ANIMATORY THINKING

An enquiry into tacit knowledge within animation practice.

Hugo Glover

A thesis submitted in partial
fulfilment of the degree of the Doctor of
Philosophy at the Royal College of Art

August 2019

Copyright

This text represents the partial submission for the degree of Doctor of Philosophy at the Royal College of Art. This copy has been supplied for the purpose of research for private study, on the understanding that it is copyright material, and that no quotation from the thesis may be published without proper acknowledgement.

This thesis represents partial submission for the degree of Doctor of Philosophy at the Royal College of Art. I confirm that the work presented here is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis. During the period of registered study in which this thesis was prepared the author has not been registered for any other academic award or qualification. The material included in this thesis has not been submitted wholly or in part for any academic award or qualification other than that for which it is now submitted

Signature:

Date: 24 September, 2019

Abstract

Since the invention of devices that use rapidly repeating still images to create a phenomenon of apparent motion, a tension has existed between the artistry of forming images and the mechanics of generating an illusion. In the midst of this tension is *the animator*, immersed inside the technology[1] whilst simultaneously relying on their embodied memory of the world to guide their creative judgement. This research attempts to illustrate this liminal state of creative practice and lays out *Animatory Thinking* as a precondition of animation practice.

Defining animation has been extensively discussed and researched (Wells 2002; Buchan 2013; Matarazzo *et al*. 2016; Levitt 2018; Dobson *et al.* 2018). A great deal of effort has been spent on segregating animation studies from film studies. Whilst my own research does not offer a new definition of animation, it does attempt to show how viewing animation practice as a design discipline can offer a new perspective to animation studies, as well as insights into tacit knowledge, temporality and embodiment as part of creative practice.

Whilst personal accounts of animation practice (Williams 2009; Thomas and Johnston 1997) are well known, this thesis will argue that such accounts fail to offer a holistic embodied view, instead prioritising specific skills relating to the technology of animation. More recent work in the area of animation studies (Lamarre 2009; Torre 2017; Levitt 2018; Dobson *et al.* 2018) has shown how rich and complex animation practice appears when explored through academic research, but again there is only partial acknowledgement of *the animator* as a central node in animation practice (Ward 2018).

This research approaches animation practice through the lens of design research in order to focus on *the animator*, with a particular focus on the tacit

---

[1] Throughout this thesis I use the word 'technology' in reference to any extension of the body (Brey 2000; Maravita and Iriki 2004). In the context of animation practice this could mean a pencil, a camera, a computer etc.

knowledge of animation practice. Action research methods (Lewin 1946; Kolb 1984) are used to triangulate three areas of enquiry:

1: Building experimental animation machines as an investigation into the relationship between technology and artistry in animation.

2: Exploring how theories of embodiment, tacit knowledge and design thinking can be used to describe how an animator crafts their work.

3: Observing how novice animators approach learning computer-generated imagery (CGI) animation, and how shifting focus from animation as story-telling, to animation as a means of exploring ideas of philosophy and embodiment, can reframe animation practice.

Rather than following a classical research model of theory/action/reflection, I began with action, thus giving a position from which I could navigate theoretical ideas, before combining action and theory into my teaching, and then observing the effects.

This research articulates a heterogeneous flow between technology and embodied memory through *an animator's* tacit knowledge, defined as *Animatory Thinking*. Going beyond a single person making animation, this research also acknowledges the role of a wider collective community as the environment in which *the animator* works. *Animatory Thinking* lays claim to the knowledge that animators "problem-solve by synthesis" (Cross 1982: 223) through a *tacitness of time* existing within the animatic apparatus (Levitt 2018).

Research Questions

> If you want to find out anything from the theoretical physicists about the methods they use, I advise you to stick closely to one principle: don't listen to their words, fix your attention on their deeds.
>
> Albert Einstein (1929), quoted by Sir Peter Medawar (2008).

1. How can an understanding of animation as a creative discipline be constructed from *practice* rather than *output*?

2. By arguing for the animator as a focal point within a larger system of animation practice, can we illustrate how animation practice appears through the lens of design research?

3. How can articulating aspects of tacit knowledge influence a novice animator's understanding of how their own lived experience relates to the craft of animation practice?

Research Outcomes

Figure 1. Animation machines at various iterative stages, 2014–17, Hugo Glover.

These research outcomes consist of a series of experimental animation machines which are documented through videos. The written thesis charts the development of the experiments as well as illustrating how specific themes – embodiment, technology and tacit knowledge – have emerged from the practice. The thesis also demonstrates how these themes have been folded into design briefs for novice animators as part of an Action Research cycle. Emerging from the practical and theoretical bridging between design research and animation studies is the term *Animatory Thinking*. This term foregrounds an animator's lived experience and tacit knowledge as a hitherto unmapped component of animation practice.

Acknowledgments

I give sincere thanks and gratitude to my supervisors, Professor Stephen Boyd Davis and Dr. Tereza Stehlikova. Your patience, support and certainty have been essential throughout.

I thank my first supervisor, the late Professor Ranulph Glanville, whose presence and ideas live on in magical ways. Neil Baron and Dr. Dan Lockton for their encouragement at the first few hurdles of this work. Professor Ashley Hall, for his laser guided observations, which reverberate with me to this day. My external examiners for their thoughtful, rigorous and formative input.

I thank my students and colleagues at Northumbria University, specifically Dr. Paul Dolan, who broke trail in the exploration of practice-based research.

Further back in my education, I thank Dr. Gray for revealing the deep and complex stories within artworks. Richard Doust for his guidance and support at many salient times. The late Hilda Zangwill, whose tutoring terrified and mystified me in equal measure. Siiri Skerker, for not letting me cross the street until I could read the road name.

My family and friends: Julia, you showed me how learning is a lifelong passion that never fades. Timo, working together has always been a gift and a privilege, so much of my tacit knowledge has come from you. Toby and Dylan, thank you for inspiring me and showing me the way with drawings and words. Peter and Hilary, thank you for your friendship and care. And John, for helping me believe this journey was possible.

To my boys, Felix and Max, if you ever read this thesis you will find I made you both a gift I've never given you. Find it, and it will be yours forever.

For all the devoted love, support and tenderness, I give my deepest and most heartfelt thanks to my Cat.

Table of Contents

List of Figures

Terminology Preface

Animatic

The word *animatic* is well-known in animation practice as the stage between storyboard and full production. The point at which time and image are combined to create duration; an embryonic state of animation practice, gestating and emerging as layers of detail are laid down. This is a liminal space, where ideas become manifest.

In the world of animation studies, the term *animatic* is also used as a philosophical position. Philosopher Alan Cholodeko is passionate about this idea, defining the animatic as "the very logics, processes, performance and performativity of animation ... the very 'essence' of animation" (Cholodenko 2007a: 43–4). The academic Deborah Levitt, a key thinker in current discourses around animation and ontology, offers another reading of the *animatic*:

> The animatic is any aspect of image production – from animation as such, to digital special effects, to extreme camera angles [...] Animatic modes [...] are never fully determined by the material technicity of the apparatus. There's an ethological rather than a classificatory engine at work here. It's about how images work, how they behave, how they interact with other forces (2018: 58).

Simulacrum

Originally meaning "likeness or similarity", this term was used in the late sixteenth century to describe a representation such as a statue or painting. Art historian Michael Camille describes the simulacrum as being "based upon the premise that images do not so much replicate the real or substitute for it but rather are encounters with another order of reality entirely" (Nelson and Shiff 2003).

Rhizome

In botanical terms, rhizome means "mass of root" – a highly complex structure hidden beneath the surface, but fundamentally connected to what is visible above. In *A Thousand Plateaus* (1980), Gillies Deleuze and Felix Guattari use the word rhizome to describe their philosophical concept of culture. In a wider context, it is used to describe theory and research that allows for multiple, non-hierarchical entry and exit points in data representation and interpretation.

Heterotopia

The etymology of 'utopia' (no-place) and 'dystopia' (bad-place) leads us to the philosopher Michel Foucault's 'heterotopia' (other-place). Foucault uses the example of a mirror, with the reflected image representing utopia –a 'placeless place', both virtual and unreal. Concurrently, the mirror is a real object, so could be described as a heterotopia, being both real and unreal – *other*. Foucault cites examples of heterotopic spaces in society, such as prisons, cemeteries or hospitals. In the context of this thesis, I use the term to describe a studio space, and a space where animation is made, be it virtual (CGI) or physical. Such spaces have worlds within worlds.

Homeostasis

This refers to a state of balance within living systems, and in the context of this thesis, is used in reference to a state of balance as an embodied sensation.

Preface

My undergraduate studies in Industrial Design at Sheffield Hallam University, 1997–2000, gave me what I would now recognise as "designerly ways of knowing" (Cross 1982). I believe that an experiential (Kolb 2014) approach to design furnished me with a method of learning through valuing my personal experience. My formal animation training consisted of a one-day workshop on Adobe After Effects during my MA Design Products at the Royal College of Art (RCA) 2000–2002. After graduating I chose to move away from designing objects and began working in animation. subsequent projects have been papabale learning process. I found the application of a 'designerly' approach well-suited to animation practice. After many years of working as a professional animator and broadcast designer (first with the BBC, then in a freelance capacity), I wanted to continue to learn and explore animation in more depth. To do this I moved from London to Newcastle upon Tyne in the summer of 2010 to work as a lecturer and practice-based researcher at Northumbria University. This marked the shifting in focus, from generating animation as a means of income, to unpacking what I knew in a tacit form, in order to pass it on. During this PhD, it became apparent that a gap existed regarding an animator's embodied perspective within their practice and broader areas of animation theory.

Introduction

In this introduction I will lay out the context of this PhD, the gap in knowledge, the key focus of this enquiry into the tacit silent knowledge within animation practice and how it has been used to structure this work.

Notions of pilgrimage, embodied memory and distance have emerged from my practice, been applied to my teaching and discussed in depth through this thesis. I have entitled this research *Animatory Thinking*, partly to echo *Design Thinking* (Arnold 1959; Archer 1965) yet primarily as a means to bind these descriptive threads of animation practice together.

Context

Neuroscientist William Schaffer describes the process of making animation as "a kind of feedback loop circuit between existing models for the possibility of movement, the automated interval and the collective network of bodies and brains formed by animators themselves" (2011: 461). Such a system is a complex set of relationships and dependencies all in flux as an animator works. It is this system, or feedback loop, that this PhD explores. Deborah Levitt describes such a system as "media ethology" (2018: 5). Derived from the science of animal behaviour, ethology is used by Levitt as a methodology to examine the "spectator screen nexus" as an environment with an effect on the humans who perceive it. Levitt is focused on the material structures of moving image production when it meets human perception: in effect, the process. Although animators are mentioned in her work, they are in no way central to her argument. In my view, by focusing on the animator's embodied memory, the intention is to effect a change in discourse, from *process* (Torre 2017; Lamarre 2009; Levitt 2018) towards *practice* (Korn 2013; Wayne 2001). In order to do so, this PhD has been conducted as Design Research, specifically Action

Research.[2] Throughout this thesis I fluctuate between practitioner, researcher and teacher. Running in parallel with my making of animation machines is my continuous engagement with Animation Studies and Design Research literature. I use a confluence of practice and theory when designing the briefs for animation students. In situating myself as the central axis to the cycle of making, reading, reflecting, writing and teaching, the notions of pilgrimage and creative distance are present at every instance of this research.

Why Design Research?

Since the late 1950's Design Research has evolved to become a discrete area of practical academic enquiry, distinct from the Scientific or Arts and Humanities paradigms (Cross 1982).

My reasons for approaching animation practice from the perspective of Design Research are to utilize the variety of discourse inherent in the field (Hall 2017). Design Research acknowledges the fuzziness (Jonas 2006) and complexity of creative practice, facilitating rich insights into practice whilst the path of a research journey reveals itself as one's practice progresses (Lewin 1946). I will show how the application of Design Research to animation practice illuminates an understanding of tacit knowledge at work.

Research into tacit knowledge within craft and design practice has been particularly useful in my exploration of animation practice. Following an Action Research cycle of practice, relevant theory and observing students learning and making animation, this thesis will elucidate the silent knowledge within animation practice. In doing so, I am not attempting to redefine animation theoretically, instead I will argue for greater academic attention towards how animation is constructed.

---

[2] Action Research is fully explored in Chapter 1: Methodology.

The Gap

In this thesis, I will also argue that the embodied memory of the animator has an unacknowledged relevance within animation practice. "Most audiences are usually focused on *what* has been discovered: the effects of cinema, as opposed to *how* they were discovered" (Selincourt 2016: 209) [emphasis added]. The animator exists in a liminal state between lived experience and animatic effect. In this state, the animator could be described as affecting and existing, between multiple temporalities all accessed through technology.

There are several key publications that delineate this gap in knowledge. In *The Fundamentals of Animation* (2016), Paul Wells offers a comprehensive overview of the linear stages of what it takes to create animated work. In addressing 'the animator', Wells describes the multiple roles as interpreter, performer, editor and director. Methods of making animation are treated in a similar fashion: drawn, stop-motion, digital, etcetera. I find this dissection of animation practice at odds with my embodied experience of animating. In contrast to Wells, Birgitta Hosea approaches animation from within her own practice, often exploring her ideas in collaboration with her students. Whilst much of Hosea's work has been focused on performance and drawing in animation practice, it is the exploration through making that is core to her doctrine. Hosea's film Erasure (2017) draws from her memories of working as a domestic and hospital cleaner, performing repetitive invisible tasks with little recognition. Here Hosea's approach to animation practice forms context, process and meaning in her work. The gap I perceive in both Wells and Hosea's work is the tacit knowledge within the making of animation.

Other work that strives to broaden the cultural complexity of animation practice is that of Mark Collington. How theory and practice can be harnessed to offer

original and rich creative work is expertly mapped out by Collington.[3] Yet such work also illustrates a delineation between how animators make their work and what their work goes on to mean in the wider world. Collington's assertion that "meaningful animations are not driven by technology or style, but are the result of narrative form and function" (2016: 235) reinforces the idea that how culture is made is subordinate to what it goes on to mean (Frayling 2011: 19).

If we look at the work of Keith Osborn or Nancy Breimen,[4] there is a cognitive dissonance when attempting to bridge between Collington's cultural and historical groundwork and cartoon bouncing balls of Osborn and Breimen. These two camps – making and theory – seem to echo artistic pedagogy from as far back as the 1940's, when Herbert Read described 'teaching *to* art' – the professional education of an artist – and 'teaching *through* art', involving conceptual and physical skills as preparation for an unpredictable world (Read 1944). The gap that remains is how to achieve a similar awareness of how theory and practice interlock in a tacit sense in the act of making animation.

Other scholars' work that boundaries this gap include Dan Torre, Paul Wells, Maureen Furniss, Caroline Ruddell, Richard Whilliams, Frank Thomas and Ollie Johnston. Whilst such work discusses, at some level, what animators do, a great deal of the Animation Studies literature focuses on the work *produced* by animators, often in a film or media studies context. Thomas Lamarre's work offers insights into animation, how it works and how it brings value to the world (2009: xi). Lamarre also highlights the importance of the animatic interval or gap between layers, which I discuss further in chapter 2. Yet, Lamarre's work does not give equal value to the

---

[3] Collington's *Animation in Context* (2016) lays out how to apply ideas from "well-established sets of ideas" (2016: 6) in order to incorporate them into narrative and visual storytelling.
[4] *Cartoon Character Animation with Maya* (2015) by Keith Osborn and *Animated Performance* (2015) by Nancy Bienman are part of the same Bloomsbury series as Mark Collington's *Animation in Context* (2016), yet there is a significant gap between the technical cartoon based 'how to' guides of Osborn and Bienman and the culturally rich and insightful work of Collington.

human animator, instead the power of animation is attributed to technology, giving "function and value over form" (2009: xi).

There have been several studies that explore and link aspects of neurology and psychology with animation practice (Power 2008; Torre 2014). The work of Brendan Jacobs and Bernard Robin regarding *Animating Best Practice* (2016), specifically on "mental models, as depicted through the animation key frames" (2016: 1) indicated to me the potential for further work in this area. Jacobs and Robin assert the pedagogical effect on learning that animation practice can have. Basing their argument on the psychological notion of "explanatory mental models", they show how even the most rudimentary construction of animation (using PowerPoint) had a measurable effect on the children they worked with. Jacobs and Robin's work clearly lays out how a basic animation practice "goes beyond a dichotomy between process (storyboard techniques) and product (completed animation)" (2016: 279). Their work is focused on using animation practice as a means to enable a rich learning experience for school children, as a pedagogical enhancement.

In summary, in the field of animation studies there is a gap between literature that discusses animation output, articulations of technical skills, and studies that explore crossovers with psychology and wider scientific paradigms. This gap appears to have similarities to some foundational ideas within Design Research, specifically the interdisciplinarity and the difficulty of defining design as it can be related to so many discrete paradigms.

How can this gap be bridged?
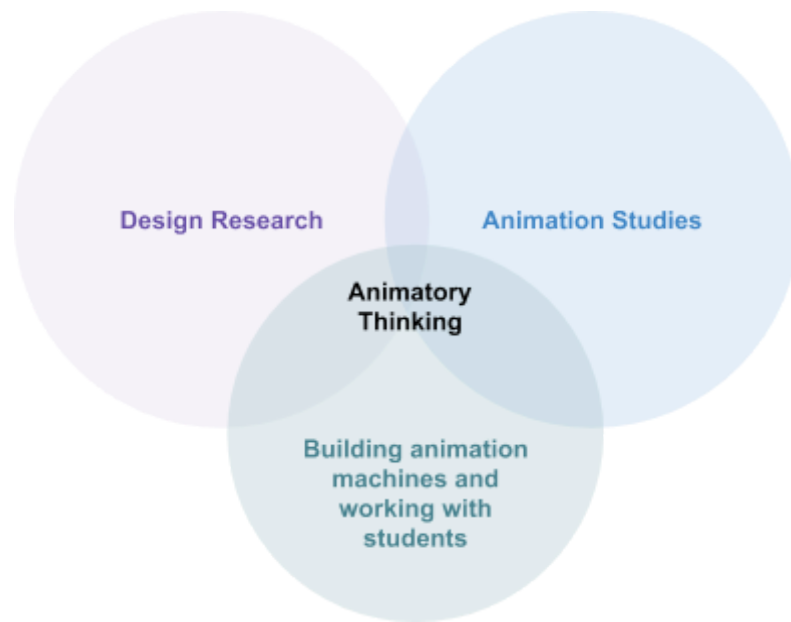
Figure 2. A diagram of the gap in knowledge, 2019, Hugo Glover.

I will show how a Design Research approach affords me the opportunity to touch on multiple sources of information, ideas and exploratory making. I will be proposing how designerly ways of knowing (Cross 1982) can be used to frame the tacit knowledge of an animator, not only in areas such as hand-drawn animation or claymation – where the animator is directly manipulating a 'material' – but how these ideas extend into digital practices of animation as well. *Animatory Thinking*, Fig. 2, uses Action Research to explore animation practice, stitching together theory and practice. This research does not attempt to pinpoint or codify what animators think or how the output of their labours constitute a performative act. Instead, I have constructed my argument for *Animatory Thinking* as a means to highlight *tacit knowledge, embodied memory* and *distance* as significant aspects of animation practice. As a contribution to theory, this PhD articulates *Animatory Thinking* as the confluence between Design Research and Animation Studies going forward.

Distance and pilgrimage

Throughout this thesis, notions of distance and pilgrimage appeared in both my practice and teaching. In order to clearly define the use and function of these notions, I will briefly lay out what they refer to and their significance to my argument.

Beginning with distance, there are two aspects. The first is an acknowledgment of the separations between states within animation technology (physical and digital), such as cels, key frames upon a timeline, poses or models. The second aspect is in reference to embodied distance between animator and technology. We see this hinterland referred to by media theorist Lev Manovich (2002) when he describes the 'medium' between the maker (computer user) and the data (computational functions behind the graphical user interface). Each time a creative loop of action–affect–reflect is examined, we can see the component parts of animator–technology–illusion, as well as the distances between. By highlighting distance as part of *Animatory Thinking,* I am arguing for its importance in relation to an animator's tacit knowledge.

Notions of pilgrimage are present throughout my work. The chronological structure of this thesis is drawn from the iterative stages of my practice as it has grown year-on-year. Through my practice of building animation machines I am exploring my own embodied memory of making and reflecting on formative experiences. In chapter 3, I use the archetype of pilgrimage as a CGI animation brief for my students. I draw parallels between the practice of making animation (the patient accretion of *action* followed by *action*, day after day) and the pilgrim, whose footsteps accrue meaning as a journey is made. In doing so, I will demonstrate how I have used theory and practice to generate new knowledge.

Limits of this research

At best, the challenge of framing a set of tacit skills that animators use to create such illusions can only be partially successful. This research, in its practical physical outputs as well as this thesis, can only offer trophies of exploration, descriptions to feelings, diagrams of systems and metaphors to draw everything together. I will show how animation knowledge can be accrued through a constant cycle of making and reflecting, adjusting and refining. This is an accretion of silent knowledge and although much of this PhD is focused around a single animator – myself – there is always a peripheral social structure around the making of animation. Christopher Frayling offers the idea of the *invisible college* (2011: 26) to illustrate the impenetrable nature of 'know how' that exists within the heterotopic space of a studio or workshop. Frayling describes how, in 1884, George Sturt inherited his father's wheelwrights' workshop. Prior to this, Sturt worked as a school teacher, where formal knowledge was stable and commutable. In contrast, in the workshop the tacit knowledge was evident through *action,* yet elusive to Sturt's attempts to quantify such know-how. Sturt's articulation of this void between formal knowledge and the craft skills of the workforce is apposite to contemporary animation practice. The significance of *distance*, between maker and material, between maker and observer, between lecturer and student, are all branches of the *invisible college*. For Sturt, the craft knowledge he observed in his wheelwright shop was unattainable, silent and protected. Notions of making (Crawford 2010; Frayling 2011; Gauntlet 2011; Korn 2014) are predominantly situated in a 'craft' or hand-made scenario, where the material resistance and its bodily experience are often the locus of such knowledge.

So, does such a guarded approach still exist within the invisible college of a contemporary digital animation workshop? The fundamental difference we experience in our digital workshops is that the information no longer only exists

solely in the hands of earlier generations, rather it is atomised and dispersed across multiple sources and media. As a tutor, the impression I have gathered is that translation of this information into a tacit sense is still fuzzy, especially in animation, where the skill set and technical knowledge has to be both broad and deep. The epistemic paradox between the hand-made and the digitally hand-made is extensively explored in *The Crafty Animator* (Ruddell and Ward 2019). In choosing craft over design, Ruddell and Ward are problematizing how technology relates to certain methods and techniques. As a result, animation practice appears somewhat bogged down by medium specificity. Such discussions of animation practice, in relation to craft and cultural value, indicate the richness and reverence that making animation has, and is lacking in Collington's approach discussed earlier. Frayling argues that makers and teachers must shed "their associations with 'the world we have lost . . . [and] get used to articulating what is special about them . . . much more clearly" (Frayling 2011: 31). For the purposes of this PhD, framing animation practice as *design* attempts to open up such discussions around animation practice, in whatever form the work takes.

Introduction - a Conclusion

In this introduction I have laid out the context of this PhD. I have articulated the rationale for approaching animation practice through the lens of Design Research. The gap in knowledge has been marked out in relation to relevant literature. I have foreshadowed how Action Research has been employed to bridge this gap in knowledge. I have also discussed the potential benefits this research may have in framing animation practice as effectively as animation theory has been.

Throughout the rest of this thesis I am attempting to articulate the tacit knowledge of animation and, in a sense, make it *un-tacit*. When we look behind the 'curtain' of animation, we do not discover its secrets, only the mechanisms of technology and judgment that attempt to create meaning through movement. So I ask you, the reader, to approach animation with the acknowledgement that it exists only as we perceive it as individuals. At best, the challenge of framing a set of tacit skills that animators use to create such illusions can only be partially successful. This research, in its practical physical outputs as well as this thesis, can only offer trophies of exploration, descriptions to feelings, diagrams of systems and metaphors to draw everything together. All of the work documented here has been perceived through the lens of a designerly reading of animation practice, with the intention of offering new perspectives around creative practice.

I will show how the act of animating can be described as using technology to adjust an animatic effect in order to create a homeostatic balance. This silent or tacit balancing by an animator is an iterative process with multiple aspects and nuances to consider. For the purposes of this PhD, I have concentrated on an animator's embodied memory of the world, framing such tacit knowledge as foundational to animation practice. Through my practice and teaching, I will demonstrate how valuing the lived experience as a philosophical and practical basis to the craft of animation offers an insight into how animators shape an illusion of life.

Overview of Chapters

Chapter 1 – Methodology

I begin with an introductory project from 2013, *Breaking Good,* followed by an overview of Design Research and an introduction of the research methodology (Action Research).

Chapter 2 – Animation Machines

The second chapter begins with my practice of building *Animation Machines*. Having established the context of Design Research in Chapter 1, I will discuss the salient aspects in animation studies, the ongoing debate around a usable or accepted definition of animation and the resultant quagmire of intersecting ideas and ideologies. Recent research (Dobson *et al.*; Harris *et al.*; Chow, Torre and Levitt) offers less cumbersome descriptions of animation in its current uses, such as the *an-ontology* of Levitt (2018), as well as the compelling arguments of Chow and his assertion for "technological liveliness" (2013: 34) instead of 'animation', as a means of describing certain aspects of simulacrum. After having shown the spread of ideas within animation studies I will begin the refocusing of my argument by engaging with theories that place technology at the centre of an understanding of animation. What is left out of such theories, I intend to argue, is both the presence and the influence of the animator, who works within these technologies to shape meaning and who has an embodied understanding of some of these processes.

Chapter 3 – Embodiment and Tacitness

Having explored technology in Chapter 2, I will then introduce embodiment as a fundamental reference point for my argument. By combining technology and embodiment, I will then discuss the silent, tacit, practice within animation, where we meet Design Research once again.

Following this, I will outline two interconnected domains of *Animatory Thinking*. I will argue that whilst the tools and skills of animation are ontologically stable, the '*an-ontology*' (Levitt 2018: 58) of animation practice is still fuzzy. After this, I explore a close reading of the practice of animation, through my own practice as well as observing novice animators beginning to learn CGI.

I will show how I used my teaching of CGI to foreground ideas of designing variety and layers of cultural complexity into students' animation projects. Out of this work around tacit knowledge I will unpack my ideas of describing animation practice as a 'tacitness of time'.

The final stage of my practice was building and installing a flame-powered zoetrope. Through the process of creating this work, I explored Albert Camus's 1942 philosophical essay *The Myth of Sisyphus*.

Emerging from this last cycle of practice came the idea of *animation as a sisyphean task*, which I explored with my students as they created CGI animation performances documenting their personal struggles.

The thesis is concluded by identifying how *Animatory Thinking* has emerged as a body of research, through practice, theory and observing novice animators, and offers an original contribution to knowledge.

Appendices I, II, III contain peripheral animation projects, details of selected student work and transcripts of interviews from interviews at Pixar Animations Studios and DreamWorks SKG.

Chapter 1: Methodology

> The satisfaction of gaining intellectual control over the external world is linked to the satisfaction of gaining control over ourselves: "This urge towards this dual satisfaction is persistent; yet it operates by phases of self-destruction. [...] This endeavor must occasionally operate by demolishing a hitherto accepted structure, or parts of it, in order to establish an even more rigorous and comprehensive one in its place" (Polanyi 1958: 196, cited in Settlage and Brockbank 1985: 161).

Integral to this PhD is my practice; each chapter of this thesis incorporates a project from which my ideas have emerged, re-emerged, been broken down, rebuilt and then discussed in detail. Each project is an attempt to experience animation practice in a novel and primal fashion. This stripping down of what constitutes animation practice was in part a self-reflective pilgrimage, taking no shortcuts, but instead building each technology, piece-by-piece. At the end of each phase of making, I would return to teaching CGI animation to my students. The primacy I experienced in my practice gave me new perspectives on how animators and technology co-exist, and therefore how animation "thinks technology" (Lemarre 2013) and in turn how this confluence of the 'human' with 'technology' could eventually become the nucleus of *Animatory Thinking*. Throughout this thesis I oscillate between CGI and hand-made approaches, often mixing multiple forms of making animation, which reflects my agnostic view of technology, whereby each offers differing mental prosthetics (Norman 1991). I consider the approach of stitching theory and practice together as core to this research, as each provides opportunities for reflection and perspective. My practice has been omnipresent for me throughout the duration of this PhD, so I have attempted to maintain this through the thesis.

***Breaking Good*, October 2013**

Design Research has a rich history of introducing provocations and disruptions as a starting point (see Hall 2016; Frayling 2015; Rodgers and Smyth 2010). Designers Boyd Davis and Vane suggest "a key contribution of designing may be to transform or subvert the original question: it may make apparent new possibilities that could not have been foreseen without instantiation through visualization. A tentative design acts not only as a corrective, allowing a poor question or specification to be improved, but also as a provocation – even an inspiration – to further questions" (Boyd Davis and Vane 2019). As a practice-based enquiry, this PhD began with a very simple design brief from my first supervisors, Ranulph Glanville and Neil Baron: "Make something for your kids, make it silly". My response to this provocation was to recreate a childhood memory of mine, with the intention of passing on the experience to my two boys, Felix (then 6-years-old) and Max (then 4-years-old). When I was a similar age, I visited a local friend of mine. My friend's grandmother lived in the family home on the first floor of their house. She had a balcony, on which flower pots were lined up along the top rail in order to catch the afternoon sun. The balcony looked out over a small back garden. Directly underneath was a patio. It is not clear to me whose idea it was, but one by one each pot was pushed off the rail ... falling and smashing on the patio below. We could not see the devastation, only hear the sound of the exploding earthenware as the potential energy converted to kinetic energy, and eventually dispersed again into sound and motion, as the pots exploded upon impact.

Recent assertions in Design Research have called for "[...] a need for the designer to be 'irresponsible' because we know that we need more playful and habitable worlds that the old forms of knowledge production are ill equipped to produce" (Rodgers and Smyth 2010). Academic Paul Wells suggests that an 'animator's atavistic intentions' (1998: 32) are an attempt to access different kinds of expressions

which form *universal animism* (Eisenstiein 1983: 35). Wells defines animism as "a pre-rational, pre-scientific state of relatedness to the organic interconnectedness of the natural world and primordial conditions" (1998: 32). We can find similar descriptions of such interactions from psychologist JJ Gibson's concept of *affordances,* which "implies the complementarity of the animal and the environment" (2014: 127). In articulating his ideas of affordances, Gibson quotes Kurt Koffka's *Principles of Gestalt Psychology* in which "… each thing says what it is and what he ought to do with it: a fruit says, 'Eat me'; water says, 'Drink me'; thunder says, 'Fear me'…" (1999: 7).

So the plant pots…
Well, the plant pots said "Push me",
so I did.

To recreate this experience for my boys, I bought several plant pots and set about finding the optimal height to drop them from, in order to best experience the phenomena of breaking them. I recorded this testing and repeated the experiment at my next supervision with Ranulph and Neil at the RCA.

I took a pot.

I dropped the pot, causing it to break.

I glued the pot back together.

I took the pot.

I dropped the pot, causing it to break.

I glued the pot back together.

I took the pot . . .

Figure 3. Still from *Breaking Good,* a film documenting the practice of breaking and remaking a single pot six times, 2013, Hugo Glover.

This first phase of my research allowed me to reflect on aspects of a process of engaging in a cyclical practice of making and breaking, reforming and recording. This exercise illustrated to me how the volume and materiality of the pot became paramount through my practice. Capturing the liminal state of the pot in freefall became one communicable output, but this exercise posed many more questions than it answered, as Ranulph and Neil had no doubt intended.

At the moment of impact, the transfer from one form of energy – that of movement into sound – and shattering distraction as the force of the ground coming

up to meet the pot found its way through the material. In tracing the weakest fissures, it reveals its life force in a moment of destruction. It was this change of state, this moment of transformation that could be relived again and again through the manipulation of moving images but could not be captured by the medium, that I sought to investigate. This suggested there was much to explore in getting as close as one could to the energy of change, as close as one could to the moment an object experiences transformation – a distinction (Spencer-Brown 1972) – from one state to another. For me, this experience was part of my embodied knowledge of the world gained through childhood curiosity; my atavistic intentions leading to a greater understanding of my environment, both material and botanical.

Emerging from Practice

Upon reflection, the significance of a physical experience of materiality and primary 'change' appeared to be at the heart of my enquiry. This first project also showed me that using moving images – in this case to capture one aspect of the experience – allowed me to cyclically relive this moment. As part of this method of exploration, I used the video recording, manipulating the sequences to create an altered state, a loop, a synthetic time which would allow the single moment of transition to be experienced and venerated. This looping felt akin to the telling and re-telling of the original story, and with each re-telling the meaning altered. In contrast to the repletion of an action, the repletion of an utterance (a spoken word) results in *semantic satiation* (Jakobovits 1962): when a word's meaning suffers a decrement in strength as it is continually repeated. The repletion of this liminal state of breaking and remaking appeared to alter its meaning, amplifying its significance and situating the observer in the loop. At the time, I had not made the connection between how I had presented the experiment with the core function of loops in animation practice.

This would emerge much later as a salient point of my research, and is explored in greater depth in Chapter 3.

The salient aspects that emerged from this work included looping (or synthetic) time, as did the connections to many aspects of Design Research, specifically iterative cycles as the engine of change within a design process. This first project made it very clear to me that investigating animation through the lens of Design Research, specifically making objects and reflecting on the making and the object itself, could offer potentially powerful new understandings of animation practice.

From Practice into Theory

Having introduced the first stage of my practice, I will now lay out Design Research as an area of academic enquiry and Action Research (Lewin 1946; Tripp 2006), which I have used as a scaffold to interconnect the three areas of practice, theory and observation.

An Overview of Design Research

The 1962 Design Methods Conference at Imperial College in London had two principal objectives: to determine the parameters of a collective agenda, and to enable discussions that would inform further developments in design methods work. In the accompanying book, the ambition is summarised as follows:

> We were particularly keen to seek out and establish systematic methods of problem solving, especially those problems associated with design. We also sought a means by which design could be taught as a creative process that could be aided by a systematic process of conscious thought, integrating experience with academic knowledge whilst at the same time keeping the imagination free from inhibitions (Jones and Thornley 1962).

Design educator and theorist Horst Rittel is associated with the rational and systematic ideas of early Design Research and design methods (Chanpory and Dubberly 2007). Through the work of John Chris Jones (1992), Bruce Archer (1979), Misha Black (1983) and others, design as a discipline continued to grow. Archer called for design to be viewed not only as a subject in its own right, but "on a par and distinct from science and the humanities" (1979: 17). Subsequent researchers would push the field towards social projects whilst also pursuing critical work within research (Pavitt 2012). Victor Margolin (2010) has argued that the 1980s and 90s saw a blending of these two divergent positions, with Nigel Cross (1982) and Archer (1979) articulating how professional practice and new approaches to problem-solving could be actuated through Design Research.

Design Research has always had a broad and diverse range of opinions, with those promoting design thinking as an engine of innovation and market growth, whilst others regarded such perpetual consumption as *the problem* design should solve rather than perpetuate. Victor Papanek articulated the interconnectedness of design, commerce and media describing how design was used to persuade people "to buy things they don't need, with money they don't have" (Papanek 1972). Patricia Conway concurred, writing in *Design Quarterly* that design was "an almost criminal exercise in greed, negligence and wilful destruction" (1973: 5). Acknowledging how ubiquitous design was becoming, Donald Schön noted "a tendency to think of policies, institutions, and behaviour itself, as objects of design" (1983: 77).

Since the 1980s, Design Research has been utilised to great effect in broader fields of innovation, business development and the application of 'design thinking' as a method of problem-framing, problem-solving and driving change (Brown 2008). More recently there has been a growing acknowledgement that the mass productivity of the twentieth century has generated an unsustainable existence, and that design

has its place in this transformation (Rodgers *et al.* 2017). In recent years, Design Researchers have openly questioned the role of design in creating the unsustainable paradox we now find ourselves in (Rodgers *et al.* 2017). "Design is either copious and being smeared as a viscous layer over the problems of the world, or what we call design is being stretched into an impermeable film expanding to keep in capital and consumption" (Rodgers and Bremner 2019). This metaphor of a 'layer' or 'film' could be interpreted as a description of (amongst other things) the screens we use, and the digital 'designed' world beyond. But design as a membrane or a skin falls short of acknowledging what is either side of this supposed barrier. Anne-Marie Willis offers a hermeneutic cycle of designing (and therefore making) objects which, in being in the world, then have an effect on the ideas and/or products that are generated. Willis suggests that "we design our world, while our world acts back on us and designs us" (2006: 80), which suggests that our thoughts shape our spaces and our tools and consequently our spaces and tools then impact what we design. Everything that we are, is constantly oscillating between mind and world. Ontological designing (Willis 2006) attempts to articulate this almost omnipotent perspective on design, a view that takes a philosophical standpoint through an intellectual observation of designer – tools/technology – user (designer). In Chapter 2, I will explore how current theories in animation studies around the spectator screen nexus (Levitt 2018) approach the same area that Rodgers and Willis have arrived at from a Design Research perspective.

As stated in the introduction to this thesis, the choice of viewing animation practice through the lens of Design Research is intended to bridge the gap in knowledge between current practical and theoretical notions of animation practice. Both Design Research and Animation Studies have existed in almost perpetual flux (Glanville 2007). Design Research has been more concerned with what *it is*, as opposed to a fixation in animation research regarding what *it is not* (Buchan 2013).

Animation is a rhizomatic discipline (O'Sullivan 2000) and appears across a broad swathe of discreet creative areas, from fine art, communication design, film studies, interaction design and computer science (this is not an exhaustive list). Design Research is equally complex in its connections and relevance across disciplines. A great strength of Design Research has been the variety and innovation produced through the application of design thinking (Hall 2016), and as Hall goes on to state, "variety is at the core of the rationale for the selection of different design methods" (2016). But within such a fluid shifting discourse of design, the word *research* is the anchor that harnesses variety into tangible, knowable outcomes. As Archer, one of the major figures in Design Research states:

Research is systematic enquiry whose goal is communicable knowledge:

* Systematic because it is pursued according to some plan;

* An enquiry because it seeks to find answers to questions;

* Goal-directed because the object of the enquiry are posed by the task description;

* Knowledge-directed because the finding of the enquiry must go beyond providing mere information; and

* Communicable because the findings must be intelligible to, and located within some framework of understanding for, an appropriate audience

(1995: 6).

Such criteria can offer a clear checklist to assess one's own research and in the case of both this thesis and practice, I have attempted to offer an articulation of animation practice, which can act as the basis for future academic work in the field of animation studies. Chapter 3 of this thesis is particularly concerned with reflecting

the extent to which the practice and emergent theoretical ideas have succeeded in fulfilling these criteria.

Current Design Research involving cybernetics articulates a similar system to my own description of making/theory/observing. In a lecture entitled 'Temporality in a theory of (and for) Enquiry' in 2019, Thomas Fischer illustrates the threads that create an epistemological triangle:
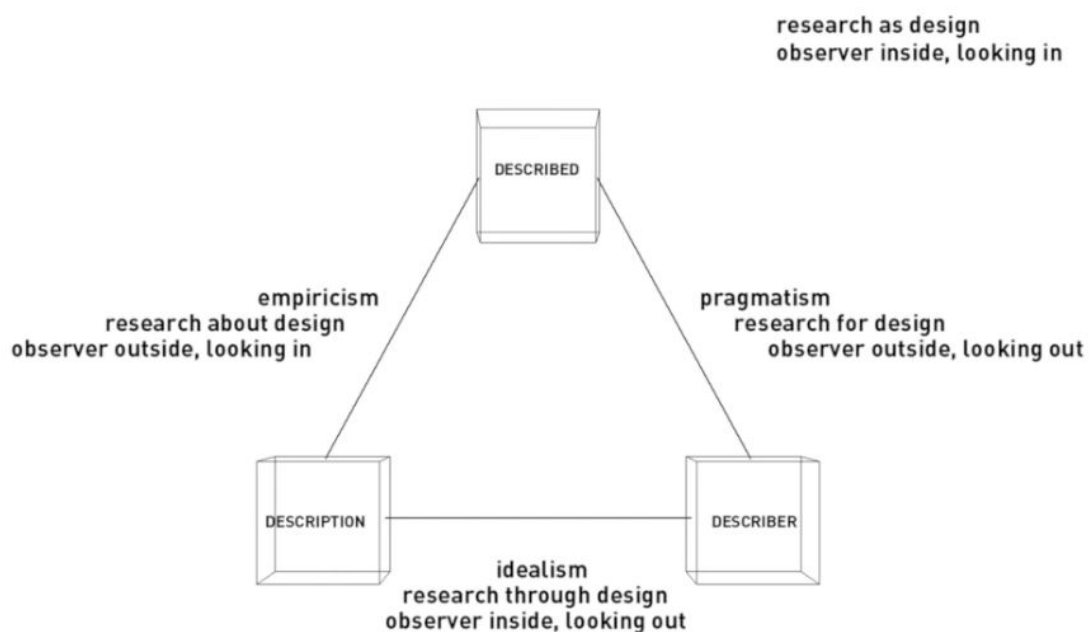
Figure 4. Design Cybernetics, Navigating the New – showing how Description (Design Theory) Described (Design) and Describer (Designers) are observed by differing modes of Design Research (Fischer 2019: 00.10.51). See also Frayling 1994.

Chris Frayling's three types of Design Research[5] which Fischer locates on his diagram (Fig. 4), depict *Description* (Design theory) *Described* (Design) and *Describer* (Designer). Fischer also includes Ranalph Glanville's 'observer' perspectives, which acknowledge the orientation of the researcher/subject. I have

[5] See Frayling (1994):Research about design, Research for design and Research through design.

redrafted Fischer's original triangle diagram of Design theory/Design/Designers, and used the structure to show how Design Research and animation are situated within this PhD. The blue overlay indicates the current location and focus of Animation Studies research, with the arrow head indicating an intended expansion and recognition of the animator: this is the focus of this PhD.
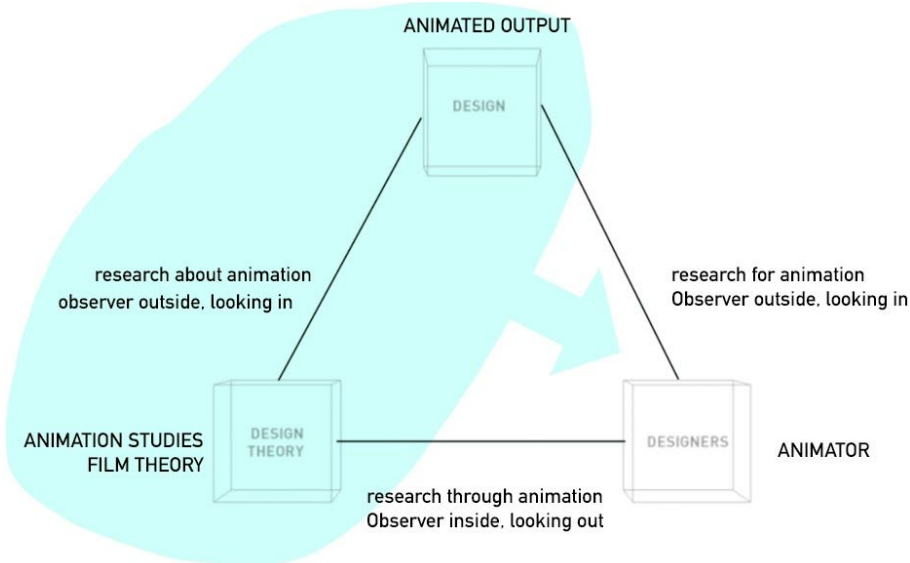
Figure 5. Temporality in a theory of (and for) Enquiry (Fischer 2019: 00.08.11) – overlaid with text linking Design Cybernetics to A*nimatory Thinking*. The blue area shows the location of the majority of animation studies research, 2019, Hugo Glover.

In order to expand animation studies towards the animator, my research attempts to offer all three observer (researcher) perspectives. Nicola Dobson suggests that "the challenge now for animation studies, as a relatively young field, is to identify and articulate its key lines of enquiry" (2018: 1). Throughout this thesis, my argument for acknowledging the animator, as part of animation studies, may encourage a maturing of animation as a medium. Boyd Davis asserts that in an "immature medium, techniques are noticed, and this act of noticing gets in the way of any direct, natural sense of 'just seeing'" (2002: 205).

The final chapter of this thesis acknowledges my role as a teacher (observer outside looking in) and how I have used my research 'for animation' and 'through animation' to construct and disseminate *Animatory Thinking*.

Methodology

Methodology is a validation process for proving the research findings. Each Design Research project has a unique research methodology (Hall 2016).

I will now unpack the emergent methodological positioning as a means of situating my work within Design Research, orientated towards animation.

Action Research

Simply put, Action Research is the combination of action and research with the imperative to provoke "change through action" (Foth and Axup 2006). By following an Action Research cycle (Lewin 1946; Tripp 2005), the body of this research (practice and theory) has consistently evidenced the processes of "reflection-in-action" and "reflection-on-action" (Schön 1987) – see Figure 7. Lewin (1946: 38) described the mechanism of Action Research as a "spiral of steps each of which is composed of a circle of planning, action, and fact-finding about the result of the action". When we see this description presented in a diagram (Figure 6), we are offered a path, deformed into a spiral denoting the stages of *plan*, *act, observe and reflect.*
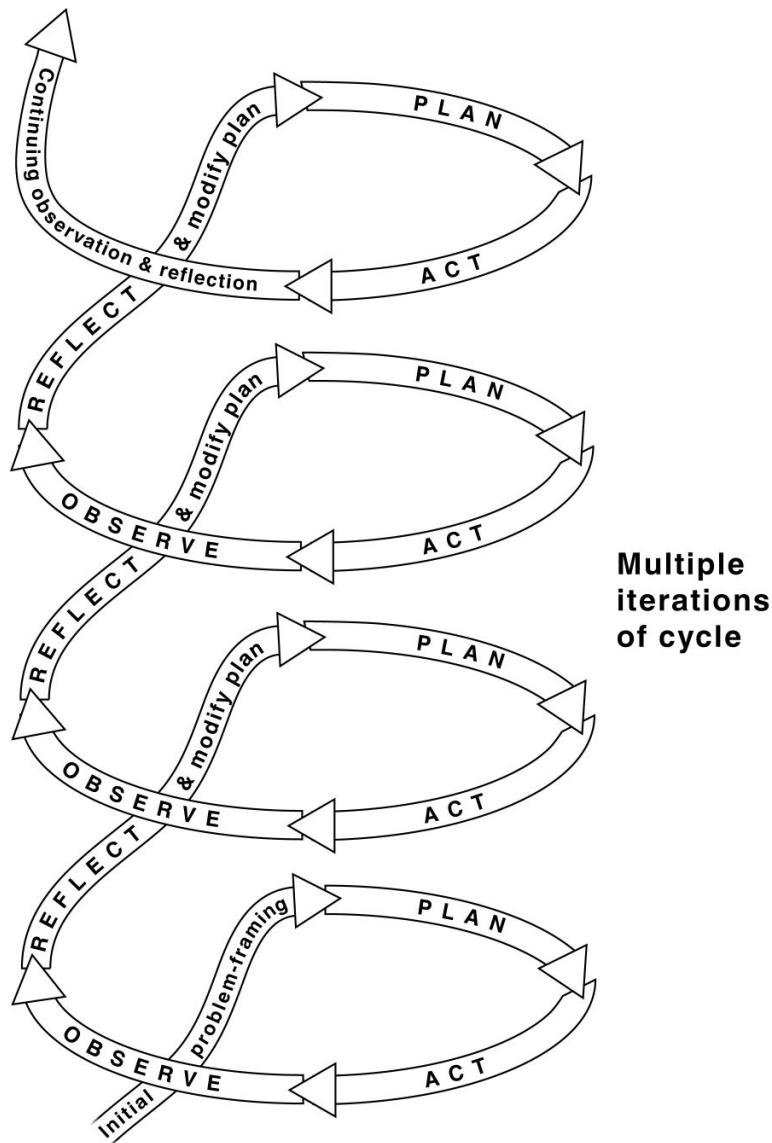
Figure 6. A synthesis of Lewin's (1946) Action Research methodology spiral, Robson's (1993: 438) plan, act, observe, react cycle and Argyris and Schön's (1974) double-loop learning.

This diagram can be applied to the overall duration of this PhD: over the past five years I have made use of the cyclical academic calendar as a structural temporal organisational tool, allowing me to practice and produce work during the summer months, teach during the autumn and winter, and reflect and write up in the late spring, and so on. The same cycle is at work at a project-by-project level, a day-to-day level and even within this, a decision-by-decision level. The simplicity that Figure 6

shows is of an abstraction or simplification of a far more complex system, almost fractal in nature: spirals within spirals. From my perspective, acknowledging the cyclical nature of Action Research methodology is important to this thesis: notions of circularity are present throughout my work, practically, theoretically and methodologically. Action Research situates the researcher at the centre of the work, so the diagrams I have used are akin to maps showing paths travelled by the Action Research practitioner. A similar approach is offered by Agyris and Schon's (1974) "double loop" learning. As well as following an Action Research cycle myself, I have made use of the work I do with my students. Over the past five years, I have reshaped and refined the modules I teach in order to foreground the emergent ideas that have grown out of my research. I will discuss working with and observing students in Chapter 3.
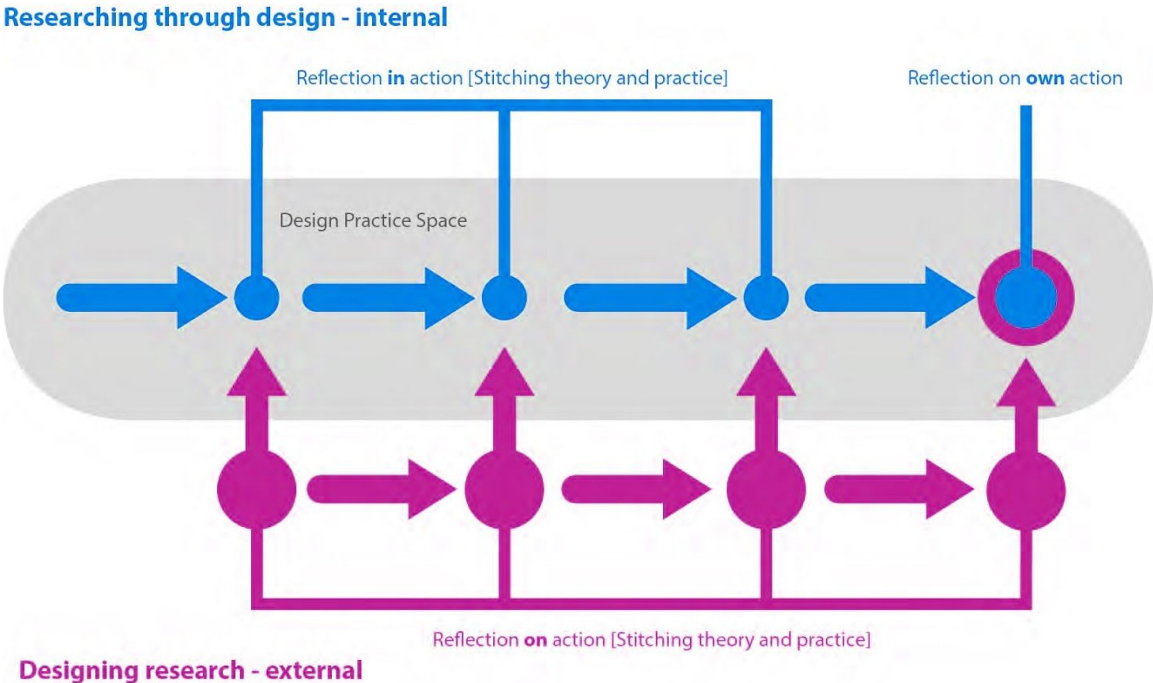
Figure 7. Reflections on action, stitching theory and practice, Hall (2018).

The limits of Action Research

So, what are the limitations in the Action Research structure adopted here? It has not been externally tested, only mediated through myself as maker, teacher and researcher. This 'fuzziness' *per se*, is an acknowledged part of Action Research.

The intent of employing Action Research within this study is to offer a notion of *Animatory Thinking* that has traction within Design Research, as animation practice has not been explored from the perspective of Design Research before.

As a model of a similar research journey, Elaine Igoe's 2013 PhD thesis constructs a compelling argument for reframing textile design within the canon of Design Research. There are many similarities between Igoe's work and my own, primarily due to the commonalities between textile design and animation practice: both silent, somewhat invisible, and often a subset of a larger creative output. To some accounts, textile design appears to have been waiting for such an enquiry even longer than animation studies. Igoe quotes Moxey (1999: 176) stating, "If textile design is to be studied in an attempt to understand its peculiarities, then researchers should aim to systematically identify the nature of textile design and the behaviour of textile designers" (Igoe 2013: 19). Igoe employs a form of meshing the voices of interviewees, her own reflective practice and pertinent theories of making and designing throughout her thesis. The effect is a body of work that reflects both the subject of enquiry and the materiality of textile practice. Igoe tells us that textiles "do not have words; they speak instead through a complete synergy of visual and haptic language" (Igoe 2013: 60).

Within my research, I have similarly employed a mixture of observation, discussion and practice as a method of exploring animation from the point of view of making objects, reflecting on this practice and using the reflection directly in my teaching students. As a result the studio becomes a *safe space for stupidity* (Kentridge 2014). For me, the value in this approach is that during the research stage, mistakes

can be made, breakages will happen and that in the studio it is possible to be more attentive to progress rather than end-perfection. These iterative phases can then be tested back against existing theoretical discussions from Design Research and animation studies, as well as broader fields such as philosophy, neuroscience, linguistic theory and art practice. "[A]nimation makes every discipline, including by definition animation studies, always already between disciplines, interdisciplinary, as well as transdisciplinary" (Cholodenko 2016). In the 1970s, Bruce Archer proposed 'The Three Rs' (Figure 8) in which 'Design' was proposed as the missing segment of education. I have respectfully reproduced Archer's diagram here, with a proposed location for animation.
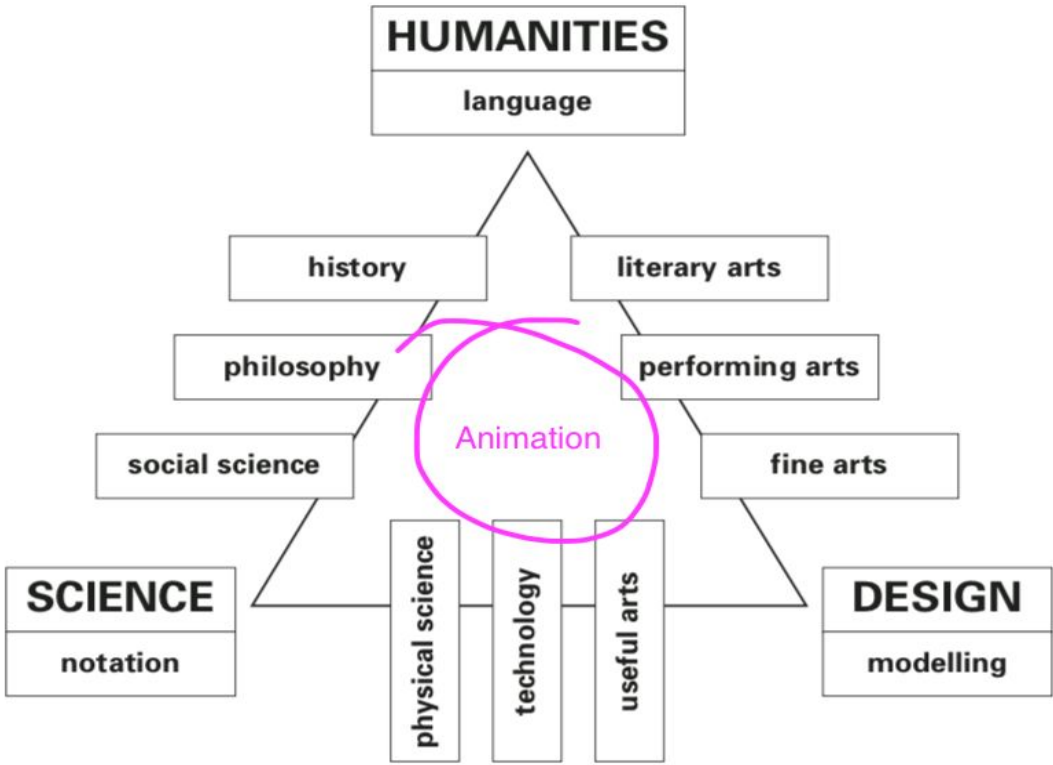
Figure 8. A modified version of Archer's 'The Three Rs'. This paper can be regarded as the foundation document for the work that took place at the Royal College of Art during the 1970s and 80s. It was presented in a number of different forms at conferences and seminars and formed the Preface to the Design in General Education report that the RCA delivered to the then Department of Education and Science in 1976 (Archer *et al.* 2005: 8).

I have placed animation in the centre of Archer's Three R's to assert the idea of animation practice as a nodal point with fluctuating relationships to every type of knowledge on Archer's diagram (Fig. 8).

Following an Action Research model, the intent of this methodological approach is to improve practice. If we look at the modified version of Archer's Three Rs, with animation at the centre, then connected to every aspect of the model there is a bias at work in how animation is approached, often wholly situated in the technology and useful arts. One aspect of *Animatory Thinking* is to rebalance this network, where animation as a form of design practice is actively and knowingly connected to each and every aspect of the diagram. At differing stages of practice, there will be a bias towards one area, but the ability to move between each of the boxes on Archer's diagram is key to the success of design thinking, and will be equally important to the validity of *Animatory Thinking*.

The animation studies academic Paul Ward asserts that "the combination of time, space and performance is especially apposite as a model for understanding animation, and new synthetic knowledge is created by examining these concepts through animation as practice" (Ward 2013: 332). Ward takes Kolb's model of experiential learning (Kolb 1984) and adds "critical juxtaposition" (animating) at the centre.
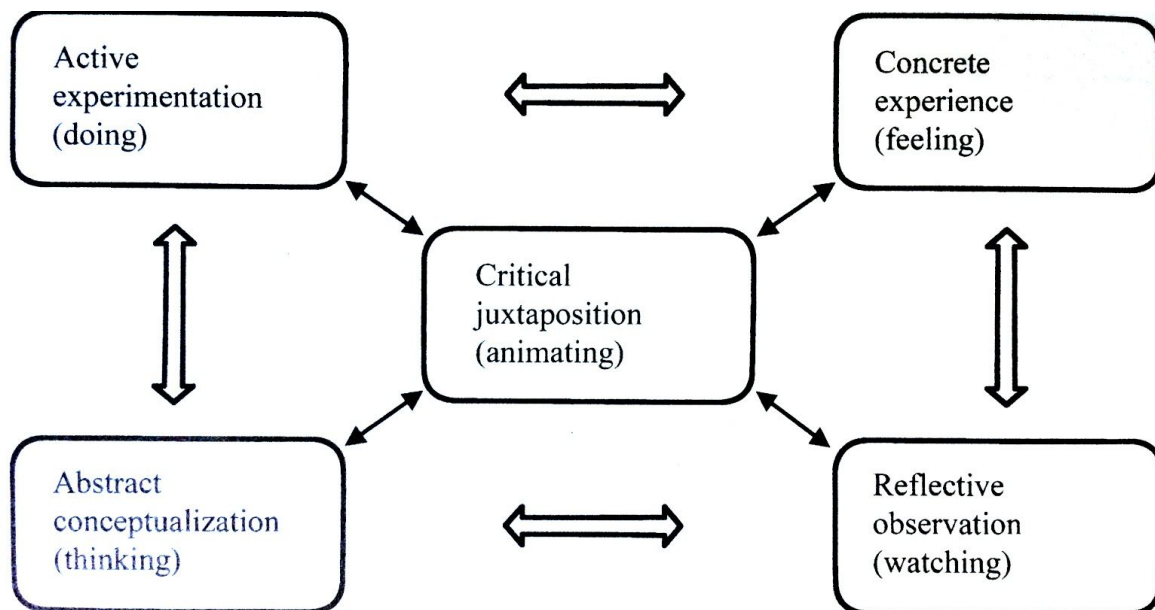
Figure 9. Kolb's model of experiential learning re-animated (adapted from Kolb 1984) (Ward 2013: 332).

More recently, Ward has revisited his argument for viewing animation as an interdisciplinary practice through applying a typology of cultural practitioners proposed by Mike Wayne (Ward 2018). Ward finds this typology especially useful as many of the theoretical paradigms applied to animation have been done "without first fully thinking through how animation's theory and practice might inform *them*" (Ward 2004: 288). A value of Wayne's critical practice is how it interrogates the problematic relationship between practitioner and technology (Ward 2018: 97). In breaking down cultural production, this typology offers three descriptions of how one can be self-conscious about one's work. We can consider these as strata between surface learning and deep learning (Biggs and Tang 1999). Wayne's typology of different modes of understanding or interrogating practice (2001) is as follows:

The Reflexive Practitioner. This is someone who can reflect on and interrogate the production process, who can learn from what worked and what did not, and can chart the development of ideas – the choices and decisions made which affected the outcome.

46

The Theoretical Practitioner. The practitioner who directs our attention to the product, the symbolic artefact that has been worked up out of the production process. This has involved a transformation of pre-existing (cultural) materials into a definite article using specific codes and conventions of the medium in the first instance, and then genre(s).

The Critical Practitioner. This is, I believe, the most difficult kind of practitioner to produce. The critical practitioner is able to interrogate the *politics of representation*. This requires a movement from the text (the domain of the theoretical practitioner) to context.

Wayne's typology was originally intended as a provocation to media studies but Ward has suggested it as a model within animation. In doing so, Ward is attempting to shift the emphasis in animation from reflexive to critical practice. Animation, Ward suggests, is often approached solely from a technological standpoint, and therefore situating it (at best) in the reflexive practitioner category. Such an approach ignores both the potential for animation to influence and coerce (Buchan 2013: 1) and, more importantly, the responsibility for animators to understand the wider political implications of what animation can articulate. The intent of reformulating animation in a broader context as *critical practice* has resonance with other contemporary theories. Responsibility in the field of Design Research is a well-ploughed furrow (Rodgers *et al.* 2017). Yet, despite the repeated assertions in animation literature of the *power* of animation in a cultural context (Buchan 2013), the act of making – from which meaning emerges – is often masked behind the curtain of technology. This separation is also evident in industry as well as academia, with the segregation of '2-D and 3-D' as a somewhat unquestioned distinction. I believe such segregation is a distraction from the wider impact that animation could offer as a site of temporal plasticity and theoretical complexity.

As stated in the Introduction, I am concerned here with looking at the development and impact that design thinking has had in academia and the wider world, as a series of signposts that animation could follow in order to place the animator at the centre of this research instead of the output of their work. What interests me primarily is the understanding of tacit knowledge in design, and how one could take these viewpoints to begin to best articulate the tacit knowledge of the animator, not just in their specific technical subset of animation but in a broader temporal knowledge. I am specifically referring to the ways in which animation practice requires the animator to hold differing temporalities in their mind at any one time, oscillating between motion and stasis (as explored in Chapter 3).

As previously stated, the opportunity to create my own work alongside my students is fundamental to this research, as it allows for a combination of deep personal insight and reflection, followed by an unpacking and dissemination of the ideas through folding them back into exploring animation practice with my students. In doing so, I have had the opportunity to discuss and explore ideas that have since emerged as core to my research. Exploring these ideas with students has offered a rich and in-depth dialogue running alongside my own reflective practice, and forms the spine of this Action Research.

Chapter Conclusion

Figure 10. A reformed pot part way through making *Breaking Good*, 2014, Hugo Glover.

In this chapter, I have introduced the first cycle of Action Research and shown how this was formative in setting a trajectory for my PhD. 'Breaking Good' established the position of real world experience and how it might relate to the manipulation of time through moving images.

I have discussed how Design Research has evolved over the last 50 years and touched upon some of the similarities between Design Research and animation studies.

Action research has been described and explored as the core methodology used through this PhD. In addition to Action Research, double loop learning, critical practice and research through design have also been discussed. In each case I have foreshadowed how and where these ideas and approaches have been employed within the PhD. I will go on to demonstrate how this study is intended to offer new knowledge to the world of animation, and to related fields of practice-based Design Research, tacit knowledge and how our lived experience may be present in creative practice.

A strength of design-led enquiry is a so-called 'magpie' approach (or "pick and mix", as Yee (2010) describes it. In the following chapters, I will be exploiting the plasticity of Design Research through peripheral areas, such as cognitive science, philosophy and fine art practice. As peripheral areas of knowledge and expertise, these disciplines offer pertinent reflections on animation practice, though I will not be discussing them in great depth.

As discussed earlier, the animator can be considered a *critical practitioner* (Wayne 2001) as they navigate various strata of craft skill as an omnipotent creator (Wells 1998). This position forms a critical argument as to the validity of animation as a complex and multi-faceted design practice.

Chapter 2: Animation Machines

After the first cycle of Action Research (which followed the iterative steps of plan, act, observe), key points emerged as signposts for the next stage of my practice:

1: Exploring animation in the real world, unbounded by a screen, foregrounds many aspects of a design process as well as acknowledging the physical agency of the animator.

2: This practice is primarily about change and the direct manipulation (Shneiderman 1982) of change, therefore making the differences between the elements as accessible as possible could allow for a closer reading of this primary element of animation.

3: By making objects, machines, I (as the Action Researcher) have to establish the stability of the animatory effect as well as create the animation. This highlights the interdependency between animator and technology: a theme that will run throughout this PhD.

So, this second cycle begins with a much more focused approach to practice, and a far wider scope of theory: the PhD practice is situated between Design Research and Animation Studies, and required me to touch on aspects of cognition and, eventually, embodiment (in Chapter 3).
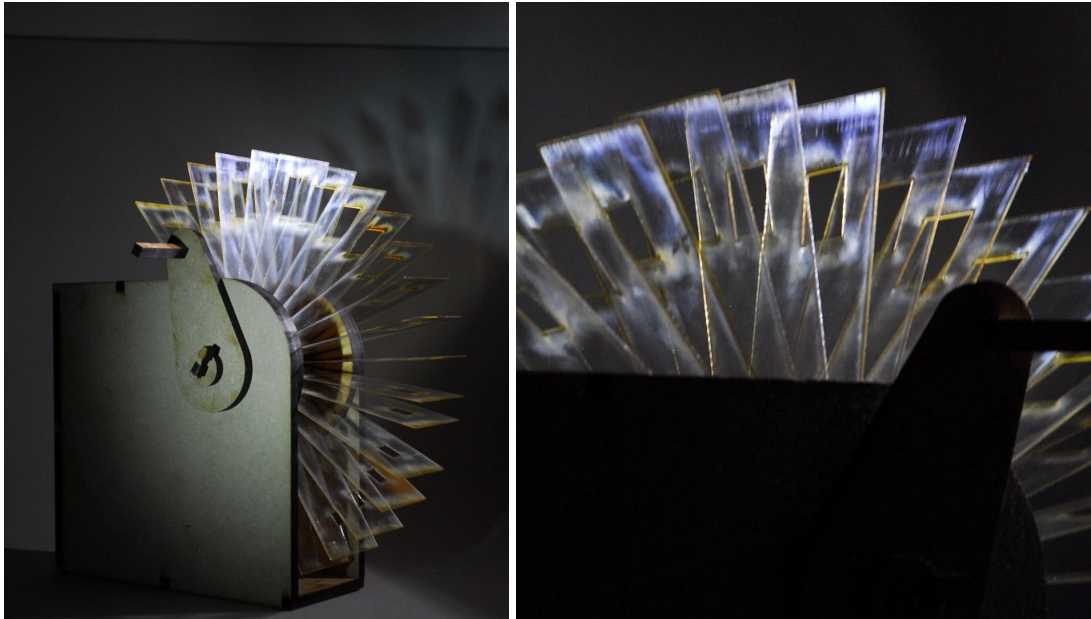
Figures 11 and 12. Hand-powered mutoscope. The translucent cards had a cut out animating void. As the machine was operated, the void would appear to metamorphosize from a square to a circle, 2014, Hugo Glover.

I started by building hand-powered mutoscopes, or *philosophical toys*[6] (Gunning 2014: 31). The original nineteenth-century mutoscope was a hand-operated device offering up to one minute of visual movement from approximately 800 sequential cards, which would flick past the viewing slot. As the moving images could only be seen by one person at a time, there emerged a certain degree of intimacy between viewer, experience and mutoscope. Such devices often showed "pictures in which nude art has been carried to the extreme of indecency" (Doane 2006: 11).

---

[6] Nineteenth-century optical devices also included zoetropes, phenakistascopes and mutoscopes.

THE CORRUPTION OF YOUTH.

WITH the invention which has made possible the "mutoscope," the "artoscope" and all the other forms of exhibition in which photography is given a semblance of the movements of life, a new instrument has been placed in the hands of the vicious for the corruption of youth. They have been prompt to take advantage of it. They have copied pictures in which nude art has been carried to the extreme of indecency, they have induced vile women to pose in half nudity, and of these they have made scenes to tempt the depravity of manhood and the curiosity of youth.

Figure 13. Expert from the *San Francisco Call* newspaper, 1899.

Gunning quotes film and media theorist Mary Ann Doane, who describes how "the image of movement itself was nowhere but in the perception of the viewer" (Gunning 2012: 11). Such an image results from the physical interaction with the apparatus. Doane goes on to assert that the "image of movement could be produced at will, through the labor of the body, and could, indeed, be owned as a commodity" (Doane 2006: 11). Setting aside the social hubbub of the times (see Figure 13), Doane's description of the physical engagement with such machines illustrates part of the rationale that I was interested in exploring through making mutoscopes: that of a sense of physical ownership and of holding movement in one's own hands, controlling time.

Figure 14. Hand-powered mutoscope, 2014, Hugo Glover.

Using translucent plastic instead of images, each card in my mutoscope had a laser-cut aperture, and as the handle was wound and the cards flicked against the pins so that the shape on the card would fluctuate. The primary idea was to explore animation outside the confines of the screen. By making the technology myself, the intention was to attain a perspective on what making animation constitutes. Despite the relative simplicity of a mutoscope, it still required several iterative versions to achieve a visually stable system in order to create an illusion of movement. Once a device was stable, creating an illusion, the animator could begin to adjust the elements of the system in order to modify the resultant effect, tuning existing situations into preferred ones (Simon 1981).

Animation Machines
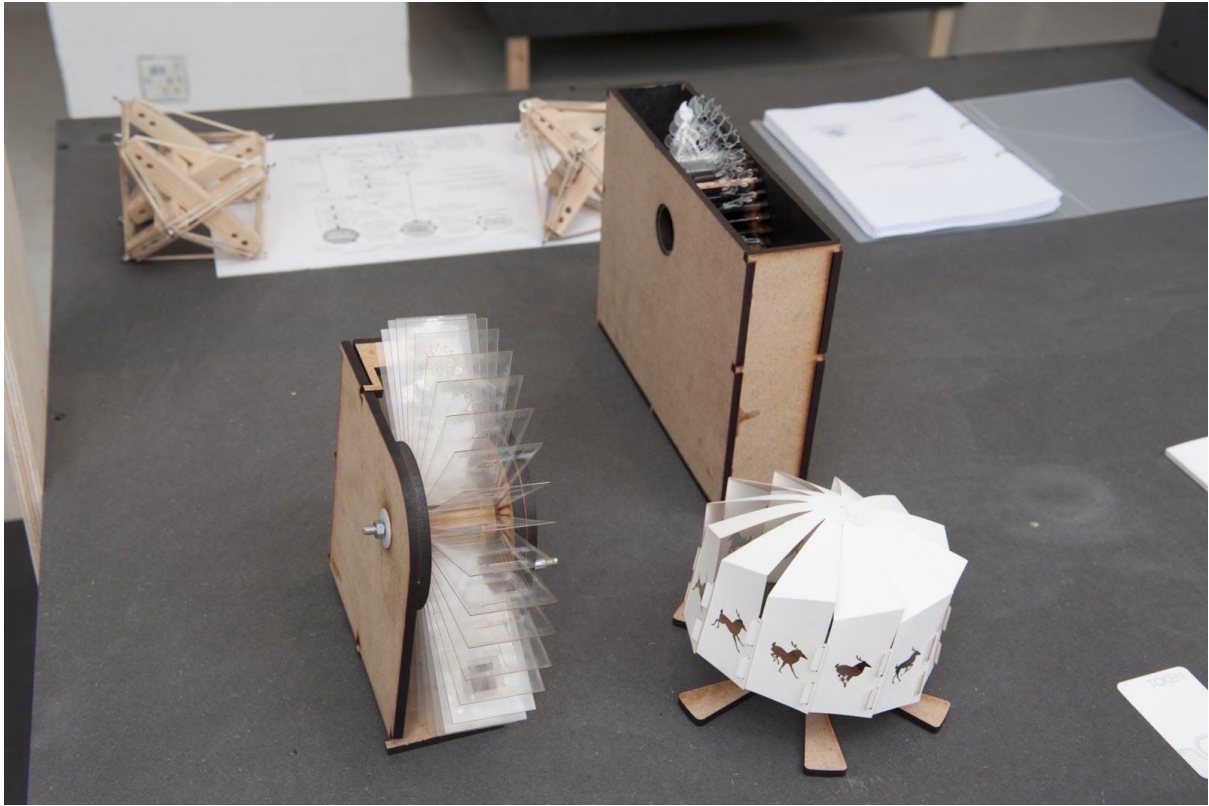
Figure 15. Royal College of Art 'Work In Progress' show, 2015, Hugo Glover.

When rotated, the cards would bring the aperture to life. Through the experience of perceiving such a visual trick, the operator of the machine would experience a perpetual state of change. This was in contrast to the breaking pots, which shattered then slowly reformed, changing from one state to another. But here, inside this animation machine, time was not bound by the formalities of a linear perception of events. The animation machine produced a synthetic form of time, where beginning and end are only defined by human interaction. When in motion, the cyclical mechanism and its illusion are not in service to a narrative; rather they illustrate a form of flux. Art historian Ina Blom describes how philosopher Henri Bergson's ideas regarding bodies are as "images that act like other images, receiving and giving back movement": in relation to a material world defined as a flow of images, the human body and its perceptual apparatus is above all a centre of action, an object

destined to move other objects and not the sort of apparatus that, in the act of seeing, gives birth to a representation" (Blom 2014: 145). So as the cards at the top of the mutoscope are coming closer to the viewer and the cards at the bottom are moving away, this loop produces a flickering static vitality, trapped inside the animatic apparatus.
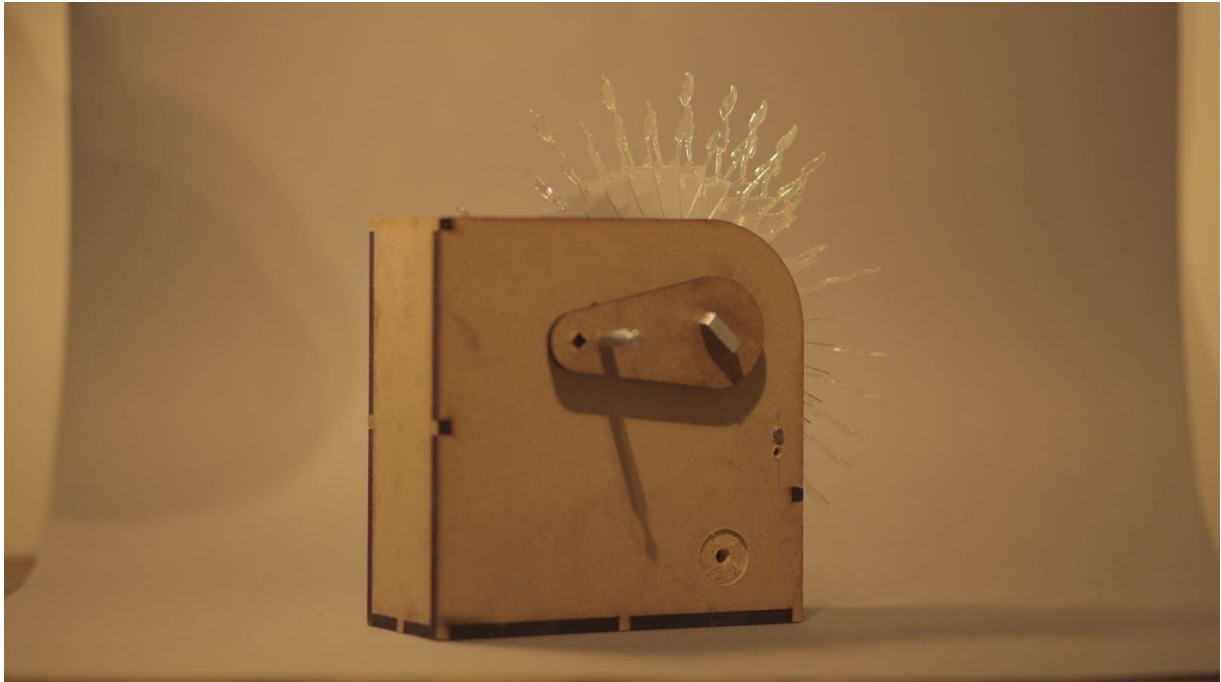
Figure 16. Hand-powered mutoscope Version 2, 2015, Hugo Glover.

The first animation machine acted as a practical demonstration of Norman McLaren's animation theory which states that a fundamental aspect of animation is the "invisible interstices that lie between frames" (Sifianos 1995: 62–66). Exposing the internal workings of a mutoscope presents both the frames (or cards), as well as the McLaren interstices, thus uncloaking the mechanics of animation. The intention was to bring the animator, as well as the viewer, as close to the tangible elements of the illusion as physically possible.

The next objective was to evolve this process in order to make the illusion of this subtle animated void more immediate. By introducing a light source at the centre of

the animation machine, the transparent cards were illuminated by *total internal refraction* defining the edge of the void and heightening the effect of the animated void.
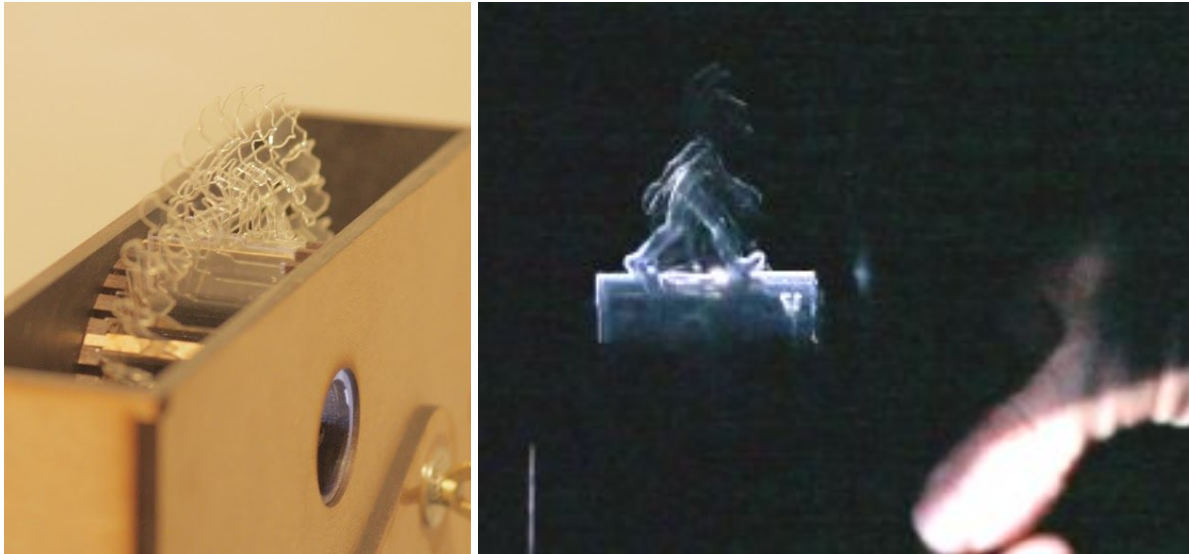
Figures 17 and 18. Hand-powered mutoscope Version 3, 2015, Hugo Glover.

My interest in animation has always been its illusory virtue, which evokes a connection with the viewer: a sense of what the animator David O'Reilly calls *aesthetic coherence* (2012). O'Reilly asserts as a core theme to his work that "coherence spreads to all areas of a film; dialogue, design, sound, music, movement etc. Together they create a feedback-loop which reaffirms that what we are looking at is true. The human eye wants this aesthetic harmony" (2012: 2). The coherence I was exploring by building these animation machines was both aesthetic and tactile. As the machines became more refined, I wanted the internal animation to carry a more grounded physical presence.[7] To achieve this I introduced a figure of a walking man as the animation within the third machine. The machine was human-powered

---

[7] Later on in this Chapter, I will discuss in more depth the work of Kenny Chow, who describes how animated phenomena are connected through our embodied knowledge of the world.

(wound by a handle) so the physical interaction between the spectator and the animation was an important consideration. This relationship between making the machine, powering the machine and observing the resulting animatic effect became central to my work.

In the next section of this chapter, I will begin to look in a more detailed way at existing ideas within animation studies as an academic discipline. The dearth of research on animators, which this PhD is attempting to frame, calls into question how academic enquiry can offer meaningful perspectives on animation practice *without* engaging directly with the practice of animating. In making animation machines throughout this PhD, I am attempting to gain first-hand knowledge of the interdependency of the animator and the technology they use. Making these basic animation machines allows me to take an alternative view of more technologically complex methods of animation such as CGI, which I will be discussing in more depth later in this chapter. Whilst the animator may be the silent presence in discussing animation, what is evident is a pervasive categorisation between differing technology: hand-drawn, CGI, stop motion, etcetera. In making my own animation machines, I was not attempting to create a new form of animation, but rather a form of hybrid, which would allow me to step outside of existing categorised silos in animation studies, and approach animation from the perspective of design.

Media Theories of Animation – Contextual View
Current State of the Art in Animation Studies

> New organs of perception come into being as a result of necessity, therefore increase your necessity so that you may increase your perception. (Rumi: 1284)

In this section, I will offer an overview of the current state of the art in animation studies research. In order to situate this argument, I begin with the historical context of image-making as a representation of lived experience. Following this, I will introduce current ideas of how animation is being discussed as a manifestation of process philosophy (Torre 2017). I will then explore ideas of the interconnection of computer technology in animation practice (Wood 2009), followed by Levitt's ideas of animation as a *super medium*, as well as Chow's argument for understanding animated phenomena through embodiment.

Some of the earliest examples of human art (Lascaux cave paintings in France, *c*.15000 BCE) suggest a form of animated movement (Furniss 2017: 12). Such images were not drawn from life but from memory. Paul Wells offers a circumspect acknowledgement of such images and their relevance to animation:

> The first acts of animist animation come in the form of cave drawings, in which expression is not a consciously creative act but an automatic physical engagement which reveals hand/eye coordination and the ability to affect a stroke-drawing of mark (Wells 1998: 32).

In a similar manner, animation scholar Chris Pallant notes that "it is worth revisiting the popular cliché that animation can trace its origins back to the real-world cave paintings of the Palaeolithic period ... cave people were not seeking to

make animated images of the type we recognise today" (2015: 3). Pallant does assert "beyond the speculative myth-making, is that the landscape becomes a selective record, a site of inscribed information". As much of my argument involves articulating an animator's lived experience and its influence on their creative work, Pallant's description opens up animation, acknowledging the world beyond the cave.

Animation scholar Birgitta Hosea explains that there is an "ontological unease and uncertainty in the field of animation, in both theory and practice, since the very material basis of animation has changed from analogue to digital" (2012). This position is consistent with points of view expressed by Buchan (2013) and Wells (1998), which is that animation is elusive to pin down. As a model of understanding creative practice, the Cybernetic loop[8] of maker/tools/materials/outcome[9] could be considered as a system that describes design practice and, in the context of this thesis, animation practice as well. In *What is Animation: The Six Blind Men and an Elephant Conundrum*, Vera Matarazzo suggests that "first we must establish that animation is the moving image sequence, not the process (or art or technique) used to produce or display it" (2016); this is contrary to my argument. Matarazzo goes on to suggest that imagining animation could also be considered within a broad definition, yet in doing so it seems as though Matarazzo is attempting to sidestep the thorny issues of medium specificity that has embroiled other definitions. The philosopher Jeff Malpas suggested a definition of animation as a *making move* (2014), and whilst being the briefest definition I have encountered, is also the closest to my own position. By shifting the focus from output to 'making', Malpas acknowledges the complexity of what is behind the illusion of life – the maker.

---

[8] Cybernetics has a growing significance within Design Research and underpins much of the discourse on current theoretical debate in the field. As a subject, it is beyond the remit of this PhD, though much of the language and mapping of animation practice within this thesis is directly influenced by cybernetic theories, specifically those of my first supervisor, Ranulph Glanville.

[9] See Fischer 2019, in which Design Research and cybernetics are presented as a guide to PhD enquiry in this area.

Definitions such as: "Animation is movement, or change, of the created image in recorded time" (Wells 1998), begin to situate animation in its own field. Hosea (2012:22) says that "[a]nimation consists of mediated, moving images of a manipulated, artificial construct that could not have been photographically captured by a camera in real time", thus delineates between constructed temporalities and our lived experience of time.

As mentioned in the previous section, the animator Norman McLaren explains that: "Animation is not the art of drawings that move, but the art of movements that are drawn. What happens between each frame is much more important than what exists on each frame. Animation is therefore the art of manipulating the invisible interstices that lie between frames" (Sifianos 1995: 62–66). McLaren's quote discusses frame-by-frame animation, yet I believe he makes a profoundly accurate articulation of a core philosophy of animation. This idea reinforces the notion that at the core of animation is a shared philosophy of interpreting change, from our lived experience of the world through the medium of a material, by managing perceptible shifts in state from one static point to another.

THE THAUMATROPE.

Above: How the designs of the two sides are placed with respect to each other.
Below: The combined image when the thaumatrope is twirled.
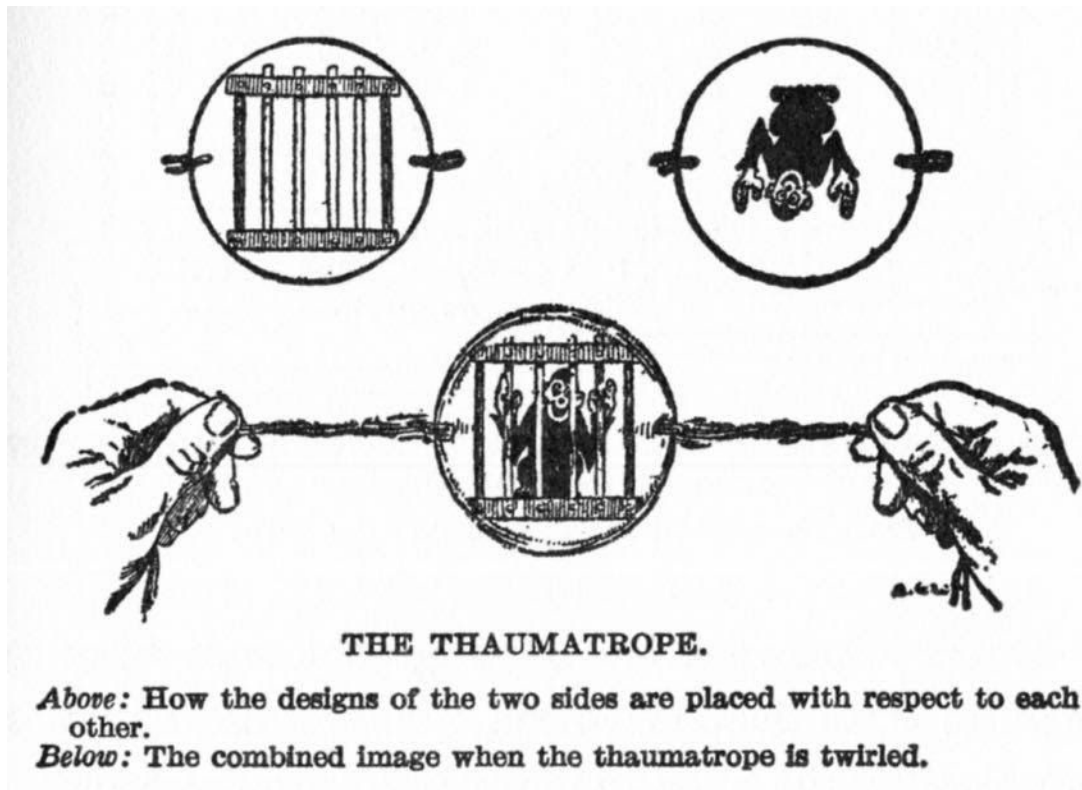
Figure 19. The Thaumatrope, 1824.

How Does Animation Work?

In 1941, film director and film theorist Sergei Eisenstein described the paradox of animation:

> We *know* that they are ... drawings, and not living beings.
>
> We *know* that they are ... projections of drawings on a screen.
>
> We *know* that they are .... 'miracles' and tricks of technology, that such beings don't really exist.
>
> But at the same time:
>
> We *sense* them as alive,
>
> We *sense* them as moving, as active.
>
> We *sense* them as existing and even thinking! (1983: 55).

To really understand how the *trick* of animation, or 'apparent motion' (that which is created through the technology of showing a rapid succession of still images), researchers and scientists have been evolving theories and descriptions for nearly 200 years. One theory, which is often misquoted and misunderstood, is the 'persistence of vision', as proposed by John Ayrton Paris in 1824. Paris used his thaumatrope (Figure 19) to demonstrate how an 'after image' remains on the retina for 1/16th of a second, allowing for the illusion of apparent motion by the viewer. Tom Gunning, a media theorist and dominant figure in the world of historical animation, writes at length about how Paris's persistence of vision description lasted until 1912, before being disproved by psychologist Max Wertheimer. Wertheimer introduced phi phenomena and beta movement descriptions of how we perceive motion from still images that have endured ever since, as more accurate descriptions of the phenomena of motion perception. Gunning states that "the attraction of the theory (persistence of vision) for the nineteenth century, I believe lies largely in its essentially mechanical view of the human sensorium (and its persistence in some account of cinema to this date indicates how much a mechanical view of perception and cognition still underlines the assumption most people maintain about vision" (Gunning 2014: 28). Gunning goes on to describe such a theory as "extremely Cartesian, in the sense of driving a wedge between what we know and what we see – and decidedly valuing what we know over what we see" (2014: 33). He goes on to discuss the complexity and continuing argument around human perception of apparent motion, which is still in flux to this day. Carol MacGillivray's PhD thesis charts her work developing the *Diasynchronoscope* (2014) and also gives a comprehensive overview of historic and contemporary arguments around how animation works. Citing studies from the late nineteenth century (Exner 1875) to recent work at MIT (Larsen, Madsen, Lund and Bundesen 2006), MacGillivray articulates how no single approach – be it perceptual psychology or media studies –

has offered a definitive answer to how apparent motion works. Eisenstein's paradox, as mentioned earlier, appears to come to a similar conclusion; we know it is a trick and yet even though we are aware of the fallacy, we seem unable to resist the illusion.

Although it is pertinent to this thesis to acknowledge such an elongated and inconclusive series of ideas and theories, I am beginning from the position of the animator, who accepts and embraces the peculiarities of the phenomena. I am also situating my work within the broader arena of Design Research, which again accepts and acknowledges the fuzziness of human engagement with the world (Foth and Axup 2006).

Creating a distinction between how film translates the 'real' and how animation can offer alternative experiences, has been extensively explored in media theory (Wells 2002; Cubitt 2013; Ward 2013). In recent years, aspects of animation studies have acquired traction, relevance and status as interdisciplinary research: "Alongside changes in the forms that animation can take, academics have sought to reclaim an area of practice that had previously been considered by many to be 'for children' as the subject for serious academic study" (Hosea 2011). Suzanne Buchan's book *Pervasive Animation* has acted as a nodal point in the grounding of animation as a subject for broad academic enquiry. Buchan asks for a much-needed dialogue as well as "new perspectives" around the "multidisciplinary nature of animation" (2013: 8). Buchan does not attempt to define animation: in part the main thrust of the book is that animation defies an overarching context or a way of being. Buchan sums up how pervasive animation has become within our contemporary media landscape, suggesting that animation has the power to "astonish, influence and coerce" (2013: 1) an audience. What is evident from Buchan's extensive range of ideas, subjects, examples and discussions around animation in this book is how elusive a definition of animation is: "Is animation a genre? A technique? A mode of film? An art form?" (2013: 3).

In more recent research, such as *The Animation Studies Reader* (Dobson *et al.* 2018), there is greater acknowledgement that animation "defies a unified theoretical approach" (2018: 5). In offering a position which is useful to my argument around the importance of the animator, Lilly Husband and Caroline Ruddell suggests that "animation is an entirely *constructed* form" (2018: 7). In addition to construction, "animation particularly foregrounds embodiment. Even if we do not see the animator's hands moving objects on screen, we are aware of the human agency acting between frames" (2018: 83). Ruddell also mobilises notions of embodiment when describing the work or Lottie Reiniger in *The Crafty Animator* (2019).

Anime Thinks Technology, Thomas Lamarre

Figure 20. The multi-plane animation stand Lamarre describes (2009: 24).

As a more historic view of technology's effect on creative practice, Thomas Lamarre's book *The Anime Machine: A Media Theory of Animation* is focused primarily on the technology of multi-plane animation, which is a technique used predominantly to create anime. Lamarre focuses on how "anime thinks technology" (2009: XI) and in doing so clearly articulates how the method of making animation and the thought processes behind the intent of animation are intermingled. In order to make his point, Lamarre discusses *The Railway Journey* by Wolfgang Schivelbusch: specifically the impact that train travel initially had in exposing the traveller to a new form of *ballistic perception*, with the passengers of a train encased within the projectile vehicle. Schivelbusch offers an insightful and embodied description of how technology – in this case train travel – has had a profound effect on how we experience the world. It is useful to my argument for two reasons. Firstly, that the passengers (viewers) are encased within the apparatus and, secondly, because the "dissolution of reality and its resurrection as panorama thus became agents for the total emancipation from the traversed landscape; the traveller's gaze could then move into an imaginary surrogate landscape, that of the book" (2009: 19). Lamarre's reference to train travel as an example of a technology that shifted human perception is extremely pertinent to animation, which achieved a similar shift through the combination of technology and human creativity. I find that there is much that is appropriate in Lamarre's book, but I believe that there is also much that is missed: fundamentally the role of the animator in the process. Lamarre's focus is on the apparatus – the physical animation stand – and does not give any traction or significance to the animator who is working in this medium. Lamarre does weave a formidable argument in articulating the rhizomatic complexity of anime, and this is achieved by highlighting the technological, cultural and economic factors that constitute internal tension within animation. However, the resultant *force* is ascribed

to the animatic interval – the separation between the elements of a screen and thus the emphasis by Lamarre on the animation stand.

Animation theorist Dan Torre proposed *Cognitive Animation Theory* (CAT) in 2014. Torre's argument focused on cognition and process philosophy as theoretical tools through which we can comprehend animation. A fundamental proposition in his theory is that "movement and image should be considered as distinct entities both in the animated form and in cognition" (2014: 48). Although Torre is considering animation viewing, what is useful to my practice is that CAT discusses a "more generalised philosophical consideration of the form" (2014: 48) of animation, building on Torre's suggestion that there is far more untapped epistemic potential in the subject. I found a useful component of CAT was the notion of "animate vision", first defined by Dana Ballard (1991). When reading an animation, Torre claims:

> We do not simply look at a room, take a mental 'photograph' of it and work from that stored image. Our vision is much more akin to our cognitive processes; it is continually in process. Animate vision involves the movement of, not just our eyes, but also our head – in fact, our whole body is in constant motion as we visually perceive our environment (2014: 53).

Torre references descriptions of visuospatial working memory proposed by Robert Logie (1995: 2):

> Visual and spatial working memory are best thought of as separate cognitive functions. In this two component model, spatial working memory retains dynamic information about movement and movement sequences, and is linked with the control of physical action. [Whereas] visual working memory is passive and contains information about static visual patterns.

Whilst I find a separation of the visual and the spatial somewhat incompatible with my personal experience of making animation, its inclusion by Torre illustrates how animation as interdisciplinary research can make use of debates from other areas. Torre's work is part of a larger movement in animation studies which has embraced the ideas of embodiment and the value that such a perspective can offer. With my practice in mind, I have read much of Torre's work with great excitement, as it offers a complex and rich mix of theoretical influences around animation.

Torre's CAT was included as a chapter of his book *Animation Cognition and Actuality* (2017), building on his ideas from 2014. Torre suggests that: "everything is in a state of flux, everything is becoming other: therefore continually metamorphosing" (2017: 28). Torre's background and continued practice as an animator adds depth and breadth to his arguments. In summing up his position, he asserts that "we have the medium of animation, which happens to be a very proficient method through which we can not only reflect upon but also act upon our world's perpetual instability" (2017: 249). Whilst Torre's writing illustrates how blending cognitive science and philosophy, etcetera can enrich animation studies, there is still a focus on output, rather than my interest in how animation is made. In the following chapters, I will show how I have used philosophical arguments as questions to which animation can propose multiple answers, as well as viewing the making of animation as an embodied act.

The British academic Aylish Woods offers an insightful and close reading of the interconnectedness of artist and scientist when she discusses computers in animation. In her 2014 book *Software, Animation and the Moving Image*, Woods lays out a structured and comprehensive overview of how computers became a central technology in the creation of animation. This publication charts the rich tapestry of influences, from military-funded research in visualisation and computer

development, to the close collaboration between artist and computer programmer. Key to the development of CGI were individuals who bridged these two worlds, with Ed Catmull being a pivotal figure. Catmull's *Computer Generated Hand* (1972) was a historic milestone in CGI: "For the first time, I saw a way to simultaneously create art and develop a technical understanding of how to create a new kind of imagery" (2014: 13). John Whitney Senior (the first artist in residence at IBM in 1966) described the computer as an "instrument that can integrate and manipulate image and sound in a way that is as valid for visual, as it is for aural perception" (1975). The interviews with Woods offer first-hand accounts from animation practitioners, including Jacky Jiang of ThatGameCompany, who describes the medium of CGI as having a "digicality" (Woods 2014). This is not explored further by Woods, but it is a useful glimmer into the sensations that I am investigating.

Although the teaching I have included in Chapter 3 is all based on CGI, I have attempted to balance the influence of research areas such as Human Computer Interaction (HCI) and the far wider areas of digital creativity. Again, situating this PhD in Design Research has afforded me the latitude to follow my practice, as a compass or divining rod, which spans the animation machines I make and the CGI work I do with students. This position outside of a single dominant technology of animation has allowed me to focus on the animator, as present in all animation. The intention is to be as technologically agnostic as possible. Again, in Chapter 3, I will illustrate how this breadth of animation techniques has shaped my argument.

As previously discussed, Thomas Lamarre's assertion that animation 'thinks technology', focusing on the animation stand as a point at which the *force* is channelled into the work, does acknowledge that there is a hidden vitality within animation. Levitt builds on Lamarre's ideas in *The Animatic Apparatus* (2018). Levitt offers *an-ontology* as a means to understand the vitality or life which appears to exist within animation. She also makes a case for animation in which:

. . . the material structures of moving-image production, the always changing human perceptual apparatus, and the set of cultural assumptions and epistemologies that frame and structure the modes of experience and forms of life generated at the intersection of materialities of communication and perception (2018: 5).

Levitt creates a compelling and forceful theoretical argument for animation within a media studies context and includes the structures of how animation is made. By discussing how materiality and artificiality can co-exist within animation, Levitt is reaching into animation, towards the core of my argument but from a theoretical context as opposed to a practice-led enquiry. Levitt considers:

How we make sense (meaning) of sense (sensation) as these emerge together – and constitute one another at the spectator-screen nexus. While inextricably bound to material structure of both media and perception, this nexus is as much a phantasmatic – even a hallucinatory – domain as a material one. And it is precisely here that we find new forms of life and modes of vitality emerging (2018: 5).

In progressing the position of animation in a broader media landscape, Levitt takes Buchan's ideas of the pervasiveness of animation and suggests a reframing of animation as a "super medium" (2014: 144). Levitt throws down a gauntlet to her reader: that to know animation is to make animation. "Worlds are perceiver-depended, that is, generated through the interactions (structural couplings) between our nervous systems and our environments" (2018: 124). Levitt describes such interactions as "an opportunity in this an-ontological space to experiment with

vitality affects and forms of life that expand our attention." Much of Levitt's argument references Mamoru Oshii's philosophically oriented film *Ghost in the Shell 2*, (2004). Levitt describes Oshii's work as a kind of anti-Pinocchio, in which the artificial creatures do not aspire to become real, or human, but to be themselves. The film, and a close reading of the characters, are used together to construct Levitt's an-ontology of animation. Levitt tells us that "Bodies exist in the space of an ontological crisis: Present or absent? Here or there? Living or dead?" (2018: 17). In building her argument, Levitt challenges the reader to embrace the unstable existence of animation, an idea I have already touched upon from Torre.

Embodiment is a key concept throughout this PhD, and I will look at it in more depth in Chapter 3. In animation studies, there are a growing number of publications that recognise the significance of embodiment as a structural coupling between our lived experience and the various animated phenomena with which we engage. The academic Kenny Chow offers a reading of what he calls *animated phenomena* (2013: 4), in which he is referring to novel aspects of various computer interfaces that use animation to capture a user's attention and guide their journey through the digital landscape. Chow's clear articulation of embodiment, as a way to understand the complexities of technological liveliness, is only at the point of interaction. As well as animation, Chow describes physical objects and their implied functionality, such as the making of coffee in a cafetiere. An object's 'affordances'[10] (Gibson 2014) should offer a user clues as to the function of an object – perceptible features which correspond to a user's mental model. Despite making the connection between affordances and animation, Chow does not explore the designing that has to occur to make an object or animation offer the correct affordances to a user. The notion of internal 'mental models' is a concept that I will revisit in Chapter 3, as it is

---

[10] James Gibson's theory of *Affordances* refers to what an environment offers a perceiving individual. An often-cited example is a door handle, which by its design, offers clues as to its function.

a key aspect of embodiment and tacit knowledge. Chow's work does offer an insightful description of how affordances and mental models are linked through conceptual blend theory (Fauconnier and Turner 2003), which shows how the elastic anchor (animated phenomena) connects with the sensorimotor experience.

In quoting computer scientist Ben Shneiderman (2013: 28), Chow indicates how interface design is attempting to align itself with Jean Piaget's theory of child development, where the human (child) makes sense of their environment though physically engaging with it. If an environment is well designed and suited to its inhabitants, there is little cognitive friction in navigating the environment, be it physical or digital. Chow states that users should be able to map the "perceptual clues to their own mental models" (2013: 29). There are close similarities between Chow's position and that of Paul Dourish's *embodied interaction* (Dourish 2004). Chow references Dourish's design principles, specifically how they should allow the user to engage in an environment according to their habitual skills with physical objects as well as their own social activities. Chow does extend beyond Dourish, in as much as he focuses more of his argument on the animation of phenomena and the animations relationship to a user's lived experience.

In describing how his work offers new perspectives, Chow suggests that prior research is often situated towards a pragmatic or a semantic function, and he argues that these should be bridges: that is, thought of as one. A similar debate could be seen as form and function in a broader design context, of which the simultaneous design and construction of hardware and software in computer development is often the nexus of such philosophies. Chow is keenly focused on how we make meaning of artefacts, in his case the animated phenomena, and in doing so, draw from a rich lexicon of theoretical sources, broadening the base of his argument with great effect.

Chow is attempting to move away from the laboured and misconstrued connotations of the word 'animation' by identifying and specifying *technological*

liveness (2013: 5) as both a theoretical idea and a design principle. To Chow, technological liveliness symbolises the creative impulse in today's cross-disciplinary design practice. Whilst I embrace Chow's notion – primarily due to the acknowledgement that such a sense of *life* has value and importance in design – he does not touch on the idea that anything which appears to move, in a digital space, does so because it is designed to, by a human (an animator/designer/programmer). What his work does effectively do is illustrate the blending of lived experience with digital movement.

In dissecting liveliness into primary (main focus of a shot or action – character animation) and secondary liveliness (cloth blowing in the wind, flies buzzing round a character's head), Chow creates a hierarchy: the animate and the less-animate. When it comes to the making of animation I believe that such a separation offers little insight. Throughout a process of making work, defining what should or should not move is a key design skill of an animator. This is particularly evident in motion design, where the ebb and flow of a sequence is often generated by a multitude of attributes (camera movement, patterns, lines, typography, etcetera). I accept that there is often a sequential building of each aspect, akin to that of an actor's performance in a bare rehearsal room, growing through repetition and refinement, until the time to add costume, set, lighting and all the additional aspects of a finished performance. Animation often follows a similar sequence of iterative steps, but ultimately the medium is unbound by the gravitational constants of acting in the real world. Chow does allow the two forms of liveliness to reconvene within a spectrum of liveliness that he calls *holistic animacy* (2013: 63). This train of thought leads to a complex situation, where Chow has pinpointed liveliness but within a much larger framework of a simulacrum. The last point Chow makes regarding technological liveliness is a call for a more progressive agenda that bridges the technological and the humanistic together. His ideas are as relevant to programmers and developers as they

are to designers, if only to shift the discourse from animation being window dressing for the 'important', 'clever' stuff that happens behind the GUI, to acknowledging that a system as a whole can succeed or fail based on how a human engages with it. Such engagement is the system meeting the human half way, between the lived experience of a lively and dynamic world and a digital domain, which although built by humans is not of this world. Chow suggests that computers are "colleges of humans" (2013: 35) and technological liveliness is a subset of the computational universe. In some senses, it is the outer periphery of such a universe and, for the vast majority of computer users, the only experience they will ever have of a digital world.

For the purposes of this thesis, it is possible to frame both Chow and Levitt as identifying the interconnectedness of our lived experience and the media that forms part of our environment. Whilst Levitt casts a far broader net, encompassing philosophy, gender identity and the more staple aspects of simulacrum (such as anime), we can begin to see how far-reaching and malleable the various lenses of animation can be. How one affects the other is beyond the scope of this PhD, but applying Chow and Levitt's ideas to how animators reach into and create parts of our media environment (the heterotopia, of animatory space) and how they measure and assess the changes made within the animatic apparatus, is in some sense replying to the challenge that their ideas have laid down.

So Levitt allows us to begin at a wider, unbound universal scale of animation. She articulates the interconnectedness of humans, their attempts to understand a world prior to the digital age, and shows how work such as the film *Innocence* (Oshii 2004) or the holographic pop star *Hatsune Miku* (2007) exist within the simulacrum and offer little notion of ontological hierarchy, between a digital way of being and a human way of being. Levitt's ideas extend Haraway's *Cyborg Manifesto* (Haraway 1994), in that *we are cyborgs*; our way of being in the world is heavily mediated through our technologically enabled connections. So we can view Levitt's ideas as an

umbrella of technocultural geography, within which Chow performs a task of articulating how various GUI's animated phenomena – the gatekeepers of deeper levels of simulacra – are intrinsically linked to our embodied knowledge of the world. When we are using such navigational aids, we are conceptually blending our lived experience of the world and a gestalt of technology. Within this space, we can now begin to look at the heterotopia of an animator at work. The key aspects I will be exploring in the following chapters are how an animator's current practice is reliant on evolving and engaging one's embodied knowledge, whilst contending with the friction, or lack thereof, within technological systems of animation that often enable or exclude vitality.

3. The Principles of Animation
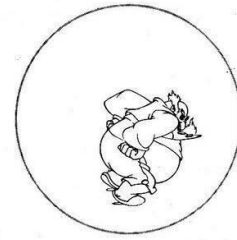
"When we consider a new project, we really study it . . . not just the surface idea, but everything about it."
Walt Disney

A new jargon was heard around the studio. Words like "aiming" and "overlapping" and "pose to pose" suggested that certain animation procedures gradually had been isolated and named. Verbs turned into nouns overnight, as, for example, when the suggestion, "Why don't you stretch him out more?" became "Get more stretch on him." "Wow! Look at the squash on that drawing!" did not mean that a vegetable had splattered the artwork; it indicated that some animator had successfully shown a character in a flattened posture.

Some of this terminology was just assigning new meanings to familiar and convenient words. "Doing" a scene could mean acting out the intended movements, making exploratory drawings, or actually animating it; and once it was "done," the scene moved on to the next department. Layouts were done, backgrounds were done, recording was done, and, eventually, the whole picture had been done. Mixed in with these terms were the new names and phrases with more obscure meanings.

The animators continued to search for better methods of relating drawings to each other and had found a few ways that seemed to produce a predictable result. They could not expect success every time, but these special techniques of drawing a character in motion did offer some security. As each of these processes acquired a name, it was analyzed and perfected and talked about, and when new artists joined the staff they were taught these practices as if they were the rules of the trade. To everyone's surprise, they became the fundamental principles of animation:

1. Squash and Stretch
2. Anticipation
3. Staging
4. Straight Ahead Action and Pose to Pose
5. Follow Through and Overlapping Action
6. Slow In and Slow Out
7. Arcs
8. Secondary Action
9. Timing
10. Exaggeration
11. Solid Drawing
12. Appeal

Figure 21. 'The Illusion of Life', Thomas and Johnston (1997: 67).

Having discussed some of the wider issues around the perception of animation, I will now take a look at two significant works regarding the skills and complexities of animation practice.

Walt Disney described the connection between our lived experience and an animatic representation as: "bring[ing] to life dream fantasies that we have all thought of as a foundation of fact ... we cannot do the fantastic things based on the real unless we first know the real" (Disney 1935). After a further four decades of animation production at Disney, Ollie Johnston and Frank Thomas (two members

of Disney's 'nine old men' – the core animators who created the great works of hand-drawn animation at Disney) published *The Illusion of Life* (1981), where they laid out the 12 principles of animation. This was a distillation of nearly 50 years of industrial-scale animation production knowledge, and came at a moment in time when computer-generated animation was beginning to emerge from the laboratories of university computer departments, and into the hands of animators.

The 12 principles are primarily based on the practice of hand-drawn (or traditional) animation, though viewing them today, many of them still have relevance to other techniques of animation. They are also focused on character animation, or at least as stated in the book's Introduction, creating the "illusion of characters adhering to the laws of physics" (1997: 10).

In a similar fashion to *The Illusion of Life*, another notable published work in this area is Richard Williams's *The Animator's Survival Kit* (2001). In this, Williams has created an in-depth manual of techniques that allow animators to manage the complexity of the technological medium with which they work. An important point to acknowledge is the distinctly outdated gender stereotypes that Williams uses. In Alison Reiko Loader's review of Williams, she notes his "troublingly normative views on gender" (2014) and in doing so, prompts a significant online discussion that culminates in a clear demand for up-to-date resources, from a sociocultural perspective and technical standpoint. Nancy Beiman's *Animated Performance* (2016) is focused on enmeshing notions of acting and animation, yet depictions of highly sexulised women are still used and discussed as examples with no acknowledgment of the wider implications of normalising such work[11]. In the same series of books, Keith Osborn's *Cartoon Character Animation with Maya* (2015) is an attempt to translate the 'principles' from hand-drawn techniques to CGI

---

[11] How technology and sexuality coexist within animation, specifically Anime, are explored by Lamarre (2009) and more recently by Levitt (2017). Wider discussions of depictions of gender in culture are important to acknowledge, but beyond the bounds of this research.

methods. Again, we see a disconnect between discussions of how animation is made *technically* and how it is constructed *culturally*[12].

If we consider the canon of 'how to animate' books, they present a considerable amount of explicit knowledge, presented in a manner that is accessible and applicable to contemporary animation practice. In attempting to apply such knowledge, there is a general requirement for the animator to translate or adapt the techniques to fit with the technology they are working with.
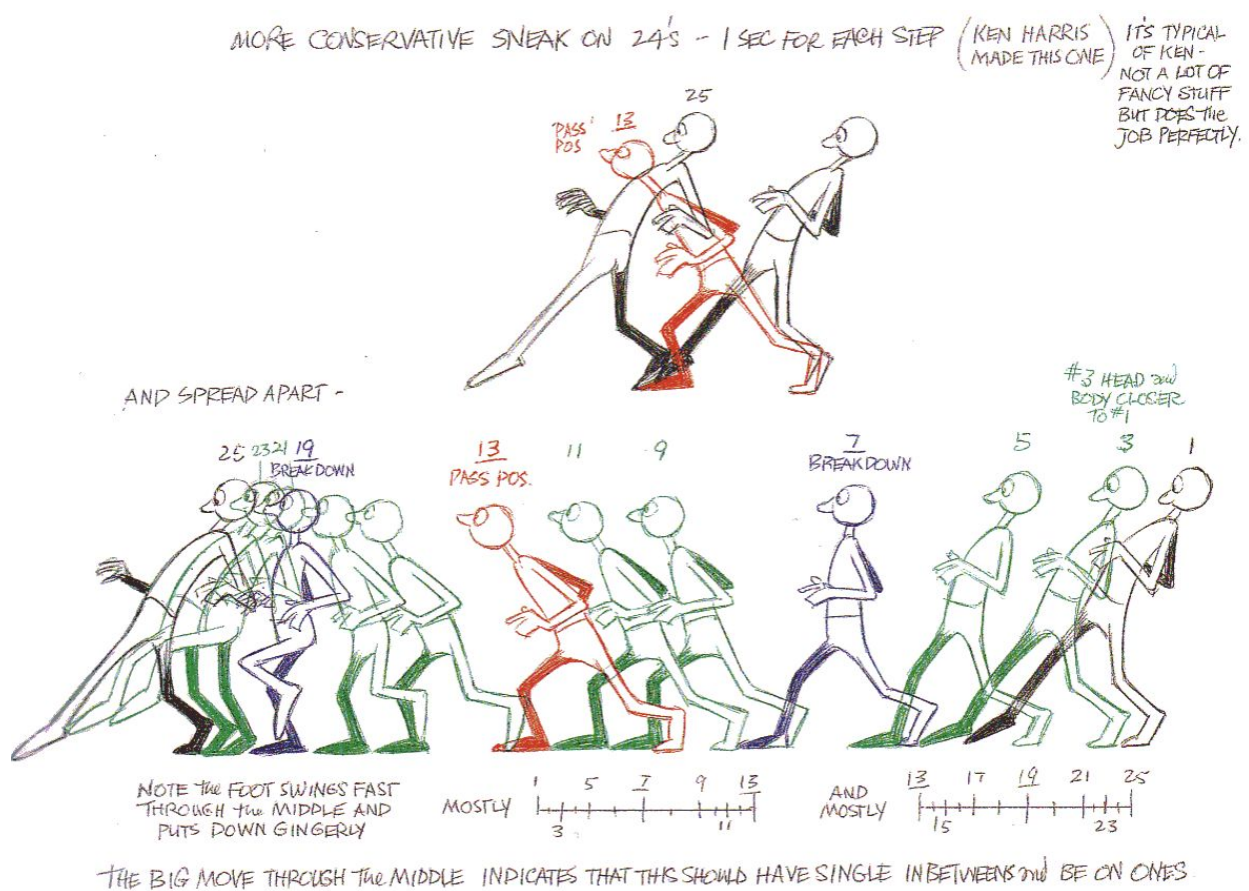
Figure 22. *The Animator's Survival Handbook,* Williams (2012: 54).

Much of the skill of a traditional animator is based on their personal abilities in drawing, perhaps most specifically in maintaining volume. One of the 12 principles

---

[12] In the Introduction, I discussed the work of Mark Collington (2016) which maps out how to leverage theory in developing animation, creating depth, breadth and cultural connections.

of animation references this, and is in fact what Johnston and Thomas define as *solid drawing* (1997: 43). In other forms of animation (computer-generated, for example) this is not as relevant, as the volume exists and the animator's role is to manipulate the volume rather than to maintain it. And herein lies a fundamental benefit to the animator of the digital world – the flexibility to duplicate and play. When describing traditional animation Warren Trezevant, Character Animator at Pixar, asserts:

> The additive process of traditional animation being impossible to adapt or reversion, you can only re-make. Whereas in a digital world there is the opportunity to continuously experiment and adapt an idea whilst always being able to revert back to a previous incarnation, time travel if you will (Glover 2012).

The Pixar motto 'digitally hand-crafted' and their heritage of training traditional animators in digital techniques is an interesting example of how transferable an animatory mindset can be. *The Animators Survival Kit* and *Illusion of Life* publications – originated by some of the most skillful animators of their respective generations – offer a distillation of the technical aspects of the craft of hand-drawn animation, but there is little focus given to understanding animation in a wider context. I will discuss tacit knowledge in greater detail in Chapter 3, but it is useful to note that what these two books attempt to do is to pass on the collective tacit knowledge of thousands of animators working in this medium. The publications are, in essence, a documentation of an apprenticeship in a craft.

An effect of packaging animation knowledge so tightly with a specific technology (in these cases, the frame-by-frame drawn technique) still dominates how animation knowledge is framed to this day. Online courses in CGI animation that are advertised to give direct access to becoming an animator offer a distilled version of animation.

Organisations such as AnimationMentor.com, Escape Studios or Digital Tutors all perpetuate the pedagogic philosophy of animation as industrial production. This approach frames animation solely as a process-orientated act, with little acknowledgement of reflective practice or iterative cycles of growing or evolving ideas through the medium. Earlier in this chapter I discussed various 'how to animate' books in order to highlight the compartmentalising of animation knowledge into a blinkered silo, divorced from broader discussions of creativity, culture or critical practice. There are similar boundaries in place around training provisions such as Escape Studios, which are purposefully streamlined towards the requirements of industry. There is an unapologetic behaviorist focus on training, skills and repetition – an environment that Wayne might describe as reflexive practice. The constructivist approach taken in a university setting (reflexive, theoretical and critical practice) was debated at the Mend the Gap symposium (2019). In one way an argument between a behavioural versus constructivist approach to learning was being measured against the requirements of industry; a generalised outcome being that all parties had a part to play.

In working with students learning animation and reflecting on my own journey as a novice animator, I found that knowledge of how to animate was rare, and resources, such as those discussed, only offered a discrete sequence of steps to achieve a predetermined outcome. In contrast, failure is a complex force to actively introduce into a learning environment, and when done so effectively, can be a potent and compelling catalyst. This PhD strongly advocates for the exploration of failure in animation practice, of destruction and rebirth as part of the creative process. Whilst I clearly stated in the Introduction that my work is not intended as specific pedagogical research, it is important to note that the literature and training courses discussed here have an effect of narrowing animation practice, eradicating uncertainty and instability in a way that I argue is deeply unhelpful.

Chapter Conclusion

I began by making a simple mutoscope; the intent of this practice was to gain a practice-based perspective on the relationship between technology and animator. In this chapter, I have described how this practice framed my exploration of animation theories which explore the interdependence of animation and technology. I have also explored arguments around technique, technology and how the intricacies of cognition have illustrated the rhizomatic complexity of current animation theory. Also discussed were relevant literature and training courses that often attempt to reduce animation practice to a series of steps as well as subcategorized into discrete methods of making. The gap which this PhD is attempting to bridge, between the theoretical and practical, is now clearly established.

To sum up this chapter, I have shown how theory can be used to explore and unwrap animation. I have also illustrated how minimal the presence of a human is within most theoretical discussions of the process of making animation. My intention in revealing the inner workings of animation practice is to offer a practice-based argument as a counterpoint to the overly theoretical positions discussed.

Chapter 3: Embodiment and Tacit Knowledge

Chapters 1 and 2 illustrated how the early stages of my practice emerged and expanded. In the course of this practice, I reflected on the actions taken and began to make connections with Design Research and theories of animation. In due course, through my job as a Senior Lecturer in animation, the opportunity to explore the emergent ideas with my students offered a third point to the Action Research cycle. Also in the previous chapter, I discussed Lamarre's notion of the *animatic interval* (2009: 18), the space between layers, or, equally for McLaren, the space between frames. Through this awareness, these spaces or voids in animation practice have become more noticeable to me; indeed, they appear everywhere. When making work I am managing the states of differentiation either side of an interval. When I watch my work back in order to review progress, I see the animatic interval between myself and the illusion. I step back again to review another animator's work, and I observe how the interval grows again. As a lecturer, I find myself at a significantly *large* interval between the work being done by the students and my own creative instincts and habits. I have always found this position of guiding people through their first animation a fascinating and privileged vantage point. In terms of reflecting on animatic intervals, going frequently and regularly from the narrowest of intervals with my animation machines to the largest of intervals when working with students and back again, has offered me an opportunity to chart this experience. This has become deeply embedded into the Action Research cycle.

Before I look at the projects conducted with my students, it is important to note that although this phase of Action Research was conducted within a pedagogical setting, it is not the intention of this PhD to offer insight into pedagogical research or pedagogical knowledge directly. Working with students has allowed me to observe how I could use the concept of *Animatory Thinking* to approach animation as a design process, and in doing so, challenge the students to

identify and value their lived experience as a creative resource. It has also allowed me to observe *what animators do* and question what forms of knowledge are at play in such practice. Over the duration of this PhD, I have seen students progress through their degrees, constructing their animation knowledge and moving from novice to expert, often imperceptibly. I have attempted to highlight these tacit/silent or invisible journeys as I see them emerge.

Educationalist John Dewey suggests that "learning is incomplete unless it is shared" (2010: 35) and in describing teaching, Dewey observes that:

I have often been asked how it was that some teachers who have never studied the art of teaching are still extraordinarily good teachers. The explanation is simple. They have a quick, sure and unflagging sympathy with the operations and processes of the minds they are in contact with. Their own minds move in harmony with those of others, appreciating their difficulties, entering into their problems, sharing their intellectual victories (2008: 345).

Two themes are foundational: embodiment and tacit knowledge. In order to evaluate how these concepts could offer fresh approaches to animation practice, I decided to use the design briefs I set for animation students as experimental vehicles to explore hypotheses. The design briefs involved were for a first-year undergraduate module which aimed to introduce students to CGI through the use of 3-D software, in this case Autodesk Maya.[13] The second module, which is discussed at the end of this chapter, was aimed to build on knowledge gained by students during their first year and to support them in the process of generating animatory performance using CGI.

---

[13] See Appendix II, Module Briefs and selected student blogs.

The intention with these modules is to reshape the students' expectations of the technology they use to make animation. Pixar animator Warren Trezevant notes:

> Animation has a mystique. People [an audience] know that it is a bunch of drawings .... But that's alive. Similarly, people know that computers have circuits, etcetera, but again there is a mystique. When you combine the two, the mystique is doubled ... people [the general public] assume that the computer does all the work (interviewed by Hugo Glover, 12 January 2012).[14]

As I had gleaned from my practice, this animatic interval which technology creates and that allows an animator to internally adjust parameters, creates a sense of separation from the tactile knowledge of a material (Stehlikova 2012). Amongst the animation studies literature, there can be found a number of examples relating to animation and education. For example, if looking at experimental animation, the academic Miriam Harris argues for animation education to leave behind the medium specificity in favour of hybridity as "digital animation is rhizomatous" (2019: 114). In Chapter 1, I looked at Paul Ward's description of a "critical juxtaposition" (Ward 2013: 334), as an additional step within Kolb's model of experiential learning. Ward explains:

> Animators are already masters of what I am calling Critical Juxtaposition: myriad skills in life drawing; observation and distillation of look as well as how they feel when acted out; experimenting with all manner of mark making; technical and digital know-how, to be an animator is truly to be a remarkable all-rounder (2013: 334).

---

[14] See Appendix III for a full transcript of interviews.

The effect of Ward's model is akin to psychologist Mihaly Csikszentmihalyi's description of 'flow', which postulates three conditions that have to be met in order to achieve a flow state:

1. One must be involved in an activity with a clear set of goals and progress. This adds direction and structure to the task. [The beginning and end of an animated scene.]

2. The task at hand must have clear and immediate feedback. This helps the person negotiate any changing demands and allows them to adjust their performance to maintain the flow state. [Reviewing the animation allows the animator to compare the illusion to the internal model.]

3. One must have a good balance between the *perceived* challenges of the task at hand and their own *perceived* skills. One must have confidence in one's ability to complete the task at hand. [The choice of animation process and the repetition of this process allows skills to be acquired incrementally.] (Csikszentmihályi *et al.* 2005)

In the process of animating, these conditions are not necessarily stable: despite the assistance of digital technology to mitigate mistakes and afford opportunities to experiment, there is still a tension between the complexities of manipulating an animation system and generating a controllable illusion.

Ward poses some useful questions around what constitutes "animation knowledge? How do we – and how might we – teach it?" (2013: 318). As Ward unpacks his position on animation as a subject in higher education, it becomes clear that he is speaking from the perspective of animation sitting within other 'media and cultural studies', which in many institutions it does. Many educational institutions have some interdisciplinary offering and/or research groups (Innovation Design Engineering at the RCA being one). Animation as a discrete subject is in some

respects as broad an arena of creative practice as design, and is often broken down into different fields. In some institutions (such as the RCA), animation is located in the area of communication; in others, such as Teesside University, it resides in the School of Computer Science. In Duncan and Jordanstone College, animation is located within the art school. All of these locations are legitimate creative landscapes in which animation can be explored, as Buchan asserts that "animation uses almost all the arts, and their materials, and has long responded to the searching the world of imagination and of dreams and desires" (2013: 5). By focusing on the craft of animation and subdividing the broader subject, Ward makes a tentative case for aligning specific skills with broader cultural literacies. In much the same way that one can study the craft skills of woodwork or pottery, one can acquire the tacit digital skills of character animators by repeating steps as demonstrated by others. I touched on this in Chapter 2, specifically the way in which online communities such as Animation Mentor or the ACME Network compartmentalise knowledge in order to achieve repetitious results. For many students, this appears to be the key knowledge they are seeking. Such basic receptive skills produce an artificially simplified view of the world. *Animatory Thinking* by contrast is intended to provoke students to explore the fuzzy and murky territory of visual culture, out of which their animation work can emerge. To do this I have adopted a technologically agnostic approach to introducing students to animation as a creative space in which to explore how movement can be used to craft meaning.

If we return to the intent of the design briefs, there is a mismatch between a student's skills and their aspirations as they begin their CGI journey. The philosopher Herbert Dreyfus modelled levels of expertise into seven stages. The first level is a 'novice', where one considers the objective features of a situation, as they are given by experts, and follows strict rules to deal with a problem. The final level is 'visionary', where one would strive to extend the domain in which he/she works. At

each level of Dreyfus's model are elements of an animation student. Whilst a student's skills can be at level one (novice), at times, their *ideas or concepts* can be at level seven (visionary). *Animatory Thinking* is attempting to scaffold this gap between levels one and seven, providing the students with the tools they need in order to bridge these positions, and thereby moving through Dreyfus's iterative levels of growing expertise.

To sum up the landscape of animation education, we have a significant online industry of 'training' providers offering tutorials and sometimes mentoring which give students step-by-step instructions on how to perform certain tasks. I am not suggesting that such an approach does not have its benefits – such a wealth of information can only make animation more accessible to those wishing to make it part of their lives. But I would argue that such an approach is at best a process of assimilation: a first-stage introduction. A by-product of this closed loop of technology, training and implementation, is one of repetition: follow *these* steps to achieve *these* results. There is little space for exploration or appropriation, mixing ideas and testing them as one might do in a workshop. If we go back to Dreyfus's levels of expertise, I would suggest that the most in-depth function knowledge of how a CGI system of animation works would only extend to level 4 – in other words, proficient. If we look at level 5 (expert), Dreyfus suggests that such a level is "a very comfortable level to be functioning on, and a lot of professionals do not progress beyond this point". I would argue that design education, and in the case of this PhD, animation education, would be constructed in such a way as to go beyond a "comfortable level", and challenge students not to be satisfied with what already exists but to push at the edges of the possible, and generate work that challenges the status quo.

If we take a step back into Design Research, Professor Ashley Hall describes how ubiquitous tendencies in design practice and education have impacted on the level of variety on a global scale (2017). Hall has also outlined how approaches such as creative destruction can provide a reinvigoration of variety into cultural value systems (2016). Hall uses examples of homogenisation in design, mobile phone handsets and the almost imperceptible differences across contemporary car design. If global animation output is looked at through the same lens, I believe that there is an even more homogenised situation, with variety – although not lacking in commercial animation – almost imperceptible. Hall asks if there might be a reticence in design education for variety, perhaps due to a fear of "limiting the career opportunities of our graduates by reflecting local rather than global values" (2017: 4). Design Research makes a clear case for the value of thinking differently, generating variety and doing so by breaking down existing paradigms. Despite the unbound creative scope of animation, there is a crushing weight of ubiquity, both in commercial content and consequently in the minds and aspirations of students studying animation. *Animatory Thinking*, by contrast, is designed to optimise the creative environment of the animator to value their local identity, by valuing and accessing their lived experience.

As mentioned at the beginning of this chapter, embodiment and tacit knowledge are two foundational areas of theory that have informed both my practice and my teaching. In the following sections I will unpack these areas of knowledge.

Embodiment

> No human being can be separated from an ability to make meaning associated with the time before reason had begun (Chakravorty 2018).[15]

As a philosophical perspective, embodiment contradicts a 'traditional' Cartesian view of mind-body dualism, by acknowledging the entire human as a material system in a perpetual state of interaction within a material environment.

Embodiment is a sizable subject, so I have explored areas of female embodiment (Beauvoir 1997 [1949]) which leads in the literature to the embodied mind (Johnson 1990). There is also a crossover between neuroscience (Damasio 1996) and the philosophy of embodiment, which can offer some tangible descriptions of the physical (bodily) relationship between intuition and our embodied experience in the world. In order to approach such a broad area as embodiment, it is important to re-state why this is useful to my argument. If we begin from the act of making, we define an environment (studio) into which a human (animator) enters, bringing with them their own embodied memory of the world, in which the animator is a *container*, as is the studio (Lakoff and Johnson 1980). Within this environment are tools and materials: the maker (human) uses tools to change the state of the material. In defining such an act of making, my intention is to frame the self-evident context for the relationship between ideas of making/craft and embodiment. I am going to discuss craft in greater detail later on; at this point though I am considering the maker and how they carry their knowledge of the world in their body.

Philosophical arguments around mind/body dualism have echoed for centuries. The most useful aspect of such discourse for my argument is how philosophers such as Beauvoir (1997 [1949]), Dewey (1925) and Johnson (1990) have defined embodiment, from which we can understand and approach a tripartite

---

[15] Gayatri Chakravorty, 'What is it to translate?', (lecture), February 2018.

mind-body-*technology* debate. Before I discuss how technology altered both the environment and, therefore, the body, I will lay out some key points of the embodied mind. In the 1920s, John Dewey's 'naturalism' defined the body as existing within its environment: "To see the organism *in* nature, the nervous system in the organism, the brain in the nervous system, the cortex in the brain is the answer to the problems which haunt philosophy" (1925: 224). Mark Johnson's work in this area gives *equal weight* to the environment and the body. To illustrate this, Johnson shows footage of his baby granddaughter; she is 11 months old and learning to walk. This pre-verbal stage of being, Johnson explains, is the basis of how we exist and as we grow and develop we continue to use the same process of engagement, assessment and understanding of our environments. He says: "We are little motion machines, we are animation, we are life. This is the beginning of engagement with the affordances of the world, that's where meaning is going to come from" (2016: 00:13:41). If we begin to tie a description of the embodied mind into a scenario of creating animation, we would not be altering any aspects of the bodily organism (animator), but modifying what the 'environment' can mean in this context. At the centre of the making environment are the materials and the tools used to manipulate them. We will be describing this inner world of making in the following section on tacit knowledge. The purpose of this section is to acknowledge what humans bring into their environment, namely their embodied memory, their bodily logic. As Johnson has illustrated, this logic is built from the very beginning of our lives, from learning to walk and talk, bounce balls, run, play – these are all methods of experiencing and understanding our environment. From such experiences, we retain primal truths about our body in the world, up–down, front–back, entering–leaving a room. Johnson describes this as when you "experience verticality, you experience containers, you experience things moving from a source along a path towards a goal. You move your own body in that way to achieve purposes. You experience balance,

and loss of balance ... it's the result of the nature of our bodies in the nature of our environments" (2016: 00:20:47). Here, Johnson is marking the boundary between his arguments which focus on the embodied mind and larger questions about the body in space. In my argument, the environment is the first stage of defining the context of *Animatory Thinking*, which the animator inhabits.

Whilst my research has not specifically focused on issues of gender, I have been aware that ideas of physicality and embodiment are core to my thinking. In order to gain perspective on the relevance of embodiment to animation practice I have looked at the salient points of this increasingly important and vibrant discourse. In book one of *The Second Sex* (1997 [1949]), the philosopher Simone de Beauvoir offered a commanding and precise perspective of embodiment when she stated that: "to be present in the world implies strictly that there exists a body which is at once a material thing in the world and a point of view towards the world". Beauvoir is credited with being the originator of the sex/gender dichotomy. In the 1970s, Marion Young continued this position as she described how women often experience their bodies as things, and she wrote they are "looked at and acted upon" (2005: 39). If we step back to animation as a practice, the object being animated is both "looked at and acted upon", but unlike the point Young is making about female embodiment, the animated object is brought to life by being acted upon, by being or becoming embodied. Donna Haraway's *Cyborg Manifesto* (1984) redefined an even more complex gendered social landscape, with the emergence of computers and robotics and the beginnings of cyberspace. Haraway defined a time in society when we could no longer discuss gender or embodiment without attending to and including the machine. Levitt (2018) cites the continuing cultural influence of Haraway's manifesto, which famously describes "boundary breakdowns" between machine and animal, physical and non-physical. Much of the discourse in feminism, embodiment and animation focuses on the cultural deployment of the animatic

effect within society. Whilst this is hugely important, my argument is within the process of making, but is not separate from these wider discussions as the output of animation practice feeds into this cultural milieu. The function of embodiment in my argument is specifically related to the shared physical effects of existing in an environment where gravity is present, where moving from one place to another requires active physical engagement with the world. The specific sex of the animator and/or their subject matter has a profound effect on how they, and therefore their animation, moves; I will return to these questions of gender and physicality when discussing the final stage of my practice, at the end of this chapter.

Having described the importance of the environment to embodiment we can move closer still – inside the body. Brain imaging techniques such as magnetic resonance imaging (MRI) have afforded researchers tools to explore aspects of human cognition previously hidden inside our bodies. Antonio Damasio's research analyses how rationality, emotion and our physical bodies are all intertwined, and all play a part in our intuition and judgement. Damasio describes how "an organism has to maintain a homeostatic balance if it wants to survive and flourish" (2016: 00:27:07). We could interpret this as the body's effective engagement with the environment; or, this is how you are feeling right now! But when your environment changes, for the better or worse, so does your body. Damasio (1996) describes such reactions as *somatic markers* – for example, feelings in the body that are evoked by our environment (such as a rapid heartbeat when we are anxious). These are described as neurological events which influence our choices, hunches or gut reactions. If we relate the description of somatic markers to animation we could do so by relating an embodied memory of how a ball feels when we bounce it to how it appears on our computer screen. If we chart a process of animating such a scene we could suggest that in the first instance, such an animation does not closely relate to our embodied memory, or as Chow would describe it, the elastic anchor in tension

with a sensory experience. As the animator works, adjusting timing and spacing, the appearance begins to relate to the memory, the elastic anchor and sensory experience are similar, the memory matches the animatic effect. If we relate such ideas to descriptions of tacit knowledge (which we will look at in greater detail later on), we could suggest that within each animator, their embodied knowledge is in fact collections of somatic markers. This is a transitional space between the philosophical/physiological structures of embodiment and the pre-lingual tacit choices that we make when involved in animating.

Mental Models

Peter Korn, craftsman and educator, offers an unguarded insight into the complexity of his mind. This 'template' acts as a tool he uses to triangulate his rhizomatic being in the world, as a means of orientating himself.

> My own mental map [model] is an unholy scribble. It includes my feelings for my wife, the rules of croquet, the taste of vanilla, the biological characteristics of wood, the tunes of a Beatles song – in short, the sum total of what I perceive in the world, how it all connects, and why things are the way they are. These elements fuse into a singular template, which I place over the unfathomable complexity of the universe so that I may point to a few simple coordinates and say, with some conviction, "Here I am, right here!" (Korn 2013: 109)
>
> Note: Square brackets are placed around the inserted word 'model' in this example to let the reader know that I am suggesting Korn's use of the word 'map' can be considered a 'model' for the purposes of this section.

As a primary function of an internal mental model, knowing where you are offers a sense of grounded security, from where creative leaps into the unknown can be made. If we have an internal method of re-centring ourselves, we can make bold creative strides with the knowledge that, if needs be, our mental model will lead us back to safety. Without this ability to ground oneself, to know where we are creatively, one can become untethered, lost.

The animator is engaged in a process of making a change, recording that change and allowing a technological process to show the residual effect. When observing the effect, the animator is both reflecting on the effect balancing if there is a perceivable progression or regression toward an internal emotional 'model'. This process is iterative and deeply personal. If we compare such a description of making animation to theoretical definitions of animation such as Matarazzo's, who suggests that to think of (that is, imagine) an animation is to create animation (2016), there are similarities. In order for the animator to compare the illusion in front of them with the internal imagined animation, that model must be constructed, be it from direct experience or memory. The animator's sense, the empathic connection with the perception of apparent motion, is a core skill of this craft: the balance of constructing the mental model and allowing one's modulation of an animated event to make what we feel and what we see align. In this moment, the animator could be described as balancing both nebulous experiences simultaneously. The un-uttered questions of what to change, adapt or accept are made at a tacit level, a judgment call, a matter of sensation. This process can continue almost indefinitely: the cycle of watching, adjusting and re-watching is only drawn to a close when either satisfaction has been reached, or time demands a resolution.

Conducting a practice-based enquiry into animation, I have been acutely aware of my own mental model, in my practice but even more so when working with students. The majority of the work I do with students could be framed as guiding

them through the constitution and reconstitution of their own mental models, be it their cultural awareness, their visual acuity or their functional problem-solving. I have a notion of what I consider to be a mental model: how I respond to descriptions of such terms as a 'minds eye' or 'third eye'. In Chapter 2, I briefly touched on the importance of Ed Catmull and his pioneering work in CGI, as well as being a founding partner at Pixar Animation Studios. Ed retired in 2018, but before he left he asked 540 Pixar employees to take a test regarding the vividness of their visual working memory. One might expect that the 'artists' at Pixar would present with the most vivid visual working memory, however, the results showed a fairly even distribution across technical and art departments, with the strongest collective results coming from the production teams. Ed Catmull himself has a condition called *aphantasia* –he has no ability to visualise at all. He is not alone in this; the renowned hand-drawn animator Glen Keane cannot picture images in his head either. The neurologist Adam Zeman has conducted a study of our distinctively human ability to imagine. 'The Eye's Mind – a study of the neural basis of visual imagination and its role in culture' is a significant project, and an in-depth application of its findings is beyond the remit of this PhD, so I am taking a "pick and mix" (Yee 2008) approach by referencing this work. In doing so, I am not attempting to validate my proposition directly, but to acknowledge that there are wider debates on the periphery of this thesis. What I glean from Zeman's studies is the fluidity of theories in philosophy, psychology and cognitive science around visual imagination. The Canadian philosopher Zenon Pylyshyn frames the subject through "abstract mental structures to which we do not have conscious access and which are essentially conceptual and propositional, rather than pictorial, in nature. Such representations are more accurately referred to as symbolic descriptions than as images in the usual sense" (1977: 1). The psychologist Philip Johnson-Laird (1983) proposed a similar interpretation of multiple types of mental representations: "Propositional

representations, which are strings of symbols that correspond to natural language, mental models, which are structural analogues of the world, and images, which are the perceptual correlates of models from a particular point of view" (1983: 165). Johnson-Laird suggested that mental modelling is a dynamic process, depending on what a task demanded.

So if we take Pylyshyn's assertion of "symbolic descriptions" (1977: 1) and Johnson-Laird's dynamic blending of memory back to animation (where one might expect a dominance of visual imagination), we could consider that animators have to make decisions on how their animations appear to them. *Animatory Thinking* is built on the idea that such decisions are being made, partly, through a comparison to an animator's mental model. This model may not be only visual, it may be emotional, spatial, visceral, a blend of humanity; but it is embodied.

In the following diagram, Figure 23, I attempt to illustrate *Animatory Thinking*, a key aspect of which is that animation "thinks technology" (Lamarre 2009). The concept of an extended body schema proposed by Maravita and Iriki (2004) suggests that using tools (and in this case I propose that it is the technology of making animation) provides an:

> ...extended motor capability [that] is followed by changes in specific neural networks that hold an updated map of body shape and posture (the putative 'Body Schema' of classical neurology). These changes are compatible with the notion of the inclusion of tools in the 'Body Schema', as if our own effector (e.g. the hand) were elongated to the tip of the tool (2004: 79).

Later on in the thesis, I discuss animatory space (Maya, stop frame studio, animation stand – any animation technology in which we manipulate time) and how it could be approached as a heterotopia. An essential part of this otherness of

heterotopian animatory space, is a human body and for the purposes of this thesis that body is an animator at work. The animator is habituated into her space, this familiarly is akin to the way we might each move around our home: we have embodied knowledge of how hard to pull certain drawers, or precisely where a light switch is. The expert is so familiar with her space that she is free to introduce new ideas into her environment without having to attend to orientating herself.
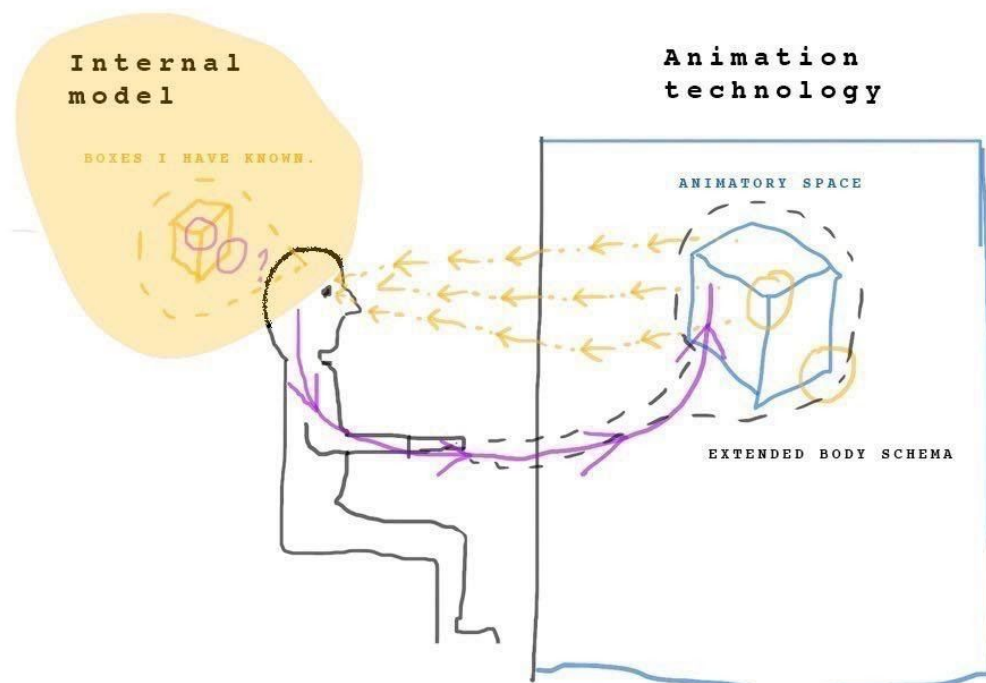
Figure 23. A system of *Animatory Thinking*, 2019, Hugo Glover.

In the previous section, I established the idea of mental models and how *Animatory Thinking* has been designed to optimise variety in the initial stages of creating an animated world. In this section on embodiment, I have looked at the history of embodiment and illustrated how our internal mental model is nourished by our embodied engagement with the world. I have also proposed how the ideas outlined in Chapter 2 regarding technology and the interdependence between the

animator and technology forms the basis of *Animatory Thinking*. In the next section, I will explore tacit knowledge and show how concepts of tacit knowledge can be used to join an animator's mental model, through their embodied presence and extended body schema via the animatory space (Figure 23).

Tacit Knowledge

"Anything said is said by an observer to an observer who could be him/herself."
(Maturana 1979)

As I mentioned in the introduction, tacit knowledge, by definition, cannot be effectively articulated with words. Attempting to slice animation practice into carefully delineated areas of knowledge and skills would be beyond the remit of this PhD, and would run counter to the Action Research methodologies and practice described. Dorst and Reyman articulate how design is a mixture of skills and knowledge, and their discussion of design expertise acknowledges some of the variety of definable knowledge by suggesting that:

> Learning design doesn't just involve skill acquisition, it also involves the learning of declarative knowledge, and the building up of a set of experiences that can be directly used in new projects. These experiences become a repertoire of earlier solutions that can be applied by the designer (2004: 4).

Christopher Frayling states that the 'know how', or tacit knowledge within design practice are under researched, and Design Research can become abstracted from the practice. The use of computers in design (Frayling refers to 3-D printing) has redistributed design thinking from the end of a process of making to the beginning, the point at which an object is in a virtual state. In Chapter 2, Chow and Woods described this *digicality* as ever present when engaged in a creative practice which utilises a digital representation of the real world. Instead of describing *Animatory Thinking* as *digicality,* I have chosen to frame the animation/technology notion in terms of *distance*. As we begin to explore tacit knowledge in relation to animation practice, the system I am unpacking (Fig. 23) has an animator, technology (tools) and

the application of skill (making a change within the animatory space), whilst simultaneously comparing the resultant effect to an internal model. There are internal distances within this system, between the input from the animator and the output from the technology as well as external distance – stepping back to view an entire shot or viewing the work at a larger scale.

If I begin with the central tenet of Michael Polanyi's theory of knowledge that "We can know more than we can tell" (1967: 4), then we are thrust into the heart of a paradox: if we can't articulate it, how can it be knowledge? How can it be transferred? Jean Piaget carefully deconstructs the "myth of the sensory origin of scientific knowledge" by asserting that "knowledge never derives from the sensation alone, but from what action adds to this data" (1977: 46). Toom argues that tacit knowledge is by nature: "a context-bound and sticky concept". Broader criticisms of tacit knowledge theory seem to occur when it has to fit in with larger philosophical definitions of knowledge. Bengt Molander discusses: "practical skills as *silent knowledge* that is implicit in a person's world and actions, but that is not cognitively explicit or critically reflective" (2012: 624). For Molander, this silent knowledge cannot necessarily be translated into a formal structure. So we are building a picture of how elusive describing 'what we can't tell' is, but what does emerge is how important these discussions are when we consider education. For the purposes of my research, an understanding of how to communicate animation practice is a key aspect unpacking my own tacit knowledge.

Argyris and Schon's approach to tacit knowledge is based on articulating the complex interrelation of thinking and action. The delineation of tacit knowledge into *theories-in-use* (evidence of a person's actions) and *espoused theories* (the articulation of why and how the actions and results were performed) has been deployed in many studies of knowledge and knowing (1992). As a basis for approaching animation I need to modify this approach as there are several layers in

the relationships between thinking and action when making animation. As discussed in the previous section, a relationship between *embodiment* and viewing animation as part of practice is foundational to my argument. The animator's ability to *notice* the inconsistencies between their mental model and the animatic effect they observe is the first stage. The skills and competence of attending to, and altering, the animation, thus aligning the animators mental model to animatic effect is the second stage. Toom offers a definition of skills as "dimensions of the ability to behave effectively in situations of action" (2012: 627) and in discussing Argyris and Schon, she also points out that "it is difficult to use verbal forms to construct skills; and if skills are presented in verbal form, the content is really informational" (2012: 627). A succinct example of this difficulty is the complexity of offering written feedback to animators (or students) via email – whereas a one-to-one conversation about the work can be far more effective. In such circumstances we are communicating more than we can say.

Malcolm McCullough's book *Abstracting Craft* (1998) begins with an in-depth and broad overview of handcraft and how it relates to computer use:

> There has been much study of skill in executing long sequences of discrete events ... data entry or parts assembly. By contrast, there seems to be less documentation of skills that are not so purely behavioural, for example, skills of recognition, of appraisal, of knowing the limits of material (1998: 3).

McCullough goes further in his description of knowledge by discussing how an "entire body may 'know', as in dance ... Knowledge is all the more likely to be physically inscribed" (1998: 8). The philosopher Ilkka Niiniluoto suggests that "a skill can be considered as something that lays the groundwork for knowledge, not as knowledge itself" (as cited in Toom 2012: 25). Niiniluoto has a somewhat traditional

view of knowledge, claiming that skills are learned through trial and error and when we consider animation there are clear parallels with such a process. In the context of my teaching, the first steps into CGI animation (Maya) as a basic introduction are made using a master–apprentice flow of knowledge. The way I have articulated to students when their work begins to progress towards a skilful use of tools would be at the point when their ideas, visual research and distinct style emerge and become identifiable; in essence, when their creative presence is more dominant than the structures of Maya. In order to begin to bridge the creative space between their ideas and what Maya affords the user, a student must gain the basic skills of orientation, creation and manipulation. In tandem with digital skills are the analytical and aesthetic judgements and when both are attended to, the skill of translation from ideas to animation can be developed in parallel. The poet Octavio Paz offers a captivating description of hand-made objects in which there is: "a constant shifting back and forth between usefulness and beauty. This continual interchange has a name: pleasure" (1987). This shifting intercepting of aesthetic judgements and skills to effect change in a system is the next stage of understanding how tacit knowledge could be described in animation practice.

Auli Toom's research does not "offer a clear, simple, and unambiguous definition of tacit knowledge" (2012: 640). Before we look at the categories we should be aware of the limits and fragility of tacit knowledge and related fields of theory.

As previously mentioned, much of animation studies research concentrates on the output of making (evidence of ability), this masks underlying skills and competences. Tacit knowledge is often discussed in a semi-abstracted sense, with examples such as firefighters or chess players introduced in a secondary context (Crawford 2010). Research into the transfer of knowledge (Wood *et al*. 2009) offers a richer resource for my explorations. They attempt to map aspects of tacit knowledge within knife-making, capturing it and passing it on to novice learners.

Wood focuses on observing expert knife-makers as well as learning the craft herself. Upon reflection, much of Wood's work is related to aspects of tacit knowledge that the expert makers have, but do not (or cannot) articulate. Wood is not attempting to devalue the experience of working with a master craftsman but to highlight where the value lies in the interactions between participants in the study. To reflect on my argument, I am suggesting that aspects of an animator's tacit knowledge are based on their lived experience and the skills of manipulating technology are the 'bridge' (Wood *et al.* 2009) between this embodied knowledge and the depiction of life that their animation creates. We all have different life experiences and therefore a different knowledge of the world. I have used the opportunity of teaching animation to unpack my approach to learning; in doing so I am understanding of some of the bridges I have used to cross from industrial design practice to animation.

William Kentridge's ideas, writing and practice have close relevance to many aspects of my research and are a pertinent reference point for my study. In his early years, Kentridge aspired to be an actor but it was his skill and persistence in drawing which laid the foundations of his artistic career. When in his early thirties, Kentridge combined his love of acting and his passion for drawing and began to make animation. His work spans many mediums from sculpture, film, installation writing etcetera, but what combines this multidisciplinary approach to making art is his childlike curiosity and playfulness which he constantly references. Kentridge's writings on the subject of his own practice are truly insightful and in his book *Six Drawing Lessons* (2012), he articulates in mesmeric detail how and why he makes work. He effortlessly blends history, practice and reflecting in a finely poised flux, describing his drawing work as "meeting the world halfway – and that our projection, our moving out towards the image is an essential part of what it is to see, to be in the world with our eyes open" (2012: 18). My interest in Kentridge is how present he is in his work, in the mechanism of drawing, as he walks back to a film

camera to take a single frame of animation before returning back to the paper to adjust, erase or add to his drawings. Kentridge describes the walking as being a profound part of the process, as new ideas or directions present themselves as he walks away from the drawing or returns to it. This process of making changes to his drawings through introducing kinetic distance, a move towards reflective objectivity is akin to Torre's "animate vision" (2017: 106) but set in the context of the studio. So despite placing himself at the heart of the animation, Kentridge's process can never be presented as deterministic or mechanistic, but an extension of both his physical being in the world, to make marks, and travel between canvas and camera, with the act of embodied cognition also engaged and invested in the hypnotic cycle of making, evolving, walking and returning. Kentridge acknowledges his embodied knowledge of the world and his tacit knowledge of applying it within his practice. His ability to make his practice commutable and accessible through his lectures and writing exemplifies creative reflective practice.

To conclude this section, I have highlighted how defining tacit knowledge can be "sticky" (Toom 2012). When justifying such knowledge in a written form it becomes fragile and elusive, but in the practice form, in what we experience, the skills and competencies of a practitioner are often more evident than they realise, as I shall show with the students' work later on. Adding to the elusiveness of such knowledge is the dichotomy of accruing knowledge, then owning (being aware) of such knowledge. By unpacking skills, competences and abilities in myself and subsequently with novice students, this research offers a close reading of the distinctions between such aspects. In this section, I have given an overview of how existing research in tacit knowledge is still fluid with regards to a definition. What has been useful to my argument is seeing how the segregation of ideas such as skill, competence and argumentation can be superimposed on to animation as a process of making in order to map silent knowledge. I have attempted to show how Johnson's

(2016) ideas of the embodied mind could act as a basis for understanding tacit knowledge, specifically by foregrounding the importance of the human being as the hub of a making process. I have pointed out how some discussions of tacit knowledge have not chosen to focus on the human but rather discussed knowledge in a separate intellectual context, at which point I would suggest, the argument for tacit knowledge becomes ungrounded and somewhat unstable. Another aspect that is often not addressed in tacit knowledge discourse is that of technology. There are often examples of hand-made objects, pottery etc, but the separation that computer use brings between the human, the tools and the materials, adds a multiplying factor to such inquiries. Rather than separate these sections, I have always attempted to simplify a unified process instead of looking at the components (human, technology, knowledge) as puzzle pieces. It is only when all three are silently interlinked that the internal phenomena of the maker is evident at work. McCullan concludes that:

> The possibility of craft lies not so much in the technology as in the outlook you bring to it. The greater paradox of computing is that the better this thinking apparatus becomes, the more we appreciate the value of a conscious human being (1998: 272).

Polanyi's (1967: 23) assertion that "we know more than we can tell" is especially relevant when attempting to understand the phenomena of animation. Tacit knowledge is a knowledge built on the foundations of our embodied mind and in the context of *Animatory Thinking*, we could consider that such knowledge forms the structures that translate the embodied memory of the world through the skills and competence with tools that craft time to create movement with meaning.

Embodiment and tacit knowledge are integral to how physical performance and animation performance have significant crossovers. The actor and mime artist

Etienne Decroux took the body as a means of expressing the starting point of creation with the aim of "making the invisible visible" (Leabhart 2007). Our animator is attempting a similar translation, to generate the illusion of life where there is none. Whereas the mime uses their body as both receiver and transmitter of emotion, the animator must receive the affordances of movement from their experience and transmit these through the technology of moving image in order to affect an audience. So there is an assumption on the part of the animator that their experience of the world can translate through the language of moving images to an audience in an intelligible way.

So how can a designerly way of knowing (Cross 2007) be used to build animatic competences that represent both action and the underlying cognitive functioning (Westera 2001) within animation practice? In the next section of this chapter I will show how I have woven embodiment and tacit knowledge into my work with animation students.

Observing Novice Animation Students

I will now introduce the first example of my teaching in this PhD, an *Introduction to 3-D Animation* module for level 4 students.[16] By describing the design of the brief I will show how *Animatory Thinking* has emerged through discussion, observation and reflection by myself and the students. A key aspect of this research is to facilitate a refocusing away from storytelling, towards an engagement with the *politics of representation*[17] (Wayne 2001). I will show how ideas of embodiment have been

---

[16] The second example, a level 5 module, in which the students explore CGI as a medium to create performance with a sense of vitality and variety is discussed at the end of this chapter.

[17] Wayne describes the *politics of representation* as understanding "text in relation to the wider context of unequal power relations in which culture is produced and consumed. The dynamic here is between text and cultural context, between the particular representation, which a practitioner has produced, and its relations with other representations on a similar theme or topic" (Wayne 2001: 31).

deployed as a philosophical approach to animation practice. By starting from such a position, we will then explore how the students have accrued the tacit skills of translating their knowledge of the world into their CGI animation. In addition to the skills and subsequent competencies of navigating the software (Maya), I will also highlight how designerly problem-solving is discussed and encouraged. The intended outcome of this pedagogical approach (as part of the broader Action Research) is to encourage a philosophy of *curiosity* in the students, by acknowledging from their first steps in CGI animation that problems and challenges in all creative practice are inevitable. Most of my students have grown up with CGI as a normative medium for animation. Unlike hand-drawn or hand-made animation, there is a significant barrier of technological complexity that guards the inner workings of CGI as a medium.

My constructivist approach to lifelong learning (Kolb 2014) is directly based on my own academic and professional journey: in 2002, I moved from working in industrial design over to animation. To make this shift I applied methods of design thinking to the problems I encountered in creating animation. This approach proved extremely effective, and the continuous state of learning was hugely stimulating. In 2010, I moved from making animation to researching and teaching, and again I relied on design thinking as a basis from which to frame problems and generate solutions.

At the end of Chapter 2, I discussed the focused Behavioural approach to learning often found in literature as well as training courses which focus exclusively on skills. As a lecturer, I see my role consisting of two primary functions: to acknowledge to students that creativity is inherently unstable and that stability and certainty emerge as a product of practice; secondly, that their primary skills in creative practice are to be *curious* and *passionate,* again both unstable liminal states of

being. Media theorist David Gauntlett describes creativity as being: "… identified by its outcomes: things or ideas which haven't been seen before and which make a difference in the context in which they appear" (Gauntlett 2011), a similar position to Cross with "designers produce novel, unexpected solutions" (1990: 130). Students often have a fixed impression of how their work should look, they expect it to look like the animation they already know, they aspire to ubiquity. Paul Ward suggests that "the assumption often seems to be that learning *the craft*[18] is the most vital thing … but [this] tends to close off some of the more interesting critical avenues" (2018: 92). There is a pervasive culture of recreation, of repetition and of constructing the idealised echo of animation that feels comfortable to them. Their prior knowledge of animation is often the basis to their passion for wanting to pursue the subject as a career, and they tend to believe that the accretion of recognizable skills and competencies are the only requirement or indeed the only guarantee of such a career.

Much of the ubiquitous reproduction present in many aspects of animation, be it games design or episodic television, I see mirrored by my students. As I have previously mentioned, Design Research attributes ubiquity to factors such as industrial production technologies, specific technology functions which limit scope and marketing strategies that discourage new typologies (Hall 2016). A countermeasure to such a creatively restrictive climate is the enhancement of 'variety' in design. To achieve this in my teaching, I highlight foundational structures with which a student can continuously build variety into their individual mental models. This highlighting is built into the process of research that each student follows in order to scaffold the creative steps they need to take.[19]

---

[18] Animation as craft is not explored directly in this thesis but it is useful to note a description of craft from David Pye as "simply any kind of technique or apparatus, in which the quality of the result is not predetermined, but depends on judgment, dexterity and care which the maker exercises as he works. The essential idea is that the quality of the result is continually at risk during the process of making; and so I shall call this kind of workmanship. 'The workmanship of risk': an uncouth phrase, but at least descriptive" (2007: 20).

[19] See Appendix II for briefs.

Animatory Thinking is designed to optimise variety in animation practice and demonstrate to the students that multiple layers of cultural depth are not only projected from the viewer, they are constructed by the maker. The intention is to challenge the students to nurture their internal mental models, and to change their visual diet to a varied and invigorating mixture of influences. This generates a creative unease, a sense of otherness, which is often uncomfortable for students, some of whom have only fed their mental models on a narrow spectrum of ideas and imagery. *Animatory Thinking*, and its use of design thinking as a method to optimise variety, directly challenges the entrenched cliché, pushing the limits of what a 'constructed image' (or animation) can be.

Context of Approaching Animation as Pilgrimage

To maximise the potential variety of student's work, the creative landscape they are asked to explore must be defined through a brief. In order to generate "networked collective ideas rather than traditional ideas" (Hall 2017), visual research as well as instructional demonstrations of software are conducted in small teams. This lays a foundation of distributed knowledge, as students often assume they need to learn it all. The intention is to guide students towards a mind-set of valuing their own intuition and curiosity, rather than just accruing skills of repetition, again, in order to push the limits. I introduce CGI animation with the metaphor of a pilgrimage: for some it will be the duration of their studies, for others it will be their entire career.

Before I introduce the creative brief, I explore the concept of 'pilgrimage' with the students, as it is useful to touch on wider discussions of its function and significance. The anthropologist Victor Turner was interested in how pilgrimage produced "liminal identities" (1969) within the social groups engaged in a pilgrimage. The *communitas*, as Turner (1974) called it, is a sense of shared purpose as the journey is made, or a networked collective (Hall 2017). James Buzard (1993)

describes a distinction between tourists and pilgrims, with a tourist relying on machine transportation as they are sped to a destination with little or no physical or spiritual engagement, whilst the pilgrim takes time and feels the rise and fall of the landscape in their bodily engagement with nature. Through such a process, the pilgrim is afforded a far greater authentic experience. As I touched upon in Chapter 2, Schivelbusch (2014: 54) describes the impact of nineteenth-century train travel as creating a "ballistic perception" of the landscape, separating the passengers from nature. Train passengers, Schivelbusch suggests, no longer belong to the same space as the perceived objects in the landscape, as their view is mechanically mediated by the apparatus of motion. If we relate these two contrasting experiences of moving through a landscape to animation, there are aspects of both the pilgrim and the train passenger. As we have seen in Chapter 2, animation is bound to a structure of technology, akin to the apparatus of a train, but the practice of making animation is not a linear experience. Animation often takes many months or years of consideration and attention to each frame-by-frame, step-by-step, key frame by key frame. Our creative journey through this technology could relate to a pilgrimage, with each day being a day closer to the destination, but when we arrive at the final destination it is the journey that we remember. Sean Slavin's description of the Camino pilgrimage to Santiago de Compostela reveals the internal experience of the pilgrims and how 'the way' is a metaphor not bound to space but 'between from-and-to'. Slavin also reveals how rhythm is "external to the body or mind and cannot be controlled", and he is describing walking and how we "give ourselves to a rhythm allowing it to control the body like an involuntary movement". The detailed embodied description of walking that Slavin offers evokes the specific types of memory I attend to when animating, and when walking is described as lying "halfway between what can be willed and what can direct itself" (2003: 10). I think of animation in a similar fashion. A final point to draw from Slavin's pilgrimage is

how "the binary of perceiving subject and external object is undermined. Rhythm is both a creative act and an objective thing in the world" (2003: 11), and it is this sense of embodied rhythm or *rhythmising attitude* (Abraham 2003) that I recognise as an invisible, almost imperceptible attribute of animation. I experience this specifically when I see a student's work shift from being within the technology to transcending it, and when it *feels* alive, the point by which the animator has constructed a rhythmising attitude which is recognised through an embodied response, the authentic moving body.

Teaching an Introduction to 3-D Animation – Pilgrimage

As well as foregrounding the concept of Pilgrimage, the brief[20] also draws inspiration from *Tomb of the Unknown Craftsman* by artist Grayson Perry (2009), and is designed to provoke a philosophical approach by the students in connecting their lived experience to the exploration of CGI animation as a creative space.

The exhibition *Tomb of the Unknown Craftsman* consisted of curated objects from the British Museum archive in London as well as original artworks by Perry himself. As a child, Perry and his teddy bear Alan Measles, fought countless imaginary battles with the Germans. As part of the BBC television series about the exhibition, Perry goes on his own creative pilgrimage; riding a custom motorcycle to the German city of Backnang (twinned with his own birthplace of Chelmsford) "in order to make peace with the Germans" (Perry 2011). Perry articulates the way he sees the world, the objects and aesthetics that hold significance to him: "I look at things, that's my job" (Perry 2011). He directly connects his lived experience, both childhood and his artistic presence within his artwork, and his pottery. In a similar way to Kentridge, Perry is an exemplar of creative practice. He conceptually and physically blends history, materiality, culture and craft, laying out a roadmap for the

---

[20] See Appendix II for the brief.

students to follow. His practice is beholden to a sense of place and sense of history: he is constantly attending to how he fits into this larger world and offers objects that articulate his vision and his ideas of where contemporary society is and where it has come from. Identity is key to Perry's work, but mostly a mapping of how identity fits within society and how society, in return, forms identity – an archetype critical practitioner (Wayne 2001).

Perry approaches the British Museum as a heterotopic space which houses objects made by people who are both forgotten and therefore also unacknowledged. At the beginning of my students' journey into manipulating and crafting time and space, it is important to begin with significant creative people who wear their craft skills proudly and make work that has a tangible effect on the people who experience it. I hope that my students' work will have an effect on their audience, but I want them to value their role and their responsibility, to know what they are making and why, and to interrogate the *politics of representation* (Wayne 2001). The use of these ideas are three-fold:

1: Students are just beginning their education in animation, and for some this will be a lifelong journey. Because this is the beginning, it is important to mark the time and place where they each start. The module/the brief, will not be the end of the journey but a point at which they can pause and reflect on their first few steps. So the analogy of the pilgrimage is applicable for its relationship to the idea of learning being a lifelong process.

2: 3-D animation is really good at some things and really poor at others. The Euclidean realm represents both freedom and imprisonment – anything can be built, broken, distorted, deleted, controlled, etcetera, but it can never leave the confines of the screen, the internal digital space; we have to visit and we cannot stay. For this reason, the concept of a journey or pilgrimage implies the construction of some form of landscape, a beginning and an end, both of which are easily explored in CGI.

3: In order to answer the brief, students must have engaged with a creative, intellectual process of unpacking and understanding *pilgrimage* – a journey with purpose. To do this, they must construct an ideology that will underpin the reasons for the journey. As well as an ideology, they must also conceive of a *shrine* or significant place that will signify the completion of the pilgrimage. Again, the challenge asked the students to unpack the real motivations and understand the system of belief (ideology) they have proposed.

Another tool I used to orientate the students' mental models and cultural knowledge is the seminal 1972 BBC television series *Ways of Seeing* with John Berger. As an extension of Walter Benjamin's 1935 essay 'The Work of Art in the Age of Mechanical Reproduction' (Benjamin, W. and Underwood, J. 2008), Berger harnessed the technological possibilities of television to challenge the audience, about art, but also about the medium they experience it through. Berger asks his audience to be "sceptical of what they see". In the same fashion, I ask students to be sceptical of what they make, to be consciously and actively engaged within the cultural landscape they are constructing. The hope is that they will not just reproduce a landscape but begin to take ownership of the responsibility of depicting their ideas and their ideology on the world. Perry describes the word 'craftsman' as mystical: "he is crafty, a trickster, a sorcerer, an androgynous shaman communicating with the spirit world, a member of a secretive guild holding his alchemical secrets close to his chest" (2011: 23). The same could be said of the animator's – invisible, mystical, emotional and with the skill required to transcend the materials of its making.

Jan Švankmajer, a master of animation and its power as a political tool, describes his use of the medium:

> Animation enables me to give magical powers to things. In my films, I move many objects, real objects. Suddenly, everyday contact with things which

people are used to acquire a new dimension and in this way, casts a doubt over reality. In other words, I use animation as a means of subversion (as cited in Wells 1998: 11).

The mechanics of this brief required the students to examine the world we live in. As part of their creative process they are challenged to unpack how society is underpinned by shared beliefs, rules, doctrines and unquestioned 'truths'. Collington's *Animation in Context*, discussed in the introduction, outlines how to incorporate critical, cultural and contextual analysis in the development of animation projects. In addition to this, we can use the metaphorical notions of hierarchies[21] and control to understand and conceptualise how an animator uses tools like CGI.

Digital animation is built on mathematical calculations, very few of which are directly accessed by the animator but ultimately underpin everything we do in the medium. Introducing this type of philosophical debate directs the student toward a sceptical view of the interdependence between humans and technology.

By introducing a sceptical approach to technology, and by emphasising the students' own embodied knowledge of the world, the intention of this practice is to set students on a trajectory of enquiry where the digital tools of CGI are used to combine and create new ideas and new forms of movement, related to but not imprisoned by either the digital nor the real world.

As mentioned earlier, the metaphor of a pilgrimage situates the students' experience as a journey. For some the road will conclude at the end of their degree. For others it will be part of a lifelong exploration of animation, CGI or otherwise. In many ways the teaching I have described in this section sets the students' trajectory,

---

[21] I am referring here to the arrangement of 'parent-child' relationships between nodes within an Autodesk Maya scene file.

the next stage for them being their second year, and another CGI module which I describe at the very end of this chapter. In the next section I will look further inwards, towards the locus of *Animatory Thinking*.

Examples of Tacitness Within Animation Practice

An animator primarily works on a static object, a drawing, a model, a construct, a fact (Kentridge 2014: 36). Unlike live action, there is a separation between our lived experience of time and the construction of a moving image that presents an illusion of time. Just like fixing a watch, time can appear to stop and start in the animatory space. Understanding the relationship between the timing and spacing of individual images is the core skill of animation.[22] No matter how physically close the animator is to the construction of the image.

The animator is constantly switching between being a viewer (reviewing their work), an actor (embodying the action or desired emotional resonance) and resolving these two states through craft. The animator is making instinctive changes through the tools available to produce an effect that is simultaneously *process* and other.[23] I am attempting to describe the minute outcomes from the tacit knowledge applied in animation practice. Polanyi describes tacit knowledge as having two terms: *proximal* (that situated nearest to oneself) and the *distal* (that situated further from oneself). Polanyi described the functional relationship between these terms as "knowing the proximal only through what it tells us about the distal" (1967: 17). To move from the knowledge we rely on (proximal = our skill at manipulating animation technology) to the knowledge we focus on (distal = movement and our critical reading of it), the animator must engage their tacit knowledge of animation.

---

[22] Timing is the '9th principle' (Thomas and Johnston 1997). Richard Williams puts great emphasis on understanding 'spacing' as well, and how the two are different. Translating the terminology of 'Timing & Spacing' (hand-drawn principles) to digital keyframes and the 'interpolation' between keys is often attempted (Osborne 2016), but is intertwined with principle 6 - *slow in slow out* (hand-drawn), or *ease in ease out* (digital).
[23] Deborah Levitt describes this as *an-ontological* (2018: 17).

Polanyi's structure of tacit knowledge supports earlier arguments in this thesis regarding the animatic interval. What I am adding to Polanyi's structure is the separation of transmission and feedback. In Nicola Wood's studies of knife-making, she observes the knowledge flowing through the body into the materials and back the same way (Wood *et al.* 2009). In animation, I propose that the knowledge is flowing down the arms and back into the body via the *visual*, the *illusory* (Fig. 23).

Wood's documentation of students accruing a tacit knowledge of knife-making brings to light the complexity of translating the 'feeling' of how a process, which relies on the haptic feedback of tools, can be unpacked and communicated. When making a single object there appears to be a far more stable perception of what a learner is trying to attain; one can place two knives next to each other and fairly clearly access the inaccuracy. In animation, due to the continual moving characteristic, it is much harder to pinpoint where something has gone wrong. It may be on a single frame, it might be on all the frames, and in order to make any changes you have to stop the animation to ascertain the accuracy of your reading, adjust a parameter and review the results, whilst also retaining a memory of what it was like before, as well as an idea of what it should look like in the future. This triangulation of three different judgments is the looping iterative method of making that is key to animation practice.

Kentridge describes the distance between himself and his charcoal drawing:

> If you work with a really thick piece of charcoal, a stubby piece under your fingers, you can't actually see where the charcoal is touching the page. Somewhere in that mess it is hitting the paper. You have to work with a kind of confidence that your aim and your hand are doing the right thing (2014: 114).

The visceral connection between this imagined movement (internal model) and a visual representation that it corresponds with, is time. On top of this ever-moving, multi-directional, contraflow of time are the notions of technology, skill and taste, all of which are constantly changing or interchangeable. Kentridge recalls being in the midst of making animation:

I didn't know in advance what gesture was needed, so I kept moving each puppet in front of my eyes until it felt right, which is to say, until it corresponded with some notion of thought or desire that I had (2014: 134).

So far in this chapter I have shown how approaching animation education as lifelong and not necessarily bound to one method or skill set, is primary in *Animatory Thinking*. The acknowledgement that animation is *rhizomatous*[24] as a medium should therefore direct the education of novice animators to address the construction of complexity and depth as a key skill of an animator.[25] Embodiment, mental models and tacit knowledge have all been touched on as salient points within *Animatory Thinking*. I have shown how illustrating animation practice as a system can show how all these ideas interlink within tacit making. With all of these points addressed, the next section explores how descriptions of *time* are pertinent to a full understanding of animation practice.

---

[24] Miriam Harris (2019: 114).

[25] Many graduates aspire to work in the games industry. Chris Pallant illustrates how the games industry has an unwillingness "to engage with the politics of representation in any meaningful way" (Pallant 2008), and over a decade later there has been little change.

A Tacitness of Time

This section of the thesis focuses on the very core of animation knowledge which is in play between technology and animator. This embodied experience is used as a schema to judge if the changes to timing and spacing correlate with the animatic illusion.

In order to orientate this argument, I must first define what it is about time that I am discussing here. I begin with a personal experience of time as an illustration of how habitualised we all are to time as a concept that is external to our bodies. I will then introduce how the sociologist Barbara Adam articulates historical theories of time, before discussing the viewpoints from practice.[26] But I begin with my personal experience of time:

> *My wristwatch had been broken for months.*
> *One of the screw heads had sheared off, so the back could not be removed and no one would fix it.*
> *In my workshop, I drilled out the remnants of the screw and replaced the dead battery.*
> *As I placed the new battery into its cradle, the mechanism sprang to life in my hands, as the second hand began to move.*
> *Time began again.*
> *Time, at that moment, was 'restarted'.*

For me, this experience illustrates how the mechanical metaphor of a moving watch hand is linked to one's own sense of time as a progression. Other larger cyclical indicators, such as the rotation of the earth, or its orbit of the sun, are less evident;

---

[26] William Kentridge and Bill Viola both articulate how their practice uses time, and examples of both artists are used later in this section.

the minute and the second are one's daily experience of time, sliced into bite-sized chunks. Fixing my watch created an experience in which I had a sensation of *feeling time*. When I returned to animating after this experience, I felt a relationship between the restarting of the wristwatch and the constant starting and stopping of the timeline in Maya. Time, on my wrist or on the computer, appears intrinsically connected to the technology we use to mark it.

That same afternoon, I picked up my son from school. In the playground, a child had traced their shadow at various times of the day. The body as a clock; chalk marks as technology (Fig.24).

Figure 24. The body delinating time, 2019, Hugo Glover.

The examples I have described are an attempt to frame time in two ways:

1: An embodied sensation of time, subjectively and objectively mediated. A sensation associated with aspects of change in daily experience.[27]

---

[27] The rising and setting of the sun or a feeling of hunger in the middle of the day.

2: The measured, external, numerical and controlled technological experience of time.

Our human relationship to the movement of the hands of a watch, and an existential acceptance of existing within time, is beyond the remit of this PhD. Instead, I am discussing a different experience of time, that which an animator explores in her thinking and action. The ticking watch is the world in motion, life in a directional sense, and this is also the experience of viewing moving images, even if the phenomenological perception of time is manipulated. Galileo used his own heartbeat as a clock to time how long it took a lead ball to drop. The experimental filmmaker Peter Kubelka evokes an embodied phenomenon of a pre-clock time where the human body and its movement through the world, is taken as an internal measure of the world. Kubelka suggests that humans understand the world in steps, as this is the kinetic rhythm of our natural movement, and it shifts the perceived location of time from external mechanisms of clocks or technology, and gives residence to our bodily experience of the world. The application of our own bodies as tools to measure the world could be considered part of our proximity to time.

In *Time and Social Theory*, Barbara Adam states that:

> Time is always social time because only humans regulate and organise their life by time. Only they conceptualise time, only they use, control, allocate, and sell their time, only they lead an 'in time' existence and create their own histories and futures (1990: 154).

Prior to mechanical means, time was delineated through events and phenomena. Adam describes how the "world religions [share] an eternal, transcendent principle behind time and space from which our world emanates and to which we are ultimately to return" (2004: 90). Adam suggests that her work, through focusing on

practices and temporal relations, is attempting to make a shift from a "boundary world" towards "engaging with processes and interdependencies" (2004: 151). Her stated intention is to "minimise distance" and "render the distant close and the strange familiar". To achieve this, Adam positions her argument around the four C's of *Commodified, Compressed, Colonised* and *Controlled* time.

In Medieval Europe, a commodity such as time was in the hands of the church. The shift from a bodily experience of time, to a collective synchronisation of time, has the effect of not only controlling people but commodifying their time and any resultant labour. The pursuit of such a conceptual and technologically dominant idea has led to social advantage and economic growth. For this to happen, the embodied personal experience of time – which Kubelka describes as he strides across a stage beating his chest in rhythmic harmony – had to change. "It is a decontextualized empty time that ties change, creativity and process, but static states are given a number value in the temporal frames of our calendars and clocks" (2004: 124).

Adam's theories of time have illustrated an externalisation of time. A cinematic experience of time (Sobchack 1991) is untethered from a mechanised linear construct. When we are making animation, there is a process of condensing time, from years of labour, to minutes of illusion. Such endeavour is experienced in a temporal flow which has been precisely crafted in order to effect an emotional change in an audience.

So how do animators experience time? Can we describe the mixture of temporalities (our experience of 'now', our memories of past experience and the technological affordances of making animation) as analogous to manipulating physical matter or material?

In Kentridge's discussion of *The Refusal of Time* (Kentridge and Morris 2013), he chooses to illustrate time as distance:

a huge amount of animation is so much about turning distance into time. When you're making a mark across the paper, you're not just making a line but you're characterizing the line, temporally: 'It's four seconds long' ... . I suppose it is about man as a performing clock (2013: 65).

Artist Bill Viola describes how the most important place his work exists is in the mind of the viewer:

> ... it is only there that it can exist. Freeze a video in time and you are left with a single static frame, isolated from context, an abandoned image, like a butterfly under glass with a pin through it. Yet, during its normal presentation, viewers can only physically experience video one frame at a time. One can never witness the whole all at once; by necessity it exists only as a function of individual memory. This paradox gives video its living dynamic nature as part of the stream of human consciousness (Lilley 2015).

Viola's point, about experiencing moving images in contrast to experiencing a single frame, is a useful observation to my argument. It is this relationship between the still image and the moving that an animator exists in, and which they must bridge. It is this liminal state that I suggest has a tacit sense of materiality. Animators, within an extended schema loop, manipulate/compress/coerce time in the process of making an animation. I suggest that time could be treated by animators as matter, being a tangible substance that is adjusted and moulded, cut, spliced, re-shaped and duplicated.

A concurrent principle throughout the history of making moving images is the manipulation of time. If we accept time as the primary basis of animation then we

can begin to construct an understanding of the tacit manipulation employed by animators in their practice. An important distinction to make here is between a subjective and objective experience of time. Historian Peter Galison describes "the refusal of time" as a "node of signalled time, this interconnection of colonial, cartographic technologies and the abstractions of time physics. It relies on a to-and-fro between abstract time, and time in the physical, visual, musical world" (2013: 314). The relationship between numeric segmentations of time (seconds or frames) is analogous to the contours of a map, used to give a 3-D reading of a hill within the 2-D image or page. When reading a map, we can feel the shapes and steepness of a hill, but when we see and experience the hill in physical terms, we do not expect lines every five metres. In the same way, we do not expect or require a visual representation of time as we proceed through an animation; the subjective temporality is familiar enough for us to suspend an objectively marked experience of time.

At this point, I am debating time and space and their inseparability, so I wish to return to animation practice and how to frame these issues with regards to *Animatory Thinking*. Animators use numbers in a multitude of ways in animation in order to slice a movement into separate elements, and when presented in rapid succession, they produce an illusion of movement. We could also describe this as a slicing of time into sections, thereby deconstructing time as if it were solid matter. Despite knowing we are being fooled, we cannot separate our experience of viewing animation from our understanding of movement in our lived experience.[28] So our subjective experience (such as a looping animation in a zoetrope) is based on our objective rational experience, as the expressivity of a representation evokes a memory of similar movements from our lived experience. The division of time into frames, models, cells, etcetera, adds another layer of duplicity; externally, we might read these

---

[28] See Galison's "to-and-fro" (2013: 314).

individual components as the material of animation but – as McLaren points out – it is the interstices between frames and their manipulation that constitutes animation. So, the animator manipulates what occurs in the interstices through the adjustment of images either side of the space time of the interstices. If we define a material as "the matter from which a thing is made" (OED 2017) then we would have to include this interstice within the collection of elements that constitute animation, and the technology of animation as the tool used to shape this material.

To conclude this section, the tools of animation technology afford control of *the animatic,* as well as the possibility of repeatedly reshaping the effect. I have situated these descriptions of time as a primary material from which animation is made. As a core idea of *Animatory Thinking*, it is the manipulation, shaping and reshaping of synthetic time that constitutes animation practice.[29] In the next section, I will build on these ideas of time in animation practice by describing how the contrast of building large zoetropes and working with students using CGI, allowed me to apply *Animatory Thinking* across a range of situations.

---

[29] See Appendix I for examples of one-day animation projects that focus participants on the primacy of animation practice.

The Banyan Deer Flame-Powered Zoetrope, 2015

Figure 25. Candle-powered zoetrope, 2014, Hugo Glover.

Having built several iterations of animation machines, it was evident that such a practice was guided by the control of change. There was little opportunity for failure, for fresh insights. In order for my work to progress, I needed to invite in aspects of random energy, as opposed to the human/mechanical hand-driven movement. There was also the opportunity to work at a larger scale, one in which animation would shift from being held in the hand to being experienced bodily. Such a change of scale meant that the experimentation moved from a worktop into the open air outdoors, bringing the simulacrum closer to the observer. Chris Pallant's work on animated landscapes describes an "instrumental dynamic [...] between artist and real-world environment" (2015: 2). Pallant is describing the connection between depictions of landscape in animated film and one's lived experience of landscape. The acknowledgement of such a relationship works both ways, as "the physical

125

landscape can both become *animated* and itself be an *animating* space – forcing the animator to respond in unique, site-specific ways" (2015: 2).

As a prototype, I built a small candle-powered zoetrope to experience the process before embarking on a larger machine (Fig. 28). By returning to the essential basis of animation, the mechanism of a zoetrope can reveal what Tom Gunning refers to as the "paradox between still and moving images ... Or rather the transformation of one into the other" (2014: 32). Jonathan Cray claims that nineteenth-century visual devices focused on the question of the body and the senses – "Vision, rather than a privileged form of knowing, becomes itself an object of knowledge" (2006: 90). Zoetropes, amongst other 'philosophical toys', do not obscure truth about the world, "[...] but rather offer new information about the process of perceiving and the perceiver's body" (Gunning 2014: 27). In building at a scale that is more aligned to the human body than the human eye, I attempted to explore the paradox that Gunning describes. By first taking animation from a computer screen into the hand, and from there into a field, and finally, an estuary, it situated the zoetrope at a location that at any one time is either land or water, river or sea; a location that signifies ebb and flow of tides and time.

Kentridge offers a description of what it means to make marks in time, weaving together history, drawing, movement and philosophy. He describes the tale of Plato's Cave,[30] and how: "the questions it provokes, its metaphors, are the pivotal axes of questions both political and aesthetic" (2014: 10). Kentridge uses the myth of Plato's Cave as a method to understand the fundamental importance of perceiving shadows. He extends this argument into how we make and understand drawings and thus, can understand animation. The flickering flames of a fire evoked many childhood memories for me, as well as being a source of heat and light. It was the primal essence

---

[30] The allegory of people imprisoned in a cave, unable to look away from a wall illuminated by a flickering fire. Behind the captives, objects or puppets are paraded, appearing as shadows on the wall. Plato's tale of imprisonment, escape and return to the cave illustrates the importance of learning/education/philosophy, rather than accepting how the world appears at first sight.

of Plato's Cave, combined with the descriptions by filmmaker Werner Herzog of how torchlight revealed the astonishing drawings of running animals in the caves in Chauvet, France, that influenced the creation and design of the Banyan Deer flame-powered zoetrope.

Figure 26. Banyan Deer flame-powered zoetrope installed and turning at the Lindisfarne Music Festival, 2015, Hugo Glover.

In Chapter 2, I described how the environment of an animator at work could be considered a form of liminal space (Turner 1974). Other research studies (Woods 2009; Lamarre 2009; Manovich 2002) have focused on the dominance of software in this liminal space. Whilst I acknowledge that the software is an integral part of the animation system, an overemphasis of its effect on the system distracts from much of the 'softer' parts, such as the animators themselves. Each new iteration of animation machine has involved a progression towards understanding and framing a discourse

that exists between human beings and a technologically enabled illusion of life. As a method of exploring my own tacit knowledge of animation practice, each of the machines has taught me something new. In viewing the animatory effect, I gained continuous feedback and experience on the product of my *Animatory Thinking*, skills and competencies, primarily in building physical mechanisms as well as interconnecting technology and context. The technology defined the animated content in a similar way to other instances of emerging moving images.

Figure 27. *L'Arrivée d'un train en gare de La Ciotat*, 1897, Lumiere brothers.

Technology representing technology, both concerned with the transportation of people, one physically, one sensorially. For my work, I began with a deer leaping, nature in motion, dancing with the flames.
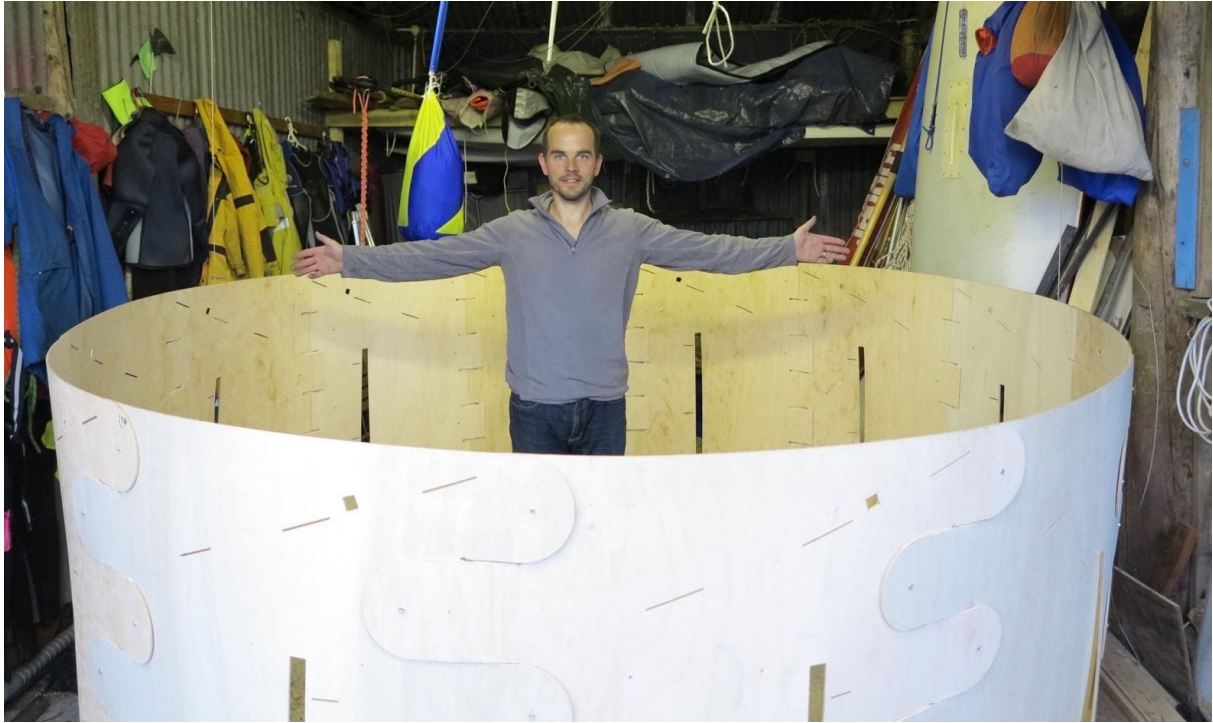
Figure 28: Myself, standing inside the 'animatory space' during construction, 2015, Hugo Glover.

Building the zoetrope involved several iterative steps to acquire the ideal materials, strong enough to support themselves, light enough to be revolved by the convection currents of a fire. The candle-powered zoetrope had allowed me to test various angles of attack for the blades of the machine, but scaling up the bearing at the centre of the zoetrope relied on trial and error. Similar scale stroboscopes[31] use a motor to power the rotation and precise lighting to create the animated effect. The animator and academic George Griffin describes the sculptor Gregory Barsamian's stroboscopes as a "kinetic theatre in the round – and often in the dark – offers a rich reading of actual space, as every facet of the three-dimensional figures are[sic] visible depending on one's (theoretically infinite) points of view" (2013: 278).

---

[31] Spinning sequential objects that appear animated when a strobe light flashing at the same speed as the rotation is used. See Matt Collishaw, Gregory Barsimain and Peter Hudon.

The other aspect of the Banyan Deer zoetrope, along with its 3-D physicality and integral movement generated by convection, was the physical animation objects inside the machine. These 12 wooden laser-cut shapes were of a deer staged in a progressing run cycle. When installed at regular intervals inside the zoetrope, when the zoetrope spun it created an animation with dynamic cyclical energy.

Figure 29: Banyan Deer flame-powered zoetrope at the Lindisfarne Music Festival, 2015, Hugo Glover.

Another trajectory of this project was to create a hybrid form of animated physical practice that would sit at a point between stop frame (manipulating an object and taking an individual photo at each stage of the manipulation) and sequential, image-based (frames) animation. Griffin describes such work as *concrete animation*, a "non-theatrical site-specificity, but its presence is experienced spatially as a very specific type of kinetic sculpture: one which is created only with 'synthetic time', through the tricks of intermittent perception" (2013: 275). The artist Gregory Barsimian quotes Edwin Carels describing animation from a critical art perspective

as "more than purely a filmic practice, animation thus needs to be understood as the staging of an agency: the manipulation and interpretation of intervals, not only between film frames, but also between images and objects in space" (2013: 294). From a spectator's perspective, the zoetrope presents animation in a raw form, deriving both energy and illumination from the flames of the fire. It shows how animation can be thought of as a process of production in harness with a technology to perceive it.

The scale of zoetrope created a physical animatory space in which future animation projects could be brought to life. The most unexpected insight for me was how the whole zoetrope seemingly 'disappeared' when one viewed the animation; when you stare into it everything but the movement of the deer would fade from one's perception. As an object, the zoetrope is an almost silent spinning drum. The spinning movement creates the illusion of 12 deer running on the spot, fixed in time and space, perpetually moving, but pinned to the wall of this inner world of animation.

If we consider the recurrent idea of *distance* in relation to animation practice, the building and installation of this machine, as well as its functionality, gave a visceral experience at each iterative stage of making. Creating this work afforded me the opportunity to experience animation as a tangible medium. All of the formal structures of a stable animatic system were evident: the deer running, the mechanism of sequential images disappearing from one's perception. For me, this installation encapsulated the essence of why I find making animation so captivating: the iterative steps of building a system requiring both creative and mechanical problem-solving at each stage, with a final performance when the effort and the risk are evident but peripheral to the experience.

In the next section, I will discuss the significance of loops in my animation practice and how an animator oscillates between adjusting and observing these loops.

Figure 30. Banyan Deer flame-powered zoetrope, internal detail, 2015, Hugo Glover.

Loops in a Tacitness of Time

The animator Gregory Bennett describes his work as "synchronous and asynchronous time: Loops, cycles, intervals and durations are both moving forward and concurrently held in a kind of dynamic stasis" (Harris *et al.* 2019). In my animation practice, Bennett's *dynamic stasis* constitutes the relationship between viewing a short section of animation, assessing what to change, making a change and experiencing the result. In this section, I will unpack the use of loops in my work as well as looking at examples of other animators' work, such as Studio Smack and Alan Warburton, who bring this raw aspect of animation to the foreground of their

practice. I believe that it is within these loops that a tacit form of animation knowledge emerges.

Figure 31. *PARADISE*, 11-minute looping animation, 2016, Studio Smack.

In 2016, the Museum of the Image (now Stedelijk Museum Breda) commissioned Studio Smack to create an animated interpretation of Hieronymus Bosch's painting *The Garden of Earthly Delights* as part of a 500-year celebration of his work. Viewing the animation, I was struck by a sensation of wandering: my eyes roamed the screen as the flickering movements caught my attention. As there are no edits, or other cinematic tropes, I was left free to roam the multiple animated loops and appreciate the characters, who appeared to be trapped in an infinite cycle of self-delusion. Bosch's original work has often been interpreted as a "didactic warning on the perils of life's temptations" (Kleiner and Mamiya 2004: 564) and Studio Smack's homage to this timeless work of art offers us a similar view. I include it here as an example of how loops of animation can be used to present an idea of being

locked in time. They also have the effect of focusing attention on movement, as opposed to a narrative.

Another influential animator whose work employs a similar use of looping animation is Alan Warburton. In his film *Spectacle, Speculation, Spam* (2016), Warburton gives an overview of current commercial animation (spectacle), contemporary digital art practice (speculation) and his fusion of the two (spam). Warburton uses commercial levels of production quality to generate probing and speculative insights that question how the surface of CGI animation fails to engender the materiality of its production. His analogy of 'spam' in relation to his own, and other leading artists in this field, reflects his belief that the artist must be immersed within the making process in order to critically explore digital representation. Both examples, untethered from narrative, can be experienced as *animatic*.

In my own work I consciously distance myself from working in a digital arena. The intention of positioning myself outside of the digital space is to offer an insight and perspective back into what the digital offers. In *The Refusal of Time* (Galison *et al.* 2013), Kentridge includes a transcript of a conversation between himself and the editor Catherine Meyburgh. Part of their discussion revolves around a comparison of the digital editing software and the editing of physical film. Meyburgh describes the complexities and multiple temporalities of her editing process, to which Kentridge replies:

WK: 'It's imagining it in your head, then seeing it on the screen and then going back and redoing it. In a strange way, the digital makes it more labour intensive in some ways.

CM: Because of the possibilities.

WK: Because of the possibilities, and once you have those possibilities, you can't ignore them. (2013: 294)

In constructing animation machines, I am limiting the flexibility of the animation, as there are fewer possibilities than those afforded by digital animation; what remains are the bare bones of manipulation.

The repetition of a loop of movement allows an animator to get a 'feel' for the movement. In this practice of making changes to our animation, we are playing with time, manipulating, reworking and polishing an animatic effect. When we are creating an illusion of movement in animation, the plasticity of the medium has the effect of decoupling us from more normative experiences of time. These two examples of animation practice at either end of the spectrum of processes – stop frame and CGI (Fig. 32) – are illustrated below using this view of animation methods and overlays on a graph depicting 'expressivity' – what Chow would call *liveliness* (2013) – on one side and 'control' on the other.
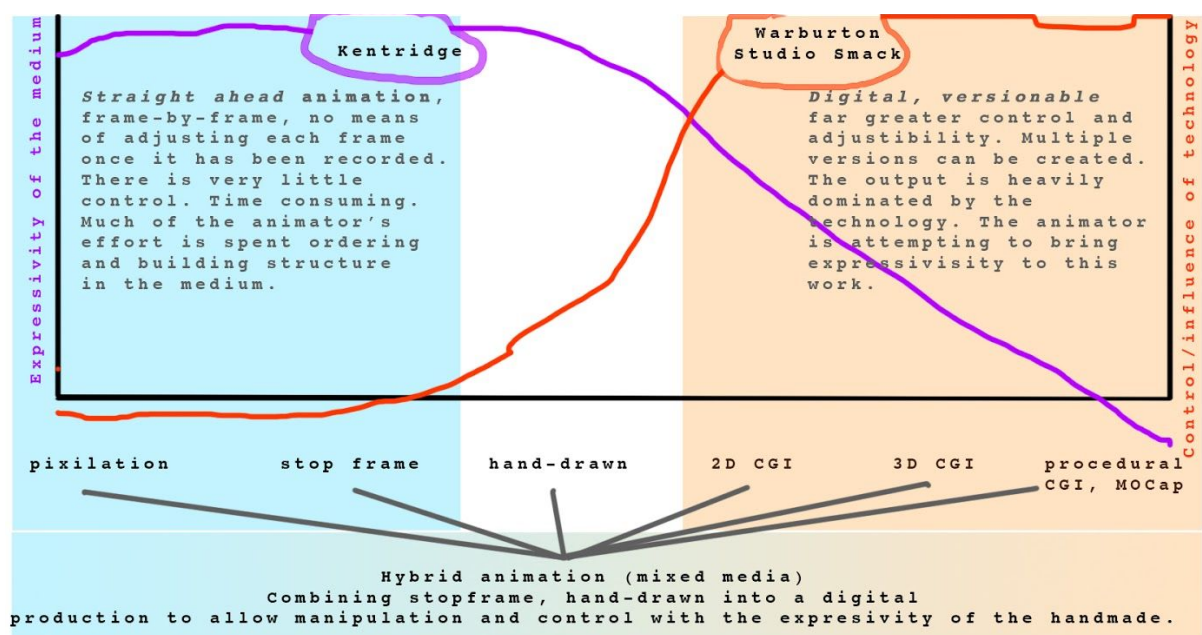

Figure 32. A graph illustrating Expressivity versus Control of animation mediums, 2019, Hugo Glover.

135

Stop-frame animation uses rigs to support aspects of a character or set in a frame when it would be accelerating or decelerating in real time; thus the experience of the animator is always in a static frozen moment before progressing to the next. In this instance, there is a great deal of physical interaction with the material of the objects/set but a large separation from the experience of time. The opposite is true in CGI animation, where no experience of a haptic nature is found. The manipulation is structural but the technology allows a far greater interaction with time as a material as CGI software allows an animator to work in a more fluid fashion. Figure 32 attempts to illustrate the idea that in every technique of animation the objective is to generate an illusion that is engaging. This does not mean a life-like or accurate representation of our own perception of the world, but a representation that emphasises the expressivity that animation can communicate.

When an animation is perceived, there is a palpable sensation of life, and of depth, into which we project our own understanding of the world. In *A Schema for Depiction,* Stephen Boyd Davis explains that "perception is not the sum of a series of flat pictures, but the result of an active negotiation with the world in depth" (2007). Both Warburton and Studio Smack's work seems to demand an internal negotiation by the audience, to question preconceptions of how bodies move, how landscapes look and how repetitive movements allow time to fold in on itself, looping around and around.

The area of hybrid animation/mixed media allows an animator to mix the expressivity of the hand-made with the control of the digital. I would argue that we are beginning to experience a maturing of technological development in the creative fields of animation. Classical boundaries between styles and/or technologies of animation are increasingly indistinguishable, thanks to the accessibility of digital technology and a constant cultural appetite for animation that has the power to "astonish, influence and coerce" (Buchan 2013: 1).

'Push' Flame-Powered Zoetrope, 2017

Figure 33. Zoetrope, reconstructed at the Newbridge studios, Newcastle upon Tyne, July 2017, Hugo Glover.

In 2017, I rebuilt my zoetrope in Newcastle upon Tyne, UK. This construction gave me time to experience the animatory space and reflect on the two years of building and rebuilding this machine. At the time, I was also working on a design brief for second-year BA Animation students based on Camus's *The Myth of Sisyphus.*[32] Camus suggests that a close reading of the myth and its relation to the human condition allows one to contemplate Sisyphus not as a tortured, labouring, wretched lifeless prisoner, but as a person happy in their toil. No matter if it is the same boulder and the same hill, each time the experience is unique and on the descent of the hill, there could be a satisfaction in experiencing the world as if refreshed. I believe that this refocusing of the myth from a tale of suffering to one of optimistic

---

[32] See Appendix II.

revelry in the fine detail of a lived experience has close parallels with the practice of making animation. Animation scholar Sean Cubitt states that:

> Direct animation maintains the eternal presence of flux, the mythic time of undifferentiated perception. This external present is the pure expression of subjectivity as experiences, a phenomenological and unending becoming shared by the world and our consciousness of it (2013: 94).

Figure 34. Installing the 'Push' zoetrope, Afon Dwyryd estuary, North Wales, 24 August 2017, Hugo Glover.

Figure 35. Feeding the fire as the tide rises, 'Push' zoetrope, Afon Dwyryd estuary, North Wales, 24 August 2017, Hugo Glover.

The fire is lit, heat rises and the zoetrope begins to turn.

As tidal waters saturate the landscape, logs are placed on the raised fire. Flames shout and rage, pop and fizz as embers cascade into the water below.

Time passes.

Listen.

Time passes.

The fire has spread, this system has come to life.

The presence of the animatic emerges from the confluence of fire, water and machine. Sisyphus's eternal struggle is rekindled, and I am exhausted from my efforts.

But I am happy.

Figure 36. 'Push' zoetrope, Afon Dwyryd estuary, North Wales, 26 August 2017, Hugo Glover.

This machine is a technological imposition on the landscape. The zoetrope has been realised over four years of exploring animation through constructing scenarios, some mechanical, some performative; each acting as a bridge between animation practice and Design Research. Within the exploration of *Animatory Thinking* and practice within my PhD, this final installation was designed to signify the furthest point that my practice could reach within the scope of the study. It began with exploring animation unbounded by a screen or frame; it concluded with a pyre, a machine, an animated sequence of Sisyphus and black mirror of shimmering tidal water.

The short sequence of frames within the zoetrope are taken from Marcell Jankovics's film *Sisyphus* (1974). Sisyphus is in mid-toil, the boulder barely moves, every sinew of this body is exerted to progress the task. As the blades of the zoetrope

turn, the animation emerges and the viewer/audience watching should experience the looping, staggering figure, trapped within technology, between water, fire, earth and air.

Figure 37. 'Push' zoetrope – Sisyphus, Hugo Glover.

As the tide rises, the fire is reflected upward and outward towards Sisyphus and the audience. The fire needs constant attention, adjustment and refuelling. As an animator, this is my only role in this performance: to adjust the parameters of the fire, which in turn breathes life into the machine. The experience of seeing this machine moving, living, breathing is difficult to take in. I know that I cannot capture these phenomena in any recorded means and I am exhausted from my own efforts of transporting and constructing it, with the immovable timely deadline – an incoming tide. Until the fire was lit, I was at work for hours inside the machine, tuning and shaping each of the 12 objects in turn, and loading and setting the wood underneath,

considering the size, burnability, weight and arc shape as essential fuel for the zoetrope. While the zoetrope was static – prior to the lighting of the fire – I felt interwoven with the materials and connected physically to the stability of the machine. The process of building the work, of constructing, solving and resolving the machine generated for me a palpable, lasting memory of its physicality. When I lit the fire, it changed; as the machine and its environment aligned, the time-consuming installation became a time-based performance and a spectacle. As soon as it had its own energy, I was no longer a part of the system; I was outside the circle. This was the first time that I had installed and lit a fire under a moving zoetrope over water, and I was captivated by the effect. The phantasmagorical performance was the end of the making and I took my place within the audience. I had evolved from animator to viewer.

The machine had taught me that however immersed I had become in the making, that ultimately, the animation had its own life. I had left the animatory world and returned to the lived world. I had felt this experience bodily, and I had exerted physical and mental energy and constructed this stable system which then existed without my input. How could I ask my students to follow the same journey or at least be aware that the practice of animation was one of construction and craft, rooted in physicality? The final output being both the goal and liminal transition from inanimate components into life, when one's work will have left its own influence and can exist on its own. As well as this relationship to the machine, the setting of the work in a landscape, between tide and fire, brought into focus the importance of the environment in both constructing and viewing animation.

Emerging from my practice are questions: What have I learned? How can I use this experience in my teaching? When I use the computer, will my ideas of animation and technology have altered?

On returning to Newcastle upon Tyne, and commencing another academic year of teaching, I experienced a palpable void between the computer animation and the immersive bodily experience of the zoetrope on fire surrounded by water. As I re-acquainted myself with the technology of CGI animation, I sensed the erosion of the zoetrope experience as I wrestled with the weight and complexity that CGI encompasses.

I found that my re-acquaintance with Maya was akin to the sensation of returning back home after a period of travel abroad. The further I have travelled, the longer I have been away, the greater the culture shock as I see the world through different eyes, highlighted especially on my return. The practice of building and installing the zoetrope had given me this technological expedition, which I could now share with my students through technological and tacit means.

The students' exploration would be within the confines of CGI animation, which again would allow for reflection on the contrast in animatic apparatus and its affordances within a computer lab. As previously discussed, ideas around embodiment became a useful method to illustrate to students how they could construct and use their lived, embodied experience within their practice. In doing so, each student could consider themselves an expert in how their character represents their own personal struggle.

Animation as a Sisyphean Task

The second case study follows Level 5 (second year) BA Animation students building on their knowledge gained in the 'Pilgrimage – Introduction to 3-D' module that I discussed at the beginning of this chapter. The students had already experienced the value of constructing layers of meaning into their work. Whilst they could simply fly a virtual camera through CGI worlds for the Pilgrimage brief, a character performance in CGI requires a far greater immersion within the medium. Ward points out that:

> There will always be a tendency towards the fetishization of technology in those courses that are predominantly merely reflexive, simply because what is being reflected upon is the production process (rather than, as Wayne (2001) argues, the broader theoretical and conceptual dimensions) (2018: 98).

The tension that Ward describes between creativity and technology, must be harnessed through *critical practice*, thus establishing a dialectical relationship between the two.

The Sisyphus brief emerged from the 'Push' zoetrope installation I discussed in the previous section. As part of an Action Research model, this interconnection between practice, research and teaching encompasses an "ongoing, systematic, empirically based attempt to improve practice" (Tripp 2005). The intention of this brief was to focus the students' attention on their own life experience as the basis for a CGI character animation project. The rationale for this approach was to foreground the ideas of the embodied mind (Johnson 1990) and begin to connect the embodied knowledge that the students already possess with their new skills and competencies in CGI. By asking students to place their own personal life struggles at the centre of their creative animation process, I intended to connect their

unarticulated subconscious understanding of an internal struggle with a digital representation they would create. This module focuses on creating an engaging and believable performance which, ideally, transcends the method of production, whilst conveying a sense of gravity, weight and toil of a laborious bodily experience.

The brief had three stages:

1: Identify a personal 'struggle'.

2: Translate this struggle into a looping performance that communicates metaphorically the essence of the struggle.

3: Develop and deploy the digital skills of manipulating a CGI character to enact a believable performance.

We began the brief by going for a walk to the top of a nearby hill (Figure 38). Whilst on the walk, the students and I discussed possible research directions. Two hours later, at the end of the walk, each student had arrived at an explanation of how they wanted to approach the brief, and what their personal 'struggle' could be.

Over the following weeks, as the students accrued the various technical skills and competencies necessary, they also developed their initial struggle into a physical performance that they could translate into CGI. Annabelle Honess Roe offers a detailed articulation of how animation is a type of performance "imbued … with ideas of embodiment and the corporeal" (2018: 69). Honess Roe suggests that we consider the act of animating, adjusting and manipulating drawings or puppets, as "bringing something into being" (2018: 74), and therefore a type of performance in itself.

Figure 38. Animation students walking up a hill, Newcastle upon Tyne, October 2017, Hugo Glover.

Emphasis was placed on students acting out and recording each other performing the movements that they wanted their own characters to perform. Acting out a scene has been a fundamental part of animation practice from its inception (Hayes and Webster 2013). What is different in this case is that the animators are attempting to directly translate their struggle into action, as opposed to acting from a script of stage direction. The process is therefore not mediated through a third party (screenwriter or director). The intention of this approach was to position the student as the expert, in order to allow them each to connect intimately to their own struggle, which would scaffold their learning by attending to the skills and competence required to recreate their experience. This would ultimately lead

them to use this subsequently heightened level of expertise when creating their animation.

To illustrate this trajectory, one of my students used his personal passion for, and experience of, making music as the basis of his animation. He reflected later:

> I came to the idea of pulling a bandwagon, attached to the coattails of the character's jacket, whilst blindfolded. The character himself was to symbolise me as my alter ego, when I make music I am known as Baron Von Alias, a kind of old fashioned looking character with a top hat and moustache. The coat tails idea fitted in well with the look of the Baron character. The idea has since come to mean a whole lot more to me personally about the struggles I have gone through with my music career. The feeling of pulling the bandwagon, people jumping on-board when seeing my success, the feeling of carrying those people on my coattails, blindly leading the way, when essentially not knowing what I was doing or where I was headed myself. Along with the feeling of never really getting where I wanted to be, and always starting over from scratch, with mixes of tracks, promotion of releases, re-recording vocals, never being fully happy with the end product (2018).
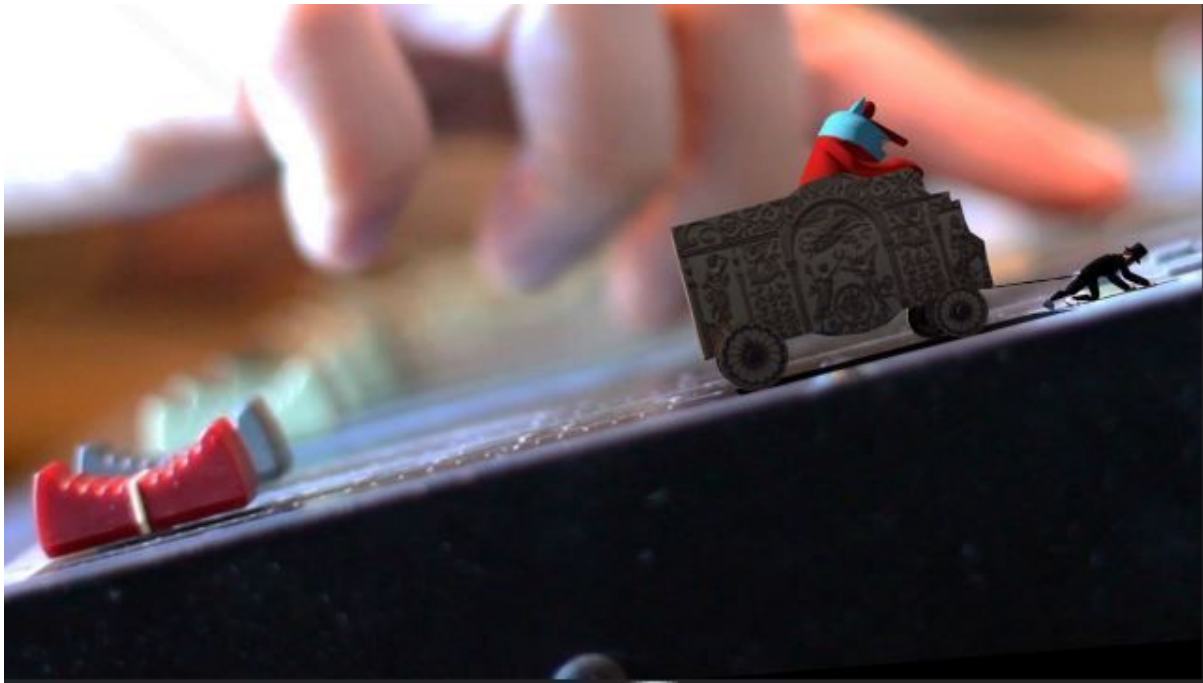
Figure 39. Sisyphean struggle, CGI animation, January 2018, Steven Haggie.

Acquiring the skills and competences to navigate the complex environment of CGI animation is a long process. Although a great deal of step-by-step guides exist by following predefined steps, a student is walking a path they have not chosen. The consequence of an over-prescriptive pedagogical stance is a creative homogenisation of both practice and output. By navigating around all of the creative and technical pitfalls students arrive at a destination with little knowledge of how they got there. The greater ownership and investment the students gain of their own creative instincts the more autonomous their learning becomes. From my perspective as a lecturer, the interactions I have with the students is less about if an animation 'looks right to me' and more that it 'feels right to them'. The students' own reflective practice through their blogs, as well as the sharing of their work in 'crits', all inform the *communitas* (Turner 1974) amongst the group. They are all struggling with the technology, but the active progress they make collectively brings with it a sense of movement, in their animation and in their skills. As the students sit and work, I could see a mixture of structural aids being employed: some were using video tutorials, others were working together, many had a second monitor showing their

own video reference of actions performed. They were all engaged in their individual flow of memory, technology and translation.

Paul Ward illustrates the dialectical relationship between creativity (the horse) and computer technology (the cart) and the problems arising from putting one before the other. As mentioned earlier in this chapter, I take an agnostic view of technology in relation to animation practice. In encouraging students to do the same we can maintain perspective on driving the horse whilst making use of the cart.

The design of this brief, and some of the animated outputs generated, could be regarded as a rich and deep learning experience for those involved, though this was not universal by any means. Many students struggled in an unproductive way with both the creative task and the technical competencies. Others found using Maya fairly straightforward but made limited progress with such a conceptually challenging way of working. Yet each student who engaged in the process had their personal experience as well as the collective journey as a community or *communitas* (Turner 1974) of practice.

Chapter Conclusion

In this chapter, I have given an overview of embodiment as a philosophical basis on which *Animatory Thinking* is constructed. I then introduced practice-based descriptions of mental models, or templates (Korn 2014), which acknowledge how creative decision-making is based on our individual accretion of lived experience. Having established embodiment and mental models, I then looked at descriptions of tacit knowledge and how all these ideas have emerged from my practice, as described in Chapters 1 and 2.

With a theoretical basis in place, I laid out how I have used my teaching, specifically the design of briefs, to foreground *Animatory Thinking* to my students. As part of the Action Research methodology of *plan - act - observe - reflect*, both my students and I would deliberately foreground this research model. In doing so I was applying ideas from my practice to the design briefs for students' practice. These reflective loops within loops acted as a measurement of creative distance. In my practice I was aware of the physical distance between myself and the animatic or animatory space (the internal space of the zoetrope). When working with my students they were engaged in an internal, tacit negotiation of the animator space of Maya, and the distance I experienced was that between lecturer and student – both physically and practically.

In the first case study, Pilgrimage, I showed how structuring visual research could be used to achieve layers of intellectual depth to student projects through *critical practice* (Wayne 2001). I also showed how a sceptical approach (Berger 2008), as opposed to a fetishisation of technology (Ward 2018) was implemented to emphasise the importance of animation's "multi-sitedness" (Ward 2018: 92).

In teaching animation I always seek parity between originality, technology, learning and experiences with the aim of empowering my students to value the road less travelled. In exploring anthropological descriptions of pilgrimage, Nicholas

Abraham's "rhythmising attitude" (2003) is an insightful description of an embodied experience of walking, which I am suggesting has relevance to animation practice, and therefore *Animatory Thinking*. It is useful to note that my PhD research has directly informed a creative shift for me as a lecturer in animation. This transition can be mapped through the year-on-year change in the briefs I have written.[33] As well as learning CGI, students also act out movements, articulating what materials the elements within the animation are made of, how much they might weigh, what inhibits their movement or enables it. All these things, I believe, foreground the tacit, embodied skills of an expert animator, and value *Animatory Thinking* as a critical, fundamentally important part of animation practice.

Having examined the first case study of observing novice animators, I then showed wider examples of tacit knowledge within animation practice (Kentridge 2013) as well as explorations in Design Research (Wood *et al.* 2009). Having established both practice and theory, I described the locus of *Animatory Thinking* as 'a tacitness of time', where notions of technology creativity, temporality and the an-ontological (Levitt) flux of animation practice are enmeshed.

The final stage of my practice for this PhD was the Banyan Deer and 'Push' flame-powered zoetrope installations (2015 and 2017). I described how the concept for such a large piece of work emerged from the earlier cycles of Action Research. From the first installation in 2015 came further theoretical positions; the importance of loops in animation and comparing expressivity and levels of control in various animation types and the presence of distance as part of animation practice.

The last installation of the zoetrope (2017) in the Afon Dwyryd estuary, was used to explore the myth of Sisyphus (Camus 1942), which also informed the design

---

[33] Previously, the animation briefs I have written have focused on commercial notions of animation practice, such as branding or advertising. Now, my briefs attempt to foreground philosophical ideas in order to highlight critical reflection and a rhizomatic approach to animation.

of an 'Animation Performance' brief for students to tackle. This final Action Research cycle illustrated how practice, theory and dissemination have each contributed to the structure and rigour of *Animatory Thinking*.

Animatory Thinking: An Overall Conclusion

In this conclusion I will briefly revisit the key questions of this thesis and reiterate how the cycles of Action Research have been used to answer research questions, and in doing so, generate new knowledge.

This PhD research, in its physical and written work, has been conducted in order to answer questions about animation practice as a hitherto under-explored area of academic enquiry.

Key questions

At the beginning of this thesis, the research questions state the trajectory of both practice and theory to be explored.

1 - How can an understanding of animation as a creative discipline be constructed from practice rather than output?

2 - By arguing for the animator as a focal point within a larger system of animation practice, can we illustrate how animation practice appears through the lens of Design Research?

3 - How can articulating aspects of tacit knowledge influence a novice animator's understanding of how their own lived experience relates to the craft of animation practice?

In answering these questions, Action Research was used in order to effect a "change through action" (Foth and Axup 2006) and in doing so to put practice at the centre of this research and its findings.

Chapter 1 - 'Breaking Good': Outcomes

This first phase of Action Research began with revisiting a childhood experience of breaking pots. Upon reflection, valuable ideas emerged to carry forward in my practice, specifically the importance of looping, or synthetic, time. Also covered in this chapter was an in-depth discussion of Design Research, Action Research, critical practice and research through design; all of which employ iterative cycles as a mechanism for change.

By beginning my research physically making objects, I was able to build on this first phase through identifying such work as core to my understanding of animation practice. The objects I made were defined by their material structure as well as the process acted upon them.

Chapter 2 - 'Animation Machines': Outcomes

The second phase of Action Research began with further exploration of synthetic time, looping and physical making as a loose triangulation of ideas. The resultant animation machines highlighted the observatory and performative necessity of an animatic effect. I wanted to get as close as possible to the animatic effect: without a screen or digital media the illusion is as accessible as possible. Out of this practice came an awareness of *distance* in articulating animation practice. Building a stable and functioning illusion of life required me to oscillate between an animator and animatic effect. I took note of this experience when exploring literature which discussed the interconnectedness of technology and animation. I also unpacked a range of literature regarding theoretical attempts at defining animation. In conclusion to this stage, McLaren's assertion as to the 'invisible interstices' (Sifianos 1995) still stands as both accurate and useful to understanding animation practice.

Towards the end of this chapter I examined various examples of literature which have attempted to convey discrete animation knowledge. Included in this discussion are training courses which also provide a skills-focused approach. Part of my argument, laid out in the Introduction, was the gap between discussing skills (how to make animation) and the broader theoretical discussions existing in much of the academic literature. In order to effectively explore this gap, I modified the parameters of my practice in readiness for the last cycle of Action Research.

Whilst I had learned a great deal from the building of small-scale machines I felt that building work outdoors, without the mechanical control of gears or cogs, would offer a deeper exploration of animator, technology and environment.

Chapter 3 - 'Banyan deer and Sysphian zoetropes': Outcomes

In this final chapter I discussed the last cycle of Action Research, beginning with the development of flame-powered zoetropes informed by relevant theories of tacit knowledge, embodiment and mental models. I unpacked in detail the function of design briefs which are directly informed by my practice, as well as ideas of philosophy and embodied memory. I documented how I explored practical and conceptual ideas of pilgrimage and the myth of Sisyphus with my students.

Having explored the key aspects of tacit knowledge, I linked this to relevant theoretical assertions of time, whilst rooting my discussion in my own lived experience.

The final installation of the zoetrope on a tidal estuary signified the furthest point of exploration into the tacit knowledge within animation practice. I used this experience as an extremity of physical technology in contrast to teaching CGI.

The following lists summarise my new contributions to knowledge. In accord with the practice-driven nature of the research, I have listed the practical contributions first.

Practical research contributions to new knowledge

- A portfolio of making animation that demonstrates a relationship between artistry and technology; dignifying making.

- A physical exploration of the myth of Sisyphus, embodied within the making of animation and its installation within a landscape.

- A series of design briefs that tested ideas of a relationship between an animator's lived experience and the animation they make.

- Demonstrating how animation as research can stitch together ideas from art practice, design thinking, philosophy and our shared, embodied understanding of the world.

Theoretical research contributions to new knowledge

- Investigating animation through the lens of Design Research.

- Defining *Animatory Thinking* as a term which values the animator as a physical, embodied, sensing presence within a larger system of animation.

- Redressing the balance away from animation output or animation technologies towards valuing the iterative practice of making.

- Adding to an understanding of 'the animatic' within Animation Studies.

To Conclude

> There's always been a kind of slipperiness that haunts the usages of the term (animation), a slippage from art to life and back again. In the animatic apparatus however, these converge, as life becomes not a property that one has, or doesn't. But a site for intervention, a production, *poiesis* (Levitt 2018: 3).

My curiosity has always been the engine which powers my creative practice. Smashing pots as a child was one of many experiences of curiosity becoming action: the 'What if …?' Taking action as a primary means of understanding one's environment has always been a natural thing to do for me. The visceral pleasure of working with my hands, shaping materials and making objects, all led me to study design. The education I received has allowed me to build on my curiosity, to see the world as an ongoing unfolding experience into which new ideas emerge through experimentation. Working as a commercial animator allowed me to exploit my making skills in the real and virtual worlds, combining them through the medium of digital compositing. What first led me into animation was a desire for my work to have life and vitality beyond its production. Once I began working inside animation I was still curious, I wanted to know how it *really* worked.

During the process of making my work the animation inside each machine kept asking me questions: What am I? How should I move? What do I mean? I was experiencing the internal discourse of the animatic, where "technical objects are not the Other of the human, but themselves contain something of the human" (Combes *et al.* 2012: 77).

Animatory Thinking is a means of acknowledging lived experience as a hitherto unmapped component of animation practice. In addition to this, *Animatory Thinking* also attempts to articulate the tacit knowledge within animation practice as a conduit between technology and an animator's lived experience.

Wading through the tidal water, feeding the fire as the zoetrope turned, I had constructed an experience which combines every aspect of my creative tenacity. For a short time my curiosity was sated as the flames flickered and Sisyphus toiled.

Throughout this PhD, my practice of making animation machines has generated the core ideas and reflection from which all other aspects, be they teaching or reading theory, have been measured. The appendices to this thesis include other experiments: some are iterative stages between the larger projects, others are one-day animations with students. What links all this work is my curiosity to pursue the way, the Camino – " . . . a metaphorical path not bound to space. It is the 'between' of 'from' and 'to' … it is marked as temporally indeterminate" (Slavin 2003). Whilst this Action Research methodology has afforded broad creative freedom, there are clear limitations to this approach. I chose not to interview my students or require them to do anything other than fulfil the design brief. Schön notes that "reflection interferes with action" (1987: 278) and can paralyse us as we "surface complexity". Although the students are reflecting on their work after they have completed it, they are recording the aspects of practice that failed as well as those which succeeded. In doing so their personal reflections[34] were not written for the benefit of my research but for their own journey. This decision came out of my own reflective practice in making my work. Whilst taking photos of key aspects became a habit of recording and gathering, it could be accommodated into the flow of making without much distraction. In attempting to articulate the tacit knowledge of animation there was the conundrum of somehow making it un-tacit. To this end, I have relied on my

---

[34] See Appendix II.

own examination of my personal design-orientated problematising practice as my tacit knowledge. In order to evaluate the validity of the ideas which emerged, including my perspectives on working with computers as a workshop for animation, I folded the ideas into the design briefs. In doing so I defined the starting point of the students' exploration, and the trajectory they should follow. They all had the same technology to use, and they could evaluate how they had translated their embodied knowledge into their work. In choosing not to interview them, my intention was to maintain the studio practice as tacit; the students' reflections expressed via their blogs [35] could capture any sparks of their own reflection.

Within the heterotopia of the studio, there are animators and technology engaged in a manipulation of worlds within worlds. These modern Prometheans are engrossed in the toil of animation. Such work is an intensely personal endeavour. The investment of attention poured into each detail can be fanatic. Even with looser, faster methods of creating animation, there is still a metronomic, rythmatising sensation of being part of the machine, of a system of generating life.

This thesis is concerned with the experience an animator has in the process of making their work. All animation practice is beholden to the effect that sequential images have on our perception and thus on our embodied experience of the world. I have not spent much time describing how animation *works*, other scholars go into great detail about the history and description of such effects.[36] How moving images work is partly explained from a scientific perspective, which could include a discussion of the speed of light, the inadequacies of the human sensorium (Gunning 2012) or a gestalt of illusion. This thesis takes the position of accepting animation as a part of human perception.

---

[35] See Appendix II.

[36] See Carol MacGillivray, *Choreographing Time: Developing a System of Screen-less Animation*, 2014.

Future Work

Throughout this PhD, I have attempted to balance a triangulation of making, theory and reflection. There are many questions which have emerged throughout this work, some of which I will highlight here.

Future Work in Animation Studies

This PhD has highlighted the richness of creative practice which comes before the final output. A significant aspect of animation production, from a research perspective, is the fact that much of the practice is re-visitable, either through the physical models of a stop motion film, or richer still, the digital incremental stages of CGI film-making.

Tales of catastrophes during CGI filmmaking[37] have become legendary within an industry that relies so heavily on the stability of computer systems. Such stories could be the tip of the iceberg regarding knowledge locked within animation industrial production. As the interview with Warren Trezevant illustrated,[38] animators make the decisions about what moves, when it moves and how it moves. There can be many thousands of distinct choices within each intervention. This is often a silent, personal, iterative flow of familiar, yet precise, movements with a pencil, a piece of plasticine or a Wacom pen. This PhD has concentrated on the single actions of an animator as an individual; more often than not animation is constructed in teams. The influence that a studio's environment exerts on the animators at work is another possible avenue to explore in the future.

This PhD has attempted to delineate a gap in knowledge regarding the practice of making animation. Having identified the fundamental relationship between animator and technology as a point at which *Animatory Thinking* is at work, I have

---

[37] Ed Catmull's 2007 lecture at Stanford University entitled 'Keep your Crises Small' recounts a series of near disasters at Pixar Animation Studios and how animators responded to these events. Trudie Styler's 2002 documentary, *The Sweatbox* offers another glimpse into the complexities involved in making animated feature films.
[38] See Appendix III.

argued that embodied knowledge has a significant presence in this space. I would hope that future research is not distracted by comparisons of differing modes of making, but instead explore commonalities of translating our lived experience into the animatic.

Future Work in Design Research

This PhD has attempted to navigate a balanced exploration of making, theorising and reflection, or research as design (Jonas 2014). The outputs generated, machines, short animations, diagrams and text each offer individual grains of knowledge and evidence of experience. As Frayling suggested in his *Provocations* (2015), one of the areas that Design Research should explore in greater depth is tacit knowledge. Frayling goes on to describe how such knowledge exists within a creative dialectic between the effort of making and the goal of bringing something new into the world. This PhD has attempted to delineate the salient aspects of what it takes to make animation, and how technology and human experience mix through practice. More work is needed in exploring tacit knowledge and the related tension between tools, materials and makers.

Future Work in my Own Practice

Building physical machines has been formative to this PhD. The comparisons between a physical experience of animation and a digital experience has offered up some compelling paradoxes. I have touched on levels of control that differing types of animation afford, as well as the levels of liveliness that are also evident. The mixing of physical and digital has been a consistent theme in much of my work prior to this PhD. In many ways, I have attempted to understand why I find such hybridity compelling to make, but more work is needed in this area in order to explore animation as more than a process.

Lastly, I hope that designers continue to make animations as a means to explore ideas, possibilities and provocations. I believe that animation, as a method of creative practice, has unbounded potential to offer a response to the questions that philosophy, politics and society can pose. The deeper we enter into the virtual world, the more we need to understand the embodied reality we occupy.

Bibliography

Adam, Barbara. 2004. *Time*. Cambridge, UK ; Malden, MA: Polity Press.

Archer, Bruce. 1965. *Systematic Method for Designers*. Council of Industrial Design.

Archer, Bruce. 1979. "Design as a Discipline." *Design Studies* 1 (1): 17–20.

Archer, Bruce. 1995. "The Nature of Research." *Co-Design Journal* 2 (11): 6–13.

Archer, Bruce, Ken Baynes, and Phil Roberts. 2005. "A Framework for Design and Design Education." https://www.academia.edu/15915348/Bruce_Archer_Ken_Baynes_and_Phil_Roberts_A_framework_for_design_and_design_education. (Accessed 08/07/2019)

Argyris, Chris, and Donald A. Schön. 1974. *Theory in Practice*. First Edition edition. San Francisco: Jossey-Bass Inc, Publishers.

Ballard, Dana H., and Christopher M. Brown. 1992. "Principles of Animate Vision." *CVGIP: Image Understanding*, Purposive, Qualitative, Active Vision, 56 (1): 3–21. https://doi.org/10.1016/1049-9660(92)90081-D. (Accessed 11/06/2019)

Beauvoir, Simone de. 1997. *The Second Sex*. New Ed edition. London: Vintage Classics.

Beiman, Nancy. 2015. *Animated Performance*. 2nd edition edition. London ; New York: Fairchild Books.

Benjamin, W. and Underwood, J. 2008. *The Work Of Art In The Age Of Mechanical Reproduction*. London: Penguin.

Berger, John. 2008. *Ways of Seeing*. 1st edition. London: Penguin Classics.

Biggs, John, and Catherine Tang. 1999. *Teaching For Quality Learning At University*. 1 edition. Maidenhead: Open University Press.

Black, M. 1983. "The Black Papers on Design: Selected Writings of the Late Sir Misha Black." Oxford: Pergamon Press.

Blom, Ina. 2014. In *Between Stillness and Motion: Film, Photography, Algorithms*, edited by Eivind Rossaak, First edition, 137–56. Amsterdam: Amsterdam University Press.

Boyd Davis, Stephen. 2007. "A Schema for Depiction." *Visible Language* 41 (November): 280–300.

Brey, Philip. 2000. "Theories of Technology as Extension of Human Faculties." Metaphysics, Epistemology, and Technology. Research in Philosophy and Technology, vol 19. Ed. C. Mitcham. London: Elsevier/JAI Press.

Brown, Tim. 2008. "Design Thinking." *Harvard Business Review* 86 (6): 84.

Buchan, Suzanne. 2007. *Animated 'Worlds'*. John Libbey Publishing.

Buchan, Suzanne. ed. 2013. *Pervasive Animation*. London: Routledge.

Buzard, James. 1993. *The Beaten Track: European Tourism, Literature, and the Ways to "Culture", 1800–1918*. Oxford University Press.

Camus, Albert. 1942. *The Myth of Sisyphus*. Reprint edition 2005. London: Penguin.

Canemaker, John, and Charles Solomon. 1987. Art of the Animated Image: An Anthology. Los Angeles: The American Film Institute.

Carels, Edwin. 2013. "Spaces of Wonder." In *Pervasive Animation*, edited by Suzanne Buchan, 292–316. London: Routledge.

Catmull, Ed. 2014. *Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration*. 18 edition. London: Bantam Press.

Charny, Daniel. 2011. *Power of Making: The Case for Making and Skills*. 1st edition. London: V&A Publishing.

Cholodenko, Alan. 2007. *The Illusion of Life II: More Essays on Animation*. 1st edition. Power Publications, Sydney N.S.W., Australia.

Cholodenko, Alan. 2016. "The Expanding Universe of Animation (Studies)." *Animation Studies* (blog). 2016. https://journal.animationstudies.org/alan-cholodenko-the-expanding-universe-of-animation-studies/ (Accessed 08/06/2019)

Chow, Kenny K. N. 2013. *Animation, Embodiment, and Digital Media: Human Experience of Technological Liveliness*. New York: AIAA.

Clift, Jean Dalby, and Wallace B. Clift. 2004. *The Archetype of Pilgrimage*. Reprint edition.Wipf & Stock Publishers.

Collington, Mark. 2016. *Animation in Context: A Practical Guide to Theory and Making*. 1st edition. New York: Fairchild Books.

Combes, Muriel, Thomas Lamarre, Brian Massumi, and Erin Manning. 2012. *Gilbert Simondon and the Philosophy of the Transindividual*. Cambridge, Mass: MIT Press.

Crary, Johnathan. 2006. "Techniques of the Observer." In *Visual Culture: Experiences in Visual Culture*, edited by Joanne Morra and Marquard Smith, 88-108. Taylor & Francis.

Crawford, Matthew. 2010. *The Case for Working with Your Hands: Or Why Office Work Is Bad for Us and Fixing Things Feels Good*. Reprint edition. London: Penguin.

Cross, Nigel. 1982. "Designerly Ways of Knowing." *Design Studies* 3 (4): 221-227

Cross, Nigel. 1990. "The Nature and Nurture of Design Ability." *Design Studies* 11 (3): 127-40. https://doi.org/10.1016/0142-694X(90)90002-T.

Cubitt, Sean. 2013. "Ecocritique and the Materialities of Animation." In *Pervasive Animation*, edited by Suzanne Buchan, 94–114. London: Routledge.

Damasio, Antonio. 2006. *Descartes' Error: Emotion, Reason and the Human Brain*. London: Vintage.

Damasio, Antonio. 1996. "The Somatic Marker Hypothesis and the Possible Functions of the Prefrontal Cortex", *Phil. Trans. R. Soc. Lond. B* 351 (1346): 1413–20. https://doi.org/10.1098/rstb.1996.0125.

Deleuze, Gilles. 1986. *Cinema 1: The Movement-Image*. Minneapolis: University of Minnesota Press.

Dewey, John. 2008. *The Later Works of John Dewey, Volume 13, 1925 – 1953: 1938-1939, Experience and Education, Freedom and Culture, Theory of Valuation, and Essays*. SIU Press.

Dewey, John. 2010. In *Teachers, Leaders, and Schools: Essays by John Dewey*, by Douglas J. Simpson and Sam F. Stack, 35–36. SIU Press.

Dictionaries, Oxford. 2010. *Oxford Dictionary of English*. 3rd edition. New York, NY: OUP Oxford.

Disney, Walter. 1935. "Memo from Walt." http://animationmeat.com/pdf/nineoldmen/MemoFromWalt.pdf (Accessed 08/07/2019)

Doane, Mary Ann. 2006. "Apparaturen Bewegter Bilder : LIT Verlag Berlin Münster Wien Zürich London." *LIT Verlag*. http://www.litwebshop.de/index.php?main_page=product_info&products_id=2061 (Accessed 02/07/2019)

Dobson, Nichola, Annabelle Honess Roe, and Amy Ratelle, eds 2018. *The Animation Studies Reader*. New York, NY: Bloomsbury.

Dorst, Kees, and Isabelle Reymen. 2004. "Levels of expertise in design education." In *Proceedings of the 2nd International Engineering and Product Design Education Conference, 2-3 September 2004, Delft*, 159–66. Delft University of Technology. https://research.utwente.nl/en/publications/levels-of-expertise-in-design-education.

Dourish, Paul. 2004. *Where the Action Is*. New Ed edition. Cambridge, Mass.: MIT Press.

Eisenstein, S. M. 1983. *Eisenstein on Disney*. Kolkata: Seagull Books.

Elsaesser, T. 2008. *Afterword: Digital Cinema and the Apparatus: Archaeologies, Epistemologies, Ontologies*. Basingstoke: Palgrave Macmillan. https://dare.uva.nl/search?identifier=91a08c45-59d6-4e2a-845d-6c81d579fb80.

Fauconnier, Gilles, and Mark Turner. 2003. *The Way We Think*. Reprint edition. New York, NY: Basic Books.

Fischer, Thomas. 2019. *Temporality in a Theory of (and for) Enquiry*. https://www.youtube.com/watch?v=Nxgawp6Ou7g&feature=youtu.be (Accessed 04/07/2019)

Foth, Marcus, and Jeff Axup. 2019. *Participatory Design and Action Research: Identical Twins or Synergetic Pair?* In: Wagner, I, Jacucci, G, Kensing, F, & Blomberg, J (Eds.) Expanding Boundaries in Design: Proceedings Ninth Participatory Design Conference 2006 (Vol 2). Computer Professionals for Social Responsibility, Canada, pp. 93-96.

Frayling, Christopher. 1994. "Research in Art and Design (Royal College of Art Research Papers, Vol 1, No 1, 1993/4)." Monograph. 1994. http://researchonline.rca.ac.uk/384/.

Frayling, Christopher. 2011. *On Craftsmanship: Towards a New Bauhaus*. London: Oberon Masters.

Frayling, Christopher. 2015. *RTD 2015 Provocation by Sir Christopher Frayling Part 3: Unpacking Craft Knowledge*. https://vimeo.com/129777503 (Accessed 17/06/2019)

Furniss, Maureen, ed. 1998. *Art in Motion: Animation Aesthetics*. London: John Libbey Cinema and Animation.

Furniss, Maureen. 2017. *Animation: The Global History*. 01 edition. London: Thames and Hudson Ltd.

Galison, Peter, Catherine Meyburgh, Philip Miller, and William Kentridge. 2013. *William Kentridge: The Refusal of Time*. Paris: Editions Xavier Barral.

Gauntlett, David. 2011. *Making Is Connecting: The Social Meaning of Creativity, from DIY and Knitting to YouTube and Web 2.0*. 1 edition. Cambridge, UK ; Malden, MA: Polity Press.

Gauntlett, David. 2015. *Making Media Studies: The Creativity Turn in Media and Communications Studies*. 1st edition. New York: Peter Lang Publishing Inc.

Gethmann, Daniel, and Christoph B. Schulz. 2006. *Apparaturen bewegter Bilder*. 1st edition,. Münster: LIT.

Gibson, James J. 2014. *The Ecological Approach to Visual Perception: Classic Edition*. 1st edition. Psychology Press.

Glanville, Ranulph. 2007. "Disciplines, Fuss, Etc." https://www.jiscmail.ac.uk/cgi-bin/webadmin?A2=ind0709&L=PHD-DESIGN&O=D&P=38261 (Accessed 08/06/2019)

Griffin, George. 2013. "Take the b Train." In *Pervasive Animation*, edited by Suzanne Buchan, 275–91. New York ; London: Routledge.

Gunning, Tom. 2012. "Hand and Eye: Excavating a New Technology of the Image in the Victorian Era." *Victorian Studies* 54 (3): 495–516. https://doi.org/10.2979/victorianstudies.54.3.495.

Gunning, Tom. 2014. "The Play between Still and Moving Images: Nineteenth-Century 'Philosophical Toys' and Their Discourse." In *Between Stillness and Motion: Film, Photography, Algorithms*, edited by Eivind Rossaak, 1stedition, 27–44. Amsterdam: Amsterdam University Press.

Hall, Ashley. 2016. "Designing Creative Destruction." Design Research Society International Conference, Brighton.

Hall, Ashley. 2017. "Is Globalised Design Education Killing DesignVariety?" DS 88: Proceedings of the 19th International Conference on Engineering and Product Design Education (E&PDE17), Building Community: Design Education for a Sustainable Future, Oslo, Norway, 7 & 8 September 2017. https://www.designsociety.org/publication/40328/IS+GLOBALISED+DESIGN+EDUCATION+KILLING+DESIGN+VARIETY%3F.

Hall, Ashley. 2018. "Stitching Theory and Practice." Royal College of Art.

Harris, Miriam, Lilly Husbands, and Paul Taberham, eds. 2019. *Experimental Animation: From Analogue to Digital*. 1st edition. London: Routledge.

Hayes, Derek, and Chris Webster. 2013. *Acting and Performance for Animation*. 1st edition. New York: Routledge.

Heidegger, Martin. 1978. *Being and Time*. New Ed edition. Malden, MA; Oxford: Wiley-Blackwell.

Hosea, Birgitta. 2010. "Drawing Animation." Animation 5, no. 3 (November 1, 2010): 353–67. https://doi.org/10.1177/1746847710386429.

Hosea, Birgitta. 2012. "Substitutive Bodies and Constructed Actors: A Practice-Based Investigation of Animation as Performance." http://ualresearchonline.arts.ac.uk/3437/1/Hosea%252C%2520Brigitta%2520PhD%2520Thesis.pdf (Accessed 10/07/2019)

Igoe, Elaine. 2013. "In Textasis: Matrixial Narratives of Textile Design." Thesis, Royal College of Art. http://researchonline.rca.ac.uk/1646/

Jacobs, Brendan, and Bernard Robin. 2016. "Animating Best Practice." Animation 11, no. 3 (November 1, 2016): 263–83. https://doi.org/10.1177/1746847716662554

Jakobovits, Leon A. 1962. "Effects of Repeated Stimulation on Cognitive Aspects of Behavior: Some Experiments on the Phenomenon of Semantic Satiation." Thesis, McGill University. http://digitool.library.mcgill.ca/R/?func=dbin-jump-full&object_id=113683&local_base=GEN01-MCG02 (Accessed 08/06/2019)

Jankovics, Marcell. *Sisyphus (1974)*. https://www.youtube.com/watch?v=tYBlAon683s (Accessed 10/06/2019)

Johnson, Mark. 1990. *The Body in the Mind: The Bodily Basis Of Meaning, Imagination, And Reason*. New edition edition. : University of Chicago Press.

Johnson, Mark. 2016. "Mark Johnson: Language and Embodied Mind." https://www.youtube.com/watch?v=nda7xAIG3d0 (Accessed 17/06/2019)

Johnson-Laird, Philip Nicholas. 1983. *Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness*. Harvard University Press.

Jones, John Chris, and DG Thornley. 1962. *Conference on Design Methods : Papers Presented at the Conference on Systematic and Intuitive Methods in Engineering, Industrial Design, Architecture and Communications, London, September 1962*. Oxford : Pergamon Press. https://trove.nla.gov.au/version/25557321 (Accessed 08/06/2019)

Jones, John Chris. 1992. *Design Methods*. John Wiley & Sons.

Kallio, Titti. 2003. "Why We Choose the More Attractive Looking Objects: Somatic Markers and Somaesthetics in User Experience." In *Proceedings of the 2003 International Conference on Designing Pleasurable Products and*

Interfaces, 142–143. DPPI '03. New York, NY, USA: ACM. https://doi.org/10.1145/782896.782934 (Accessed 15/05/2018)

Kentridge, William. 2014. *Six Drawing Lessons*. Cambridge, Massachusetts: Harvard University Press.

Kentridge, William, and Rosalind C. Morris. 2013. *That Which Is Not Drawn: William Kentridge and Rosalind C. Morris in Conversation*. Calcutta: Seagull Books.

Kleiner, Fred S., and Christin J. Mamiya. 2004. *Gardner's Art Through the Ages*. 12th edition. Belmont, CA: Thomson Wadsworth.

Koffka, Kurt. 1999. *Principles Of Gestalt Psychology*. 1st edition. London: Routledge.

Kolb, David A. 1983. *Experiential Learning: Experience as the Source of Learning and Development*. 1st edition. Englewood Cliffs, N.J: Financial Times/ Prentice Hall.

Kolb, David A 2014. *Experiential Learning: Experience as the Source of Learning and Development*. FT Press.

Korn, Peter. 2014. *Why We Make Things and Why It Matters: The Education of a Craftsman*. 1st edition. Boston: David R. Godine Publisher Inc.

Krell, Alan. 2011. *Burning Issues: Fire in Art and the Social Imagination*. London: Reaktion Books.

Lakoff, George, and Mark Johnson. 2003. *Metaphors We Live By*. New edition. Chicago: University of Chicago Press.

Lamarre, Thomas. 2009. *Anime Machine: A Media Theory of Animation*. Minneapolis, MN: University of Minnesota Press.

Leabhart, Thomas. 2007. *Etienne Decroux*.1 st edition. London ; New York: Routledge.

Levitt, Deborah. 2018. *The Animatic Apparatus : Animation, Vitality, and the Futures of the Image*. Winchester, UK: Zero Books.

Lewin Kurt. 1946. "Action Research and Minority Problems." *Journal of Social Issues* 2 (4): 34–46. https://doi.org/10.1111/j.1540-4560.1946.tb02295.x. (Accessed 15/05/2018)

Lilley, Clare. 2015. *Bill Viola: At Yorkshire Sculpture Park: Exhibition Guide*. Yorkshire Sculpture Park.

Lin, Fabia Ling-Yuan. 2013. "Doubling the Duality: A Theoretical and Practical Investigation into Materiality and Embodiment of Meaning in the Integration of Live Action and Animation." Thesis. Available at https://repository.lboro.ac.uk/articles/Doubling_the_duality_a_theoretical_and_practical_investigation_into_materiality_and_embodiment_of_meaning_in_the_integration_of_live_action_and_animation/9332945 (Accessed 09/06/2019)

Logie, Robert H. 1995. "Visuospatial Working Memory, Movement Control and Executive Demands." *British Journal of Psychology* 86 (2): 253–69. https://doi.org/10.1111/j.2044-8295.1995.tb02560.x. (Accessed 11/06/2019)

MacCarthy, Fiona. 2012. *The Perfect Place to Grow: 175 Years of the Royal College of Art*. London: Royal College of Art.

MacGillivray, Carol. 2014. "Choreographing Time: Developing a System of Screen-Less Animation." Thesis, available at http://research.gold.ac.uk/10850/ (Accessed on 12/07/2019)

Malpas, Jeff. 2014. "With a Philosopher's Eye: A 'Naive' View on Animation." *Animation* 9 (1): 65–79. Available at <https://doi.org/10.1177/1746847713520521> (Accessed on 15/06/2019).

Manovich, Lev. 2002. *The Language of New Media*. New edition. Cambridge, Mass.: MIT Press.

Manovich, Lev. 2013. *Software Takes Command*. Int edition. London: Bloomsbury Academic.

Maravita, Angelo, and Atsushi Iriki. 2004. "Tools for the Body (schema)." *Trends Cogn. Sci*, 79–86. Available at https://www.sciencedirect.com/science/article/abs/pii/S1364661303003450 (Accessed 16/06/2019)

Margolin, Victor. 2010. "Design Research : Towards a History, In Design & Complexity: Design Research Society International Conference Montreal". 7-9. available at http://www.drs2010.umontreal.ca/data/PDF/080.pdf (Assessed on 08/06/2019)

Matarazzo, Vera. 2016. "What Is Animation? The 'Six Blind Men and an Elephant' Conundrum." *Animation Practice, Production & Process* 5 (1): 15–38. Available at https://doi.org/10.1386/ap3.5.1.15_1. (Accessed 16/05/2017)

Maturana, Humbert R. 1979. *Autopoiesis and Cognition: The Realization of the Living*. Softcover reprint of the original 1st ed. 1980 edition. Dordrecht, Holland ; Boston: D. Reidel Publishing Company.

Mccullough, Malcolm. 1998. *Abstracting Craft: The Practiced Digital Hand*. New edition. Cambridge, Mass.: MIT Press.

McWilliams, Donald. *Creative Process: Norman McLaren*. Canada, National Film Board of. N.d. https://www.nfb.ca/film/creative_process_norman_mclaren (Accessed 31/03/2016)

Medawar, P. B. 2008. *Induction and Intuition in Scientific Thought*. Reprinted 1st edition. London: Routledge.

Miku, Hatsune. 2007. "About HATSUNE MIKU | CRYPTON FUTURE MEDIA." 2007. https://ec.crypton.co.jp/pages/prod/vocaloid/cv01_us. (Accessed 04/07/2019)

Moore, Samantha and Paul Wells. 2016. *The Fundamentals of Animation.* 2nd edition edition. London ; New York: Fairchild Books.

Muybridge, Eadweard. 2000. *Animals in Motion*. Reprinted 1st edition. New York: Dover Publications Inc.

Nelson, Robert S., and Richard Shiff, eds. 2003. *Critical Terms for Art History, Second Edition*. 2nd Revised edition. Chicago: University of Chicago Press.

Norman, Donald A., and S. W. Draper, eds 1986. *User Centred System Design: New Perspectives on Human/Computer Interaction*. Hillsdale, N.J: Lawrence Erlbaum Associates Inc.

Norman, Donald A. 1991. Cognitive Artifacts. In: J.M. Carroll (ed.) Designing Interaction. Cambridge, MA: Cambridge University Press.

O'Reilly, David. 2012. "Basic Animation Aesthetics 2" http://www.davidoreilly.com/downloads (Accessed 04/07/2019)

Osborn, Keith. 2015. *Cartoon Character Animation with Maya: Mastering the Art of Exaggerated Animation*. 1st edition. London: Fairchild Books.

Oshii, Mamouru. 2004. *Ghost in the Shell 2: Innocence*. http://www.imdb.com/title/tt0347246/ (Accessed 05/07/2019)

O'Sullivan, Simon D. 2000. "Cultural Studies as Rhizome, Rhizomes in Cultural Studies." In Cultural Studies and Interdisciplinarity, Trinity and All Saints College. University of Leeds, United Kingdom. Available at http://research.gold.ac.uk/15527/ (Accessed 06/04/2019)

Pallant, Chris, ed. 2015. *Animated Landscapes*. New York: Bloomsbury.

Pallant, Chris. 2015. "Disney Pluralism: Beyond Disney-Formalism [Keynote Speaker]." Conference presented at the Discussing Disney, University of Hull, 2015. http://create.canterbury.ac.uk/13747/ (Accessed 06/05/2019)

Papanek, Victor J. 1972. *Design for the Real World: Human Ecology and Social Change by Victor J. Papanek*. Pantheon Books.

Pavitt, Jane. 2012. "Input/Output: Design Research and Systems Thinking." In *The Perfect Place to Grow 175*, 129–39.

Paz, Octavio. 1987. *Convergences : Essays on Art and Literature*. 1st ed. San Diego : Harcourt Brace Jovanovich. https://trove.nla.gov.au/version/14869958 (Accessed 12/08/2019)

Perry, Grayson. 2011. *Grayson Perry: The Tomb of the Unknown Craftsman*. 1st edition. London: British Museum Press.

Perry, Grayson. 2011."BBC One – Imagine…, Grayson Perry and the Tomb of the Unknown Craftsman." 2011. https://www.bbc.co.uk/programmes/b016ycnn (Accessed 15/05/2018)

Plato, Melissa Lane. 2007. *The Republic*. Translated by H. D. P. Lee and Desmond Lee. 3rd edition. London: Penguin Classics.

Polanyi, Michael. 1967. *The Tacit Dimension*. Garden City, N.Y.: Anchor Books.

Power, Patrick. 2008. "Character Animation and the Embodied Mind—Brain." *Animation* 3 (1): 25–48. https://doi.org/10.1177/1746847708088734 (Accessed 06/04/2015)

Chakravorty, Gayatri. 2018. 'What Is It to Translate?' Part-1." New Delhi, February. https://www.youtube.com/watch?v=NJ8TDXET5Qw (Accessed 06/04/2019)

Purcell, Lee. 2012. "Rethinking the Pipeline: DreamWorks Animation Advances the Art." 2012. https://software.intel.com/en-us/articles/rethinking-the-pipeline-dreamworks-animation-advances-the-art.(Accessed 05/05/2015)

Pye, David. 2007. *The Nature and Art of Workmanship*. Herbert Press.

Pylyshyn, Zenon W. 1977. "What the Mind's Eye Tells the Mind's Brain: A Critique of Mental Imagery." In *Images, Perception, and Knowledge: Papers Deriving from and Related to the Philosophy of Science Workshop at Ontario, Canada, May 1974*, edited by John M. Nicholas, 1–36. The University of Western Ontario Series in Philosophy of Science. Dordrecht: Springer Netherlands. https://doi.org/10.1007/978-94-010-1193-8_1 (Accessed 17/06/2019)

Read, Herbert. 1944. *Education Through Art*. 1st edition. London: Faber & Faber.

Reiko Loader, Alison. 2014. "Surviving The Animator's Survival Kit: 'I'm Not Bad, I'm Just Drawn That Way.' Animation Studies 2.0.". https://blog.animationstudies.org/?p=869. (Accessed 23/06/2020)

Riki, J. K. "Review: The Animator's Survival Kit." Animator Island (blog). https://www.animatorisland.com/review-the-animators-survival-kit/ (Accessed 23/06/2020)

Rith, Chanpory, and Hugh Dubberly. 2007. "Why Horst W. J. Rittel Matters." *Design Issues* 23 (1): 72–91. https://doi.org/10.1162/desi.2007.23.1.72. (Accessed 08/06/2019)

Robson, Colin. 1993. *Real World Research: A Resource for Social Scientists and Practitioner-Researchers*. Blackwell Publishing.

Rodgers, Paul A., Giovanni Innella, and Craig Bremner. 2017. "Paradoxes in Design Thinking." *The Design Journal* 20 (sup1): S4444–58. https://doi.org/10.1080/14606925.2017.1352941 (Accessed 02/07/2019)

Rodgers, Paul A., and Michael Smyth, eds 2010. *Digital Blur: Creative Practice at the Boundaries of Architecture, Design and Art*. Faringdon: Libri Publishing.

Roe, Annabelle Honess. 2018. "Animation and Performance." In *The Animation Studies Reader*, edited by Nichola Dobson and Amy Ratelle, 69–79b. New York, NY: Bloomsbury 3PL.

Rossaak, Eivind, ed. 2014. *Between Stillness and Motion: Film, Photography, Algorithms*. First edition. Amsterdam: Amsterdam University Press.

Ruddell, Caroline, and Paul Ward, eds. 2019. *The Crafty Animator: Handmade, Craft-Based Animation and Cultural Value*. 1st edition. New York, NY: Palgrave Macmillan.

Rumi, Maulana Jalalu-'d-din Muhammad. 2011. *The Masnavi I Ma'navi of Rumi: Complete 6 Books*. England: CreateSpace Independent Publishing Platform.

Rust, Chris. 2004. "Design Enquiry: Tacit Knowledge and Invention in Science." *Design Issues* 20 (4): 76–85.

San Francisco Call 1 April 1899 – California Digital Newspaper Collection." 1899. 04 1899. https://cdnc.ucr.edu/?a=d&d=SFC18990401.2.76&srpos=2&e=-------en--20-SFC-1--txt-txIN-the+corruption+of+youth-------1.(Accessed 04/06/2019)

Schaffer, William. 2011. "Animation 1: The Control Image." In *The Illusion of Life II: More Essays on Animation*, edited by Cholodenko, 1st Edition. Sydney N.S.W. Australia : Power Publications, Sydney.

Schivelbusch, Wolfgang. 2014. *The Railway Journey: The Industrialization and Perception of Time and Space*. First Edition. Berkeley: University of California Press.

Schön, Donald A. 1987. *Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions*. Educating the Reflective Practitioner: Toward a New Design for Teaching and Learning in the Professions. San Francisco, CA, US: Jossey-Bass.

Schön, Donald A. 2017. *The Reflective Practitioner: How Professionals Think in Action*. Routledge.

Selincourt, Chris de. 2016. "Where Is the Mind of the Media Editor? An Analysis of Editors as Intermediaries between Technology and the Cinematic Experience." Thesis, Cardiff Metropolitan University. https://repository.cardiffmet.ac.uk/handle/10369/8682 (Accessed 04/07/2019)

Settlage, Calvin F., and Reed Brockbank, eds 1985. *New Ideas in Psychoanalysis: The Process of Change in Humanistic Science: The Process of Change in Humanistic Change*. 1st edition. Hillsdale, N.J: Routledge.

Shneiderman, Ben. 1982. "The Future of Interactive Systems and the Emergence of Direct Manipulation." *Behaviour & Information Technology* 1 (3): 237–56. https://doi.org/10.1080/01449298208914450 (Accessed 04/06/2019)

Sifianos, George 1995. "The Definition of Animation: A Letter from Norman McLaren" in Animation Journal (4.1) 1995 (Spring): 62-66 (Accessed 06/06/2014)

Simon, Herbert Alexander. 1981. *Simon: Sciences of the Artificial 2ed*. 2nd Rev and edition. Cambridge, Mass: MIT Press.

Slavin, Sean. 2003. "Walking as Spiritual Practice: The Pilgrimage to Santiago de Compostela." *Body & Society* 9 (3): 1–18. https://doi.org/10.1177/1357034X030093001 (Accessed 04/07/2019)

Sobchack, Vivian. 1991. *The Address of the Eye: A Phenomenology of Film Experience*. Princeton, NJ: Princeton University Press.

Spencer-Brown, G. 1972. *Laws of Form*. New York: Crown Pub.

Stehlikova, Tereza. 2012. "Tangible Territory Inviting the Body into the Experience of Moving Image." Thesis, Royal College of Art. http://researchonline.rca.ac.uk/1139/ (Accessed 13/06/2014)

Thomas, Frank, and Ollie Johnston. 1997. *The Illusion of Life: Disney Animation*. 1st edition. New York: Hyperion.

Toom, Auli. 2012. "Considering the Artistry and Epistemology of Tacit Knowledge and Knowing." *Educational Theory* 62 (6): 621–40. https://doi.org/10.1111/edth.12001 (Accessed 04/07/2019)

Torre, Dan. 2014. "Cognitive Animation Theory: A Process-Based Reading of Animation and Human Cognition." *Animation* 9 (1): 47–64.

Torre, Dan. 2017. *Animation – Process, Cognition and Actuality*. Bloomsbury Publishing USA.

Tripp, David. 2005. "Action Research: A Methodological Introduction." *Educação e Pesquisa* 31 (January).

Turner, Victor. 1974a. *Dramas, Fields, and Metaphors: Symbolic Action in Human Society*. Symbol, Myth and Ritual. Ithaca, NY: Cornell University Press.

Turner, Victor. 1974. "Liminal to Liminoid, in Play, Flow, and Ritual: An Essay in Comparative Symbology." *Rice Institute Pamphlet - Rice University Studies* 60 (3). https://scholarship.rice.edu/handle/1911/63159 (Accessed 09/07/2019)

Turner, Victor. 1969. *The Ritual Process: Structure and Anti-Structure*. Chicago: Aldine Pub. Co.

Warburton, Alan. 2016. *Spectacle, Speculation, Spam*. https://vimeo.com/194963450. (Accessed 04/04/2019)

Ward, Paul. 2004. "The Place of Animation within Film and Media Studies : A Theoretical and Pedagogic Approach." Thesis, Institute of Education, University of London. http://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.406571. (Accessed 02/07/2018)

Ward, Paul. 2013. "Animation Studies as an Interdisciplinary Teaching Field." In *Pervasive Animation*, edited by Suzanne Buchan, 317–36. New York ; London: Routledge.

Ward, Paul. 2018. "Some Thoughts on Theory-Practice Relationships in Animation Studies." In *The Animation Studies Reader*, edited by Nichola Dobson, Annabelle Honess Roe, and Amy Ratelle, 91–108. New York, NY: Bloomsbury.

Wayne, Mike. 2001. "Problems and Possibilities in Developing Critical Practice." *Journal of Media Practice* 2 (1): 30–36. https://doi.org/10.1386/jmpr.2.1.30 (Accessed 08/06/2019)

Webster, Chris. 2005. *Animation: The Mechanics of Motion*. Taylor & Francis.

Wells, Paul. 1998. *Understanding Animation*. 2nd edition. London: Routledge.

Wells, Paul. 2002. *Animation: Genre and Authorship*. Wallflower Press.

Williams, Alexander. 2019 "Escape Studios Animation Blog: Did We Mend The Gap?" Escape Studios Animation Blog, February 13, 2019. http://escapestudiosanimation.blogspot.com/2019/02/did-we-mend-gap.html (Accessed 01/01/2020)

Williams, Richard. 2012. *The Animator's Survival Kit: A Manual of Methods, Principles and Formulas for Classical, Computer, Games, Stop Motion and Internet Animators*. Expanded edition. New York: Faber & Faber.

Willis, Anne-Marie. 2006. "Ontological Designing." *Design Philosophy Papers* 4 (2): 69–92. https://doi.org/10.2752/144871306X13966268131514 (Accessed 01/03/2018)

Willis, Anne-Marie, ed. 2017. *The Design Philosophy Reader*. Berg Publishers.

Wood, Aylish. 2014. *Software, Animation and the Moving Image: What's in the Box?* 1st edition. Houndmills, Basingstoke, Hampshire, UK: Palgrave Pivot.

Wood, Nicola R., Chris Rust, and Grace Van Horne. 2009. "A Tacit Understanding: The Designers Role In Capturing and Passing On the Skilled Knowledge of Master Craftsmen." International Journal of Design http://ijdesign.org/index.php/IJDesign/article/view/559/275 (Accessed 15/05/2018).

Yee, Joyce S. R. 2010. "Methodological Innovation in Practice-Based Design Doctorates." *Journal of Research Practice* 6 (2): 15.

Young, Iris Marion. 2005. *On Female Body Experience:Throwing Like a Girl and Other Essays*. New York: Oxford University Press.

Zeman, Adam. n.d. "The Eye's Mind | A Study of the Neural Basis of Visual Imagination and Its Role in Culture.".

http://sites.exeter.ac.uk/eyesmind/ (Accessed 17/06/ 2019)

Appendix I

Animation Days: 1–6

When I took up the role of Program leader of the BA Animation course at Northumbria University in 2015, I wanted to start the year with a celebration of just how much fun making animation is.

In discussing this with my colleagues the charcoal animation of William Kentridge was suggested as an exercise the students would enjoy, as well as making the freshly painted walls of the new animation studios a bit less white.

<u>Animation Day 1</u>

Figure 40. Students drawing on the walls of the animation studio as part of Animation Day 1 2015, Hugo Glover.

Date: October 2014

Location: Northumbria University, animation studios

Equipment: each studio had

1:DSLR with tripod

(white balanced to the colour temperature of the room)

2:Audio track,pre selected by me

<u>Studio 1 - Bjørge Lillelien's famous 1981 commentary after Norway had beaten England 2-1 in a World Cup Qualifier. Maggie Thatcher Your Boys Took A Hell Of A Beating</u>

<u>Studio 2 - Audio Bullys - Shot You Down ft. Nancy Sinatra</u>

<u>Studio 3 - Four tet - Angel Echoes</u>

Aims: This workshop focused primarily on the playful and spontaneous aspects of making animation. The structure and design of the whole event was to mitigate the often slow and painstaking progress of many animation practices. It was a collaborative exercise which, once the students had roughly planned out what they wanted to do, they could autonomously progress the animation frame by frame, with the knowledge that it was an achievable task. A secondary intention of the workshop was to foster a sense of community and ownership of the studios by the students.

Brief: We split the students into three equally sized groups (8 to10 per group) and dispatched each group to one of the three animation studios. In each studio I had selected one long white wall, and at each end of the wall I had drawn a small shape

(triangle in one room, square in the next and a circle in the last studio). These shapes acted as the beginning and end points of their charcoal animation. The audio track was there to act as a guide for the students: they could interpret it any way they wanted to. I had selected three pieces of audio: one spoken word, one very rhythmic and one more abstract track. Finally there was the duration of the day: approximately five hours to animate from one shape to the other.

Figure 41. Students drawing on the walls of the animation studio as part of animation Day 1, 2015, Hugo Glover.

Output:Once all three rooms had completed their traverse of the studio wall we compiled the films and watched the resultant animation (https://www.youtube.com/watch?v=NIGBFSiDB_4).

In setting the parameters,spatially and temporally, as well as supplying audio accompaniment, the students could focus on the act of animating. Kentridge's

charcoal technique of drawing, photographing, and erasing before drawing again, had tactile qualities as well as a rhythmic physical engagement for the students. The simplicity of the animation process, as well as the necessity for physical engagement with materials, offered the students a visceral and embodied connection with the work, the space and the fabric of the studio.

Conclusion

This first workshop was a great success, so much so that the students asked if they could do another one at the start of the next semester. At this point in my PhD, I had not fully recognised how the theory and ideas I was reading about (and beginning to make work myself), were influencing the ways in which I engaged the students in exploring animation.

<u>Animation Day 2</u>

Figure 42. Students setting up props in Studio 2 for Animation Day 2, 2015, Hugo Glover.

Date: January 2015

Location: Northumbria University, animation studios

Equipment: each studio had

1: DSLR with tripod (white-balanced to the colour temperature of the room)

Studio 1 - Rostrum camera set up overlooking a large white table along with 300 to 500 pieces of Lego

Figure 43. Students working with Lego below a rostrum camera, Studio 1, animation Day 2, 2015, Hugo Glover.

Studio 2 - A series of invisible wire (monofilament cable) stretched between the floor and the ceiling, creating a 3-D volume into which materials could be introduced and manipulated to generate a stop frame animation in 3-D space.
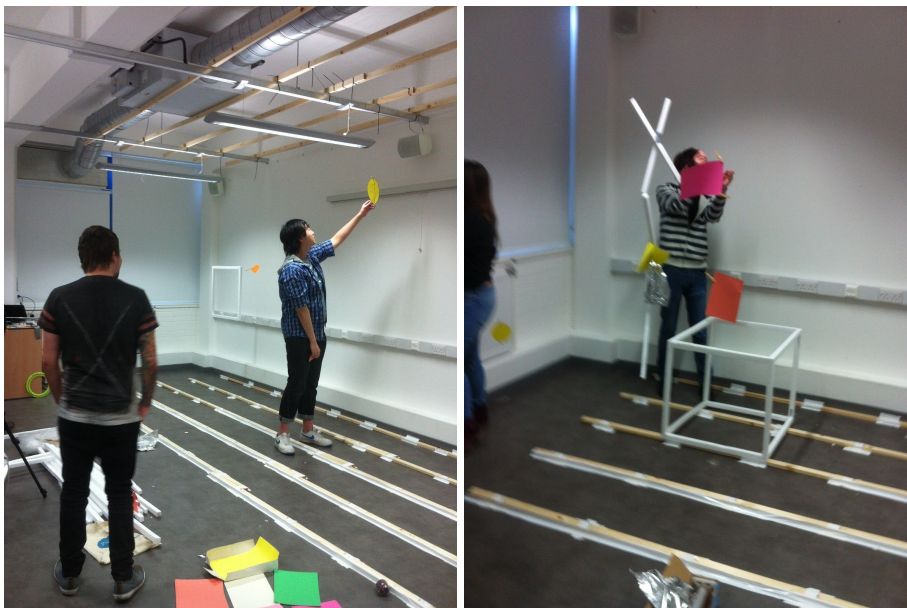
Figures 44 and 45. Students setting up props, Studio 2, animation Day 2, 2015, Hugo Glover.

Aims: Building on the first animation day, we moved from the walls of the studios to the space within. Whilst the students had enjoyed the first iteration of Animation Day, there had been an emphasis on the 2-D surface. I was keen to see if moving away from a 2-D surface would challenge the students to explore the volume of the studios in a more abstract way. In a sense I was removing the accessibility of figurative drawing and building an animation system with less defined visual outcomes.

Brief: With the studios set up, the students split into two groups. Over the five hours of animation time, each group had to generate one minute of animation from each studio.

https://vimeo.com/202932638

Conclusion

Although the output of the day had some very unexpected animation, the students did not engage in this workshop with as much enthusiasm as the first day. Neither process had the tactile enjoyment or visual accretion of charcoal. I also noted that there was very little sense of ownership of the animation process, as there had been during the first animation day.

Reflecting on this workshop retrospectively, it's clear to me that the students sense of separation from the creative act could be attributed to their lack of prior knowledge and aptitude with the medium. They could all draw, thereby making the first workshop a great success. Their ability to sculpt in abstract 3-D space was less rewarding.

Animation Day 3

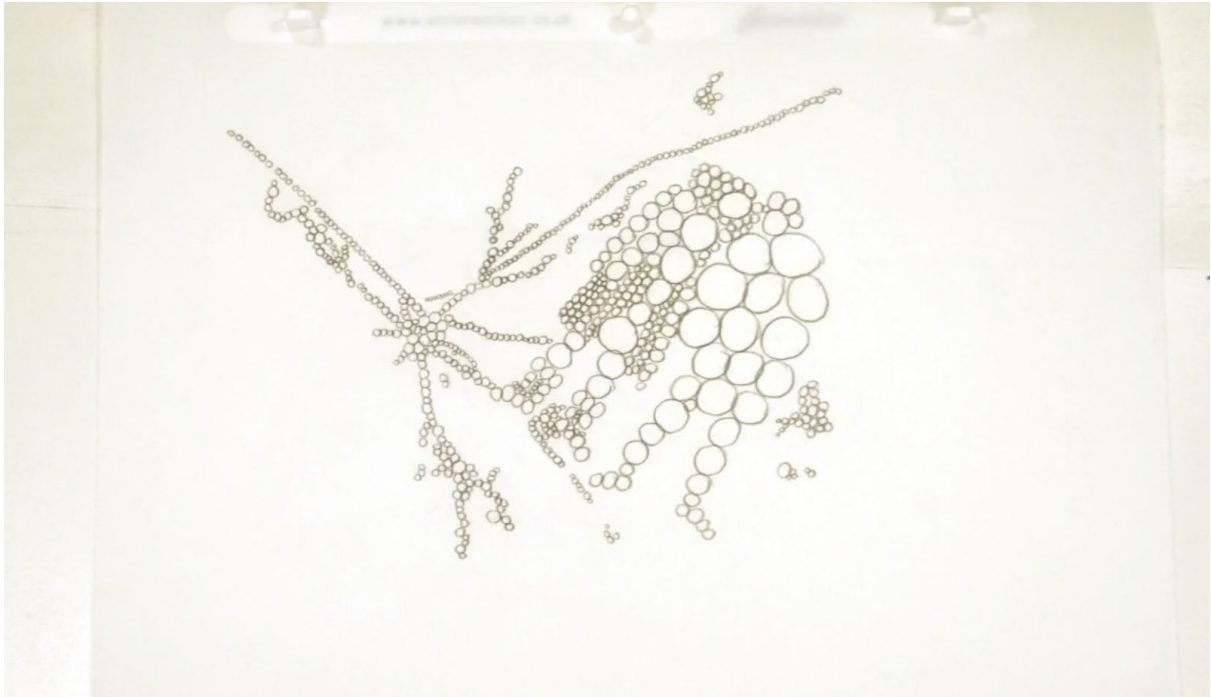Figure 46. Frame No. 234 from Studio 1, animation Day,3. 2015, Hugo Glover.

Studio 1 - rotoscoping https://vimeo.com/242553378

Figure 47. Frame No. 113 showing light painting with pixel sticks, from Studio 2, animation Day 3, 2015, Hugo Glover.

Studio 2 - light painting https://vimeo.com/345872973

Date: September 2015

Location: Northumbria University, animation studios

Equipment: Studio 1 - Animation paper, pencils, pens, rostrum camera

                         Studio 2 - Pixel sticks, 2 x DSLR cameras, tripods

In Studio 1, the students rotoscoped frames from three different films. Each scene had been printed out frame by frame. Each student took 10 to 20 frames to trace. The redrawn frames where then re-shot.

In Studio 2 we used pixel sticks (a device which is used in combination with long exposure photography to create an image appearing to float in space: http://www.thepixelstick.com/).

Aim: a very basic animation day. Hugely enjoyed by the students, very productive and peaceful,almost monastic.

<u>Animation Day 4</u>

Figure 48. Still from pixilation animation at the Yorkshire Sculpture Park, animation Day 4, 2016, Hugo Glover.
https://vimeo.com/345878267

Date: 2016

Location: Yorkshire sculpture park

Equipment: 3 x DSLR cameras and tripods

Three groups of students employing pixilation as a response to the environment of the Yorkshire Sculpture Park.

Aim: Again a very basic animation day, with the simple objective of making a piece of animation outside.

Animation Day 5

Figure 49. Students getting stuck into claymation animation in Studio 1, Animation Day 5, 2017, Hugo Glover.

Date: November 2017

Location: Northumbria University, animation studios

Equipment: Various objects, bag of clay, charcoal, 3 x DSLR cameras and tripods

Three groups of students employing pixilation as a response to the environment of the Yorkshire sculpture park

Aim - Again a very basic animation day, the simple objective of making a piece of animation outside.
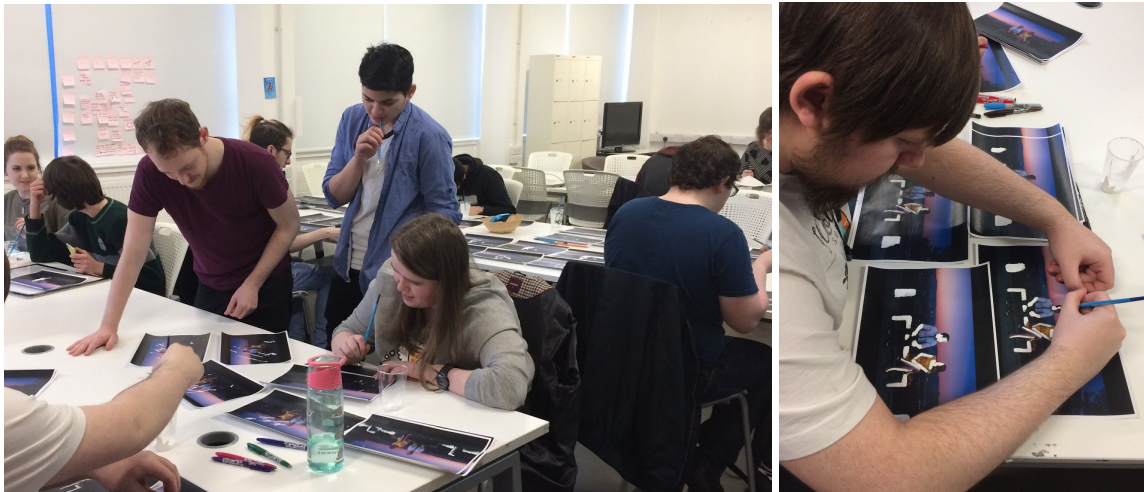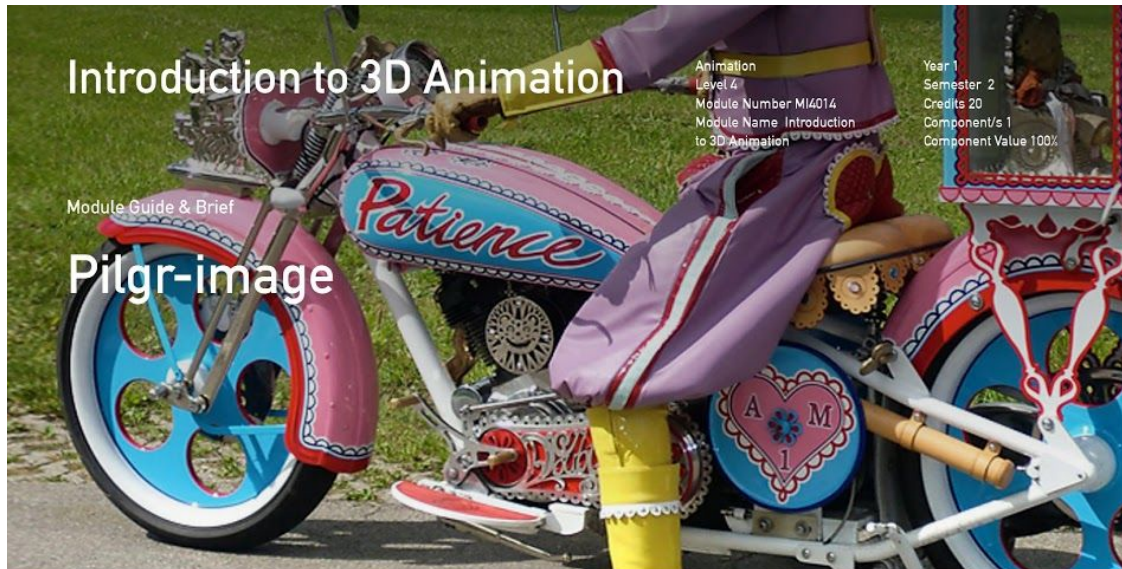
Animation Day 6

Figure 50. Students in Studio 1, painting directly onto frames from *La La Land*, 2018, Hugo Glover.

The students chose to use rotoscoping as they had done on Animation Day 3. Instead of tracing the frames, this time they painted directly onto the printed out frames from the film LaLa Land.

Appendix II

Pilgrimage: Introduction to 3-D Animation Module Brief

Introduction to 3D Animation

Animation
Level 4
Module Number MI4014
Module Name Introduction
to 3D Animation

Year 1
Semester 2
Credits 20
Component/s 1
Component Value 100%

Module Guide & Brief

Pilgr-image

BRIEF

We all need a good reason to go somewhere, to get up and move. Sometimes the reasons are clear, we need food, water, warmth. But sometimes it is less clear, we have a need, a desire, a yearning to visit a place of significance to us personally. We could call such journeys a 'pilgrimage', where the destination has moral or spiritual significance. There is an inherent narrative to such journeys, they begin, progress and resolve, only to begin again, either by returning to where it all began, or by starting anew. You have all begun your journey into animation, and using Maya is a steep and challenging part of your chosen path. For some of you this could be the beginning of a life-long cyclical journey into the Euclidian realm of CGI, for others it will be a short and informative adjunct, either way Maya can offer a limitless space to build worlds of wonder and spiritual significance.

Your brief is to create a one-minute 3D animation that seamlessly loops (the first and last frame are the same) based on your interpretation of 'Pilgrimage'. In order to generate an original and compelling idea, we will go through a three-stage process of visual research which will equip you with the conceptual and creative skills to produce your own mythologies, shrines and innerworlds in Maya.

Your research will explore **belief, politics, philosophy and art** in order to generate a creative reservoir of possibilities, out of which your ideas will emerge to be realized within Maya.

Deliverables

1 - One-minute looping animation with audio. Your final one-minute animation must be rendered out to the following specification: 1280 x 720 QuickTime - H264 (best quality) with audio.

2 - Tumblr blog documenting each and every stage of your journey through the module. This should include all the problems you have had as well as the solution you have found. It should also include all the Maya exercises you do with Gary.

SYNOPSIS

In this module, you will be introduced to how 3D computer animation can be used to create original and creatively diverse animation through learning the fundamental aspects of 3D.

An introduction into visual and cultural research methods will provide you with skills to develop your own research into culturally significant areas such as fine art, literature, poetry, architecture and design, and aspects of this research will form the basis of your exploration into 3D space and how it can be utilized as a creative workshop in which you can craft your ideas. The research underpins your own generation of original and diverse animated work in response to the brief.

LEARNING OUTCOMES

Knowledge & Understanding:
Demonstrate an awareness of key historical critical and contemporary issues within the 3D animation industry.

Acquire a knowledge of 3D animation production processes that underpin 3D animation practice.

Intellectual / Professional skills & abilities:
Effectively develop digital animation skills.

Effectively conduct research.

Personal Values Attributes :
Evaluate critically reflect and respond to feedback on personal practice.

Introduction to 3-D Animation 'Pilgrimage': Selected Student Work

This appendix contains content from a first-year level 4 module I teach at Northumbria University. Below is the module brief, followed by examples of how the students responded to the stages of research, ideas generation and combining everything together in Maya.

Excerpts from Student Blog

Below are the salient points of BA student Carys Lewis's response to the Pilgrimage brief, containing visual research, idea development and a frame from her final film.

Figure 51. BA student Carys Lewis's research for the Pilgrimage brief: artist, designer, writer, 2018.

Lewis describes how she found her artist: "I came across Thomas Cole while researching artists in the university library, and I was drawn to his work, despite it not being something I'd originally go for. I have a graphic design background, so my experience with fine art is limited."[39] In selecting Castiglioni and Orwell, Lewis had completed her research. The next stage was to pull all three of these influences

---

[39] Tumblr blog - https://mi4014caryslewis.tumblr.com/archive - accessed 12 January 2019.

together into a coherent design. In doing so, the student is challenged to blend the imagery of the artist, the ideas and discourse of the writer and the physical form of the designer. In selecting, and then combining these elements, the student is constructing a world with layers of cultural references and considering the meaning behind each and every aspect of the design.
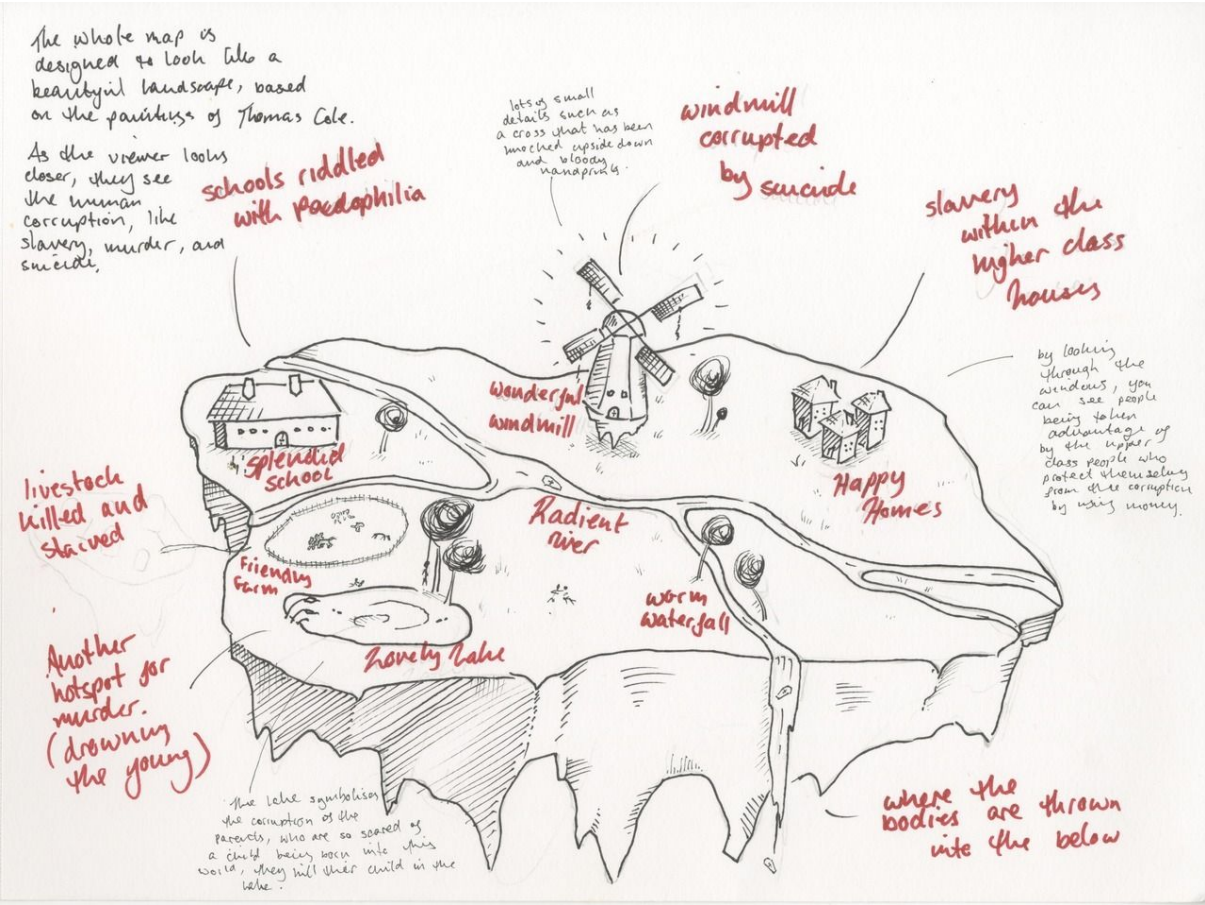

Figure 52. BA Animation student Carys Lewis's response to the Pilgrimage brief, 2018.

In Figure 52, Lewis has combined her research around the design of a shrine in the form of a windmill. Added to this she writes that "this idea of man made destructive behaviour is something that I think will be incredibly interesting to work with, I want the shrine to show you something new every time you look at it."

The final animation is a haunting and complex atmosphere, in precisely the way Lewis intended. Describing her experience of making the work as 'ironic', her blog charts both her creative and technical journey.

Figure 53. BA Animation student Carys Lewis's response to the Pilgrimage brief, 2018, final render.

Sisyphus: Animation Performance Module Brief

Animation Performance
Module Guide & Brief

Sisyphus.

Animation	Year 2
Level 5	Semester 1
Module Number MI5017	Credits 20
Module Name	Component/s 1
Animation Performance	Component Value 100%

SYNOPSIS

In this module, you will learn how to research, refine and produce performance in animation, through a process of deconstructing and reconstructing movement with a range of animation processes. You will learn how to generate ideas for character animation influenced by social, political and cultural issues and historical and contemporary knowledge of character-led animation

The aim is to extend your knowledge of character design and animation into an advanced and more specialized appreciation of the subject.

Appropriate tools will be introduced as aids to help stimulate conceptual thinking and develop creative solutions.

Teaching will be by a combination of lectures/tutorials and workshops with Hugo and technical workshops with Gary.

This will be supported by directed learning and independent learning through set exercises, to develop the appropriate technical skills.

You will produce a body of work articulating your journey through the process of creating a professional standard of CGI character performance.

There will be formative and summative assessment to establish and build on visual communication skills.

Key questions

What aspects of 'performance' are most important with regards CGI animation?

What processes can be employed to maximise the quality and believability of an animated performance?

How can we use these process to convey a believable sense of 'weight' in a CGI character?

BRIEF

Sisyphus was punished by Zeus for his trickery and deception. He was forced to roll a giant boulder to the top of a hill, once at the summit the enchanted boulder would roll away from Sisyphus back down the hill, where upon he would have to roll it back up, repeating this task for eternity.

The term 'Sisyphean' is used to describe tasks which have no end, but the idea has also been used as a metaphor for the human condition and the animation process itself could be described in these terms. We will use the myth of sisyphus as a framework to explore the relationship between our lived experience of the world and animation performance.

The module has three steps:

1 - Reflecting on your own experience, select a '*thing*' which represents a struggle you have experienced in your life (this could be a physical *thing* such as a computer or a football?, or a conceptual *thing* - such as 'peer pressure' or 'expectation'?)

2 - Design/model/rig your character (this will be outlined in greater detail in class.)

3 -Using the 'Animation Performance Process' animate your character pushing/rolling/dragging the 'thing' up a slope. 30 seconds long, looping animation with audio, rendered from Maya.

Learning Outcomes

Knowledge & Understanding:
1. Identify appropriate research and show evidence of critical design development and aesthetic analysis for animation performance.

Intellectual / Professional skills & abilities:
2. Generate, progress and communicate design concepts and solutions, through drawing, with traditional or digital technologies.

3. Use tacit and digital design skills in an experimental and innovative way to create animation performance.

Personal Values Attributes (Global / Cultural awareness, Ethics, Curiosity) (PVA):

4. Show awareness of historical and contemporary character animation.

Appendix III

I visited Pixar Animation Studios (Pixar) in 2012 and interviewed Warren Trezevant, an animator who had, in his own words, "entered animation sideways", as he had initially studied industrial design. Trezevant described the intricate detail of CGI character animation, how multiple versions of the same shot, hours and days spent fixing the finest, sub-pixel nuance that may be almost imperceptible – it was no surprise to hear that as a company Pixar describe their output as "digitally hand-crafted".

As well as interviewing Trezevant at Pixar in 2012, I also spoke to Phil 'Captain 3-D' McNally at DreamWorks SKG. Initially this conversation was based around McNally's work as a stereoscopic supervisor; however another aspect to our conversation was his background in industrial design and how he had taught himself CGI animation (well enough to go from the RCA to Industrial Light & Magic – a leading CGI Hollywood company). McNally's relentless curiosity, coupled with his ability to problem-solve and draw on multiple areas of inquiry such as photography, animation, computer science, as well as his furniture-making, all aided his practice at DreamWorks where he developed industry-leading tools to automate and manage the generation of stereoscopic processes in animated feature films. What emerged from our conversation was the realisation that McNally's perception that whatever he was interested in solving, he could achieve by applying the approaches of a design process. DreamWorks CGI 'AgilePipeline' (Fig. 55) acknowledges the cyclical development of these key stages, as opposed to the 'waterfall' structure of previous hand-drawn animation industries.
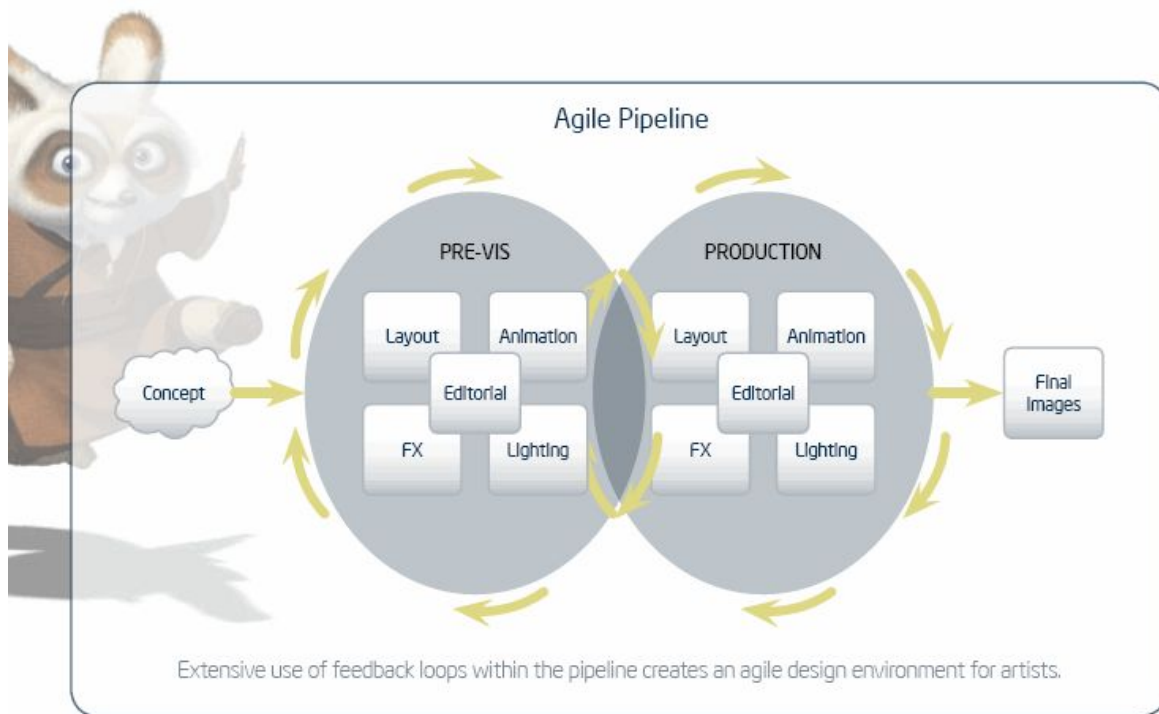
Figure 54. Rethinking the Pipeline: DreamWorks Animation Advances the Art (Purcell 2012).

Transcripts of interviews with Warren TrezevantPixar Animation Studios, 2012; and Phil 'Captain 3-D' McNally, DreamWorks SKG, 2012.

Interview with Warren Trezevant, Senior character animator.
Pixar Animation Studios, January 2012.

Warren [00:00:06]: I definitely entered the animation business sideways. A lot of people that I've worked with, at an early age pretty much wanted to be animators. They even learned how to draw or do stop motion animation at home. And this is back before digital. Right now you can get free software you can download; what's available to animators is insane. It would have been a much different situation now because I always wanted to do that as a kid but it required … well I would have to get a Bolex and be able to develop your 16mm film which is … oh my god. So you know, really that the closest thing I could do was watch movies, and you know, I always

described myself as a Star Wars kid, and what that meant to me was special effects, like wow like, they made light sabers and Wookies and spaceships and other planets. How did that happen? And it was as I kind of investigated that I discovered Industrial Light & Magic. And when I investigated them I discovered using computers as artistic tools. That was always made to me. That was really fascinating. I love that idea. So that was always something I wanted to pursue. But in the back of my mind I want to make movie magic someday. So Pixar comes from the tradition of hand-drawn animation. Really. I mean John Lasseter was a hand-drawn animator. I mean, he was really looking to Disney as the inspiration for how we make films. So what that means is, it comes from a very strong pose, strong acting, but everything is done by hand. And so in that sense we do no motion capture. There's no procedural processes done on our characters. It's all hand-created, a lot of the textures in the film are hand-created, a lot of models are hand-built. So you know we've always ... It's funny 'cause people say "oh we use computers, you must use the computers to, like generate all of this stuff! The creating gets done on the computer does it?" You know, we still do everything. So we kind of, well there's a phrase that Pixar is adopting which is 'digitally hand-crafted'. Which was to say, you know there's humans behind every aspect of the film-making process, behind all the lights are hand-placed and hand-selected, you know, we choose where the shadows go. We choose where the colours go, we choose all emotions like there's actually people who hand-crafted each of these films. But it's funny, because I always feel that animation has a somewhat 'mystique to it', like people understand looking at drawings or computers or stop motion, but they get so engrossed in the characters everything they kind of forget about it. And they know it's done on a stage where, and it's filmed one shot at a time you know, they kind of will know that. But. To them it's still real. Like, so there's this mystique "y'know it's not real. I know that's a bunch of drawings but, but, that character no no no, that character is alive." And I find that computers also have a

mysticism about them because ... "I use computers and I know that there is a circuit board, and memory, and stuff, and they can kind of name things. But I don't know how it works. It just does." And I always found that computer animation kind of doubles the mystique because people are like: "I understand computers. I understand how ... I would tell friends "like oh yeah we have lights in the computer, we have cameras. I have my actors, you know our characters" and they would say "I don't understand that". And so, pure animation is actually very interesting because people understand that we make these movies on computers but because of the double mysticism they're just baffled. Yeah well, if I had to say, I would say that we don't let the computer make any choices. Right. So every time there's an eye blink in the movie it's because an animator chose, but I think at that time.

Hugo [00:03:48]: But you're interpreting between keyframes?

Warren[00:03:49]: But a lot of times we will happen. I mean a lot of the shots I work on, I do frame by frame. Especially with hands, I mean unlike interpolation. But I choose the interpolation? Right, I mean, its funny, I'm teaching this animation class right now. And you know the thing that's different like when you're drawing and you have a piece paper, the pencil is not going to make, I mean you could draw a bad line but the pencil is not going to interpolate your drawings poorly. But for computer animators, if you set two keys in time, the computer wants to do something, and it's the wrong thing. It's always the wrong thing. The computer always makes the wrong decision. Right. And so literally, as a computer animator your job is actually to undo everything the computer does or create stronger opinions of the computer but the computer will always give you the wrong thing. And poor animators are the ones that let the computer make the decision. So this is one of the reasons I like computers over stop motion; stop motion is purely an

additive process. You can't go back. Right. You have to move forward. Right. And in that way stone-carving first is very similar. It's an additive only or is subtracted only. Yes but it's a single direction. You can't. Like when we put some stone back "on I've chip too much off!" And so, for me personally, something that's purely additive, or purely subtractive really freaks me out ... So to me, computer animation is much more like clay because you can edit it. In that way it's a little bit more like drawings because when I'm drawing you can like "let me take some drawings out", "let me put some drawings in", "let me re-order it, let me re-time it" ... So you like; I have three ideas, let me try it, save it, try it, save it.

Hugo [00:05:47]: So it becomes the idea that's important; you're not enslaved to the process?

Warren [00:05:53: Well, I think you could be more experimental more quickly. A bunch of people going to sit in a dark room, together, and watch something for a period of time. And we're magicians in the way that we have to make them believe that a character exists, is alive and thinking, is going through an emotional journey and people are entertained by that. And so, when we think of story in THAT sense, we think of story in terms of "where is the audience in relation with the character". They are behind the character in terms of knowledge? Where in the arch of the character's journey are they? How does the character's personality shape their movement styles. I think that knowing about story and inhabiting a character whether you're looking out to improve a ritual of something or an object they have in there or interaction that they have in their world. I think that, that translates like imagining that journey. I think ideally as an animator, a lot of times, I look at my shot and I have nothing to go on. I know why this shot is in the movie. I know who the character is. I know we're an arch that they are on, but then I have to kind of

inhabit the character and start thinking like "what would I do with my face my hands" and kind of really consider that, and kind of design the performance of the character.

Hugo [00:07:19]: Who is your client'?

Warren [00:07:20]: I would say our director is our immediate client. And so, ultimately we need to satisfy them. We also have to keep in mind, trying to get our own creative ideas in there to support the story and ultimately try to get something entertaining for the audience. But ultimately it should satisfy the director. I mean because ultimately it's the director's tastes that are on screen and we need to support that. So I see my job as really making sure my director is getting the story they want on the screen, on time and on budget.

Warren [00:07:55]: So my first job at Pixar was actually animating television commercials because at the time, this was before *Toy Story* came out, the only way Pixar made any money was by doing television commercials. And in those cases we had external clients and that was also the time when CGI animation was not very well known. So we would show them kind of first stages of work, we would show it to the client, and they would have no idea what you're looking at. And they're like. "It doesn't make the finished commercial". This is a hard process and we have to go through it. But even then, late in the game they [the client] would want to make changes that were too complex to turn around. One of the nice things about the arrangement we have now is that the director and US are all in-house so it feels more like an internal client than an external client. So they know there's kind of a framework in place to kind of help guide the director to make sure that the feedback is working. It's kind of the two of us working together to make a great product versus

195

"we're trying to make a great product that satisfies some external client that doesn't really understand what we're doing". Because to some degree, the director, is a film-making artist and we're film-making artists trying to make a great film. One of the reasons I did industrial design is spatial thinking, like you know I can look at an architectural plan or like a 2-D plan and understand what the point is. And I think by looking at the screen I'm working on and seeing the characters, I understand that space that they're in and I know how they move through the space. So I think industrial design trains you to understand form and understand that the form is based on the minimal information. That skill set translates very well. I think the other skill sets are mostly graphic design because ultimately what we produce is something that's going to be presented on a flat image. And so really it's about composition and where the eye's going. Where are the dominant forums and where are the shapes, where are they positioned in the frame? Cinema as such, has so many things; so there's motion. So we're involved in the motion, so it's also designing the motion so that we can control the audience's eye. So we have our motion constructed in a way so that we know where the audience is looking and we are going to encourage them to look somewhere.

Interview with Phil 'Captain 3-D' McNally, Stereoscopic supervisor, DreamWorks SKG, Los Angeles, USA, January 2012.

Phil [00:00:06]: Is it recording there?

Hugo [00:00:07]: Yes it is.

Phil [00:00:13]: So I'm Phil McNally, or Phil 'Captain 3-D' McNally at DreamWorks Animation and I'm the stereoscopic supervisor here which really means anything that you wear glasses for, I'm kind of responsible for that.

Phil [00:00:30]: So let's talk about stereo pipeline at DreamWorks ...

Phil [00:00:35]: So we've come from the point of, our boss Jeffrey Katzenberg. He's said "we're going to work out how to make 3-D movies not just add 3-D." So what does that mean? Go and work it out. Two sides of this discussion is psychologically, creatively, what does it mean to think about spatial movie-making? And how do you compose and all that stuff. Second to that is just a very straightforward technical pipeline type of thing. If you're gonna to make a 3-D movie, how would you do that. Where does it fit in? And if you're going to have influence over how things are created, in stereo, you have to see it from as early as possible in stereo so that the medium influences what you're going to do. Because obviously if you're going to sculpt in wood and you do it all in plaster first, you're not going to get any 'Woody-ness' out of your sculpture. You're going to get a shape that might be fantastic in plaster, but you're not going to get anything that's unique to wood.

Phil [00:01:47]: In terms of where this all fits into DreamWorks's pipeline, the aim of it is to get it as early as we possibly can. Now that doesn't mean to say we're going to storyboard and convert them into 3-D storyboards, although actually we have tested that. The minute it goes from a storyboard, which is really writing in our world, you don't write words, you write cartoons. The minute it goes into Maya, or any CGI world, we can make it stereoscopic. And so, 'pre-vis' is stereo, we tend to call it rough layout. So we can make it stereo, from the moment we go there and we've even got to the point now of 'the look of picture', which is before we created models. We are converting 2-D images and we're doing work in After Effects, set-up stereoscopically, so that we can do the fly through the art, and we're doing it for the pitch to the execs. "This is the sort of potential we have for 3-D".

Phil [00:02:56]: I heard it a lot at the beginning "we're interested in story. That's why stereo isn't interesting". Or something along the lines of "stereo is a gimmick. We're interested in story". My response is "Well if you're interested in story. Write a book!" You know because the whole of movie-making is a gimmick. They're just visual techniques that have nothing to do with the story. It's just a way of telling it. Stereo is just a way of telling it. So yeah I mean the other thing is people often had asked "would this be a good movie for stereo or would this be a good movie for stereo?" Well if you mean "would that 2-D movie be good for stereo then probably not, although some fit better than others. If you're saying: "could this story idea be told successfully using stereoscopic techniques?" Then of course the answer is yes, because that applies to every story. If we go back to just stoy-telling of any kind. Presumably the earliest form would be round a campfire or something. You can go through all the progressions you know: theatre, books, radio and film, colour, sound. You can add all these layers. Well every layer which has been successfully created from a technology point of view has stayed. And every next development has been,

just another one of the sentences being made better, stereo being a very natural progression. And so, if you go all the way back to the beginning again you remove all technology. The ultimate way to experience another world is by dreaming. The moment you know that you're in the dream, you are generally not aware that it's a dream. You fully believe the world you're in and every sense is alive as if you're there.