Production. Furthermore, the conceptual framework was intentionally designed to be flexible so that it can grow with the evolving landscape of Virtual Production.

Chapter 6 Research Conclusion

6.1 RESEARCH SUMMARY

This study investigated an actor's perceptual limitation to a virtual environment during a performance in computer-generated Virtual Productions. In these productions, an actor typically has no way to perceive the virtual elements naturally. Additionally, actors are frequently held responsible for overcoming this perceptual limitation during their performance, which increases their cognitive workload and distracts their attention from the performance. This study aimed to minimise this cognitive workload by establishing a multi-tiered approach for facilitating and mediating an actor's perceptual experience of the virtual environment during a performance. To address this problem, the following research question was formulated:

> *How can the technology or approaches used in Virtual Production be*
>
> *adapted to facilitate or mediate an actor's perceptual experience of the*
>
> *virtual environment during a performance?*

Answering this question began with an examination of the various concepts and literature surrounding the study, including current technologies and approaches adopted in contemporary Virtual Productions. This examination led to the study being situated solely in computer-generated Virtual Production because they cause the perceptual limitation for an actor during a performance. Typically, this perceptual limitation is created for an actor because there is no natural way for them to perceive the computer-generated content during their performance. Furthermore, this examination established the MoCap Technician as the most appropriate parties for addressing an actor's perceptual limitation to the virtual environment during a performance in Virtual Production. Therefore, the study focused on tailoring any findings for

this role to enable its adoption into Virtual Production. A more in-depth exploration surrounding this examination can be found in Chapter 2.

Overall, the examination of various concepts and literature surrounding this study informed the implementation of the research design, which adopted a qualitative approach structured by a phenomenological paradigm. Phenomenology played an essential role in the study due to the existential nature of the research. Therefore, a practice-led methodology was adopted to explore an actor's experience of this existential nature by conducting three cycles of practice. These cycles investigated strategies that facilitated or mediated an actor's perceptual experience of the virtual environment during a performance in Virtual Production. A more in-depth exploration of the research design adopted in this study can be found in Chapter 3.

The findings from the examination and the adopted research design created a foundation for investigating an actor's perceptual limitation to the virtual environment during a performance in Virtual Production. This investigation was achieved by conducting three cycles of practice, which were crucial for collecting observational and interview data required for analysis. Furthermore, these cycles of practice resulted in a selection of creative outcomes that provide a vital link between the theory and practice in this study. These creative outcomes include a series of short behind-the-scenes documentaries, two short animated films and an animatic. A detailed description surrounding these cycles of practice including the creative outcomes, can be found in Chapter 4.

The resulting data from the cycles of practice were analysed using the processes and procedures of conventional content analysis. This analysis led to the discovery of three spectra of immersion for an actor in Virtual Production, which includes Bodily Immersion, Spatial Immersion, and Perceptual Immersion. Each spectrum illustrates the varying experiences of an actor from the RR to the VR in Virtual Production. While these spectra provide an approach

for understanding an actor's experience in Virtual Production, they do not clearly illustrate how to facilitate or mediate an actor's perceptual experience of the virtual environment during a performance.

Therefore, these spectra of immersion were used to develop a conceptual framework for creating an immersive performance environment that incorporated the strategies discussed or explored in this study. The resulting framework provides an approach for the MoCap Technician to diagnose and increase the level of immersion for an actor in Virtual Production and, thus, contributes to the growing landscape of Virtual Production and answers the central research question in this study. A detailed discussion surrounding the critical analysis of the data collected in this study can be found in Chapter 5, which includes the resulting spectra of immersion and conceptual framework for creating an immersive performance environment in Virtual Production.

6.2   FUTURE RESEARCH

This study established a conceptual framework for diagnosing and increasing an actor's level of immersion in a Virtual Production. However, this framework only emerged from exploring the experiences of a small selection of actors with varying levels of professional experience. As such, to further establish and verify this framework, additional research should be conducted on a larger sample size of actors, in the contexts of professional productions, or questioned in relation to the motion capture technician to assess its impact. Furthermore, additional focus could be made on the actors training or the type of performance required for the virtual production. Alternatively, a quantitative approach could be used to investigate the effectiveness of the proposed conceptual framework in this study. This could be achieved by comparing productions that adopt the conceptual framework against productions that do not. Furthermore, additional focus could be made on areas like avoiding penetration and the accuracy of motion.

While this study responds to a problem identified in Virtual Production, it is not the only improvement that is being discussed in the industry. Girish Balakrishnan, a director at Digital Domain[23], discussed several potential ideas that could improve the Virtual Production workflow. These improvements include the ability to control the lighting of the virtual environment in real-time, the improvement of MoCap technology, but most interestingly the adoption of VR HMDs (Workman, 2014). While this research project established that VR technology is a viable strategy for immersion, it did not yield the ideal results due to the system's limited capability. However, new VR technology has become available that builds on the capabilities of the systems used in this research. Furthermore, some of these new systems are introducing wireless capabilities or adaptors, like the HTC Vive Wireless Adapter[24] and the Oculus Quest[25], which eliminates the need for a tether. For this reason, further research into these newer systems should be conducted to assess their impact on an actor during a performance. While these newer systems have more potential to be adopted into Virtual Production, they do not address the occlusion of an actor's face, which impacts on the process of Performance Capture.

However, a new combination of technologies is emerging that can overcome this occlusion of an actor's face caused by VR technology. This combination of technologies incorporates facial tracking into VR technology. In fact, during this study, a new company exploring this combination of technology announced an early prototype. This company has officially developed the first VR system with built-in facial tracking, naming the system 'Veeso' as seen in Figure 41. A Kickstarter campaign was set up for Veeso to gain the required

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[23] Digital Domain is a well-known visual effects and digital production studio. For more information on the studio, visit https://www.digitaldomain.com/ [accessed February 2019].

[24] For more information on the HTC Wireless Adapter including specifications and capabilities, visit https://www.vive.com/au/wireless-adapter/ [accessed September 2019].

[25] For more information on the Oculus Quest including specifications and capabilities, visit https://www.oculus.com/quest/ [accessed September 2019].

funding to develop their prototype into a commercial version. However, the company did not reach its intended funding goal, which led to the campaign being cancelled. While Veeso seemed promising, it was difficult to ascertain the capability of the headset through the Kickstarter campaign (Smith, 2016; Veeso, 2016). This failed campaign did not mark the end of VR technology with integrated facial tracking. Currently, the company Oculus[26] is experimenting with the integration of these technologies. These experiments aim to provide a rewarding social experience where anyone can have a meaningful interaction with other people in VR (Simonite, 2015). When this new technology becomes available, new research should be conducted to explore its potential adoption into the process of Virtual Production.
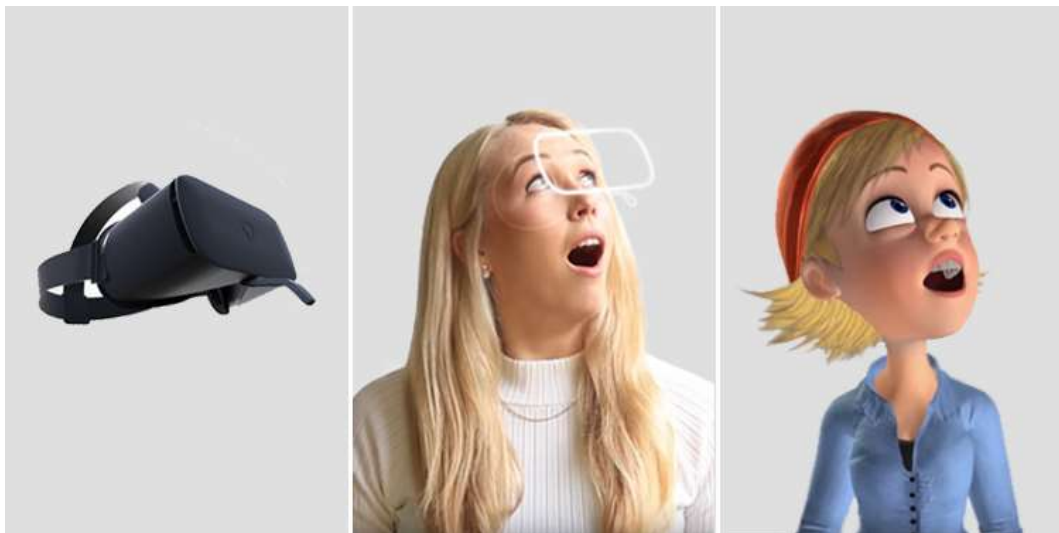
Figure 41. Veeso Virtual Reality System (Smith, 2016; Veeso, 2016)

This push in VR to create a social experience also connects back to the original theories of phenomenology, specifically the existential of relationality. Relationality or lived other refers to the relations we make or maintain with others. These relations include the communications and relationships we experience with others through spaces and interactions (Rich et al., 2013; Van Manen, 1997). Overall, this research used the existentials of corporeality

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[26] Oculus is a well-known technology company that has developed several commercial VR HMDs like the Oculus Rift DK2 used in this study. For more information on the company, visit https://www.oculus.com [accessed November 2019].

and spatiality to uncover virtual corporeality and virtual spatiality as dimensions of immersion for an actor in a Virtual Production. While this research paid specific attention to these dimensions, there is an opportunity to extend the conceptual framework from this study by exploring the connection of relationality on an actor's experience in Virtual Production. This could be explored by immersing two or more actors into a virtual environment during a performance, so that they can interact and react to each other. Furthermore, this study paid specific attention to immersing the sense of vision into the virtual environment. Therefore, attention could be made on the other senses by adopting other immersive technology to simulate sound, smell, wind, temperature, and more.

Another interesting outcome for this study was the identification of divergent anatomies between the actor and the virtual character. Overall, this study indicated that exaggerated virtual characters that significantly diverged from the actor's anatomy impacted on their ability to deliver a performance. While this was an interesting outcome it was outside the scope of the research because it impacted on the actor's ability to deliver a performance, which competed against the objectives of this research. Therefore, more research should be conducted exploring these divergent anatomies. Furthermore, additional focus could be made on the MoCap process, the integration of prosthetics to align the anatomies, and the comparison of quadrupedal anatomies against bipedal anatomies.

Finally, this research project identified the untrustworthy performance environment. This untrustworthy environment was created when physical references did not accurately match their virtual counterparts when immersed in VR. Further investigation into this issue should be explored due to its impact on an actor's ability to interact with the virtual environment. Specific focus should be spent on the level of accuracy needed between RR and VR when considering physical references and their virtual counterparts. Identifying this level of accuracy should lead

to a deeper understanding of the untrustworthy performance environment and its impact on the actor.

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Appendices

APPENDIX A: INTERVIEW TRANSCRIPTS

Cycle 1: Interview Transcripts

Interviewee: Joel Bennett
Interviewer: Steven Mohr
Date of Interview: 05.10.2013
Transcribed: 20.01.2014
List of Acronyms: JB = Joel Bennett, SM = Steven Mohr

Begin of Transcript [00:00:00]

SM: [00:00:00] So, hi Joel, I just wanted to ask you a few questions regarding virtual production and the Powers Above project that you worked on. So, what is your name, first of all?

JB: [00:00:03] Joel Craig Bennett.

SM: [00:00:06] So, Joel, what is your performance background?

JB: [00:00:15] I actually don't have a performance background, per se. I'm from animation, originally, so I have some formal training in animation techniques and acting and I have attended some acting workshops, as well. So, limited background, but I do obviously have an understanding of it and would classify myself as an amateur actor.

SM: [00:00:40] Okay, fantastic. So, an amateur actor, alright. Have you ever had any experience in motion capture or with virtual production before?

JB: [00:00:50] Yeah, so I had my first experience a couple of years ago when I first got introduced to the Xsens motion capture system and I did a little bit of work for QUT and then I did my Honours in motion capture, mucking around with the Optitrack, similar system, which is the same system we used in this project and I've been dabbling around with virtual production in those two years as well. They kind of, virtual productions are this big buzz word at the moment in the industry, so it'll be interesting to see where it goes.

SM: [00:01:27] Do you have any sort of general thoughts on working in virtual production? So, where you see yourself or, you know, the sort of people that are involved in that sort of production or how it's carried out?

JB: [00:01:42] Yeah, I think I'm really interested in the technology side of virtual production, which is really what powers virtual production. So, I'm typically a behind-the-scenes guy, being a motion capture tech or motion capture technician working on the sidelines. Mucking around the technology, getting it to work

appropriately, so you can actually capture these virtual productions. But, yeah, generally, it's a new space and it's an interesting space and that can also make it a difficult space. So, you know, at the moment, me performing in this, Powers Above, is actually an element of a major work that I'm doing or major research project that I'm doing, where I'm exploring some of the difficulties around virtual production and that's specifically looking at, you know, the technology and how that impacts the performance environment as well, so.

SM: [00:02:49] So, when it comes to virtual production, do you have any thoughts on realities, virtual realities and how they go together, if at all?

JB: [00:03:01] Yeah, so, I think there's an opportunity for virtual reality and virtual reality technology to be adopted into virtual production. They're both virtual technologies, obviously, one's working at making films, or games, or screen content and the other one's about immersion. So, I think there's opportunities for these two to connect. What that looks like, I'm not sure and, from what I've read, some people are starting to explore those possibilities. But, obviously virtual reality's quite young, you know the Oculus Rift DK2 is the only kind of product that's out on the market at the moment. So, it'll just be interesting to see it progresses, like virtual reality at the moment, they kind of like use it as well as a similar buzz word to virtual production, where they're specifically saying, "it's going to be the next consumer product in everyone's household". Whether or not that'll be the case, time will tell, but it's definitely an interesting technology and there's opportunities for virtual production and virtual reality to, kind of, be connected together.

SM: [00:04:14] But what about your, sort of, relationship in this project between the virtual world you're interacting with and the physical world during your performance? So, like, how did you navigate that relationship? So, what was your as an amateur actor on this production?

JB: [00:04:33] Yeah, so, I came into this to, kind of like, experience this common thread or this common discussion or discourse that's happening within the industry around actors and they always describe, kind of, working in virtual production as challenging. You know, like, and they, kind of like, say, you know, a good example is, I think Valery Curry, kind of, talks about how, not only does she have to remember her lines and deliver an emotionally intense performance, but that she also has to imagine a world around her and also, you know, remember cues and elements from performers and pretend that they're interacting with this robot and, so, she says it's a lot of work. It's similar to working in stage, but there's a lot more elements added and she, kind of, says that that's challenging, and this is, she's not the only one that says that. It's kind of like this constant discourse that's happening, and I thought, you know, number one: why is this happening? and I don't really know the answer yet. And two: how can we go about fixing it? So, this first, kind of, this Powers Above was my first, kind of, step into that world and it was an opportunity for me to experience this discourse of what all these actors are saying as like, well actually what are they experiencing? How hard is it? I kind of went sideways a bit there to describe my research, but I found it fun to work with these virtual characters 'cause I got to become, like, a troll and Mara. So, this enforcer lady, this sci-fi enforcer lady and this, like, menacing troll. So, that was fun virtually, but physically, in the world, like, I'm an amateur actor, so I actually found it, at times, to be, kind of, very difficult and even

distressing that I couldn't physically achieve what I wanted to on the stage and there was a disconnect between my performance and what we wanted the virtual characters to do. And whether or not that's because of my limited background, or because of the relationship of it being completely virtual, and me relying purely on my imagination, I'm not sure, but it is interesting.

SM: [00:07:11] So, you would say that, so that would be one of your, sort of, limitations during your performance and production. Do you have any other, sort of, limitations that you came across during this process?

JB: [00:07:22] Yeah… Yeah… I found a few things, like, obviously, I'd mentioned, I have this limited background in performance, but I also, kind of, knew what we were trying to achieve throughout the whole production. I knew that I was trying to live this performance, I knew how the character was made and I, kind of, knew how they moved. But even with that knowledge, it was still quite difficult, especially for the troll character. So, Mara, I think I mentioned, I found quite straightforward to perform as her because she was very similar proportion size to me, very humanoid, normal human looking character and she had this military background. So, it was easy to develop this physicality for the character, where she was very stern and upright and had formal training and every move was kind of calculated and when I performed that would be really easy because, you know, it's not hard for myself to push my body to do those things and to think in that way, but then, as the Troll character, on the flip side, it was challenging because the arms are elongated, the torso is bigger, the legs were stumpier. So, I had to pretend that I was nearly two times heavier than what I was with every movement. So, that movement is not something my body can actually do, it was something I had to force myself to do. So, like, achieving that same kind of performance compared to Mahara — Mara sorry, Mahara — Mara, the enforcer character, was very time consuming and there were a few points where you were definitely trying to push me to get better performance, as well, that I struggled with, so.

SM: [00:09:22] When, sort of, just regarding the limitations of each of the characters, did you find the projected reference of the virtual world in the background, did you find that was helpful as a performer, just regarding the character?

JB: [00:09:37] Yeah. So, there was definitely benefits to it, obviously, being able to see the character, especially when we're setting up, like, there gave me time to play and explore and feel out the character, like, how do my movements look on that character? How, when I move around or jump or whatever, what happens? It was really, actually, really interesting at the start 'cause, you know, I had this sense of play, this sense of exploration, this sense of, like, fun kind of thing. It was just like, oh, and now this other person and how do I move? And how do I act as this other person? I kind of like laughed at a thought, where I thought, you know, no wonder they call it play, like stage plays, because it is you playing someone else and I had that kind of feeling when I first came in to the performance. But, on the flip side, after we actually got into, out of that, moving into rehearsal takes, being able to play back my performance and you being able to pick out, like, elements that could be improved or things that I did wrong or, you know, maybe not quite hitting that personality of the character. Especially with the Troll, where it was like well, you're not moving the way that you should be. It was really helpful, but the hardest thing was, when we were

actually doing recorded takes, was trying to ignore that screen, 'cause, because of, I think it was because of my limited background, I always had this kind of pull, or this need, or this nudge at the back of my head that I always wanted to look, to see what my performance was acting like, but I was meant to ignore it and to purely focus on my performance. And I think that got easier over time, but definitely at the start, I was always like: and what does that look like? what does that look like? And, really, I should have been like well, it doesn't matter what it looks like 'cause we can always play it back. I should have just focused on just what the actor is meant to do, which is deliver their performance.

SM: [00:11:39] Did you find it easier to, like, we talked about the physicality immersing yourselves in the Troll character was quite difficult versus Mara, did you find there were any other, sort of, varying experiences between the two?

JB: [00:12:00] Yeah, I think, like I said, that the translational or the connection or the matching, maybe is the word, of the body was a big thing. So, my arms as Mara was basically the same length, but my arms as the Troll were maybe half a metre past my actual arms, so when I would scratch my head or when I would touch my body, or something like that, my arms would penetrate through that character. And, so then, you had to be mindful of where do I put my hands when I touch my head or when scratch my head. If I'm delivering a performance, maybe I need to pretend that my head is somewhere else, or my hand is actually longer than it is. So, I kind of had to, like, break my perception of what my body was and pretend that it was the same as the Troll's and, yeah, at times it was doable, but at other times it wasn't. You know, I think it depended on the difficulty of the performance and the challenge of the performance. If it's something simple, like walking and stuff like that, there's no penetration, but if it's, you know, banging your chest or if I'm pushing things out of my way, or I'm coming in to punch someone, you know, it was like you had to have that forethought.

SM: [00:13:25] Would you have felt that, if you had a prosthetic of some sort, whether that be some sort of fixture on your head or elongated arm attachments or something that would have enabled your performance as the Troll, or do you think having those additions would've been as limiting without them?

JB: [00:13:54] Yeah, I think it'd be interesting. I think, definitely, there would be times where it would be extremely beneficial. Like I said, you would no longer have to imagine this arm, it would actually, physically, be there. So, when scratching your head, for example, you would know that you were scratching with the end of the prosthetic and not, you know, actual hand. But, I think other times, it might be, like a hinderance, like there's no point if you're walking, there's no point of carrying these arms, but maybe, maybe there is because we're actually add extra weight to you and stuff like that. So, maybe there is a potential for it to always be used, but then, you know, if we go for something like a more high fidelity system that can capture the hands, and stuff like that, and the movement in the hands, then using a prosthetic kind of loses that functionality if your using that, so. In this case, in the production, I think it'd be really good, but maybe in others it might not be.

SM: [00:15:00] I noticed that, as the production went on, you, it got more and more difficult for you. Can you talk to your experience in how, towards the end, how you, sort of, felt and what your experience was at that point?

JB: [00:15:17] Yeah, I think I distinctly remember a point where I was just like: I refuse to do anything extra, like, I am done for now. And we went away, and we had a long rest and we had some, like, some food and drink and we came back, and it was quite, like, having that rest and that time to get away from it. You know, we were able to get what you wanted by just remembering, like, you're not quite hitting that performance you need to do this, you need to do this, and I kept trying, trying, and trying and it just wasn't clicking for some reason. And I think it was because I was tired or fatigued, you know, we had performed as Mahara and, like I said, she was, or Mara sorry, yeah, the enforcer character, for quite some time, like, maybe an hour or maybe less, I'm not sure and then we moved into the Troll where I said it was more challenging to perform as the Troll. And then as I'm performing, and performing, and performing the exercises was kind of getting to the crescendo of the production, where it was quite energetic, lots of running and jumping and punching and stuff like that and, so, I just remember just going, trying and trying and trying and trying to get the movements right, but just not being able to hit the marks, the timing, or anything like that and, you know, there was definitely tiredness and fatigue, but then, also, just this overwhelming, like, kind of, want to not do it, you know, like, not, not do it, but like, a wall was in my way kind of thing that I couldn't climb over for some reason, like, I just kinda hit that wall physically and mentally and just went: okay, I need to stop. And then, once we came back, it was like that wall had kind of crumbled away and it was easier. It was definitely a hard thing to do, I remember, you know, I was running, jumping, and punching the ground, pretending my arm was longer as well as trying to get off the ground as well as trying not to hit the ground, so it was like, we did it, we got the take in the end, but it was definitely something that was hard to achieve.

SM: [00:17:40] When… when it comes to the industry, as we progress, you know, onward from this point, as the virtual becomes more integrated into these computer-generated worlds, these computer-generated productions, these virtual productions, do you think immersing performer into these worlds would become common place during these motion capture performances?

JB: [00:18:09] Yeah, I'd like to think so. I mean, there's this kind of trend in games that or, not even trend in games, but just this, kind of like, want for society to create these virtual worlds, like there's books about simulated universes and, you know, some people even question whether or not reality is reality or whether or not it's simulated and, you know, we have films like The Matrix and stuff like that. So, I think, you know, from what I can see, where technology is now, if we progress in the way that I would assume, technology getting better and better and better and better, it would make sense to immerse the actor into the virtual. Especially if you're performing these vastly, like, fake worlds, you know? Like, in Avatar is a good example, where it's on this different planet, Pandora, and you're acting as different characters. There's nothing on Earth that looks like this alien planet. To replicate it would be, physically, would be challenging and costly. But if you did it virtually and then you could immerse yourself in that, to a high level of immersion, that you felt like you were there? I think that would be exciting and would make sense and it

would also, kind of, maybe, flip what these characters are saying, like, they're saying: Oh, it's challenging, because you've gotta remember all this stuff, but immersing them into the world, instead of getting them to imagine the world might be the solution. But really depends on the technology and where we end up.

SM: [00:19:53] I know when we were working in the, in the studio, we had some physical props in the space. I, I know that we avoided using any physical reference in volume because, obviously, we couldn't build the entire set, but we did have a few things in place and I'm aware there are, there are productions, like Avatar, that use physical objects in their motion capture studios to help place the, the actors. Do you think, do you think that that would be something we would continue to do or that we would, you know, would be beneficial for immersing the actor in their performance having a partial built set, but obviously not to the extent of the virtual world that their completely immersed in?

JB: [00:20:49] Yeah, yeah, I think it's interesting, like, when we were obtaining this production, for my research, I was kind of really interested in the actor's connection to the virtual characters and what they felt performing as those virtual characters and I, I kind of like, took this mindset that well, I'll focus on the virtual characters this time and minimise any opportunity for the virtual, interacting with the virtual environment 'cause the, in the production itself, there's not that many times where you're performing or interacting with the environment. There's a lot of, a lot of just walking and interacting with characters and, kind of like, a lot of suspense, you know, so like, building that suspense. But, you know, as we were going through it, you know, I eventually just had to bring in these chairs, like you said, and I think we even had like a, what did we use as the, the gauntlet thing, the bracers that we broke out of?

SM: [00:21:53] So, we used the, several reflective markers joined together as a.

JB: [00:22:00] Yeah.

JB: [00:22:02] Yeah, so we did end up make, like, making a prop and we did end up using those chairs. We tried it without it, but I just remember, when we were, when the scene was set up, we walked to the volume, and it was like no, no, you're still, you're inside the boxes. You need to go back a couple of steps. And then I started using, like, markers on the ground to be like okay, that's where the boxes are. So, I was like innately, kind of, using reference. Well, if I'm already using reference with scuffs and marks on the ground, then let's bring these seats in. And the other thing, when we were doing the performance, we're breaking out or pushing away these, these boxes and breaking out, or surprising the Mara character. And, you know, delivering a performance where you've got nothing, like, you're breaking out of something, just kind of like looks like you're waving nicely. But when we brought the chairs in, there was actually something physically for me to push, physically, to get out of my way and it changed my performance from faking moving boxes to actually moving boxes. Even though there weren't boxes, they were chairs on wheels, as well, but it gave, it added to my performance. And then, picking up the item is like, there was a certain approach and curiosity and I, I had to look at this marker, so without having a physical thing there. I probably would have done the same thing, put a marker there, and so it's just like I'm picking that up. So, yeah, I think that was really interesting, so I really made my performance more authentic in a way, like, it felt

faked without it and more authentic with it. But that also led to penetration of assets, so I remember, you know, we were moving, pushing these boxes out of the way, but because my, the Trolls arms were longer than my arms, when I pushed the chairs out of the way, it wouldn't actually be correct, like, I'd be, my hands would be through the boxes and then I would push them and then, like, I remember you just saying: Oh, we'll just fix that in post, you know, like, there's not much we can do about that, but at least the performance is authentic and it's easy for us to translate that character back through cleanup to still make it feel like we are pushing those boxes appropriately.

SM: [00:24:28] So, in terms of major takeaway as the amateur actor of this, within this production, what would you say are the, sort of, major takeaways from this virtual production?

JB: [00:24:41] Yeah, I think, I think definitely, like, the play element, like, having that time to explore the character or characters and the rehearsals as well. Being able to deliver a performance and then get feedback and view that performance, you know, you're telling me what I'm doing wrong compared to you telling me and showing me as well, what I did wrong was, like, really valuable. Especially 'cause, you know, I don't have this strong, like I'm not, like, a professional performer, so, like, having that really, I think, help evolved my performance and improved it. I don't know, would you agree?

SM: [00:25:27] Yeah, absolutely, yeah.

JB: [00:25:29] So, I think that was really interesting and then, even though it wasn't part of it, and I really see the potential of having these virtual, these physical references and physical props of the virtual in the spaces, kind of like nearly 100 percent necessary, you know, like, like I said, it was a difference between a fake performance and an authentic performance because I would be physically touching and interacting with those things that existed in the virtual. You know, it might have been really interesting to actually have those boxes to push away and it might have been interesting to have the weight. But even just having those chairs was just a big, big difference.

SM: [00:26:15] So, the, the physical elements, utilising those in the production space, rehearsing, and getting feedback from the, from myself, from the director, and that element of play. Are there any, sort of, other things that you would take into another virtual production to help if you were to, again, be an amateur actor or, so just your experience and any other things that you would take into another production?

JB: [00:26:45] Yeah, I think, I think the next big step would be actually exploring that idea of the virtual environment and those physical props and objects and what that actually means because, you know, I said, like, innately, we started to do it and you can see in these productions, like Avatar and stuff like that, in the behind the scenes, they're also doing it. So, there must be something there, like, I haven't read anything saying that this is the be-all end-all and you should do this, and I know that there's are productions out there that don't use any reference and just rely on the actor. But yeah, so, I think that would be really interesting to take forward and especially interesting for my research. As well as … you know, we're talking about

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virtual reality, maybe it would be really beneficial to get an Oculus Rift and immerse and try and immerse the actor into the virtual and see where that, kind of, takes them or leads them. So that, you know, you could go, you know, look at the environment and then look at immersion or look at them together or, yeah, you know? Looking at all these things together, like, how does the character effect the environment that effects the immersion.

SM: [00:28:08] Is there anything else that you'd like to add? Or just, sort of, summarize from this point?

JB: [00:28:16] No, I think we covered most of what we kind of achieved and did here. Obviously, it's early stages in the research, so, you know, we're probably ahead of the game by doing this production. But it's good to have done it and kind of know a direction and where I'm going with it. And it'll be interesting to test this on other performers as well, like, and other productions, you know, but yeah, I think that's it.

SM: [00:28:49] Great, thanks very much.

JB: [00:28:50] No worries.

End of Transcript [00:28:58]

Cycle 2: Interview Transcripts

Interviewee: Damian Castellini, Beth Liddle, Jongki Daniel Seo, and Steven Mohr
Interviewer: Joel Bennett
Date of Interview: 03.07.2015
Transcribed: 27.01.2016
List of Acronyms: JB = Joel Bennett, DC = Damian Castellini, BL = Beth Liddle, JS = Jongki Daniel Seo, and SM = Steven Mohr

Begin of Transcript [00:00:00]

JB: [00:00:00] So, Damian.

BL: [00:00:02] Oh, wow.

DC: [00:00:03] Yep.

JB: [00:00:06] As a director, how did you find the reference of the TV against actually giving them directions and stuff like that.

DC: [00:00:14] Umm, I think I actually needed a combination of both, because, yeah it was easier to direct the actors being in there, in the scene with them and, sort of, telling them were to stand and moving them around a bit, but without the umm, the larger screen to have as reference, it was really hard. Especially for the things like the limbs and exaggerated necks and stuff like that. You really needed to be able to see how that translated into the virtual screen.

JB: [00:00:42] Yeah.

DC: [00:00:43] To be able to put them into the right place and to see, like, where the two heads were tilting, for example. Being able to direct them next to each other, without being able to see what was actually going on screen.

JB: [00:00:51] Yeah.

DC: [00:00:52] Would have really been, well you saw. So, it was actually, I think it was a combination of both.

JB: [00:00:56] Yeah. And Dan, do you find that you used the TV as reference while you were acting? Or you just went into your character and only looked at it.

JS: [00:01:07] I actually used that one as a reference.

JB: [00:01:10] Yeah, whilst you were acting, though?

JS: [00:01:11] Yes.

JB: [00:01:12] Yeah, yeah.

JS: [00:01:13] It was easy for me to, you know, ever so, kind of, reference for me.

JB: [00:01:18] Yeah.

JS: [00:01:19] To act. otherwise, you know, I don't know where my head has to go or how, you know, how my neck supposed to be working like that.

JB: [00:01:25] But when you're actually in the scene, I didn't notice you look at the screen.

BL: [00:01:28] No, No.

JS: [00:01:28] No, No.

BL: [00:01:29] When we actually doing the actions.

JB: [00:01:30] Yeah, yeah.

BL: [00:01:31] When, like, but, it's nice to have it there to.

JS: [00:01:33] Yeah.

BL: [00:01:34] To ground yourself in the scene and then you can, it's easier to visualise.

JS: [00:01:38] Yeah, Yeah.

SM: [00:01:41] Would it have been more beneficial to have something tactile, I was thinking some sort of strap around helmet with the same height as the Slender's heads?

BL: [00:01:50] In this instance, I don't think so because of the way, like, when you bend your head, it, like, it was, you could, you could figure out how, like, it forms in relation. You just had to think that: okay, when I bend my head, I need to bend down like this.

SM: [00:02:04] But I was thinking, specifically, like, when you had to touch your own chin or, like.

BL: [00:02:08] Maybe that would be useful, yeah.

SM: [00:02:09] Yeah.

BL: [00:02:10] In terms of interacting with your own face.

JS: [00:02:16] If we can check something beforehand or before we take our action.

JB: [00:02:19] Yeah.

JS: [00:02:20] We can check and, you know, do some kind of.

JB: [00:02:21] Yeah.

JS: [00:02:22] Yeah, yeah.

JB: [00:02:23] What about the physical props? do you find they help? If I didn't have them in there, do you think it would have been harder?

BL: [00:02:29] It would definitely be harder

JS: [00:02:30] It definitely would be, yeah, yeah.

JB: [00:02:32] That's what I want.

JS: [00:02:33] Yeah.

DC: [00:02:33] Yeah.

JB: [00:02:33] But it helps my research

DC: [00:02:37] You need props.

JB: [00:02:38] Yeah, what is it?

DC: [00:02:39] Doing the Herb thing, I didn't have a walker, I used a cane, from when I hurt my leg and I acted that, I created, you know, Herb for that, I think Michelle did it too. And all of use used the cane because it, it let you lean down and let you actually put yourself into the persona of that person instead of pretending to lean forward, while not overbalancing and actually falling forward, so.

JB: [00:03:03] So, my research is, at the moment, you look at the screen, but I was saying: well, we've got this virtual world, we've got all these characters, what happens when we put you in the space and actually give you something like the Oculus Rift? And so, when you actually look, when you're looking at him, you actually see his virtual character, not his actual self. And, so, if he's taller than you, you'll actually, physically, know that you have to look higher because the camera will be attached to your head, kind of thing, so.

BL: [00:03:29] Yeah.

JB: [00:03:31] you'll feel shorter and smaller and stuff like that. And in comparison, when you go to high-five, you'll be seeing his virtual self, so it would actually high-five and stuff like that, which is really cool. But, like, it's a stepping stone. At the moment, I was like: How do props help the performance? And then, if I put you in the virtual world, does it help with
Performance?

BL: [00:03:48] Yeah.

JB: [00:03:49] One of the things Damien said was, as an amateur actor, it's important to have that screen, but I find that, when he's actually physically acting, he said he was looking at the screen for reference to inform himself whether or not he was doing it right. The good thing about this, I think one of the things, as Damien is actor and director in his Herb thing, that was necessary, but in this circumstance, 'cause Damien's the director and he's directing you guys, you're actually relying on him to make sure.

BL: [00:04:21] Yeah.

JB: [00:04:22] You're doing it right. For him to be like yes, which gives it more of a professional sense environment, I think. Anyway, I'm talking. You have any more stuff you
liked?

BL: [00:04:32] I think even, even though the props we had weren't perfect. You know, it wasn't exactly the height of the table it was still, like.

SM: [00:04:38] It didn't.

BL: [00:04:39] It helped a lot.

SM: [00:04:40] It didn't need to be one-to-one.

BL: [00:04:41] You knew, you knew that it was this far, that was the table, you know, that's where the table might be, so, like, it was a really solid…

SM: [00:04:48] It didn't need to be one-to-one, just there-abouts.

BL: [00:04:49] Yeah.

DC: [00:04:50] Although, I think the closer that something approximates what you actually need it to be, the less you're thinking about stuff, so, if the tables the right size, right? Right. Then you're, you're purely thinking about, like, if the shelf had been in the right place, the table had been the right height, the right place, then and there'd been a book there and the flask on the left. All Daniel would have had to think about was literally: this is my actor, my character action, I am this character, here's the book, I'm going through the book, I turn, and I grab this flask.

JB: [00:05:16] Yeah.

DC: [00:05:17] But by having to think: oh, I'm meant to have a book here and I'm meant to keep my finger on the book that's not actually here and then I'm turning around to a shelf that's not actually there to find a flask. It's reminder how I said earlier, the more things you have to think about, the less you're actually able to focus on the acting.

BL: [00:05:31] But also depends on how well the actor is able to adapt to the MoCap environment.

JB: [00:05:37] That's exactly right. So, seeing people, like masters in the trade, like Andy Serkis, for example. He's fluent in that kind of environment. Without having anything there he can actually act. And one of the things that came up in my research was, I was always saying: Oh, it's going to make it easier for actors, some people were like: well, Andy Serkis can do it fine already, why does he need this extra for? And it's like: Well, okay, maybe it's more for amateurs getting to the point where Andy Serkis is.

BL: [00:06:05] Yeah.

SM: [00:06:06] Who says that Andy Serkis doesn't need it?

JB: [00:06:08] Oh, it was just a question that he's already mastered his trade in MoCap.

DC: [00:06:12] That's a really exceptional sort of case. Like, to use him as the example for what everyone would sort of act like. He is an exception, 'cause he is an exception.

JB: [00:06:22] Yeah.

DC: [00:06:23] I would imagine that most probably need, like, we're living with that actress, Kerstin, she did need things around to give her some motivation and she was like a drama student actress.

BL: [00:06:31] If you want to use, like, it's just, I know a lot about Lord of the Rings, so let's go with that. Like, Ian McKellen, when they were shooting The Hobbit, in the dining room scene? He had a lot of trouble and, like, there's no denying that he's a good actor, so.

SM: [00:06:46] I'm surprised they actually did everyone individually.

BL: [00:06:51] No, no, no. It was, Gandolf was individual.

SM: [00:06:53] Oh, was, yeah, yeah.

BL: [00:06:54] And all the rest of the dwarfs were together.

SM: [00:06:55] Yeah, yeah.

DC: [00:06:56] Oh, Aye.

BL: [00:06:57] But Ian McKellen had a, like, an extremely, extremely difficult time acting in that environment, so.

JB: [00:07:01] Yeah.

SM: [00:07:02] He broke down at one point, didn't he?

BL: [00:07:04] Yeah, he did.

DC: [00:07:05] Really?

BL: [00:07:05] So, yeah, and, like, they had props and everything, to scale props.

DC: [00:07:10] Like, broke down? Oh, I can't do it.

JS: [00:07:11] Wow.

BL: [00:07:12] Yeah, it was.

DC: [00:07:14] Actors, man.

SM: [00:07:16] You can imagine, like, that scene where he's, like, gripped by Sauron and he's, like, coming at him, like the walkway just sort of disappears beneath him. You can imagine, that would all be green screen, just, okay, be really afraid.

DC: [00:07:34] The green's going to eat me.

BL: [00:07:36] I wonder if that has anything to do with actor's backgrounds as well, 'cause a lot of these people are coming from theatre and that's extremely reliant on, like, eye contact and stuff like that. Whereas, just regular TV, and like, there's a lot of camera cutting and stuff like that. Whereas theatre, you get really involved on a, like, on a personal level.

JB: [00:07:49] Yep.

BL: [00:07:50] So.

DC: [00:07:51] I almost would have thought that theatre, because you do have to make a lot of it up, they don't actually have all of the set there, all of the time.

BL: [00:07:56] You do.

DC: [00:07:57] Especially with impromptu sort of stuff, you just sort of doing it.

BL: [00:07:59] Yeah.

DC: [00:07:59] On the spot. I almost would've thought theatre actors would have been able to bring more of that over them.

BL: [00:08:04] You thought, I think it's that interaction scenes, I think, is the worst because.

DC: [00:08:06] Yeah, right, right, right, right.

BL: [00:08:07] You're there and you can't stuff up, you keep going and it's a relationship.

DC: [00:08:11] So, you need someone to come in there with, like, a ping-pong ball with two eyes squiggled on it.

JB: [00:08:14] Yeah, yeah, yeah.

DC: [00:08:16] I'm actually Smaug, alright.

JB: [00:08:17] Yeah, yeah, yeah, yeah.

DC: [00:08:19] Ah, pong-pong ball.

BL: [00:08:20] That's what they did.

JB: [00:08:22] One of the things that I thought helped you guys achieve your performances was a lot of analogies to help you understand what, like, obviously, the diaper one. There was another one that you were saying, like: you need to move like this and then you gave an analogy.

BL: [00:08:36] Like a dancer?

JB: [00:08:37] And like it just clicked, king of thing.

BL: [00:08:39] Yeah.

JB: [00:08:41] Those kinds of things, I think, helped, which was interesting.

DC: [00:08:44] I find it really helps, and this probably just came from animation and stuff, you do the actual for them and stuff.

JB: [00:08:49] Yeah.

DC: [00:08:50] Instead of just describing it, if you have to do a silly walk, you've got to do something for Herb, you do it.

JB: [00:08:53] Yeah.

DC: [00:08:54] You show them how they do it.

JB: [00:08:54] Steve, Steve, does the same thing and I'm a hundred percent sure a director does do the same thing in a professional sense.

DC: [00:09:00] Alright.

JB: [00:09:02] Damien, for you, going from Powers Above, where you're more of an artist and experienced motion capture, kind of, not for your first time, but, that kind of sense and going into director roll. How did you find the transition there, like?

DC: [00:09:19] I think, because I did so much directing for the Herb thing, it was pretty natural, like, I really did appreciate the tips that you guys were, like, giving me because, you know, like, you don't know all what other people have learnt and stuff like that.

JB: [00:09:34] Yep.

DC: [00:09:35] But, yeah, I felt like I went into it pretty naturally 'cause I was.

BL: [00:09:38] Yeah.

DC: [00:09:39] doing a lot of that for the Herb thing and, like, directing myself and teaching myself how to dance and doing the same with other people and stuff, so. Even with the Mondrak thing and stuff like that, I remember a point, almost trying to take over to direct because.

JB: [00:09:53] Yeah, yeah, no, yeah.

DC: [00:09:54] I kind of already stepped into that a little bit and, you know, once you have, it's really hard to.

JB: [00:09:57] Yeah.

DC: [00:09:58] Pull back.

JB: [00:09:59] Yeah, yeah.

DC: [00:09:59] And just, yeah, not do it.

BL: [00:10:01] If it was awkward at all at the start, it really picked up, like, really quick, so.

End of Transcript [00:10:08]

Interviewee: Liam Soden
Interviewer: Joel Bennett
Date of Interview: 24.07.2016
Transcribed: 18.02.2018
List of Acronyms: JB = Joel Bennett, LS = Liam Soden

Begin of Transcript [00:00:00]

JB: [00:00:10] There are no right or wrong answers. I ask you a questioned, but I want you to base it off the fact... Like answering it away you kinda of explaining the whole thing. So, if I go, what is your name? go my name is such and such, so not like giving me the whole story because if we cut it up and we put it in there won't be asking the question. I'll actually cut that out it will just be you answering questions kinda of thing. Or it doesn't work I'll put like a question box or I'll put out a recording or something like that or I'll sit there, and I'll re-say the questions, I'm just to figure it out later.

LS: [00:00:48] Yep, fix it post.

JB: [00:00:51] Exactly, So What's your name again? What's your performance background? Have you used virtual production before? Have used virtual reality before? What are your initial thoughts about VR and motion capture? How does it play a role in the future of production? And I'm looking more into the nitty gritty about VR and all that kind of referencing stuff that we have done. We might have more specifically as a few threads that I might want to pull from the conversations we had yesterday, but I think we'll just kind of, roll with it and see where end up kinda of thing. Cool alright. So, and you know look at camera, look wherever you want, use your hands if you want to explain things. Just comfortable however you feel. You don't have to act, just do your thing, how you feel. So, what's your name?

LS: [00:01:53] My name is Liam Soden, and do you want me to continue?

JB: [00:01:58] Yeah, we will start Liam Soden and just a bit about yourself. Like I'm an actor or I do this or I'm student at QUT, however you want.

LS: [00:02:07] My name is Liam so I'm a third year acting student at QUT and I haven't done really too much professional stuff, but I've done a lot of school plays and amateur plays and stuff like that and I've never experienced motion capture before I've never even used virtual reality before.

JB: [00:02:36] Cool that just answered my two questions anyway. Alright so the next question is, how do you see virtual reality and virtual production and motion capture going into the future, do you think it's going to be highly beneficial? Is going to grow? Is it going to shrink?

LS: [00:02:53] Yeah well to me you know as much as... I see virtual reality as essential, it seems like, it just seems to be the next natural step in the order of animation because we've gone from 2D to the CGI and now I think people are really loving the more lifelike these animated films become. And so, in my opinion it just seems like the

next step and it's also a way to have the personality of that actor or actress in there as well which you know. I feel like that could really encourage audiences to come along as well. If they see a big-name star in an animation. Who knows…?

JB: [00:03:55] So what were your initial thoughts coming into the motion capture space. How did you feel and what were the thought processes that you had?

LS: [00:04:03] Well my initial thoughts going into the motion capture space, when I first put on the suit and stuff and I could see my model up on the screen, like you just instantly become almost painfully aware of all your movements and all your tendencies and physical habits and especially seeing even just something as simple as walking. I've never seen a version of myself walking in that complete fashion. So, it's really interesting to see how you actually read to other people when you're just walking when you think something so simple but it's actually full of character and full of nuance. So, it was really interesting to see that.

JB: [00:04:46] And do you find that the avatar of yourself a distraction or do you find it like, Did it kind of feed you, am I walking the way I should be walking or did you kind of embrace it and go, like this just gives me an extra toolset.

LS: [00:05:02] Yeah well. Yeah initially when I first saw the avatar. You know I just had to sort of get used to it and I had a bit of a play around with it on screen but I sort of compared it to normal acting like you know in a normal film where you actually just have to forget that the cameras there and it was just the same sort of concept where I just had to forget everything that I've just seen and stop judging myself or walking just like I might adjust myself for how I look on camera. After I'd stopped judging myself or my movements and just lose everything and sort of try and act as natural as possible and not let outside influences affect that. So, it's like acting in that respect so.

JB: [00:05:48] So, you did the doughnut exercise in three levels. The first level was obviously developing a kind of, I don't know, sixth sense of where this doughnut existed. Just describe your experience of that first exercise, when you actually just didn't have any kind of physical representation but the screen content.

LS: [00:06:11] So when we did the doughnut exercise I had to jump through a virtual doughnut that was projected up on screen and I could see my body and movement to try and make it through and honestly it really started to get the imagination going, it was really fun to try and find my physical sort of proportions to try and figure out how big this doughnut was, how wide it is, how big this hole is, and then try and solve the problem. I got my whole body through and yeah, using the screen was, was completely fine just as fun and yeah, I didn't have a problem with that at all.

JB: [00:07:00] All right. So, then the next... It was great explaining the exercise at the start aswell. So, the next exercise we moved into are physical props. So, you said you had fun playing with that imagination and stuff like that, but there was something specifically you talked about… Precision, that you could be more precise when you have the physical props aswell, so I'm just reminding you.

LS: [00:07:21] Yep, oh can I talk about that. Sorry I thought that was the next question. How you took away the screen and had to remember where…

JB: [00:07:30] Yeah, we can do that first.

LS: [00:07:32] Okay so. I'm starting again.

JB: [00:07:33] Yep.

LS: [00:07:34] So, I had to do an exercise where there was a virtual doughnut on screen, and I had to sort of make my way through the doughnut without clipping the edges. At first, I had the screen up there and I could see obviously my model and where the doughnut was, and I had to try and get through. After a couple of times of successfully getting through, the screen was taken away and I had to try and remember in my mind's eye where that doughnut was exactly, and where that hole was, and try and get through it without touching the edges. Obviously when that screen first comes down, you feel a little panicked but once you start remembering those physical actions and I made physical references to where exactly the hole was. I managed to get through without touching the sides and that wasn't too challenging, I could see how it would be possible to act with your imagination completely.

JB: [00:08:34] Cool, yeah so, we will move onto the second exercise which was the props, the physical props and precision and stuff like that.

LS: [00:08:47] So the second stage of that exercise we would put a box to represent the bottom of the doughnut and then a sort of, just, dressing hanger that would represent the hole to try you know make a little impromptu doughnut. I found that helpful to get right through it, it was just as easy, I could imagine the doughnut being there and it was nice to have physical reference. However, it starts to get difficult when the representation on screen wasn't exactly what it was on the floor. So, we had a box at the bottom of the floor instead of the curved edge of a doughnut. So, and I'm sort of looking up on the screen I would walk towards it and suddenly my foot would hit the corner of the box and on the screen it's a curved edge. But in physical life it's a square. OK so that was a little sort of trip that I had to get over. It sorts of brought me out of the experience a little bit, especially when we started getting into virtual reality.

JB: [00:10:02] So you talk about the precision as well because that was something, I thought was really nice comment about. You know that you are doing it correctly, that way kinda of thing.

LS: [00:10:15] Okay so yeah.

JB: [00:10:16] You can just not start again but just say you know, just build off what you were saying.

LS: [00:10:20] Yeah cool, having the different shape of the box there it really affected the performance I think, because the performance in this respect was just simply getting through a hole. But when you sort of had a box there that wasn't quite the same as what was represented on screen. I feel like the precision of the performance was affected dramatically almost because I would have to move around an object that wasn't represented on screen so it wouldn't have looked as refined as it could possibly be, because I had actually an extra obstacle there which I didn't have represented onscreen.

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JB: [00:11:08] So, well move on to the third exercise which is actually the full immersion of the virtual scene and then you can talk about, you know, originally we did have there for a split second the boxes and stuff like that but again because it wasn't an accurate representation for virtual object. I automatically took it away because I knew it was just too much. So, we'll talk about that.

LS: [00:11:32] So the third stage of the exercise is putting on the virtual reality headset, so I could see myself as the character and see this doughnut in front of me and originally we left all the boxes and props there from, from the previous stage and this is when you start to get fully immersed in it in this whole world even though it was just a doughnut in front of you and I walked towards it and I remember going up touch it to try and you know, figure out the proportions and you know sort of you know sense myself, so I could eventually get through and I bumped into the box which again was not represented on screen. This time I was completely immersed in the world so I couldn't even see the box when I looked down. So, it was really sort of jarring just to walk forward and bump into an invisible object and again that took me out of the process completely. It actually it's sort of shook my trust a little bit as well in this virtual world because I suddenly became aware that there was completely different things happening outside my control and I couldn't see it, so I tried to get through with the props there and virtual reality headset on it but I was really hesitant. Joel decided to take the props away and then once I sort of, you know, re-organize myself. I found myself just again completely immersed and focused on my goal to get through the doughnut. Even though there was nothing there, I feel like it didn't really matter because as far as I was concerned, I was seeing something there and the whole the whole idea was not touch. So, in my world it was, it was perfect.

JB: [00:13:29] So. Let's talk about the tether, as a separate question. You did mention in the other one that overall, your experience in those worlds. How did you find tether of the virtual reality? Because that's something that I found that as long that performance doesn't 'cause you actually interact to too hard and heavy with it, you do forget about it. So, feel free to go

LS: [00:14:19] So yeah, when I first saw the virtual reality headset, I saw there was a massive tether. You know just wires connecting it to the computer and stuff like that. Automatically I sort of thought that my movement would be a bit more restricted because your actually hooked into a computer. Yes, the leads were long, but you've got something dragging behind you suddenly. It was the same when I first put it on my face. You know it adds a bit of weight to the head as well. Especially since the way I've been getting through the doughnut was jumping through, it was kind of, a bit, a bit sort of restricting in that sense. But once I sort of played around and as I said before started to get immersed in that world, I honestly completely forgot about the tether, completely forgot about the weight on my face and I jumped through it just like I had done in the previous stages, and even more precisely since I could see exactly what my objective was. Then we did an exercise where I had to run back and forth just to get use to the space wearing this headset and the tether behind and it was again a bit frightening because I didn't want to trip over the lead. But once you get immersed, you know it's just like getting immersed in the world as an actor. Once you see this world you know you completely forget that the camera there and you completely forget about the sound guy here and you completely forget about you know the whole crowd watching you, so

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it wasn't a problem.

JB: [00:16:03] Cool, one of the experiences you described in the virtual world was actually how you trusted or brought your own knowledge of the actual world and said you didn't want to physically walk through something, you didn't want that to happen. So, just about that experience as well.

LS: [00:16:22] Cool so, having the virtual reality headset on I could obviously see the doughnut right in front of me, and I found doing the other exercises, even when the doughnut wasn't in front of me and I was using my imagination, you kind of have to respect that world. So, even when I jump through an imaginary hole, you'd see me walk around the edge and I wouldn't just walk straight through that or the doughnut. You kind of have to keep that world alive in your head, so when I walked back around. Then obviously when I put the virtual reality headset on it just became more apparent and I was told after I jumped through, to try and experience walking through a wall… I walked up to it and put my hand out and you start seeing your hand clip through, and something sort of instinctive almost tells your body just stop since there is an object there and you can see the object there. So, it was really quite an experience being able to walk through a solid object after you get over those initial instincts to just stop, not because you're scared. It is just nature, you know, that you don't walk through a wall.

JB: [00:17:54] So after experiencing that slue from kind of the start of motion capture all the way through the separate stages of props and virtual reality. Do you think that is actually avenue or do you think that this will actually become a thing or a toolset that an actor would use to help performance?

LS: [00:18:17] Yeah. So, I definitely think there's room for virtual reality in the motion caption business because to me just as I said before it seems like a natural progression in the order. I've always thought seeing these digital movies where the actors are acting to a green screen or reacting to the environment about them. It always felt to me that the animators and the actors would have to be on the exact same level, they have to almost be seeing the exact same things for it to work and look like it's real. So, I was thinking if I was in a movie and I was on a pirate ship and that you know I'm acting to a green screen and got the motion capture suit on and I'm having a conversation, and suddenly in my head I see a seagull fly past… Something just so you know as simple as that or as detailed as that. The animator would watch that back in the cutting room and he might have no idea what that movement was... The relationship will be skewed between the actor's world and the actual world. But I think when virtual reality is put on and you see the whole world around you and you do see a seagull of fly past; you can react to that. And since the animator sees the same world, the exact same world you're seeing it just seems like it marrys those two worlds together and really make the whole project more effective.

JB: [00:20:08] How did you find your experience of your virtual body compared to actual body. So, like, when you put your hand out and you see a different hand. My automatic thing is that, oh that's my hand now. Like I automatically was that's me in this world. Just that experience aswell like becoming something else, someone else.

LS: [00:20:28] Yeah so, once with the virtual reality set on, your immediately layered over with the character that you're representing. Some people would think that's jarring

or I might have thought that's jarring beforehand but I think you actually accept it quite quickly in my opinion you kind of see your hands and you're like aww yeah, okay I'm wearing a pink top. I've got three fingers, and this is just me right now. As you get more and more immersed in the world you just start to accept it more and more. Like obviously I look at a tree over there, that's not what a tree looks like in Liam's world but in this world it fits perfectly. And I found myself sitting down for some reason the shoes were really funny because something as simple as clothes. It's so personalized to the character and suddenly I'm wearing this lady's shoes. So, I thought that that was the funniest part. But again, it's just easy to accept. And it really helps trigger your imagination, I think.

JB: [00:21:46] Do you think the missing senses such as touch or even used sound now. That's why we had ambient sound, I want to I'm gonna cut that up and have looping tracks. Do You think that will further immerse you aswell and again and again another level?

LS: [00:22:04] Can I talk about when I touch the chair because that was insane

JB: [00:22:06] Yeah, Yeah, yeah that's a good idea, yeah, we do that didn't we.

LS: [00:22:11] Mmmm, Yeah.

JB: [00:22:11] So just talk about it was really an exercise it was just an exploration. Like…

LS: [00:22:19] We went to another scene in virtual reality where I was in the restaurant. And I was told the character sits down at the restaurant and sort typing on the table and from this point. I was sort of living in the world, just walking around looking at things I could see myself in the world. But obviously I couldn't feel and touch things. But we actually brought in a physical chair into the space and we positioned exactly where it was in the virtual world. And I remember reaching out and touching for the first time my cartoon hand touching a cartoon chair. While my real hand is touching a real chair. It was just I thought I was an immersed before but that really, really took it to another level that, that was honestly insane. I reached out, sat down and couldn't stop feeling around and I looked down and said this casting chair. You could have left me there for hours I think that was amazing.

JB: [00:23:21] Cool. Oh yeah okay something you talked about as well as returning from your virtual self to your actual self and the disorientation that you have in space because you're like oh, this is where am now. So that's another good one.

LS: [00:23:43] Yeah. Okay. Yeah. So, when I took the virtual reality set off, I think I was in it for 10 or 15 minutes. And I was just playing in this square box, in the back of your head you know you have this sort of level of awareness where you think you are in the square. But once I took that headset off, I was absolutely nowhere near where I thought I was, I wasn't facing the right way, I wasn't in the right corner. It was really weird to re-calibrate myself because I completely forgot where I was in the real world because I was so immersed in the virtual world. It was just the square; it was the same square in the real world than in the virtual world. But I just got so caught up to where I was, I forgot that this side was the trees and that's where the door is, and this side was

the road and that's where Joel and Steve are. I just, I just got so caught up and after 10 minutes of being in there, it was real shock to lift up and come back to us to somehow almost foreign because you start to accept the other place so readily.

JB: [00:25:00] So last question I think well do which kinda covers everything was talking about just nauseam. So, what we call the virtual headset or the HMD… It's actually DK2. So, it's like pretty old compared to some of the systems we have available now. Just talking about, did you feel nauseous, were there times you felt nauseous and stuff like that.

LS: [00:25:32] Do you want to talk about when you brought that stuff up on the computer.

JB: [00:25:37] Yep.

LS: [00:25:38] Yeah. Okay. So yeah. Using the virtual reality, I thought I would get motion sickness because I normally do in cars especially if it's like riding backwards or whatever and I heard that people do get sick. But as I said before I found myself in the world for about 10 or 15 minutes I'm not sure whether it was because I was focused on something else or because my mind wasn't thinking about that I didn't feel sick at all. The only times I felt sick was when you were sort of setting up the program and setting up the world. You can see everything that happens on the desktop and there's is a certain view where one screen covers each I see you're actually seeing double and I think your mind tries to fit your two eyes together just to try and make sense of what you're seeing but you're actually seeing two the same thing and that I was told to close my eyes but I remember opening every now and then and that really it seconds really makes you feel ill. It's just tricking your brain and yeah there's something odd about that but as far as being in the virtual world and playing around I don't feel it at all.

JB: [00:26:57] Before we finish is there anything else, that you'd like to say or talk about that comes up in your head I suppose we could talk about the car experience aswell.

LS: [00:27:03] And then we did another exercise where I was told to get out of the way of a car coming out me in this virtual world and it was quite a rush obviously because you see the car coming at you and you move away in real-time. If I was comparing that to maybe imagining a car coming at me. I don't know, I feel like with the virtual reality set on, it felt like a more realistic reaction to be honest because it was more sort of instinctive. I remember watching the playback and seeing me sort of shuffle over and sort of huddled in the corner to get away from it, which you know maybe not as cool as what I would have done if I saw this car coming at me. in my mind I'd jump out of the way. But once the virtual reality set is on. I don't know all your reactions seem to be more realistic to be honest. If I was told to do that in my mind I definitely would have done this dramatic jump and get out of the way, but with the virtual reality I was sort of like, oh shivers, gosh, and ran out of the way. I just think that the virtual reality actually provokes a more realistic reaction and maybe you can train yourself out of that but that was my initial reaction to having set on.

JB: [00:28:31] Cool I think that's it, cheers

LS: [00:28:32] Thank you very much. Hopefully I tried to ah, you know.

JB: [00:28:38] Nah you smashed it man that was awesome. Like I said no right or wrong answers. It's good that explained things as well. That was awesome.

End of Transcript [00:29:10]

Interviewee: Maeve Hook
Interviewer: Joel Bennett
Date of Interview: 24.07.2016
Transcribed: 18.02.2018
List of Acronyms: JB = Joel Bennett, MH = Maeve Hook

Begin of Transcript [00:00:00]

JB: [00:00:02] ...Cool so we'll start off with more of who you are, like what's your name, where are you from, like QUT or do you have abit of performance background is that you proud of that you want talk about you don't have to say actor or aspiring actor or whatever. You can talk about your circus background stuff like that if you wanted... Yeah so, just go for it

MH: [00:00:43] My name is Maeve Hook I'm an actor with a large background in circus and different movement styles, things such as gymnastics and dance which is awesome... Currently studying acting QUT.

JB: [00:00:59] Cool well awesome. Have you ever used motion capture or virtual reality before?

MH: [00:01:08] I've never used motion capture or virtual reality before. I am an avid watcher of behind the scenes. So that has been the extent of my exposure to motion capture and VR, yeah.

JB: [00:01:25] Yeah Cool and what were your initial thoughts coming into that space. like working with Steve and stuff like that aswell, like using motion capture, how do you feel about, just a general is it cool do you find it handy you see the benefits, where is it going in the future, anything

MH: [00:01:43] Coming into the space I was super excited to try it. Cause, yeah, I see a large future motion capture and virtual reality in terms of film making and also in terms theatre making, particularly virtual reality. There's been a lot VR involved shows recently which is super exciting. Because the possibilities of what you can do with motion capture and with virtual reality is really exciting and I think you know a where you could go with that was just really cool. So, I was super excited to try it.

JB: [00:02:24] We didn't use props.

MH: [00:02:28] Very briefly but not with the Virtual Reality, with the chair.

JB: [00:02:31] Oh yeah, I suppose we did, but I talk about that...

MH: [00:02:34] And a stick for the acts with Steve.

JB: [00:02:36] Yeah, he was talking about that and said it was fun.

MH: [00:02:39] It was

JB: [00:02:42] So... I will talk about that, it's another question later on about touch and

how enhances the experience. having another sense in there... So. When you were performing for Steve and myself and when you weren't immersed in the virtual world and we're using screen content. Do you find that you utilize that to inform your direction you find it distracting to your performance, like you could actually see basically a whole new movement, a whole kind of lens on your body and how you move and stuff like that so or about yeah... or did you think about actually getting to see your overall movement and then on top of that... I have already forgotten... Did you find distracting having that screen for your performances?

MH: [00:03:44] I found the use of the screen and putting up reference videos and that kind of stuff on it actually very useful as a start point. To then go, okay this is what you want me to do and then seeing. Well seeing the motion captured version of my body on the screen was actually really exciting because it is a totally different lens to see your body and it meant that... While I was actually doing it, I wasn't watching it with Steve because you know you focused on doing the action or doing whatever it is that we're trying to achieve. But in terms of seeing it and trying out things I have this quite what you're after and I've got instant visual reference of what my body is doing and what Steve seeing. So that was actually really useful and quite exciting.

JB: [00:04:42] Cool.

MH: [00:04:44] Does that answer the question.

JB: [00:04:46] It does you and Liam because you're more traditionally trained actors and have more performance backgrounds. Your use to doing the performance and being in the moment kind of thing. I think that's correct, I think that's Stanislavski, So...

MH: [00:05:00] Yeah, well you just don't usually get that feedback straight away of what you look like unless you're in mirror. And even then, it's flipped.

JB: [00:05:09] So I'm, I'm not an actor at all but I've taken roles in acting for some production and I find it distracting. I always want to look at myself performing the whole time and obviously.

MH: [00:05:21] Ohh right.

JB: [00:05:23] Because I'll be like am, I doing this right thing making sure I'm hitting my notes or doing the performances I want to do. So, I think that's more an answer of, hey you've had training before and it's something that I expected. I was just curious to find out because most of the time worked with people that worked with motion capture but had no acting experience. So, they were always trying to look. you like the screens behind you. Ah yeah, yeah, what am I, am I doing right Yeah, yeah okay. And then it's like, oh you just ruined whole scene, you looked at the screen.

MH: [00:05:55] I didn't find it distracting during the scene at all.

JB: [00:05:57] Cool that's... Cool that's good.

MH: [00:05:58] And actually watching it back was super useful because instantly watching what you just did and you okay well that's not quite what he's after or I need

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to emphasize this.

JB: [00:06:12] It's something I said to Liam whilst Steve's not an actor he really understands the animation and how to move. So, when he gives directions is something, I always thought was quite good because directed me. He's like no I want you do this and actually do it and you're like I, I get it, but I don't know if I can do that.

MH: [00:06:28] He show it to, I think I got more from his demonstration.

JB: [00:06:31] Yeah exactly

JB: [00:06:32] I sometimes found the animation concepts abit difficult to apply to what he was asking you to do. I'm not quite sure exactly what you're asking but let me show me or you know give a little word. Oh yeah, okay so this is the intention, this is where we are going

JB: [00:06:46] Yeah, he is really good at that and he likes that I understand. He was saying the commonality of language and stuff that is gonna be really handy and he was like I didn't even think of that.

MH: [00:06:57] It just made the process way more efficient because if everyone is on the same page talking in the same language and even if it's not like your technical language. Yeah

JB: [00:07:05] So that tether something I noticed with you is you did. Does it anchor you to the real world it felt like you moving, yeah, the tether?

MH: [00:07:15] Yes because I could kind of feel it and I didn't want to step on it. So, it was something that I was aware while I was doing that.

JB: [00:07:22] Was any time you lost that awareness of it.

MH: [00:07:25] Yes. God when you got me to run the first time that I ran out of the space. That was all focused on because it was kind of like a trust run where you run with your eyes closed, which we have done in class and it's terrifying. But yeah, so when I was moving around and when I was with the chair, it was just when I could kind of feel and I did have an awareness that I didn't want to step on it.

JB: [00:07:53] Yep.

MH: [00:07:56] Yeah, I think it was actually more, I was quite aware of the headset and the weight of that and also it slipped occasionally so that kept me aware of the tether as well I think

JB: [00:08:10] So I think one things that I would have had to do is probably tighten it a bit compared to my head and maybe Liam's head, I don't know yours might be smaller and as soon as you lose it a bit it becomes blurry and it breaks your immersion straight away and the you go okay, I'm actually not in it, not here I'm somewhere else and that..

MH: [00:08:34] I think also because I got a little bit nauseous, I think that broke

immersion aswell because I was going can I keep it on for much longer do I need to take it off. You know yeah.

JB: [00:08:45] That's fine, I should have said if you feel nauseous you feel uncomfortable it's fine. I did it with Liam, it was just 'cause we were rushing to stuff done. I was exciting that the... It took me 20 mins to get that bloody VR to work, it's so temperamental

MH: [00:08:59] Well actually it was perfect timing as we back.

JB: [00:09:01] I know right, cool so I might do another question again towards being nauseous. Like when you feel nauseam and umm yeah, it's affecting obviously, you being in the world, just start again fresh from that.

MH: [00:09:20] I think... Well I felt nauseous when it was... You're moving all the time but particularly fast movements and it also it was just the nausea kind of grow as it went along. I think you know because screens really close to your face and also yeah with this looking a little bit my focus was occasionally refocusing on the screen and then back into the world. Yeah I think it was just having it so close actually then... Yeah it wasn't that it wasn't like anything in particular instantly made me nauseous but the nausea kinda grew as I kept it on for longer and then when I moved quite dramatically it kinda swelled up, so I was okay pause, pause…

JB: [00:10:12] Nah that's great that's got to do with two things one our eyes are used to see depth. So, we're just looking at flat screen which sucks and they're looking at new technology for that

MH: [00:10:24] But it also felt I was looking at depth and I enjoyed being in the screensaver because you know, it was like you're in space and there's all this and it went everywhere in every direction just kept going and you know you normally see that screen saver just on flat screen, so it was like oh wow. I think actually being in the screen saver was when I felt the most immersed. Because I wasn't moving around heaps and I was just there, and it was fully, yeah.

JB: [00:10:52] Was one of the issues that come across with this obviously as the technology gets better, I think it will get better and it's got to do with frames per second. Our eyes can see ridiculously fast. I think it's like 240 or 360 frames per second we can kinda just process bit we are only doing it 60 frames per second so when you do those fast movements. It takes a little bit to catch up and that's what makes you sick. I'm just explaining for your own curiosity if you wanted it. Nearly every question that you'll answer or every issue you tell me about I already know. From my own experience as well as I get really nauseous all the time. Like I said I car motion sickness

MH: [00:11:32] I do when I you read normally, normally if I'm in the car or if I'm reading or texting.

JB: [00:11:37] Yeah same with me I can't do it at all.

MH: [00:11:40] I can just slightly.

JB: [00:11:41] Claire's like message someone, I was like can't cars stopped and she's like okay. Yeah okay. So, one of the questions was do you think you're missing senses mainly touch, and we didn't have sound either has affected your interaction with the virtual world. Do you think being able to touch chair and move... If we have more time and more money and all that kinda stuff. When you pick up at chair actually make it move in virtual world. I could actually put the dots on it, connect it up like I connected you to the body. So, when you move stuff, it moves aswell. I also wanted get table and put it in there, but our table doesn't come until Monday, a circular table. So just mainly how did that, having that extra sense of touch help. And do you think having those more senses utilized more through virtual interaction with virtual would make it more immersive

MH: [00:12:40] Yeah, I think the more senses that are being catered to while in virtual world, the more, like the more I'd be immersed in it. Having the touch was great it was really, and I was like oh I'm sitting down. And I think of myself talking as soon as I could see my hands again aswell. That. And touching my feet really immersed me in the world, you know touching things I think really, really did help with that immersion.

JB: [00:13:16] That's good, I don't know if you experienced this much but when returning from your virtual body to your I call it corporeal but it's your actual body… and we not returning, we haven't gone somewhere else, I guess you kinda have. How did you feel about coming back like it's described as body amnesia because you're actually in a different place when you come back you can't forget that orientation where you were and where you are and Liam maybe because he utilize a bit more, came out was like, oh I okay, this were I am in the space. How did you feel about, did you have that feeling or were you always keeping your awareness of where you were the actual world?

MH: [00:13:58] I wasn't aware I was in space, but I was always aware of what the floor was because you know you're still on the floor. Did you want me to phrase the question in that?

JB: [00:14:10] Yeah. Ummm, I guess you could phrase it as you like. Ah god now I have to think. Yeah. So. Coming in and out of the world. Did you find yourself that you had a disconnect, like that you didn't realize what you were?

MH: [00:14:31] So coming in and out of two worlds. I didn't actually feel disconnected. I didn't have a sense of where I was in the space in relation to things up here, but I could always feel the floor because I'm still standing. And so, when I came out it was like oh that was the floor. And so, I didn't feel disconnected at all actually I just kind of felt like I was there. It was like you know you go from one location to the other because the floor was stable, I was stable, yeah.

JB: [00:15:07] And we are getting quite there, we talked about the tethers, talked about the props. I guess I'll just cap it off with the question that I'm most curious about which is do you think there's an application or need for this kind of approach to technology to help performance. So, for example you're flying a dragon. I can VR headset and I can have a dragon there and actually attack you and the technologies in its infancy so it's gonna get better and better as it grows. How do you feel about it you think it's necessary, do you think maybe it's just pure performances? I can't imagine it enough for

me to be actually deliver the performance, there is no right or wrong answer. I want to say its better, what you feel is correct for you ~~as~~ from your performance background

MH: [00:16:05] As far as applications of VR goes. I think. I think there is definitely. Like it could be incredibly useful. I think the way it works; it would be. As it gets the technology furthers it'll, I assume get smaller because everything does. But you know the thing is there are less impacts how you normally feel and how you feel in space that the less invasive it will be for the performance. I think it's always helpful to have something to play off of something to give your imagination. So, the more immersion you have in the world from... You know if it's coming from virtual reality or if it's coming from your imagination… But if there's something physical like that. Like the VR, then you do have something to play and I think that's always helpful. I don't think it's always necessary. And we see that now in films you can totally imagine things and totally imagine reactions but as a tool for performers and for actors it makes our job easier and it... It also could potentially make it more fun, these was that a recent example with Ian McKellen breaking down on hobbit but so much of the actor's job is you know reacting with how the people are reacting with environments and being open to all these things. Within film, in those computer-generated environments, you often don't have anyone to react off and if it's greenscreen or whatever and so that gives you something to play with and it gives you something more they can stimulate your imagination. So, it's one of those things is just another tool that I think could be really, really useful.

MH: [00:18:00] Yeah, I think the technology needs to be developed further before it... Because the more realistic aswell and the more you can immerse yourself in it without going oh there is a weight on head or ah there is this. But I do see a real use for it, yeah

JB: [00:18:18] Cool that's a great answer Ian McKellen already know about, I'm gonna talk him in my research, one of the reasons why I'm doing this.

MH: [00:18:25] But there is a thing there too because the virtual reality is not a replacement for having the actor with you.

JB: [00:18:31] I know but I could put another actor with you in Virtual Reality.

MH: [00:18:35] And that would be really interesting if you you're two people in the same space.

JB: [00:18:40] I could put 10 people in the same. The difficulty is the VR and the tether. So, it would have become tetherless and there is a technology that exists now. I do here but I haven't set it up and got it working out. So. This is just saying... This is more explanation of hey these marry together is there any point of doing this at all and you've kinda answered it's like, it's just another tool on your belt. Plays is an excellent word, that I would say that it comes from the kind of play, like it's not like acting it's more like stage because you've got something work off

MH: [00:19:22] It's more exploration and it depends what you get time for as well if you're if you're just filming you get schedule and you need to get this this and this done but if you've got the room to play in that world. Then there's other things you come up with that you just don't think you just don't imagine off the top of your head or even

through research or whatever process you do.

JB: [00:19:44] My research will be... Mines about presence, feeling like you're in the environment. So as soon as that presence is broken by you know the HMD, feeling how your feeling with tether and stuff like that, that's not good. So, there's no point of doing it unless you get some kind of strong amount presence. Physicality is another one having sensory feedback and interacting with the virtual world. And spatiality which is awareness of the relationships between objects. Like your body as a character was miss proportioned and you experience that when you're touching your feet, you were like my feet are really small and my hands are massive

MH: [00:20:21] Yeah and I only have three fingers.

JB: [00:20:23] I've only got three fingers. So that's always going to be an issue if you put someone virtual world and I make a one for one representation of you, so when you touch your face feet you are there, that could be really important, but it seems like people.

MH: [00:20:41] Just depend whether you're playing a human character. Like if your using virtual reality with motion capture to create say an ape, or a whatever, even a dragon or just something that is not human. It would be really interesting to experience, that body. From the perspective of the head of that animal or that creature or whatever it is and I think that could be another application that would be really interesting as an actor to explore, going okay that's what I look like and this is, this is what it's like to see the outside of my body and the parts that I see which would be fascinating.

JB: [00:21:26] I guess. Any final thoughts before we go, like that you want to bring up.

MH: [00:21:32] Like Virtual Reality.

JB: [00:21:34] Or just anything about your experience. There is no pressure you can say no.

MH: [00:21:40] I can't think of anything.

JB: [00:21:42] Sweet, I think go it, I got alot of good stuff there.

Begin of Transcript [00:23:05]

Begin of Transcript [00:00:02]

JB: [00:00:02] Yeah, no, you're right when I can go straight yet. So, I mention this but just to refresh your memory. There are no right or wrong answers. So just talk about how you feel it's going to be the best outcome for my research anyway and when ask you a question usually try rephrase it or just describe the exercise you're doing, so like, you know to start with, you know what's your name and your performance background... or and... It's easy for you talk about that kind of thing just from the gecko, hello I'm such and such but something like does your experience of your virtual body align with your actual body and you can talk about how you know, when, when, at first glance it kinda felt real to you but then afterwards when we start to really feel around you can notice the variations because the body wasn't aligned to your body and then maybe and like I'll ask you a question afterwards if I think there's something that... And describe kinda what I'm thinking to you, to help you understand what I'm thinking and can build of that and tell me your thoughts from it. When I talk about the exercise is a good idea to start off with like you know first started off when I was trying to walk through an environment and then you know cause I'll ask your first experience in VR and then you know I'll talk about exercise, okay in the first exercise we tried to walk through this environment.

LES: [00:01:36] So I should describe it

JB: [00:01:38] Yeah describe it yeah, yeah... Cool, but I'll give you a refresher as well and we can start and stop and if you don't feel comfortable, we can stop again. All right. So, the first lot of questions are more kind of generic, Who Are You, Experience, Blah, Blah, Blah... So, we'll start off with... Are you ready, you think it's okay?

LES: [00:01:59] Yeah and you want me to just speak to the camera.

JB: [00:02:02] Well yeah, so speak to me, speak to the camera however you feel comfortable, like use your hands if you need to be that something that you do normally. I do it all the time, so I think it helps describe my situation.

LES: [00:02:16] And another question… Are we going back to things from yesterday aswell as today?

JB: [00:02:20] Yeah

LES: [00:02:21] Okay

JB: [00:02:22] Yeah, we will go back from the very start and will move into the actual one… Cool, okay, so, yeah, what is your name and some of your performance

background?

LES: [00:02:33] I'm Lorin Eric Salm and I am an actor and mime artist. I specialize in character movement within acting and so I perform in mainstream roles. Mainstream acting roles but also do a lot of work with either, either mime roles or roles requiring unusual kinds of movement or special movement. I also teach mime and I teach character movement for actors. So, training wise, I was, I studied theater and they studied mime with Marcel Marceau at his school in Paris for three years and that's why I specialize in mime acting. But since, since then as an instructor and as an actor I've applied, I've applied mime skills to many different forms of performance. So, I used that for a film and television for theater and for instance for coaching actors in film and TV. Sometimes I go coach actors who need to do mime but are trained in mime and other times for now you play a character that has unusual movement requirements, Maybe their robot a zombie a character made a different, made of some unusual substance, anything, even a character playing a different age that requires them have to move differently, I'll often be brought in to coach actors like that. But I also applied what I do to animation to teaching animators how characters express themselves with the body. How they express personality, express what their thinking and feeling. I have also worked as a reference... A movement reference actor for animated films and TV shows. Creating movement reference video or motion capture for the animators to actually use.

JB: [00:05:00] Cool. I've been holding onto this cough for ages. Something caught in my throat. Do you want to talk about some of the more prominent roles, like, that you worked on, something like the companies that you work for or if it's up to you if you want to do that, yeah?

LES: [00:05:19] Sure, with animation I worked for. I started working with well with what was called at the time Walt Disney Feature Animation. I worked with them… The first thing I did with them was working on Dinosaur which was the first film that incorporated CGI. It wasn't even fully CGI filtered incorporated CGI and I and then several years later I worked with them on Chicken Little which was the first fully CGI film that Disney had done and in between I did other I did other training for Disney as part of their artist development program which wasn't necessarily feature specific projects. But I also taught my workshops at DreamWorks Animation, and at Sony Pictures ImageWorks, at Rhythm and Hues Studios, and at different animation schools as well. As far as live-action, I've got a chance to play these movements techniques to films like Surrogates with Bruce Willis and Radha Mitchell where almost everyone in the film was playing a robot essentially a very lifelike Robot but people that had to move in a way that let you know they were quite human. So, I used mime skills to help the director develop a way for everyone to move the film and I coached particular actors in how to do certain movements that they were going to need to do or even had to play the character in general. I've also coached for a couple of zombie features creating… where directors instead of just telling your actors move like a zombie and letting everyone do whatever that meant to them and then again potentially ending up with a lot of different ideas or something incredibly cliché, you know hands out front. They wanted me to help them create something specific to that particular story. Why are there zombies, zombies and then I could create a movement that was there was special for that particular feature and different. So, I would create movement and I would coach the actors in how to do that movement. One of them was House of the

Dead 2 which was well known because of the videogame franchise that it was based on.

JB: [00:08:07] Mmm that's, Cool...So have you ever been in a virtual production or used motion camera before. What was your previous experience with Motion Capture?

LES: [00:08:17] I first worked with motion capture on, on a student film actually at Chapman University in Los Angeles where we were working, we were working with a MoCap system that Robert Zemeckis had donated to the school, it was the system he used for Polar Express and then donated to the school when he moved up to something newer. So I go to work in a very good system in a very small space but it was it was a great introduction for me to MoCap and it gave me some experience working with the technology and seeing what I could do with mime skills seeing, how useful, how helpful they were in MoCap and partially as compared to other actors who didn't have that kind of movement training or experience. And a lot of the other work I did in animation as a performer was more movement reference rather than MoCap.

JB: [00:09:19] And then. Have you had any experience in virtual reality headsets and virtual reality in general?

LES: [00:09:29] I never had the experience with virtual reality headsets or virtual reality prior to, prior to this project. This is my first time wearing a VR headset and seeing what that was like.

JB: [00:09:44] Cool and your general thoughts just on virtual reality itself, to start off with. So, like... What do you think about the technology?

LES: [00:09:55] I think the VR technology the idea of it is very exciting. I like the idea of being able to be immersed in the universe, an artificial universe for, for whatever reason. For a game, for a film or just a virtual experience of some kind. I think that the potential applications seem... Seem to fit in and I'm excited about the technology.

JB: [00:10:39] So we'll probably jump, the rest of it starts to go really into what we've been doing today. So, it's kinda like the general stuff. So, the next question I might start with is... So being... How long has it been since you've used MoCap? Like has it's been a little while.

LES: [00:11:04] It's actually been several years since the last time I used MoCap, so the current technology is more sophisticated now. Even the suit and the markers... Well the suit is not terribly different the markers have gotten smaller and there are a lot more manageable than the markers they started with originally. That were, they were larger, they fell off frequently or transferred to another actor's suit. So, these, that there are definite improvements there and in the technology itself. So, it... It seems that the technology can capture a lot more movements a lot more accurately than before. In fact the first time I worked with it there were certain things, certain exaggerations of certain other stylization of the movement that were required just to get the equipment to be able to pick up the movements because it wasn't as sensitive and that was actually something where I thought that was also going to affect what kind of actors were going to be able to most effectively accomplish that because a mime actor is more accustomed to move in either in a.. Well it is more easily to move in an exaggerated way that's called for but is more, is more able to stylize their movement to move in a

way that's unnatural when it's called for then most actors to be able to, but it seems like that's less necessary that it used to be.

JB: [00:12:48] So our first exercise was what is called. I've got here actually... I'm gonna try and call it the right thing. So, we went through three separate stages is what I've called them the first is invisible reality, the second was the physical reality, and the third one was the virtual reality and so the first exercise we did was called walking through the invisible. Where I actually got you to try and memorize the environment... In your mind's eye, in memory and then actually perform by moving around that environment. Just your general thoughts on that, something that I noticed between the two exercises myself was… And something that you mentioned yesterday, was it took a lot more time to really start to visualize in your head. Something I noticed obviously was precision, and accuracy, and the confidence in the second time when we actually used props was a lot more... It was there. I think that confidence and precision we could have got there in the original one, but I think it would just would have taken more time. So yeah, just that first exercise walking through the invisible, just your thoughts and experience on trying to perform to nothing.

LES: [00:14:10] Okay.

JB: [00:14:12] Or doing the exercise to nothing, sorry

LES: [00:14:16] The first exercise the invisible reality where I had, I had a reference on the screen of what the environment looked like and what the objects in the environment were and where they were. It required a lot of time on my part to explore the space. To see my movement on the screen in relation to the objects, to figure out where the objects were and then to create for myself some kind of visual reference in the space. I found myself finding markers on the floor in reference to things that were marked off on the floor to the boundaries of the space that were marked of even to screws is a floor to anything that would give me a visual marker that I can use to tell me where the boundaries of the objects were and I spend a lot of time mapping that out for myself so that then when the screen will be taken away I could have those visual references memorize as a way of navigating through the objects that were there. So, I felt like that went pretty well and then it seemed like I was able to pretty successfully do that, but it was very time consuming to go through that process.

JB: [00:15:52] Yeah, I agree, you did do it really well, sitting behind the computer. his gonna do it. So... Oops I'm getting a phone call, it's probably my girlfriend.

Phone Call: [00:16:08] I am just doing interviews at the moment. Do you have time to get a coffee? I could probably leave after that or do you have to go home... Yeah, cool I should be closer to done. No, I think maybe half an hour is all we need. Okay. Bye... No, No I'm good. Thank you though. Bye

JB: [00:16:39] Claire just happens to be going by, I was like might aswell get a lift with her, I'll get home and do some work. So yeah building off that exercise obviously I was quite difficult without any kind of markers and the next exercise on top of that is actually with three dimensional markers, kinda thing, skeleton's I think we ended up calling them, of the props. So just the... Going from exercise to the exercise where you've actually got reference and moving through the same kind of thing. How did you

find that helped you or did it like, something I mentioned before confidence, precision, time, much easy, much faster? So just, whatever you feel, and the exercise was called again, this time it was the physical reality, where we actually have physical elements in the environment for you to use. Cool.

LES: [00:17:48] In the end the second phase of the exercise is what we call physical reality. We're had skeletal structures of the objects in the environment. It was certainly, it was drastically easier to become accustomed to what that environment was like. There were... I could see the objects I could see exactly where they were. I could see their boundaries, there dimensions so there was, there was no time required for me to, to map it out in my head, to visualize the objects or to create my own spatial markers that I can memorize before the screen was taken away. In fact, I'm not sure I spent much time looking at the graphic image at all. I was able to spend all my time simply orienting myself to the real objects there in my environment and just familiarizing myself where everything was. So, it was just it was a much quicker, much more efficient, required much less imagination on my part. Other than to imagine that these skeletal structures had other properties that they were solid objects or whatever other properties they had that the skeletal representations didn't have. But it required much less imagination on my part and much less set up time. There was I remember there was an interesting experiment that came to mind in the process where I tried to navigate my way through it without looking at the actual objects but just looking at the screen while real objects were there and that was kind of interesting to. To see if I could use that reference for the real objects.

JB: [00:19:55] I was gonna asked you about that aswell. So, good that you already talked about it.

LES: [00:20:00] Anything else you wanted me to say about that

JB: [00:20:02] No, No, so we might stick it, in the same frame and talk about the virtual reality as well after that. Even though we did it and the next day. So, the virtual reality aspect is I put, I go you put on headset. It's probably much more vivid in your mind. Maybe we should talk about. Well let's talk about your first experience about being in the VR actually because you put on the VR, you started to explore your body, you started to explore space a little bit and just really kinda of experience VR for the first time… I think, let's start there first. So, your first experience.

LES: [00:20:47] Alright, my first experience in that VR headset at first was a lot of getting oriented and just seeing and testing my peripheral vision, moving my head around to see how it responded to my head movements. To take in what it, what it looked like to look around me and to see how much that resembled looking around in it in a real environment. It was very interesting at first. I mean it was really fascinating at first to see this virtual world and to take in how, how real it seemed. Not so much of the environment seemed like a real environment that it seemed like I was really looking out this artificial environment this virtual environment. So that was fascinating right from the beginning. In terms of getting otherwise oriented with it when I started moving around and walking around. It was a little disorienting some of the, the fact that it wasn't keeping with the speed of my movements it wasn't rendering everything quite as quickly as I was moving around. There was a little jerkiness to the movement. That was a little disorienting. And also, I knew that the running of the environment seemed to

make a big difference to the default set before we went into the virtual environment that we were. Really during the exercise with this nebula in space that you had around was so detailed that it was very. There was a, more of a sense of reality there and then when we went into this very abstract room, we were very abstract objects and there was very little detail. It was it wasn't. It was more disorienting and moving my way around it, it was a little bit harder to get a sense of, to feel like it was a real environment or that I was in a real environment. It wasn't a feeling it wasn't too hard to adapt to the spatial aspects in terms of being able to move around. I could tell how far I could go. I could tell where the boundaries were, and I could see where the objects were and how I feel. I had a quick sense of how to navigate my way around them. That seemed to come pretty easily. There were some issues with my body itself. Being in the body of the character that. Seeing. Seeing the character's hands as my hands and seeing that my body looked different. That was I mean that was interesting and it wasn't there wasn't it didn't really throw me off that much until I got to things like the proportions of the body where I try to look down at my feet and found that I had to look in an entirely different way. Partially because of things that headset but also just the proportions of my body were different and. So that that was a little Strange. But then after I think about 15 minutes and in spite of the fact that it was somewhat disorienting I didn't feel dizzy or like I couldn't balance I actually did a balance test to see if I could balance and that was, yeah it was a little off. I feel like I've been in there a little longer. Maybe I could have found my balance better but then suddenly I got very nauseous with no warning. It just after about 15 minutes it just hit me out of nowhere. I didn't feel it coming on slowly and suddenly I was. Was very nauseous and I felt like I needed to get out of the headset to recover.

JB: [00:25:32] So. Just talking about that first experience. So, I move on to the. virtual reality and moving around in the environment that you could see. So, stepping from the physical reality to the virtual reality and doing that walkthrough exercise again. How did you find that compared to the first two stages? Because one of things you noticed was and you mentioned, it was like I couldn't kinda see my feet. But was as easy as physical reality to really... and you didn't know as well as spatially it felt right and as you move around you. You could move around and understand the space. So just, just general thoughts on that exercise, the virtual reality, doing the walkthrough exercise.

LES: [00:26:29] Okay, Walking through the virtual environment. Spatially seemed pretty natural, even though for instance I had trouble, I mean I couldn't see my feet when I was an intentionally trying to look at my feet. As I was moving around that didn't seem like much of an issue. The fact that I couldn't see where I was stepping, I still felt as I looked at the objects that I was walking in between and walking around. Everything made sense and I felt like I had a good sense of where I was and where I needed to be in relation to objects in order to avoid walking into or working through them as they moved around and the same with the walls. Spatially I felt like I felt like I had a good sense of where the boundaries were, and it didn't seem very difficult to move. To within the boundaries or around the objects.

JB: [00:27:25] So spatiality, I have three, three kind of components to my research I think I've come out spatiality, the way of spatial relationships then ability to understand the relationship to yourself and the environment is really important, So, what actually done in the volume is I made the volume, you know, the right size, I made the triangles the right size everything was kind of proportionally to reality, the same. So, it's good

that you're commenting on your spatial awareness. The other two things that is important is physicality is the actuate of response and sensory feedback when we're interacting with the virtual environment. Which is one the later exercises when you actually had to take the chair and desk. You could interact with those objects. And they weren't perfectly one for one, but you did comment a few times about. you know. It kinda felt. You were confident that if you sat in the chair, you'd sit in the chair, the physical chair and the virtual chair. well talk about that later

LES: [00:28:29] Yeah there was a comment about that if we have time.

JB: [00:28:31] Yeah, yeah. So. Cool... Let's talk about the doughnut exercise. So, the doughnut exercise built off, just that simple exercise but brought up a performative aspect to it. My research is specifically testing the boundaries of whether or not virtual reality is going to be handy in delivering or enabling the actor to see the virtual world and interact with it and not have to imagine it so they can actually use that brain capacity and focus on their performance and the lines which we didn't even have and stuff like that. So. Yeah. Let's start with just the doughnut exercise from the beginning, which was the, the invisible doughnut. How did you find imagining the doughnut, walking around doughnut, eating the doughnut? Like, how did find that as a mime artist and as an actor.

LES: [00:29:39] When we did the doughnut exercise. I felt like the first time he did it with invisible doughnut was much like when we did the invisible triangles where it took a certain amount of time for me to establish a visual fort in my imagination where I could imagine it in the space I could see its dimensions. I could see its placement in the volume and I spent a lot of time measuring it again and measuring where was the bottom of it in relation to my body where was the top of it, how large was the opening, how big around was it, how did I need to move to get my, to get the characters body through it. That took a lot of investigation and a lot of time to get that image. So, what we took away my reference for I could reproduce that. When we moved into do, I'm into just...

JB: [00:30:55] Yeah, Yeah, I saw you thinking so I didn't want to cut you off but yeah, we'll move on to the second exercise which was the physical doughnut, having that physical reference. I can't specifically remember what you're talking about the other day... Even though it wasn't a one for one representation you did mention that just simply having a skeleton enabled you to not have to remember all those kinds of... You didn't have to remember where I was and space and an area you could just know that it's there and do the imagination of actual doughnut. So, I think you did mention that you think you liked the idea, or you actually quite enjoy being able to do some part of imagining that doughnut, that having an actual doughnut there seemed to be too much for you. I think you mentioned that but not your exact words but something along those lines I was trying to rejog your memory of that thought you had... If that's... If I'm wrong that's fine... And then, you know, you didn't to performance again so what did you think about the invisible world also the physical doughnut.

LES: [00:32:09] When working with the physical doughnut having the skeletal representation of the doughnut like with the triangles. It was, it took away something that worked for me. I didn't have to spend time memorizing where it was in space or certain aspects of its dimensions. I could move right to interacting with it. For what it's

worth even with the invisible doughnut I felt like once I had established something for myself I was able to still, I feel it didn't hinder my performance a lot, the dramatic interaction with it. Except, that with the invisible one, I still had to... A certain party my attention was still given to making sure I was in the right place that I wasn't off in terms of where it was supposed to be. Once the physical Doughnut was there, I didn't have to develop... I wouldn't say I didn't have to devote any attention to that because the skeletal structure showed me where it was and its primary dimensions. But I still had to use my imagination to add other properties to it to add the roundness. I mean all I had was the center of it and I still had to know that based on that scale to the borders of the interior border was this much further in and the exterior border that was further out. It still required some imagination to visualize the entire object and other properties of it. Even once the skeletal structure took care of its location for me. So that was the main thing I benefited from having that there was its location in space, that was a primary thing. Its location in space and its general dimensions but I still I still had to use some imagination for the rest of it and also pay some attention to the accuracy but now we have a reference point too. Now when I put my hands up to touch the inside of it I rather than having no reference point I at least knew okay it had to be so many inches away from where the skeletal structure was and I had something, something to work with. And that helped again and allowed me to give that much more attention to my performance because had less details of the object to worry about.

JB: [00:34:48] Okay, how are you going with water? Are you thirsty at all?

LES: [00:34:50] I'm okay.

JB: [00:34:51] Okay cool, just cause I abit of a tickle.

LES: [00:34:54] Did you want to get some water.

JB: [00:34:55] I might, we might soon but well get through the next, there's a nice flow happening, I think. So. The next thing I actually want to talk about is just divert for a second and talk about there was a... After that exercise there's a specific element of conversation where we start to talk about the truth of or holding true to the environment that you've created in my head. That even know you knew the doughnut wasn't there you still even outside of performance walk around the doughnut. You gave, I don't know enough to make it real in some sort of way to yourself in my opinion and something that I've noticed with most actors and of you mentioned afterward and the discussion was. Until it's done with it's there and to help you imagine that there, you've always got to stand truth to it, is what I was trying to say, that was the word I was looking for. Yeah, your thoughts are on that.

LES: [00:36:04] As an actor and I probably even more as a mime actor when you create an illusion for yourself and ultimately for the audience you have to believe in it yourself to a certain extent. You have to commit to the illusion that you've, to the reality of the illusion that you've created in order to be able to act, to give a believable performance, one that looks like you truly believe that this object is there or that it has the properties that you're, that it's supposed to have. And think. Then once you create that then I think it, it lasts as long as you're continuing to work with it. Even in moments when you may not be capturing, or you may not be rolling. I think that you almost instantly develop an instinct to treat that object as you've created it to walk

around it to respect the dimensions and the properties that you've given it. It happens a bit I think without thinking about it and only when you're completely done with the scene and when you are going to use it anymore. Does that freedom to ignore it or treat it as invisible or just if was a partial representation then you just treat as what it actually is. That freedom comes back but for a while you, I think you can feel it you want, you want to hold on to that because if… you let it go, then you have to recreate for yourself every time you go to do another take. So, it almost makes sense to hold to it until you really don't need it anymore.

JB: [00:38:00] True, I agree. So. The next exercise was the doughnut in the virtual reality. This was coming off the guise of getting sick, but you were talking about... You know we had the visual reference there and stuff like that. That was very handy, and you had the doughnut, but this time doughnut was there. I don't know if you had to imagine anything, maybe you did, like you know that there's frosting and there's... Or whatever that it was an actual doughnut, but the actual dimensions of it and everything was provided to you. So, your thoughts on, on that process sort of... Did it actually enable just to perform? Did enable you just not have to imagine or if you did have to imagine elements of it, was it reduced? Just say whatever you, yeah.

LES: [00:38:52] I think when we did the doughnut and exercise in virtual reality… Well I was immediately able to just perform with it, to interact with it, to look at it, to react to seeing it there, to improvise how I felt about it, without any concern for having to... You know I certainly didn't have to think about where it was in space to me it simply appeared to be there, and I could see all its dimensions and whatever detail it had. I think that's for the purpose of the exercise I treated it as a doughnut only to the extent that it was shaped like a doughnut, I don't that I really treated it as a giant piece of food in the sense that I didn't visually add details to it in my imagination. I didn't imagine frosting or a particular colour. I treated it exactly as it looked in the virtual reality just as a shape and even though I made a movement like I was taking over which is something we done in the in the physical and invisible. I think that I really just accepted it as it was, and I treated it and react to it exactly as it was. But he was very easy to just to go immediately to that. It was there and I didn't want to do any other work.

JB: [00:40:28] Cool, So the next question is probably... Well move on to the virtual world. So, we started off with the invisible reality. We didn't do that exercise because it's too hard to sit down on a chair and table and do it.

LES: [00:40:56] You didn't ask.

JB: [00:40:57] I'm sure could have... Actually, come to think of it you probably could of actually and the we did the... We did do the physical reality where gave you chair, and a table and you sat down and did a performance piece. You didn't really look at the screen because I didn't think was necessary or also facing away from it, purposely. So, you didn't get distracted from it. But I doubt you would have anyway, I would have. But so, just your thoughts on.

JB: [00:41:32] Having physical props attached to kind of virtual props and being able to touch them. In a standard performance these days what they will do is they'll create the environment around you and you can just like you said in one whole scene walk

around deliver your performance and know that these cues, these places you have to do, the doors you have to open are aligned to the virtual space. So just your thoughts on that process and I move on to... Like I'll ask you again to refresh my memory about the virtual experience of that.

LES: [00:42:11] In doing the exercise with the table and chair where I had the physical objects there but not yet, not yet in VR. It seemed, it seemed very, very naturally like... I say, I'd probably relate it mostly to a theatrical experience meaning stage because in a stage in a stage performance, you often have representative pieces of furniture or other things that in an environment which is not complete. So, I mean I guess that applies on the set as well. You have a similar kind of thing. And that just seemed relatively natural to be able to even though these were purely representative they didn't have much detail. There wasn't much context, it was pretty easy to just treat them in the way that I normally would and imagine that... To fill in with my imagination where they were and where I was but in terms of the objects itself, there wasn't much else to do.

JB: [00:43:29] Cool and so the virtual world, the step on top of that was that you got to interact with the virtual objects but there's physical objects attached them as well, they weren't perfectly attached of course but they were somewhat, somewhat represented of it. You did say that you sat down. Like the first time you sat down you're like oh am I going to break this virtual chair is it gonna support me. Cause I don't know, I think part you, didn't think about physical I think there was a part, there was a moment maybe where your actually kind of getting that immersion to that point where you were thinking that what you were saying was there because you could feel it and stuff like that. So. Just your thoughts on that the virtual world.

LES: [00:44:13] When I started working with the with a chair and table with the headset... I actually this is a thought that occurred to me later on in fact. When we did an earlier exercise where I was standing in the middle of the road and a car drove toward me and we worked with jumping out of the way of the car and what my reaction to that was and how it felt to be in that situation. I commented that I think the abstractness of the car in terms of the way it was rendered gave me the sense that he didn't pose any true danger to me that I could let it run into me or through me and I didn't I didn't experience any fear that it was going to cause me or like a real car would. I think that the very same thing that made me instinctively think that the car wasn't going to have the real properties it were in real life that real properties that would have caused me harm I think was exactly the same thing that happened when I went to sit down in that chair for the first time in VR. I think I also didn't expect it to have the true properties a real chair would have and that caused me to not... Just for a moment to not expect it to support my weight when I sat down in it. There was just a little bit of hesitation there, I was able to grab it, I could feel it and yet because of what it looked like because it didn't... I mean it looked like a virtual chair it looked like a cartoonish version of a chair, just before I went out in it I felt for a moment like maybe it wasn't going to support, maybe it wasn't to have the strength it needed to actually support my weight but I sat down into it, in it... And that's a little strange because I could feel that chair, I could feel the... It felt like a real chair, I was holding a real chair and yet until I sat down in it, I wasn't 100 percent sure it was going to act like a real chair.

JB: [00:46:52] Cool, so we'll move on to some more specific questions to my research and this probably builds off. Do you think the missing senses? So, you experienced a

bit of touch but also, we haven't we didn't play around sound. Like if you... If I got a box and attached this cardboard box put the box past your kind of thing and I attached a sound to it in virtual reality. So, when it comes you feel the presence of something coming towards, you hear it, you can feel some kind of wind pressure around it. Do you think that will take it to the kind of the next level do you think that that immersion that you think that was missing where you don't really believe that it's there, that you didn't kind of react to it, in a way that it was real. Do you think that would help?

LES: [00:47:53] I think the addition of more sensory information whether it's more visual information or greater degree of visual detail or the addition of other sensory information sound, wind, other, other... anything else, any other sensory information. I think the more sensory information there is the more real it will feel in every sense and the more the more I think I would feel immersed in a new environment and I think the more, the more truthfully I would be able to interact with that environment. I think there will always be an awareness of being in a virtual world, but I think that awareness will... It will be easier to suspend my disbelief in that environment, the more the more real it gets through that additional sensory information.

JB: [00:49:00] And the level that it was at in this case it hack job. Was there a point where you did find yourself an immersed and that there was points that you did have a suspension of disbelief or was there never that moment for you this time around.

LES: [00:49:20] I think that... I don't know, I don't think I ever really got to a point where I felt like I was completely there where was I was completely immersed in it. I think I began to trust to trust it a certain amount and to... Enough to feel comfortable acting as if I was there. Moving around respecting the walls respecting the location of objects. I felt like it was... I felt immersed enough to be able to play along with it as it were, you know, to respect it for what it was and almost as if I was trying to say I... Okay I agree with what you've given me, and I'll act accordingly but I don't think, I don't think at this level I ever started to truly feel like I was in that in that environment and that it... Or at least... I know if I can really make that distinction clear but the distinction between feeling like an environment or feeling like it was a real environment. I think those are two slightly different things but. I don't think I ever 100 percent felt either one.

JB: [00:50:53] So something you mentioned before that you did find that the objects in the world to be spatially correct. That you look at something, okay that is a desk and that is the right height, I'm the right to the desk and I was purposely done but if I... And something I might do later on. What were your just initial thoughts on what happened shrank you or skewed the objects or did something very, very abstract, like I turned the whole world upside down walking on the roof or something like that. Do you think that. Until actually do know what the experience is going to be. But do you think that you would still accept the world that you just came towards just upside down. That, That's the world I'm in or do you think that would actually make you feel sick because it's incorrect, walking around it's not quite right. You know that kind of process.

LES: [00:51:56] I think if you were to drastically skew the environment, that I think we have to try it to know how it would be. If you had for instant walking on the ceiling or you changed... You made me unusually large or unusually small. I think I would have to experience that to know for sure. My. I like to think that I would just adapt to

whatever I'm given. If I'm given a room that's upside down and now, I'm navigating through light fixtures instead of through tables and chairs, I feel like I could possibly accept that as this is this is the reality and adjust to that. But now I am thinking that in relation to what I said before about the abstract nature of it now I'm thinking that the more abstract that environment is than the more easily I might be able to adapt to something strange like that whereas the more realistic it is the more disorienting it might be because it will be more obviously... unlike... It will look like something I am used to seeing but it will be very obviously turned around in a way not use to seeing. Can I make another comment about the last thing we talked about?

JB: [00:53:19] Yeah, yeah go for it.

LES: [00:53:20] I was going to say in terms of whether or not I felt completely immersed in the environment or not. The one thing I should mention is that even though I don't feel like I was ever 100 percent immersed in it I have to say that I, I feel like I was able to at least, almost completely ignore my actual environment. When I was in there I didn't I, I was never imagining the actual room I was in. I was able to complete the ignore... I wasn't trying to keep track in my mind of what or where I was in the actual space anymore. I was comfortable giving in to knowing where, for instance where my boundaries were based on the virtual... On the virtual world and I was no longer, I was never at any point worried about walking into a tripod or walking into, into an actual object in the room. If I didn't see something in front of me, I accepted that there was nothing in front of me. I think if you would put a real object in front of me, I would have walked right into it. And I didn't... So, I didn't try to keep track of the real environment while I was in the virtual environment to that extent and I, I made that switch over to being able to just then go, okay this is where I am now and act and act within the virtual environment. So, in that respect maybe I was more immersed in it than I thought I was because that's another aspect that I hadn't considered before.

JB: [00:55:04] So actually the next question kind of builds off that. It's about theorist out there that describes the entering and exiting of virtual worlds disorientating to start off with, but he also calls body amnesia, a lot people comes out of virtual reality, they go, okay this, okay I exist still, I'm still, I'm here kind of thing, okay I'm back. So there was plenty of times that you were moving in and out of virtual environment some of my actors, did what you said they got into the space, they knew it and they started to forget about the external world around them the physical world and over time where they took it off and went, Oh, okay this is where I am, I didn't even realize that I had moved to this area of the space because they had forgotten about the space around them. So just your experience in coming in and go out of the environment. Was it nauseous, were there times that you had to actually orientate yourself? I found that you were orientating yourself in the virtual, to just go okay this where I am but was that similar to the physical as well, just that kind of thought process.

LES: [00:56:19] When coming in and out of the headset, in and out of the virtual environment. I feel like going into it there was there were always adjustments to make. Some of it was simply getting the headset itself adjusted properly not just to my head but also in particular to getting the image in focus, was always something that I had to do. Once that was done and then I was able to look at where I was in the virtual space than it was seeing which way I was facing, I mean what I was looking at which way I

was facing in the virtual world. When I would come out of it, I don't feel like there was much adjustment going on there. I don't think I ever... I don't think there was even one moment where I took off the headset and discovered I was facing a different direction than I thought I was. I think I always knowing which way was facing when I put headset on, I think I never lost my sense of which way I expect to be facing when I came out of it even if I had spun around many times. I think I always knew what I was going to be looking at when I came out of it and not just directionally, but I don't feel... I didn't feel a period of adjustment where I had to... Where I'd become so immersed in the virtual world that I felt uncomfortable or in any way now disoriented getting back in the real world.

JB: [00:57:55] Cool. Did, do you find the HMD and/or the tether that's attached to the HMD, the headset that we used, like affect your presence in the virtual world. Did it anchor you to reality because it is anchor? How did you find it? Were there times that you could forget about it or was there always a mindset that... And I did make you do that, purposely. Don't forget there's a tether and you have to turn this way and then you start doing as well, you started to make sure that you did it. There was a point in time where you are moving around, and I was being very clever and getting... I'd had to flick the thing over you and there were noises sometimes and oh, its fine, its fine, I'm just making sure you don't die. So, what were your thoughts on tether, and do you think... and the HMD and what you think about not having tether would that help your immersion. Did you feel anchored to reality, just what are your thoughts?

LES: [00:58:58] The headset itself was... Took a little getting used to, the weight of it in particular and in the fit and just having something and something on my head. I don't feel the... Once I got it on and adjusted properly, I don't feel like it really held me back a lot. I do feel it would certainly be more comfortable the smaller it was, I think the more comfortable it would be. The tether on the other hand, I think I was always more aware of it and was more, was more of an issue. I could hear it; I could feel it. There were times when, when even, when even I felt the need to grab onto it to pull it with me which of course altered my movement because now I was during my own cable wrangling. So that took me out of being able to use my body fully for that performance. But even when it wasn't touching I was aware of it and in my mind thinking I don't get it twisted but I do feel like it was a tetherless set, a tetherless headset that I would feel much more free without that... And that I could completely forget about that.

JB: [01:00:30] Cool and that is potential, that we will experience before you leave. So hopefully I can get working. It's a little just, a little more difficult, but we have the technology available.

LES: [01:00:37] I'd Like to try.

JB: [01:00:40] Yeah, I'd like to try too I'll ask this question just because I think it's interesting for my research and maybe something I'll comment on, but do you find that having windows into the virtual world actually distracted you when you're doing your performance or anything like that. I know specifically you. I noticed that it didn't. So, having the world up on the thing you didn't notice when you actually did a performance, you just forgot it was there

LES: [01:01:18] I'm not sure what are you referencing.

JB: [01:01:20] So the screens, the screens into the virtual world like I find it... I mentioned a few times I find it very distracting when there are no acting experience, I was finding myself looking at it.

LES: [01:01:31] Oh you talking we're not wearing the headset.

JB: [01:01:32] Yeah, we're not wearing headset. It would be interesting immersing you into an environment that's the same environment that would be interesting.

LES: [01:01:40] Oh when the screens on the wall.

JB: [01:01:42] Yeah, yeah, the screens on the wall oh ah okay.

LES: [01:01:48] I think when, when working in the suit but without the VR, I think... I would... I might look to the screen just to get myself oriented when about to do a scene but once I'm in the performance for me I feel it's easy to ignore the screen.

End of Transcript [01:04:15]

Interview Continues

Start of Transcript [00:00:00]

LES: [00:00:01] I don't think it accrued to me or what occurred to me much to look to look back. At it in the middle of what I'm doing I feel, and I would really take me out of it and because I had a certain point I just get focused on the performance and I forget that the screen is even there even if I can see it in my peripheral vision. I think I really just block it out and focus on what's in front of me and around me.

JB: [00:00:35] So to your question, I guess. The question...

LES: [00:00:42] Sorry can I just add something to what I just said.

JB: [00:00:45] Yeah.

LES: [00:00:46] I think part of that may be that I don't really worry about whether once they begin doing it, I do worry about whether I'm doing it right or wrong. For instance, even when we were working with invisible objects and I could have looked at the screen as a reference to know if I was in the right place. Once they started doing it, I feel like I have to fully commit to it so if I'm going to make a mistake, I'm going to... If I'm do something wrong. If I were, I'd rather do it really wrong than interrupt my performance to make sure I'm doing it right. So, I am going to fully commit to whatever that was even if it was a huge mistake. I'd rather do another take than reduce the quality of the performance because I'm trying to check myself in the middle of it.

JB: [00:01:47] So the last few questions are more just my research and like is it going to be plausible. The first person even more as mime artist and an actor and all that your kind of mastered the imagining of a world you've experienced what it's like with props and found seem like you could quite easily function in a typical MoCap environment

and deliver a performance very well, extremely well. Do you think that having the VR headset, do you think that that's actually an encumbrance to the process of being in my mime artist and being an actor? Do you think that actually removes any kind of fun and experimentation of actually being an actor? I'm actually just giving you the world. You don't have a say in what it is, how it is, aspects of it. It's just there and that something you mention you do you find as negative, do you find cumbersome, do you not find it cumbersome and you actually can just deliver your performance, just your thoughts on that.

LES: [00:03:01] Well I think in terms of what VR gives or takes away from the performance in terms of being able to use my own imagination I guess it depends on what kind... What kind of project it is and what the purpose of it is? Because as a mime performer. My mime is it is two different things. It's a style of performance in which part of the nature of the performance is imaginative, it's the actor using their imagination and requiring and allowing the audience to use their imagination to create a world to create a… Well to create a virtual reality in its own sense and imagined reality one that is imagined rather than seen and that requires a certain kind of performance to achieve that too. On the other hand, in using mime skills to within Performance Capture and whether there a virtual reality based or otherwise, I think the goal is different. So, if the goal is to create an animated environment, an artificially created environment and an act within it in a way that's believable to an audience then, I don't think... I mean that's the goal and that's the process. Do feel like it would rob me of anything that I want to do or expect to be able to do, by being given what's being given. I mean as an actor, as a film actor you work in a... in a mostly real estate environment as a mostly there's still a lot of imagination that's required of the actor to make even an otherwise realistic style film look real. But a lot of it is done to make it as real as possible to begin with even for the actor. So that's just the nature of that kind of work. So... I don't know... I think that I think one way or the other just as an actor it's part of the job and part of the joy of doing it to bring a certain amount of imagination to it. Even with all of the given's even given a virtual environment that the actor can completely see. I feel like there's still enough work left to do to give a believable performance within that environment. Like that's just the first thing to get out of the way as okay I know where I am, I know where everything is, I know and interact with this environment. I still have to be an actor and I still go on the back of my head. None of this is real and I have to make it look real for the audience which is always a challenge. So, to the extent that that's a virtual world and not a real world there is already an extra bit of imagination or an extra amount of work that I get to do to make that work. So, I feel like there's still something there and I don't feel I would... I wouldn't see it as a disadvantage in any way.

JB: [00:07:09] The last question is now that you've experienced virtual reality inside of a motion capture kind of experiment, whilst it is very... Hack job like I've called it and it's very... The fidelity is low, that's the best way to describe it. There's a tether, it's old headset you know and there's newer technology, there's a possibility of not using tether. Do you see that this technology actually has benefits to move into the future and be adopted into virtual production process to help actors deliver that performance, to help them imagine the world?

LES: [00:07:52] I think I think virtual reality has the potential to help make performance capture acting more believable to help actors achieve that goal and given a

believable performance without it a lot more is required on the part of the actor to get to a point where they can start to give a believable performance. They have to use a lot more of their imagination and overcome other obstacles and even VR you are right now with their limitations they're still... You know the actor has to work around things that are either limiting or interfering with an otherwise natural acting process. So I think the more the technology develops the more it gets streamlined the less it interferes with what, with what an actor would do in a live acting situation either on camera or on stage, the closer it approaches that I think the easier it will be on the actor and the closer an actor can get to do what they would other ways of doing. To combine my answer to that with the previous, with what I was talking about when I was talking about how this affects me as a mime actor in particular. I think that... Until we reach the point where the technology is so advanced that it's almost out of the actor's way, I think... I think it's actually enjoyable as an actor to be able to continue to use those skills to fill in things that are tough, to solve problems that are created by the limitations of the technology and all of those will even go away even when the fidelity of it is higher when what they actually can see is there great detail when there is no tether no matter what as long as it's virtual there are things in that world that are not going to have the actual properties that the real objects would have. And I think that's always going to require certain skills on the part of the actor to give those objects the properties they need to have for the audience to see them, to believe that they're real. They may look real… a rock may look entirely real. But if the actor tries to pick it up and then don't handle it as if it has the way or the other properties that it showed the audience is not going to believe it's real. And that's always, that's the mime aspect that is always going to be there for the mime actor or for any actor that acts in a virtual world.

JB: [00:11:08] Before I stop. are there any other thoughts or any other comments to probably be another opportunity to do another interview thing later on but is there anything that comes to mind that you want to talk about?

LES: [00:11:18] Nothing else at the moment but that's good to know that there may be another opportunity, other things may…

JB: [00:11:24] Yeah, yeah. While I try and do a few more experiments with you so... Like it might be fun just flipping the world on itself and trying to get tetherless option to work. And I've also got another environment that I can immerse you in, so I'm going to try to get set up, probably be late next week so cool.

LES: [00:12:16] Okay

End of Transcript [00:12:19]

Interviewee: Lorin Eric Salm
Interviewer: Joel Bennett
Date of Interview: 05.08.2016
Transcribed: 18.02.2018
List of Acronyms: JB = Joel Bennett, LES = Lorin Eric Salm

Begin of Transcript [00:00:00]

LES: [00:00:00] We around about down here.

JB: [00:00:02] Yep so like your yep. Yep. So, we'll start with you know after processing what we did in the first couple first couple of days there and you know I know you've done a lot as well. So, did you get a chance to think about a little bit more... Because you did say you wanted to kind of just process it before you actually wanted the opportunity to actually have another little bit of something. Is there anything else that came to mind essentially?

LES: [00:00:36] Well. I mean really, it's just some very general thoughts I think after the test that we did. I think that it would have been very challenging to do everything I did for the film itself, using the VR System as it is to say certain things in terms of how the environment was rendered may help reduce some of those challenges, but I think both in terms of... Well I mean... You know... It could have an interest too to see how I would have been able to act out scenes within the environments that you know once they take place that they would be really interesting and may even add something to my ability to really envision what I was doing. But on the other hand, both from a…. Well from the challenges of what seeing the virtual space means you know in the end how that would have been to work and also just the technical aspect of my ideas and very vigorous movements and being able to do that with the constraints of the physical headset and the tether. You know I would have been... I could see some challenges that presented.

JB: [00:02:08] Yeah. So, I did try to get really tetherless system set up, but I just didn't have the software, I would have had to develop software for it. I'm not a software developer and it requires time. But if you thought about a technology because they do exist at the moment that is tetherless that is a lighter and provides a higher quality resolution. How do you feel that that would change your perspective a little bit more towards hey actually this is getting better? Or you think would just, still be like I think there still needs more work is there other things that were barriers to performance and barriers to believing the world?

LES: [00:02:50] I think if some of the, if some of the technical aspects like the way that they headset it being able to have it untethered and having higher resolution rendering of the environment. I think all of those things that would make it... Would greatly reduce the barriers to using this kind of system in motion capture performance and then that I think the advantage of it the advantages are that it would be greatly enhanced and it would be easier to really evaluate the advantage of being able to see the virtual environment once those impediments are eliminated. So, right now, where it is now, I think it was even a little hard to evaluate how beneficial it might be, but I

certainly can't see that it could be very interesting to work in that environment.

JB: [00:03:51] Cool that's excellent. So, I'll move on to the exercise we did today I will relate them to exercise we did originally because they sprung from that. So, first off just the experiences swapping characters. So obviously there was... And you've swapped a lot of characters as well not just the ones I've demonstrated but I've been immersed with them but you have been, been kind of thing and you've gone from obviously something that's very cartoonised to know something that's very realistic, to something that's got larger arms to something that's come really short legs and big head. Do you think that those discrepancies in the changes of bodies compared to your body shape affects your performance? Or is it something that your kind of just notice when you're actually trying to do an action but realised that it doesn't like... When you are performing. Do you go okay. Actually, my hand here and then does this, or do you just put your hands together kind of thing.

LES: [00:04:53] Well I think that. It depends on just how much the character varies from a normal human being in terms of shape proportion, the mechanics of that character's movement. The more, I think what I would do is the further I character varies from an actual human being the more time I would probably want to spend developing that character's movement familiarizing myself with their limitations with the physics of proportions. Like for some of the work I did in Lost for Words. One of my biggest considerations was knowing where my head was knowing that the size of the head. And... Yeah, I think I think developing more awareness beforehand so that I don't have to think so much about it as I'm doing it but... So that I know also... So, I, I familiarize myself with how much you have to be aware, when you consider it and in what ways you to consider it. Because there are certain characters that we try out that if I would actually play them out in a scene I would definitely want to make some adjustments for them as it did and some of the other experiments and some of the other exercises that I did where I had characters greatly varying body types and I was changing their weight, I was changing other things about the movement based on either their personality or things like that so yeah I mean I think all that has to be figured out for the character to know how to play it and I don't think you can just look at the character and see what it looks like and then forget about it and then just move like yourself and hope that it will all map correctly on to the character or that the animator will fix any discrepancies later.

JB: [00:07:05] Excellent. So, we did it essentially three exercises that I would say you just skewed your world. The first one was one that I hypothesize that really wouldn't affect I shrink you down to little tiny kind of thing. The second one was where I really just messed with your field of view. Really just made your field of view insanely large and then the last one was where I just knew the world on a slant. Just your thoughts on them specifically on delivering a performance in those kinds of worlds and whether or not you were still spatially aware of the world around you. So everything still felt, correct, is what I would say like spatially you knew that that box would, how far you had to walk to it or you knew that you know if you turned this way that you would see what's to your left or your right and stuff like that. So.

LES: [00:08:05] I think that being skewed versions of the environment, I didn't find it disorienting as I thought it might be just from the sound of it. I felt like my brain very quickly set new rules for itself. Once I saw my relationship to the environment, I think

that well just in terms of looking around and taking a few steps within those worlds I don't think that was... It seemed pretty easy to adapt to in that minimal way. I think if I started to move to take longer walks in those environments or to try and accomplish certain tasks or act out certain actions then I think it may get, well it could get more challenging but you me it may just be more rules for my brain to figure out to get used to this is what happens if I move this way. This is what I need to do to accomplish this particular kind of thing when the world is skewed in this particular way and I wasn't able to explore those environments fully enough to discover all what those things might be. I just got a small taste of that by taking a few steps looking around. And... It wasn't terribly off putting but I think that if I had actually tried to act a scene in those environments, I might even answer some questions about what are the rules supposed to be. How does gravity act in this environment based on…? There are things on a slant and yet they're not sliding down anywhere. What happens to me in this environment or what what's supposed to because do I need to act a certain way, or do I need to act as if gravity is acting on me in a different way than it actually is in the volume. So, do I need to adjust my movement intentionally to match the environment you gave me. I want to ask some of those questions.

JB: [00:10:33] That's good. I guess I might ask one last question. I don't want to put words in your mouth either... So, when you're in a world that mimics the real world, that has the same rules as the real world, do you find that you can act in quite quickly and adapt to it. That's what I feel like I can do, I haven't experienced the skewed world so interesting for me won't do it. If compared to the skewed worlds you think that your brain still adapts quite quickly to it, but you still think that there might be a bit more exploration on because the rules have changed from a standard reality to something new. That you would need more time to unpack that, is that something that I'm getting kind of right.

LES: [00:11:29] I'm not sure.

JB: [00:11:30] So I trying to figure out whether or not. Obviously when we do these performances you do them in a real mimicked environment. I was trying to skew the world's, just to see... Not to say that no this is the right thing to do with actually really interesting that you head, you just accepted it. But more saying you know compared to this world this mimicked world, a skewed world is not the way to go... A mimicked world is the way to go but I don't want to say I don't want to say that if that's not what you think. kinda of thing.

LES: [00:12:02] I guess I would need... to be able to evaluate whether using an environment mimics a normal world vs. a skewed world is... Well in order to evaluate whether that's helpful or not helpful, I guess it depends on the purpose of doing it. I would want to know what is. What is it that we're trying to accomplish by skewing the world is it to...? I guess... what's the creative point in doing that, I we trying to represent a character who, who is disoriented, and you know who is in a real world but who sees the world in a different in a different way. Are they in a world that actually is somehow turned on its side or upside down or something like that? Is there some other you know I guess there are different ways you could are different reasons you could do that? And I think in order to know how to play that as an actor as a character, I would have to know what it is and what effect you're trying to achieve dramatically and visually. So, we know how to approach it.

JB: [00:13:31] That was excellent, that was a good answer. Yeah, nah that's good because I... you could skew the world if you were sick or you know, I don't know, if you had a lazy eye you could actually get one of those cameras and do this which would be really weird.

LES: [00:13:45] Yeah, Yeah.

JB: [00:13:47] You would be like.

LES: [00:13:47] Yeah two different things.

JB: [00:13:51] So what we'll do is we'll move on to... It did... There was nothing else you wanted to add.

LES: [00:13:58] Just one other thing that's a little side note that's out of context in all these experiments that we did with the skewed world as compared with the first experiments we did with the environment that was just a small room with some objects in it the second environment that was much more detailed in the rendering I felt was much easier to adjust to. I felt like I could have moved around that environment a lot longer without experiencing nausea or disorientation. The addition of detail was very grounding and orienting and felt much more comfortable not only right from the beginning but the longer I stayed in it the, the more the more comfortable it felt like it was it was gonna continue to be. I was with the similar environment I was to have the sense in the beginning that at some point this was going to start to get us off certainly for unsettling.

JB: [00:15:13] Now that's really interesting and something I didn't even think of. Did you want to comment on the size and your immersion. Because I think what you're trying to say there is because of the higher texture rendering and stuff like that but it wasn't a low poly world that it was a higher poly world, that there was a moment when... You, you know how was saying when you take your helmet off you kind of lose yourself in the world enough that you come out you go oh okay this is where I am. That actually happen to you, which I, was a good thing that I think you get to experience... And... Also, just the vastness. You felt that you were in that massive cavern enough for you to come out and go oh actually, we're actually in a much smaller room. So, I think there was a point there where yeah you did get to that closer end of immersion compared to where you were in the original environment, so you want to comment on that at all.

LES: [00:16:11] Going... Are you wonder if I have anything to say beyond the way that you just described it?

JB: [00:16:17] No just the experience of actually losing yourself a little bit and when you're taking the cap, the thing off and losing your orientation to the real world compared to the virtual world.

LES: [00:16:27] Yeah what I was in a more detailed virtual environment. After a while I really did start to settle into that environment in particular the size and the dimensions of it so that even though I still had an auditory connection to the room it was actually I

could hear voices and get some sense of where I was oriented in the in the volume based on where I knew those voices were coming from. When they finally emerge from the virtual environment. I had... My sense is space had adjusted itself quite a bit to the virtual world and I felt like, I thought I knew where I was in the volume and it turned out I was in, I was in a pretty different spot than I thought I was because I had started to reassess space around me and I also started to feel like I was a much larger space the virtual space I was in was representing a much larger room. And when I took off that headset I was almost expecting to be in a room of equal size if not look the same at least one of equal size and sort of an expectation that I would be in the same place within that room. So, it was there was a little bit of a surprise to me. It was like just having someone spin you around and move you around and take off a mask and you suddenly have no idea where you were expecting to be.

JB: [00:18:19] Cool. Nah that's good. So, we'll do the introduction of yourself. I don't think you have to go too much and your acting performance background. Unless you feel like you want to a little bit and then.

LES: [00:18:33] Is more just like saying like who I am in relation to Lost for Words.

JB: [00:18:34] Yeah just a hey in relation to lost for Words, that's right and then just your kind of interpretation of what Lost for Words is... Like if you a synopsis of the Lost for Words, you kinda know aren't you because you've played it so many times. So just go for it.

LES: [00:18:53] Okay, let me just take one second.

JB: [00:18:56] Yeah, no your right.

LES: [00:18:56] to summaries it.

JB: [00:19:09] I might just stop recording.

End of Transcript [00:20:11]

APPENDIX B: CREATIVE OUTCOMES

The appendices provide a complete list of creative outcomes conducted as part of this study.

Creative Outcomes Digital Package Download

https://joelbennett.com.au/phd

Cycle of Practice 1: Creative Outcomes YouTube Playlist

https://www.youtube.com/playlist?cycleofpractice1

- Cycle of Practice 1: VIMMA Project BTS

    o https://youtu.be/3Sl5GUzdShg

- Cycle of Practice 1: Powers Above BTS

    o https://youtu.be/nVBcEkyWHVA

- Cycle of Practice 1: Powers Above Animation

    o https://youtu.be/YQO8Fb8GRVM

Cycle of Practice 2: Creative Outcomes YouTube Playlist

https://www.youtube.com/playlist?cycleofpractice2

- Cycle of Practice 2: DeepBlue and the Perff Bots BTS

    o https://youtu.be/7UXXv1ugmA8

- Cycle of Practice 2: Automancy BTS

    o https://youtu.be/5AtxJ39BIvY

- Cycle of Practice 2: Automancy Animation

    o https://youtu.be/m9EVkRJ2q_g

Cycle of Practice 3: Creative Outcomes YouTube Playlist

https://www.youtube.com/playlist?cycleofpractice3

- Cycle of Practice 3: Production Test BTS

- o https://youtu.be/LR7btNR5jSc

- Cycle of Practice 3: Lost for Words BTS

  - o https://youtu.be/as304K-BZEc

- Cycle of Practice 3: Lost for Words Animatic

  - o https://youtu.be/K-TPCvxWMyg