Videogame Ecologies: Interaction, Aesthetics, Affect

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Abstract

This project is driven by omissions at the intersection of ecological game studies and media-ecology. Although authors have studied videogames from a variety of ecological approaches, few have attempted to develop a holistic methodology, embracing videogames' specific attributes while recognising their role within larger physical systems. This thesis is an attempt to address this, reading videogames as simultaneously about and functioning as ecologies. My methodology draws on the agential-realist philosophy of Karen Barad whose theory of 'intra-activity' is abundant with ecological ramifications. Adapting Barad's 'intra-active' framework for use with contemporary videogames, I read them as assemblages of hardware, software and their human players. I explore three significant aspects of game studies: interaction, aesthetics and affect. Focusing on interaction, I analyse the game *Shelter*.[1]

Emphasising the role of hardware and software, I read these processes in conjunction with an understanding of gameplay. This encourages a shift away from seeing gameplay as 'interaction' as it is defined within human-computer-interaction, and instead promotes a view that is 'intra-active'. Siding with Barad, play is radically reframed as a phenomenon that produces the apparent objects of its inception. In the second study I approach a series of more experimental games illustrating how an agential-realist worldview influences aesthetics. Analysing high-concept puzzle games *Superhot*,[2] *Antichamber*,[3] and *Manifold Garden*,[4] I suggest that these games place a focus on aspects of ecology often over-shadowed in so-called 'natural' imaginings of our world, such as time, space and their entanglement.

Finally, bringing my focus to the role of the player in my ecological understanding of games I analyse a number of short, human-centred or biographical games. Seeing the role of the player in an ecological manner, designers deviate from traditional methods of generating pathos and affect. Rather than developing empathetic relationships between player and avatar through immersion, viewing the player as only a part of an ecological system demands a posthuman response from players. These designers ask players to empathise while acknowledging their role is small and not central. This thesis presents a novel point of view that draws attention to the ambitious design practices of artists while suggesting new avenues in the future.

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[1] Johannes Wadin, *Shelter* [PC Videogame] (Sweden: Might and Delight, 2013).
[2] Piotr Iwanicki, *Superhot* [PC Videogame] (Poland: Team Superhot, 2016).
[3] Alexander Bruce, *Antichamber* [PC Videogame] (Australia: Demruth, 2013).
[4] William Chyr, *Manifold Garden* [PC Videogame] (USA: William Chyr Studio, 2017).

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Introduction

This thesis is a contribution to the field of ecological game studies, providing a posthuman/ new materialist/agential realist approach to the relationships between human players, technological systems through a focus on the fundamental forces that allow material connections. It is, however, based on a realisation I had while playing a videogame. [5] My hands connected to a mouse and keyboard, I was busily engaged with *Shelter*, the game pictured on the cover of this thesis and the subject of Chapter Three. To play the game is to take control of a family of badgers, with the objective of surviving their harsh world until such time that the young can look after themselves. A detail that initially caught my attention was that the mother and her kits are connected to one another algorithmically. If they stray too far, they eventually come running back to the mother. If the kits all die, so too does the mother and so the player must start again. This mechanical entanglement amidst a representation of the stereotypically 'ecological', so-called 'natural' world, struck me as important. In playing the game, a tension is created between the representation of ecologies through narrative and image, and the performative construction of ecological connections through the bio-technological processes of contemporary play.

I was reminded of the increasingly prevalent eco-games criticism, such as the work of Bainbridge and Chang (discussed in detail in Chapter One) whose work in particular highlights how game mechanics, the systems through which players interact with games, coincide with the ecological messages they may impart. In her study of virtual farm games, for instance, the lack of need to let fields go fallow, has a potential to portray rural landscapes as nothing more than endless sources of income (an idea uncomfortably instilled in the 'mega-farming' practices of North America).[6] In this regard, *Shelter* fared well but said nothing particularly new. Nature is depicted simplistically as a dog-eat-dog idyll. The aforementioned entanglement of mother and kits comes to shape your perception of your digital surroundings. The deaths of other creatures serve to further your survival; the deaths of your young are to be avoided at all costs. The natural world it represented through gameplay was, I felt, lacking in complexity.

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[5] The spelling 'videogame' as opposed 'video game' is used throughout this thesis in accordance with the long running Game Studies journal. I sometimes use 'digital game' or 'game', when contextually appropriate, interchangeably with 'videogame'. This is only to avoid repetition. No difference in meaning is intended.
[6] Alenda Chang, "Back to the Virtual Farm: Gleaning the Agricultural Management Game", *ISLE* (Vol. 1, No. 1, 2012) pp. 237-252.

After a while, a technical fault caused me to rethink my initial assumption. Although the game employs an origami inspired, 'low-poly' visual style (one that is extremely efficient as it limits the number of vertex calculations required by a system), it was still placing extreme demands on the relatively rudimentary laptop I had at my disposal. The machine's fans, designed to cool down the excess heat created by the high and low voltages (the means by which we currently enact 'binary code') coursing through the silicon CPU and GPU, were functioning at their full capacity. After an hour or so, the screen suddenly went blank. Service quickly returned with the message that there had been a 'critical error' and, as a result, my graphics processor had ceased to function. However, the computer continued on, just as intended by the programmers, reverting to a much lower resolution, utilising the built-in graphics from the motherboard. Without the GPU's assistance, however, the game began to warp and distort. It glitched and shuddered, producing weird visual artefacts and a bizarre play experience, I was forcefully reminded of how this artwork, this digital 'text', was entirely dependent upon the hardware that underpins it.

Although the game was certainly not functioning as intended, I continued to play. My play style had to change to accommodate the jerking movements of the on-screen characters. My fingers, muscles, my eyes, began to flow into a different rhythm. The broken version of this game was being produced in front of my eyes. Janet Murray's *Hamlet on the Holodeck*, and her ideas of multiform stories and plots were foremost on my mind. It certainly would have been possible to read this iteration of the game was simply a new retelling, analogous to a differences in the recitation of a folktale in keeping with the oral tradition.[7] This, however, did not satisfy me entirely as the game I was playing now seemed to be so fractured that to argue for its connection to the play experience as intended would have been an exercise in futility.

I was reminded of studies of glitches, of German media archaeology and some aspect of new materialism. I felt I was looking directly into the execution of the code of the game, seeing the functions laid bare, without any accommodation for my human comprehension. At the same time, however, it was clear that this was a material function of a machine dealing with the restrictions of the material world. It was the properties of iron and silicon, their ability to

[7] Janet Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (London: MIT Press, 2017 [originally 1997]).

conduct heat and influence electro-magnetic fields that determined this play experience I was becoming a part of.

Yet, there remained something specific in this experience worth discussing. Something that I felt brought together many of the elements of computer science, philosophy and critical theory that I had read. It was something about how what was being performed on screen was not a representation (or perhaps not solely), but was a manifestation of the digital, electrical pulses failing to keep up with the demands of their programming. The images of the badger family, shaded pixels, flickering at wildly varying rates of 10-60 frames per second, were still being rendered; groups of volts in RAM and CPU, connections of lights on the LED screen, remained entangled. But now, as their entanglement was being affected so clearly by their materiality, it became clear that their initial, idyllic entanglement was only ever possible through the same processes. A new, more engaging entanglement came into view. From the unfathomably complex activities of my brain and body to my fingers connecting with the keyboard to the processors to the electricity coursing through them, each element of this extended body was playing its part in an ecological process; a process that, in turn, was possible only because of the conditions of this world. I will come to discuss the notion of entanglement more throughout this thesis but let me state here that what began as an initial observation about proximity and shared activities, let's call it circumstantial entanglement, gave way to the realisation of physical connections between various worldly scales, similar to the meaningful entanglement that binds particles across space at the quantum level.

Understanding games as entangled, material phenomena, to be experienced more than read allows us to expand upon ideas of interaction, videogame aesthetics and affect established in game studies scholarship. This ecological quality stems partly from videogames, regardless of their content, being networks of hardware, software and human activity. Party to this, videogames can also enact ecosystems. Through a complex web of entangled background processes, code 'if loops' and hardware clock cycles, 'God games', such as *Populous*, task players with managing the welfare of an entire planet.[8] Through expertly designed algorithms that were, in turn, stored as voltage on Amiga floppy-diskettes, *Populous*' familiar but fictional planet thrives and decays in real time. The human user, in their unimaginable complexity, comes to contribute to these otherwise cybernetic processes, their intentions

[8] Peter Molyneux, *Populous* [PC Videogame] (Guildford: Bullfrog Productions, 1989).

transformed into voltage through keyboards and controllers. Taking the entangled qualities of games such as *Populous* together, videogames can be understood as simultaneously enacting ecologies while functioning ecologically in their own right. I propose that it is, therefore, this multiple, simultaneous quality that characterises their unique eco-characteristics.

Understanding videogames, media objects often radically distinct from commonly acknowledged 'green' texts requires an adjustment in thought. Timothy Morton has clearly defined 'thinking ecologically'. He writes, "the ecological thought is the thinking of interconnectedness. The ecological thought is a thought about ecology but it's also a thinking that is ecological".[9] Ecological thinking is not just thinking *about* ecologies (as when considering the state of the environment or deliberating recycling practices), it is a thinking that is acknowledged to happen within the vast interconnections that guide our daily lives. From an analytical perspective, videogames can embody this duality of the ecological thought. They can be *about* ecologies in their visual and narratological mediations of virtual environments. At the same time, they *are* ecologies, in that they combine a vast array of processes, both organic and inorganic.

An issue that videogame ecologies poses, one that will be addressed throughout this thesis, is that of scale. When playing a videogame, there are forces at work at the most minute scale, and, often, interconnections traversing the entire planet. At the same time, humans interact with games in complex, sensitive ways, investing emotions and forming cultural norms around play. Yet their input into the cyborg, hybrid apparatus of the computer/human videogame is relatively limited when compared to the rapid, global, machines providing the means for their experiences. Jaime Banks suggests that we should work across scales when studying videogames, to "examine phenomenal assemblages of play at micro-, meso- and macro – levels".[10] I will return to this idea time and again, but it is at the core of my ecological approach to games analysis: we must understand that the micro world of electrical hardware activity is entangled with the processing of software code, which, in turn, is entangled with the moment to moment actions of the player, which, in turn, are entangled with the larger, abstract human notions of excitement, exhilaration, pain and loss of gameplay. My framework

[9] Timothy Morton, *The Ecological Thought* (London: Harvard University Press, 2010), p.7.
[10] Jaime Banks, "Object-relation Mapping: A Method for Analysing Phenomenal Assemblages of Play", in *Journal of Virtual and Gaming Worlds*, vol. 6, no. 3 (2014), p. 235.

attempts, as best possible, to account for this web of activity.

This introductory chapter will unpick some important terms and present my observations about the specific ecological nature of videogames in the simplest possible way. Drawing on a number of independent games, I make observations on the current state of videogames and ecologies; how games represent, mediate and function as ecologies. Following from this, chapter one is dedicated to surveying relevant existing criticism from the overlapping areas of game studies, media ecology and code studies. Although this unique ecological quality of videogames is so definitive, I reveal that it is currently underexplored in game studies and relevant areas of media studies. In chapter two, therefore, I develop a methodology that serves as the backbone for the rest of this work. Rather than analyse videogames as other game studies or media scholars have, I, instead, use the writing of Karen Barad, using elements of her radically posthuman 'onto-epistemology' as a base for this thesis. Although not an explicitly 'eco' philosophy, her new materialist, 'agential realist' philosophy, is founded on a discussion on the interconnections of matter. Though vast in scope, it provides an invaluable lexicon and is the cornerstone of my ecological understanding of videogames. As I understand games as hardware, software and biological action simultaneously, Barad's writing allows me to discuss these seemingly disparate properties as an interlinked whole. Chapters three, four and five are each dedicated to examining a different implication of exploring videogames through my ecological method. Focusing on the specific relationships highlighted through my close analysis, I argue that the specific games I have chosen challenge established theories of interaction, aesthetics and affect.

My reason for using Barad's philosophy is born out of the current state of ecological game studies. At present theorists suggest the ecological nature of videogames but do so in a way that opens up avenues for further exploration. As will be suggested in my review of relevant literature, theorists' tendencies to focus on elements of the videogame ecology comes at the expense of understanding the whole. For instance, Thomas Apperley's study of ecological gameplay focuses on players, perhaps overshadowing the games themselves.[11] Jesper Juul discusses the complicated relationship between rules, players and games coming to the conclusion that they exist as only "half-real", potentially softening conceptions of the very real

[11] Thomas Apperley, *Gaming Rhythms: Play and Counterplay from the Situated to the Global* (Amsterdam: Institute of Network Cultures, 2010).

impact videogames have on society.[12] Similarly, Ian Bogost's posthuman, 'object-oriented' assertion that while videogames take on multiple roles, their noumenal, 'real' existence is beyond the reach of conscious beings, can be read as devaluing the visceral immediacy of the gameplay experience. Adopting Barad's broad-ranging, posthuman, new materialist framework allows me to bring these ideas together. The new materialist nature of her philosophy highlights the entangled impact of videogames and players together on the 'real' world, discarding notions of videogames as in some way 'virtual' or 'vaporous'.[13]

Barad's writing accommodates for the wide range of current modes in game studies and can, therefore, fill a current blind-spot in that discourse. Rooted in new materialism it demonstrates a realism influenced by scientific discoveries and writing on science. The ontology explained in her work places a focus on phenomena over objects. She suggests that while phenomena cannot be viewed as 'things in themselves' they should still not be understood as existing in a Kantian paradigm of noumenally/phenomenally real. She writes, "crucially, then, we should understand phenomena not as objects-in-themselves, or as perceived objects (in the Kantian or phenomenological sense), but as specific intra-actions".[14] Her coined term 'intra-activity' will be explained in detail in chapter two. Put simply, for now, it issues forth from her agential-realist worldview as the means through which apparent objects, though the result of phenomena, appear to 'be'. Adopting Barad's view, we are forced to engage with the reality that videogames are an active part of forming everyday existence. This new materialist, posthuman approach is precisely what is missing from the current game studies discourse and so serves as a useful complement to established views.

It is imperative to note that, throughout, 'ecology' will be understood in a media-ecological sense, referring to the complex networked relationships between multiple human and non-human entities. Although the term may resonate with contemporary popular ideas of a so-called 'natural', my understanding of videogames as ecological is distinct from those rooted in 'green' ecocriticism. Matthew Fuller writes that 'ecology' is the term "most expressive language currently has to indicate the massive and dynamic interrelation of processes and

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[12] Jesper Juul, *Half-Real: Videogames Between Real Rules and Fictional Worlds* (London: MIT Press, 2005).
[13] I am influenced here by the discussion of the 'vaporous' qualities of media in Wendy Hui Kyong Chun, *Programmed Visions: Software and Memory* (London: MIT Press, 2011), p. 21.
[14] Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (London: Duke University Press, 2007) p. 128.

objects, beings and things, patterns and matter".[15] At the same time, Fuller is careful to note that 'ecology' (like 'economy') has a history: from the Greek 'oikos', it suggests ideas of households, families and order. Ecologies are attempts at making some sense of order out of potentially chaotic, vast interrelations. Unlike similar terms, with shared history, the nature/culture divide is absent from 'ecology'. Whereas 'physis', 'polis' and 'techne', suggest the division between the human and the wild, 'oikos' does not innately suggest such a distinction.[16] My use of ecology, therefore, promotes a posthuman, materialist idea of videogames as combined biological and technological activity. 'Ecology' highlights this material point of view and suggests the complicated entanglement of the natural and technological in videogame play.

Although Barad's work is not explicitly ecological, in that she does not use that phrase, in many senses it is a sublimely ecological theory. To be clear, Barad's work does invoke some elements of eco-criticism and, in the latter stages, shows a preoccupation with the environment and environmental practices. She discusses 'biomimickry' and the extent to which it can be seen as an answer to the problems of human impacts upon the planet. However, this eco-critical project does not persist for long as Barad works hard to break down the distinctions between so-called 'things' and their so-called 'environments'. She writes, "'environments' and 'bodies' are intra-actively co-constituted. Bodies ('human', 'environmental', or otherwise) are integral 'parts' of, or dynamic reconfigurings of, what is."[17] In breaking down these distinctions, her theory is forged through a preoccupation with the same 'massive and dynamic interrelation of processes' mentioned by Fuller, with the exception that, for Barad, it is these processes that go on to continuously reconfigure and reproduce the apparent 'things' of the universe. While Barad may simply refer to what I call 'ecology' as 'the universe' or inevitable outcomes of the universe, I am content to use the term in order to assist my project of foregrounding the connections between the apparent objects of videogame play.

While my terminology is intentionally provocative, so too are the videogames I have chosen to analyse. My work is predominantly focused on independent videogames with some small examples drawn from more popular titles. This choice was made for two reasons: firstly, for

[15] Matthew Fuller, *Media Ecologies: Materialist Energies in Art and Technoculture* (London: MIT Press, 2005), p. 2.
[16] Sean Cubitt, *Eco Media* (New York: Rodopi, 2005), p. 18.
[17] Karen Barad, *Meeting the Universe Halfway*, p. 170.

better or worse, videogames from the independent sphere simply resonated more with the qualities I wished to highlight. Although the arguments I present in chapters three, four and five could be fruitfully applied to games created by large studios, they are particularly apt to the chosen videogames. Secondly, the independent game designers were forthcoming with information about their games that would have been impossible to legally obtain or reproduce had their games been the intellectual property of a larger company. This included insights into the games themselves but also working builds of games not yet finished.

The games I explore in this thesis are not exclusive to any platform but have all been played on a Windows PC. The reason being that the majority of independent games produced today appear on the PC. I am not attempting to dig deeply into a specific game system, as in the school of platform studies. It should be understood then that my analysis of these games is unique to my particular experience, due to the relative lack of uniformity symptomatic of PC gaming. Two different PC's, even if both run the same operating system, can have different motherboards, running different BIOS' and have different levels of efficacy when using the same hardware. As such, when I am examining some of the shared tools for independent game design throughout the work that follows, such as the Unity game engine and development software package that allows rapid game development, it must be understood that the particulars of my experience may vary to another user on a different computer. This was unavoidable as the Unity engine forms a part of the shared ecosystem of contemporary independent games; its stability, accessibility and ease of use are important contributing factors to the rise of independent games in recent years.[18] At the same time, it is testament to the agential realist underpinnings of my work. Although we have a tendency to think in terms of objects and subjects, I am urging a focus towards a phenomenal ontology that places performance before things. While it is tempting to think of a game as a uniform object it is, in keeping with Barad and Judith Butler's concepts of performance, produced uniquely by phenomena.

As many of the videogames in each chapter were developed using the Unity engine this allows me to make certain, necessary assumptions about their construction. For instance, given the characteristics of Unity, I can surmise that the functional logic of these games follows certain protocols, enabling me to comment on their ecological properties. The three languages that

[18] Unity 3D, "Public Relations" (online resource), <unity3d.com/public-relations> [last accessed 19/07/2016].

can be used to construct scripts in Unity are C#, Javascript and BOO. Of those three, C# and Javascript are the most widely used today with more frequent support offered for Javascript. These languages both function using similar, object oriented logic. As such, when analysing games in depth, it is possible to construct similar scripts following the syntax permitted by those languages. Analysing games with the knowledge that they follow the patterns of object-oriented programming allows me more acutely engage with their micro-ecological properties. I can determine how data is shared or restricted between game objects, given the properties of Javascript and C#. In turn, taking my lead from Banks, I can acknowledge that these micro-properties impact how I view the meso-scale world of gameplay, and the macro-scale dimension of human emotions and online global networking.

A further aim of this thesis is to side with existing 'ecocritical' discourse surrounding the depictions of landscapes or biomes in fine art, literature and cinema. Videogames can make us aware of qualities of the natural world we seldom consider. In part, this is a technological achievement as high-definition graphics have the potential to bring us close to the awe-inspiring quality of nature cinema with added apparent control and time for reflection. At the same time, increasingly intricate interactive narratives allow us to get lost in the romance of an imagined 'wild'. Most importantly, however, when playing a videogame, we are constantly reminded of our place within a 'system' of some kind. Whether through a glitch or a gameplay 'mechanic' we can become aware that we are acting within an expansive web of databases, clock cycles and computational loops.[19] Although a far cry from the complexity of the biological, videogames, when considered as ecologies, prompt us to consider our place within the systems of everyday existence.

Given that I take systems and ecologies as almost synonymous it is important to clarify that although the way I theorise exchanges between players and machines in videogame play resonates with complex systems theory, I do not intend to utilise this approach in my methodology. It is possible that an approach founded on complex systems may have produced similar outcomes. As one of the aims of this thesis is to understand this unique ecological

[19] Game mechanics are combinations of rules and actions that allow players to interact with videogames. For example, the 'jump' mechanic of most games is the combination of the player pressing a button and the rules that govern how that button-press affects the game world - how high and far will the jump be; do you pass through objects or not, etc. All games have mechanics, but every game will not have the same. They are often the heart of a game but are more or less reflected in the narrative depending on the game.

facets of independent videogames and to explore the implications therein. Just as I intend to see videogames as ecological systems, in that tradition, simple actions are seen to have vast implications on a global scale, with this holding true for biological and non-biological activity alike. Norbert Wiener sought to blur the boundary between animal and machine in his mathematically grounded work on cybernetics: "the synapse is nothing but a mechanism for determining whether a certain combination of outputs from other selected elements will or will not act as an adequate stimulus for the discharge of the next element and must have its precise analogue in the computing machine".[20] Friedrich Hayek and Stephen Wolfram, work in a similar vein, finding the mathematical patterns behind the functions of nature. Complex systems theory presents a fascinating method with which to approach questions of the foundations of the natural world. Although I aim to show that games expose their own and other complex systems, complex systems theory was not the most appropriate choice to explore this point. In part this is because, as my argument progresses through this thesis, my work becomes less focused on the functioning of systems themselves and more on how videogames can be read as drawing attention to and commenting on accepted ontological theories. I become less concerned with the impact of the workings of a system and more interested in the outcomes of these complex systems.

A further point for clarification is that I do not wish to suggest games should be understood as ecologies *metaphorically*. Rather, I am suggesting there is a *material* basis to games; each has roots in electronic computer processes, a materiality that is often overlooked in game studies. Engaging with games in close detail, paying close attention to source-code as actions prompted in computer hardware, highlights a web of interconnected physical processes often viewed as vaporous. I ultimately argue that videogame ecologies are an important part of a much wider whole. Although they are active mechanical systems in themselves, games also involve human players who, it should be understood, through play, become active parts of a wider apparatus. To explore these claims, I look to an array of contemporary ecological philosophy and cutting-edge humanities research, rigorously taking apart the concept of an 'ecology' and examining how videogames fit into it. This is undertaken with reference to a small number of independently developed videogames, released within the last ten years. Each of the games mentioned in this work has been chosen because it displays an interesting

[20] Norbert Wiener, *Cybernetics or Control and Communication in the Animal and the Machine* (London: MIT Press, 1956), p. 14.

depiction of some form of entwined system; these games are worth exploring because they draw attention to aspects of how we think about ecology in general or else because of how they challenge our concept of videogames as part of worldly systems. In all, this thesis aims to present a new view of independent games within the context of the complex biotechnological network of contemporary western society; one provides an engaging insight into how this specific form of leisure technology plays a part in and simultaneously shapes everyday culture.

VIDEOGAME ECOLOGIES

In certain circles, a romance surrounds the independent game designer. Assisted by the 2012, Sundance award-winning documentary *Indie Game: The Movie*, the phrase 'independent developer' can conjure images of a lone visionary, struggling against the demands of powerful industry.[21] Likewise, in gaming magazines that attempt to broadcast an alternative idea of videogame culture, the independent designer does not merely create games; they are attempting to make art.[22] However, 'indie' games have also come to suggest a genre rather than the financial situation of their creators. In recent years, 'indie' games have been released with suspicious levels of support from larger distributors, challenging the idea that these games are produced outside of conventional channels. Whether working alone in a bedroom or within a relatively large company, regardless of budget, platform, with or without support from a major publisher or distributor, games seem, nevertheless, to earn the title 'independent'.

Without recourse to the romantic idea of an independent, struggling artist ideal, however, we can still confirm that in the last decade, 'indie' games – whatever they might be – have been innovative and challenging compared to their mainstream relatives.[23] Amidst this varied landscape, a number of games have distinguished themselves as 'eco-games' through a focus on contemplation, reflection and exploration. Games that place an explicit emphasis on the environment, *Firewatch*[24], *Walden, a Game*[25] and *Nature Treks: Healing with Colour*[26] set the player the task of exploring environments and little else.

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[21] Lisanne Pajot and James Swirsky, *Indie Game: The Movie* (film), (USA: Blinkworks Media, 2012).
[22] Dan Solberg, "The Beginners Guide to the Art of Videogames", *Killscreen* (online resource) <https://killscreen.com/articles/beginners-guide-art-videogames> [last accessed: 26/07/2016].
[23] Mike Diver, *Indie Games: The Complete Guide to Indie Gaming* (London: LOM Art, 2016).
[24] Jake Rodkin, *Firewatch* [Videogame Multiple Platforms] (USA: Panis, 2016).
[25] Tracy Fullerton, *Walden, a Game* [PC Videogame] (USA: USC Game Lab, 2016).
[26] John Carline, *Nature Treks* [PC Videogame] (Published online, 2011) <www.greenergames.net> [last accessed, 26/07/2016].

There is an attempt, within this independent scene, to capture the beauty of the so-called 'natural' world; that 'thing', in Timothy Morton's words, "'over there' that surrounds us and contains us".[27] Through the use of striking graphics and elaborately detailed three dimensional environments these games represent the perceived natural in painstaking detail. These creations resonate with the writings of Lawrence Buell and other literary eco-critics who seek to foreground the environment within our readings of classical texts. Buell asserts that a text is 'ecocritical' when it adheres to certain criteria. He suggests that in a text that is ecocrticial "the nonhuman environment is present not merely as a framing device but as a presence that begins to suggest that human history is implicated in natural history".[28]

Nature Treks and similar titles make a game out of appreciating the environment. Throughout play, we do nothing but move through an extraordinarily well rendered 3D environment (figure 1). There are no explicit rewards but seeing rare bursts of wildlife such as birds or butterflies, though entirely random, begins to feel like a reward in itself. Spending time in the calming, peaceful game world is a zen-like experience, limited only to the player's patience. The game's focus is clear; to generate an appreciation for the so-called natural world. In this, the newest era of humanity's technological history, that of ubiquitous computing, is beginning to find its place in natural history as Buell suggests.

[27] Timothy Morton, *Ecology Without Nature*, p. 1.
[28] Lawrence Buell, *The Environmental Imagination: Thoreau, Nature Writing and the Formation of American Culture* (London: Harvard University Press, 1995), p. 7.

Figure 1. *Nature Treks: Healing with Colour*

In a similar, perhaps even more explicit vein, David O'Reilly's *Everything*, provides the user with a protracted, abstract and often surreal interaction with the titular 'everything'.[29] From microbes and plankton to cows, pigs, all the way to air-balloons, the game gives the user the chance to play with simple representations of these familiar objects in a manner reminiscent of an overstuffed child's playset (figure 2). The entire experience is set to the backdrop of the philosophy of Alan Watts, making the point clear that this is intended as a thought-provoking, but very playful, experience, beyond a traditional 'videogame'. O'Reilly's previous game, *Mountain* provided the user with a similarly absurd, thought provoking experience of what it was to be a mountain – in essence, an opportunity to do nothing but stare, in awe, of the procedurally generated graphical monument.[30]

[29] David O'Reily, *Everything* [Playstation 4 Videogame] (USA: Double Fine Productions, 2017).
[30] David O'Reily, *Mountain* [iOS Videogame] (USA: Double Fine Productions, 2014).

Figure 2. David O'Reilly's *Everything*

There is, however, something unfulfilling in the current mediations of natural environments. Something stands out as almost uncanny in the level of beauty of these rendered worlds. Morton suggests the potential of a 'dark ecology' writing, "with dark ecology, we can explore all kinds of art forms as ecological: not just ones that are about lions and mountains, not just journal writing and sublimity. The ecological thought includes negativity and irony, ugliness and horror".[31] Although there is a concerted attempt to represent nature in games like *Nature Treks* and *Everything*, there is an element of Morton's 'dark side' of ecology that is missing. Although we walk on mediated soil in each of the games, there is never the possibility of becoming dirty or hungry; our digital bodies will never perish or decompose in any meaningful way. There is no opportunity for our energy to become part of the same system that brought about the objects we see. In each game, there is never any sign of the necessary decomposition of matter that is required to sustain the landscape. There is an unavoidable distance created in these photorealistic but nevertheless shallow representations of reality. Playing these games, one quickly becomes discontent with such idealised portrayals of reality. It is difficult not to recall a short sequence from *The Matrix*.[32] Late in the movie, 'Agent Smith' (Hugo Weaving) reveals that 'The Matrix' was originally designed as a paradise. Smith elucidates, however, that the cybernetic overlords had to abandon this design because humans 'rejected it'. Like a utopia created by machines, there is something almost parodic about these games' attempts at mediating a perceived 'natural' world. Without the 'dark ecology' that is so essential to our biological existence, games can appear lifeless while attempting to seem

[31] Timothy Morton, *The Ecological Thought* (London: Harvard University Press, 2010), p. 17.
[32] Lana Wachowski and Lilly Wachowski, *The Matrix* (USA: Universal Pictures, 1999).

full of life.

A small number of games are far better attempts at representing the natural world that, to a degree, engage with the 'darker' elements of our ecological existence. *Rust*, for example, places players in control of an avatar in a post-apocalyptic world.[33] Uniquely, however, the avatar begins the game naked, starving and alone. To gather supplies players must destroy flora and fauna and craft tools from their surroundings, fending off other players for the seemingly limited resources. The game is commendable for its featuring 'hunger' and even 'hypothermia' systems. However, there is a level of detail still missing as the local biome is still limited to a few stochastically generated objects that reappear as time passes. In spite of appearances, resources are not limited and simply regenerate over time. Even in this attempt at focusing on the darker side of humanity, there are elements of ecological complexity that are side-lined in the act of representation.

Putting aside the importance of impressive graphics for mediating the natural world, other game designers adopt alternative approaches. Taking inspiration from world-building simulators of the past such as *Sim City* a number of independent games forefront complex systems over attractive visuals, aiming to recreate a world of (re)activity.[34] For example, *Dwarf Fortress* stands out for its graphical simplicity but systematic complexity.[35] In the tradition of *Rogue!*, *Dwarf Fortress* utilises only the 'ascii' characters as graphics (figure 3). Various coloured letters and symbols to represent features. Amidst the features of *Dwarf Fortress* one that foregrounds its complexity is the first step required for play: to generate a world. After the player has chosen from limited parameters for a small number of options such as the number of beasts or the number of settlements, the computer pseudo-randomly or 'procedurally' generates a world of predetermined size. Worlds are often thousands of squares in area and each of these squares will be taken up with a forest, a mountain, a river or some form of landscape. We can then zoom into these squares and reveal their hidden complexity: a forest is mostly trees but will also contain rocks, water, birds, plants. Comparably, a desert will mostly consist of sand but will also have some percentage of vegetation. Within *Dwarf Fortress* an important aspect is 'history'; as the world is generated, the effects of time are felt

[33] Garry Newman, *Rust* [PC Videogame] (USA: Facepunch Studios, 2013).
[34] Will Wright, *Sim City* [Macintosh Computer Game] (USA: Maxis, 1989).
[35] Tarn Adams, *Dwarf Fortress* [PC Videogame] (USA: Bay 12 Games, 2006).

as the squares adjacent from each other affect the topology of the other.

In a similar manner to John Horton Conway's *Game of Life*, the cellular automata simulation, patterns emerge in the landscape of *Dwarf Fortress'* worlds. Rivers erode mountains, verdant areas are deforested, towns are destroyed and concentrations of civilisation appear. Eventually, in contrast to the games mentioned above, *Dwarf Fortress* achieves a staggering level of complexity ranging from the condition of the skin tissue, muscle and bone of each of the hundreds of dwarves in your control, to the level of sediment contained in nearby rivers; there appears to be a fully realised ecology at work, over which the player has some small degree of influence.

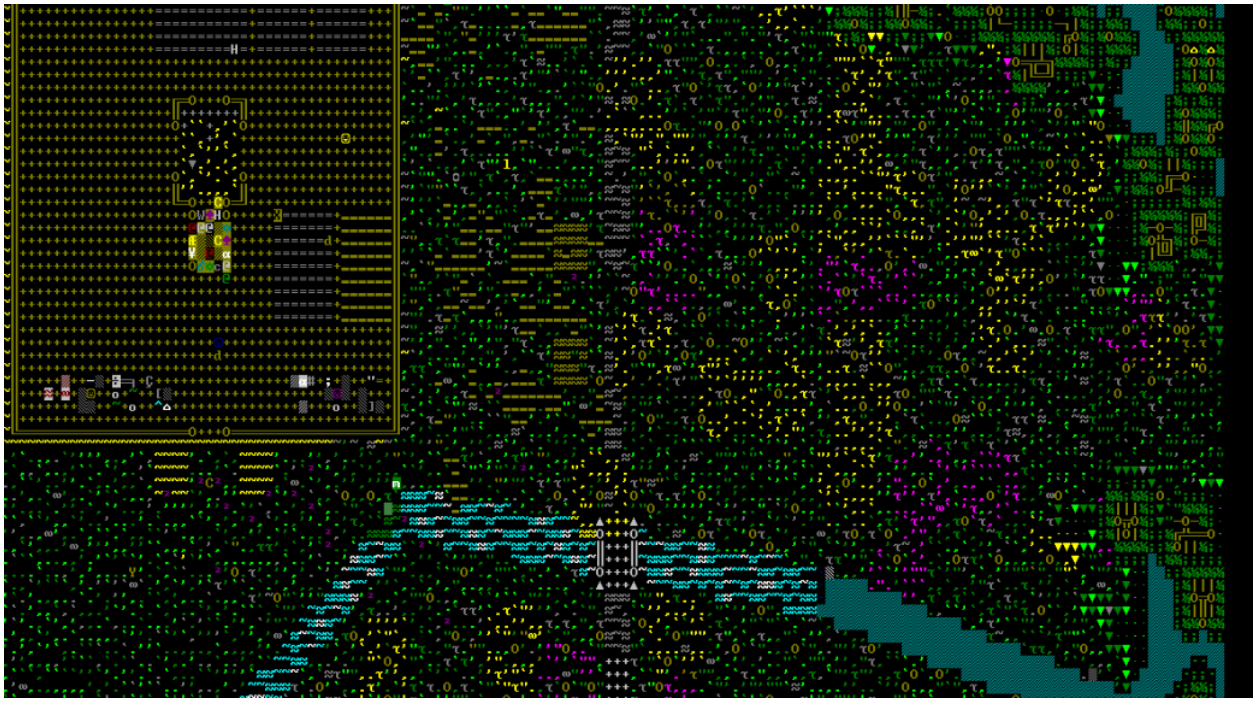

Figure *3. Dwarf Fortress*

Although *Dwarf Fortress* is a game of staggering complexity it, nevertheless, pales in comparison to the complexity of biological entities. The working game is composed of hundreds of entangled variables, that produce thousands, if not billions, of computational interactions per second. These interactions produce the on-screen 'world' we perceive in front of us; withering trees, eroding rocks, dying heroes, giving way to new life for generations until an eventual, unavoidable defeat. This complexity, while admirable, of course, still pales in comparison to the complexity of any activity of a biological entity in our worldly biome. Eugene Thacker brings to the surface the immense level of complexity of living beings in his study of biocomputing; Thacker reminds us of yet unharnessed potential power of DNA to

function in a computational manner with the sobering thought that "for silicon-based computers, calculating all of the possibilities of such problems can be computationally taxing. However, for a molecule such as DNA, the well-understood principle of 'base pair complementarity' (that A always binds to T, C always binds to G) makes for something like a parallel processing computer, except that it functions not through microelectrical circuits but through enzymatic annealing of single strands of DNA".[36] Thacker's idea, that forms of code may ultimately be interchangeable, suggesting the potential for remediating the human genome, brings to mind the bewildering complexity of the human bodies we so often take for granted. Though it may seem obvious, it is important to not forget that although a game like *Dwarf Fortress* brings attention to the complexity of computation, its interconnections will never and can never hope to compete with the complexity of biological beings.

Of course the complexity of *Dwarf Fortress* in comparison to biological material is neither intention nor what is important about the game. *Dwarf Fortress* is not the one-to-one scale map of Jorge Luis Borges' 'On Exactitude in Science'; the map that perfectly represents a space down to individual details, asking the question, what is it that distinguishes the 'map' from the 'world'. A videogame will never be a perfect simulation *of a* world because it is always already a part *of the* world. What is important is how the eco-system produced by the game can help us conceive of the complexity, disregarding what is biological or technological, of the world in which we are a part. *Dwarf Fortress* provides us with an insight into the ecological power of games; they reveal interconnected systems to us, inviting the thought that the system we are using is connected to wider systems beyond that.

The game makes a powerful statement about the position of machines and computers in our natural world. Visible through its stripped back, unrepentantly machine-like aesthetic, this 'game' is a host of computations with symbols representing variables, strings and arguments that each have effects on the other. In a sense, *Dwarf Fortress* is more a representation of computation than a biological environment: although the processes can be paused, there is an automation to the events that unfold. This is not a 'natual' ecology in any way; this is a computational construction of astounding complexity. That being said, though it may not inspire reflection on the interconnectedness of the so-called natural aspects of the world in which we live, it still prompts us to consider our ecological connections to the machines we

[36] Eugene Thacker, *Biomedia* (Minneapolis: University of Minnesota Press, 2004), p. 3.

use. The unrelenting complexity of the game challenges us to grapple with our persistent, daily reliance on machines. Though we may not initially understand the symbols and significance of each input, we quickly come to learn. In doing so, we are meeting the machine half-way, rather than controlling it. We do not dominate *Dwarf Fortress* but merely co-operate with it for as long as we can.

The ecosystem of *Dwarf Fortress* foregrounds an entirely different type of ecology to that mentioned by Buell; present here is a technical ecology following a biological logic. This is the type of ecology theorised by Matthew Fuller's 'media ecology', wherein objects are "understood to mean processes embodied as objects, as elements in a composition. Every element is an explosion, a passion or capacity settled temporarily into what passes for a stable state".[37] The world is abundant with systems and each of these is bursting with novel interactions; videogames are a relatively new form of worldly ecology, but are ecologies nevertheless.

It is tempting, when analysing videogames, to consider the world of the text as distinct from the world we inhabit. This thinking is prevalent within writing about games and has its roots in the 'possible worlds' theories of Thomas Pavel. The idea of a possible world can be understood as "abstract collections of states of affairs, distinct from the statements describing those states, distinct thereby from the complete list".[38] If we consider all the various possible ways in which a world *could* be, understanding that the world we have come to know as the 'real world' is just one possibility, it becomes difficult to discount for certain the potential existence of fictional worlds. Though Sherlock Holmes did not exist in this world "due to an unpleasant natural incident", he could have existed in another "state of affairs".[39] Videogame worlds are taken by many game scholars to function in a similar manner. What's more, the incompleteness of these virtual worlds - such as those factors left undetermined in *Dwarf Fortress* - actually add to the level with which the user engages with fictional worlds. The undetermined gaps in the virtual provide a space in which the user can imagine details and make personal decisions on how they picture the world.[40] This space for our imaginative

[37] Matthew Fuller, *Media Ecology*, p. 1.
[38] Thomas G. Pavel, *Fictional Worlds* (London: Harvard University Press, 1986), p. 50.
[39] Thomas G. Pavel, "'Possible Worlds' in Literary Semantics", *The Journal of Aesthetics and Art Criticism*, Vol. 34, No. 2 (1975), pp. 165-176, p. 167.
[40] Marie-Laure Ryan, *Possible Worlds: Artificial Intelligence and Narrative Theory* (Bloomington: University of Indiana Press), p. 32.

interventions may be one of the many reasons why videogame worlds have such a strong pull and increasingly draw users away from the 'real' and towards the 'virtual' space.[41]

In spite of the lure of conceptual worlds following Pavel and narratological game studies, there is good reason to think on simpler ontological terms. If we choose to discount the potential existence of virtual worlds we can focus clearly on their functioning as part of the world. Rather than viewing the worlds of videogames as fictions, we can view them as the outcome of activity in a singular material plane. We can cease to view games as representational 'texts' and instead attempt to view them as performances. Judith Butler urges us to consider the discursive practices through which 'matter' comes to 'materialise'. From her distinct social-realist perspective the social practices that label matter also come to shape it. She provides the example of gender construction which, as an action, must presume an 'I' or a 'we' to enact it. However, Butler suggests that "the 'I' neither precedes nor follows the process of this gendering, but emerges only within and as the matrix of gender relations themselves".[42] In a similar fashion, N. Katherine Hayles has suggested a focus on materiality for understanding humanity arguing, "the posthuman subject is an amalgam, a collection of heterogeneous components, a material-informational entity whose boundaries undergo continuous construction and reconstruction".[43] The time has come to bring this frame to videogames, perceiving them as 'material-informational amalgam' to embrace the implications of their processes. Although a game like *Dwarf Fortress* tells the story of a number of fictional creatures attempting to cultivate a fictional land, it is also a fascinating dynamic system of mechanical actions.

Thinking back to Thacker's *Biomedia*, wherein DNA can be represented in a computer or can itself, do the computing, we can begin to shift focus from what computer programs *represent* towards what it is they *do*. I have asserted that the simple aesthetic style of the game encourages this reflection: the use of individual symbols, rendered anew in each CPU cycle, constantly liable to change, resulting in a computational ecology following biological logic. Flipping how I have applied Thacker's approach, however, focusing instead on how biological

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[41] Edward Castronova, *Exodus to the Virtual World: How Online Fun is Changing Reality* (New York: St Martin's Press, 2007).
[42] Judith Butler, *Bodies that Matter: On the Discursive Limits of 'Sex'* (London: Routlade, 1993), p. 7.
[43] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics* (London: University of Chicago Press, 1999), p. 3.

material can complete technological functions, videogames like *Dwarf Fortress* enact a technological form of ecology similar to that found in biological entities; rather than functioning through DNA, the machine creates an ecology through the microelectrical circuitry mentioned by Thacker. Pushing past distinctions of microelectricity vs aneles and enzyme, we should instead seek to find the complementary interlinking functions of any system. Hayles urges "in the posthuman, there are no essential differences or absolute demarcations between bodily existence and computer simulation, cybernetic mechanism and biological organism".[44] A game like *Dwarf Fortress*, so inescapably constructed of overlapping activity, does not have to be relegated to the realms of the 'technological'; regarding it simply as material allows us to focus on its ecological properties.

That videogames may not just represent but may *be* material ecologies has specific ramifications. I explore these throughout this thesis but it is important to give an indication of what these are before we proceed. If you will allow a brief shift in narrative voice, I want to share a personal anecdote to illustrate the impact of independent videogame ecologies. In 2008, volunteering with a youth group on a foreign exchange trip, I found myself on a ferry surrounded by a number of adolescent students. There was no wireless internet on board and no cellular signal. Nevertheless, each of the children had some form of electronic device in their hand; these devices were predominantly Apple-branded but a few were clearly Android-powered devices, designed by numerous hardware manufacturers. The children discussed strategies for a building project. The most extrovert of the children issued commands: she told the others where bricks should be placed, who should receive what resource and how they should be utilised. One child, quiet and on the outskirts of the group was clearly also playing the same game though was not being directly included. After a time, the majority of the children began to scream and panic; simultaneously, the quiet child began to smirk. The group shouted protests that their hard work had been pointless and that the lone child wasn't 'supposed to be on their server' anyway.

If it is not obvious by now, the children were playing *Minecraft*.[45] Specifically, they were playing *Minecraft* in its networked form, in the 'creative' mode where players are free to build as much as they want without penalty. Created over a number of years by designer Marcus

[44] N. Katherine Hayles, *How We Became Posthuman*, p. 3.
[45] Marcus 'Notch' Persson, *Minecraft* [videogame] (Mojang: Multiple Platforms, 2011).

‘Notch’ Perrson, *Mincecraft* is the nearest answer that videogames have to the freedom of play and design that characterises interlocking block toy systems such as Lego. Characteristically, the game is composed entirely of three-dimensional ‘blocks’, procedurally generated into a landscape in a similar manner to *Dwarf Fortress*. The game has a number of different modes, some of which are more ‘videogame’ like than others, with goals and challenges to overcome. In ‘survival mode’ for example, players must use the land around them to create a shelter in order to survive against an onslaught of exploding creatures dubbed ‘creepers’ when night falls. To build a shelter, players must find wood by chopping down trees, must create fire by rubbing together rock and flint, must construct tools of increasing complexity from the materials available. In contrast, ‘creative’ mode allows players to roam and construct endlessly. Although the game was created without a singular intention it has been commercially successfully and even integrated into teaching curriculums around the world, helping to create a dialogue between pupils, children and the computers they use.

While *Minecraft* presents an interesting story of technical innovation in itself, it also has the power to create ecological relationships that spans through a range of materials. In the example I provided above, the ostracized child took it upon herself to use the freedom of ‘creative’ mode to destroy what the other children were working on. Though the majority of the children complained and told the isolated one that she wasn’t allowed on their ‘server’ anymore, in time they began to laugh. There was a shift in power and the group descended from organised work into anarchic play. The one-time leader had used their voice and physical stature to issue commands to the others; however, the rules she has attempted to enforce were interrupted by the freedom of the digital system.

Through a fusion of technological, biological and social activity, a complex system of interactions took place for the children on that boat. Indeed, if *Minecraft* had been designed any differently, this exchange could not have taken place. Through a masterwork of computer engineering the designer has created a digital ecosystem that can maintain stable connections between devices running different operating systems with different hardware capabilities. This has been done so seamlessly that children are capable of creating games within a digital space with rules that can be maintained or destroyed. At the most visible level there are the connections between the players who interact in a real world space. Beneath that, there are the connections between the devices using a mixture of ‘Bluetooth’ technology and each device’s

own ability to send and receive data wirelessly. A server-network is created between the children as the data that generates the world is shared in uniform fashion between them. Beneath that there is the relationship between the children's input and the game algorithm. Each action must is accepted and interpreted into meaningful activity by the game code. Beneath that still are the signals between the mobile phone's processor and video screen. Yet, none of these layers is distinct. Each level permeates into the other to form a dense and meaningful relationship. This is exactly the manner in which I propose we begin examining games; as systems of profound interconnectivity and as texts that reflect on that nature.

LOOKING PAST THE SURFACE

Exploring videogames as ecologies is a somewhat daunting task. Videogames are capable of creating reasonably accurate or at least satisfying mediations of real-world ecologies; at the same time, they are intricate systems that ape biological processes, urging a reconsideration of current paradigms relating to divisions of the bio- and the techo-. However, these 'real', material ecologies also generate meaningful relationships between machines and players through an ecological system that permeates software, through to hardware and into the everyday of flesh and blood. From the posthuman stance of Butler and Hayles outlined above, this is a logical outcome. As the supposed distinctions between matter, meaning, bodies, biology and machinery collapse and we instead attempt to perceive matter as a productive apparatus, hitherto 'virtual' videogames, come to matter. My understanding independent videogames as ecologies is an attempt to accept systems of agential electronic interconnections as material rather than virtual; at the same time, it is exploring the potential implications of those electronic activities upon the environment that they are produced by, and play a role in producing. Accepting that *Minecraft* is a material, performative phenomenon and that its microelectrical activities, as demonstrated above, are shaping the lives of the humans that interact with it, requires a specific frame from which to view the world.

The worldview on which this thesis is founded is borrowed from Karen Barad, whose new materialist, agential realist philosophy argues for the profound interconnections in all things. Discussing how we come to consider apparatuses and the interconnections between their parts in a manner reminiscent of Fuller's media ecology, Barad writes,

> If a computer interface is hooked up to a given instrument, is the computer

> part of the apparatus? ls the printer attached to the computer part of the apparatus? Is the paper that is fed into the printer? Is the person who feeds the paper? How about the person who reads the marks on the paper? How about the community of scientists who judge the significance of the experiment and indicate their support or lack of support for future funding? What precisely constitutes the limits of the apparatus that gives meaning to certain concepts at the exclusion of others?[46]

Barad's example points to the illusory nature of boundaries in our current epistemological paradigm. Adopting a posthuman stance, these perceived boundaries fall away and return us to considering Hayles' posthuman subject, the "amalgam" of "heterogenous components". Barad, by questioning the divisions between humans, machines and inanimate objects, urges us to think past amalgams, into a realm where we abandon a pretence of the subject (almost) entirely. Barad is proposing ecological thinking in a radical new sense.

Shifting away from the office spaces suggested in Barad's thought experiment, in this thesis I propose a similar question for videogames. If the ROM that stores the varying voltages of the game 'code' is part of the computer essential for running the game, is the ROM part of game? What about the player holding the controller, inputting values that impact on the electronic data, stored on that ROM? What about the millions of players with which our initial player is connected to over the satellites and fibre optic networks, servers and radio towers that compose the internet? Videogames represent our world in meaningful ways; at the same time, they are systems; novel systems that are interconnected with a variety of worldly processes. Material effects such as changes of voltage go on to affect players. At the same time, players' feedback and provide material changes that stimulate further activity within the machine. The interplay between the various interconnected activities is not teleological, building neatly from the micro to a cumulative effect on the macro. Rather, it is more complex, borne out of the dynamism of interchanges from its biological and physical parts.

The first chapter of the thesis situates this study within a broader context of game studies ecological media studies. By first examining environmental analyses of videogames I establish that the ecology I focus on has little to do with a perceived 'natural' world. Rather, it has more to do with the complicated systems of interacting parts identified in studies of machines and media forms. I champion exploring games using the techniques of 'media ecology', the study

[46] Karen Barad, *Meeting the Universe Halfway*, p. 199.

of complex communication systems as environments pioneered by Lance Strate and Marshall McLuhan among others. Suggesting an ecological study of games focusing on their specific formal features. This requirement leads to an engagement with software and critical code studies. Although the experience of engaging with games on different apparatuses undoubtedly shapes the experience of play, by engaging with source code we are able to find a common ground. Code analysis provides a new way of conceptualising gameplay; not as actions between distinct entities – player and machine – but instead, as algorithms to be executed unless other factors arise. I propose analysis of game code and hardware and an attempt to correlate this with the desired player experiences intended through a game's design. For example, looking back to *Dwarf Fortress*, if we were to focus on its formal characteristics, we would acknowledge that it is composed of a web of databases or 'look-up tables' that continually update while the game is in operation. The game's simplistic visual style results in it being a highly efficient program, with values crucial to the game state (whether the player wins or loses) being updated regularly and rapidly. As a result of this 'efficient' design – speaking from the perspective of what makes a computer program efficient – the game is notoriously difficult for first time players to understand. In this way, the microecological properties of the code can come to have larger ramifications, even affecting a player's feelings.

Throughout the first chapter my approach to games as ecological systems is contrasted against similar methods such as Nick Montfort and Ian Bogost's 'platform studies'. Distinct from media ecology more broadly, platform studies aims to highlight the specific qualities of a piece of videogame hardware such as a commercial console. Although the focus on hardware yields otherwise unobtainable insights into games as processes, the specificity limits the potential for ecological enquiry. Although platform scholars view the machine as a hotbed of activity, its efficacy is viewed as 'terminating at the video-out port'; the machine is studied as a self-contained entity while, the game that is produced by it, is understood as a ludo/visual text.

My ecological approach to independent games proposes a holistic view of this complex medium. As such, I work with various games across multiple platforms appreciating them as complex amalgamations of visual, auditory and sensory stimuli. Linking back to the idea of an eco-performative approach to the digital text-as-performance I make it clear that analysis of

code or hardware must always be related back to a study of the game, the player and culture. This is a somewhat unprecedented step in a study of games; although digital texts have been read as material entities, on the one hand, and the effect of games on players have been explored, on the other, rarely have these two desires been brought together. Given this new ground, the initial chapter concludes with a call for a malleable philosophical framework to facilitate the mental leaps required to jump between the material analysis of 'platform studies' and the user-centric focus of game studies.

The second chapter, my methodology, addresses the difficulty of clearly discussing the interaction of computational and biological entities, namely, players and gaming machines. This is mostly due to enormous disparity between computational and biological entities. To find some way to bridge the gap between computer and human processes, to enable a further discussion of how game systems can have meaningful impacts on their players, I aim to centre this project within posthuman philosophy. Taking inspiration from Donna Haraway I present videogames as a meeting point of biological actors and information systems, viewing them as "hybrid entities made of, first, ourselves and other organic creatures in our unchosen 'high-technological' guise as information systems, texts, and ergonomically controlled labouring, desiring, and reproducing systems" while respecting the distinct quality of software to act as "communications systems, texts, and self-acting, ergonomically designed apparatuses".[47]

I place an emphasis on exploring videogames systems as a whole, rather than attempting to extricate individual parts. Playing a videogame, I suggest, is becoming one part of a host of synergistic relationships between who-knows-what neurons firing just in sync with a difference in voltage, just as a particular copper memory bus meets integrated circuit micro-chip. While in the future imaging technology may make it possible to identify specific biological and technological actors (this is doubtful, though, given the near sub-atomic nature of cerebral and computational activity), for the present it is important to employ a theoretical lens that allows us to incorporate our uncertainty into our understanding. As such, it is more important to view videogame play as an act that presents potential for posthuman exploration. As N. Katherine Hayles suggests "computation can serve to deepen our understanding of what it means to be in the world rather than apart from it, co-maker rather than dominator, participants in the complex dynamics that connect 'what we make' and 'what (we think) we

[47] Donna Haraway, *Simians, Cyborgs and Women: The Reinvention of Nature* (London: Routledge, 1991), p. 1.

are'".[48] Videogame play provides us with an opportunity to reflect on our being entangled with a media environment.

The majority of my second chapter, however, is spent unpacking Barad's philosophy and developing a cogent theory for use in the analysis of games. Her central premise, derived from an understanding of quantum physics, is that 'objects' are never ontologically separate from a whole. Troubling metaphysical notions of subjects and objects Barad suggests an engagement with what she dubs 'intra-activity':

> The notion of intra-action is a key element of my agential realist framework. The neologism "intra-action" signifies the mutual constitution of entangled agencies. That is, in contrast to the usual "interaction," which assumes that there are separate individual agencies that precede their interaction, the notion of intra-action recognizes that distinct agencies do not precede, but rather emerge through, their intra-action. It is important to note that the 'distinct' agencies are only distinct in a relational, not an absolute, sense, that is, agencies are only distinct in relation to their mutual entanglement; they don't exist as individual elements.[49]

From this radical ontological stance common ideas of computer use from game studies are pushed. We no longer must think in terms of a 'player' and 'game'. Rather, there are phenomena that emerge through intra-action and continue the process of intra-action through their emergence. As human beings continue to grow alongside computers we are witnessing the implications of the intra-active entanglement of humanity and machines. New possibilities are emerging through this relationship of flesh and digital games. Labour tools have enabled novel activity between electrical impulses in synthetic materials meeting the products of billions of years of evolution. Digital games enable new materials for imagination, recreation and experimentation. Using Barad's theories, I suggest that games are meeting points of entangled agencies, generating emergent new agencies through intra-activity.

Each chapter from this point takes the form of a case study, and plays a role in developing the overall argument: that videogames are fantastic tools for examining specific ecological relationships. Chapter Three is the most straightforwardly 'ecological' of the case studies in this thesis. However, it is also where I, to a degree, 'prove' the effectiveness of the

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[48] N. Katherine Hayles, *My Mother was a Computer: Digital Subjects and Literary Texts* (London: University of Chicago Press, 2005), p. 242.
[49] Karen Barad, *Meeting the Universe Halfway*, p. 33.

methodology outlined in Chapter Two. The initial case study focuses on *Shelter*, an independent production from Swedish game designers, Might and Delight. I argue the game illustrates the rich potential for games to suggest the entangled role of players within videogame ecologies. This shift, I suggest, necessitates abandoning ideas of 'interaction' in favour of Barad's 'intra-action'. The chapter opens with a brief recap of the most relevant games studies criticism, positioned in opposition to my own research. Alongside this, I provide a brief description of some current thinking on videogame interaction. From there I provide an overview of the game, in which the player is tasked with controlling a family of badgers in the wilderness, keeping kits fed and preventing attack from various predators.

Shelter's innovate aesthetic and, more importantly, its gameplay mechanics draw attention to actions as occurring within an entangled environment. My analysis begins visually, drawing attention to the origami influenced aesthetics - a distinctly 'material' appearing digital world - and the use of colour to guide player action, to make clear the extent to which the game attempts to engage players. I then draw attention to the central game mechanics, how every action taken corresponds to the world as a whole; choosing to feed one kit results in another going hungry just as choosing to protect one against a predator results in the death of another. Entwined with these important aesthetic and mechanics, I argue, is the underworking system of the game. Using approximations of the game's code, designed within the Unity game engine, the same as the game itself, I suggest how the interrelations between the player and the various entities on screen goes beyond the visual. The relationships we witness and interact with are hardcoded into *Shelter*. These suggest a distinct form of ecology from those analysed in previous games studies scholarship. What's more, these hardcoded relationships shape the potential of player activity: the constant shifting of various factors at the level of code can limit or extend the range of options open to the player at any given moment. I conclude how an underlying complex system permeates through to the level of engagement.

An aspect of my posthuman stance discussed in Chapter Three is a deliberate attempt to look beyond the human when considering videogame play. In this instance, 'the human' is understood as that liberal humanist subject, "accompanied by notions of free will, autonomy, rationality, consciousness as the seed of identity, and so forth".[50] In Haraway's words, the

[50] C Theory Live Interview, "N. Katherine Hayles in Conversation with Arthur Kroker," (Los Angeles: C Theory Live, 2006), (online resource), <http://pactac.net/pactacweb/web-content/videoscroll4.html#3> [last accessed

'human' "depends on the myth of original unity, fullness, bliss and terror, represented by the phallic mother from whom all humans must separate, the task of individual development and of history, the twin potent myths inscribed most powerfully for us in psychoanalysis and Marxism".[51] The human is that absurd figure embodied in teleological notions of progress, such as protagonist of an Ayn Rand novel, wherein the will of a human being can provide mastery over the very materiality that necessary for their existence.

Within the realms of game studies, the outdated idea of the human manifests itself within visions of computer use that position the user in a place of control or power. Lars Schmeink writes, "The question 'What would happen if …?' can be answered by simply taking the other route in another round of the game. Thus, in several turns of the simulation the game, as is inherent to the medium, discloses its own governing rules and also the ideological imperative that created them, making the potency of his agency transparent to the player".[52] Here, Schmeink hints that the computer and the play it allows is important for realising the limits of agency. However, he does not go far enough to acknowledge the role of the machine. While this may be implied, the moment is right to assert the fundamental role of the non-human in forming the apparatus of human agency. Adopting a posthuman mind-set we choose to understand choices as being made through the posthuman conglomeration of biology and information coming to make a more complex system that produces new possibilities. Chapter Three outlines this point in more detail, using videogames to present a new, posthuman perspective, on interaction.

In Chapter Four I set out with the goal of pushing beyond what I argued for in Chapter Three; to demonstrate that videogames not only generate intra-active ecologies that are interesting and engaging but that are unique to that medium. I focus on videogames as entangled bio-technical performances that mediate features of lived experience we do not commonly associate with ideas of ecologies or environments. The first game I examine, *Superhot*, mediates the passage of time in a specific manner, allowing it to progress only when the player moves. In this analysis I aim to draw out Karen Barad's assertions of intra-activity, showing how action is an ecological experience with almost limitless connections throughout material

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[51] Haraway, *Simians, Cyborgs and Women*, p. 151.

[52] Lars Schmeink, "Dystopia, Alternate History and the Posthuman in Bioshock", *Current Objectives of Postgraduate American Studies*, Vol. 10, No. 1 (2009) pp. 2003-2032.

existence. Following on from that I analyse *Antichamber* a game which does much the same thing but with space. As the user moves through the world of *Antichamber* the world seems to form around them, responding to their actions and activities. This is further in the experimental, yet to be completed *Manifold Garden* in which space appears limitless by looping around the user's activity. These games demonstrate a trend in independent videogames of attempting to visualise and make interactive alternative conceptions of lived experience. As such, I argue, these games are symbolic of what I dub the oncoming 'intra-active aesthetic' realised through interactive media such as videogames.

The final case study of this thesis seeks to explore what lies beyond connectivity in gameplay; drawing further influence from Barad's philosophy, I propose that games are capable of initiating a 'cut' between subjects and objects, distancing the interconnected apparatuses of the intra-active system of existence from one another. Although I have taken pains to suggest the extent to which apparent 'objects' are interconnected and intra-acting when playing videogames, an important aspect of intra-activity is the emergent becoming of 'apparent' objects. I argue that games are playing an increasingly common role in producing these types of becomings in the everyday. Looking at some of the most personal games in this thesis I engage with how games can shape our apparent humanity through sensory and emotional engagement. Exploring first a number of games designed to be counter intuitive to play, games that ask us to use difficult to reach keys on a keyboard or that map buttons to unexpected mechanics, I suggest how games can reinforce a sense of our humanity by asserting their own logic based computation. Although it may appear odd to us for a keystroke to launch an avatar far into the air or cause them to self-destruct entirely, for instance, these apparent activities are carried out without judgement by the computer. Through intra-action players can emerge as distinctly 'human'. This feeling is reinforced with explorations of games that engage with issues of disability, gender and the death of a loved one. Filtering these human concepts through a logical lens, I argue, serves only to heighten their impact. We are left with no choice but to realise the cost of our being human; far from the definition proposed by the liberal human tradition wherein humanity brings with it a dignity beyond the nonhuman, in my posthuman understanding, playfully intra-acting with machines, we are left with a keen sense of our flawed, mortal existence.

A final, prominent aim of this thesis is to bring attention to some of the least discussed

properties of the thriving contemporary independent game design scene. Each of the games analysed in this project, whether designed by a single programmer or by a team of differently skilled individuals, pushes past common preconceptions of the potential of videogames to deliver novel experiences. Importantly, these experiences all make explicit their reliance upon relationships. Whether that is the relationships of in game entities, or of hardware, software, and player. These (apparent) objects, we are reminded, rely on each other for their existence. My suggested method of game analysis provides us with an opportunity to shift our conceptual view, and become aware of this entanglement and our role in it. It shows just how videogames are particularly suited to asking provocative questions about the nature of being within systems of interrelated parts, and how they illuminate the valuable implications that these experiences provide. In the following chapter I will provide an overview of the critical landscape in which this project is founded; the intersection of game studies, media and software studies.

Chapter 1: Review of Relevant Literature

In this thesis, I explore a small number of independent videogames as ecologically entangled bio-technical performances aided by agential realist philosophy. This chapter places my study in context: game studies at the intersection of ecocriticism, media-ecology and posthumanism. It also establishes the need for my nuanced approach by identifying the current lack of cross-talk between in current approaches. At present, contemporary ecological approaches to videogames can be divided into four strands: eco-critical, media-ecological, eco-spatial and the posthuman. I provide an overview of each of these strands, along with some explanation of the sources they draw on where it is relevant to my project. Banks' suggestion that we should endeavour to discover the micro-, meso- and macro-levels of videogame relationships is fundamental here.[53] As a theorist endeavouring towards a holistic approach to game studies, she provides a clear goal for likeminded scholars; we must attempt to conceptualise an ecology of videogames that traverses boundaries of scale. This chapter establishes the importance of my project, seizing upon the wealth of existing scholarship, attempting to shape it into a cohesive, productive, holistic method. In doing so, elements and objectives of various methods are lost. What persists is a dedication to establishing the entangled, ecological, material basis of videogames and highlighting their potential to illuminate (through performance rather than representation) human players to their place within a complex world.

ECOCRITICAL APPROACHES

Perhaps the most straightforward ecological approach to videogames is one that borrows from the established field of ecocriticism. It the majority of cases, this approach produces as outwardly critical view of their representation of the 'natural' world. William Sims Bainbridge takes the position that representing the biological environment through simplified abstractions could negatively impact players' attitudes towards conservation. In a speculative essay hypothesising the potential of games to play a role in future social development he writes, "virtual worlds could encourage people to abandon efforts in the physical world to preserve wilderness areas and biodiversity".[54] Although Bainbridge has carried out many studies of virtual worlds and ultimately perceives that they will play an important role in future social structures he nevertheless perceives a potential for games to have harmful impacts if they

[53] Jaime Banks, "Object-relation Mapping"
[54] William Sims Bainbridge, "Virtual Sustainability", *Sustainability*, Vol. 2, Issue 1 (2010), pp. 3195-3210, p. 3208.

continue to be designed as they are today.[55]

In a study of the ecology of the Massively Multiplayer Online Role-playing (video)Game (MMORPG) *World of Warcraft*,[56] he highlights that players, rather than being rewarded for their preservation or avoidance of wildlife are instead actively goaded into killing them and collecting their remains.[57] He argues, from an environmental perspective, that the environments modelled in MMORPG's could encourage a perspective towards the natural world not dissimilar from the "curiosity cabinet" collector mentality of the Victorian-era. Bainbridge concludes, "...it seems likely that extensive experience in game-like virtual worlds would prepare people to conceptualise conservation in terms of information, and facilitate a radical reduction of the scope of environmentalism, to merely ensuring clean air and water for human use, and letting much of wild nature die after it had been digitally documented".[58]

Bohannon, Gregory and Eldgrede, working alongside Bainbridge, also voice concerns around the environmental representation in virtual worlds. This group of researchers from multiple disciplines analyse Will Wright's *Spore*.[59] This group take the game to task for claiming to have a greater level of biological fidelity than it actually possessed, in particular, the use of the term 'evolution'. They write, "*Spore* is not a game with any deep linkages to biology".[60] They continue by arguing that there is no technical reason for the game to not possess a biologically accurate depiction of evolution given that a "biomimetic" form of computation has existed for decades. The group outline how such a game might work:

> It is easy to imagine a strategy game that had the player shape evolution by adjusting the natural environment of the world, for example modeling allopatric speciation – the separation of one species into two, facilitated by limited gene flow between two areas and somewhat different environments in those locations – by setting up distinct regions and constricting movement between them. For later stages of the game, the genetic algorithms could be treated as a multiagent system, for example in modeling the emotive and religious social behavior of the tribal and

[55] Bainbridge, *The Virtual Future* (London: Springer, 2011).
[56] Rob Pardo, *World of Warcraft* [PC Video game] (USA: Blizzard Entertainment, 2004).
[57] William Sims Bainbridge, *Online Multiplayer Games* (International: Morgan and Claypool, 2010).
[58] Bainbridge, "Virtual Sustainability", p 3208.
[59] Will Wright, *Spore* [PC Videogame] (USA, Electronic Arts, 2008).
[60] John Bohannon, T. Ryan Gregory, Niles Eldredge, and William Sims Bainbridge, "*Spore*: Assessment of the Science in an Evolution-Oriented Game", in William Sims Bainbridge (Ed.), *Online Worlds: Convergence of the Real and The Virtual* (London: Springer, 2010), p. 83.

civilization stages.[61]

Although they concede that, as researchers, they could not predict if their game would be as commercially popular as *Spore* their case for the scientific gaps in *Spore*'s design is strong. The scholars come to the consensus, however, that for games to adequately portray our planet's ecosystem, they must strive for greater complexity in design.

A similarly negative stance is taken on videogames in environmental education by Peter N. Goggin and Michael Springer who argue that the increasingly task centred design of games could produce a conceptions of place "ecologically limited to very few generic species of flora and fauna, and cityscapes and landscapes sterile and repetitive […] if the concept of 'globalization', that is, the flattening or 'Walmarting' of the world, can truly be said to apply anywhere, it is in the virtual ecology of videogames where biodiversity, cultural diversity, and geophysical diversity are extremely limited".[62] For Goggin and Springer, like Bainbridge, the limited biodiversity in free to roam, 'sand-box' videogames, could serve to blind players from the immense level of biodiversity in the natural world. They argue that games must be designed in a way that allows educational games to compete with games without explicit educational elements in terms of engagement and a capacity for fun.

A related standpoint within this burgeoning field is the openly critical conception of videogames as producing technological waste. Elizabeth Grossman, for instance, details the life-cycle of the technology used in creating videogame consoles and other media products: from the raw materials, including highly precious and rare resources, to conversion into technical components - capacitors, transistors, magnetic drives and processors - to marketing, retail and eventual disposal, Grossman notes the enormous human and environmental impact of digital goods.[63]

Since the popularisation of videogames in the 1970s the videogames industry has continued to play a central role in the production of technological waste. For example, computer processors

[61] John Bohannon et al., p. 82.
[62] Peter N. Goggin and Michael Springer, "Digital Cities: Rhetorics of Place in Environmental Video Games", in Peter N. Goggin (ed.), *Environmental Rhetoric and Ecologies of Place* (London: Routledge, 2013), p. 112.
[63] Elizabeth Grossman, *High Tech Trash* (Washington D.C.: Island Press, 2006), p. 45.

contain materials such as tantalum, a remarkably effective conductor so and because of this an ideal component for capacitors. Grossman writes, "tantalum provides a stark reminder of the global reach of the materials that go into high-tech electronics".[64] This mineral is also the most lucrative raw material produced within developing nations such as the Democratic Republic of the Congo (DMC) where, due to war, hunger and disease, supplying tantalum to electronics producers has become a humanitarian crisis resulting in the deaths of 5.4 million casualties between 1998 and 2014.[65] The videogame industry, when we include the hardware required to produce and play games, continues to push this desire for ever more powerful and demanding technology, producing masses of digital trash and exacerbating global humanitarian and ecological crises.

An example of the trash generated by videogames is so breathtakingly wasteful that it has become a cultural symbol, emblematic of the waste produced by the games industry. Known as the 'Atari Video Game Burial' it is a site where unsold Atari videogame cartridges and other paraphernalia were disposed of at the end of the fiscal year of 1983. That year saw the release of the disappointing, seemingly unfinished, *E.T. The Extra-terrestrial* videogame for the Atari 2600 console.[66] Though other factors such as limited technology, a lack of commercial interest and competition from Japanese developers contributed to Atari's losses, that year, the American videogames industry crashed. Jamie Russell describes the formation of this man-made trash mountain in vivid prose:

> On Thursday 22 September 1983, a fleet of 18-wheel trucks rolled out of a non-descript manufacturing plant in El Paso. They trundled through the streets in single column, engines groaning as they eased onto Route 54 and headed north. Their cargo? Millions of Atari VCS cartridges including E.T. The Extra Terrestrial, the most hyped game in the company's history. Their destination? A landfill site in Alamogordo, New Mexico.[67]

While it remains unclear whether "millions" of copies of the game were disposed of, the event has nevertheless entered the cultural imagination as a clear example of the excesses of the games manufacturing process. Ian Bogost states that though *E.T.* has come to symbolise many

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[64] Elizabeth Grossman, *High Tech Trash*, p. 52.
[65] Intel Corporation, "In Pursuit of Conflict Free Minerals", <www.intel.com/content/us/en/corporate-responsibility/conflict-free-minerals.html>, online resource, last accessed 24/01/2015.
[66] Howard Scott Warshaw, *E.T.: The Extra-terrestrial* [Atari VCS] (USA: Atari Inc., 1982).
[67] *Jamie Russell,* Generation Xbox: How Videogames Invaded Hollywood *(Sussex: Yellow Ant, 2012), p. i.*

things, it is ultimately

> a sign that depicts the circumstances surrounding the videogame crash of 1983, a market collapse partly blamed on low-quality shovelware (of which E.T. is often cited as a primary example). In this sense, the sign "E.T". is not just a fictional alien botanist but a notion of extreme failure, of "the worst game of all time": the famed dump of games in the Alamogordo landfill, the complex culture of greed and design constraint that led to it, the oversimplified scapegoat-ing process that ensued thereafter—otherwise put, "E.T". is Atari's "Waterloo".[68]

Although criticising a game from the early 1980's may seem anachronistic, there are few clear suggestions that practices have improved in any way. On the one hand, Big Fish Games, a company who do not produce physical copies of their products, have championed cloud computing as an answer to the problem of technological waste. In a study of the environmental impact of physical videogames compared to alternative methods of production, they estimate the weight of non-biodegradable plastic waste produced by Nintendo alone since 1983 at 2.5 billion pounds. In contrast to this, they estimate that if a single popular game series (in the case of their study, *Call of Duty*[69]) were sold only as downloads and not made into physical copies it would have a similar impact to 20,131 cars being taken off the road for a year.[70] However, on the other hand, the scholars below present engaging criticisms of cloud gaming.

In a similar vein, James Newman's work on the often anonymous, experimental and politically focused producers Molleindustria, seeks to forefront their environmentally motivated critique of technological production. Newman explores *Phone Story,*[71] a game created by activist Michael Pineschi and designer Paolo Pedercini, that follows the same path of mining to construction to distribution and destruction as detailed in Grossman's *High Tech Trash* but in a 'gamified' way. Using several subtle mechanics that influence in-game score, the game makes clear that maximising the exploitation of workers encourages greater profit margins and the most in-game rewards. Mimicking the simplistic, cute aesthetics of popular games such as

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[68] Ian Bogost, *Alien Phenomenology: Or What It's Like to Be a Thing* (Minneapolis: University of Minnesota Press, 2012), p. 18.
[69] Zied Rieke, *Call of Duty* [Multi-platform Videogame Franchise] (USA: Activision, 2003-present).
[70] Big Fish Games, "Environmental Impact of Videogames", online resource, <www.bigfishgames.com/blog/environmental-impact-of-video-games.html>, last accessed, 26/01/2015.
[71] Michael Pineschi and Paolo Pedercini, *Phone Story* (online videogame) (Italy: La Molleindustria, 2011), <phonestory.org/game.html>, [last accessed: 19/07/2016].

Zynga's *Farmville*,[72] *Phone Story* does not condemn players' actions that may, taken out of context, appear immoral. It simply seeks to represent the flows of modern production cycles, illustrating how it is that technical waste and the associated human casualties that come with it, are produced. The most remarkable achievement of the game is that it (however briefly) appeared on the iOS 'App Store', encouraging users to engage with the practices that produced the phones they use. Newman notes, "With Apple and its global production ecosystem at the heart of Molleindustria's criticism, the game exists as a self-referential critique of the [mobile gaming] platform - delivered on the platform".[73] As mobile phone gaming, like cloud gaming – discussed above – is often considered outside of the same chains of waste production as games sold in physical packages, Newman's analysis of Molleindustria's work is poignant.

Similarly in opposition to Big Fish's positive estimation of the power of downloadable software, Sean Cubitt, writing on the environmental impact of 'the cloud', notes that American server farms (large collections of robust machines supplying remote services) consumed 61 billion kWh in 2006 and continues to grow by 12% a year.[74] Through the use of a term synonymous with pastoral imagery, 'the cloud' Cubitt notes, is an attempt on the part of big-business to disguise the enormous amounts of waste generated through the operation of servers which, by their nature, must remain active as much as possible. The effect of the cloud on the biological environment is particularly interesting in relation to online videogames. Due to their dependency on always-on servers *World of Warcraft* and many of the other online games do not have physical products. *World of Warcraft* alone operates through many hundreds of dedicated servers to supply the enormous amount of information and media required to play the game.[75] As noted above, there are arguments both for and against the exodus of software to cloud servers. Although year on year the size and energy consumption decreases of personal computers and the machines that supply them with content, it is clear that, as Cubitt notes, "Sustainability will only be achieved once the larger population realizes that the internet is not weightless and information is not immaterial".[76] This presents a serious

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[72] Zynga Inc., *Farmville* (online videogame) (USA: Zynga Inc., 2009).
[73] James Newman, *Best Before: Videogames, Supercession and Obsolescence* (London: Routledge, 2012), pp. 48-49.
[74] Sean Cubitt, Robert Hassan and Ingrid Volkmer, "Does Cloud Computing Have a Silver Lining?", *Media Culture and Society*, Vol. 33, No. 1 (2011), pp. 149-158, p. 149
[75] Guildox, "Realm Raid Progress", online resource, <http://www.gamecyte.com/world-of-warcraft-now-with-115-million-subscriptions> , last accessed, 27/02/2015.
[76] Sean Cubitt et al., as before, p. 155.

dilemma if seeking to explore online videogames as an 'environmentally-friendly' alternative to physically distributed games.

Not all the work on videogames from a 'green' ecological stance illustrates its wasteful practices. Ian Bogost's writing on environmental videogames is exemplary of a positive approach to independent games. Bogost highlights the explicit environmental focus of certain titles to show the potential of digital play as a tool for knowledge. He examines another piece created by Molleindustria, the *McDonald's Videogame*.[77] In this game which is, ostensibly a strategy game similar to the classic city building game *Sim City*,[78] players must control four different aspects of a production cycle (agriculture, slaughter, restaurants and corporate) balancing public opinions and profit margins. The primary goal of the game is to make a fast-food chain that remains competitive while causing minimal lasting damage to the global biophysical environment. In playing, it becomes clear that decisions to limit environmental impact not only reduce profits but can have wider negative social ramifications: for example, sourcing environmentally friendly oil or using beef produced to higher welfare standards increases food prices limiting units sold and, in turn, profit. This can result in the loss of jobs for low-skilled employees and so affects the community. The frenetic pace of the game forces the player to make unethical decisions before long, making clear the banal evils that produce environmental decay.

For Bogost, videogames like *McDonald's Videogame* use digital play as a space for critical thinking, empowering the player to make decisions and see their actions. This allows an active engagement with contemporary issues without simply promoting clear-cut answers. Games such as this show that it is possible to take complicated social issues and distill them into core components. Compiling these components into a game system allows players to consider social constructs and conundrums in a playful way. Bogost labels this process "procedural rhetoric", and argues that it is a quality unique to playable media.[79] He writes, "verbal, written, and visual rhetorics inadequately account for the unique properties of procedural expression".[80] For Bogost, the procedural quality of videogames provides a level of

[77] Michael Pineschi, *The McDonald's Videogame* [Online Videogame] (Belgium: La Moleilindustria: 2006) <http://www.mcvideogame.com/index-eng.html>.
[78] Will Wright, *SimCity* [PC Videogame] (USA: Maxis, 1989).
[79] Ian Bogost, *Persuasive Games* (Cambridge, MA: MIT Press, 2007), p. 29.
[80] Ian Bogost, Persuasive Games, p. 29.

engagement with social issues that is beyond other media forms. He continues this line of argument in his later publications arguing for the effect of videogames in affecting public opinion regarding governmental policy.[81] Bogost's work in this matter makes a strong case for videogames having a great deal of potential to positively impact upon society, playing a role not only in environmental issues but as a tool for societal good generally. Work such as Bogost's highlights that analyses of videogames benefit from a focus on ecological aspects. *The McDonald's* game is a particularly apt example as it presents a manner through which players can begin to "think ecologically" as Timothy Morton dubs it; thinking through the objects with which we interact on a daily basis, considering their origins and implications.[82]

Similarly posed against the openly negative critical backdrop, Alenda Chang voices a minority alternative opinion. Arguing that games do not need to be visually or scientifically complex to allow an effective engagement between the player and her environment Chang presents an engaging understanding of a multitude of games, some of which have graphical representations, others that are text-only. All of these game worlds, she argues, are environments. She writes, "rather than seeing such works as introducing a barrier to understanding, we can see the particular realization of an environment—whether textual, visual, or procedural—as a filter that helpfully selects certain aspects for consideration while excluding others".[83]

Chang's argument borrows from the ecocritical theories of Lawrence Buell and Timothy Morton arguing that games can function in a similar manner to literature or other media, bringing our attention to and changing attitudes towards the biophysical environment. She provides the example of the minimalist art-game *Flower* in which the player controls the speed and direction of wind, guiding a flower petal around stylised rural environments.[84] For her, although *Flower* "does not strive for biological or ecological accuracy, considering the game in the light of Buell's criteria for environmental texts, allows us to credit *Flower* for its foregrounding of natural environments as constitutive of, rather than supplementary to, gameplay".[85] It is perhaps not necessary then for games to be designed with a meticulous

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[81] *IanBogost,* How to do Things with Videogames *(London: University of Minnesota Press, 2011), p. 63.*
[82] Timothy Morton, *The Ecological Thought.*
[83] *Alenda Chang, "Games as Virtual Texts",* Qui Parle*: Vol. 19, No. 2, 2011, pp. 58*
[84] Jenova Chen, *Flower* [Playstation 3 Videogame] (USA: That Game Company, 2009).
[85] Alenda Chang, "Games as Virtual Texts", p. 75.

attention to biological details, providing we broaden our concept of 'the environment'.

Further to Chang's claim that graphical fidelity is not the most important aspect of ecological games, she argues that games have an unprecedented ability to affect users because of their specific form of "social realism". This is to say that games have – for Chang – a hitherto unseen ability to encourage their user to reflect upon their immediate impact on the environment. Chang notes that, in later gameplay stages of *Flower*, in which the stylised pastoral environments are exchanged for arenas with a predominantly technological aesthetic, the ensuing conflicts highlight the delicate nature of the player's avatar (the lone flower petal). Simultaneously, this change in setting engenders a feeling of helplessness in players. It is difficult not to develop associations with technological environments as threatening and dangerous through play of this sort. Following this, Chang argues that a game's ability to conjure 'realistic' environments does not, therefore, rely on graphical means but through affecting storytelling and play; it is through explorative and reflective play that we come to formalise a space or environment and populate it with the qualities of reality. For Chang the ecological relationship between player, game and society is a unique strength of the medium.

Although, initially, Chang's argument is positive, looking at her work as a whole it becomes clear that current games do not achieve her desires for, what she deems, "meaningful game ecologies".[86] She writes, "games represent an array of missed opportunities to model more richly entangled dealings between plants, animals, people, fungi, bacteria, and inorganic matter, for example, by encouraging smart crop-rotation practices or symbiotic cross-species interaction. We need game environments that respond to human agency and yet seem to possess life independent of player actions".[87] From this perspective, Chang appears more in line with the previous scholars discussed, criticising existing games for not satisfying a perceived ideal experience, rather than looking deeper into their complexity. Ultimately though, Chang's argument is against graphical complexity but nevertheless still for further technological complexity. Her arguments are, in this regard, in line with those that come before: it is games that must change if they are to satisfactorily represent the environment.

The majority of environmentally focused videogame scholars focus on the detrimental

[86] Alenda Chang, "Back to the Virtual Farm", p. 252.
[87] Alenda Chang, "Back to the Virtual Farm", p. 240.

potential of games. Taking into account the above critiques, we can assert that - with noted exceptions - scholars take issue with videogames either for their role in the production of electronic waste or for failing to represent the environment with adequate complexity. In all, the studies of Buell, Grossman, Bainbridge, Springer, Goggin and Chang promote a policy of advocacy and broadcast a desire to change industry practices. Although they disagree on many issues, in all, these scholars collectively criticise a wide array of videogames as inadequate, looking ahead to a hypothetical better future of development.

The stance adopted by the above scholars promotes a position wherein the academy should attempt to influence best practice in private industry. For my own part, however, I wish to suggest an alternative ecological approach. I propose that videogames are perhaps more fruitfully viewed as playing a part in a wider scheme of "ecological thinking", as discussed by Timothy Morton. Games are a part of an ecology of "factories, transportation, architecture and economics. Ecology includes all the ways we imagine how we live together. Ecology is profoundly about coexistence. Existence is always coexistence".[88] As will be explored throughout this thesis, this does not mean abandoning a central concern with their engagement with the environment. Rather, it means looking past the surface to find new ways to explore their engagement, placing it in a new light to see if there is a role they can play in ecological thinking.

Appraising existing eco-critical approaches to videogames makes one thing abundantly clear: there is potential for a new intervention into this field that takes advantage of the many existing strands but uses a more all-encompassing methodology to make plain the distinct ecological qualities of the medium.

MEDIA ECOLOGICAL APPROACHES

As discussed in my introduction, videogames abound with ecological systems; they represent entwined biological worlds while, at the same time, depending on tremulous interconnections between a numerous materials and energies. To bring these qualities to the fore a partial shift of thinking is required wherein 'ecology' can be understood more broadly. By viewing videogames as ecological without necessarily focusing on their environmental impact, we can adopt an ecological stance thought that, at once, allows for us to penetrate into the

[88] Timothy Morton, *The Ecological Thought*, p. 4.

multiplicitous layers of a videogame without losing touch with the physical world.

The work of McLuhan and Postman whose 'media ecology' has opened the floodgates for a wide range of analyses that place an emphasis on connected systems. Described by Matthew Fuller as "a kind of environmentalism: using a study of media to sustain a relatively stable notion of human culture" media ecology in this sense tracks the development, flourishing and eventual cessation of media forms.[89] McLuhan, for instance, presents us with the history of the printing press to chart the rise of the readily available contemporary books and contrasts this with the advance of the television and other media forms. He writes, "in years to come historians will chart the effects of radio on the movie and of TV in disposing people towards new kinds of space as, for example, of the small car. It seemed quite natural to Rabelais to hymn the printed book, product of the new wine press".[90]

A similar thread is continued in Jussi Parikka's form of media entomology where a study of insects (or more accurately, a study of studies of insects) provides the basis for a reading of contemporary media such as online communication and group trends. Parikka brings to light some of the criticism of this form of thinking wherein we attempt to use biological parallels to understand ultimately human inventions. Countering them, he writes, "in the context of contemporary network technologies that operate with distributed, nonhuman speeds and logic, questioning such parallels remains relevant and is perhaps a reason that the notion of insects has persisted in high-tech media environments".[91] Within these studies there are patterns, like those we can view in the biological world, of co-operation and dominance between media forms. What is most important, however, is how the specific properties of a medium influence its reception and application. Just as the printing press shared qualities with the wine press, making it familiar and popular to use, or the ambient qualities of technology engender insect-like communication within society, technological specificity must be explored to understand its social impact.

Likeminded academics agree that, when applied to videogames, media ecology brings a host of ecological implications arise. Among these thinkers Bogost and Nick Montfort's platform

[89] Matthew Fuller, *Media Ecologies*, p. 4.
[90] Marshall McLuhan, *The Gutenberg Galaxy: The Making of Typographic Man* (London: University of Toronto Press, 2011), p. 172.
[91] Jussi Parikka, *Insect Media: An Archaeology of Animals and Technology* (London: MIT Press, 2010), p. 11.

studies approach to digital games showcases the potential of such a particular techno-conscious criticism. In focusing on the particular details of, say, a games console, we attempt to understand what properties enabled this medium to have the impact it has. What's more, this approach reveals how a study of games can have ecological without environmental preoccupations. This is evident in their study of the Atari 2600, *Racing the Beam*, named after the coding practices adopted by Atari designers having to contend with the irregularities of cathode-ray television sets. They highlight the specificities of the machine and argue how these produce a specific user experience. They begin with a reverse engineering of the 2600, from its history and inception to its function, going so far as to break apart how sprites are formed from binary code at the level of patterns being exchanged between read-only-memory and the central processing unit.[92]

Bogost and Montfort's study has inspired a small following in academic circles such as Mia Consalvo's study of the Sega Dreamcast.[93] To date, platform studies is not without a nostalgic element, evident in claims such as Consalvo's that the streamlined elegance of the Dreamcast design was conducive to the favourable software production environment. While this may be true given the existing "homebrew" amateur programming scene for the now long discontinued Dreamcast hardware, their claims are difficult to substantiate. Putting the nostalgic element aside, however, platform studies represents the first steps into a focused study of games consoles as media within a wider conception ecology.

The studies above provide a starting point for a focused exploration of game systems as media objects. This area of study can be thought of as ecological in a different sense than those noted so far. Bogost refers to this hard and software conscious study as one of "micro-ecologies"; he writes, "media microecology seeks to reveal the impact of a medium's properties on society. But it does so through a more specialised, focused attention to a single medium, digging deep into one dark, unexplored corner of a media ecosystem, like an ecologist digs deep into the natural one".[94] The concepts suggested through Bogost's micro-ecologies, resonating with Banks' sentiments stated earlier, are fundamental to my approach to games. However, though

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[92] Ian Bogost and Nick Montfort, *Racing the Beam: The Atari Video Computer System* (London: MIT Press, 2009), p. 71.
[93] Mia Consalvo and Nick Montfort, "The Dreamcast, Console of the Avant-Garde", *Loading… The Journal of the Canadian Game Studies Association*, Vol 6, No. 9: 2012, pp. 82-99.
[94] Ian Bogost, *How to do Things with Videogames*, p. 7.

Bogost urges us to see the impact of the minutiae of the medium on society, we must not fall into the trap of seeing micro as constructing the meso that constructs the macro. Ecologies are rarely related in a straightforward hierarchical manner. It is tempting to think of a focus on minute details as, 'digging', as Bogost suggests, similar to using a microscope – in a metaphorical sense – wherein we discover the small parts that make up a whole. With videogames, there is rarely such a structured order to their ecologies.

We may be inclined to think of computing, as Bogost does, resultant from western philosophical tradition, in terms of the organised 'body-politic'. Viewed under more scrutiny, the enactment of videogames are only complicated interrelations. Even on the level of programming, it is common – depending on the programming language chosen – to define a 'main' class or body of functions. However, as Kittler draws our attention to, when our code is executed, it is broken down into its smallest possible actions of addition, subtraction and storage while the exact order of events is determined by the pipeline architecture of our CPU.[95] What is more, when we engage with the specifics of binary code as it exists today, the activity of the highly symbolic 1's and 0's can be understood as high and low voltages, endlessly modulating currents, and streams of aberrant electrons, behaving in ways we barely understand but with enough regularity to build a global infrastrucutre.[96] A focus on the materiality of gaming technologies in their execution reveals a more rhizomatic structure than the linearity we are promised in graphical user interfaces.

The method of micro-ecological analysis resonates with certain related fields, such as the technological media archaeology of Wolfgang Ernst and, more recently, Shintaro Miyazaki. These scholars examine the interior ecologies of technological objects, continuing technological studies in a new era dominated by software and graphical user interfaces. Although there are divisions between the broader media archaeology and the game-centric platform studies, the two disciplines have been used successfully together. Parikka and Thomas Apperley's study of the limits of platform studies seeks "not to dismiss the core concerns of platform studies, but rather to use media archaeology to locate conceptual paradigms from the existing studies of individual platforms that can provide a basis for an

[95] Friedrich Kittler, "There is No Software", *CTheory.net* (1995) [online resource] <http://www.ctheory.net/articles.aspx?id=74>
[96] Friedrich Kittler, *Gramophone, Film, Typewriter* (California: Stanford University Press, 1999), p. 246.

explicitly articulated critical methodology of platform studies".[97] This means bringing certain clarity to aspects of platform studies that had previously been critiqued for creating a sort of epistemic cul-du-sac.[98]

Through studies of numerous platforms (The Atari VCS, the Nintendo Entertainment System), modding practices such as Corey Archangel's circuit-bending of Nintendo cartridges to produce works of art and even software languages that produce specific digital codecs (HTML5, Adobe Flash) they conclude that platform studies - when brought in line through media archaeology - is, "a fruitful way to frame not only studies of digital gaming but also media history".[99] Throughout this thesis, as has been demonstrated so far, an awareness of platforms will be consistently present. This aids in my intended shift away from texts towards an understanding of games as entangled ecological performances. Importantly, however, I do not often discuss the games I played with regards to specific pieces of hardware though it should be understood that specific hardware does shape the performance. This is in keeping with the new materialist influence of my project – I am not discussing the games in my project as uniform entities that can be discussed unilaterally. They differ in small but important material ways on each machine they are played.

While my approach borrows, to an extent, from the machine-focused arena of platforms and more it also borrows from a 'code studies' approach to videogames. Bogost and Montfort note that "code is a level where explorations are still only beginning. Code studies, software studies, and code aesthetics are not yet widespread, but they are becoming known concepts".[100] Mark C. Marino, a prominent figure within 'critical code studies' suggests that a study of code can pay attention to details such as the lives of the programmers that wrote now ubiquitous code, providing the example "we might note that the Lisp 'Hello World' did not appear out of nowhere. It was written by Mark Singletary, a programming architect, variously employed by NASA and other software firms".[101] Putting a human face to code does make it more approachable but problematically underplays the co-operation programming depends on.

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[97] Jussi Parikka and Thomas Apperley, "Platform Studies' Epistemic Threshold", *Games and Culture*, Vol. 21, No. 1 (2015), pp. 1-21.
[98] Dale Leorke, "Rebranding the platform: The limitations of 'platform studies'", *Digital Culture & Education*, Vol. 4, pp. 257–268.
[99] Jussia Parikka and Thomas Apperley, "Platform Studies' Epistemic Threshold", p. 16.
[100] Ian Bogost and Nick Montfort, *Racing the Beam*, p. 147.
[101] Mark C. Marino, "Critical Code Studies", *Electronic Book Review* (online resource, 2006), <http://www.electronicbookreview.com/thread/electropoetics/codology> [last accessed: 19/07/2016].

Game based studies of code are related to the much wider fields of critical code studies and 'software studies' such as Matthew Fuller's *Behind the Blip*, one of the earliest examples of software studies (though he referred to it as "software criticism"). Fuller combines the tactics of computer hobbyist magazines (bench-tests of "bit-rates" and "clock-speeds") alongside studies of human-computer interaction (HCI), programmers' self-accounts and critical theory. This approach views software from the perspective that social impact is achieved through the smallest configurations of technological entities. Showing the relevance the smallest scale machine can have on large, human-scale experience, he writes, "your wage statement is the cryptic blip that instantiates the enormous machine of class relations".[102] Building on critical code studies, there is an academic enthusiasm for intricately reading micro-scale technology as affecting the macro-scale human society. This is visible in the 2008 collection of essays, *Software Studies* that combines fundamental contributions, Friedrich Kittler's "Code", with new directions, such as "Weird Languages" by Michael Mateas.[103]

Joasia Krysa & Grzesiek Sedek focus on the minutiae of programmed code, going so far as close critical readings of uncompiled source code as a tool of expression as valid as poetry. Focusing on the details and idiosyncrasies of specific coders on an open source project, *Barszcz.net* which aims to expressively code recipes for a popular eastern-European soup, they write, "In a wider cultural context, this exemplifies a general way of thinking about source code as an open model for creative practice; it can be used to encourage collaboration and further development of existing work on the level of contribution, manipulation, and recombination, and can be released under the same or similar licenses in the public domain".[104] Similarly, Nick Montfort's analysis of "Null Programs" employs an in-depth knowledge of IT terminology "strings" and "sets", evaluating how characteristics of code can produce computer programs even "without code".[105] This provides an interesting backdrop for my thesis, bridging the gap between code, which is so often seen as vaporous, and materiality.

Geoff Cox & Alex McLean close read source code going so far as to analyse certain aspects

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[102] Matthew Fuller, *Behind the Blip* (New York: Autonomedia, 2003), p. 31.
[103] Matthew Fuller (Ed.), *Software Studies: A Lexicon* (London: MIT Press, 2008).
[104] Joasia Krysa and Grzesiek Sedek, "Source Code", in Matthew Fuller (Ed.) *Software Studies: A Lexicon* (London, MIT Press, 2008), pp. 236-243.
[105] Nick Montfort, "No Code: Null Programs", *The Trope Tank*, Vol. 1, No. 1, 2013, pp. 1-12.

that are used within many fundamental computer programs including videogames. In a chapter called “working code” the scholars analyse the possibilities of esoteric or broken programs to trigger a return of the unknownable to a late-capitalist era otherwise dominated by the code of digital logic. As part of this, they provide the example of *Forkbomb.pl*, a “bomb” program coded in the perl programming language, that tasks a computer with a simple routine to be completed on an infinite loop, requiring the user to switch the machine off to regain control. Cox and McLean provide the short program in full:

```
#!/usr/bin/perl
no warnings;
my $strength = $ARGV[0] + 1;
while (not fork) {
     exit unless --$strength; print 0;
     twist: while (fork) {
          exit unless --$strength; print 1; }
          }
goto 'twist' if --$strength;
```
[106]

Importantly, the scholars provide details of how this code functions, without going into so much detail it could be misconstrued for a Perl tutorial, and draw important details from the outcome of this code in operation. Cox writes, “the script prints out zeros in the outer and ones in the inner while loop […] as white and black pixels. Because *forkbomb.pl* pushes the system to its limits, it becomes sensitive to subtleties of timing and state in the operating system” only to conclude, “the way endless loops work on themselves — as if in self-recognition of wider conditions — neatly corresponds with a dialectical understanding of the inherent antagonism between internal and external factors, oscillating between what is possible and what actually exists”.[107] Cox and McLean ultimately argue the dominance of computer code risks losing important communicative nuance in the rise of coded societal communication. Their theoretical leanings are more semiotic than media ecological, however, often relating human or social concepts such as memory or history to the similarly named but only loosely related computer processes. That said, their methodology, presenting, analysing and interpreting code, provides a basis for some of the methods used in the case studies that follow. In Chapters Two and Three, I undertake some code analysis to elaborate on how the micro- world of videogames is entangled with the meso- and macro- realms of gameplay.

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[106] Geoff Cox and Alex McLean, *Speaking Code* (London: MIT Press, 2013), p. 44.
[107] Geoff Cox and Alex McLean, *Speaking Code*, p. 44.

Montfort, Bogost and eight others built on this examination of hardware by addressing the internal, software "code" of early gaming machines. In the ground-breaking *10 PRINT* writers from the gaming industry and associated academic disciplines write anonymously about the varying potential uses of a particular line of code for the gaming system Commodore 64.[108] The line of code in question is:

```
10 PRINT CHR$(205.5+RND(1)); : GOTO 10
```

this abnormally concise program written in the Basic programming language generates a sequence of '$' symbols, pseudorandom in length. However, as denoted by the 'GOTO 10' at the code's conclusion - a computer command to execute line '10' of the current program which, this line happens to be - the program repeats itself indefinitely. This, in effect, creates an on-screen, maze-like drawing until interrupted by the user. Distinct from the purely technological focus of *Racing the Beam*, the various chapters of *10 PRINT* theorise on the social impact of code. As a study on a single line of code, 10 PRINT is unique; nevertheless it hints at the potential of studying single lines of code that could be part of a larger program broken up into sections or focused on in an abstract sense.[109]

As noted above, a code studies approach to the games chosen for exploration in this thesis allows me to engage with the ecological nature of games on a different level. To provide a very brief example of how I will employ this method, I will again look to *Minecraft*, as it contains an excellent example of gameplay hinting at its underlying programming; that which, in software studies, "lies beneath".[110] By analysing the intricacies of this particular feature, we can enrich our analysis beyond what can be gleaned through visual analysis alone. Within the fan lore associated with the game, the term 'Far Lands' is used to describe a glitch that occurred in older versions of the game (figure 1). When a player drifts far enough from the centre of the game map, the usually solid, familiar mountains and trees of the game begin to distort into otherworldly apparitions. When we dig into the source code of *Minecraft* we begin to unravel the mystery of the Far Lands and instead find a unique ecological system. The

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[108] Ian Bogost, Nick Montfort, Patsy Baudoin, John Bell, Jeremy Douglass, Mark C. Marino, Michael Mateas, Casy Reas, Mark Sample, Noah Vawter, *10 PRINT CHR$ (205.5+RND (1)); : GOTO 10* (London: MIT Press, 2013).
[109] Ian Bogost, et al., *10 PRINT*.
[110] Wendy Chun, *Programmed Visions:Software and Memory* (London, MIT Press, 2011), p. 20.

designer, known as 'Notch', speaks openly about the Far Lands glitch and engages with the contributions they make to gameplay stating, "the bugs add mystery and charisma to the Far Lands".[111] The bug is a product of the 'procedural' map generation of *Minecraft* that works by creating maps in sections of 16*16*128 blocks. The mathematical nature of the program determines that the values of map generation are determined by a preset 32-bit integer. This corresponds to assigning values to memory addresses in a computer system (though this is often only through the employment of a virtual machine which is then interpreted by a governing system). Map sections can be created and assigned a value in a range of roughly minus two billion to positive two billion. Beyond that, map chunks will begin to overwrite other chunks. As such, as blocks are assigned increasingly large integers, even those that would exceed 32-bit limits, the system attempts to compensate. Rather than retrieving data from the 3rd *billionth* memory address, which the system cannot do, it will instead 'wrap around', assigning the same integer to multiple blocks. This integer overflow causes a 'wrap around' - a common exploit in computer hacking - produces the 'Far Lands' glitch.

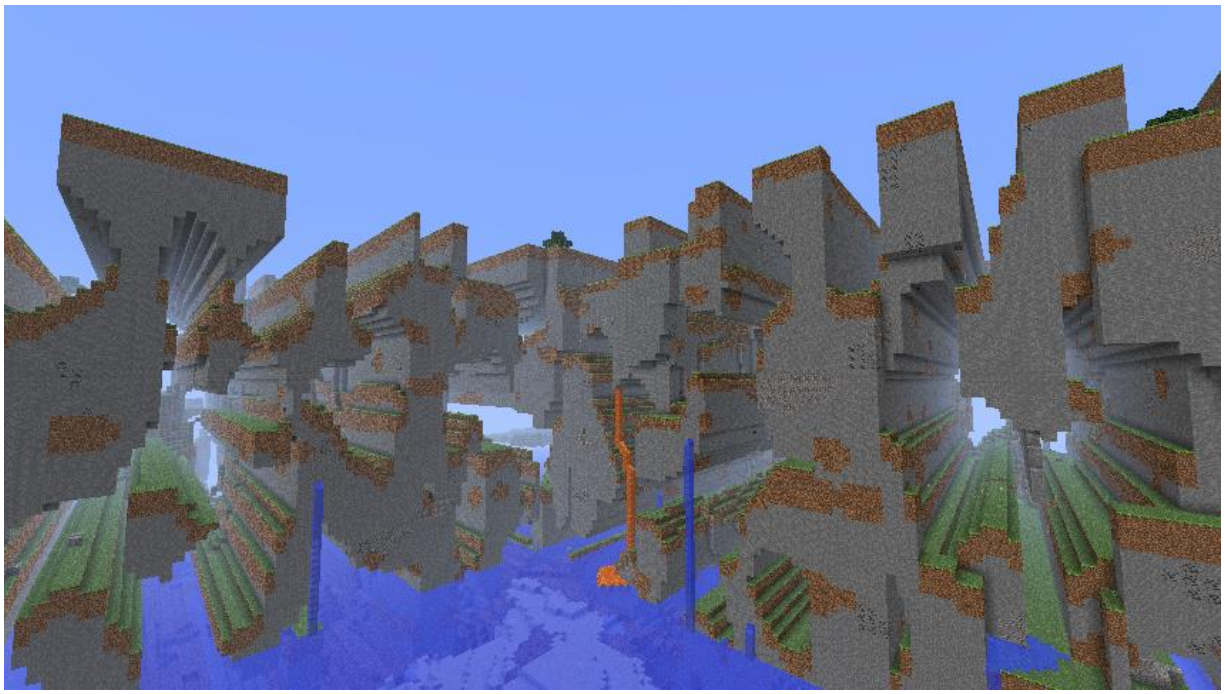

Figure 1: The Far Lands

The unexpected behaviour, as we see it, of the 'Far Lands' glitch is resultant from a system of unique interdependencies between system resources. Engaging with a game that is glitching, such as this, requires an 'ecological' perspective with knowledge of the game's code, how it

[111] Notch, "Terrain Generation", *Minecraft Blog* (online resource) <http://notch.tumblr.com/post/3746989361/terrain-generation-part-1> [last accessed: 20/07/2016].

interacts with hardware and an appreciation of the effect it can have on the player. We are made aware of interconnections between data impulses because we can acknowledge they are making connections different to those we are familiar with. This is a far cry from the seductive idea of a 'virtual world' that closes players off to the technological functioning of digital games. Indeed, in Johannes Huizinga's concept of the "Magic Circle", a foundational concept in game studies, players make are understood to construct liminal spaces within public spaces so that play can take place.[112] Players close themselves off to other forms of stimulus to maintain the consistency of their play experience. Within this, they are no longer aware of the practicalities that provide their play, but only concerned with play itself. When we embrace code, hardware and the ecological relationships of these features as a facet of game studies, we are given access to a view of a game that can accept it not only as a narrative object but a technological object as well. This form of study that appreciates games technologically will be most prevalent in the initial two case studies of this thesis. While still informing the final study, as my focus shifts to questions of aesthetics and affect less time is spent on specific technological details.

My proposed media-ecological study of games will embrace the particularities as media objects, just as in media archaeology and platform studies, but do so to foreground the ecological connections these create. Alexander Galloway observes playing a videogame is being part of a "massive, multipart, global algorithm. To play the game means to play the code of the game".[113] Games are enormous, modular systems in which, through play, we can participate. By examining game code we can come to realise this clearly. At the same time, while 'global' in this instance refers to the reach of the game code (extending to all aspects of the mechanical functioning of the game as a system) it can come to take on other meanings as well. In the case of the online games mentioned earlier, *World of Warcraft*, for example, the effects of coded systems literally span the globe. McKenzie Wark provocatively suggests a videogame ecology that has subsumed a seemingly unrelated materiality within it: "once, games required an actual place to play them, whether on the chess board or the tennis court. Even wars had battlefields. Now global positioning satellites grid the whole earth and put all of space and time in play".[114] Although these statements are grand, they are committed to the

[112] Johannes Huizinga, *Homo Ludens* (London: Routledge, 2002[1949]), p. 10.
[113] Alexander Galloway, *Gaming: Essays on Algorithmic Culture* (London: University of Minnesota Press, 2004), p. 90.
[114] McKenzie Wark, *Gamer Theory* (London: Harvard University Press, 2007), p. '010'.

realisation that game space is becoming inextricable from the material realm. The examination of code and software, platforms and hardware of gaming devices are all relatable to the wider ecologies stemming from the act of play. Throughout the case studies included in this thesis, one eye will remain trained on the technological complexity of the games I explore; in all cases, however, these algorithmic qualities will be understood with regards to their ecological impacts within my ecology of videogame play. Though I will explore games at the level of code and, on occasion, hardware, these are intricately interlinked with play practices.

Code studies offers an entirely new way to examine videogames; however, it is not without its detractors. Scholars have suggested a need for restraint when analysing code. In a more "spectral" move, Wendy Chun urges scholars to view code analysis as a "fetish", deriving deviant pleasure from the abstraction itself, rather than seeking further meaning instead embracing the symbolic disconnection.[115] In a more straightforwardly critical tone, Lev Manovich raises two major objections to 'software/code studies' practices: first, he objects to the methodology occasionally employed by Fuller and associated writers. Specifically, he takes issue with the practice of analysing the minutiae of computer programs, of "reading the code" wherein authors pay attention to the particularities of how code is written (for instance, 'Perl Poetry'), a practice similar to reading scores in music studies or analysing the quality of the paint in a painting.[116] He reasons that "in the case of any real-life interactive media project, the program code will simply be too long and complex to allow a meaningful reading - plus you will have to examine all the code libraries it may use. And if we are dealing with a web application (referred to as "webware") or a dynamic web site, they often use multi tier software architecture where a number of separate software modules interact together (for example, a web client, application server, and a database)".[117] Code, in other words, is never simple and studying it may be more an act of excavation than analysis.

Manovich's second objection is that studying code detracts from the more important study of the user experience, of the central "interactivity" that defines digital media. He writes, "even if a program is relatively short and a critic understands exactly what the program is supposed to do by examining the code, this understanding of the logical structure of the program can't be

[115] Wendy Hui Kyong Chun, *Programmed Visions: Software and Memory* (London: MIT Press, 2011), p. 51.
[116] Mark C. Marino, "Critical Code Studies", p. 1.
[117] Lev Manovich, *Software Takes Command* (Creative Commons, 2008), p. 16.

translated into envisioning the actual user experience".[118] Manovich contends that, as a branch of the humanities, code studies must always inevitably return to the human user for its focus.

It is difficult to disagree with Manovich. In reference to program complexity, contemporary digital games – the subject of this thesis – are often constructed through a combination of many different code languages. Adding to this, increasingly, game design takes place in development 'engines' (design environments) that provide complex mathematical elements of graphics rendering, pre-programmed and ready to be implemented or even augmented at the flip of a (digital) switch. It is easy to see why Manovich contends that Kittler's argument that students should seek to understand the "essence" of the machine through an understanding of underlying code behaviours, denies contemporary IT practices.[119] Some software studies theorists succeed in examining the software objects they examine without ever providing an example of code. One excellent example of this is an essay on the Twitter API where the effects of the coding of the program are examined in depth without any formal analysis of the source code itself.[120] Rather than examining older forms such as assembler languages (as Kittler does) Manovich contends that we must look at GUI reliant computer environments, such as game engines, content-creation systems and media platforms. At this level of computing, he argues, the central concern is successfully interfacing with a human user.

The division between Fuller and Manovich's approach to software studies has rippled through more recent scholarship; some have gone so far as to deem code analysis 'fetishishising code', as Chun calls it, contending that it risks scholars losing sight of function in favour of the allure of an esoteric digital language.[121] Rob Kitchin in his *Code/Space* invokes the well-worn techno-scepticism of Jean Baudrillard, asking the questions: "what are the implications of reducing the world to a small ontological subset and a sequence of algorithms? Does the sensibility of a relatively small cadre of programmers become the overriding blueprint for future everyday social relations? Will defaults in code become the defaults for living?"[122] Though Kitchin views code as part of an entwined system, as I intend, he bemoans code as capable of reducing the perceived complexity of an idealised, non-algorithmic 'reality'.

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[118] Lev Manovich, *Software Takes Command*, p. 16.
[119] Lev Manovich, *Software Takes Command*, p. 10.
[120] Taina Butcher, "Objects of Intense Feeling: The Case of the Twitter API", Computational Culture, Vol. 2, No. 1, 2013.
[121] Rob Kitchin, "The Programmable City", 2014.
[122] Rob Kitchin and Martin Dodge, *Code/Space: Software and Everyday Life* (London: MIT Press, 2011), p. 248.

Kitchin and Martin Dodge's concerns are timely as nations begin to adopt digital voting and healthcare systems. There is a real potential that decisions made on behalf of programmers can shape the everyday lives of others, through code; they write, "developers make, on the one hand, critical, ontological decisions about what to capture, categorize, and represent in the world".[123] Giving this level of power to corporations with vested interests in how a cybernetic society develops is, of course, cause for concern. Nevertheless it serves to confirm the entwined nature of software and the everyday.

Though a healthy scepticism of code analysis is perhaps warranted, it also provides an ideal jumping off point for arguments in favour of this approach. Returning to Manovich's two arguments against analysis of code - that it is difficult due to its sprawling nature and that it detracts from an analysis of human experience - although they are reasonable, it is still possible to make a case for the role of (some) code-reading as one part of a wider ecological analysis of videogames. In response to Manovich's first detraction, that contemporary code is too long, too complex and too interrelated, I suggest an ecological analysis of code. Indeed, Fuller argues for the use of the term "ecology" within software studies, saying that as a term, "it is one of the most expressive language currently has to indicate the massive and dynamic interrelation of processes and objects, beings and things, patterns and matter".[124] Manovich's argument, that the underlying complexity of code, should not deter us from closely examining programs. Rather, the vastness of code should be seen as an invitation for new exploration using experimental methodologies (such as critical code studies) to reveal unexpected outcomes. Rather than seeing complexity and interconnectivity of software code as an obstacle we can view these qualities as the grounds for an ecological analysis of code. Though we may not be able to grasp the enormity of a programme (its associated libraries, databases and languages) we can attempt to understand the structure of a program through an examination of source code. Building on the software studies research shown above, rather than focusing on small programs such as *forkbomb.pl* or '10 PRINT' we can examine the source code of smaller, but functioning programs such as independent digital games. Within this, analysis of individual lines of code can yield an understanding of the importance of individual lines of code to a whole; while we may not be able to grasp the entire picture of the running program we can develop an indication of characteristics of that program ingrained below the reach of

[123] Rob Kitchin and Martin Dodge, as before, p. 246.
[124] Matthew Fuller, *Media Ecologies*, p. 2.

the user. Indeed, it is not even necessary to use the exact source code that a program runs (obtaining source code is difficult as it is often highly copyright protected). By observing the properties of a game and *approximating* code, we can still learn a great deal about the game in question.

For example, in the first case study of this thesis in which, through a close reading of Might and Delight's *Shelter*, I elaborate upon the ecological outcomes of the framework of this thesis. A part of this process is a reverse engineering of some of the primary game 'mechanics' (the functions of the game, influenced by the basic rules). I observe that our avatar, a mother badger, is followed by her young 'kits' throughout the game. From the movement of the kits in relation to the avatar it is possible to observe possible ways this could have been coded (when paired with my working knowledge of the Unity game engine). Given that the kits stray a fixed distance from the mother, take a specific amount of time to become 'hungry', and trigger the 'game over' state in if they all die, it is clear that the mother badger code has been written in such a way as to share values with the computer-controlled kits. Approximating code allows us to see the extent to which these 'shared' values such as hunger, distance and life, are fundamental to the functioning game. In this instance, reading code by approximating similar code brings us closer to understanding the inter-relations we see mediated on-screen. What's more, we can understand otherwise abstract rules (such as, in this instance, kits cannot stray a certain distance from their mother unless attacked) in more specific terms (for instance, the centre-point of the character model will begin to move towards the centre-point of the player avatar within a certain range of distance values, unless other factors intervene). Although we are not made privy to the functioning of the program as a whole, we can appreciate the manner in which certain aspects of the program function to ensure aspects of the visuals and narrative of the game.

At the same time, while analysing code can bring us a deeper level of understanding of on-screen actions, it can also be used to illustrate how code functions reverberate through the programs to the human users – how the syntax of each line, even the specific integers within lines, affects the potential of how these programs are eventually perceived. Though Manovich claims a reading of source cannot tell us how a human will react, it can certainly tell us what spectrum of possibilities are open to the players and how the designer has tailored this specific experience as best possible. For instance, in the final study of this thesis, Numinous Games'

That Dragon, Cancer exploring how the game functions allows us to see that the set-pieces have fixed times.[125] If a player does not achieve the set objective of a vignette within that time the game's overall structure or 'game class' ensures that the next vignette begins, regardless. While we cannot know how a player will react to this, we do know that it ensures a flow of narrative between the various set pieces, regardless of player ability. At the same time, we can interpret that this game, an intensely personal narrative piece, is designed to disempower the user, limiting their ability to impact upon the virtual world.

Taking the two examples above together, reading or approximating source code can show us at least two ecological qualities specific to games: firstly, an internal ecology wherein interdependencies within the code shape the overall character of the program; secondly, an external ecology where these qualities affect the properties of the program in the world at human scale.

As useful as code analysis and a media ecological approach may be for highlighting the affect of micro-ecologies on other scales of play, alone, it brings us no closer to a comprehensive method for analysing the videogame ecology. To date, no theorist has attempted to bring the intricacies of videogame code to bear on the human user's experience. Close readings of games have been completed without a focus on the human, and readings of media technology outside the videogame world have connected the dots. As such, alongside the opportunities presented from existing ecocritical approaches, so too do mediaecological approaches present a trajectory for this project. Bringing code analysis into view with ecocriticism brings us closer to a method adequate for analysis of the nebulous techno-ecologies of games outlined in my introduction. However, to form my analytical lens using currently established theories would be to adopt their existing shortcomings.

ECO-SPATIAL APPROACHES

There is an identifiable subsection of game studies in which scholars dedicate themselves to understanding the space in which games are played. This understanding often places an emphasis on the 'ecological' connotations of game spaces. I will provide an outline of the major contributions below. Before that, however, it is important to note that the authors' visions of ecology are nuanced forms of the ideas expressed so far. For instance, Thomas

[125] Ryan Green, *That Dragon, Cancer* [Multiple Platform Videogame] (USA: Numinous Games, 2016).

Apperley (discussed in greater depth below) frames his ecological understanding of game space writing, "digital games extend out of the individual mechanical operations of the games, software, and players' into wider cultural assemblages that elicit a mutual and reciprocal transfiguration of contexts. The notion of media ecology invokes a general 'connectedness' of digital games in messy and complicated assemblages, that avoids the artificiality of conceptualising them as closed systems: tidily discreet, virtual, hermeneutic objects."[126] Apperley's words, similar to Banks' notions of scale, prompt us to take seriously the specific physical/material happenings generated by videogames throughout the world. It is not enough to consider videogames an ecology because they utilise the same global network of servers, cables and satellites as the world wide web. Rather, they come to play a part in particular social human activities and are, in turn, shaped by them. This attention to videogame spaces, as part and product of the entanglements of digital and human activities all as a combined physical performance, has become a visible trend in game studies in the past ten years.

The 'space' of a digital game can be considered any socially meaningful space resulting from our interaction. The earliest influential writings on game space - though not videogames - predict a discourse of game spaces. Huizinga's "Magic Circle" contends that spaces such as the school playground are socially constructed, infused with meaning by the inhabitants, so that games can take place.[127] Just as the court room, the office or the altar are imbued with social significance through societal norms so too do we demarcate the spaces of play. His term comes originally from a Flemish word for a space in which practices could take place that were seen as distinct from normality. Marked by four ropes the '*veirschaar*' denoted a barrier between the everyday world and the space of play. Game spaces are always socially constructed. With regards to videogames, the 'magic circle' has come to play a significant role in contemporary game studies theory, particular when discussing augmented reality games in which the everyday and the playful are blended through the use of a handheld computer (a games-system or smart-phone) as in the studies by Adriana de Souza e Silva, Chris Chesher and William E. Cartwright.[128] Hector Rodriguez discusses *Can You See Me Now?*, by the British group Blast Theory, that encourages players to chase each other through urban

[126] Thomas Apperley, *Gaming Rhythms: Play and Counterplay from the Situated to the Global* (Amsterdam: Institue of Network Cultures, 2010), p. 13.
[127] Johannes Huizinga, *Homo Ludens* (London: Routledge, 2002[1949]), p. 10.
[128] *William E. Cartwright, "Exploring Games and Gameplay as a Means of Accessing and Using Geographical Information", Humanit, Vol. 8, No. 3 (2006), pp. 28–67.*

environments. Through the use of GPS systems players track each other and attempt to evade detection. In this case the 'magic circle' is not denoted by a specific geographic location - as with the *veirschaar* but instead by how we use space in a semi-playful way. Rodriguez notes, however, that the overlaying of urban space with game systems can lead to sudden, unexpected permeations of that space when "play becomes intertwined with seriousness whenever it moves into everyday locales and faces up to the possibility of unpredictable events from outside the formal system of the game".[129]

Whether a social game space is just a consideration of a lone player's surroundings, a more complicated analysis of a large e-sports competition, or even the sprawling augmented reality space of contemporary mobile games, these contemporary digital artefacts motivate the human perception of the environment. In each of these senses, a game's particular 'space' forms an important part of how we view it ecologically. For instance, the world of crime-spree game functions to ensure the player remains engaged while playing. On one level, it is kinetically engaging as it provides a harmonious synchronisation between input and feedback. On another level it provides the stimulus to support the sensations of a player's perceptions of character and plot. Further still, cutting-edge graphics ensure verisimilitude which may allow players to more easily suspend their disbelief. These three components work together to ensure our interactions, either between ourselves and the computer or ourselves and other players, flow in a particular manner when playing a game. Given this, the construction of space is the construction of relationships which, in turn, is the construction of an ecology.

The construction of digital game spaces resonates with theories of the social construction of space developed by Henri Lefebvre. In his work, social space is broken down into three different planes: 'spatial practice', which secretes a certain society from another; 'representations of space', which is "conceptualized space, the space of scientists, planners, urbanists, technocratic subdividers and social engineers"; and representational space, "space as directly lived through its associated images and symbols, and hence the space of 'inhabitants' and 'users'".[130] Comparatively, writing on videogame spaces Henry Jenkins suggests, "game spaces are designed to be rich with narrative potential, enabling the story-constructing activity

[129] Hector Rodriguez, "The Playful and the Serious: An approximation to Huizinga's Homo Ludens", *Gamestudies* (online resource), Vol. 6, No. 1 (2006) <http://gamestudies.org/0601/articles/rodriges#d> [last accessed: 23/07/2016].
[130] Henry Lefebvre, *The Production of Space* (Oxford: Blackwell, 2001), p. 38.

of players".[131] The idea is that the construction of the game environment in terms of level design has an effect on the player; not just on how they play the game but also how spaces create possibilities for the formation of emotional engagement. Though that may be, making spaces will only influence, rather than control, the way players behave in a digital environment. Lest we forget, the spaces are also, inevitably, shaped by the players in return.

Game spaces can be local, but at the same time, they can stretch throughout the world. Apperley suggests that game ecologies can, firstly, be understood as "embedded and situated within the material and mundane everyday".[132] This fits a stereotypical view of videogame play as a form of relaxation, utilising a television as part of the social home. In contrast, Apperly similarly contends that game ecologies allow us to understand, "connections between the global and the local, the general and the specific". While games can connect players in a living room they also connect international cultures through online play. Importantly he notes that specific practices or 'rhythms' of play (Apperly invokes Henri Lefebvre's 'rhythmanalysis'), provide unique pictures of local culture and appropriation of otherwise global artefacts. Though gaming seems to stretch across the globe there are specific practices and ways of playing linked to various communities. Players make game spaces that are varied, ranging from the particularities of specific players in a home to the visible trends of a nation en masse.

There have been several attempts at constructing taxonomies of game spaces. For instance, Michael Nitsche, building on Lefebvre, proposes videogame spaces have five planes, beginning with the rule-based dimension (which includes code and the inherent logic of digital game systems), extending through to the mediated dimension of representation, the fictional dimension of human conception, the actions of play and the social dimensions such as play geography and sharing the game experience with other players (figure 2). These are not discrete and constantly influence each other. Axel Stockburger similarly adopts the methodology of Lefebvre's spatial triad, augmenting it into five categories, defined as: physical or user space, narrative space, rule space, audiovisual representational space and kinaesthetic space.[133]

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[131] Henry Jenkins, "Game Design as Narrative Architecture", in Noah Wardrip-Fruin & Pat Harrigan (Eds.), *First-Person: New Media as Story, Performance and Game* (London: MIT Press, 2003) p. 129.
[132] Thomas Apperley, *Gaming Rhythms*, p. 8.
[133] Axel Stockburger, *The Rendered Arena: Modalities of Space in Video and Computer Games* (Vienna: VDM

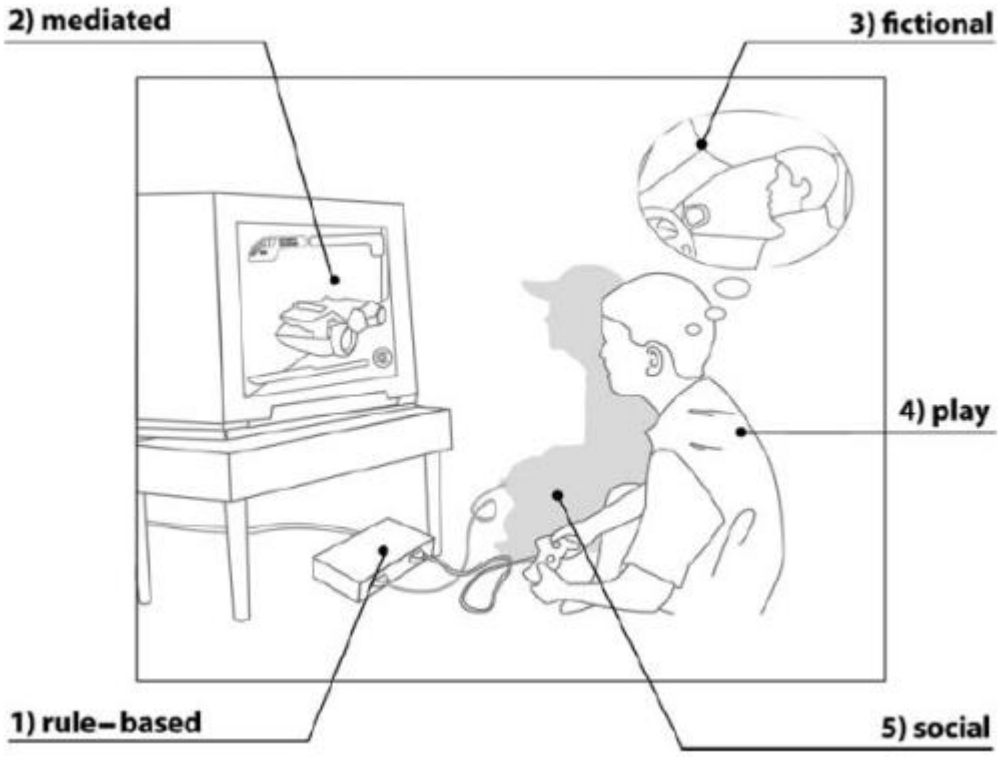

Figure 2. Nitsche's videogame spaces

If, as the above theorists suggest, gamespace is constructed by how players use and perceive it, an understanding of the social element of gameplay is an important level of an ecological theory of gamespace. As Nitsche writes, "although it might seem as if companies and commercial interests are pushing these models, in reality it is the growing acceptance of game worlds as cultural places that drives them... As video game spaces have been established, and their colonization has reached a certain level, we see their inhabitants settling in—and changing the face of the virtual world".[134] It is important to attempt to understand just how games are played and what effect this has on an overall system.

Applying a systematic reading to humans as processes within a space Jonas Linderoth applies Gibson's 'perceptual ecology' to videogames. He writes, "the ecological approach is a theory of perception, action, and learning that has as its primary units of analysis the opportunities and constraints that the environment provides for humans and other animals".[135] Linderoth's

Verlag, 2009) p. 55.

[134] Michael Nitsche, *Videogame Spaces: Image, Play and Structure in 3D Worlds* (London: MIT Press, 2009), p. 246.

[135] Jonas Linderoth, "Beyond the Digital Divide: An Ecological Approach to Gameplay", *ToDIGRA*, Vol. 1, No.

study draws attention to the importance of perception of affordances to facilitate gameplay. James Gibson's perceptual ecology allows us to reconceptualise the human subject. In Gibson's framework, subjects assess space by sensing environmental 'affordances' - objects that can allow possible actions. For example, a human subject perceiving a bicycle does not perceived only rubber and metal; the bicycle is conceived through its signification of potential abilities to enable action.[136] In a sense, Linderoth's work expands the dimensions of Nitsche and Stockburger's 'first' dimension of game-space. Perceptual space, it seems, is not just part of an ecology but also an active ecology in itself.

The scholars above suggest an important aspect of an ecological view of videogame play. That is, understanding the various 'planes' that make up 'play-space'. However, the varying number of clearly defined planes across different works suggests something interesting. The player, the computer, the narrative, visuals, controllers and associated apparatuses all inform the game ecology. What is more, each of these stages may themselves be near-endlessly multifaceted. To what minute level can we suggest the local comes to impact the global? In many ways, Apperley, Nitsche and Stockburger's work represents the clearest point of departure for this thesis. Rather than attempting to trace the impact that the minute can have on the massive, it is instead possible to focus on how the minute can draw attention to itself. Though neither scholar calls it such, the ecology of play-spaces provides a useful blueprint from which to work from. The multiple, interlocking planes of game space they define, generate an ecology in which rules, mediation and fiction shape and are, in turn, shaped by the physical acts of play that generate unique social contexts. As Apperley points out though a multiplayer game may have specific rules (rules governing its interactions with system hardware, rules governing the options it allows players to engage with) the responses to these rules vary dramatically across the globe. My suggestion is an inversion of this methodology. To generate a means by which we can see how the same processes may instead lead us on a journey inward, rather than outward; downward, towards the materiality of the objects that are so often considered only a part of wider human activities.

1 (2013), pp. 85-114.

[136] James Gibson, *The Ecological Approach to Visual Perception* (London: Erlbaum, 1986).

POSTHUMAN APPROACHES

A potential problem with the studies of play above is their fixation upon the human subject. Following Fuller's media ecologies, we should attempt to embrace games as the "massive and dynamic interrelation of processes and objects, beings and things, patterns and matter".[137] The ecocritical and, particularly, the spatial readings of games are, to varying degrees, guilty of placing undue attention on the human player. This seems flawed for several reasons, but most simply because the wide range of behaviour of players complicates any view of gameplay that attempts to guess what a player may do or feel. It is difficult to take into account, all at once, the specific actions of any human player, their thoughts, hopes, feelings, particular practices of nationalities and beyond, when viewing gameplay. The human, therefore, present within Nitsche, Stockburger and Apperley's work, must be framed as only part of an overall system of play.

Reading videogames ecologically prompts us to look past the human as the central of study. Reflecting the diversity of the theory it is drawing on, there are a range of approaches in posthuman studies of videogames that I will engage with below. Each of these approaches have informed elements of this thesis. They are not, however, without their flaws. Above all, they have informed this work's contention that the human cannot be placed at the centre of an analysis of videogame play and that any posthuman approach must be appropriately nuanced for the medium in question.

Given the fervour of discussion relating to gender and identity within the gaming community it is not surprising to find a substantial portion of posthuman research is dedicated to questions of queer and transgressive human identity. Taking inspiration from Haraway's radical theory of cyborg bodies, Elsie Vist draws attention to conflicts of identity within contemporary gaming culture. Vist's notion, 'cyborg games', loosely denotes "the particular kind of game that creates feelings of disorientation in people by twisting the tropes and forms of videogames. This creates a space where normative bodies and normative gamers are not immediately oriented".[138] In Vist's formulation, the game becomes the prostheses whereby 'normative' gamers can come to adopt, to limited success, a more transgressive identity. In a

[137] Matthew Fuller, *Media Ecologies*, p. 2.
[138] Elise Vist, "Cyborg Games: Videogame Blasphemy and Disorientation", *Loading...* (2015), Vol. 9, No. 14, pp. 55-69, p. 66.

similar fashion, Edmund Chang's formulation of the 'technoqueer' is one who has adopted the cyborg identity in the knowledge that this is done at the "stabilisation or policing of others".[139] Chang operates from the posthuman assertions of Cary Wolfe whose exploration with "greater specificity" reveals 'humanity' as "prosthetic creature".[140]

Haraway sees posthuman thought as "a fourth wound, the informatic or cyborgian, which infolds organic and technological flesh and so melds that Great Divide".[141] By 'wound' she is following the trajectory of Copernicus, Darwin and Freud, who each served to disrupt human exceptionalism. This chapter seeks to twist the knife, adding to this fourth wound in the myth of the liberal human subject. I intend to invoke this posthumanism in my work, alongside that of Hayles who writes, "embodiment makes clear that thought is a much broader cognitive function depending for its specificities on the embodied form enacting it".[142] Hayles proposes that different bodies and embodiments are productive of different forms of knowledge. The same principle will be followed throughout my thesis as I view the structure, the code 'body' of a videogame, and posit that this agential apparatus, mingles with the human.

Haraway's posthumanism plays a role within my analyses, shaped, as it is, by ideas of beings produced by their comingling with other beings including machines. In the chapters that follow I am never far from the underlying assertion that 'the human' is formed by its available technology. However, unlike Vist or Chang it is not my intention to privilege one group of human over another. Rather, as Betty Li Meldgaard suggests below 'humanity' can be viewed only as one source of input within a wider techno-biological system. I a more interested in the outcomes of viewing games as ecological systems, how they affect notions of interaction, aesthetics and affect, than I am in evaluating their ability to play a valuable role in the worthwhile task of raising awareness for often side-lined social groups.

Meldgaard has carried out studies of videogames using Gibson's perceptual ecology, as Linderoth above, but pairs this with an acknowledgement of cognitive studies. Meldgaard sees the player as an "information seeking system", and breaks down play into the actions of motor

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[139] Edmund Chang, "Dissertation Abstract", *Ed(mond)Chang(ed)Agogy* (online resource), <http://www.edmondchang.com/portfolio/dissertation/>, [last accessed, 12/01/2016].
[140] Cary Wolfe, *What is Posthumanism?* (MN, University of Minnesota Press, 2010), p xxv.
[141] Donna J. Haraway, *When Species Meet* (London: University of Minnesota Press, 2008), p. 12.
[142] N. Katherine Hayles, *How We Became Posthuman* (Chicago and London: University of Chicago Press, 1999), p. xiv.

neurons. Meldgaard questions, as Gibson did, whether or not human players can be said to be automatons. The human, player or user is devolved into the form of "(ex)propriospecific information" whereas the game text, controller and other aspects are consider "exteriospecific" information.[143] For the sake of this thesis, such an enquiry - while fascinating - is unnecessary. Attempting to fathom the place of the human within a game space only requires us to separate their actions from the perhaps limitlessly complex whole of the liberal humanist subject defined in my introduction. Thinking with affordances, therefore, can provide us with a method for ecological understanding of human action within the context of videogame play.

When we begin to break down users into their actions, as Meldgaard affordances method does, we can resist a perception of the human user as whole, overwhelmingly complex entity. Focusing on actions taken during play we can hone in on processes. Rather than attempting to fathom how it is a human conceptualises games we can work with how that game space provides opportunities for action. Given these possibilities we do not need to concern ourselves with habits of individual humans. Indeed, to do so would limit the efficacy of this explorative thesis. Following Meldgaard's posthuman approach, human agency is viewed as 'activity' without attempting to posit reasons or intentionality.

Meldgaard does not make the connection between her exploration of the human sensory ecology and posthumanism explicit but it is nevertheless reminiscent of N. Katherine Hayles' meditations of the similarity of computation and cognition. Within her Regime of Computation, Hayles suggests, "if computation generates physical reality at the subatomic level, then one can claim that in this sense cognition is computational, even while conceding differences in embodiment and the integral relation between embodiment and human cognition".[144] Likewise, as Eugene Thacker suggests in his studies of how the biological can be mediated as a function/statement based computer code such as "bioperl".[145] Adopting a posthuman stance on human activity allows us to distance ourselves from intention and the myth of the 'human' as in possession of a consciousness in some way distinct from that of other creatures. Rather, we are invited to interpret human action as informing a larger 'computational' system.

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[143] Betty Li Meldgaard, *Dangerous Forms - Playing by the Visual Rules: Ecological Approach to Videogames as Activity* (Denmark: Institut for Kommunikation, 2011), p. 130.
[144] N. Katherine Hayles, *My Mother was a Computer: Digital Subjects and Literary Texts*, p. 217.
[145] Eugene Thacker, *Biomedia* (London: University of Minnesota Press, 2004) p. 58.

To mark the impact of Hayles and Meldgaard's work on thesis, therefore, I will refrain - as much as possible - from referring to the player as in someway privileged. As the thesis progresses, however, it is my intention to comment on how the activity of a computer system can, nevertheless, play a part in creating the phenomenon of affect. Without being prescriptive or overly speculative, this is achieved through an acknowledgement of the important distinctions that embodiment triggers between nonetheless entwined bio-computational systems. While in these early chapters it is important to realise the similarities between computers and human beings, in later chapters, it becomes just as important to recognise the difference, in line with Hayles' writing on embodiment.

One popular posthuman approach to videogames is the adoption of Callon and Latour's Actor-Network Theory (ANT). This theory can be roughly understood as implying that, "both society and technology, actor-network theory proposes, are made out of the same 'stuff': networks linking human beings and non-human entities ('actors', or, in some versions, 'actants')".[146] Seth Giddings uses this actor driven approach in reference to strategy games in which players issue commands to multiple units, suggesting a form of valid artificial life. He writes, "the technological agency exercised through digital gameplay here is literal and unmetaphysical, everyday and playful. Yet this very mundanity and ubiquity may suggest a technoculture more far-reaching and significant than that once promised by enthusiasts for the exclusive experiences of Virtual Reality and 'cyborg' prostheses".[147] I am sympathetic to this bold claim and will adopt this approach, a belief in the significant mundanity of videogame play and presence of nonhuman agency throughout this thesis.

Giddings mentions the idea of automata in his work, as "self-moving agents".[148] As in discussions of machine ethics, machines are increasingly considered to have a form of autonomy.[149] Bogost, in his theories of 'unit operations', similarly invokes the operations of cellular automata to discuss machine agency: "these units interact with one another, exposing

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[146] Donald MacKenzie and Judy Wajcman eds. *The Social Shaping of Technology* (Buckingham: Open University Press, 1999), p. 24.
[147] Seth Giddings, "Playing with Nonhumans: Digital Games as Technocultural Form", in: de Castell, S. and Jenson, J., eds. *Worlds in Play: International Perspectives on Digital Games Research* (New York: Peter Lang, 2007), p. 126.
[148] Seth Giddings, "Playing with Nonhumans", p. 125.
[149] Michael Anderson & Susain Leigh Anderson (Eds.), *Machine Ethics* (London, Cambridge University Press, 2011).

what scientists, computer scientists especially, have hoped to exploit as a viable model for artificial life".[150] This has been heightened and extended by many automata enthusiasts but perhaps none so clearly as Daniel Shiffman in his *The Nature of Code* in which code is thought of not only as automata but indeed as an autonomous agents.[151] What becomes clear in each of these discussions, however, is that 'self-moving' agents are never working entirely alone.

This is perhaps the most valuable element of Giddings' work for my project. While we are inclined to think of agents as active individual entities with will and agency, this becomes problematic in an ecological framework. In discussing a digital network, it must be understood that all activity is interlinked by the nature of code. For code to function it must be entangled appropriately. This will be discussed in more detail in the next chapter of the thesis. For now, it is enough to say that, while there are currently undercurrents in game studies challenging the notion of willful and unique human users, as Giddings does, I wish to further this assertion throughout my analyses. When my methodology is explained it full it will become clear that I reject the notion of actors within a system entirely and instead promote the notion of an agential ontology following Barad. For now, it is enough to say that Giddings' work makes plain the need for new theories with which to approach questions of agency in videogames.

Distinct from the posthumanism of Latour, Haraway, Hayles or Wolfe, Jonathan Boulter approaches the question of the posthuman from a distinctly melancholic perspective. Studying games such as *Deus Ex*, in which humans become 'cyborgs' in a style William Gibson would approve of, Boulter highlights the limits of the "promise of the prosthesis".[152] Just a the human protagonist of the game's narrative is technologically altered only to be controlled by dystopian overlords, so too, Boulter suggests, is the player subsumed in a world of technological consumerism.

While a compelling argument, one might suggest that Boulter is too quick to jump to a Marxist ideology, reducing consumer capitalism to a game of 'us and them'. At the same time, though he suggests prosthesis as promising what cannot be delivered he runs the risk of

[150] Ian Bogost, *Unit Operations* (London: MIT Press, 2007) p. 93.
[151] Daniel Schiffman, *The Nature of Code* (Creative Commons, 2012).
[152] Jonathan Boulter, "Posthuman Melancholy: Digital Gaming and Cyberpunk", in Graham J Murphy and Sherryl Vint eds., *Beyond Cyberpunk: New Critical Perspectives* (London: Routledge, 2010), p. 148.

suggesting there is anything to be lost. Ironically, Boulter's posthumanism veers dangerously close to reinstating the very human it is attempting to think past. He writes, "unlimited extension of the posthuman condition of being otherwise, insofar as this relation is defined between the human and the game, cannot be sustained. The posthuman position is, thus, only ever a promise, forever haunted by the structural necessity of a return to the world of the all-too-human".[153] It is clear that he operates from an ontology bound by humanist assumptions of existing entities, prior to activity. As I will argue in this thesis, it is a leap to assume there is a 'world of the all-too-human' to revert back to. Rather, there is the constant undulating of phenomena, of which humanity is a small part; given the ecological properties of games described in my introduction, nothing displays this reality better than the enfolded act of gameplay.

In side-stepping the posthumanism of Haraway and Wolfe, Boulter draws attention to the difference between American and European posthumanism. Bernhard Siegert has written on the difference between German post-humanism and American post-humanism and sums up this difference eloquently:

> Within the [American] framework of cybernetics, the notion of 'becoming human' had as its point of departure an anthropologically stable humanity of the human that endured until increasing feedback systems subjected the 'human' to increasing hybridizations, in the course of which the 'human' turned either into a servomechanism attached to machines and networks, or into a machine programmed by alien software (see Hayles, 1999, 2010). By contrast, French (and German) posthumanism signalled that the humanities had awakened from their 'anthropological slumber'. This awakening, in turn, called for an anti-hermeneutic posthumanism able to deconstruct humanism as an occidental transcendental system of meaning production.*[154]*

Wolfgang Ernst's writings are an excellent example of the 'anti-hermeneutic posthumanism' in question. In reference to computational knowledge, writes that a computer:

> Even operates below the sensual thresholds of sight and sound – a level that is not directly accessible to human senses because of its sheer electronic and calculating speed. Synesthetically, we might see a spectrographic image of previously recorded sound memory – a straight

[153] Jonathan Boulter, *Parables of the Posthuman: Digital Realities, Gaming and the Player Experience* (Detroit: Wayne State University Press, 2015), p. 123.
[154] Benhard Siegert, "Cultural Techniques: Or the End of the Intellectual Postwar Era in German Media Theory", *Theory, Culture and Society*, Vol. 30, No. 6 (2013), pp. 48-65, p. 53.

> look into the archive. The microphysical close reading [...] where the materiality of the recording medium itself becomes poetical, dissolves any semantically meaningful archival unit into discrete blocks of signals.[155]

Ernst's approach may initially appear to have a similarity to code analysis or platform studies. However, his particular branch of media archaeology is distinct from those approaches in that it disregards the necessity for human comprehension of machine processes. Within machines are forms of knowledge, archives, that cannot be comprehended by humans and do not, as such, require comprehension. They transfer data without any need for interpretation.

To date, I am unaware of any other studies of videogames that have attempted to use european posthumanism or German media-studies as a basis for their explorations. Taking inspiration from Ernst's writing we can incorporate the rapid computer processes, ulterior to human knowledge systems, into a 'poetical' view of interaction. Though the speed of computer processing places it outside the human senses, we can nevertheless interpret these computations as meaningful, though not in a semantic manner, within the process of human-computer-interaction. Videogame play is a posthuman conglomeration of knowledge systems, in which distinct forms come together in productive ways.

Though this may sound abstract, the distinct knowledge produced by computational speed has affected gameplay since its inception. Playing the original *Space Invaders*, to draw on a very literal example, the game would appear to 'speed up' and become more difficult as the game progressed. However, this acceleration was, in reality, correlated to the number of 'aliens' still in play. The more the player eliminated, the fewer sprites the computer needed to render. This resulted in speedier calculations for the processor. While, on one level, *Space Invaders* is the result of rapid electronic activity at a minute level, human users still incorporate these miniscule actions into their experience. However, there is an element to these videogame processes that remain autonomous through their incomprehensibility. Bearing this in mind we can instead view experiences such as this in a new light, as collaboratively produced processes. Rather than accepting the view that 'the aliens' of *Space Invaders* 'speed up' we can instead rationalise that perception is an outcome of our human perspective.

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[155] Wolfgang Ernst, "Media Archaeography: Method and Machine versus History and Narrative of Media", in *Media Archaeology: Approaches, Applications, and Implications* (Berkeley: University of California Press, 2011), p. 243.

This complexity from simplicity is reminiscent of complex systems theory but also of the work of Friedrich Kittler. Kittler viewed the function of all code, from user interfaces, to 'high-level' coding languages, down to assembly, binary/machine code (essentially the annotation of electrical current) as the breaking down of the natural world into discrete units. He wrote,

> Slow-motion shots of the spirit will exorcise it. Chopped up like movements in front of the camera, equations finally solve themselves without intuition because every discrete step during storage, transfer and calculation takes place with bureaucratic precision. The discrete machine forms a solitary union with cinema and the typewriter, but not with neuro-physiology.[156]

This idea that the step-by-step processes of computational machines aligned with their speed will "exorcise" the spirit from the world is also present in Vilem Flusser's words, "A new form of thinking based on digital codes directs itself against procedural 'progressive' ideologies, to replace them with structural, system-based, cybernetic moments of though".[157] Similarly, Wolfgang Ernst writes, "Digital media reduce everything to numbers, with profound consequences for the nature of visual realism"[158]

While there are distinctions between European and American posthumanism, in this thesis I fuse aspects of both approaches in a productive manner. Though I am still concerned with the questions of bodies and cybernetics after Haraway and Hayles, I follow the principles of Wolfgang Ernst and associated European scholars' concepts of machines as being producers of a specific, non-human knowledge. Combining these posthuman approaches, rather than focusing on one or the other as existing scholars do, opens new doors for game studies scholarship. Rather than placing an emphasis on gender construction through prosthesis or the limits of technology as Vist and Boulter, we can attempt a combinatory approach: placing an emphasis on how humans and machines come together through play to produce new paradigms.

As stated throughout this chapter, however, this approach alone – though fascinating – is not

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[156] Friedrich A. Kittler, Gramaphone, Film, Typewriter (California: Stanford University Press, 1999), p. 248.
[157] Vilém Flusser, as cited in Strohl's introduction to Vilém Flusser, *Writings* (Minnespolis: University of Minnesota Press, 2002), p. xxxiii.
[158] Wolfgang Ernst, *Digital Memory and the Archive* (Minneapolis: University of Minnesota Press, 2013), p. 157.

in itself adequate to describe depth and breadth of the phenomena I wish to discuss.

BRINGING TOGETHER AN ECOLOGY OF IDEAS

Many of the theoretical approaches to videogames outlined above overlap to varying degrees. To date, however, no single work ties them together into a cohesive form. In the chapters that follow, I take influence from many of the scholars analysed above. From the ecocritical concerns of Chang, Bainbridge, Goggin and Springer, I infuse my research with a focus on materiality. In their 'ecological' study of videogames, ecology is often read as a synonym for biological environments. Building on their work I want to look at less familiar ecologies and explore how the videogame form affects these. This 'material' focus is clarified in the following chapter. In short, through the lens of new materialist scholar, Karen Barad, I want to analyse how games allow us to perceive alternative ecological ideas.

As stated earlier, environmental studies of games share traits with the media ecology of McLuhan and Postman. My project focuses on the form of videogames, rather than the content. I do not dedicate a great deal of analysis on images or narratives of games. Rather, I focus on analysing the characteristics of the games I have chosen that define them as a medium. Explicitly, in my case studies I explore how source code or game mechanics shape relationships, be that with their players, hardware, other lines of source code or an amalgamation of the above. Bogost, Montfort and Consalvo, through their studies of videogame code and platforms have already made some of the first steps in this direction. Code and platform studies encourage me to approach videogames as amalgams of code and hardware, looking beyond their visual or narrative aspects. This approach provides a distinct way to appreciate the ecological formal properties of videogames; it allows us to see how videogames are ecological, rather than how they represent the ecological.

Of course, the videogames I approach in my later chapters remain, undeniably, 'games.' As such, I will not overlook the current ludic approaches to videogame ecosystem but instead use them to inform my understanding. The variety of studies from authors such as Thomas Apperley, Michael Nitsche and Alex Stockburger provide an insight into how videogame ecologies can be understood spatially. The notion that there are specific different 'spaces' involved in playing games such as 'game space', 'narrative space' and 'code space', plays a particular role in Chapter 5 where I discuss videogames and affect. However, my project

furthers this work, fortifying it with media ecological and material understandings to place greater focus on the often overlooked areas of space these authors have previously defined.

The posthuman studies of videogames crosses into many of the areas previously listed. As addressed by Giddings, Edmund Chang and others previously, videogames present us with easy to understand instances of being cyborgs, or of engagement with non-human actors. At the same time, however, the posthuman focus also plays into ecocritical, media-ecological and ludic approaches to game ecologies. In each of these approaches, a scholaraly emphasis is placed on engaging with the notion of 'the human', questioning the role it plays and the shape it takes. In ecocritical studies this lineage is well established as it is common practice to sideline anthropocentric interests in ecocritical readings in favour of foregrounding environments. Media-ecology, particularly when approached from a European perspective, is often openly posthuman, focusing on qualities of objects over their cultural reception. Similarly, in analysing the spaces of games, the elements that allow videogames to take place beyond human agency, there is a tacit decentring of the human. As such, it is the posthuman approach to games that truly ties together the various ecological approaches I have presented in this chapter; though each have their own specific goals, there is an implied consensus that focusing on the human impact alone is not currently of key importance when considering videogames as ecological.

Though the bulk of this scholarship that forms the basis for my own inquiry criss-cross in intriguing ways, these ideas do not fit easily together. For instance, attempting to marry ecocritical desires for more accurate representations of 'so-called natural' ecologies with media-ecological or particular posthuman aspirations of side-lining biological actors in favour of a focus on machines, could result in overlooking many of the nuances that make these theoretical approaches unique. The friction they generate has prompted me to seek an academic salve, for lack of better word, to smooth the intersections of this thinking. Though I have mentioned Barad before, it is her work, that shall be read in detail in the following chapter, that will play this part. Appropriating elements from Barad's writing, such as her agential realist ontology (explained in detail later), allows these distinct theoretical approaches to coalesce into a cohesive ecological theory of videogames.

Reflecting on how each of the various theories discussed in this chapter can form a cohesive

whole, I borrow from Jaime Banks who suggests that we should endeavour to discover the "micro-, meso- and macro-" levels of videogame relationships.[159] This is the challenge that I endeavour to seize upon throughout this work where the microscopic actions of the processors will be brought to bear on the meso levels of moment to moment interactions between players and their games while paying attention to how these form the macro scale conceptions of games within society. Importantly, however, this relationship is understood as non-linear and non-hierarchical, differing wildly from iteration to iteration of a game, as performance, as experience. This chapter has outlined the existing major contributions to ecological videogame studies. As I have outlined, the major areas of research as I see them consist of ecocritical, media ecological, eco-spatial and posthuman approaches to analysing videogame ecologies. Of these distinct threads, it is my desire to create a through line, putting each, to varying extents, in conversation with the others. It is worth noting, however, that in my hope to create a more holistic ecological framework for analysing games, there is a risk of overlooking some of the nuances of particular theories. As such, I endeavour to formulate a methodology that allows me to engage with videogames while harmoniously engaging with the mainstay of the theory in this chapter. My chosen method, applying agential realism to an ecological purview, will be explained in depth in the following chapter.

[159] Jaime Banks, "Object-relation mapping".

Chapter 2: An Agential-Realist Method of Videogame Analysis

In this chapter I define my method for exploring videogame ecologies. As discussed in the previous chapter, existing literature does not adequately capture the scope and scale of the ecological nature of contemporary videogame play. As such, I will here employ the agential realist philosophy of Barad to develop an adequate lexicon to describe the complex inter-relations between humans and machines visible when observing gameplay. The vocabulary defined within this chapter forms the backbone to the remainder of this thesis. These terms are necessary to discuss the specific meeting of players and machines that I have identified as occurring when playing videogames. As discussed in my introduction, I am formulating an understanding of videogame play from a posthuman perspective, allow us to explore how the macro- is entwined with meso-levels of playing which are, in turn, entangled with microscopic activities.[160]

If we, for now, put aside questions of visuals, narratives and player experience, videogames can be viewed as complex electrical systems. Ernst writes that, beyond a certain level, a machine, "dissolves any semantically meaningful archival unit into discrete blocks of signals".[161] Videogames, at the level of machine action, are likewise free of the potential for semantic meaning. Nevertheless, these machine actions have real impacts on player lives. As such, if attempt to combine this anti-hermeneutic posthumanism, its roots in German media archaeology, with the work of N. Katherine Hayles, we can see human brain activity as a part of this combination of signals. Discussing the similarities and differences of human cognition and machine computation, Hayles concedes that, at a subatomic level at least, "one can claim that in this sense cognition is computational, even while conceding differences in embodiment and the integral relation between embodiment and human cognition".[162] Continuing in this posthuman vein, videogame play, by extension, can be seen as an entanglement of biological and mechanical processes. This view is contrary to a user/game relationship expressed in early game studies and allows us to consider the technological and biological web of process from

[160] Jaime Banks, "Object-relation mapping".
[161] Wolfgang Ernst, "Media Archaeography: Method and Machine versus History and Narrative of Media", in *Media Archaeology: Approaches, Applications, and Implications* (Berkeley: University of California Press, 2011), p. 243.
[162] N. Katherine Hayles, *My Mother was a Computer*, p. 217.

hardware activities to human emotional responses.

Typically, theories within media ecology have found ways to discuss human/machine relationships through metaphor. For example, Anna Munster discusses the entanglement of human and machine as similar to that of the cooking technique 'folding'. She uses the metaphor to build on the 'folding' discussed by both Deleuze and Leibniz focusing on the technique "so as to maintain something of their singular properties (which each brings to the other) *and* to combine them into a new consistency".[163] This image provides us with a corollary through which the understand as easily as possible the idea Munster is putting across, the fusion without sublimation of machine and biological body.

In contrast to this Barad's work goes a step beyond much that has come before. She forgoes metaphor and instead suggests a radical new ontology from which we can approach human/machine interactivity. In Barad's worldview no limits are placed on specific objects or entities. Rather, in place of assumed, materially distinct entities, the assumptions that inspire us to think of a human as materially separate from the food they eat, the clothes they wear, or even the machines they use, Barad instead suggests a new approach to objects. We can see them as only ever 'apparent objects' resulting from phenomena. She emphasises that 'things' are not reducible to fundamental, singular elements but instead differentially distinguished from their surrounding material environments through defining performative acts. Although not explicitly an 'ecological' theory, her work is, nevertheless, concerned with ideas of environmentalism and touches on aspect of Bruno Latour's work on ANT and Timothy Morton's extended ideas of ecology. Thinking through her agential-realist framework, wherein phenomena precedes objects, we are given an insight into a truly ecological theory in which all apparent 'things' are entangled, emerging into existence through co-operative acts of separation. These complex ideas will be unpacked below but suffice it to say, Barad's theory is of an impressively ecological scope.

Barad's philosophy allows me to explore videogames from the perspective I have suggested; rather than seeing games as pre-existing machines, subject to a pre-existing, controlling, human player, we can instead see a myriad of productive physical activity. This myriad is then

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[163] Anna Munster, *Materialising New Media: Embodiment in Information Aesthetics* (New Hampshire: Duke University College Press, 2006), p. 33

open to meaningful distinguishing performances of differentiation; through their engagement, humans and machines come to reveal themselves. Using Barad's philosophy the unique ecology of videogames can be seen as a process where human and machine activity are brought together; in a posthuman light, they can be viewed as equal without one *using* the other, only as allowing new outcomes. At the same time, it is also a process through which human and machine are, performatively, distinguished. Ultimately, Barad's work provides the terminology through which I can describe the ecology of videogame play as a posthuman, performative relationship in which human and machine activity function as equals to produce new and intriguing outcomes.

Structurally, this chapter will be predominantly spent adopting Barad's radical philosophy into a tool for my intended exploration of videogames. The objectives of this chapter are therefore straightforward: I will define Barad's theory in depth, defining two of the main terms used in her work, 'agential realism' and 'intra-action' in a way that is useful for my thesis. I will provide limited context, defining some of Barad's most important influences such Niels Bohr and feminist/posthuman theorists, Judith Butler and Haraway. I will unpack two examples from her work that each display a different use of her agential realist philosophy: an understanding of a specific phenomena and an exploration of a more widespread practice. From there I will delve into videogames. Using my approach to Barad's work I will discuss a small program I have written to discuss a particular element of videogame mechanics. I will display how the interlinked properties of software allow games to function only when they act in unison before discussing the implications of this observation. Finally, I will engage with classic game *Pac-Man* to provide insight into how the underlying ecology of game systems have an expansive reach.[164] In all, Barad's work allows me to engage with the specific ecology of videogames I have identified in a novel manner, encompassing the observations made about interlinked systems in media ecology studies with the far reaching implications of studies of videogames and the environment.

BARAD'S PHILOSOPHY

To provide some brief biographical detail, Karen Barad is a feminist philosopher, now known primarily for her take on agential realism and closely associated with the school of new materialism. Initially, however, Barad researched theoretical particle physics with early

[164] Toru Iwatani, *Pac-Man* [videogame] (Japan: Atari inc., Atari Arcade Machines, 1980).

publications including 'Minimal Lattice Theory in Fermions' in 1984. In 1988, Barad began to push her scientific work in physics towards the humanities with the publication of 'A Quantum Epistemology and its Impact on Our Understanding of Scientific Process'. Barad's 'quantum epistemology' has further taken shape from that point, growing into one of the defining features of her 2007 work *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. At its heart, Barad's work hinges upon her detailed understanding of the physical world at the quantum level. This is used to discuss the nature of scientific experimentation, unpicking common misunderstandings of certain well known thought experiments such as 'Schrodinger's Cat' and Heisenberg's 'Uncertainty Theorem'. Barad distances these popularly discussed scientific talking points from their popular understandings. Unpacking them, she explains their potential for a powerful impact on everyday notions of existence within a western liberal humanist tradition.

For instance, Barad dedicates several dozen pages to an extended exploration of Michael Frayn's play, *Copenhagen*, a fictional account of the reunion of Niels Bohr and Werner Heisenberg in 1941.[165] The crux of the play's action centres around the idea that 'we can (in theory) never know everything about human thinking'. Characters in the play remain 'uncertain' of each others' motivations and intentions. For instance, Bohr cannot be certain if or why Heisenberg may be planning to design an atom bomb for Hitler. Similarly, Heisenberg cannot even be sure of his own thoughts; why, for instance, did he come to Copenhagen? Barad is quick to clarify that while this makes for engaging drama, it has little to do with Heisenberg's theory of uncertainty. She writes,

> Frayn is not applying the Heisenberg uncertainty principle - which concerns the limits to our knowledge of the behavior of physical objects, like atoms or electrons - to the problem of what it is possible to know about human behavior; he is simply drawing a parallel. Using this analogy, Frayn moves rapidly from the realm of epistemology (questions about the nature of knowledge) to the domain of morality (questions about values), from the uncertainty of intentionality to the undecidability of moral issues. On the basis of his own uncertainty principle, he reasons, or perhaps moralizes, that because we can never really know why anyone does what he or she does, moral judgements lose their foundation.[166]

Frayn, Barad argues, creates his own 'uncertainty principle' which may or may not have

[165] Michael Frayn, *Copenhagen* (London: Methuen, 2016).
[166] Karen Barad, *Meeting the Universe Halfway*, p. 4.

scientific merit. It is clear, however, that the observations of the physicist Werner Heisenberg, namely that by using apparatuses to measure the momentum or location of minute amounts of matter, the same apparatus will yield unusual results about that matter's other properties, play very little part in Frayn's work.

Barad does not critique Frayn's play without reason. Rather, she wishes to use *Copenhagen* as an example of what she hopes *not* to do with her philosophy. Rather than using analogies, inspired by the work of physicists, to spur on analytical thinking and cross the gap between scientific discovery and common sense, Barad wishes to use as literal an understanding as possible from which to approach and actively queer understandings of everyday activities. She states, "I offer a rigorous examination and elaboration of the implications of Bohr's philosophy-physics (physics and philosophy were one practice for him, not two). I avoid using an analogical methodology; instead, I carefully identify, examine, explicate, and explore the philosophical issues".[167] This is crucial for understanding Barad's work and how it is that I desire to employ it.

It is not that Barad desires to draw parallels between the movement of atoms and the actions of people, or some such analogical, reductionist frame that has been attempted by science-inspired philosophers in the past. Rather, Barad believes it is crucial that we approach the issues of human life, the ethical dilemma's of the everyday, with a consideration of empirically observed physical reality. This does not mean, she clarifies, that "a meaningful answer to the questions about the relationship between science and ethics can be derived from what physics alone tell about the world. Physics can't be bootstrapped into giving a full account of the social world".[168] It is, however, crucial that we approach ethical considerations with a full understanding of our physical nature. In a similar vein, although I do not approach far ranging ethical issues as Barad, I wish to approach media from an equally materially informed perspective (indeed, I have attempted to frame my work in this way so far, speaking of videogames as performances as opposed to 'texts'). Her philosophy opens the door to viewing videogame play as a process without recourse to loaded terminology such as, 'the human' or 'the machine'. Rather looking at processes in their most basic state, sets us free to begin analysing human-computer interaction from a posthuman, materialist paradigm.

[167] Barad, p. 24.
[168] Barad, p. 24.

Barad's science-philosophy challenges the essentialist notion of the human subject according to humanist thinking. This is evident in Barad's criticism of Frayn's notions of intentionality and the human subject. Frayn, she reasons, is victim to the assumption that intentions are "preexisting determinate mental states of individual human beings".[169] She suggests, as an alternative, that human intentionality, and agency by extension, can be better conceived of as "a complex network of human and nonhuman agents, including historically specific sets of material conditions that exceed the traditional notion of the individual. Or perhaps it is less that there is an assemblage of agents than there is an entangled state of agencies".[170] Barad argues, exhaustively, that 'the human' does not exist as a discrete, indivisible, essential self, acting through their self-determination within a void. Rather, whatever a human may be, it is involved with an ongoing dance with the matter that surrounds it.

The assertion that there is no a priori 'human', challenges some of the fundamental assumptions of the humanist worldview. For instance, Cartesian notions of the 'internal' and 'external', of the 'real' versus the represented, of the knower and the known, cannot be possible when 'knowing' is a material property dependent on countless physical entities often not thought of as part of the human being. Barad instead encourages us towards a "healthy Cartesian doubt" and to break what is "simply a Cartesian habit of mind" by challenging the representationalist go-to of western philosophy.[171] Instead of accepting the human as a representation of the real we should think of the neurons, chemicals and tissues that enact the complex activity of brain processes, that produce and take away such feelings as thinking, knowing and self.

Representational, dichotomous habits of thought can be attributed to atomist thinking, fundamental to western philosophy, introduced by Democritus and vital for the development of scientific reason; the belief that "the properties of all things derive from the properties of the smallest unit - atoms".[172] Such thinking inspired the notion that there is something *beneath* what we can be observed; a 'real' or essential object. Following the discoveries made about the universe from quantum physics, however, we know the truth to be far more complex. She

[169] Barad, p. 23.
[170] Barad, p. 23.
[171] Barad, p. 49.
[172] Barad, p. 138.

writes, "the primary ontological unit is not independent objects with independently determinate boundaries and properties". Instead of an indivisible unit of existence, Barad argues that phenomena occur that produce what appear to be distinct entities, "phenomena do not merely mark the epistemological inseparability of observer and observed, or the results of measurements; rather, phenomena are the *ontological* inseparability of agentially intra-acting components".[173]

Though Barad uses scientific theories to question the efficacy of a work of literature and, later, to analyse social practices, it is important to note, her intention is not to bring the philosophy of science to bear the unenlightened humanities. Quite the opposite is true.

Establish Barad within the humanities tradition. Performativity. Practice.

Point out, however, that we cannot always mix and match her theories with others as Levi Bryant attempts to do.

Barad succeeds in challenging humanist traditions by formulating two substantial theoretical concepts: agential-realism and intra-action. Firstly, agential realism

> Rejects the notion of a correspondence relation between words and things and offers in its stead a causal explanation of how discursive practices are related to material phenomena. It does so by shifting the focus from the nature of representations (scientific and other) to the nature of discursive practices (including technoscientific ones), leaving in its wake the entire irrelevant debate between traditional forms of realism and social constructivism. Crucial to this theoretical framework is a strong commitment to accounting for the material nature of practices and how they come to matter.[174]

Agential realism is taking the stance that matter and meaning are intrinsically, causally related. It is a courageous leap into an unknown. It states that to act is to have impact on reality. It maintains that social constructs too are physical and they and their impact can be quantified. As stated before, this is a rejection of Cartesian dualisms or Kantian notions of noumenal/phenomenal distinctions.[175] Similarly, it is a rejection of 'things in themselves'. It is

[173] Barad, p. 33.
[174] Barad, p. 45.
[175] Barad, p. 128.

a novel ontology in which activity, action, is the basis of reality. This reality is not kept safely out of arms' reach by metaphysical distinctions. We are a part of it so much so that we cannot act outside of it.

Barad's thinking has roots in the work of numerous scholars but is, nevertheless, clearly distinct. Barad's realism is comparable to that of Nancy Cartwright and Ian Hacking's "realism about entities" in which we are urged to think of entities whose influence on the world is observable as real.[176] Similarly, it resonates with Latour who stresses that entities have variable ontology in relation to their stability. At the same time Haraway, who emphasises that it is the instability of an entity that allows us to be sure of their action within wider processes, can be seen as a corollary. That Haraway urges us to think of objects of knowledge, for instance, as capable of simultaneously being agents in the production of knowledge because of their indeterminate existence, seems to echo much of Barad's work. Ultimately, however, Barad's work rests on the notion that that direct engagement with the material world, the world-in-itself, is not only possible but constant. This is established through a thorough understanding of the technological means by which we attempt to understand the nature of our world.

Reading her agential philosophy provides in-depth accounts of the scientific activities that allow nature and culture to interact. Rather than suggesting a new means to understand the world, Barad suggests that by theorising we are already acting within the world; she states, "experimenting and theorising are dynamic practices that play a constitutive role in the production of objects and subjects and matter and meaning… theorising and experimenting are not about intervening (from outside) but about intra-acting from within, and as part of, the phenomena produced".[177] Distinct from theorists that attempt to define the nature of representation and our ability to intervene, Barad draws a line in the sand. Her contention is staggeringly bold; we do not exist outside of or beyond the touch of the world, attempting to find new ways to find it. We are entangled with the world already. Experimentation and theorising are both shared, discursive material practices between human and non-human.

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[176] Ian Hacking, *Representing and Intervening: Introductory Topics in the Philosophy of Natural Science* (London: Cambridge University Press, 1983), p. 28.
[177] Barad, 56.

Understanding the chief inspiration for Barad's radical new materialism makes it much easier to grasp. Her challenging centuries of accepted thought is not done on a whim. Rather, it is through a deep appreciation, understanding and somewhat controversial interpretation of the work of Niels Bohr that she has come to her conclusions. In particular, Barad is inspired by Bohr's Nobel Prize-winning (and now, somewhat obsolete) model of the atom. In Bohr's model the atom appears to have similar properties to planets in orbit around a sun. A central nucleus is surrounded by a discrete set of electrons that move in concentric motions around it. This model, one that so closely resembles a 'little solar-system' has been superseded by the more broad and less intuitive quantum shell model. However, Barad uses this model, and a selection of Bohr's other work, to argue one point brilliantly well; because of its lack of solidity, because the atom is an apparatus composed of distinct entities, it implies that "things do not have inherently determinate boundaries or properties".[178] In Bohr's model, and in subsequent developments of theoretical physics, the atom is not a solid entity but a porous group of various forces: protrons, neutrons and electrons, each engaged in an activity that requires the others. The exact 'limits' of the atom, where it stops, where it begins, are never completely clear. Extending this understanding of the matter previously understood to be the fundamental building block of life to entities larger than it, to the scale of humans and their machines, is a fascinating position, one which, Barad urges, must be taken; what are the limits of an apparatus and how do we find them? It inspires divergence from the atomist worldview that inspired representationalism, metaphysical individualism and essentialist humanism:

> Bohr's naturalist commitment to understanding both the nature of nature and the nature of science according to what our best scientific theories tell us led him to what he took to be the heart of the lesson of quantum physics: we are a part of that nature that we seek to understand. Bohr argues that scientific practices must therefore be understood as interactions among component parts of nature and that our ability to understand the world hinges on our taking account of the fact that our knowledgemaking practices are social-material enactments that contribute to, and are a part of, the phenomena we describe.[179]

Although revolutionary in the 1920's, challenging Newtonian physics, Barad reminds us that Bohr's work was far from posthuman. It is Barad, not Bohr who uses the atomic model to radically queer the suppositions of human singularity. With alarming certainty, Bohr declared that an apparatuses are "macroscopic arrangements through which particular concepts are

[178] Barad, p. 138.
[179] Barad, p. 26.

given definition, to the exclusion of others, and through which particular phenomena with particular determinate physical properties are produced".[180] These criteria are initially inspiring as they seem to account for the entangled relationships of the experimenter and the machines through which they experiment; the combined observer and observed, subject and object. However, for Bohr, only "concepts defined by their specific embodiment as part of the material arrangement - which includes instrumentation (e.g. photographic plates, pointers, or digital readout devices) that marks definite values of the specifically defined properties and can be read by a human observer - are meaningful".[181] With these assertions, Barad affirms, Bohr "overshoots his mark and places the human not merely back in the picture where he or she belongs, but at the centre of all that is".[182] Bohr's unfortunate wording implies that the experimenter takes on the role of recording some supposed objective data, confirmed by an envisaged scientific machine in the form of a closed apparatus. She confirms, as does Hacking, that Bohr "cuts the apparatus off from all the activities that enable experimental practice to work".[183]

Barad, therefore suggests that we approach Bohr's work with a more open, agential realist, frame of mind. Instead of limiting the apparatus to being read by the human, of objective data to be 'discovered' by the inquisitive, exceptional mind, we must instead understand that "apparatuses are the material conditions of possibility and impossibility of mattering; they enact what matters and what is excluded from mattering".[184] Apparatuses are performative and productive meetings in which matter generates characteristics and can appear and act as an object. I suggest that we begin to see videogames and videogame play as precisely this way.

The 'agential realist' framework is one in which we co-opt a post-Bohrian view of the universe and abandon ideas of bodily boundaries. Apparatuses, as understood by Barad, are meetings that produce the apparent matter of the universe. Barad dubs this productive collision of non-pre-existing entities, this specific entanglement and re-arrangement, "intra-action". Intra-activity is the second crucial tool within her philosophy and forms the basis from which I will attempt to understand the ecology of videogame play. As stated, Barad finds Bohr's

[180] Barad, p. 142.
[181] Barad, p. 143.
[182] Barad, p. 143.
[183] Barad, p. 144.
[184] Barad, p. 148

worldview to be problematically humanist. In an attempt to rectify this, she looks to form a posthuman performative practice based on material-discursive practices as formulated by Foucault and, much more consequentially, Butler. Butler builds on the notion that "Foucault points out that juridical systems of power *produce* the subjects they subsequently come to represent".[185] That subjects do not act separately from the discourses of power they are operating within. Barad refines Butler and Foucault's work and concretely defines the notion of 'discursive practices' both authors allude to, as those "sociohistorical material conditions that enable and constrain disciplinary knowledge practices such as speaking, writing, thinking, calculating, measuring, filtering and concentrating".[186] They are the actual, historical, social conditions that define what is/was culturally possible at a given time. She highlights how this concept then "resonates" with Bohr's account of apparatuses: just like Bohr's account, we can see how discursive practices can be open-ended material apparatuses. Through this working, Barad extends Bohr's notions to social constructs, not just scientific apparatuses. Discursive practices become:

> The specific material (re)configurings of the world through which the determination of boundaries, properties and meanings is differentially enacted […] they are casual intra-actions – they enact causal structures through which some components of the phenomenon are marked by other components in their differential articulation… 'things' don't pre-exist; they are agentially enacted and become determinately bounded and propertied within phenomena. Outside particular agential intra-actions, 'words' and 'things' are indeterminate.[187]

Intra-actions resonate with the previously discussed theoretical ideas but are nonetheless distinct. In the agential-realist view they are the causal events that continuously (re)form the material world. However, they are not separate from the material world. They are not epiphenomenal. Through intra-acting, what we commonly perceive as 'things' come to be. Perception, from an intra-active perspective, is the phenomenon that shapes the apparent actor in relation to what it is observing. So far, intra-actions are similar to the assemblages in the sense that Bohr hinted at, and similar to the discursive practices following the language of Butler and Foucault. However, they are also, crucially distinct. Intra-activity does not need the human observer identified in Barad's reading of Bohr. Further, intra-action is an entirely material, activity of worldly matter. There is no Kantian noumenal/phenomenal distinction at

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[185] Judith Butler, *Gender Trouble: Feminisim and the Subversion of Identity* (London: Routledge, 1990), p. 342.
[186] Barad, p. 147.
[187] Barad, p. 149.

play here.[188] Nor is intra-activity simply a reinvigorated social constructivism. To understand intra-activity as Barad proposes it, hangs on our ability to accept phenomena as material processes that underpin only apparent objects.

Returning to focus on videogames and play, accepting intra-activity marks a departure from 'interactivity'. Accepting Barad's framework, putting it to use for my own theoretical ends, we depart from seeing play as activity conducted between multiple independently determinate objects. Interaction, instead, takes place in a reality in which "distinct entities do not precede but rather emerge through their intra-action".[189] Play, we can see, is just another name for the productive processes through which bodies perform an apparent existence. Although Barad focuses on the minute scale of quantum physics these performances still influence a more 'classical' scale. In play, individual identities are often suspended or pushed to their limits - like children playing make believe as noted by Roger Caillois.[190] Even if we don't play along, we are still defining ourselves in some way. Interaction is not the passive act of a set form. It is the refining or even the creation of unstable and permeable bodies.

Barad puts her theories into action through an array of engaging examples. Some these elaborate on how her theories of emergent properties apply to scientific experimentation; one of the major inspirations on her thinking. The example of Otto Stern and Walther Gerlach's demonstration of space quantisation is provided to show how seemingly innate objects are not passive in the formation of knowledge. While the complexities of the experiment are not necessary to explain here, the central idea was to "use a beam of silver atoms and an external field configuration such that the two possible orientations of the electrons orbiting the nucleus of the silver atoms would follow separate paths… in other words, the beam of atoms would be split in two, leaving separate traces on the detecting screen, which was a glass plate".[191] Although the tests were initially unsuccessful, when Stern held the glass plate in his hands, his breath, sulfuric from having smoked a cheap cigar, turned the nearly invisible silver traces into jet black silver sulfide traces. Barad points out a few key factors of this story that are rarely given the attention they deserve; firstly, the idea came to Stern one morning when he was too

[188] Barad, p. 128.
[189] Barad, p. 33.
[190] "In children, as soon as the personality begins to assert itself, and before the emergence of regulated competition, unusual challenges are frequent", Roger Caillois, *Man, Play and Games* (Chicago: University of Illinois Press, 2001 [first published as *Les Jeux et les hommes*, 1958]), p. 16.
[191] Barad, p. 163.

cold to get out of bed; secondly, it is important to note that "not any cigar will do".[192] Stern was, at that time, the equivalent of an assistant-professor and could not afford adequate heating or good cigars. The cold of his living quarters provided him time to think while the 'bad cigars' he smoked contained a lot of sulfur which acted as a catalyst. What's more, Barad notes, that the experiment, although often stated in a 'push a button and note what happens' format, has only recently been recounted in its current, complex form. Above all, it has only recently come to light that what they had discovered was not 'space quantisation' at all, but rather the idea of electron spin.[193] Scientific experiments are not passive discoveries. They involve the lives of those who enact them and are subject to a constant, active web of re-interpretation. Seeing experiments as Barad does opens us to a world of ecological considerations where moments such as the Stern-Gerlach experiment is only one instance along a long line of instances involved in a web of material activity.

Barad also provides examples from elsewhere, to explore the potential of intra-activity to discuss how human lives are continually produced by their environments. She draws on Leela Fernandes' analysis of the Calcutta jute mill.[194] Barad argues that "ideas of political economy and cultural identity are inseparable".[195] Taking in the depth of Fernandes' remarkable study that outlines the particular conditions of mills, Barad finds that "while the mill is perhaps most obviously an ongoing process of the materialisation of capital, the iterative materialisation of the mill is also the outcome of the exclusionary practices of the workers themselves, but not via some linear additive dynamics… structures are themselves material-discursive phenomena that are produced through the intra-action of specific apparatuses of bodily production marked by exclusions".[196] I take Barad's words to mean that while we can accept a Foucauldian idea of space delineated by capitalist structural practices, we must also understand that these practices are brought to life by the bodies that enact them in a microcosmic manner. The machines, whether these are in the literal sense or the socio-political sense, we are engaged with come to shape us but only through our intra-action with them. In doing so, we too have shaped the machines as they have come to take a specific role in our apparatus. The cigar is no longer a cigar but a scientific instrument. The labourer is no longer a labourer but an

[192] Barad, p. 167.
[193] Barad, p. 166.
[194] Leela Fernandes, *Producing Workers: The Politics of Gender, Class, and Culture in the Calcutta Jute Mills* (Philadelphia: University of Pennsylvania Press, 1997).
[195] Barad, p. 226.
[196] Barad, p. 237.

instrument of social control. Extending this to my own means then, we must draw a line in the sand and stop envisioning a 'player' prior to act of gameplay. Rather, we can see a vital, volatile, active property that shapes and is shaped by the combined act of play itself.

The radical departure from social-constructivist ontology marks Barad's theories of agential realism and intra-action as specifically 'posthuman'. Her definition of this contested term emerges from, but is distinct to, popular feminist posthuman texts. Certainly, she takes influence from Haraway's discussion of human difference.[197] It is familiar with Hayle's notions of intelligence being material and physically embodied (though, for Hayles, still dissected into terms of the enacted versus the represented).[198] However, her work remains distinct. She writes, "I am not interested in postmodernist celebrations (or demonisations) of the posthuman as living testimonies to the death of the human, nor as the next stage of Man".[199] Barad makes plain that her posthumanism is not just a critical device or a celebration of ensuing transhumanism and technological body modification: "no uncritical embrace of the cyborg as the ironic liberatory saviour is at issue here".[200] Rather, Barad's posthumanism is, in a way, more basic; more fundamental. Barad takes reality at face value; but does so with enormous theoretical ramifications. She explains,

> Posthumanism, as I intend it here, is not calibrated to the human; on the contrary, it is about taking issue with human exceptionalism while being accountable for the role we play in the differential constitution and differential positioning of the human among other creatures… Posthumanism does not presume that man is the measure of all things. It is not held captive to the distance scale of the human but rather is attentive to the practices by which scale is produced… Posthumanism doesn't presume the separateness of any- 'thing,' let alone the alleged spatial, ontological and epistemological distinction that sets humans apart.[201]

Barad's distinct posthumanism is one of the most significant reasons for my using it to analyse videogames. Barad's theory destroys conventional notions of the human 'player' as imagined

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[197] Donna Haraway suggests that the idea of the interference pattern caused by diffracting light is a more suitable notion for considering notions such as difference and similarity between humans and other beings. She notes, "diffraction is a mapping of interference, not replication, reflection, or reproduction. A diffraction pattern does not map where differences appear, but rather maps where the effects of difference appear". Donna Haraway, "The Promises of Monsters: A Regenerative Politics for Inappropriate/d Others," in Lawrence Grossberg, Cary Nelson, Paula A Treichler (eds), *Cultural Studies* (New York; Routledge, 1992), p. 300, pp. 295-337.
[198] N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature and Informatics* (London: University of Chicago Press, 1999), p. xiv.
[199] Barad, p. 136.
[200] Barad, p. 136.
[201] Barad, p. 136.

in game studies, towards and beyond the approach adopted in some forms of human-computer interaction studies. For instance, game studies scholar on narratives and emotion, Katherine Isbister writes, "Avatars and NPC's allow players to identify and engage in new ways, awakening different kinds of emotions".[202] Isbister's writing assumes the fixity of both the human and the machine; that one has the ability to elicit emotions in the other. In a similar manner, Alan Dix provides a more in-depth view of the user as an "information processing system" with limited memory, processing capacity, capabilities and affected by emotions.[203] Humans are conceived as static surfaces, primed to absorb information that exists prior to its consumption. This is not very different to Barad's description of Bohr's perception of scientific experiments. Data exists in the world and it is up to humans to discover it. To Isbister, and perhaps the majority of game studies scholars working outside of an agential realist ontology, games and the emotions they inspire exist, to be discovered. Working from the agential realist frame, no such presumptions can be made. Humans are not privileged systems, able to discern and bring forth meaning. Instead, we can say that the phenomenon of gameplay comes first and produces distinct experiences. Given the vast potential of videogames particularly to provide unique experiences, this posthuman perspective makes sense.[204] This allows an investigation of games at a much deeper level than the one at which games studies currently operates; an exploration of games as ecological entanglements that produce specific outcomes only through the cooperation of forces at a minute, physical level.

Applying Barad's framework to questions of interaction, aesthetics and affect is a radical undertaking for videogame analysis, even to other posthumanist scholars. The most substantial difference is the 'materialism' that underpins Barad's thought, going against the Cartesian, representationalist trend of the majority of posthuman scholars. However, Barad's posthuman frame suggests a further departure. Rather than seeing 'the human' as radically altered or influenced by 'machines' Barad dissolves these distinct entities and promotes a quantum performative ontology. For instance, Hayles conceives of humans playing electronic texts as "the existence of entangled dynamic heterarchies binding together humans and intelligent

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[202] Katherine Isbister, *How Games Move Us: Emotion by Design* (London: MIT Press, 2016), p. 14.
[203] Alan Dix, *Human Computer Interaction, 3rd Edition* (Essex: Pearson Education, 2004), p. 12.
[204] Janet Murray coined the term "multiform story" to describe the vast array of potential experiences a single videogame can yield due to the potential for difference in the specific manner individuals play. Importantly, resonating with Barad's work, she notes, "part of the impetus behind the growth of the multiform story is the dizzying physics of the twentieth century, which has told us that our common perceptions of time and space are not the absolute truths we had been assuming them to be". Janet Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (London: The Free Press, 1997), p. 34.

machines".[205] By the same token, Munster posits the "translation of the continuity of embodied experience into a discontinuous code".[206] Working within Barad's proposed purview, there is no 'binding together' no 'translation' from one form of 'human' to another. Indeed, conceiving of a pre-existing 'human' that could be influenced becomes absurd. Within an agential realist paradigm, the 'human' is like a hydrogen molecule that existed before a proton came to balance its nucleus. Instead of thinking of a before and after, of transition and change from one solid state to another, we must accept that 'the human' is an always unstable, ongoing physical process. While there may seem to be little distinction between Barad's proposal and the entangled systems Hayles envisions, the difference is substantial.

My ecological perspective of game play is guided by the phenomenal principles of an agential realist world view. It does not assume the pre-existence of entities, even entities conceived of as systems. Rather, complex systems are produced by their intra-activity; a process that both reveals the lack of boundaries of apparent objects and enforces them. Unlike, as Hayles suggests, the nature of the machines we use have the potential to shape 'us', to produce a "co-evolution", I am suggesting that we are only ever what we are because of our interactions.[207] There is no 'us' to be shaped.

My formulation may initially appear as an argument that biological and technological entities are materially indistinct. However, when followed through, it actually provides a basis for 'the human' and 'the machine' to continuously emerge, clarified and distinguished by the means for that very emergence. Videogame play becomes a material-discursive practice that allows us to become one with but also distinct from the machines we use. Fundamental to this notion is the idea of the 'agential cut' that shall be discussed in the final study. She writes, "the larger material arrangement enacts a cut that resolves the inherent ontic-semantic indeterminacy through which the "subject" and the "object" emerge".[208] To my mind, in videogame studies, the cut represents the feeling of pressing buttons and feeling them whole and solid in your hands. The cut is the moment where the indeterminacy of play as 'intra-action', the fusion of human/machine, becomes mere interaction once again. Though I will add depth to my

[205] N. Katherine Hayles, *Electronic Literature: New Horizons for the Literary* (Indianna: University of Notre Dame, 2008), p. 59.
[206] Munster, *Materialising New Media*, p. 148.
[207] N. Katherine Hayles, *My Mother was a Computer*, p. 31.
[208] Barad, *Meeting the Universe Halfway*, p. 143.

understanding and application of the cut, for now it is important to note only to clarify my understanding of apparent objects in an agential-realist world.

Accepting the terms of Barad's theory we are invited to marvel at our place in the universe. My intention is a humble contribution towards that goal. Videogames, as I see them, are ecological processes that, when examined in depth, resonate particularly well with the agential realist worldview. As I will exemplify in detail shortly, if we cease to look at games as narrative texts or as visual art but instead as Baradian 'arrangements', they give themselves up for fruitful analysis. Their myriad processes but seemingly singular existences suggest a core tension of intra-activity. Videogames provide helpful insights into how entangled processes can come to be productive. Although, within this agential realist account, we accept that what is produced are processes still, they are the processes of creating numerous potential feelings. Seeing videogames as ecological systems within agential reality reframes interaction as intra-active, material-discursive practices that produce the players we are and the games we play.

VIDEOGAME ECOLOGIES AND INTRA-ACTION

Barad's writing allows an innovative approach to understanding the specific ecology present in digital games. To explore this statement, let's start small. I want to focus on an element of gameplay: the movement of videogame sprites through game worlds. This is a familiar concept that takes on many guises. Mario's movement through the 'Mushroom Kingdom', for instance, or the falling of a Tetris-block. However, I do not want to focus too much on the visual impact of this process. Although it may have a very different impact on a viewer to see Mario's tiny body move rapidly over some green pipes than seeing the slowly descending block they desire in a heated puzzle-game, my focus lies elsewhere. I want to look at a program that allows movement to take place. As such, I have made a very simple game and included the code in its entirety at the end of this thesis. It's not an advanced game; there are no objectives and no fancy graphics. It's a simple collection of code that produces a process familiar to everyone: moving objects around the screen. The point of this program, however, is to illustrate that even the simplest of actions within a videogame world is the process of many entangled systems, actively producing outcomes. The point of this small program is to highlight the ecological nature of even the simplest videogame.

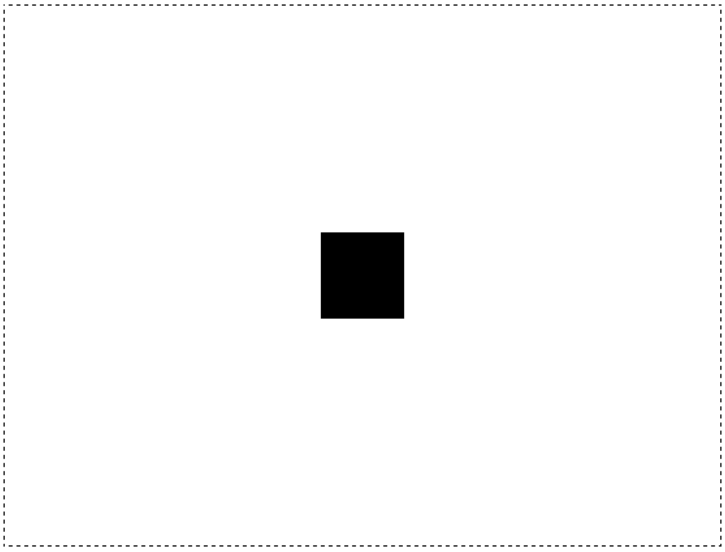

Figure 1: A very simple game

You would be forgiven for thinking that it was just an image of a square - it is just an image of a square - but underneath the image are a few simple lines of code that allow movement. Pressing the up, down, left and right keys on the keyboard, the black square can be moved around a space.

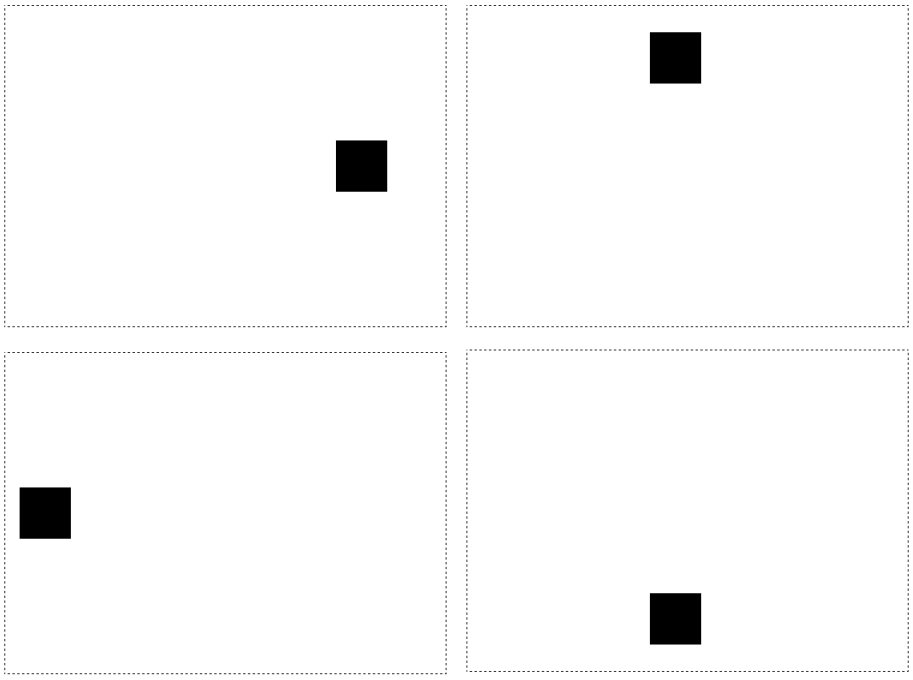

Figure 2: Still a very simple game

If we were to try to describe my very simple game in terms familiar to games studies, it would likely be, ‘a black square that can be moved around a white space.’ While there are certain

omissions being made here for time, the implications of using such language to explain games speaks to the current ontological paradigm in which games studies most commonly operates. I want to look closer at exactly what processes are allowing our so called 'black square' to 'move' within the 'white space'. I want to do that by examining snippets of code in some detail.

Let's begin with the black square itself. How is the image displayed on screen? This may seem a banal question but the answer yields a level of complexity that is often overlooked in games studies and is essential to my agential realist understanding of games. The image is a very simple block of data, 239 bytes to be exact, that tells the computer to display 64x64 pixels as black on whatever screen it may be connected to. It is called to the 'game' with a simple command: "`image.src = "blacksquare.png";`".[209]

It is tempting to think that 'blacksquare.png' is *the* image we want to call forth for our game. Like a photograph kept in a drawer, we want to pretend that the computer has our image stored away somewhere and it can call it up whenever it needs to. The reality is not so simple but perhaps just as easy to understand. In reality, the black square is only a continuous process. This is made more clear when we start to consider that the line of code above would not function without some accompanying lines:

```
var image = new Image();
image.addEventListener("load", loadHandler, false);
image.src = "blacksquare.png";
```

Before the image can be called into the game it must first be made clear within the syntax of the program that the process of displaying the image will take place. The program will load the image specified. This allows any pixels within that image to be called on demand when needed. This is important when we consider that the black square would *still* not be displayed if we do not first declare that we want to create a digital object, of which the image will only be a part. To do this, we need to first create a code that will specify what properties we want our object to be able to have. As we are creating a simple an object as possible, we will want an object that draws from our source image from the most basic starting point, takes only what

[209] I wrote this particular game in the easy to use javascript language. All the commands are specific to that language.

it needs from that image, is of a similar height to what it draws from and is displayed in a sensible place on screen.

```
var spriteObject =
 {sourceX: 0, sourceY: 0, sourceWidth: 64, sourceHeight:
64, x: 0, y: 0, width: 64, height: 64, vx: 0, vy: 0 };
var bs = Object.create(spriteObject);
bs.x = 243;
bs.y = 168;
var image = new Image();
image.addEventListener("load", loadHandler, false);
image.src = "blacksquare.png";
```

Our code is quickly becoming long winded and we haven't yet been able to display the square! Unfortunately, before we can display the black square, there are still further complications. As I said, to display our square we must first make it clear to the machine that there is a digital object, shown above as '`var bs`', with specific properties. As you may have notice, '`var bs`' uses the function, '`Object.create (spriteObject)`' as part of its properties. This means that our black square, is actually a digital object but one that uses another digital object, this time a function, as part of itself. '`Object.create (spriteObject)`' is a sort of template that generates an empty object with a number of holders for characteristics. It generates an empty digital object that can take up space on screen. The specifics of the object, however, must be generated later in the program. Only once the image, the digital object and the function are in place can we place the object on screen. There is, however, another complication. Although this information will pass data between programs, it will not display it to an external user. To achieve this, we must first specify a 'renderer' for the program to use. In this instance, because of the simple 2D nature of the program, the renderer is the simplistic 2D renderer that does not calculate vectors in three dimensions.[210] Adding this renderer to the equation, that creates a total web of the image becoming an object, dependent on a function and output by a renderer. In short, then, even in a piece of software this simplistic, no piece of code is an entity in its own right. It exists only as part of a process. Writing code for games is writing for a machine that is constantly processing information and never static.

Now that our black square has been displayed, we come to the process of actually 'moving' the square around the screen. Here again, videogames - even as simple as this - seem to enact

[210] For brevity, I have excluded the renderer from the main body and restricted it to the appendix of the thesis.

the agential realist world Barad describes. Within the movement script of the object there is a host of simple mathematics. For every clock cycle completed, if the a particular button is detected as being depressed, 5 pixels are added to the location of the black square. This is achieved by adding or subtracting a number to the 'velocity' variable of the square and then adding that variable to the position. For example:

```
//Moving left
if(moveLeft && !moveRight)
{
bs.vx =- 5;
}
//Adding the velocity and the position of the black
square
bs.x += bs.vx;
```

This information must be passed to the renderer and the object must be 'updated', placing the object on its new position. This updating of information takes place within an 'animation loop'. The first step of this loop, before updating any objects, is to clear the digital space of any information displayed in the last frame. Without doing this, the objects on screen would not appear to move but would instead appear to grow - like strokes from a paintbrush (a hint as to why you may not want to select this option!). At the same time, it is important to note that this is not just any animation loop. This is a specific type of animation known as '`requestAnimationFrame`'. Developed in 2011 by designer Paul Irish it replaces animation using the idea of a fixed frame rate with a less resource hungry process of developing new frames only when the machine can. I will discuss the implication of '`requestAnimationFrame`' being designed by a specific designer later in this chapter. But for now it is important to understand that what is often said to be 'moving' a character in a game, in our case, moving the black square across the screen, can instead be conceived of as a process of erasing, calculating and updating new data.

Examining game processes at this level of detail brings into focus the complex entanglement of code programs, particularly videogames, are comprised of. The specific ecology I have been attempting to pinpoint is beginning to come into view. However, this entanglement has powerful implications. When viewed from a Baradian perspective, videogames are examples of intra-activity at work. To engage with this we must first stop seeing the many seemingly

distinct elements of a phenomenon as separate and existing prior to the activity in question. Then, we can begin instead to see those parts as seemingly 'produced' by the phenomenon itself. Although the various lines of code appear separate, they function only as part of a whole and would have different outcomes were they placed together differently. The outcome of this program, that of the 'black square' 'moving' across the screen, is determined by the intra-activity of the various computational processes these lines of code instantiate.

Each line of the code of this simple program is required. If one is removed, the code will not run at all. At the same time, each line actively calls upon a host of other processes. As they clash, entangle and produce their novel formations, they produce apparent entities (the 'black square' and its 'movement'). What's more, although the program was written by me, it takes on a performative role when the program is engaged: for instance, the variable for velocity changes in response to the push of any of the keyboard buttons. This variable then influences the variable for position and so on. What's more, these variables are only iterations of a different, base, digital object, defined but not given specific characteristics at the beginning of the program. As code is executed, phenomena take place and entities are produced at a rapid pace. This calls to mind exactly what Barad's ontology is asking us to come to terms with: "distinct entities do not precede but rather emerge through their intra-action".[211] At the most basic, there is no singular line of code that either *represents* or *is* the 'black square'. The 'black square' is an ongoing material production, a phenomenon, of the active coming together of an array of machine processes. This is precisely the ecological activity I believe must be focused on when analysing a videogame and the first prominent conclusion of this exploration.

When examined under close scrutiny there is a productive resonance between the simple program I have created and Barad's explanation of the Stern and Gerlach experiment. In the Stern and Gerlach experiment, as mentioned previously, the silver particles of the beam, the silica of the glass and the sulphur of the cheap cigar, were all required to intra-actively produce the reaction witnessed by the scientists. What's more, the phenomenon asks us to question our understanding of 'things' as the 'sulphur' became sulphur oxide when it reacted with the silver. This shows the instability and potential for change in what we commonly assume are fixed entities. The phenomenon has also been re-evaluated as time has gone on as

[211] Barad, p. 33.

evidence of particle spin, not space quantisation. In a similar fashion, Paul Irish, the creator of the screen refresh protocol used for my small game above has no doubt had as much of an impact of his choice to become a programmer. In turn, his contributions to web development and computer engineering have had palpable effects on how world's programmers create online applications and what internet users expect of them. Barad's argument follows that phenomena, such as the Stern Gerlach experiment, are material performances that speak to the ever changing but highly entangled nature of this universe. Whether the phenomenon in question is a simple game or a physics defining experiment, examining it in this way brings to light complicated entanglements beneath the surface.

I have endeavoured to unpack the complex, entangled, performative existence that Barad highlights. Following that, I have shown how videogames, through their entangled nature as programs, typify many aspects of Barad's theory. Agential realism makes the important claim that objects do not pre-exist phenomena. This has powerful ramifications on game studies in which there are frequent discussions of, discussed in the introduction of this thesis, 'virtual worlds' or of games being 'half-real'. The complex materiality of game systems is too often overlooked in favour of an examination of surface aesthetics or else of rules from a representationalist stance. Applying an agential realist ontology to game studies encourages us to deal with the seemingly ephemeral nature of code and machine processes. It allows us to take a first look at the ecology of videogames.

EXPLORING GAMES WITH INTRA-ACTION

Having established that Barad's theories can drive a novel development in game studies, we can now dive a little into this agential approach. The previous example drew a parallel between Barad's theorising the experimental apparatus and the videogame system. In the following example I want to extend Barad's analysis of discursive practices to gameplay. An agential realist approach reveals the videogame ecology in the way I suggested in the introduction to this thesis. Applied to a popular game, it opens a host of new and interesting questions. I am cautious, however, of analysing too complex a game too soon. An analysis of a game that uses now cutting-edge technology, globally interconnected servers or complicated system interactions such as WebGL graphics would needlessly over complicate my study at this stage. This is because my intra-active approach to videogames as ecological systems brings a myriad of specific machine properties and functions to the fore, entangled with a

variety of social factors. I want to restrict the number of factors as productively as possible to make my point as exhaustively as I can. As such, in the following section I will the look at the classic arcade game *Pac-Man*.

I want to ask an intentionally provocative question of *Pac-man*: what single aspect made the game so popular in 1980s USA? Was it some element of the code? Some distinctive piece of hardware? Was it the social conditions in America at the time? This question is, of course, a discursive conceit; I will ultimately conclude that it is not possible to answer this question in an uncomplicated manner. However, the conceit serves as a useful frame for an investigation that nevertheless reveals the ecosystem of complicated entanglements that produce and are produced by *Pac-man*. Ian Bogost conducts a very similar thought experiment using *E.T.: The Extra-terrestrial* in his object-oriented philosophical approach to games. He discusses *E.T.*'s hardware, its source code, the "RF modulations that result from user input and program flow".[212] However, Bogost concludes that "All of these sorts of being exist simultaneously with, yet independently from, one another. There is no one 'real' *E.T"*.[213] Reiterating what I stated in my introduction, this is precisely the interpretation of videogames that I am rallying against. The multiplicitous nature of videogames, existing as they do in simultaneous code, machine action and player experience, makes them ideal texts for such conclusions. However, this standpoint limits the extent to which we understand the entangled physicality of videogames as 'real'. Viewing them as ethereal, semi-entities stops us from appreciating their potential to make us aware of the complicated world we live in.

Counter to Bogost (and the object-oriented philosophical approach he represents) the ecological, agential agential realist approach I adopt suggests that *E.T.* and *Pac-Man* are all the things he mentions - and more - but in a very material, very 'real' way. When brought to America in 1980, compared to its moderate and slow success in Japan, *Pac-man* was overwhelmingly successful. The game earned more than 2.5 billion dollars and surpassed *Space Invaders* as the most popular arcade game of the era. The reception of the game was so explosive, *Pac-man* was converted into a wide range of merchandise including lunchboxes, shirts, posters, pop-songs and eventually a less successful television show.[214]Understanding

[212] Ian Bogost, *Alien Phenomenology: Or, What it's Like to be a Thing* (Minneapolis: University of Minnesota Press, 2012), p. 17.
[213] Ian Bogost, *Alien Phenomenology*, p. 18.
[214] Dustin Hansen, *Game On!: Video Game History from Pong and Pac-Man to Matio, Minecradt and More*

Pac-man as a vast ecology of entwined properties, what specific element made it such an enormous hit? A number of suggestions have been made attempting to explain *Pac-man*'s success. It has been suggested it may have been that it introduced a series of short intermission videos between levels; the birth of what are commonly known as in-game 'cut-scenes' today.[215] At the same time it has been suggested that "more important than the sheer amount of memory afforded by the arcade cabinet is how it was allocated and organised".[216] Although I have already stated that it is my intention to argue no single element can be given credit for its success it is still worth examining the vast network of features that make a popular videogame.

In attempting to answer exactly what element made *Pac-man* so popular at its time we are fortunate to have a wealth of research available. For instance, we know that *Pac-Man* was made by Toru Iwatani. We know that Iwatani was 27 at the time and that it was a mixture of adoration for Popeye and an encounter with a semi-eaten pizza that provided the inspiration for his lead character. We also know that Iwatani's cute, cartoonish and comparatively non-violent characters came as a reaction to then dominant sci-fi combat aesthetics. His rationale was that girls were just as viable a market for videogame design and that programmers should be attempting to attract them just as much as boys. This lead to the blatantly targeted sequel *Ms. Pac-Man* the following year (if only current generation designers felt the same way). That being said, however much is known about Iwatani and however much his personality impacted upon the final game, there is little ground to suggest that any of this could have been present within the experience enjoyed by players across the world. Pac-man doesn't really look like a pizza, has no association with pizza and, even if he did, it would be very difficult to substantiate claims that this had an impact on how players responded to the game. Once again, the personal touch of Iwatani cannot be discounted as a reason for the game's popularity but, again, it cannot be given any special status.

If the answer for popularity was not the guiding hand of an auteur, it may be of value to look at the system's hardware. To drawing on the media ecology theory that closed the previous chapter, Ernst states, "in a digital culture of apparent, virtual, immaterial realities, a reminder

(New York: Feiwel and Friends, 2016), p. 19.

[215] Geoff King, Tanya Krzywinska, *Screenplay: Cinema/Videogames/Interfaces* (London: Wallflower, 2002), p. 111.

[216] Ian Bogost, Nick Montfort, *Racing the Beam: Racing the Beam* (London: MIT Press, 2009) p. 68.

of the insistence and resistance of material worlds is indispensable, and all the more so from a media-theoretical point of view".[217] There is an important role to be played in placing a focus on hardware. Although tempting to think of the 'videogame' as divided by a noumenal/phenomenal distinction as Bogost suggests, a focus on hardware can serve as an important reminder of materiality.

In the case of the original 1980 *Pac-man* arcade cabinet, the custom made system board featured the Zilog Z80 processor that dominated the microprocessor market of the 1980's. In a running *Pac-man* arcade unit, the Z80-CPU completed three-hundred calculations a second (3mhz). These calculations were drawn from the main program data which was itself stored on two kilobytes of RAM. The Z80 processor did not work alone: the data for the game, formed of uncompiled assembly code, was stored on four, 4k RAM chips. The central processor and RAM worked together, driving the processes of the game forward. Three hundred times a second, therefore, a series of electrical impulses cycled through this machine. This electronic data processing resulted in manipulations of the electricity being supplied to the attached screen device. Unlike the state of the art 'requestAnimationFrame' mentioned earlier, a protocol that works from an assumed 60hz refresh rate and is even designed to function only when the advanced CPU is not completing other actions, the animation of *Pac-man* relied on comparatively straightforward digital-to-analogue processes. The on-screen animations were the result of electromagnetic impulses from the firing of a cathode ray tube, and special magnetic screen coatings. This resulted in a screen refresh rate closer to an approximate 24fps. 24 times a second, therefore, the 'beam' of the screen completed an entirely new image out of mechanical and electronic processes.

The exact game produced in 1980 would not have been possible without the array of various chips, transistors and capacitors that formed the motherboard of the original Pac-Man systems of the time. These specifically chosen components moulded the flow of electricity into the computable 8-bit bytes that corresponded with the Z80 architecture. Gameplay, viewed in this granular level of detail, is an undeniable performative practice - the impermanent meeting of an array of industries and technologies to create a specific phenomena at a moment in time. However, an enormous number of game systems from the 1980s up until the mid 90s used similar chips in a similar manner. The Z80 was the heart of the Sinclair spectrum, for instance,

[217] Wolfgang Ernst, *Digital Memory and the Archive* (Minneapolis: University of Minnesota Press, 2013), p. 43.

and even played a role in the Sega Megadrive and Master System. As such, while it is important to maintain a close eye on the hardware of the given system, to appreciate its complex materiality and exchanges of energy, it would be unwise to place undue attention on it.

Moving on from the hardware, the software of the game could also have played a central role. *Pac-Man*, although comparatively 'simple' compared to modern games is a remarkable achievement of early videogame programming. This process consisted of manipulating the restricted instruction set of the Z80. Through a combination of binary coding and clever use of the memory addresses available, an array of data representing on and off states came to represent 'ghosts' and 'pills' being eaten by the ever hungry 'puck man' (later shortened to 'Pac Man' in western releases). A particular achievement for the time were the uncommonly challenging four antagonist 'ghosts' with which they player competed. When the game begins the player is given a certain amount of time to navigate the Pac-Man, collecting all the yellow dots in the maze without making contact with one of the four 'ghosts'. Named Blinky, Pinky, Inky and Clyde, the four ghosts were each said to have their own 'personality' in the release notes, which in technical fact amounts to algorithmic processes. The first is perhaps to be expected - Blinky moves toward to the tile that Pac-Man currently occupies. It 'pursues' Pac-man directly but at 75% of player speed. The second ghost - Pinky - is similar, but instead moves to a space 4 tiles ahead of the direction of the moving Pac-Man. This, of course, means that the ghost will - if confronted head on - move away from Pac-Man.

The two patterns of movement were interpreted in the original game as personalities of determination on Blinky's part and cowardice on Pinky's part. Clyde's movement's were much the same but followed Pac-Man to within 8 spaces of his position, returning to its beginning tile if brought any closer, giving the characteristic of stupidity. The most interesting ghost of all, at least for my purposes here, is Inky. Inky's movement is determined by both Pac-Man and Blinky's location. The destination Inky heads towards each cycle is twice the vector distance between Blinky and a tile; the tile two spaces ahead of Pac-Man. At the time, very few games had such complex enemy behaviour; this undoubtedly added an element of novelty to the game system, but there is not enough evidence to suggest that this was a key reason why people of the time were so drawn to the game.

The more abstract realms of the game's setting and visuals, though still enjoyable to this day, are unlikely to have been much of a contributing factor. The layout is familiar: the player is greeted with a maze, itself a 28x33 equal tile grid - each tile comprised of 8-pixels - populated with 244 yellow dots. Mazes of this kind were not a large jump from the colourful world of *Galaxian* released the previous year.[218] The main character, a small, yellow, controllable entity (Pac-Man) was no huge departure from other games at the time. Players could move the puck-shaped protagonist around the visible space, pick up collectibles and devour their enemies. However, as *Space Invaders* had already been available for some time, very little of this would have seemed new to players. As an interesting quirk, when the player leaves the screen to one side they are said to 'loop around' appearing on the other side of the screen. Once again, this is just a manipulation of the numbers. At the same time, this technique had been established in *Asteroids* the previous year so this may have been unimpressive to some of the players at the time.[219]

Historical factors equally cannot be discounted when searching for reasons why *Pac-man* was so influential. For instance, another bestselling form of amusement in 1980's America was the Rubik's Cube. Just like playing the Rubik's cube, playing *Pac-man* is a material-discursive practice in the way that Barad suggests, "through which (ontic and semantic) boundaries are constituted".[220] The popularity of these entertainments let us know that there was a sizeable portion of the population with the ability to dedicate their time to these tasks. Looking into the wider discursive practices that produced the players of *Pac-man*, the American economy was yet to undergo the financial crash of 1982 and the American videogame industry in particular was still blossoming. The ingredients were still in place for the country's middle-class youth to have an excess of capital and free-time, allowing for co-mingling within American arcades. This likely accounted for some of the millions of quarters deposited into arcade machines in the years before the eventual videogame crash of the mid-1980s that saw companies like Atari turn their back on videogames. These social conditions, these discursive practices, played a role in producing the phenomenon that is *Pac-man*. The conditions can also allow us to surmise that the relatively affluent players of *Pac-man* were well off enough to afford to play the game; at the same time, however, they must have been either socially-inclined enough to

[218] Kazunori Sawano, *Galaxian* (Japan: Namco Midway, Arcade Cabinets, 1979).
[219] Lyle Rains, *Asteroids* (USA: Atari Inc., Arcade Cabinets, 1979).
[220] Barad, p. 141.

play the game in crowded arcade parlours, or else not wealthy enough to afford to purchase a home computer entertainment system to play the game at home. Adding this socio-economic element to the fray of what made *Pac-man* so popular introduces an array of new potential issues, such as the cost and availability of the japanese made machines against the American competition; a factor that would play into the ensuing financial collapse of the American games industry.

By now, the conceit of searching for a single element that 'made *Pac-man* so popular' should be tired out. My hope, however, is that the search has revealed the vast array of elements that are entangled into *Pac-man* as a phenomenon. Barad suggests in her analysis of Fernandes' work that "not only do the politics of space in the jute mill produce workers as appropriately disciplined subjects in intra-action with the ever-changing relations of power, but the spatiality of capitalism is itself produced through the politics of gender, community, and class and daily contests over the relations of power by those very subject".[221] As shown in my unpacking of the Stern Gerlach experiment, apparatuses connect and even produce a wealth of apparent entities, including the human activity seemingly guiding these activities. In reference to videogames, this is visible even in a piece of code, such as my short program examined above. When we begin to introduce society, such as in Barad's study of the jute industry or my exploration of *Pac-man* it quickly becomes clear that drawing the line around any system is a difficult task.

From an agential realist perspective, it would be foolish to suggest that any particular element could make any game successful. What's more, it would be foolish to suggest that any apparent element of the game preceded any other. The impact of the game at a specific moment in time, highlights how difficult it is to draw the line on a phenomenon, even one as apparently trivial as playing *Pac-Man*. In asking, 'what made the game so popular' it was my objective to point out that no single element preceded any other. The hardware of the game systems became entangled with a populous that was poised and ready for this specific kind of entertainment. Equally, Iwatani's vision of a specific game was, quite literally, 'engendered' by his identification of a gap in the market that was itself produced by gaming culture at that point.

[221] Barad, p. 236.

Barad highlights that "structures are apparatuses that contribute to the production of phenomena, but they must also be understood as thoroughly implicated in the dynamics of power: structures themselves are material-discursive phenomena".[222] The agential-realist vision allows us to tackle games from a brave new perspective; it encourages game studies scholars to embrace the difficulty of encompassing a broad range of practices within an umbrella term for a complicated system. This is precisely my vision of the 'videogame ecology'; a simultaneous collision of machine, biological and social activities producing specific, real entities within the world.

In this work I am combining a number of different academic disciplines and putting them into conversation through a discussion of videogames as intra-active processes: game studies, platform studies, media ecology and posthumanism are all equally influential but each only captures a small element of the vast number of processes that the umbrella term 'videogame' encompasses. As discussed throughout my literature review, there is a need for some extra element to smooth the gaps between these ways of thinking. When videogames are embraced as phenomena within an agential realist framework we accept that players, consoles, controllers, all objects, are themselves part of a vast material apparatus. Though existing posthuman and media ecological studies of games have been a dominant influence on this project, they fall short in capturing the broad implications of the influence that players and gaming machines have on each other. Though ideas such as Munster's 'enfolding' help us to theorise the contemporary human, they do not fully break from commonplace human notions such as the presumed fundamental existence of objects.

By integrating Barad's writing into established theories of interaction, aesthetics and affect, there is the potential to encourage game studies in new directions of posthuman analysis. The key point to bear in mind, however, is that what we think of as 'the human' cannot pre-exist the apparatus; "in summary, the primary ontological units are not 'things' but phenomena - dynamic topological reconfigurings/ entanglements/ relationalities/ (re)articulations of the world".[223] Bringing this belief to bear on contemporary analysis of videogame play, this ecological process is exposed as one of complex mattering, through the deeply entangled relationships of code, hardware and human. Games, I argue through this thesis, are powerful

[222] Barad, p. 237.
[223] Barad, p. 141.

instruments that help generate the enactment and experience of the complicated nature of our existence, as understood through the lens of agential realism. Through a game like *Shelter* (Chapter Three) we can come to realise that we are a part of a complex technological ecology. Through *Antichamber* (Chapter Four) we can take part in the quantum-weirdness of our existence. Through *That Dragon, Cancer* (Chapter Five) we can play with the methods through which subjectivity comes to limit our experience.

In the following chapter I discuss how an agential realist approach challenges current concepts of interaction, replacing them with intra-activity. This opens discussion even further, allowing me to elaborate on how games can represent this quality through their mechanics and aesthetics.

Chapter 3: From Interaction to Intra-action

In this chapter I utilise my ecological method of analysis to explore the independent, pastorally focused videogame, *Shelter*. In doing so, I challenge certain persistent notions of interaction in game studies scholarship; namely those that frame interaction as a human user manipulating software to suit their intentions. Building on this, I outline a conception of player engagement with videogames using aspects of Barad's agential realist philosophy. Moving away from 'interaction' as hierarchical exchanges of information between player and machine, I reveal complicatedly ecological 'intra-actions' that take place during game play. Fleshing out the proposed ecological approach to digital game studies outlined in the previous chapters I build on the existing discourse of ecological thinking in application to games. Analysing *Shelter* with a focus on the role of code processes in play, at a level of detail more commonly aligned with software studies, I draw attention to the techno-ecology inherent in the software system that underpins the game. This involves some discussion of the Unity game design environment or 'engine'. I suggest that the complexity of contemporary gameplay supports a Baradian world-view where agency is divorced from ideas of individuality and reimagined as an enactment of the relative differences of otherwise materially entangled entities.[224]

SHELTER AND THE PROBLEM OF ECO-VIDEOGAMES

Produced by Swedish independent game developers Might and Delight, *Shelter* tasks a player with the obligations of a mother badger in a stylised forest environment (figure 1). Exploring the world outside the safety of the set, the player must protect the five computer-controlled kits, preventing them from starving or falling prey to larger predators. The game begins in medias res placing the player right into the central conflict that drives gameplay. In the first moments of gameplay we are shown a large badger accompanied by four lively, squeaking kits, while a fifth kit remains motionless on the floor beside you. From this initial state you assume control over the mother badger and can move freely throughout the cave in which the game begins. Near you, a turnip glows to allow it to be recognised as an object with which the player can interact. The mother badger can pick this turnip up and feed it either to the fallen kit or else to the other four living kits. The decision is yours whether you wish to spread your resources evenly or else to take a more specific approach. The search for food, to quest to keep the other kits alive is the only motivation for movement which, in turn, drives the non-

[224] Karen Barad, *Meeting the Universe Halfway*, p. 33.

linguistic plot forward that sees the badger family traverse numerous obstacles, hardships and – potentially – loss.

Figure 1. The comfort of the set

It is possible to read Shelter as an inherently positive text, promoting an appreciation of the non-human natural world from an almost posthuman perspective. Haraway draws attention to how human behaviour changes when we attempt to see animals as social equals. Commenting on zoological experiments with chimpanzees she notes that researchers find "entirely new ways of being in the world".[225] While we are not engaging with a 'badger' per se when playing Shelter we are exposing ourselves to an attempt at mediating a specific world view (akin to Von Uexküll's "Umwelt"[226]), that of our digital badger avatar. We come to learn to decipher between the various small characteristics in appearance and movement that distinguish our various young. The kits behave in specific manners in specific situations, reacting fearfully when attacked, running away from your protection, or else running towards you if they have drifted too far. We can engage with these non-human actions, taking them into account as they represent the conditions for our victory but also shape our narrative and emotional experience. What is more, as players, our decisions throughout the game come to test our morals/ethics. Increasingly, we are pushed into making snap decisions akin to with those of a wild animal. Regardless of our own morals, other creatures in *Shelter*, foxes, frogs, small birds, rodents, are a valuable source of energy that allow us to keep ourselves and our

[225] Donna Haraway, *When Species Meet*, p. 24.
[226] Jacob Von Uexküll, "A Stroll Through the Worlds of Animals and Men: A Picture Book of Invisible Worlds," in C. H. Schiller (Ed.), *Instinctive Behaviour: The Development of a Modern Concept* (New York: International Universities Press, 1957), p. 10.

young alive. Although you may object to the idea of killing animals, even the representation of it in media, it is made clear here that eating others is essential for survival. Equally, there are times, as in the beginning of the game mentioned already, when sacrifice is necessary as allowing one kit to die may be necessary to keep the rest alive.

Of course, reading the game in this way opens it up to the equally valid investigation of the game's shortcomings. For instance, although the game maps are designed in such a way as to appear unlimited, using various techniques for shading and rendering so that the edges of the game maps appear to fade away into deep forest, the space in which we are able to roam and act is, in fact, very limited. While the game compensates for this by placing resources in a semi-linear path, drawing us towards a certain goal akin to Gibson's idea of affordances as mentioned earlier, it is nevertheless a pale imitation of the freedom, whether positive or negative, offered by the world outside of the computer screen. In a similar manner, referring to Morton's notion of "dark ecology" discussed in my introduction, although there are elements of 'darkness' here in the animal-eat-animal nature of the game, there are a host of other processes that are left unrepresented. Although we must feed our kits, keep them warm and close and safe from harm, we do not see them defecate, do not see them fight with one another, do not see them even scrap over which gets what food. At all times, the kits are adorable and their loss is decidedly framed as a moment to be avoided. If the die, it is not simply the turning of the great 'circle of life', so to speak, it is something to regret and – in my case – something that prompted many frustrated restarts of various levels.

To an extent, this shortcoming of *Shelter* that its beautiful depiction of the natural world fails to encompass the complications therein, is emblematic of the problems with eco-videogames as a genre. Given the shortcomings of *Shelter*'s representations of the so-called natural the complaints of Chang and Goggin, that game simulations will always simplify ecologies, seem to be upheld here. Reading the game from their mind-set, it is possible to see *Shelter*'s badger family as negatively portraying the minds of non-human creatures as short-term goal oriented, or else as anthropomorphising them by providing the human player control over the lead avatar. At worst, the badgers are depicted as our play-things; our pawns in a game to mourn over but, ultimately, forget and see only in reference to our own progression. Although a gorgeous spectacle, when read using the same methods as current eco-critical game theorists, the same results come to the fore.

It is possible to approach playing *Shelter* another way entirely: by focusing on the experience of playing the game, on our interaction with the non-human entity of the gaming machine itself, new conclusions come to light. Although it may simplify so-called natural ecosystems through its stylistic mediation, there is, nevertheless, a wealth of complexity under the game's surface. The difficulty, as I see it, is the expectation of Chang, Goggin and other classically eco-critical theorists, is the expectation of ecological videogames to function as text objects. As things, external and complete from the user. I want to argue that the value of playing *Shelter* is derived from the chance to engage ecologically with its undulating and entangled systems. In doing so, we challenge the existing idea of interaction, that I will explain presently, and suggest a novel way of conceptualising videogame play.

Let us examine a particular behaviour from the game to explore the ecology underneath what is represented. Throughout the game the kits wander freely around you, but always return to your side. In levels set during the night, they stay much close and when attacked or startled they will scatter and run away from you. However, for the majority of play, the kits can be relied on to move steadily towards their mother. Knowing what we do about the game, that it was programmed in the Unity engine and the observable behaviours exhibited by the characters on screen, we can approximate the following small code snippet to imagine an aspect of the overall movement of the kits.

```
using UnityEngine ;
using System.Collections ;function Awake ()

{ myTransform = transform; }

function Start ()
{ myTransform = GameObject.FindWithTag ("Player"),
transform ; }

function Update ()
{ myTransform.position += myTransform.forward * moveSpeed
* Time.deltaTime; }
```

Although the source code of the kits would, in reality, be a mammoth collection of scripts that captures their various behaviours, the above code gives us an idea of the exchange of variables that takes place in their actions. The first thing to note is that the code is C#, a common form

of source code. Although the Unity engine was used to make *Shelter* the programmers still would have had to write special scripts to determine the behaviour of their characters in a common language. The second thing to note is the inclusion of Unity itself in the code; reflexively, although C# was used to write the scripts, a special 'library' of commands, '`using UnityEngine ;`', is required to allow the most efficient interaction with the Unity program. Already we are getting a picture of an entangled structure where programs inter-depend on each other for stability. This is before we even consider the complexity of Unity itself, a graphical environment that has been built by game developers in order to expedite the production of 3D games. Unity fulfils the vast number of tasks expected of an engine: it provides a 'virtual world', an effectively infinite space functioning in a fixed x,y,z grid; it provides 'physics' algorithms that allow in game objects to behave as if they are solid and/or to respond to each other, by bouncing and touching rather than simply passing through one another ('tunneling'). Physics algorithms can also provide a relative dimension of time, close to what we experience as humans, rather than the computer completing everything as fast as it can. The engine also handles communication between the source code written by developers and the video output hardware, such as video sync, the process of smoothly animating games by ensuring generated frames are output in an orderly fashion. These preprogramed materials become the fundamental laws of the game that objects are coded in response to. For instance, if a game object is not explicitly coded to behave in a way that corresponds to the physics engine (for example, if the object is not specified as having mass or as being affected by gravity) the object will behave in unexpected and novel ways. As such, this first line already suggests a vast number of connections to software libraries and entities that exist outside the code and assets that one would commonly think of as the game *Shelter*. Although it could be argued that *Shelter* poorly reflects the complexity of the natural world in its graphics and play systems, it is an ongoing ecological process within itself. The same could be said for all games that are built on the numerous programming languages that call into action the contributions of many across space and time.

More specifically, *Shelter* resonates with its underlying code-ecological concepts in the manner that the on-screen characters behave. For example, in the command, "`GameObject.FindWithTag`" the 'tag' feature is a public class that can be referenced by other lines of code. In this case the game object in question is the 'player'. The 'player' refers to our mother badger, the avatar we see, and all code associated with it. The ability and style

of movement, its ability to hold food, its physical reactions to the wider game environment can all be easily referenced in other lines of code elsewhere. This means that when this code, the desire for the young kits to move towards their mother, is initiated, it begins to access the variables associated with the mother badger – her position, her speed, her trajectory. It is not just that the kits move towards their mother when she wanders too far away, they take on characteristics of her and use them to influence their own activity. This process must also be reciprocated as the mother badger's variables are shared to the kits but not to predators – if the predatory animals of the game could embed that data in the same way the kits could, it would be incredibly hard to make any progress! The kits cross-reference the properties of their 'mother' multiple times a second, constantly updating their data as she updates hers. Perhaps this is overemphasising the extent of paternal bonds among living beings, but there is something primitive in an attachment being so hard-coded into a being.

Seeing which lines of code share either private or public variables helps us to analyse the extent of the technological ecological being constructed. The various interdependencies and vulnerabilities that are built into this mediation of the natural world. This ecological systemic layout adds to the ways in which *Shelter* logically encodes ecologies. The badger and her kits are not just visually proximal as they appear on screen. Rather, their relationship is hard coded into the game. They share variables at a level beneath the representational. It was suggested by Chang that videogames do not construct ecologies with any reference to the local or specific sites on which they are modelled. In this instance, the ecology being constructed here is one which is both vastly complex, borrowing from enormous arrays of code to ensure the proper physical behaviour of the entities on screen, it is also one that enacts the interpersonal relationships that are formulated in play.

My reading of *Shelter* presents a challenge to current ideas of interactivity theory. Although the subject remains an ongoing discourse within the game studies community, with scholars like Newman declaring, "games are not interactive or even ergodic... videogames present highly structured and, importantly, highly sequential experiences", we can still attempt to forge a working definition for my needs here.[227]. For a working definition of 'interaction' between a computer and human, it is best to look outside of game studies in the first instance.

[227] James Newman, "The Myth of the Ergodic Videogame: Some thoughts on Player-Character Relationships in Videogames", Gamestudies, Vol. 2, No. 1 (2002), p. 1.

Looking to computer science it is important to note that the term ‘interaction’ has a more general meaning: interaction is understood as “phenomena that involves two or more actors. This is in contrast to action, which is what a single actor manifests”.[228] Interaction does not imply a human user or even a need for cognition or intelligence. Farhad Arbab writes, “For example, as a process p unfolds and performs its actions, one of its primitive actions, such as send, collides with a compatible primitive action, such as receive, performed by another process q. It is this collision of actions that forms an interaction”.[229] This gave rise to the specific term ‘human-computer interaction’ or HCI which takes into account the need to provide stimulus for a human and to await their input.[230]

Underlying HCI is a discussion of human consciousness, particularly the question of to what extent humans can be said to be responsible for their actions. However, such complexities are outside of the scope of HCI at present. For now, Donal Norman's three stages of the ‘human action cycle’ that revolve around the formation, execution and evaluation of goals, is a model designed to help computer scientists create systems that allow for the disjunction of human and machine logic.[231] Attempts such as these have assisted the development of systems that allow some predictability of human intention which is otherwise understood as non-computable. By understanding the human action process, it has been possible to create more pleasing interactive user-interfaces.

On the surface, HCI may appear impressively posthuman. Humans are not judged in terms of any essential qualities or assumed to act in particular ways; rather, ‘humanity’ is interpreted as a series of actions, transformed into data by machines. However, HCI oriented programming, nevertheless, places the human user at the centre of its world. Michael Heim, an early writer on virtual reality computing, linked the reality of virtual (software) objects to human use. Writing on the ubiquitous use of the file deletion algorithm commonly represented in a graphical user-interface by a ‘trash can’, Heim writes, “the reality of the trash can comes from its handy place in the world woven by our engagement with a project. It exists through our interaction”.[232] Although this quotation belies the complexity of Heim's work which is,

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[228] Farhad Arbab, "Composition of Interacting Computations", in *Interactive Computation*, p. 279.
[229] Farhad Arbab, p. 279.
[230] Michel Beaudouin-Lafon, "Human-Computer Interaction", in Dina Goldin, Scott A. Smolka, Peter Wegner (Eds.), *Interactive Computation: The New Paradigm* (New York: Springer, 2006), p. 237.
[231] Donald A. Norman, *The Design of Everyday Things* (New York: Doubleday, 1988).
[232] Michael Heim, The Essence of VR (London: Oxford University Press, 1994), p. 110.

undeniably, rich with technical detail and admiration for the complexity of modern computing, his reliance on an anthropocentric view of interaction is indicative of the more common view of human computer interaction. Indeed, Bowman and Hodges, for instance, insist that interaction is a predominantly 'simple' process of input and output.

HCI influences can be seen clearly in game studies scholarship. Influential theorist and game designer Chris Crawford presents videogame storytelling as an interactive loop where computer processes are understood as beginning with user input catalysing computer processes before receiving output.[233] Similarly, Michael Nitsche writes, "the player in a videogame is both reader (of the computer's output) and producer (via input) of events".[234] Nitsche's understanding stems from his poststructuralist view of the videogame as text. He specifies that, for him, the videogame is beyond the readerly/writerly text imagined by Roland Barthes and instead envisages an affective reaction beyond that presented in literature.

One of the reasons for the perception of interaction as a feedback system that prioritises the human user could be attributed to the games chosen to explain the interactive process. Most often examples are chosen from comparatively simple early games such as in Montfort and Bogost's study of the Atari VCS discussed previously. Early games depended upon computer processors only just fast enough to handle the data they were processing. As such, the sounds and graphics of early arcade games were due, in part, to hardware pushed to its limits. Take, for example, *Space Invaders*' infamous central game mechanic of accelerating as the player destroys the oncoming waves of alien space ships. In modern computers, this acceleration would be handled through software; an algorithm would be written that states a speed of the activity of the game relative to the amount of enemies left on screen. The acceleration in *Space Invaders*, however, was a result of the machine having to process fewer calculations. The fewer enemies on screen, the less data that had to be rendered and the faster the machine could run. As such, when we think of input and output as a simple, one in, one out, systems, the thinking almost holds true in early games.

Darius Kazemi provides an example of the input output stream of an early computer game (figure 2). This examination reinforces the view of early computer games expressed by Bogost

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[233] Chris Crawford, *On Interactive Storytelling: Second Edition* (Berkeley: New Riders, 2013).
[234] Michael Nitsche, *Videogame Spaces* (London: MiT Press, 2008), p. 31.

and Montfort.

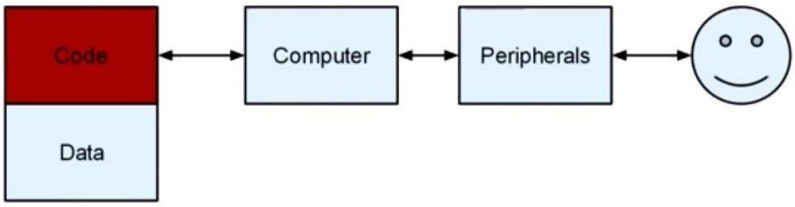

Figure 2. Darius Kazemi's diagram of early interaction

Thinking of interaction in terms of a one to one exchange becomes more difficult when we begin to consider the capabilities of contemporary technology (figure 3). Considering how we interact with a typical modern processor the situation becomes exponentially more complex. Processors today are often split into multiple ‘cores’ or (almost) identical copies of the same microchip. These copies can then complete different tasks at the same time and pass results to RAM in an order of importance. With each second many billions of these ‘clock cycles’ are completed. Each part of the network of components visible in Kazemi's diagram, from the peripherals, to the other computer hardware beyond the CPU, to the system's operating system, which, in itself, can be many thousands of processes, receives some small piece of data multiple times a second.

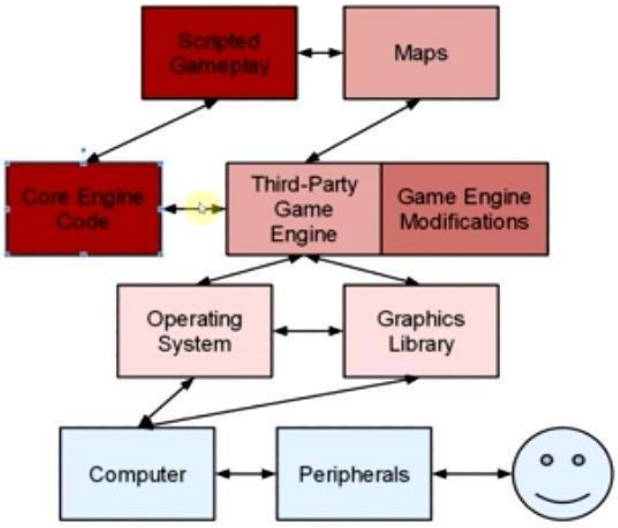

Figure 3. Modern interaction

Acknowledging that computers now complete billions simple operations at an incomprehensible speed, early perspectives of interaction simplify the complexity of our

entanglement with gaming machines. Given that the majority of computer activity does not require input from a human at all, one to one models of interaction are undeniably anthropocentric. Instead, contemporary computing is an advanced network resembling operations on a level of complexity comparable to biological systems. Indeed, the ideas of swarms of calculations or operations as envisaged by Parikka provide an apt picture of contemporary computation; he writes, "swarm intelligence characterises computer science algorithms, multi-agent systems, and insect".[235] The rapid pace of data processing in modern machines, underscored by this comparison of modern computing to non-human life, it should be clear that appreciating the scale and pace of what is actually occurring during interaction requires us to combat our anthropocentric assumptions.

Returning to *Shelter* then, how we engage with questions of interactivity must be confronted from a perspective informed by a knowledge of the complexity of contemporary games. As I suggested, when attempting to piece together how the game would be constructed through a working knowledge of game design, we are given a glimpse at a greater, swarm-like, ecology of entangled software and hardware processes. However, these entanglements do not stop at the level of code. We are indelibly entangled with these processes as well, as I will now attempt to uncover.

FROM INTERACTION TO INTRA-ACTION

Contrary to the anthropocentric view of interaction there are instances when game studies publications present interaction is in a more balanced light. Aarseth wrote of videogame play, "ergodic phenomena are produced by some kind of a cybernetic system, i.e., a machine (or a human) that operates as an information feedback loop, which will generate a different semiotic sequence each time it is engaged".[236] While Aarseth is bound to the belief that the human and machine are separate entities, nevertheless, the position that human and machine can both be viewed equally as 'cybernetic systems' is remarkably posthuman. Echoing this echological stance, as mentioned in my introduction, is Bogost's 'microecology' in which "videogames are a medium that lets us play a role within the constraints of a model world".[237] Likewise,

[235] Jussi Parikka, *Insect Media*, p. 47.
[236] Espen Aarseth, "Aporia and Epiphany in *Doom* and *The Speaking Clock*: The Temporality of Ergodic Art", in Marie-Laure Ryan (ed.), *Cyberspace Textuality: Computer Technology and Literary Theory* (Bloomington: Indiana University Press, 1999), p. 32.
[237] Ian Bogost, *How to do Things with Videogames*, p. 4.

Alexander R. Galloway's suggestion that the gamer is not in control of the videogame system but instead, "learning, internalising, and becoming intimate with a massive, multipart, global algorithm", equally hints at the true complexity of the encounter of the human and the videogame.[238] This thinking within the game studies community paves the way for an idea of interaction cohesive with those presented in philosophical media studies such as Tim Barker's model of a user that "emerges from the process of interacting with technology".[239] However, these early rumblings of a posthuman understanding of interaction in game studies should not be mistaken for a commonplace techno-ecological understanding of videogame systems as ecological texts.

The disharmony of definitions of interaction within gamestudies suggests that a new standard should be established for understanding playing videogames. I suggest we take the lead from the Barad. Revisiting intra-action we see that,

> The neologism "intra-action" signifies the mutual constitution of entangled agencies. That is, in contrast to the usual "interaction" which assumes that there are separate individual agencies that precede their interaction, the notion of intra-action recognises that distinct agencies do not precede but rather emerge through their intra-action. It is important to note that the "distinct" agencies are only distinct in a relational, not an absolute, sense, that is, agencies are only distinct in relation to their mutual entanglement; they do not exist as individual elements.[240]

This "intra-active" principle has wide ramifications for concepts of interaction within gamestudies. In the context of videogames this presents an approach that takes power away from the human user, suggesting that their agency exists only because of its proximal entanglement with the non-human agency of an aspect of the game (which is, reflexively, agential due to a proximity to various other agencies, including the user). However, this is an oversimplification of what is exactly occurring moment-to-moment during gameplay; exactly the kind of employment of metaphor that Barad would warn against. In the time of the processors involved in completing the electronic processes of the game as code in communication with devices completes, in the chronology of the computer system, the existence of a 'user' seems out of proportion to the microscopic scale of computing. As Barad

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[238] Alexander R. Galloway, *Gaming: Essays on Algorithmic Culture* (Minneapolis: University of Minnesota Press, 2006), p. 90.
[239] Timothy Barker, *Time and the Digital* (New England: Dartmouth University Press, 2012), p. 37.
[240] Karen Barad, *Meeting the Universe Halfway*, p. 33.

suggests, there is less a concrete, whole 'user' and more individual instances of agency at specific moments that, in close analysis of the game as a functioning system, we can begin to fathom.

Appreciating the complexity of computing has the potential to disrupt an anthropocentric view interactivity particularly when combined with posthuman philosophy. As stated, my understanding of the posthuman is made clear by Hayles, stating "in the twenty-first century, the debates are likely to centre not so much on the tension between the liberal humanist traditions and the posthuman but on the different versions of the posthuman as they continue to evolve in conjunction with intelligent machines".[241] It should be accepted that we are disregarding the liberal-humanist subject, discussing how machines produce a variety of new, unlimited ideas of what 'the human' can be. I want to bring these posthuman concerns to the foreground when applying my Baradian methodology for videogame analysis.

Taking the lead from her philosophy, I will now frame *Shelter* as "not calibrated to the human; on the contrary, [as] about taking issue with human exceptionalism while being accountable for the role we play in the differential constitution and differential positioning of the human among other creatures (both living and nonliving)".[242] In my previous example I discussed the process in *Shelter* where the computer controlled kits move away from their mother. Following a code study methodology, we could shed light on how this process resulted from fluctuations in values and variables that are shared between the digital assemblages of both mother and children. While this entanglement is important for understanding *Shelter* as an ecological text, the implications are deeper than that when pursued from an agential realist mind-set. Not only do these entanglements mean that connections are shared between the badger and her young, these entanglements provide us with a better insight into how proximity, activity and action (phenomena) is productive of 'things', not the other way around. Indeed, it is not possible when referring to code to speak of a 'thing' pre-existing its activity. As discussed above, *Shelter* depends on C#, the Unity engine, the activity of the machine it is run on, power, the human playing it (the stability of the material universe!) in an ecology that stretches endlessly outwards. The nature of the game, however, the focus on relationships of mothers and children within a digital environment, is what prompts us to make this discovery.

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[241] N. Katherine Hayles, *My Mother was a Computer*, p. 2.
[242] Karen Barad, *Meeting the Universe Halfway*, p. 136.

The impact of *Shelter* depends on its being a videogame. We are prompted to ask, 'how deep does this relationship go?' Following this trail of logic, we find this never-ending bread crumb trail of entanglements. This is precisely why Barad's agential ontology is so apt for the analysis of videogames. This relational, differential production of bodies can be understood as the entangled nature of machinery, code and humanity. Just as in any videogame, as in the small program from my methodology, in *Shelter* no digital object simply 'exists'; rather they emerge out of an entangled mass of code, constantly producing new output in the form of images and entwined variables.

The first realisation provided by my agential-realist, ecological focus, is that videogames simultaneously function as and can prompt us to think of the far-reaching entanglements of the universe. Interaction is no longer a human controlling a machine but an opportunity to realise how we are a part of an entangled reality. However, there are other important ramifications. Barad mentions the processes of "differential positioning" and "differential constitution". These are the processes whereby our proximal, agential activity, does not just produce apparent objects, it also distinguishes them. It is a reminder that intra-action is not about seeing all matter as similar, as all equal parts of the same thing, but instead understanding that agency, at its core, is the production of difference. As such while we can, as posthumanists, object to human exceptionalism we must similarly accept the spectrum of our humanity. While we still understand videogame play as *inter*-action, two fixed and defined units exchanging information, we limit ourselves from other potential understandings. For instance, an intra-active theory of play accepts that the qualities that define humans as distinct from machines, whether bodies or entities, posthumans or cyborgs, are differentially established through phenomena. This "co-constitutional becoming", to use Barad's terminology, allows us to think of videogames not as playthings but rather as human-producing machines, as defined in my literature review. Flipping this notion even further, in the act of play, humans themselves act as machine-producing machines, as their emergent humanity distinguishes them from the machines they use.

Focusing on the game in question then, we must understand that intra-acting is not a process that brings us closer to the experience of an animal or even to that of the machine. Rather, it is by taking part in the apparatus of the game, being a part of the phenomena, that we come to distinguish ourselves from it. For example, during a particularly harrowing section of the early

game, the kits must be protected from a circling bird of prey (figure 4). As you, an intra-acting fusion of player and on-screen avatar, negotiate fields of symbolised wheat, entangled with the vast coded processes required to power the experience, a bird circles overhead. It flies in circles, warning of its presence but without 'hunting' you in any way. To those familiar with videogame mechanics, the puzzle is simple. Avoid moving while the shadow is near. If you move while too close, it will swoop and attack. However, the puzzle is not explained in any way. To those who do not play games, this is a moment where exploration would prove fatal. There is an overwhelming tension in this moment as the end of the level draws near. It is clear that there is very little chance of finding more food but the kits most still be pushed forward.

The urge to protect the kits and the tension, caused through this encounter with the unknown, distinguishes the human as part of the videogame apparatus. As mentioned, there is no explanation that this encounter with the bird is to be avoided. Indeed, the agents of *Shelter*, from the visible bird to the game loops that keep the program running, are entirely indifferent to your decisions. Like a natural ecosystem, the bird consuming the kits is simply one more creature being fed, one more change in variable and game state. The machine, reflexively, is also distinguished in this intra-action through its passive indifference to consequences but constant, flowing buzz of activity. Yet, the ideal player, one who is engrossed with the narrative and cares about the fate of the mediated animals in their care, will emerge from this engagement through the flourishing of their emotions.

Of course, players are always far more varied that the ideal. Looking at the encounter at a more granular level, it is not only productive of the archetypal player, it also has the potential to produce a varied palette of players as, in a posthuman manner, distinct types emerge: players may be familiar or unfamiliar with games, as driven by emotions or driven by logic, as having quick reaction times or not; of course, there will even be those who prize, for whatever reason, the destruction of the mediated badgers and the collapse of the game's narrative flow. There are no extra rewards in the game for surviving 'better'. Whether or not you protect your young is up to you. This idea of being 'produced' by a videogame through diffractive processes will be discussed in more depth in Chapter 5.

Figure 4. *Shelter*'s bird of prey

An agential approach to ecology is ideal for challenging the idea that interaction is the result of two distinct entities. It reveals that these separations are not so concrete. However, my approach is also ideal for challenging the notion that interactivity is one pre-existing entity exerting its agency over another. Although we suppose we have some form of control over the avatar that gives us access to the play world, at the same time, our avatar is intrinsically linked to the physical reality of this mediation and the other entities with which it shares this space. Our every action, our every movement is not without consequence. Although we may think of ourselves as free to move through the map, the co-ordinates of our avatar, the "player tag" and information associated with it, is changing variables in the other various coded objects on screen. This, again, can be framed by agential-realist philosophy:

> Crucially, agency is a matter of intra-acting; it is an enactment, not something that someone or something has. It cannot be designated as an attribute of subjects or objects (they do not exist as such). It is not an attribute whatsoever. Agency is "doing" or "being" in its intra-activity. It is the enactment of iterative changes to particular practices - iterative reconfigurings of topological manifolds of spacetime-matter relations - through the dynamics of intra-activity.[243]

When we play, although we may 'feel' like we are in control, that we are 'doing' and 'acting' distinct from the activity of the machine, we are, rather, a part of a joint process of

[243] Barad, *Meeting the Universe Halfway*, p. 178.

reconfiguring. As our neurons fire, so too does electricity course through the silicon veins of the microprocessor. We present the computer and the materials it is composed of, with new possibilities just as it presents us with similar challenges. We form together. Barad continues that intra-action, "is about changing possibilities of change entailed in reconfiguring material-discursive apparatuses of bodily production".[244] Each action within *Shelter* is "materially discursive" in the terminology of Barad as our actions produce the bodies of each of the creatures around us – the world of *Shelter* when analysed from an agential, ecological, code-focused perspective, does not appear lacking in detail or freedom but rather becomes one of deep intra-active significance.

Though we may acknowledge the complexity of *Shelter*'s internal ecology, it is also important to acknowledge how this ecological complexity comes to play a role in how moving the game is. For example, the kits also possess a script that means they are constantly growing hungrier, coming closer to death in relation to the time spent playing. At any moment, if food is not acquired the small animals that are by your side for the entirety of the game can succumb to their primal needs and feint. While they can, on occasion, be revived, if their feinting occurs within the sight of a predator, or if no food can be found within time, then their death is almost certain. Though it is difficult to express just how distressing this moment is to a fully engaged player, it is enough to note that it is the game's only major penalty and major driving force.

A segment of the script for such a behaviour would look something like this:

```
public class kitOneScript : MonoBehaviour
{
  public class Hunger;
     {public int food; }

public Hunger
kitOne.Hunger = newfood (150);

      void Update ()
{
    if
    (food > 150)
    kitOne.Hunger -= Time.deltaTime;
    else
```

[244] Barad, *Meeting the Universe Halfway*, p. 178.

```
            kitOne = dead(); }
        }
    }
```

Behaviours such as this provide an insight into how the highly ecological game code comes to play a part in forming our emotional responses to the game. Although the actual script for the kits would contain a myriad of different attributes, the important thing to note is the class ‘Hunger’ which is an integer set to 150 at the beginning of a play session through the prefix ‘new’. The ‘Update’ function then alters this integer in relation to the passing of real world time (due to the "deltaTime" qualifier). Using this configuration, each second a value of one is subtracted from the food integer. As I have set the variable of maximum food to 150 that means the kit would have 10 minutes before the death animation would be called on. The full script used in the game creates much more nuanced behaviour, allowing room for feeding, taking into account the amount of exertion being performed (the more the kits move the faster they become hungry) and other variables.

The programmers could have made the kits immune to hunger or could have set a different time limit easily by changing the variables in question. However, by opting for values equivalent to the ones I have chosen results in the specific experience of *Shelter.* It is not just that we can take actions to prevent our kits from dying, however. We must simultaneously recognise that our actions are mediated through a variety of different preprogramed algorithms. Our emotional response to seeing one of the kits perish is, to an extent, bound up in the reduction of a value of one in accordance with the limits of deltaTime. Acting and feeling within a videogame ecology, therefore, is not just to act, or even interact. Every action is enabled by the processes put in place to allow its occurrence and has multiple effects on those systems with which it is connected.

In *Shelter* the relationship to time is game programmed in Unity using the ‘`deltaTime.Time`’ algorithm to control the rate at which new frames are processed and then updated on-screen. This slows down the rate at which the computer shows completed frames in accordance with the human eye, allowing movements of on-screen objects not appear disturbingly rapid. On screen movement is slowed by the computer to a pace that is conceivable to the human mind. The rapid pace of the reconfiguring of code into materiality calls to mind the theories of Henri Bergson's “continuity of flow”, the “succession of state,

each one of which announces what follows and contains what precedes".[245] The time of processor is significantly different from that of the human, however, the time of the human can be accounted for and simulated algorithmically. Rather than rendering each new movement in time with what can be processed, as in *PacMan*, in *Shelter* (as all modern games) movement animations are broken down into hundreds of parts to create a smooth feeling of movement akin to what we perceive outside the digital screen. Returning to the earlier example, the code:

```
function Update ()
{ myTransform.position += myTransform.forward * moveSpeed
* Time.deltaTime; }
```

roughly reads that the position of the object in question (the three dimensional location of the point or points that cause other objects to react in specific ways if in contact) is to be updated, taking into account any changes in position at the rate pre-programmed through deltaTime. This means that position will not be updated every time a new calculation is completed but rather, that the position will be updated with reference to specific intervals of the update rate of the monitor plugged into the computer.

Time is an important part of our interacting with videogames. Although there is an onboard clock on all computers, that counts seconds as the same value as humans, at the same time, time is a complex matter in contemporary videogames. As many billions of calculations are completed within each second by multiple different processors, computational processes must take into account the limitations of the human mind when rendering game footage. Time then, in *Shelter* is not a stable thing. Time becomes relative to the bodies acting within it. Returning to Barad, intra-active practices can account for this combinatory disjunction of human and machine time. She speaks of "iterative reconfiguring of topological manifolds of spacetime-matter relations - through the dynamics of intra-activity". In other words, the relationship between matter creates the space-time-matter in which matter seems to reside, not the other way around. While we perceive time as a fixed entity, analysing rapid computer programs that are designed for human use reminds us that time is asynchronous as what can be achieved in a specific spatio-temporal moment differs between bodies, agencies or assemblages.

[245] Henri Bergson, *Introduction to Metaphysics* (New York: Philosophical Library, 1912/61), p. 11.

Intra-acting with *Shelter*, taking into account the speed of the machine and the ecological network of technological processes this accomplishes, becomes a process of dynamic and determinant intra-activity. While we take action as quickly as we can in order to succeed, acting out life and death situations to save the kits that come into danger, the machine is simultaneously interpreting our data while computing the best practical way in which to deliver this interpretation to us so that it retains a desired level of verisimilitude. As such, our body is in-turn shaped by the functioning of the machine. The vast speed of the machine ensures that not only are we responding to small sensory amounts of detail, as was the case in early games, but rather we are becoming bathed in enormous amounts of data, most of it interlinked. We do not only engage with the plight of a single kit but must also take into account the health of the other five, their relative positions in three dimensions, their relative levels of feeding with each other, our speed, our direction and the various other inhabitants of the world around us. In this way, the ecological entwining of the system becomes once more entwined with the visual and narrative stimulus of the game system, allowing us to become more involved with the game.

Videogames are ecological; to play is to intra-act and become a part of them. Although our input amounts only to changing variables which are rapidly interpreted by the computer system, our input into the system is still one of great impact on the overall process of materialising the output of the machine. What becomes clear, however, is that this mediation of reality is one that relies on its enormous rapidity in order to function and that the human player finds their place within this space-time-mattering in counter-rhythm or in syncopation with the machine itself. Our brain processes, slower but parallel and complex, stand in disjunction, intra-actively materialised out of this relationship. As such, while *Shelter* may represent the biological environment on a visual level, it seems that on a code level it does much more to reiterate and shape the divides of the natural and the technical, through an inextricable material entanglement.

What should be clear by now through this ecological analysis of *Shelter* is that viewing game code as distinct or detached from the game and how we understand it is to miss the point. They are part of a bodily (re)production taking place constantly. *Shelter* helps us see this in at least two ways: first, through the coded bodies intra-acting at every moment. As each new

variable has an impact on the web of data and information that shapes every on-screen feature which, is in turn, shaped by a vast database of underlying code libraries. Secondly, in the speed of the game as a hardware/software execution, one that takes into account the speed of the human eye, differences shape and cut out the barrier between human and machine. The human is produced in a specific temporal window. This fluidity between bodies is representative of the intra-active universe.

At the same time this production of bodies, this creation of barriers through differential intra-action, produces and destroys the limits of a so-called 'natural'. We are materially indistinguishable from the machines we use, although we seem to function in a distinct temporal mode. Carl Sagan predicted such a post-singularity state and writes,

> Because of a kind of human chauvinism or anthropocentrism, many humans are reluctant to admit this possibility. But I think it is inevitable. To me it is not in the least bit demeaning that consciousness and intelligence are the result of "mere" matter sufficiently complexly arranged.[246]

The purpose of this chapter has been to illustrate just this process at work. Interaction, I have argued, cannot be viewed as the separate activity of a human and a machine; rather, it is the complex arrangement of matter. By looking first at how computers function in a way that does not require the human at all, analysing cellular automata and autonomous computer agents and artificial intelligence within *Shelter* it is possible to see the intra-active properties of a computer system. Extending that barrier outwards but retaining a sense of scale true to the computer system, as it is something we can measure, it becomes possible to see this moment of intra-action as one in which human and machine are produced through activity. The greater message of this chapter is the shared materiality of both machine and human in the process of creating shared meaning, navigating life and death and functioning as a part of an ecology of processes, far more complex than that which appears to be on the surface.

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[246] Carl Sagan, *The Dragons of Eden: Speculations on the Evolution of Human Intelligence* (New York: Random House, 1977), p. 148.

Chapter 4: Intra-active Aesthetics

In the previous chapter I explored how reading *Shelter* from the perspective of my ecological/agential-realist framework can challenge existing notions of interaction with videogames. At the same time, my reading of *Shelter* illustrated that if we cease to view videogames as predominantly visual or interactive texts and instead accept them as complex technical assemblages their ecological complexity comes to light. In *Shelter* our actions are entangled with the other wildlife in play not only on a narrative and visual level but also at the level of software and even machine activity. Viewing the game this way *Shelter* provides an easy to comprehend glimpse at how representations of biological frameworks through technology produce new ways to conceive of ecology from a media theoretical perspective. As Anna Munster suggests, the entanglement of digital media and human bodies "emerges as part of the oscillations between polarities through which information and corporeality interact".[247] I have attempted, through my Baradian method, to push this idea one stage further, suggesting that information and corporeality are never so distinct as to enable their interaction; rather, they dynamically intra-act.

In this chapter I argue that videogames can provide us with a means to understand different types of ecological entanglements. By 'different' I mean distinct from the ecology of the supposed natural world. Instead I look at games that offer players an opportunity to explore and engage with more fundamental universal forces. This, I argue, is achieved through the generation of an aesthetics of intra-action, attempts at depicting the world as it is described through scientific theories. I look to again to Barad's intra-activity and agential realism. However, I shall focus on different aspects of Barad's work in this chapter; rather than attempting to use Barad to make points about the entanglement of matter, I wish to use those elements in her work most obviously influenced by the hard sciences to suggest our relationship with aspects of the world (time, space, action) that are often considered immaterial.

Focusing on Barad's more scientifically influenced theories and reading three different independent videogames, in this chapter I attempt two things: the first is to posit the existence

[247] Anna Munster, *Materialising New Media: Embodiment, Information, Aesthetics* (London: Dartmouth University Press, 2006), pp. 63-64.

of a movement in videogame design in which independent developers seek to reify theories of nature outside the everyday. I want to identify a clear initiative to, through gameplay, depict the world as it is described in writings on theoretical physics. This movement I dub the intra-active aesthetic speaks of an ecology of beings and forces that cannot otherwise experienced. The intra-active aesthetic depends on the videogame form to produce a vision of a world that is produced iteratively through entangled actions, not activity within a space but as actions entangled with the space of those actions. The second objective is to attempt to further involve a small amount of hard-scientific theory in this piece of humanities scholarship, in line with my main goals expressed in the introduction. This coincides with Rosi Braidotti's idea of the role of posthumanities: "we may need to review this segregation of discursive fields and work towards a re-integrated posthuman theory that includes both scientific and technological complexity and its implications".[248] Looking to Barad's focus on the thought experiments of Niels Bohr and Erwin Schrödinger as well as the more recent work of research groups such as those lead by Marian Scully is not an empty gesture. Rather, it is an attempt to fulfil the ambitions of Braidotti for one and Michel Serres for another to bring scientific practice and humanities research together in an effort towards "cross fertilization".[249] This mingling of disciplines allows an insight into artistic works that go some way to making physical and indeed *playable* views of the natural world that are often incomprehensible. What's more, bringing science to bear on these videogames allows us to see how they are not only capable of representing certain ecological relationships (once again responding to the criticisms outlined in chapter one) but are capable of making interactive ecological relations that transcend everyday ideas of time, space and matter.

SUPERHOT AND A 'NON-NATURAL' VIDEOGAME ECOLOGY

[248] Rosi Braidotti, *The Posthuman* (London: Polity, 2003), p. 43.
[249] Michelle Serres & Bruno Latour, *Conversations on Science, Culture and Time* (Ann Arbour: Michigan University Press, 1995) p. 28.

Figure 1. *Superhot*'s frozen time.

Exploring the graphical representation and underlying code of *Shelter*'s mediated ecosystem fills a gap left by other ecological videogame critics and unveils a deeper level of connectivity between digital game objects, hardware and players. Through videogame play, a mingling of coded processes and organic input, technology and biology are revealed as intimately and actively linked. However, *Shelter* focuses only on representations of biological ecologies. By invoking the symbolism of the supposed natural – its family of badgers and mediated forest – in spite being a dominantly technological text, restricts its commentary to only a number of potential ecological relationships. In choosing to mediate the relativity large-scale level of biological matter the entanglements and relationships within the most fundamental forms of matter are overlooked.

It is not uncommon for popular ecological texts to overlook the potential vastness of the theory of ecology in favour of focusing on those elements that resonate with human interests. Timothy Morton writes,

> As well as producing arguments, ecological writers fashion compelling images – literally, a view of the world. These images rely upon a sense of *nature*. But *nature* keeps giving writers the slip. And in all its confusing, ideological intensity, *nature* ironically impedes a proper relationship with the earth and its life-forms, which would, of course, include ethics and

science *[emphasis in original]*.[250]

Morton comments here on the frequent recourse of theorists and practitioners to discussions of ecologies of a similar scale to human existence in attempting to understand the term as a whole. Though writing about literature, the trend Morton has identified is visible in videogames as well. Wright's *Spore*, discussed in my literature review, purported to depict the evolution of natural organisms, from microbes to sentient life (as does, to an extent, O'Reily's *Everything*). In reality, however, players spend the majority of gameplay time with creatures of comparable in scale and complexity to the same avatars as any other game. Though the images of microbe-like structures are shown, we are not given a chance to interact with anything out of the ordinary.

To truly grasp the potential of ecology we must think, as I have suggested throughout this work, across scale. This is not, however, without its challenges. New materialist scholar Jane Bennett provides us with some tools to do this through placing a focus on "powerful nonhumans: electrons, trees, wind, fire, electromagnetic fields".[251] Bennett discusses how power supplies to North American cities shape human activities. Disappointingly, however, she references "electrons" only in a passing manner and never seriously considers the issue of scale this presents. In a similar vein, Morton's notion of a "proper relationship" with the earth could be problematic as it implies that such a broad but simultaneous understanding of reality is possible; an ecological form of thinking in which universal scale and microscopic scale coincide. Indeed, Morton admits that ecological thinking may be an attempt to understand something "immeasurably vast".[252] Rather than attempting to think in both scales at once, I believe that it is important to shift focus to less easily identifiable ecologies if we wish to have a full understanding of the potential of ecological relationships.

Videogames allow explorations of ecologies distinct from those aping the outside world. Important physical features of our world such as gravity, time and space often go without consideration when discussing ecologies and ecosystems. Virtual worlds can be fashioned that resemble the outside world; however, in these virtual worlds certain elements can be exaggerated or emphasised. For instance, it is common practice for many game designers to

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[250] Timothy Morton, *Ecology Without Nature* (London: Harvard University Press, 2007), p. 2.
[251] Jane Bennet, *Vibrant Matter: A Political Ecology of Things* (London: Duke University Press, 2010), p. 24.
[252] Timothy Morton, *The Ecological Thought* (London: Harvard University Press, 2010), p. 15.

create worlds with a weaker force of gravity than we experience in everyday life.[253] This makes games more exciting and action packed; jumps are higher, running is faster and bouncing produces powerful results. Videogames, therefore, have the ability to bring physical forces to the foreground of our experience. Once these forces are made obvious, we can begin to evaluate the fundamental role they play in our world. We can begin to think of the ecological relationships of physical entities but also the forces around them.

The three games explored below, *Superhot*, *AntiChamber* and *Manifold Garden* comment on these unusual ecological relationships; the ecological relationships of matter, time and space. [254] In doing so, a focus on what Morton, above, dubs "science", no doubt referring to currently held scientific theories, yields fascinating ecological discoveries for theorists and artists alike. Understanding the interactions of forces and materials that are infinitesimally small (such as subatomic particles) or else so intimately linked with a common sense view of reality (such as the passage of time) can provide insights into the nature of our being in the world quite different from understanding biological systems.

Superhot begins by placing the user in control of a primitive MS-DOS style user interface, "piOS". The interface's boundaries, demarcated by white lines, indicative of early 1990's computer systems are curved to suggest the convex screen of a CRT monitor (though it is no doubt being played on a flat or even concave screen in the present). You are given access only to a short list of commands and file locations such as "quit" and "art". While browsing the interface you are interrupted by an incoming anonymous chat room message. Opening it, a conversation takes place in which an unnamed messenger, though presumably a friend, offers you a "crack" (an illegally generated password) to access an experimental game still in development; a "sick shooter" that is "too hard to describe". After downloading "superhot.exe" from the anonymous source, the primitive interface gives way to a fully rendered, high-definition, three-dimensional environment. The layout is that of a standard 'first-person shooter'; a gun hovers just in front of your eye line, implying that this is *your* gun. Beyond that, a humanoid figure stands before you; with a body composed of a material like red glass, the figure has been shattered into hundreds of pieces. Through this tableau,

[253] Ian Millington, *Game Physics Engine Development: How to Build a Robust Commercial-Grade Physics Engine for your Game* (London: CRC Press, 2010), p. 53.
[254] Piotr Kosmala, *Superhot* (Independent PC Videogame) (Poland: Superhot Team, 2016).

Superhot places you in control of a killer, who shot someone (or something) just moments before your arrival.

A red figure in front of you has been shattered into many pieces and hangs in the air suspended in a freeze-frame (figure 1). If you choose to cautiously move forward, however, the body begins to collapse. Standing still once more, halts this process and the pieces stand still once again. On reaching the body an inter-title covers the screen that simply reads, "time moves only when you move" (figure 2). Moving through the remainder of this first level, it is not long before two new red figures appear, guns in their hands, ready for conflict. Choosing to move becomes a choice to allow time to pass, for bullets to leave barrels and combat to ensure. Being placed in control of the passage of time does not give you control over the other figures but it does give you time to plan; to side-step their shots and move at the speed of a bullet. Controlling time provides a form of prescience and the two assailants are dispatched with ease. Once this is achieved another inter-title appears, covering the screen accompanied by a monotonous, robotic voice that repeats the game's title over and over, "super– hot–" while a replay of your actions plays in reverse.

Figure. 2: The mysterious will of *Superhot*.

With these early moments of gameplay and the introduction of the central concept that "time moves only when you move" *Superhot* comments on the nature of interaction in most videogames. In particular, the game is exploring the pivotal role of how we accommodate time

in play. As discussed in the previous chapter, the classical idea of videogame interaction is that of a feedback loop wherein the human player provides input and, responding to this, the computer provides output. Theorists Chris Crawford, Daniel Cook and Tom Heaton have each described various forms of loops or cycles that take into account a human user and an active machine to create the stimulating process of play.[255] As I argued in the previous chapter, however, the current models of interaction miss the complexity of contemporary computing. Non-human activities, background processes, complex operating systems and hosts of graphical processes that generate the experience of videogames are overlooked in favour of overstating the importance of the human player. When exploring *Shelter* these background processes were shown to be instrumental to furthering a sense of a coherent world and to solidify the ecological relationship between the creatures visible on screen; the relationships between the creatures were all hardcoded rather than relying on the player to stimulate them. In a different approach to this underlying complexity, however, *Superhot* is upfront about its nature as a program composed of computer processes. It is does not attempt to appear naturalistic but a computer program enacted one command at a time. Indeed, even before the game play begins the representation of the game from a basic command prompt UI triggers awareness that *Superhot* is a body of code and process more than an easily comprehended narrative world. *Superhot* makes the supposed loops of interaction literal, relying on the user before any other process will take place.

By shaping the flow of time around player movement and foregrounding an older, player–centred idea of human-computer-interaction, on the surface, *Superhot* may appear initially to be an anthropocentric text as "recentering the human subject".[256] Indeed, the central mechanic "time moves only when you move" could be a description of the human-centred "movement-image" from Deleuze's writing on cinema. As Deleuze writes, in the movement-image "time [is] subordinate to movement".[257] Deleuze goes on, "[t]he principal quality of the image is breath, respiration. It not only inspires the hero, but brings things together in a whole of organic representation and contracts or expands depending on the circumstances".[258] The

[255] Dominic Arsenault & Bernard Perron, "In the Frame of the Magic Cycle: The Circle(s) of Gameplay", in Mark J. P. Wolf & Bernard Perron (eds.) *The Videogame Theory Reader 2* (London: Routledge, 2009), p.
[256] Diana Coole & Samantha Frost, "Introducing the New Materialisms", in Coole & Frost (eds.) *New Materialisms: Ontology, Agency, Politics* (London: Duke University Press, 2010), p. 26.
[257] David Martin-Jones, "Move-images, time-images and hybrid-images in cinema", in David Martin-Jones and Damian Sutton (eds.) *Deleuze Reframed* (London: I.B. Taurus, 2008), p. 92.
[258] Gilles Deleuze, *Cinema 1: The Movement Image* (London: Continuum, 2004 [1983]), p. 146.

world of *Superhot* is a very literal take on this image of a world expanding or contracting around the central actor; in this instance, the player. In the initial levels of *Superhot* at least, we can experience a concentrated version of Deleuze's ideas of the Western or the American action movie in which all other forces are subordinate to movement and action.

Although the initial stages of *Superhot* appear to place the player at the centre of its world, a large portion of the game is dedicated to dispelling precisely that idea. For instance, as mentioned above, although you can initiate the passage of time and although this can give you considerable advantages, it does not make you invulnerable; *Superhot* remains a challenging game as although you can predict the path of a bullet it is entirely possible to find oneself in a position where movement will cause a game over situation. Beyond this, from its halfway point, *Superhot* has a radical turn in theme. Having completed a mission much like any other, once again, an instant messenger conversation ensues. During this exchange it's revealed that the remainder of the levels of 'the game', speaking diegetically, are "password protected". The player is asked to enter a password only to be denied twice (regardless of what they type). On a third attempt, still regardless of what is typed, the attempt at a password is accepted. This dramatically-ironic play on concepts of 'hacking' and videogame narratives takes away any sense of achievement. It is clear the player has not outsmarted the system but, rather, has been allowed to proceed through the game. Another mission follows as usual, asking you to eliminate more red enemies. Following this, however, a new mission begins called "the tutorial". Although you may have been playing for a long time, reasonably for at least an hour, it is only from this point the game truly begins.

In "the tutorial" you are instructed to either move, stay still or "sit". On completing this mission an inter-title reads, "good boy; you are not in control". From this point on, interspersed between various usual missions are now special levels in which you must submit your control to the will of the system of *Superhot*. For instance, one level places you in a small prison cell with an open roof. Stranded in this prison enemies begin to fire at you. Although you are still ostensibly in control of the passage of time, it is not possible to avoid all of the shots. Eventually, the system commands you to die. This persistent desire to have the player submit to the game's control culminates in a conversation between the game and the player in which we are informed that the game could "keep us here forever". The game taunts us to attempt to "disconnect" meaning an attempt at exiting the game. The player must concede,

following the various steps to save and exit the game, returning to the main menu screen and finally, their own operating system. On exiting *Superhot* and returning to the desktop screen of whatever operating system players are using, they see all of their icons and files exactly where they would expect them. After a short delay, however, the game appears to instantly restart. A short dialogue ensues and the game, speaking in a collective sense, claims to have "made our point".

The increasing restriction of player agency throughout the game toys with but also emphasises the concept of control. Pairing that with an aesthetic of unfamiliar and abstract figures *Superhot* questions human assumptions about the need for a central user in an interactive system. N. Katherine Hayles writes, "[i]n the posthuman view, by contrast, conscious agency has never been 'in control.' In fact, the very illusion of control bespeaks a fundamental ignorance about the nature of emergent processes through which consciousness, the organism, and the environment and constituted".[259] In playing *Superhot* we are forced to relinquish an idea of agency fostered by cinema that indulges in the anthropocentrism of the "movement-image" and "action-image" form. Far from a human being in control of the passage of time we must rather come to terms with the concept that our actions are a part of the formation of a timeline. It is not that we act within time; rather, time is formed in unison with ours and all other beings' actions. There is no one source of control or agency. As Hayles states, rather than seeing activity as a question of will and control we must accept it instead as an "emergent process".[260]

The idea that agency is not contained within a single, central source is further developed in *Superhot* near the game's conclusion. Having completed the bulk of the central missions, we come face to face with a representation of ourselves; a singular figure hunched over a computer terminal. Although still represented in the abstract red crystalline form as the other figures in the game, there is no mistaking that this is to be understood as the body of the singular player, the one that assumes it is in control. During this encounter the game shows us an inter-title telling us, "Bodies are disposable". From this moment on we are granted a new ability, to "hotswitch" between the available bodies in a room. As we continue to play,

[259] Katherine Hayles, *How We Became Posthuman: Virtual Bodies, Cybernetics, Literature and Informatics* (London: Chicago Press, 1999), p. 288.
[260] N. Katherine Hayles, *How We Became Posthuman*, p. 288.

indulging in the "hotswitch" ability, the game speaks further, stating that "mind is software; bodies are disposable". The player is being urged to surrender a sense of our individuality and give in to the power of a hypothetical collective computer system. Although this may initially appear to be a transhuman sentiment, one which risks reimagining the human in a new technological form, it is made clear that there is no individuality within software. The realisation that "mind is software" carries with it the idea that our mind is part of a wider collective. The culmination of the game is sequence in which we must "hotswitch" into a large red pyramid referred to as "the core". This gives us the ability to hotswitch freely without being restrained by a singular body; we can move through the bodies in a room without having to settle in one for any period of time. Still, the game maintains, "something is holding you back". The climax of *Superhot* is a return to the mediated version of the player. In this encounter we are given no other option but to shoot this representation of our own physical body in the head, setting ourselves "free". Doing so unlocks "unlimited mode" which, although it sounds like a reward, is rather a fully automated version of the game representing the full surrendering of our sense of a human self.

Superhot although admittedly verging on the dystopian, nevertheless suggests a form of ecological relationship between bodies, technological and otherwise. Most obviously we see that all actions are inextricably connected to each other within a system. This is made clear from the beginning but, as it is presented early on, risks the aforementioned human "recentering". As the game progresses it is made more explicit that it is not just actions but bodies that are connected. Importantly, however, it is made clear that an awareness of this connectivity does not provide the user with greater ability to act; awareness of connectivity rather informs action instead of allowing one to transcend ecology as an individual. Although we play the game with awareness that our actions are linked to the actions of the computer controlled characters, we are always reminded that our actions are enabled by a system as when the game states, "you are not in control". Haraway writes that relationships must be thought afresh; "the flow of entangled meaningful bodies in time - whether jerky and nervous or flaming and flowing, whether both partners move in harmony or painfully out of synch or something else altogether - is communication about our relationship, the relationship itself, and the means of reshaping relationship and so its enactors".[261] Though the bodies of *Superhot* are continuously in conflict our graceful movement through them and their connectivity

[261] Donna J. Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008) p. 26.

nevertheless comments on their relationship and the nature of relationships. *Superhot* makes it painfully clear that no moment of activity is completed by a single moving body but by a conglomeration of bodies moving together, reacting to one another and their environment.

ECOLOGY AND TIME

Beyond relationships between bodies, *Superhot* also suggest an intimate and discursive relationship between bodies and time. The central mechanic of the game, "time only moves when you move" presents a distinct passage of time. There is a tendency in western culture to think of time as an abstract concept or, perhaps, a quality of living that is separated from matter. Michel Serres writes, "time is paradoxical; it folds or twists; it is as various as the dance of flames in a brazier".[262] While influenced by the philosophy of Henri Bergson amongst others, Serres' claim is nevertheless situated within 'hard science'. Time, as we know, is an element of physical nature, influenced by gravity and mass. Yet we rarely consider ourselves as functioning *as a part* of space-time. More often than not we see ourselves as 'in time'. The formulation of time presented in the game suggests moments are constructed apace with the construction of space and action. Rather than some distinct metaphysical realm that beings are 'in', time, *Superhot* suggests, is created by *doing*. This mediation of time is not only a bold choice for a videogame but is also uniquely ecological. As stated above, this is all achieved using familiar controls to other first-person shooters but by changing how these controls shape the actions on screen. For instance, though we may fire a gun in *Superhot* – which is to say, press the mouse button currently set to trigger that action – we must also move away from the place where we pressed that button. Not only does this require us to think of firing a weapon in a different way than in other comparable games, it also encourages us to consider the position of other objects around us and, importantly here, to think of the past and future of those objects. This embeds the passage of time into actions. Suggesting a connection between bodies and time is to suggest underlying connections between beings. In other words, integrating time into an ecological perspective goes further against a humanist perspective of matter as discrete self-contained objects. By creating an abstract world, therefore, *Superhot* can comment upon the nature of existence as perceived by humanity from a perspective prohibited by *Shelter*'s naturalist aesthetic.

It is important to make clear what is meant by 'time' here and, more importantly, to confirm

[262] Michel Serres, in Michel Serres and Bruno Latour, *Conversations on Science, Culture and Time*, p. 58.

that *Superhot* is not presenting time in a linear fashion. Indeed, if there is any unifying theme throughout the many philosophies mentioned in this chapter it is that time is anything but linear. Barker suggests that time is chaotic, non-directional and multitemporal. This quality of time being "out of joint" is distinct from the tradition of understanding time within Deleuze's Bergsonian influenced philosophy of time. Digital media do not always act precisely as the cinema of the "time-image" where "it is no longer time which is subordinate to movement [as in the cinema of the movement-image]; it is movement which subordinates itself to time".[263] There is no need to understand time and movement as distinct in the ecology of time offered through digital media. Rather, the addition of multi-temporality as in the instance of digital media works may result in what Barker calls a "thickening of duration" where presentness is extended, in a sense, through the addition of actions that seem to exist within and beyond a single moment.[264]

Barker writes, "the concept of multi-temporality, when applied to the digital, refers to the multiple layers of temporality that may be produced when we interact with digital systems [...] the time of the user meshes with the time of the machine, including the asynchronous time of the software, the non-sequential time of the database, the time of the network and the time of other users".[265] Barker gives examples of various artworks that suggest colliding temporalities by remediating images that conjure specific associations from the past in a looping recontextualisation within the present. For instance, he examines the art piece *T_Visionarium* that combines a variety of clips from different historical periods of Australian television. By offering an alternative to the singular, linear passing of time offered by popular television programs it provides an example of multi-temporality. At once, the historical contexts of the television clips are combined in a moment just as their narrative timelines come together. For Barker, art work such as this can engage with non-common sense ideas of time and make users a part of this experience. Barker also notes that digital multi-temporality has specific characteristics: "the digital encounter does something more specific: it actually enacts the various temporal rhythms in a physically engaging process".[266] In one of many examples illustrating this Barker explores how using GPS system while driving a car can show us how

[263] Gilles Deleuze, *Cinema 2* (London: Continuum, 2005) [originally 1985]
[264] Timothy Scott Barker, *Time and the Digital: Connecting Time, Aesthetics and a Process Philosophy of Time* (NH: Dartmouth University Press, 2012).
[265] Barker, *Time and the Digital*, p. 14.
[266] Barker, p. 74.

action can construct occasions. The physical activities of satellites, atomic clocks, mapping software, the driven car, computer generated voices, radio and higher wave signals must act in combination with the driver's internal desires. These chemical and technological processes each exists within its own experience of time; the rapid speed of radio waves against the comparatively slow experience of humanity. Following a process philosophy of time, Barker suggests that occasions can be considered an encounter of multiple different energies, "as a process that involves a common operation between a set of internal energies or forces and the milieu or context in which these forces become".[267]

Just as in the artworks discussed by Barker, *Superhot* exemplifies multi-temporality in a number of ways. Most prominently, it combines Barker's concept of "the time of the user" and the "time of the machine". For instance in a specific fire fight we find ourselves trapped in an elevator, surrounded by a number of assailants, with a gun pointed in our direction. A gunshot is fired. The fate of our avatar is sealed; they have been shot and will be destroyed; unless, that is, an external force intervenes. The game requires our comprehension of events to liberate our avatar. The game acknowledges and requires an external "user time" in order to allow progression to the next level. Just as artwork *T_Visionarium* discussed by Barker invites the perceptual time of the user in its mediation of time, *Superhot* requires this intervention. What is more, *Superhot* draws attention to the multiplicity of "machine time[s]" such as the underlying software systems required to support it. During the moment discussed above when the overruling voice of the game implies that we cannot stop playing and forces us to exit from the game to the operating system, only to restart, we are made forcibly aware of multiple times of the machine. The integration of the operating system into the game itself is a recognition of the multiple processes handled by a machine. Each of these processes accommodates a different speed of input and process from its multiple human and nonhuman input sources.

The combination of software time, database time and processor time alluded to by Barker is an essential element of *Superhot* the game. This multi-temporality however extends to every instance of play in *Superhot* as in each new moment the different objects of the game (humanoid bodies, thrown weapons, glass shards and bullets) all move at different rates. We may know and are certainly reminded that the different speeds of the objects are being calculated by the underlying hardware of the computer system and – in reality – speed

[267] Timothy Barker, *Time and the Digital*, p. 113.

corresponds to the distance between the renderings of an object in each sequential frame. However, bullets still appear to move the fastest, followed by thrown weapons, then humanoids. Each of these objects could be said to be contributing its own temporality, its own relation to one moment of time within the game. Each object has a different range of potential for action in the formation of a single moment. *Superhot* offers through its requiring user input, its admission of reliance on multiple software systems and its internal juggling of various cause and effect chains, a multi-temporal experience of time.

The implication of applying Barker's theory of durational 'thickening' to videogames is to uncover the ecology of activity that underpins gameplay in new ways. Although I have stated in this chapter and previous chapters that more attention must be dedicated to the wealth of activities that videogame play represents, thinking through the different speeds of activity is one way to come to terms with the vast array of actions involved. Understanding humans, processors and electronic peripherals all processing information at different rates is an intriguing approach to game studies, highlighting the different forms of agency involved. However, I now wish to approach the topic from a different perspective, relating to Barad's theories on space and time derived from quantum physics. Relating to *Superhot* but also other independent games, I intend to explore implications specific to videogames and time.

ECOLOGY AND SPACETIMEMATTERING

Time, as it is mediated through *Superhot*, can be understood as multiple, subject to Barker's suggested thickening of time, characteristic of digital media. However, the unique formulation of action speaks to something Barad dubs "spacetimemattering". Thinking, momentarily, of the narrative *Superhot* it is made clear that each entity within the game has a unique temporality. Although we can move however we wish, the various enemies that surround us move at different rates, as do the bullets and other harmful objects of the game world. The progression of time is generated only through our actions but there are still suggestions of multiple temporalities. While this is an interesting 'hook' for a videogame, it also resonates with a specific understanding of time in the real world, drawn from observations of the quantum realm. Barad attempts to describe the formulation of bodies moment to moment with attention to time stating,

> This ongoing flow of agency through which part of the world makes itself differentially intelligible to another part of the world and through which

> causal structures are stabilized and destabilized does not take place in space and time but happens in the making of spacetime itself. It is through specific agential intra-actions that a differential sense of being is enacted in the ongoing ebb and flow of agency.[268]

In Barad's view of the world nothing is separated from a singular, unified but subdividing system. This is what is implied with the shift from inter- to *intra*- action, discussed in the previous chapters. We may think of forces such as gravity or time as excluded from Barad's materially focused ontology but it is, rather, framed as part of the active performance of the world. To provide a clear metaphor for this idea of physicalized time Barad presents the rings within tree stumps "as the rings of trees mark the sedimented history of their intra-actions within and as part of the world, so matter carries within itself the sedimented historialities of the practices through which it is produced as part of its ongoing becoming – it is ingrained and enriched in its becoming".[269] As each year progresses the activity deep within the material of the organic matter generates a new physical appearance. Not only that, it presents the past in a visual, physical manner through specific colouration and texture. Metaphorically, the inner circles represent the past, the outer rings the present and future through inevitable expectancy of growth. Yet, all three remain present in the tree at once showing the comingling of action, matter and time. The metaphor allows us to imagine how actions, such as the formation of the rings within a tree, do not cease to exist but remain in the world as part of the process of a historical becoming. For her, time is not an evenly spaced sequence of present moments or an external parameter that tracks the motion of matter. Rather, time is a consequence of matter itself.

Superhot is an appropriate example to extend Barad's tree metaphor. When playing it is possible to guess what events may unfold in the near future; what shots will be fired, where targets will move. Although the game utilises familiar controls to other first-person shooters it also embeds the passage of time into them. For instance, as stated, we fire guns in *Superhot* but must also move as we shoot. Not only does this require us to think of space in a different way than in other comparable games, the constant movement also prompts us to consider time as part of activity. In *Superhot* spacetime is presented in a literal and interactive form. While in most games we may react to the position of enemies currently, in *Superhot* like playing a game of chess, we must consider where actions will take place in the future, before those

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[268] Karen Barad, *Meeting the Universe Halfway*, p. 140.
[269] Barad, p. 180.

events have come to pass. Not only do we need to respond to where an enemy is now, but where their bullet will be in a few moments – which is to say – actions', time. However, this does not guarantee the exact manner in which they will happen. Although we might see an assailant in front of us, readying a shot, we can move out of their way.

Movement is linked to the progression of time and, as discussed above, to the movement of all other bodies. Our moving out of the firing line of a shot is precisely what draws the shot towards us. What is more, each level ends, giving way to a replay of our actions, showing the past remaining stored in a new present. Not only does time replay, the subsequent replays can be edited. History does not remain static and time in *Superhot* can always be reshaped. Although problematic in certain ways it comes staggeringly close to a suitable visualisation of the "ongoing ebb and flow of agency" suggested by Barad. Bodies, actions and time are bound through the "specific agential intra-actions" that take place.

By the same token, by the end of the game, when physical distinctions between bodies have been overturned though the hotswitching mechanics, there are no boundaries between entities. The unified nature of time and matter is made even clearer. Hotswitching between the available bodies triggers further movement from the other mediated matter in the virtual space. Although we play the game and perceive the passage of time as nonetheless linear, we are made aware of the multiple activities that occur to build a moment in time. Time, just as space, just as actions, is shown to be a multiple, simultaneous, discursive performance constructed by multiple bodies in unison. It is revealed as agential time.

Both the multiplicity and physicality of time, as expressed through the particular experience of *Superhot* suggests a distinct form of ecology. By linking time to movement using the "time moves only when you move" mechanic, the physical actions of pushing mouse and keyboard buttons fuse time and action together as a physical process. As such time, in the game, is suggested to be a malleable, physicalized process. What is more, it is a process linked to the physical actions not just of one but of many bodies. As mentioned above, each new physical 'click' of the mouse brings about another step forward which reveals the next multiply constructed temporal moment. However, the actions of the player are shaped alongside the actions of the computer controlled entities. What is possible constantly shifts and comes to resolve only momentarily, only to be editable again. We are indelibly linked to the other

figures with whom we share a spacetime. The movements and activity of the other figures determines our course of action as we affect theirs. By entangling time and action *Superhot* provides an idea of time as a process: a multi-temporal and physical process, ecologically enmeshed with the entities constantly forming alongside it while being formed by it.

Ultimately the ecology offered by videogames that refuse to engage with the supposed natural is one that brings us back to the idea of a sense of the potentially immeasurable, vast number of interconnections supposed by Morton noted at the beginning of this chapter; the idea that "the mesh of interconnected things is vast, perhaps immeasurably so".[270] That we cannot know, cannot 'measure' the extent of our ecological connection to the world is, however, a positive thing. It suggests the limits of human knowledge and within that, a surrendering of the idea that our intelligence is somehow important. By abandoning the aesthetics of the supposed natural, therefore, *Superhot* is able to suggest ecological relationships beyond those of the scale biological world. Although relations between bodies is chief amongst these, the game also suggests a relationship between bodies and time: without the bodies moving, time stays still but equally, those bodies are restrained to a linear progression of actions once they have begun. Through this digital experience we are given the opportunity to come to terms with a perspective that defies intuition and common sense but nevertheless tells of intimate meaningful connection.

PLAY AND SPACETIMEMATTERING

I have suggested that we use Barad's theory to suggest how *Superhot* suggests connections between time and action. As in Barad's intra-active ecology of existence, a timeline is formed (and reformed) in *Superhot* through the activity of all the agents within the game's mediated space. However, Barad's ontology extends further than this two-way connection between action and time; it extends to space as well. This may seem common sense as action suggests matter and all matter is engaged in intra-activity. However, it is extremely difficult to express this type of connection visually. For instance, in *Superhot* although time and action are expressed as engaged in an intra-active becoming, the space in which our actions take place is always solid. This is, obviously, to provide some stability in which to play. However, it presents problems when suggesting that *Superhot* can visualise intra-active ecology.

[270] Timothy Morton, *The Ecological Thought* (London: Harvard University Press, 2010), p. 15.

Barad's philosophy is entirely materialist in its scientific roots. For her 'time' is only an outcome of intra-activity. She writes:

> In fact it is not so much that they change from one moment to the next or from one place to another, but that space, time, and matter do not exist prior to the intra-actions that reconstitute entanglements.[271]

Looking to the quantum realm, for Barad, time does not exist as a separate quality to space or action. Rather, time is produced agentially. As such, time is malleable, extendable, omni-directional and can be 'thickened'. As such the events of any moment can appear almost unrelated. A single 'thing' can be in distinct locations simultaneously; events that seem to have occurred after an event can have distinct impacts on the apparent 'past'. However, as illustrated by the limited tree metaphor, visualising spacetimemattering, a view of reality where processes that sound impossible become plausible, is no small task. It is difficult not to think of the quotation popularly attributed to either Richard Feynman or Niels Bohr, "if you think you understand quantum theory… you don't understand quantum theory".[272]

Returning, however, to the aforementioned metaphor of the tree, Barad elucidates that the example is not without its problems either. To recap, Barad provides the idea that the rings of a tree which, in a manner of speaking, physically denote time, continue to grow and exist after they are formed. As such, we can begin to understand that as time moves on it also remains leaving traces in its wake. The first issue with this is the idea that time is like growth, a process that marches on leaving the past in its stead, is not accurate. We must realise that the past matters and is never left behind or finished. The same is, inversely, true of the future. We should not conceive of time as distinct moments. Rather we must embrace past, future and present as all engaged in an active process of matter's becoming. Although it feels instinctively correct to think of past, present and future as separated, even in that act of thinking the past and future we are engaged in a material process shaping intricate chemical, biological and electrical processes that produce our thoughts. What's more, Barad writes, the tree ring metaphor "Does nothing to interrupt the persistent assumption that change is a continuous process through or in time".[273] Thinking of the tree growing moment by moment, its slow expanding, we blind ourselves to an alternative complex reading of material reality.

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[271] Barad, p.74.
[272] Richard Dawkins, *The God Delusion* (London: Random House, 2006), p. 409.
[273] Barad, p. 181-182.

This alternative is that of intra-activity, in which each reconfiguration of matter changes the potential for becoming. Each action creates the conditions in which the next action can occur. This process, however, is not deterministic; nor is wholly a-causal. Rather, intra-activity revolves around the assumptions of quantum materiality wherein there is an indeterminacy of space and time. As in the two-slit and quantum eraser experiments that Barad draws on for her explanations, measuring apparatuses and their subjects are bound to each other and materially shaped by their coming into contact. This is due to our being apparatuses ourselves, shaped by matter of a scale so small that it defies common logic. Following Barad's logic, therefore, I want to draw attention to a number of games that attempt to visualise the relationship between action and potential for forming new actions: games in which the space in which we play is formed by our play.

Antichamber, designer by Alexander Bruce (2013) is ostensibly a puzzle game that presents a minimalist 3D virtual world that subverts ideas of Newtonian space. Early in the game, the user happens upon a chasm. The almost entirely monochrome colour palette is disorientating, suggesting no natural light source, no inherent sense of what is 'up' or 'down'. In front of you, the word "JUMP" hangs in the air displayed in enormous 3D capital letters. If the player chooses to follow this command and attempts to jump across the gulf, they will end up falling a great distance and being placed on a different path from that which they were previously following. At first glance, this appears to be a puzzle without a solution and, perhaps if the player is not familiar with the logic of videogames, this initial puzzle could prove terminal. If, however, they persevere, manage to make their way back to this puzzle, the solution is quite simple. Returning to the starting point, however, if the player decides to walk slowly across the chasm, solid ground materialises under their feet and they are supported. The space of the game, therefore, breaks with assumptions of physicality. Although the walls and floor of *Antichamber* seem solid, and the architectural arrangement of space appears, mostly, logical, it reveals itself to be impossible; by which I mean that one could not create the spaces of *Antichamber* using building materials in the physical world. Yet these spaces exist and can be traversed. The space of the game is revealed as generated as the system loads areas. This is not a linear process where one must be loaded after another. The space of the game can be accessed in any order depending on where the player progresses. The space of *Antichamber* is generated through a combination of processes. In this, the game is an expression of Barad's 'intra-active' theory of matter, where any one 'thing' cannot be held separate from an

encompassing whole.

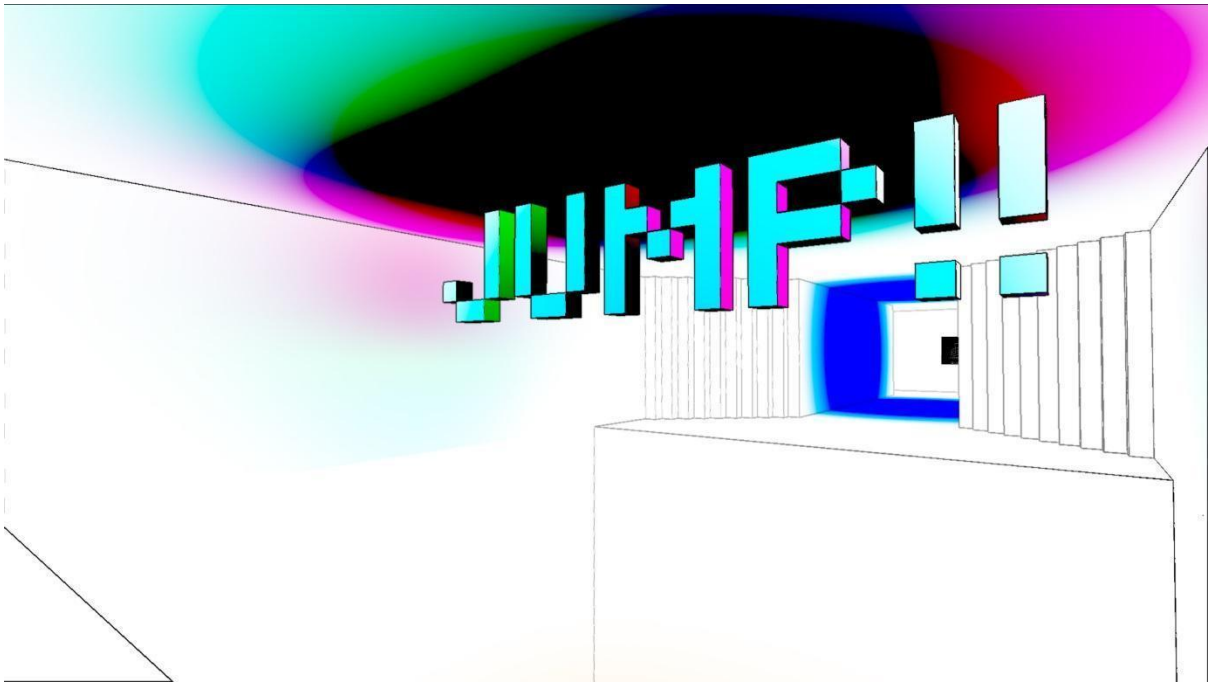

Figure 3. The chasm in *Antichamber*

So far I have drawn on aspects of Barad's ecological thinking such as her example of the tree stump and her analysis of the Indian jute industry. These examples denote the far reaching implications of her thought. This enables me to read videogames as a way to come to terms with humans within an ecological system. Looking at the external conditions that allow for a game to be played (the hardware, wires, electricity, the power grid that powers that system) allows us to think outward from the human being. As noted in my introduction, Barad provides the example of using a computer in an office situation to illustrate how it is difficult to know the boundaries of an apparatus. To recap, she asks, "does the apparatus include the computer? Is the printer attached to the computer part of the apparatus? Is the paper that is fed into the printer? Is the person who feeds the paper?"[274] The point made, is clear. Nothing is an island; no singular entity exists without being anchored within an active material surrounding. Another poignant example I mentioned from her work is that of the cigars of Walther Gerlach. Briefly, Otto Stern recruited Gerlach for a proposed experiment; to use a beam of silver atoms attracted to magnets to determine the polarity of electrons. Gerlach's low salary at the time determined that he bought cheap cigars which contained sulphur. The sulphur in his breath would go on to have an important impact on the experiment being conducted. Barad draws attention to how, in this case, an endless number of social, cultural and political factors

[274] Barad, p. 199

influenced that experiment (cigar making conditions, attitudes towards the Jewish population at the time and more general attitudes of disdain towards academics that persist till this day). However, rather than looking outwards for these wider human causes it is possible to look inwards towards the physical, material properties that allowed the discovery to emerge; the exact qualities of Sulphur, glass plates (one which the discovery was recorded) and the makeup of human breath. Both of these example of inward looking ideas towards ecology are essential in understanding the impact of *Antichamber*. By the admittance of its creator, it is an attempt to represent ideas that are often difficult to comprehend: "things that are completely incomprehensible by looking at mathematical formulas on paper, like quantum mechanics or non-Euclidean space, could be presented in a way that allows the player to interact with them more directly and understand their ramifications".[275]

I want to look at another interesting conflict from the history of quantum physics to shed light on the significance of *Antichamber* and games that employ non-natural aesthetics to visualise other ecological phenomena. The conflict of Bohr and Werner Heisenberg regarding the uncertainty principle and the theory of indeterminacy provides inspiration for Barad but also a pivot point around which we can read this game. The disagreement between the two scientists spawned in regards to the nature of measurement. Heisenberg's 1927 paper uses a thought experiment to consider the measurement of the position of an electron using a photon. This inevitably will result in the photon *disturbing* the electron, therefore changing its position. As such, Heisenberg contended there is a limit to what can be known through measurement. Bohr's counter argument is summed up neatly by Barad:

> One is not entitled to ascribe an independent physical reality to these properties [speed, distance], or, for that matter, to the notion of an independently existing object [...] For Bohr, the real issue is one of indeterminacy, not uncertainty. He understands the reciprocal relation between positions and momentum in semantic and ontic terms, and only derivatively in epistemic terms.[276]

In other words, Bohr contended that the issue in Heisenberg's thesis is the assumption that there are such things as definite positions and individual objects prior to the act of measurement. The issue is not ultimately one of what we can know but rather what can be said

[275] New Scientist Culture Labs, 'How do you Run and Jump in Warped Space?" [online resource] <https://www.newscientist.com/blogs/culturelab/2012/03/how-do-you-run-and-jump-in-warped-space.html>
[276] Barad, p. 118.

to (simultaneously) exist.

Returning to the example of crossing the chasm, *Antichamber* represents an attempt at visualising the entangled nature of being in a truly intra-active world. Although we can see empty space, the existence of that visible empty space requires our distance from it. Although we can traverse the gap when we walk slowly, our actions and the existence of the ground we walk on becomes entangled. For the ground to be there we must walk at a tempered pace. Different forms of activity shape the virtual space of the game. In this instance, the digital, iterative quality of the game helps make the example clearer as the physical exchanges of energy required to 'make' the ground under our feet cannot occur without the specific configuration enabled by our play. It is not that we cannot 'know' where the ground would be that fills the cavern as well as what speed we are moving at; these two things cancel each other out and different forms of activity result in different outcomes.

Ultimately, due to Barad's contention of non-separability, thinking intra-actively, *Antichamber* cannot hope to fully encapsulate the complexity of the scientifically engaged ontology; intra-actively, nothing can ever be simply 'representative'. Texts are always engaged in the shifting physical shaping of the world. As such, while we play *Antichamber* we are *actually* engaged in an active production of space. This generation is concurrent with the rest of intra-activity as a whole (the shifting of the material universe as discussed in Chapter 2). When we take the controller in our hands and play *Antichamber* we are, in a specific way, taking part in a shaping of the bodies engaged in the phenomenon. We should know that, just as we watch the level form around our actions, so too are our bodies realised over and again. Once again, it is unlikely that we can ever become fully consciously aware of this intra-active process but *Antichamber* allows us to experience aspects of a shifting material becoming.

Importantly *Antichamber* does not rely on metaphor to connote our activity with quantum ecology. In one sense, it could be argued that as the objects we see appear familiar, they are representations of real-world objects; of walls, of spaces, of houses. That these mediated objects behave in ways that defy our senses would not detract from this textual-reading of the game as representations. In itself, this would still be no small achievement and would be extremely difficult (if not impossible) to achieve outside the videogame medium. However, this is not the manner in which I want to engage with *Antichamber*. It is not important how we

'see' the digital objects on display. It is more important how these objects are being generated and how that generation, that digital performance, allows for an experience on the intra-active universe. It is through play, through the Baradian performance of the game, that the experience of mind-bending vertigo can be come to be. For example, a player may experience vertigo when we attempt to move through the chasm with its appearing and disappearing floor. This is an important engagement with the intra-active aesthetic. However, what is important is that this feeling is an engagement with and the outcome of a physical process. The world of *Antichamber* cannot exist outside of a videogame with its impossible architecture and appearing and disappearing surfaces. What we are engaged with, therefore, is the active performance of digital technology. The 'floor' we may feel is coming into existence, is not a floor in any way. It is a series of contingent machine operations on which our activity is reliant. Activities that can range from a feeling of successfully or unsuccessfully playing the game, to feelings of an upset stomach and a dizzying migraine.

Importantly *Antichamber* like *Superhot* also challenges the privileged viewpoint of a supposed user. As in the first example where following instructions results in a less than optimal chain of events, the game frequently seems to delight in punishing the player. There are few hints and those there are remain highly cryptic. There is also a timer, counting down from 35 minutes. When it runs out, however, there are no consequences. The cryptic nature of the game challenges players to disregard their sense of power. Staying with the image of the initial chasm, although we can 'see' what looks like empty space, we must begin to question the validity of what we see and our assumptions about space. We must accept that we cannot assume the physical characteristics of anything we can see in a game just because it is familiar. We must begin to understand that, like the presence of the cigar in the experiment or the photon impacting on the electron, our position in spacetime impacts our environment. As mentioned, when we 'see' the empty space, our position as viewer is – literally – what enables this experience. Just as Barad and the physicists she draws upon mention the action of the scientist, peering through the microscope and how this affects what she sees, in playing *Antichamber*, we are placed in a space where the environment responds to these conditions on a large enough scale as to be immediately noticeable. *Antichamber* prompts a different sort of ontology, one in which proximity and tactile contact is not the exclusive contributing factor to having an impact on the world. In this our actions become combined with the creation of our space and environment.

Staying with how the game trivialises the user, *Antichamber* often appears to undo the effects we have on the virtual environment. Although we manage to land on the, aforementioned, miraculously materialising bridge, for example, our efforts can be undone by stepping one way or another. Our position effects where the bridge appears to be. From the spot that we were previously standing on, the matter disappears beneath our invisible avatar's proximal 'feet'. Yet, it can always reappear if we choose to walk there again. While this process can be explained at the level of code (Alexander Bruce is cleverly manipulating the many 'layers' of real-time graphics rendering where the visual layer does not correlate with the algorithmic layer of co-ordinates and values) the unusual space of *Antichamber* resonates with the 'intra-active' theories of Barad on many levels. Too well to resist elaboration. As I stated above, time and space can be viewed as intimately linked with activity of spacetimemattering. As we act in *Antichamber* so too do we 'matter' as our environment formed around us in real time (but remains open to change). This is an entirely ecology way of viewing the world but in an entirely different manner than presented by *Shelter*. In games such as *Antichamber* and *Superhot* bodies are connected to one another, to their surroundings and present an iteration of the active formation of time and space.

Although an illogical environment may seem a counter-intuitive method for visualising something as potentially confusing as quantum physical reality, it nevertheless achieves its purpose. Take, for example, another one of the game's many puzzles. A space is presented with a small sign that reads, "If you don't pay attention to your surroundings, you don't know what you'll miss". A corridor is rendered that leads directly ahead and then splits into a Y-junction with both paths leading to different stair cases. The first, on the left is blue and leads up. The second, on the right, is red and leads down. However, if the player chooses to go up or down either staircase, they find themselves return to the position they were originally at. This can be repeated endlessly. No matter how fast or slow or how many times the player attempts one of the staircases, they are returned to the same conundrum. An endless loop in space appears to be in effect. However, if the player chooses to not go up either of the staircases, to instead, turn around and retrace their steps, they will find that a new area has opened up to them. There is now a third, yellow path that can be followed. On its own, this is an entertaining if initially bewildering trick. The solution to the puzzle lies simply in not trusting your perception of the space. Instead of thinking of space as something solid and dependable,

something that can be seen and so used, you must instead embrace the idea that the world is constantly being produced by endless phenomena, and so, can continuously change around you.

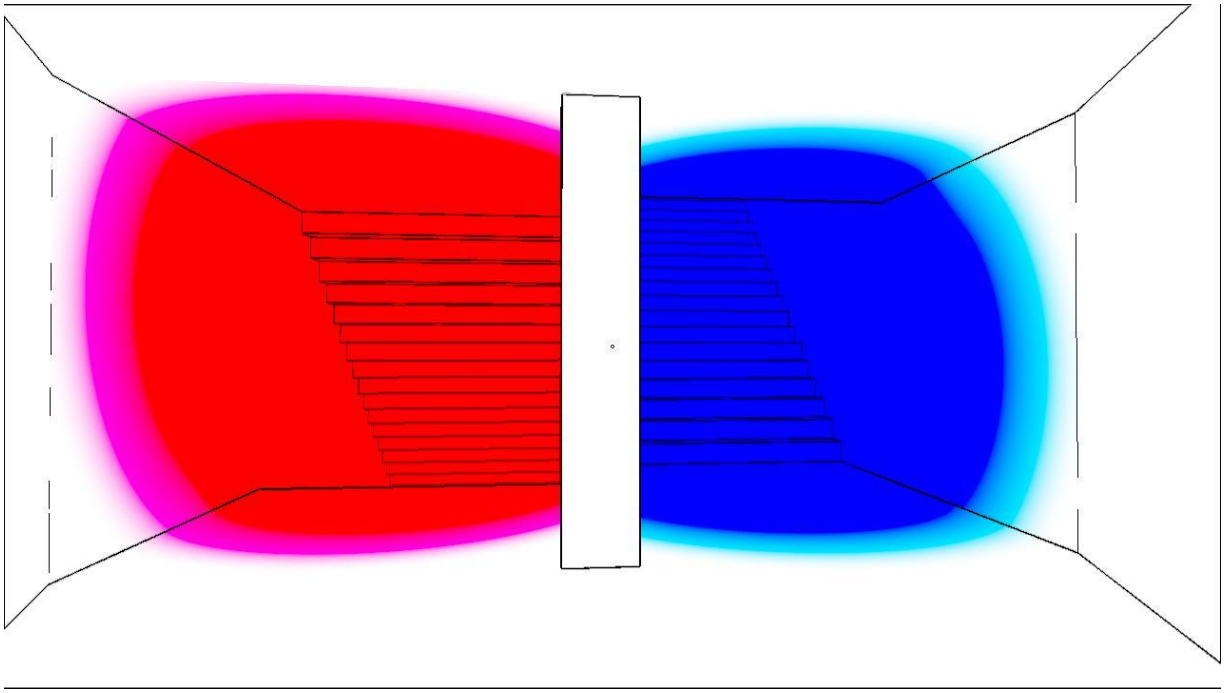

Figure 4. Two paths in *Antichamber*

Barad maintains, "it is possible for entangled relationalities to make connections between entities that do not appear to be proximate in space and time".[277] This is an important summation that we will return to but it is equally important to understand how Barad has come to this conclusion. She is drawing on the revelation of which 'which-path' experiments, conducted by countless researchers that have revealed matter to be more complex than we initially thought. Returning to what I outlined in previous chapters, amidst a debate concerning the properties of matter (and light in particular), whether all materials could be separated into two distinct camps of either 'particles' (distinct points with locations) or 'waves' (disturbances of distinct points that stretch through space) physicists looked to thought experiments in which matter would pass through a filter that separated it into two paths. The behaviour of the material could then be monitored by a form of sensor. To get a better idea of this experiment, picture sand being poured onto a surface with two holes: The sand, organised in grains, will fall through the holes and form two distinct mounds. In contrast, imagine ocean waves passing through two gaps in a barrier before reaching the shore. The stream of water passing through in intervals interferes with the other stream. This pattern of interference generates waves once

[277] Barad, p. 74.

again. When these experiments are shifted to less well understood matter such as light (photons) or, just above light in scale, electricity (electrons) the results would become more complicated. Bohr hypothesised, based on observable activity of electrons, that an individual electron would exhibit particle like behaviour when passing through the slits and when reaching the sensor. However, over time, the observable pattern left on the sensor would be that of an interference pattern. In other words, electrons could behave like both waves and particles.

What was important to Bohr was how the measuring apparatus was configured; if set to distinguish 'which path' electrons travel through, we would observe particle like behaviour. If set measure the final outcome we would observe wave like behaviour. What this suggests, and what is important for Barad, is that events, space and time are not distinctly separated but 'entangled' and changes in one part of an assemblage have a genuine impact on other parts. Again, this is explained in more depth, including a description of the more recent forms of experimentation that attempt to delete 'which path' data after places have been registered and find this has an impact but what is import to note, however, is that the effects matter can have on each other do not need to be linked through common-sense ideas of time and space. Barad concludes, "Space and time are phenomenal, that is, they are intra-actively produced in the making of phenomena; neither space nor time exist as determinate givens outside of phenomena".[278]

Returning to *Antichamber* the two halls puzzle takes on significant new meaning when approached from this science/philosophical perspective. That we can experience a looping space is pleasingly disorienting but when we come to accept an idea of space and time as non-linear, as intra-actively produced through activity, we can appreciate what it is that this game shows. Again, the solution to the puzzle of which of the two corridors we should choose is to turn around and go back the way we came. Keeping the two-slit experiments in our mind, what we see can take on new meanings. We can recognise that the nature of space and materiality is not fixed in time but actively produced through action. Just by moving, we shape the world around us. An action as seemingly insignificant as turning around can shape the world in enormous ways. *Antichamber* produces a very specific ecological statement through the two-corridor puzzle, suggesting that the player is constantly engaged in an active

[278] Barad, p. 315.

production of space and time through their activity.

The same can be said to function within *Superhot* when we experience the connection of our actions being intrinsically linked to those of the other entities within the game world. Although there are causal links, the software system, for example, these are not expressed within the game in the same way as they were in *Shelter*. In that game, connections through space and time were rationalised through the lens of a singular body. The kits and the mother badger were connected to one another by the means of survival. All the other entities within the world represented potential food sources or threats in an effort to achieve this goal. In *Superhot* however, other entities have no purpose other than their primitive programming. As you move, they move towards you, predicting your actions. Although this is very different to the example of which-path experiments provided by Barad, my ecological exploration shows, nevertheless, how videogames can make us aware of how our actions are engaged in a discursive relationship with the material world. Just as the discharging of an entangled photon from an electron within revised versions of which-path experiments shape the appearance of matter, so is our activity shaped by the spatially non-present but nevertheless guiding protocols of the game. Attempting to suggest a more holistic view of the construction of time wherein we can never know the full extent of what our actions relate to. Viewing *Superhot* in this way we can view it not only as a providing an ecological view of time as suggested above, but also the connected spatial quality of spacetimemattering.

TOWARDS AN INTRA-ACTIVE AESTHETIC

In a similar fashion to *Antichamber* William Chyr's *Manifold Garden* similarly showcases videogames' ability to express the phenomenal nature of entangled materiality. When the game proper begins, after a short tutorial – when players are introduced to the 'manifold garden' – the game's mediated space quickly comes into view. As if taken directly from the imagined architecture of M.C. Escher, *Manifold Garden* uses algorithms to generate space that imparts the effect of mise en abyme. Looking out into the distance we appear to see an endless expanse stretching out into the distance (figure 5).

Figure 5: Endless stairs in *Manifold Garden*

Of course, this is not what we are seeing at all; it is an illusion of space generated by specific soft/hardware processes. In reality, the game space is remarkably small and copies of the same small space are rendered simultaneously. We do not see our player 'avatar' in this space because there is no avatar. No hands or tools are ever used so we cannot see our presence in the reflected versions of the game world. While this explanation may sound underwhelming, even understanding how the game functions does not take away from its awe-inspiring abstract landscapes.

Adding to this, the game is designed in such a way that the three dimensional structures we are free to explore are not restricted by walls of any kind. We are free as well to change the axis of gravity and wander freely throughout the space of *Manifold Garden* seeing the same space from ever changing new perspectives. If ever we should 'fall' from the edge of a structure, we are exploring we experience the sensation of falling forever through space. This is generated by the game looping the data that represents our position to a relative 'starting point'. Put more simply, *Manifold Garden* uses the same rendering trick as was used in *Pac-Man* to prevent the player from wandering over the edge. It is important to remember, however, that in *Manifold Garden* as in *Pac-Man* although it may feel as if we are 'returning' to a place we had previously been, in actuality no such linear exchange has taken place. Rather, we must accept that the space we see is being generated anew in each moment. This is what allows the smooth

transitions, creating the appearance of an endless space.

A feature of *Superhot* and *Antichamber* is brought into focus through *Manifold Garden*. These games are linked through the presentations that defy common-sense but nevertheless, are resonant with particular ideas of space. Not only this, but these games allow users to engage with these visualisations. They allow users to play in this space. The experience of falling in *Manifold Garden*, the feeling of vertigo or "ilinix" following Roger Caillois, is brought on and made specific through the simulation of an endlessly created space. This is an important distinction, that the space, as we have seen through an understanding of Barad, is not endless prior to our engagement with it. It is remade over and again as we pass through the space. What this generates, however, is the particular feeling of being an essential part of the creation of the world we inhabit, even if that world is one as abstract and nonsensical as that of *Manifold Garden*. The vertigo that is brought on by play is not just due to the feeling of a vast open space, a feeling similar to awe; it is a feeling of calm that comes from knowing that space itself is a formulation that we are indelibly part of. It is a vertigo coming out of the "immeasurable" extent of our ecological connection to the world, to return to Timothy Morton. There is a similar quality of ecological ilinix brought about in *Superhot*, particularly when we are freed of our singular body and allowed to wander through space and time uninhibited, just as in *Antichamber* when we can create looping rooms or wander through spaces that appear in front of our eyes. In all, these games are signs of a newly occurring aesthetic that attempts to transmit the ideas of our being interlinked with the fundamental qualities of the physical universe through intelligent visual design. These games are symbolic of an oncoming *intra-active aesthetic* that is enabled through advances in technology alongside a growing knowledge of how to manipulate that technology. A unique transaction is occurring between scientific research, popular culture and technological access that is allowing us to transmit ideas in a pleasing visual form that were, previously, beyond comprehension. It is no surprise, given the intra-active nature of these games either, that this is a moment that has been reached through an enormous amount of simultaneity, through the sharing of knowledge, technology and resources. The intra-active aesthetic, the attempt to represent the newly discovered ontological qualities of the universe, is itself a vast ecological intra-action; a reconfiguring of technology and popular culture to foster both the creation and consumption of these texts. The extent of the impact of the intra-active aesthetic will have to be seen but it is nevertheless heartening to see engagements with the world that attempt to

come to terms with it as a *material production* rather than a lived experience.

The objectives of this chapter were to suggesting the developing *intra-active aesthetic* in videogame design alongside a reading of videogames that highlighted their strengths in bringing to light ecological relationships that go beyond commonplace theories of how material beings exist in time and space. Looking first to *Superhot* I suggested that the game expresses, following ecological theories of Morton and others, a kind of ecology between beings and bodies that goes beyond the standard notion of biological ecologies. Furthering this, however, with an eye to theories of time presented in the work of Timothy Barker I illustrated that *Superhot*, in practices, goes some way towards presenting bodies and beings as entangled with the materialisation of time itself. The reason behind this was to express that humanity's ecological involvement with the world does not take place at the level of entities, whether those are other humans, other species or other forms of matter altogether. Rather, after Barad, it is possible to conceive of humans as innately entangled with all materiality and our actions are a form of creation alongside those forces. Moving onto how this ecological entanglement extends throughout matter I looked to *Antichamber*, a game whose constantly remade spaces speak to a conception of reality that takes seriously the nature of constant becoming. Finally, looking to *Manifold Garden* I tied these three games together under a common theme, that of the intra-active aesthetic. These three games speak to an intimate relationship across space time and matter. They express feelings of our being caught up within an unknowable expanse through feelings of vertigo and unfamiliarity as we come to see space and time alongside ourselves as constantly remade.

Chapter 5: The Affective Ecology of Videogames

In the previous two chapters I explored the possibilities offered by my intra-active ecology of videogames. I first adopted a posthuman ecological approach to the analysis of understanding videogame interactivity. The novelty offered by this approach brings into view the ecological characteristics of videogame texts. Combining game studies and my agential-realist ecological philosophy I have advanced the idea that gameplay is not a process of discrete entities interacting but is, rather, an entwined and productive performance of materiality. In Chapter Three, I challenged 'interaction', where player and machine are seen as distinct, towards 'intra-action' where player and machine are co-constitutively produced through the phenomenon of play. In chapter four, pushing deeper into the complex ecologies of games I explored the aesthetics derived from physics algorithms and procedural number generators in a number of independent games. These emergent processes were understood as visualising the complexity of our world through a focus on the scientific aspects of ecology, often overlooked in favour of so-called nature. Examining, *Superhot*, *Antichamber* and *Manifold Garden*, I concluded that videogames are paving the way for a new aesthetic experience born out of a recognition of intra-activity.

Continuing to explore the implications of my ecological framework, in this chapter I desire to change gear, and focus on the opposite qualities that I have so far foregrounded. Rather than emphasising the ability of games to make us aware of the connections between matter in the world, I want to argue that games may similarly be able to enact a jarring process of becoming distinct entities. Barad dubs this process 'agential cuts', the process through intra-activity wherein objects appear to become distinct. In game play, the effects of these 'cuts', I argue, have a distinct affective impact. It is my contention that the bio-technological performance of a videogame has two distinct affective qualities. The first is that we can come to experience our bodies as our own. The second is that we can come to realise the limitations of our connections to one another, including the shortcomings of our emotional capacities.

To begin this chapter, I explore a game designed to a generate the feeling of a seamless coming together of biological and technical processes. Classic games feel intuitive and are known for their ability to produce deeply affecting gameplay experiences. These games are, comparatively, non-engaged with affective dimensions. We are asked, as players, only to feel

what we have been asked to – to root for the heroes, to hate the villains; the rush of an exciting section or the base stimulation of activities. Juxtaposed against these games, I compare them to a series of independent titles known to complicate the entangled nature of play. Rather than inviting intervention from users, the games examined in this chapter are all counter-intuitive or in some other way cognitively jarring. As such, they play on the barrier between affect and feeling; of the virtual and the experienced. While asking us to do one thing, they provide us with various other forms of stimulation. The experience is one of coming to recognise your body's ability to feel is contingent upon its materiality. These games are designed in such a way that the dimensions of your physical body – the specifics of an individual play-performance – come to play a role in the experience.

These non-immersive games, it will be shown, allow the ecological system of intra-active play to come to a disjuncture; in doing so they become a powerful force for recognising processes of differentiation and productive difference. In the first studies, *QWOP* and *GIRP* I argue that through the use of a complicated control system, the creator eschews immersion and the smooth entanglement. This generates the potential for realisation that play can be an attempt to control complicated machines. In making players aware of their actions, they are invited to see their becoming distinguished as biological from technical. Complicating this somewhat are studies of *Dys4ia*,[279] *Auti-sim*[280] and, finally, *That Dragon, Cancer* that push this boundary even further by telling intensely intimate, human stories. In doing so, these games ask us to simultaneously come to know, but simultaneously distinguish ourselves from the creators or characters of the videogames themselves. In all, these games make us aware that through the means by which we are brought together, we are simultaneously, pushed apart.

IMMERSIVE VIDEOGAMES

As I desire to explore affect in game play, I require an agential realist understanding of affect. Before exploring the extent to which games being immersive or non-immersive impact on affect, I will first define this broad term as I wish to use it. By "affect" I am initially referring to Brian Massumi's use of Deleuze and Guattari's use of the term which itself follows Spinoza and a host of others. Largely affect should be understood as a combination of "the ability to affect and be affected" and "an encounter between the affected body and the second affecting

[279] Anna Anthropy, *Dys4ia* [PC Videogame] (USA: Newgrounds, 2012).
[280] Krista Howarth, *Auti-sim* [PC Videogame] (USA: Games for Change, 2013).

body".[281] Affect is not to be confused with feelings or emotions as, Massumi notes, is too often the case.[282] Rather, affect is the collision of semi-autonomous pre-personal potential for what, through cognition, becomes the subjective, conscious, feeling or emotion. Discussing the example of patients who were implanted with 'cortical electrodes' in the interest of medicine, Massumi draws attention to the half-second delay between an electrical charge and the act of a human 'feeling' it. Before a conscious acceptance of stimulation, the potential for sensation takes place as physical activity is enacted by several bodies. This activity is one way of imagining the affective potential. Distilled to, perhaps, an over-simplistic definition, affect is the undiluted potential for feeling and emotion between bodies, prior to its being filtered and processed by a mind.[283]

As my aim is to discuss to affective possibilities of playing these games but within my agential realist framework, there are difficulties to address resulting from attempting to coalesce Massumi's theory with this materialist perspective. Initially, reading Massumi and Barad together, 'affect' remains possible but simply has a different explanation. Massumi contends that "when you place a brick next to another brick you are not placing matter against matter. You are placing effect against effect, relation against relation".[284] So far so good. This can quite easily be understood as phenomena intra-acting, giving rise to an apparent object. However, the idea of affect, as Massumi formulates it, is rooted in metaphysical ideas of transcendence and immanence. In one example of affect he discusses an experiment in which candidates are asked to remember the colour of friends' eyes. They are shown a number of photographs and asked to choose which of the photographs are of the friend in question. Massumi notes that in each case the result was that the candidates remembered colours as more vivid than they 'actually' were. He writes, "the blue belonging to the situation is both 'constructed' by the context, which in large part is language determined, *and* consists or persists out-side linguistic determination […] reality is not fundamentally objective. Before and after it becomes an object, it is an inexhaustible reserve of surprise".[285] Although Massumi suggests that the 'blue' that is remembered is indeed a construction, there is the lurking assertion that there was some form of 'blue' prior to perception – a potential, virtual blue

[281] Gilles Deleuze and Félix Guattari, *A Thousand Plateaus: Capitalism and Schizophrenia*, Trans. and foreword by Brian Massumi (London: University of Minnesota Press, 1987 [1980]), p. xvi.
[282] Brian Massumi, *Parables for the Virtual* (London: Duke University Press, 2002), p. 27
[283] Brian Massumi, p. 33.
[284] Brian Massumi, p. 203.
[285] Brian Massumi, p. 236.

before it is realised and becomes actual. He continues "when we speak of 'an' object or thing, what we are referring to is a complex interweaving of attributes and contents as subsumed under a nominal identity (a name). 'An' object subsumes a multiplicity that evolves situationally".[286] It is through propositions such as these that Massumi, problematically, departs from agential realism.

In an agential realist perspective, as has been noted already, such post-Kantian metaphysics are eschewed in favour of phenomena (though in a manner distinct from process philosophy). There is no distinction between virtual and actual objects. In their stead we view objects only as the apparent outcome of phenomena, giving rise to a single, constantly changing, material plane. Tackling Massumi's examples of perception of electric shocks and colour, taking an agential realist position, we understand that 'shock' or 'blue' are only apparent objects produced through certain configurations of forces (this is discussed in more detail in the previous chapter when I delve into the quantum physical underpinnings of Barad's theory). That the blue verified by a machine and the blue produced by a human mind differ is not surprising – it would be more surprising if they hadn't. Both the machine and the human being are productive apparatuses, producing anew based on their configurations. Barad reminds us, "the real is not constituted by a collapse of the existing set of possibilities; it is not a singular selection among present alternative possibilities".[287] Working in an agential realist mode, we do not need to postulate the veracity with which we perceive an object, whether this is the colour blue or anything else. Objects are, instead, the passing products of perception.

Although there are potential problems in absorbing affect into my agential realist framework, if we put these aside, affect actually comes to take on more of an important role within ontology. Given that there are no 'objects' (or 'subjects' for that matter) only the phenomena that produce them, the relationality that produces existence becomes of paramount importance. In actuality, Barad's 'intra-action' simply is a universal form of affect, yet she does not engage with the subject – in these terms – herself. Barad dedicates a large portion of her work to discussing the affective – in the sense of the reciprocal formation between apparent things – dimensions of a brittle star being in the ocean. There is an immediate relationship there between light and action, without the need for a brain, suggesting a potentially purely affective

[286] Brian Massumi, p. 216.
[287] Karen Barad, *Meeting the Universe Halfway*, p. 436.

form of activity. What we can understand, however, is that 'affect' as I use it, is concerned with the non-cognitive, non-verbal engagements between apparent objects without the need to recourse to a belief in a divide between virtual and actual.

On the whole, awareness of affect is generally something videogames attempt to limit. Massumi states, "put into words, it tends to take on positive connotations. For it is nothing less than the perception of one's own vitality, one's sense of aliveness, of changeability (often signified as 'freedom'). One's 'sense of aliveness' is a continuous, though not conscious, self-perception (unconscious self-reflection or lived selfreferentiality)".[288] It is difficult to utilise a constant state of aliveness into an easily reproducible game mechanic. Heightening a constant state of semi-awareness, lurking just behind every action would be maddening if it was expected to last as long as an average gameplay session (at least an hour or more). Rather, videogames are instead designed to satisfy our ability to be immersed or incorporated into another system. Almost the exact opposite of affect, we become less aware of ourselves and are, rather, placed within a mechanised system, expected to push buttons on queue.

While *Shadow of the Colossus* is not an independent game, licensed by the Sony Corporation and produced for the most successful console of its time, it is necessary to discuss it here to provide a clear example of how well designed 'mechanics' can lead to a state of immersion.[289] Briefly, to recap, mechanics are the relationship between player input and onscreen action.[290] Immersion, while difficult to define, has been described by seminal games designer Richard A. Bartle as linked to psychologist Mihaly Csikszentmihalyi's idea of 'flow', wherein activity no-longer requires conscious effort, and notes that some designers see the two as equivalent.[291] The main objective of *Shadow of the Colossus* is to kill giant monsters. This, of course, is nothing novel in videogames; it is the particulars of the game's design that makes hunting these monsters an immersive and engrossing experience. Players are given relative freedom within the virtual world. They can guide their avatar through a beautifully rendered but sparsely populated landscape searching for the titanic creatures. At the same time, the player is given a relatively large array of possible actions (input/output processes known as game

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[288] Brian Massumi, *Parables*, p. 34.
[289] Fumito Ueda, *Shadow of the Colossus* [Playstation 2 Videogame] (Japan: Team Ico, 2006).
[290] Miguel Sicart, *"Defining Game Mechanics", Game Studies*, Vol. 8, No. 2 (Online Journal), December 2008, <http://gamestudies.org/0802/articles/sicart> [accessed January 26, 2016].
[291] Richard A. Bartle, *Designing Virtual Worlds* (London: New Riders, 2004), p. 148.

‘mechanics’); players can walk, run, ride a horse, jump, grip, climb and use a sword or a bow (figure 1). Many of these mechanics can be combined: for instance, players can fire their bow while riding the horse, or leap from the running horse and grip onto another object. This means that spanning the sparse landscape can be a creative act, allowing the combining of actions to reach spots of distinct beauty or interest without having to be explicitly instructed to do so.

Figure. 1: The Flowing World of *Shadow of the Colossus*

When the player finds one of the sixteen titular beasts they must use combinations of the central mechanics in an attempt to scale the monsters’ bodies, search for weaknesses, and eventually exploit those vulnerabilities. Clutching fur and body parts while the attacked creatures attempt to shake the player off is a common feature of the game and is given an added level of excitement as the avatar can only grip for a limited amount of time. While combining the mechanics to successfully kill a colossus amounts, in reality, to only a few button presses, the precise timing and concentration required makes the game deeply engrossing. Stabbing a monster in its weak points requires the player to continue to hold down a button that coincides with the 'grasp' mechanic, another button to initiate the drawing upwards of the sword and then press this button again to engage in stabbing the creature. The sense of tension and relief, combined with the fluidity of the controls imparts a sense of immense stakes, of life or death struggles. At the same time, the simplicity of the input means the player is not distracted by the physical action required on their part for the on-screen action to take place; there is no discontinuity, therefore, between virtual situation and physical action. The intuitive controls allow the player to feel involved in a series of logical and narratively

consistent actions. Whether the player in question views the action or as a narrative driven David and Goliath tale unfolding in a new context, as a system with varying potential outcomes or as a new spatial paradigm, their relationship to the text is decided by the interface they use for input. The smooth flow from action to action allows players to become immersed in the game world they inhabit.

For most, immersion can be agreed upon as the feeling of being *in* the game rather than consciously inputting commands. Yet, it remains a contentious term within games studies; Sicart notes in Beyond Choices that although the term was commonly used in the early 2000's it is rarely used in academic game studies today.[292] This is particularly true since the publication of Gordon Calleja's critique of immersion in which the term is supplanted by a more holistic approach to gameplay, 'incorporation'.[293] However, while Calleja's insights into immersion are unparalleled, his investigation is somewhat close to a 'how-to' for designers, encouraging techniques for creating and sustaining incorporation through design. His interest seems to stop at the moments where incorporation is disturbed. That being said, whatever the phenomenon is called, the processes of becoming 'immersed' in play will always remain a relevant topic in game studies.

What exactly causes immersion and how literal immersion should be understood is still under question. The phenomenon has been noted since the inception of games studies by Murray as the "experience of being transported to an elaborately simulated place," resultant from the "sensation of being surrounded by a completely other reality".[294] Likewise, for Ryan immersion is noted as the moment when the player's "consciousness relocates itself to another world".[295] While playing *Shadow of the Colossus*, the feeling of being engrossed by the technically complex task allows, for these scholars, a sensation of immersion in the virtual world created by the game narrative, sustained by the gorgeous visuals and epic score.

In more recent research, it is argued that immersion can be achieved through a variety of methods, including (but not limited to) a heightened sense of competition, as when players

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[292] Miguel Sicart, *Beyond Choices: The Design of Ethical Gameplay* (London: MIT Press, 2013).
[293] Gordon Calleja, *In-Game: From Immersion to Incorporation* (London: MIT Press, 2011).
[294] Janet Murray, *Hamlet on the Holodeck: The Future of Narrative in Cyberspace* (New York, NY: The Free Press, 1997), p. 98.
[295] Marie-Laurie Ryan, *Narrative as Virtual Reality: Immersion and Interactivity in Literature and Electronic Media* (Baltimore: Johns Hopkins University Press, 2001), p. 108.

gamble in a high-stakes poker game, a sense of involvement with a detailed and emotional narrative or else through multiple sensory engagement. As such, immersion can be understood as divided into subcategories of cognitive, emotional and sensory-motor, as proposed by Bjork and Holopainen.[296] At the same time, other scholars propose eight subdivisions or more.[297] As game studies has developed, theories of immersion have developed and become more complex, borrowing from the psychological theory of 'presence'.[298] This has allowed games studies scholars to engage with immersion without resorting to concepts such as 'other realities' or 'relocation' to instead discuss it in terms of the mental construction of situational models while at play.[299] It is worth noting, following Jamie Madigan, that 'presence' is just as, if not more so, contested within psychology as 'immersion' is within games studies.[300]

Given the interdisciplinary and discursive nature of debate over immersion, it has become understood as an entwined, "multidimensional phenomenon" dependent upon a variety of spatial, ludic, narrative and social attributes with an enormous potential for further discussion.[301] A single definition of presence or immersion may be less useful than a multitude of definitions separated by subcategory as Jan-Noël Thon concludes when discussing the many varied approaches to immersion within game studies and beyond, "The distinction between its spatial, ludic, narrative and social dimensions allows for an appropriate description of player experience that builds on the much contested concept of immersion".[302]

Though immersion is regarded today as a multidimensional phenomenon, which is to say including many factors, these extra-sensory elements are considered only in their effect upon the human. Rarely is immersion discussed in terms of a multi-*directional* system that could include both human and machine agencies in an ecological fashion. The rigid acceptance of human subject and digital object is problematic as it precludes a more ecologically oriented approach to analysing immersion.

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[296] Staffan Bjork and Jussi Holopainen, *Patterns in Game Design* (London: Charles River Media, 2004).
[297] Robin Hunicke, "MDA: A Formal Approach to Game Design and Game Research", *Proceedings From the AAAI Workshop on Challenges in Game AI* [Online Journal] (2004) Vol. 4, No. 1.
[298] A McMahon, "Immersion, Engagement and Presence: A Method for Analysing 3-D Video Games" in Mark Wolf & Bernard Perron (Eds.) *The Videogame Theory Reader* (New York, NY: Routledge, 2003) pp. 67-86.
[299] Jan Noël Thon, "Immersion Revisited: On the Value of a Contested Concept" in Olli Tapio Leino & Hanna Wirman, Amyris Fernandez (eds.) *Extended Expression : Structure Analysis and Design of Computer Games* (Rovaniemi: University of Lapland Press, 2008), pp. 26-43.
[300] Jamie Madigan, *Getting Gamers* (London: Rowan and Littlefield, 2016).
[301] Jan Noël Thon, p. 40.
[302] Jan Noël Thon, p.40.

Working from a posthuman perspective, we can suggest a different approach to immersion. Instead of seeing a solid distinction between bodies and code, Anna Munster suggests, "no longer can we consider 'the body' an antimony of code; its incorporeal capacities are simultaneously amplified and divided from its physicality as we come to think of digital embodiment as a process of living in information culture".[303] For Munster, both the unerring logic of computer code and the intensive, incorporeal complexity of bodies must be seen as permeable, capable of being "folded" in upon one another, "so as to maintain something of their singular properties (which each brings to the other) *and* to combine them into a new consistency".[304] In their constant proximity in modern life they cannot help but nuance each other and bring about new states of being.

Bringing media theory to bear on immersion, it is imperative that we begin to recognise the role of code and digital processes in the creation of immersive experiences. The immersion specific to digital games must be recognised as not just multi-dimensional but as a shared state resulting from the collision of biological and mechanical process. The *amplification* and *division* of the body in Munster's theorised engagement is similarly a facet of the videogame experience. As discussed in the previous chapters of this thesis, viewing videogame play ecologically requires us to think of the human as a part of a system, of human bodies *divided* from their physicality, in Munster's terminology, by their extension to an on-screen presence. Similarly, these divided bodies are *amplified* as their minimal input comes to matter as an intervention within an electronic system.

It can be argued that videogame immersion is evidence of my ecological, processual view of videogames in action. If we accept that the processes of the human are not only sensitive to 'real world' stimuli, if we accept that vision, hearing, empathy and cognition can be stimulated by the digital stimuli of a videogame to the point that the body will privilege these stimuli over 'real world' stimuli, we can see this as an indication of the shared processual nature of real and digital worlds. Immersion can be visualised as a free-flowing exchange of energies between bodies without having to distinguish between which is 'real' or 'digital'. Smooth immersion

[303] Anna Munster, *Materialising New Media: Embodiment in Information Aesthetics* (New Hampshire: Duke University College Press, 2006), p. 184.
[304] Anna Munster, *Materialising New Media*, p. 33

then depends upon a game system that encourages this flow of processes, encourages the entwining of player and machine, and a player competent enough to take up this flow. Though the above critics have argued that immersion must be understood as accomplished in different ways (narrative, spatiality, ludic systems, etc.) these seemingly different features are all reducible to the reaction of algorithmic processes meeting and entangling with human processes in a smooth manner.

With an ecological conception of immersion established we can return to examples in search of renewed understanding of how this impacts upon affect in game play. Looking again at *Shadow of the Colossus* it is possible to re-evaluate the game's immersive design. As stated above, the game's immersive qualities are currently understood as the result of the game having an effect on the human player. Instead, we can see immersion as emerging from ecological processes. In this case the game emerges from multidirectional practices between human and non-human agents. The systems at work have been designed to allow for an uninterrupted flow of action without any obvious sources. The 'player' does not experience immersion because the 'machine' prompts it. Rather, within the saturation of information culture, there are a variety of processes that intermingle. We can speak of immersion without the need to reflect on a sources or bodies. That this should occur in *Shadow of the Colossus* is no coincidence. The game system is one of virtually limitless possibilities. The land that can be explored is vast and most objects respond to input from other objects. For instance, the game is populated with lizards that can be killed and eaten though the player is never forced or even encouraged to do so. These same lizards can also be trampled by the player's horse. The scattering of events throughout location, the many varied opportunities for consumption or destruction, shows the vast possibilities of the game's algorithms to support a wide selection of activities. This variance transfers into the main task of scaling the colossi which is not restricted to a specific path or strategy. Algorithms work so that mistakes can become a part of the flowing processes of the game. Falling from a great height may end up in a dynamic movement but does not halt the game. This flow of action is indicative of the internal game loop continuing to transpose external input and its own computational logic into a continuous stream. The entangled processes are ensured, like electricity in a complex circuit, another path through which to progress.

Returning to the question of affect then, the ecological performance of the videogame does not

look like good news. Rather, the ability to become immersed within a videogame – or incorporated – is to cease to be aware of, if awareness is even required, your affective potential. Possibility and potentials are restricted to the stimuli offered by the continuous, seductive game system.

VIDEOGAMES AFTER IMMERSION

As noted above, Munster describes the interplay of bodily and computational actions using smooth, harmonious imagery such as folding. However, at the same time, she states explicitly that fundamental to this enfolding are moments when machine/user amalgamation is disrupted out of harmony. In these moments of processual dissonance also begins a process of differentiation. For Munster, although human-computer-interaction offers an example of enfolding it also engenders differentiation; she writes:

> Most figurations of the cyborg and theories of posthumanism treat body and code as predefined unities that impinge upon and assimilate one to the other. And yet living with contemporary digital machines produces instead everyday encounters of doubling, splitting and reverberating as new aspects of our bodily experiences. We occupy and produce relations of differentiation and integration between the corporeal and the informatics, such that converging and diverting series of machine-body events begin to map themselves out.[305]

It is important to note here that Munster does not see enfolding and differentiation (convergence and divergence) as mutually exclusive terms. Rather, she explains "the multiplications by no means provide seamless matches between body and code; the mismatch characteristic of divergent series triggers the extension of our corporeality out towards our informatics counterparts".[306] Though the bonding of varied agencies is anything but "seamless", the friction of integration motivates an "extension of our corporeality" towards the non-human agents that share and foster our collective embodiment in the digital age. While this friction would likely be present in any integration of digitality into a biological body, in Munster's words, "the forces interacting with these technologies and carrying the greatest tendency toward divergence emanate from human bodies".[307] She notes that there is a specific "extensive vector" that extends from a human within these digital relationships that "draws embodiment away from its historical capture within a notion that the body is a bounded

[305] Munster, p. 31.
[306] Munster, p. 33.
[307] Munster, p. 185.

interiority".[308] In other words, the particularities of human extensive reactions allows them to refigure their sense of embodiment as one of inclusivity with the digital but never as assimilated by or impinged upon. This reframes the potential for games to be affective as it instead presents the potential for us to become affective through our digital ecology.

Luckily, Munster provides an example of this process of differentiating divergence as precipitating out of and being characteristic of the convergence of digital gameplay. She notes:

> Computers offer us multiplications and extensions of our bodily actions: cursors that glide across the screen interface, then stagger abruptly at its edges; three-dimensional anime-styled dancing characters that direct us to clumsily mimic their stilted disco moves in the "Dance, Dance Revolution" rides that populate gaming arcade; a gaze that swoops and dives over terrain in simulated game landscapes yet frequently crashes into pixellation as machine processing speeds lag behind gamers' actual movements.[309]

Abrupt staggering, stilted movement, pixilation, and lag are all seemingly unavoidable characteristics of digital games. Regardless of the hardware, it is likely that there will always be some background system or change in machine temperature that will impact upon the otherwise seductively smooth game aesthetics. This is the nature of the uniquely ecological system that videogames represent. Reframing these glitches inspired by Munster's work, however, allows for the following proposal: glitches and other shortcomings of digital games are the instigators of friction in the otherwise harmonious integrated system of enfolded, ecological play. These same shortcomings are identified as the characteristics of games that prevent immersion from taking place. Miguel Sicart dubs this phenomena 'cognitive friction' wherein a player senses disjuncture between their actions and what is represented. [310] He notes that cognitive friction is the "resistance encountered by a human intellect when it engages with a complex system of rules that change as the problem changes".[311] He provides the example of first encountering a complex user-interface (UI) such as Adobe Photoshop and the need for users to ask themselves, "where are things located? What do I do to get what I want? Where am I?".[312] He goes on to clarify that, for the most part, game designers are encouraged to minimise cognitive friction as much as possible.

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[308] Munster, p. 33.
[309] Munster, p. 33
[310] Miguel Sicart, *Beyond Choices: The Design of Ethical Gameplay* (London: MIT Press, 2013), p. 94.
[311] Miguel Sicart, p. 93.
[312] Miguel Sicart, p. 93.

In the example of *Shadow of the Colossus* this is precisely what is being implemented; the smooth transitions between states and actions allows an organic exchange between human intellect and complex system, effectively allowing a more complex system. Just as Munster, however, Sicart notes that designers are not always interested in reducing cognitive friction and that it can be used to create certain experiences. For him, "cognitive friction explains why some objects are better experienced emotionally rather than rationally".[313]In the context of a videogame, therefore, Munster's idea of folding, which is in itself an entanglement of convergence and divergence, can be thought of in terms of the level of friction the game is designed to induce. Where there is minimal cognitive friction the game is immersive; systems collide and entwine. When cognitive friction occurs, inevitability due to extensive vectors emerging from intensive human bodies, an act of extension occurs wherein the body is refigured as involving the digital but never supplanted by it.

Munster provides examples of games that lag behind the human player or fall short of fully enrapturing the player in some way. It can be argued, as Don Ihde illustrates below, that this is inevitable due to the inability of even the most advanced VR systems to capture the full sensory complexity of real life:

> The newer, virtual extrapolation – still largely primitive – adds partial tactile-kinesthetic experience to the audiovisual. This may range from minimal hand-operated interactivity (a joystick, for example) to fully wired bodysuits for higher degrees of virtuality. But if one takes nontechnological, active, wholebody experience as the norm, one can easily see that even these technologies fall short.[314]

On a fundamental level, the experience of playing a videogame – at least at present – cannot wholly subsume the human body into a process of immersion. At some point, gaps will become present in the exchange of sensory information; immersive convergence will descend into fractious divergence. However, there is something at stake in the practice of designing games to produce immersion for as long as possible against the practice of designing game to *intentionally* produce friction. At first glance, whereas the intentions of immersive design are known designing to produce friction is designing to produce unexpected results from players; it is an understanding that agency is not something that can be so neatly controlled by an

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[313] Miguel Sicart, p. 94.
[314] Don Ihde, *Bodies in Technology* (London: University of Minnesota Press, 2002), p. 128.

algorithmic process. The design of *Shadow of the Colossus*, its smooth virtual world that encourages flow by allowing a vast digital space to be traversed using a handful of easily entwined basic mechanics, encourages continuous and unbroken engagement. In contrast to this, what can be achieved through a design that seeks to prohibit immersion as quickly as possible and instead encourage the extensive processes of divergence as a matter of priority? For the remainder of this chapter it is these games that I will look to for examples of entangled action that privilege divergence over immersion.

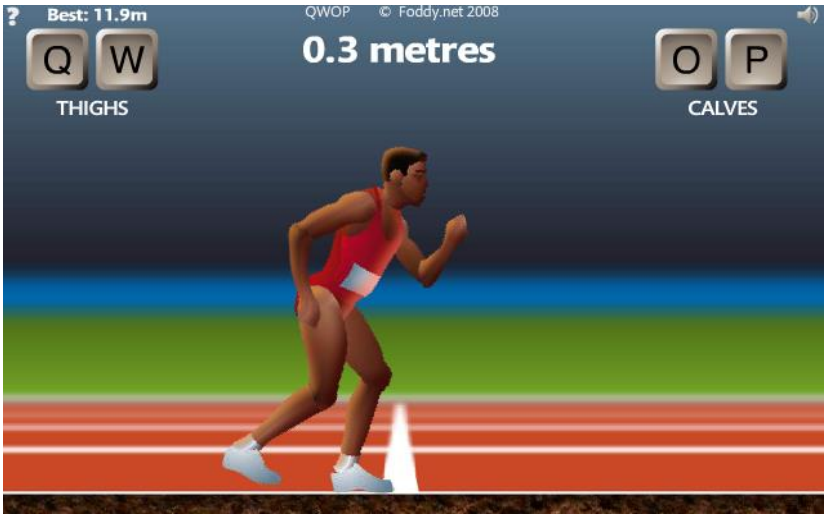

Figure 2. Qwop at rest

If it is common practice to design for immersion then Bennett Foddy's, *QWOP*[315] and to a lesser extent, *GIRP*[316] are designed in a deliberately contradictory manner. In Foddy's games executing a basic action becomes a challenge in itself. For instance, the objective of *QWOP* is simple: the player must make 'Qwop', the humanoid avatar, run. Though this may sound simple, the only method of controlling Qwop is to press a combination of the Q, W, O and P keys on a computer keyboard (or corollary on-screen controls in the iOS port). Although it is not exactly clear what each key does, it seems that pressing 'Q' raises the left thigh into a bent position while, at the same time, stiffening the left calf so that the left foot arches. Pressing 'W' does the same but with the other leg. The 'O' and 'P' keys cause a leg to completely straighten and extend. To move the avatar forward requires alternate pressing of two buttons in unison (lifting one leg and pushing out with the other) in order to make functional steps. If any of the buttons are pressed for too long the avatar's body will become overly stiff, contort and fall over (Figure 2). At the same time, the head, feet and arms are all affected by the in-

[315] Bennet Foddy, *QWOP* [Adobe Flash Web Browser Video Game] (Oxford: Independently Released, 2008).
[316] Bennet Foddy, *GIRP* [Flash Browser Game] (Oxford: Independently Released, 2010).

game ‘gravity’ (the simple downward force, discussed in the previous chapter) all of which must be compensated for as Qwop moves.

The effect of the distinct controls of *QWOP* is been described as “excessive phenomenological correspondence” by Garvin, as the input required does not match with the on-screen output.[317] This lack of correspondence generates the aforementioned cognitive friction and prevents immersion. In *QWOP* it is unlikely that the flow of steady commands and reciprocal machine output representative of immersive play will ever be reached or sustained for a lengthy duration. Unlike the chain of tasks and commands in *Shadow of the Colossus* that encourage a flow towards new challenges and opportunities, with biological and machine effort overlapping and interplaying, the challenge of *QWOP* remains the same throughout play, but is marred by constant, jolting failures. The experience of *QWOP* is one of consistent halting, restarting and returning to the initial game state. Flow is sacrificed in favour of a series of disconnected jumps. Failure cannot be recovered from in a smooth manner as Qwop becomes tangled into a knot of its independent limbs. Instead the game is begun anew with no continuum between play sessions.

The enfolded digital/human is pulled apart by the dissonant play experience of *QWOP*. Munster observes that the arcade game, *Dance, Dance Revolution* uses on-screen anime stylised digital mannequins to suggest potential dance moves for the human bodies involved in the play system. In time, the digital bodies and biological bodies become increasingly out of sync and the process of differentiation ensues. We notice the limbs of the mannequins moving in a manner that is unfamiliar and uncanny. In *QWOP* the body of the digital avatar is initially posed to run, crouched on one knee. If you do not press a button immediately, the body visibly sags, suggesting a release of stored tension between the various connected limbs. These visual signifiers trigger notions of great speed and immediacy, familiar thoughts of sprinters leaving the starting blocks. However, the first button presses will likely trigger a comical collision or a flailing of limbs that indicates the potential power of those digital limbs and the need for cohesive order and structure to their movements. It becomes clear immediately that the on-screen avatar has no guiding human-like force to make its movements cohesive. The limbs of

[317] Joseph Garvin, "One Simulated Hand, Two Real Hands: Antisimulation and Phenomenological Correspondence in Videogame Control Schemes", *Press Start*, Vol. 2, No. 1 (Online Journal) September 2015, <http://press-start.gla.ac.uk/index.php/press-start/article/view/22> [accessed January 26, 2016].

the body function through algorithms alone. Discordance between the entangled digital and biological forces is brought on by the friction of difference between systems: the human emerges from this encounter as one that functions in a synchronised and complex entanglement while the digital is one of discrete limbs that can function with no regard for another.

Figure 3. Qwop falling

At the same time, however, this dissonance gives rise to a desire for a kind of order; enacting this desire, risks breaking down, organising, complex functions. The digital body of *QWOP* is disjointed and cut-up into separate operating protocols. The desire to muster these independent flailing parts into a semblance of order is, as Munster indicates, the extension of our corporeality outwards towards our informatics counterparts. Due to the rigid user interface, the only outlet for this extension is to press one of the four buttons presented to us. To fulfil our desire for extension we must begin to organise our complex desire, 'to make Qwop run' and begin to deconstruct it into simple, individual parts, corresponding to the limbs of the avatar. This may begin as 'press Q+P followed by W+O' but as the player becomes more and more proficient these input processes are increasingly whittled down into specific organised parts, 'press Q+P for 0.5 seconds followed by a pause for 0.25 seconds before pressing Q+P as rapidly as possible before moving onto W+O for 0.5 seconds; repeat'. The logic required to play *QWOP* efficiently is that of an organised machine, down to the division of otherwise flowing time into quanta as potential moments for actions.

I will, in this chapter, eventually return to an agential realist perspective on proceedings. I will conclude that the so called 'feelings' of playing games can be understood as ecological processes and, as such, come to appreciate the potential for games to influence concepts such as affect. In order to do this I want to first establish a concept of the body within Deleuzian criticism. I feel, when approaching Deleuze and Guattari's discourse surrounding bodies, organs and organisms. It is important to first note Deleuze's concept of the body as "any whole composed of parts" simultaneously distinguished by the relation between its parts.[318] Anything from single-celled organisms to societal structures, such as the 'body politic', are bodies. When given structure, order and organisation by its parts, the body becomes an organism, classified by a "hierarchical and dominating organisation".[319] An organism is a centralised, hierarchized, self-directed body, engaged in a series of "virtual singularities actualised in such a way as to preclude the actualisation of other, alternative, patterns".[320] With the creation of ordered organisms comes desire, territorialisation and the production of social machines which come to function together within production and reproduction: "For even death, punishment, and torture are desired, and are instances of production (compare the history of fatalism). It makes men or their organs into the parts and wheels of the social machine".[321] Within the modern, capitalist system of the contemporary western world, the subject is an organised system, led by desiring organs (machines) to consume. Computer software and algorithm based programs can be conceived of as organs within the wider organism of the social machine. They function solely based on the relation of their 'organs'; their scripts, classes and variables that produce their action.

Understanding playing *QWOP* as discussed above transfigures the act of play into an engagement with levels of organisation. In playing the game, the challenge is metamorphosis: for the subject to become, as best possible, an organised organism. *QWOP* moves beyond even instinctual practices by reconfiguring familiar videogame tasks such as running and reconstructing them as discrete intervallic processes that must be input rapidly and without error. Playing the game is shapeshifting from organic body to technical organism through an entwining and becoming. Of course this occurs within a larger, societal machine at the same

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[318] Bruce Baugh, "Body", in Adrian Parr (Ed.), *The Deleuze Dictionary Revised Edition* (London: Edinburgh University Press, 2010), p. 35.
[319] Bruce Baugh, p. 37.
[320] John Protevi, "Organism", *The Deleuze Dictionary*, p. 200.
[321] Gilles Deleuze & Félix Guattari, *Anti-Oedipus: Capitalism and Schizophrenia* (London: Continuum, 2004), p. 159.

time as the body is steadily shaped to become more organised, more adapt at repetitive keystrokes and data input. In playing *QWOP*, control is the main process through which biology comes to interface with technology in becoming increasingly structured and organised to provide a series of input pulses that allow the program to continue running rather than restarting continuously. In all, the understanding of interaction I have suggested here is, following Munster, one of enfolding and entanglement that is, at the same time, following Deleuze's theories, a process of "organisation" as bodies become increasingly striated and susceptible to control.

As Munster has, so far, provided the scaffolding around which to build an understanding of this differential form of play, it is important to remember she suggests a moment where the enfolded interaction collapses. This collapse of entanglement can be understood using the body without organs. Within the confines and structures of Deleuze and Guattari's organisms there is also a force of chaos, destruction and disorder. The body without organs is the plane within which can be found collapse and disorder as well as potential and reformation. Working together, Deleuze and Guattari defined the BwO as "an egg: it is crisscrossed with axes and thresholds, with latitudes and longitudes and geodesic lines, traversed by *gradients* marking the transitions and the becomings, the destinations of the subject developing along these particular vectors".[322] This explanation has been clarified as a reference to the timeless question, 'What comes first, the chicken or the egg?' with the BwO existing adjacent to and continuously as part of a body's construction of itself.[323] The body without organs is not the enemy of other bodies but is, rather, opposed to "the organising principles that structure, define and speak on behalf of the collective assemblage of organs, experiences or states of being".[324] Though biological bodies become organised and engaged in 'control' when enfolded with technological bodies, they are simultaneously engaged in a process of transformative becoming, shifting from their old configuration into a new one.

Colin Cremin provides an example of applying the BwO to videogames; focusing on Deleuze's organised subject Cremin suggests that by playing games humans can challenge their becoming organised. By playing anarchistic games, players can 'make' a body without

[322] Gilles Deleuze & Félix Guattari, *Anti-Oedipus*, p. 21.
[323] Kylie Message, "Body Without Organs", *The Deleuze Dictionary*, p. 39.
[324] Kylie Message, p. 38.

organs with which to challenge authority. He writes,

> How do we make a body without organs? By multiplying. By exceeding what the body in its organic organisation was until then capable of. By making ourselves a body without organs we loosen the grip of organisation and compose with affects. Because affects exceed what the body defined by its (molar) identity was considered capable of[325].

Playing videogames is viewed as an assemblage of bodies that allows the human body to exceed the organism by liberating affects stored within software corroding the organised boundaries.

Cremin's concept of play from a Deleuzian perspective, particularly when he argues for a concept of play as co-creation, leads the way for even further nuance through the problems to which it draws attention. Cremin's work highlights that when we conceive of play as an assemblage it is then problematic to revert back to clearly defined concepts of 'player' and 'game'. Though he argues, "[w]e do not interact with videogames as such; we are part of a videogame assemblage"[326], he later argues, "the videogame rewards those who are receptive to the affects they liberate through their actions".[327] Without first attempting to challenge the idea of a solid subject, his approach attempts to override semiotic dependent methods of order and control while functioning within them. It is unlikely that 'I' can play 'a game' in order to receive a new experience beyond the confines of an organised self. More likely, 'I' will perceive myself as in control of 'a game', and further organise anarchic gameplay into my already stratified life.

Playing for the immersive pleasures of games cannot lead to the breakdown of the organised body. Rather, it is through failure that we can instead begin to construct a BwO through play. The demands placed on a player by a game such as *QWOP*, demands which cannot possibly be met, are the methods by which the organisation of the subject can be challenged. Even if, eventually, the enfolded player can rise to the challenge of *QWOP*'s interface and achieve a smooth, human-like form of running, the game processes do not provide a reward.

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[325] Colin Cremin, *Exploring Videogames with Deleuze and Guattari: Towards and Affective Theory of Form* (London: Routledge, 2016) p. 19.
[326] Colin Cremin, p. 19.
[327] Colin Cremin, p. 21.

Completing the objective does not stop gameplay either; instead the game continues to loop onwards. The challenge at this point shifts from one of mastering controls to one of maintaining concentration as the now boring activity becomes tiresome. As Munster suggests, the human extends its humanity in the moments of mismatch between the movements of the flesh body and the digital avatar. In the friction generated in playing *QWOP* extension occurs from the site of the organic body as the crude organism of the machine fails to mimic human complexity. Unlike in the examples suggested by Munster or Cremin, friction is not the exception but is, rather, constantly at work in *QWOP*: first, there is abundant friction as the unwieldy user-interface prevents immersion. Second, there is the lingering friction as the pointlessness of mastering the difficult task seeps in. In playing *QWOP* an attempt can be made at imitating an organised organism. However, at the edges of play lurks the body without organs, the quality of organlessness, waiting to disrupt the ordered patterns of smooth play. In brief moments of distraction, physical twitches or lack of concentration the briefly combined, enfolded, assembled organism will break apart. In the inability to rid *QWOP* of the body without organs there is the small indication that the human body can never completely become an organ within an organism.

Figure 4. *GIRP*

In a similar manner to *QWOP*, *GIRP* (also by Bennett Foddy) is engaged with disrupting the enfolding practices of biological and technological bodies. In *GIRP* the challenge shifts from running to climbing. The player is presented with an avatar half submerged in water, standing

on a ladder, facing a cliff face studded with many hand-holds, evidently preparing to climb it. The hand-holds are each assigned a letter (a-z). The closeness of the holds corresponds with the closeness of those letters on a standard western ('QWERTY') keyboard. For instance, two holds that are together will be assigned 'a' and 's' while a hold furthest away from 'a' will be assigned 'k'. The letter assignment is generated algorithmically as the player progresses up the cliff face, uncovering more letters to choose from. To move the avatar, letters must be pressed on the keyboard. This triggers the avatar to reach out to the corresponding hand-grip. Then, a click of the mouse button will extend the climber's body towards the next hold. If, for an instant both keys are released, the avatar falls into the water. Unlike in *QWOP* where a biological process is abstracted and organised into smaller processes, *GIRP* forgoes the particulars of abstracting musculature. From the outset, the user-interface makes clear that this is less a game about 'climbing' and more about challenging the intuitiveness of everyday computer input. Unlike *Shadow of the Colossus* mentioned at the beginning of this chapter, there is no grip mechanic adding a level of tension or verisimilitude to play either. Over time, however, the complexity of *GIRP* becomes clear; the challenge of the game is not to overcome the on-screen cliff face but is, rather, overcoming the specific configuration of the human body interacting with the discrete keyboard keys.

Though *GIRP* shares *QWOP*'s intentionally counter-intuitive interface it triggers the collapse of enfolded play in a radically different manner. *GIRP* forces an engagement with the sense-processes of the biological body. It provokes bodily processes into action to foster an awareness of the present and the physical. More than that, it provokes an awareness of the specific body at play. The concept of embodied play is not a new one: Bryan Behrenshausen writes in opposition to "occularcentric" play, analysing the practices involved in *Dance, Dance Revolution*. Behrenshausen claims that games studies should become more attuned to studying bodily movement whether "examining the hyperbolised bodily movement evident in *DDR* or the same (perhaps more subtle) bodily movement required for playing any videogame".[328] The main method *GIRP* uses to provoke embodiment is harnessing the physical distance between the keys on the keyboard and the on-screen holds. The distances force a human body to stretch its fingers, keeping one in place at all times, reaching for the next key. At the same time, a hand must be kept on the mouse, forcing the over-extension of

[328] Bryan Behrenshausen, "Toward a (Kin)Aesthetic of Videogaming: The Case of *Dance Dance Revolution*", *Games and Culture*, Vol. 2, No. 4 (2007), p. 353. pp. 335-354.

digits. This achieves a similar goal as the timed input of *QWOP*, generating constant awareness and readiness to input. Conversely, the sensations of play shift from a mental or cognitive friction to one of physical friction as the physicality of the hand becomes a gateway to success.

Although *GIRP* is reminiscent of playing a keyboard version of 'Twister', it is possible to reconceive this impact in light of the entanglement of biological and technological bodies. As the player stretches their hand, inducing a slight, dull-pain, a novel phenomenological quality is added to the game play. In inducing pain, however slight, *GIRP* enforces a feeling of discomfort into the processual collision of gameplay. This physical discomfort forces the entanglement of bodies to collapse and triggers a singularly embodied form of play. This is reminiscent of phenomenological philosophy in which there is the possibility of a beautiful pain.[329] However, I would liken the feeling to something more akin to the vertigo experienced on a rollercoaster or using a 'shocker' arcade machine that administers small electric shocks. While there is pain, there is also, fundamentally, a playful challenge. This is a pain that relates to the first "manifestations of *paida*" noted by Caillois.[330] The desire to compete with this small discomfort relates to the formative principles behind which we begin to play as children.

GIRP is still operating within the enfolded and eventually differentiating idea of interactivity presented by Munster. Bodies become entangled but begin ultimately to separate themselves. At the same time, the processes of "organisation" are also occurring here; input is limited to the specific requests asked for by the machine. Rising water in the game world ensures that these requested tasks must be implemented within a certain time frame: the physical dimensions of the keyboard are organised by the dimensions of the on-screen world and time is organised by the impending death of the avatar. As with *QWOP* however, this is not an immersive game; it has been designed specifically to disrupt the absorbing enfolding and organising processes typical of digital games. In this instance, however, disruption is brought on by a particular aspect of the body without organs as plane of immanence. *GIRP* is not nearly as 'difficult' as *QWOP* and its mechanics can be grasped easily. It does not demand the same concentration of the player. As such, occasional mistakes are not manifested as slips or faults of concentration; rather, disruptive failure comes out of the physical restrictions of the

[329] Dermot Moran and Timothy Mooney, *The Phenomenology Reader* (London: Routledge, 2008) p. 41.
[330] Roger Caillois, *Man, Play Games*, p. 29.

body at play. The physical size of the hand being used to input commands limits the potential for progress. This form of physically embodied play brings a different outcome into view. Rather than the realisation that the biological body cannot stick to the stringent organisation of the machine, there is the realisation of the limits of physical form. In this, playing *GIRP* has a potential to make aware of the posthumanity of our intra-actions.

As argued in Chapter 2, it is possible to understand playing digital games from an intra-active perspective by focusing on Barad's definitions of performative practices. As established throughout this thesis Barad's theories presume agential-realist ontology in which 'things' are separated, "cut", away from their unified whole through co-operative performative practices. Barad notes that her theory "doesn't presume the separateness of any-'thing', let alone the alleged spatial, ontological, and epistemological distinction that sets humans apart".[331] To substantiate this ontology Barad looks to quantum physics in which scientific equipment such as the measuring apparatus "plays a much more active and intimate role in experimental practices than classical physics recognises. Apparatuses are not passive observing instruments; on the contrary, they are productive of (and part of) phenomena".[332] She writes,

> That is, the larger material arrangement enacts a cut that resolves the inherent ontic-semantic indeterminacy through which the "subject" and the "object" emerge. Apparatuses are the conditions of possibility for the determinate boundaries and properties of objects and meanings of embodied concepts within the phenomenon.[333]

Although Barad's ontology is far more vast and far reaching, it is also more concerned with the "specific embodiment as part of the material arrangement" that is produced within an apparatus.[334] Incorporating this focus of material apparatuses into my exploration furthers my ecological investigation.

Playing, *GIRP* it is not only that the body is biological that is important. The game is engineered in such a manner as to be difficult for a specifically constructed body, an assumed assemblage of limbs and material with five digits and an appropriate level of cognition to find the game challenging but not impossible. The 'game' is the collapse of immersion which

[331] Karen Barad, *Meeting the Universe Halfway*, p. 137
[332] Barad, p. 142.
[333] Barad, p. 143.
[334] Barad, p. 143.

depends upon a particularly configured biological body. The game is designed in such a way that as we continue to play, we begin to feel to limits of our ability to touch the furthest keys while holding down the previous. We are reminded of the exact dimensions of our hands, the flexibility of our muscles and tendons. Different players will, of course, have distinct experiences, because of their specific bodies. But this does not necessarily translate to being more skilled; rather it suggests that the 'material arrangement' of their particular body is more suited to this particular apparatus. Although this may seem a strange logical leap (perhaps not so odd given the direction of posthuman philosophy under Haraway's guidance), if we imagine the game was to be played by an octopus – an octopus that had taken it upon itself to play games or a game system specifically design for their vision system – the challenge of the game would disappear. Again, through material apparatuses, we come to define our nature. The game's difficulty and challenge arise out of the need to stretch the hand in play. If that need for stretching was not present, the game could become easy or even relaxing; a vastly different experience. The nature of the hand needed for play is an important material quality; it is the experience of that hand becoming stretched to the point of inoperability that substantiates the game. *GIRP* embraces the difficulty of inputting commands depends on the potential for physical shortcomings of the hand.

The shortcomings of the human hand are what produces this agential cut in play. As Barad argues:

> It is when the body doesn't work – when the body 'breaks down' – that such presuppositions generally surface. It is often when things stop working that the apparatus is first noticed. When such (in)opportunities arise the entangled nature of phenomena and the importance of the agential cut and their corollary constitutive exclusions emerges.[335]

It is the "breaking down" of the body that is of importance here as the game requires stretching and this stretch encourages failure while failure, in turn, provokes awareness of our embodied, affective potential.

Accordingly, awareness is, in itself, an outcome of the physical properties rooted in the specific material configuration of the body during play. If we approached the phenomenon following Deleuze we could say the following: the chaotic interference of the body without

[335] Barad, p. 158.

organs, the immanent plane of the process of becoming, gives rise to the phenomenon of differentiation. Following Barad, however, we can attribute the outcomes of Deleuze's BwO to material processes. Within my agential-realist ontology, the disruption of material entanglement is an outcome of the particular physicality of playful intra-action.

Distinct from the ecological functioning of Chapter 3, *GIRP* is not a harmonious intermingling of human, code and hardware processes. Although the ingredients seem the same – the keyboard, the computer, the player may all be similar – their functions become radically different through a slight reconfiguring. Suddenly, the keyboard is no longer an instrument of control but an instrument of discovery. As the game continues to ask us to play 'Twister' with our right hand, we become increasingly aware of our previously fluid intra-activity with the machine. We are encouraged to discover our apparent boundaries as limitations, and inabilities to perform the unexpected. This radically different outcome, produced by reconfiguring the apparatus calls to mind the cheap cigars of the Stern-Gerlach experiment. A seemingly subtle reconfiguring of the apparatus can have vastly different impacts.

GIRP and its player are both apparently distinct entities within an intra-active apparatus. By playing the game, feeling the discomfort, agential 'cuts' are made and the player is divided from the machine. Using Deleuze's terminology once again, this produces the 'sensitive body' as distinct from the 'insensitive body' of the machine. However, as this differentiation is resultant from intra-action, it is only by coming together that this precise feeling of differentiation can come to exist. Playing *GIRP* – and, in particular, being bad at it – imparts a unique feeling of difference from the machine. As such, although a player can be differentiated, this differentiation is dependent upon intra-active entanglement.

QWOP and *GIRP* though interesting, are relatively simplistic videogame systems. Both are two-dimensional with simplistic algorithmic relationships between the various objects expressed in their virtual worlds. Although I have argued these games are differentially productive through their abstracting of bodily processes into counter-intuitive interfaces, expanding upon this requires drawing on examples from more complex games. *Ampu-tea* serves as a perfect case study in this instance. Much like the games above, *Amptu-tea* takes a process and breaks it down into a number of abstracted steps. This, again, estranges the player from the represented everyday action and seems to resist the experience of immersion found in

other, more traditional, games. In *Ampu-tea* the task set is to ‘make a cup of tea’ through the operations of a robotic arm and hand. Whereas *QWOP* and *GIRP* break the human actions of running or climbing into two to four processes, *Ampu-tea* breaks the familiar action (in some cultures) of 'making tea' into multiple, branching steps. The digital body is ‘organised’ into four individually functioning fingers and a thumb, each of which can bend to differing degrees. At the same time, the wrist of the digitally mediated arm is articulated and the whole apparatus can be positioned anywhere within the three-dimensional space. This creates an almost incalculable amount of potential permutations for interaction. Similarly, the main task is organised into smaller tasks such as "Add Teabag; Add Water; Unsweetened; Milky; Serve!" which imply corresponding needs for action.

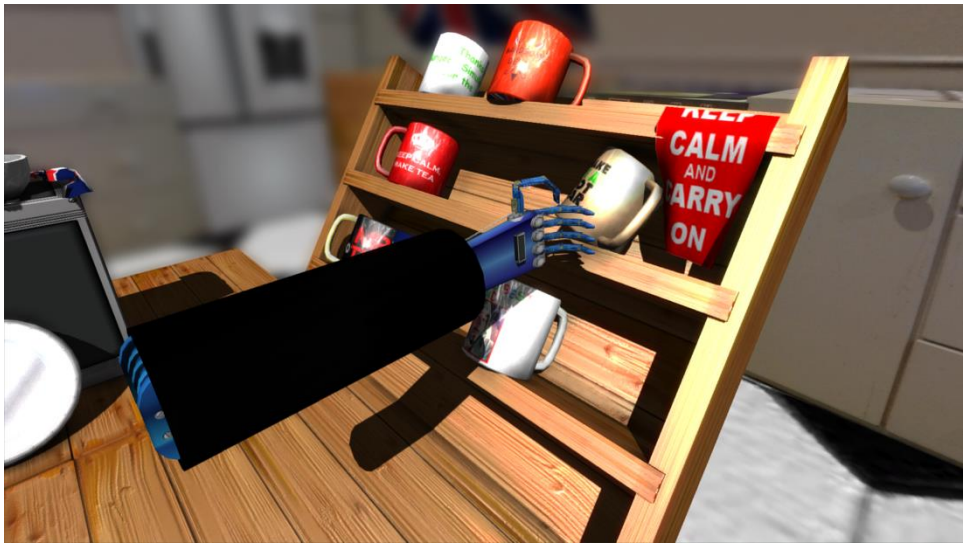

Figure 5. *Ampu-tea*’s problematic physics

Ampu-tea shows, however, that adding a teabag to a cup, can become a painstaking task when broken down into many individual actions. This sensation is exacerbated by a remarkably counter-intuitive user interface. To complete the challenge, the arm must be positioned in front of a cup; this is achieved by dragging the mouse to move horizontally, and dragging the mouse while holding a keyboard button to move vertically. The hand must then be rotated clockwise or anti-clockwise, by pressing a mouse button and dragging the mouse, so that the prosthetic hand comes parallel with the targeted cup's handle. Keyboard buttons can then be used to close a variety of fingers around the handle of the cup and position the thumb in a position that allows an attempt to grasp the mug. If their grasp is sufficient, they return to the previous mechanics to move the cup to the table. They can then repeat similar processes with the teabag, hot water, milk and sugar. At any point, if movements are too quick, the arm may flip the entire table, throw objects into the air or cause general chaos. At the same time, the arm is

remarkably fragile and can break if not treated with care.

The feeling of playing the game is that of a world where objects appear remarkably separated and individuated from one another. Though, of course, the digital objects in this game still exist within a software ecology at the level of code, hidden from the user, the designers have taken great pains so that, on screen, they appear to function independently. Recalling, with restraint, the code analysis of the earlier chapters, we can look in depth at the game system. This behaviour of individuality is achieved by programming a specific type of 'collision detection' algorithm within the physics engine - similar to those mentioned in the previous chapter. In popular videogames objects are programmed to favour collision in order to ease gameplay for the player. Returning to *Shadow of the Colossus* mentioned at the beginning of the chapter, the collision-detection plays a large role in the game mechanics. Although the player may initiate the 'grab' mechanic, the system must detect that the player's avatar is sufficiently close to an object that they are capable of 'grabbing'. To make the game more fun and more immersive *Shadow of the Colossus* allows quite a favourable margin for error when players attempt to grab certain objects. If the player falls or jumps, even if the player's avatar is visually quite distant from a piece of wall or fur that can be grabbed, the system will sometimes place the player's character on a grab-able surface, ensuring narrative presence. This technique of collision detection is similar to that of 'snap to grid' in graphic design where objects can be centred automatically to ensure symmetry. What's more, this is common practice in game design. In *Ampu-tea*, however, this 'snap' collision detection has been rejected in favour of having objects behave as distinct to one another as possible. The digital objects of *Ampu-tea* have been programmed to avoid interpenetrating (or 'tunnelling' as it is known to designers) and to behave as if solid or liquid. Aside from these qualities, the programmers have not attempted to make this digital world one that it is easy to function within as objects collide in destructive ways rather than combining in meaningful ways.

As a result of this rigid object programming, the objects in *Amput-tea* are unable to 'sense' the other digital things that surround them (more accurately, they are programmed to ignore them as the data will always be available between objects). It is this lack of sensitivity that generates uncomfortable play here. The missing ingredient, so to speak, that complicates the simple task of the game is the unresponsiveness of the objects within this virtual world. As objects collide *Ampu-tea* provides an insight into the absurdity of a world in which objects are truly

separated. Barad writes, "All touching entails an infinite alterity, so that touching the other is touching all others".[336] In the physical world, touching has a complexity that is derived from the subatomic complexity of the world we inhabit. This digital mediation of touching, abstracted into a number of different mechanics by ways of an obtuse and counter-intuitive interface, is unsatisfactory due to what it excludes from its mediation of the world. The smooth, interpenetrating and ecological nature of action is here replaced with an iteration of a world of individual objects.

Playing the game, many minutes can be spent painstakingly adjusting the angle of a particular finger so that the grasp on the handle of a mug is accurate. The weight of the mug when lifted, however, may cause it to fall from the prosthetic-limb, snapping off fingers as it does. Angles, surfaces and textures are considered as important parts of processes that would be simple if only not broken down into so many stages. Linking back to the arguments made in the previous chapter concerning non-human agency contributing to an ecological form of play, *Ampu-tea* provides the experience of an intervention into a digital world without support from those non-human agencies. Actions are not completed by physics algorithms, rather they are allowed to flow into inevitable chaos. Although the interface may, initially, appear far more organised than the games mentioned to this point through the highly individuated controls and on-screen appendages, the system presented is one in which the objects, indeed the organs, of the game are not driven by central desires for completion. Instead they are designed to prevent progress.

Ampu-tea's comparatively complex web of digital objects and multi-faceted user-interface generates a particular agential cut from that of the differential phenomena of *QWOP* and *GIRP*. *QWOP* generated a rhythmic and consuming pattern where bodies are organised into a process of adjusting interactions constantly, compensating in a loop of sensations, and emerging through moments of failure. *GIRP* demanded the body attempt to materially configure itself in such a manner that agrees with the on-screen commands, prompting an embodied experience through the instigation of physical sensation. *Ampu-tea* is neither rhythmic nor physical, it is insensate. A cognitive differentiation is inevitable here as the world rendered on screen, although now three-dimensional and capable of many more

[336] Barad, "On Touching - The Inhuman that Therefore I Am", Differences (2012), Vol. 23, No. 3, pp. 206-223, p. 211.

possibilities, attempts to visually eschew the complex inter-relatedness of intra-activity.

The game attempts to display a rigid interpretation of the fixity of objects in Newtonian, classical physics and the humanist world-view. *Shelter* illustrates an interwoven world, an entangled material whole, following Barad, as the digital objects of the game were all linked visually, ludically and structurally. *Amput-tea* is the nearest attempt to operate in an entirely contrary manner. The coding of the objects of the game connotes the idea of a world in which things are literally disconnected from one another. Barad summates this world view in an appropriate manner, discussing the boundaries of bodies:

> At first glance, the outside boundary of a body may seem evident, indeed incontrovertible. A coffee mug ends at its outside surface just as surely as people end at their skins […] physics tells us that edges or boundaries are not determinate either ontologically or visually. When it comes to the 'interface' between a coffee mug and a hand, it is not that there are x number of atoms that belong to a hand and y number of atoms that belong to the coffee mug.[337]

As discussed throughout this thesis, objects exist in an agential fashion, intra-actively being cut away from, while existing within a wider whole. In videogames, this lack of determinate boundaries between objects is compensated for through rendering techniques such as collision detection that allow digital objects to better appear to touch or entangle into one another. Without these techniques, when rigidly adhering to an understanding that the coffee cup should have "x number of atoms" or should take up x amount of space on a screen, the enfolded player/machine collapses as there is no attempt to recognise the complex and flowing intra-activity of objects.

Ampu-tea presents a distinctly non-ecological, non-agential realist, view of the world by upscaling the potential for alienation and anxiety that comes from living in a world of discrete objects. The game provides players with a clear depiction of the world as it would be if 'things' truly existed and were truly separated from one another. This is not a shortcoming of the game either; it would be easy for the programmers to add some rudimentary code that would make the objects snap together neatly, as in the blocks of *Minecraft*; to ignore one another and become a singular, passive whole. Rejecting this, they have painstakingly

[337] Barad, *Meeting the Universe Halfway*, pp. 155-156.

engineered a chaotic microcosm of simplistically envisioned objects and the complex physical forces that would govern them. The game is helpful to come to terms with the idea that our physical reality is not produced out of solidity but out a countless, infinitesimally small, complicated exchanges between forces. Boundaries are not determinate. At once, these indeterminate boundaries, the products of forces, push apart but also, bring together.

AFFECT THROUGH ANTI-IMMERSION

The games mentioned above prevent the feeling of immersion and can function as a part of a material discursive practice differentially producing organic and technological bodies. Following Barad's terms, I have argued that for this performative practice to take place the videogame must create a dissonance, defined by Sicart, disrupting the immersed fusion of user and software. The games mentioned above and their respective designers manage to achieve this dissonance through the abstraction of familiar actions, breaking apart smoothly entwined biological processes into the discrete mechanics rendering them unfamiliar in the ways discussed. Within the last two decades, however, a new genre of videogame has appeared that, while still mediating human processes, attempts to do so in a personal manner with a focus on emotional story telling. These games have an enormous potential for the ideas of affect suggested above.

Games can alter how we see affect through their ability to make us aware of the limitations of our own bodies and emotions. Through Massumi we come to see the body’s pre-cognitive abilities to be sensate, to be alive, down to a quantum physical level (allowing his theories to integrate quite tidily with agential realism). Through Munster, however, we see that these affective dimensions can be extended through machines, but ultimately, they come to collapse on themselves. Barad’s notion of the cut enters here as we can express this moment of ceasing to flow within the system of the game as the sensation of being enacted as an apparent object. These events can occur when playing games that ask us to connect with others in a sympathetic or empathetic manner. I suggest, that as games invite us to perform as another being, though we may be initially ecstatic at the extension of our affective bodies, this is followed by a collapse that leaves us in no doubt to the limits of our bodies and our machines. Though we may be connected through a material ecology, becoming engaged in the bio-technological performance of another, we are made aware of the limited experiential

capabilities of our bodies.

In direct contrast to the often comical, sometimes curious games analysed above, the games I will now explore are designed around personal life experiences of the utmost seriousness. Play becomes a method for sharing personal experiences or for discussing and spreading awareness relating to political issues, rather than of narrative or sensory immersion. Rather than using unfamiliar mechanics as in the examples above, to create the necessary cognitive friction for reflection, these games rely on using familiar mechanics in entirely unfamiliar settings: the mechanics of 'stealth' games such as *Metal Gear* are appropriated into a dialogue on gender dysphoria. The mechanics of survival horror games where proximity induces madness are used to represent autism. The design of *Mario Kart* is adopted and reconceptualised as a brief moment of respite in between the hospital appointments of a terminally ill child. These games, however, complicate the affective experience as, far from allowing players a sense of immersion, these games remain deeply personal to their creators or their represented groups the entire duration of play; the games rarely, if ever, allow the player to see the game as 'their' experience and instead retain a sense of authorial presence.

Figure 6. *Dys4ia*'s shaving

There are a small number of game designers attempting to use videogames as a means for affect. For these designers, a common tool is to 'gamify' subjects not commonly associated with games. A number of games were released around 2012 that dealt with difficult subject matter. Some, such as the controversial *Super Columbine Massacre RPG!*, seemed to take on their content in a provocative manner as a statement about perceptions of the videogame

medium.[338] *Actual Sunlight* represented social isolation, depression and – eventually – suicide through the videogame medium.[339] Emerging from attempts at reflecting on real world issues in games *Dsy4ia* charts the designer's experience with hormone replacement therapy. Anna Anthropy has made it explicit that her game is an expression of her experience changing her natal-sex to match her self-perceived gender. *Dys4ia*'s range of various mechanics allows the player the chance to engage, in some way, with the experiences described by the author. For example, the narrator of the game describes in on-screen text how they feel weird in their body and never seem to fit in. This then triggers an opportunity to play a warped form of Tetris where the player guides a block upwards towards a wall.

Using familiar mechanics of guiding a moving block and switching its alignment the player could be forgiven for believing that it is possible to move the block past the hole in the wall. However, no matter how much the player twists the blocks, eventual victory is not possible. The point of this mini-game is simply that the blocks do not fit. This use of familiar gameplay tropes against themselves builds a form of cognitive friction as players familiar with the mechanics of Tetris may attempt to complete their goal only to be prohibited by the game system. As the game progresses, this moment is revisited twice: the second time, the narrator informs us that having begun hormone replacement therapy that they "feel weirder about their body than ever" and the block takes on an unmistakably phallic appearance while still not being able to slide through the wall. The third time, once hormone replacement therapy has started to take effect, the block quickly shuffles through a variety of different shapes, signalling the narrator's hope for the future and the potential for change. The varied mechanics of *Dsy4ia* work to actively subvert user expectations while staying true to a compelling and personal story.

The subversion of expectations in *Dys4ia* should generate the necessary cognitive friction to allow the distancing effect discussed in the examples previous: the player should see that their efforts to play the game in an efficient manner are not matched in on-screen output. Just the same as the games above, there is a discontinuity between physical action and on-screen correlate. However, a radical difference in design here has the potential to alter the range of player reactions. *Dys4ia* presents the user with a limited capacity for experience; although play

[338] Danny Ledonne, *Super Columbine Massacre RPG!* [PC Videogame] (USA: Independently Released, 2005).
[339] Will O'Neill, *Actual Sunlight* [PC Videogame] (USA: WZO Games, 2013).

here should still be understood as an "assemblage" as suggested by Cremin, as intra-activity over interactivity, player intervention is distinctly limited. For example, from its opening screen *Dys4ia* appears very 'game like', introducing the player to a 'Press Start' title screen displayed in simulated 8-bit era graphics. These nostalgia evoking graphics and familiar formal aspects inspire ideas of input, summoning memories of simpler, activity driven games. Pressing the space bar moves the game start forward and presents the user with a menu screen where they can select between four distinct chapters: these chapters are eventually revealed to be titled, "Gender Bullshit", "Medical Bullshit", "Hormone Bullshit" and "It Gets Better?" but on first playing the game, only the first of these options is available. Playing through each section, it is clear that the game moves along at a pre-set pace: each of the four sections is populated with small 'mini-games' that convey the various concerns of the author but these are only experienced briefly and with little relation to player activity.

For example, accompanying the phrase, "Shaving is humiliating" is a small mini-game much like a primitive racing game commences (figure 6). The objective is to guide a razor across a pixelated top lip and not 'crash' into the lip itself. Although this reflects Anthropy's traumatic experiences in an arresting fashion, the shaving mini-game cannot impact upon the story as a whole. The next stage is triggered more through the passage of time than player agency. The block-movement mini-game discussed before will continue only as long as the game programmed before moving to the next dialogue screen. No goals or values have been set and no score is being recorded. None of the games have any impact upon the narrative: no matter how poorly the player does, the text will still read the same way. Although the question mark in the title of the section, "it gets better?" suggests an ambiguity in tone, the player is confronted by pastel coloured pixelated imagery depicting a butterfly emerging from its cocoon and taking to the air. It is difficult to read this in any way other than as a suggestion that, through treatment, Anthropy has achieved some level of satisfaction. Ultimately the ending is a cautious message of hope. As such, in contrast to the previous examples, in which, the actions and digital objects that made up the videogame were interlinked, and could be affected by player intervention, in *Dys4ia*, Anthropy has placed her authorial stamp upon the proceedings. She has produced a rigid system of algorithms that can be altered cosmetically by player influence but in no more significant way.

Though the game cannot be altered as significantly as the others, this does not mean, however,

that the game has less impact. Sicart, discussing *Dys4ia* in particular, has argued that the challenge for designers of these games is to encourage the "ethical player". He argues, "ethical gameplay implies that the player makes compromises by constructing an ethical meaning of the game and by engaging with the very consequences off the act of play, within and outside the game world".[340] In this, Sicart means that the games should encourage players to accept the appropriation of ludic staples and the autobiographical nature of these games in a sober and respectful manner, while at the same time designers make games that "use their essential, procedural core to encourage a gameplay performance that communicates interesting ethical challenges".[341] I am not wholly convinced by Sicart's assertion. Given the volatility of players and the vast potential of ethics, it may not be a reasonable challenge to adopt: games are *games* and, regardless of their subject matter, will be eventually played against themselves. Games like *Dys4ia* should not be concerned with 'virtues' but instead in constructing an apparatus from which the players can establish their shades of difference from the authors in an act of performative becoming. These games pervert familiar interfaces to go beyond cognitive friction and enter into a form of cognitive disturbance.

The understanding of games I am proposing is distinct though familiar to similar approaches. Cremin's understanding of games as part of the Deleuzian affective process proposes that games should be the 'objects of affect', producing this experience by picturing games as a canvas onto which players create, as "the images and affects of reiterative actions: play as a rupture that produces the new".[342] This processual view does not go far enough as we should not imagine a game as a canvas or any other object. A game is the product of a specific performance. In the case of *Dys4ia* we are asked to perform tasks, assuming the role of the game's creator. This requires us to enact certain tasks, but there is a constant pressure on us to decode the meaning of those tasks. We are being invited to adopt the life of the author. This is not achieved through a call to metaphor however. Rather, we must consciously act and affect our surroundings and the conditions of the game performance we are forming. As Helen Thornham notes similarly that where it was previously the common view that the (human) body was nothing more than the "site of affect" within game studies – which is to say, receiving stimulus from the machine and interpreting it in a method more complex but

[340] Miguel Sicart, *Beyond Choices*, p. 80.
[341] Sicart, p. 135.
[342] Colin Cremin, *Exploring Videogames*, p. 106.

nevertheless similar to semiotics – increasingly the view is that the body is fully engaged and in a cognitively aware state of engagement during play.[343] We can focus on a game like *Dys4ia*'s potential for affect as phenomena.

The lack of opportunity for input in *Dys4ia* obviously works to the advantage of the game's auto-biographical message. Without having to privilege the player's input, the game is free to carry on encouraging us to realise the specific narrative we are forming alongside it. This lack of interaction is a boon to *Dys4ia* as a posthuman performance, as discussed by Jane Bennett. One of the main objectives of posthuman thinking has been to challenge the anthropocentric nature of the western worldview, "ascribing agency to inorganic phenomena such as the electricity grid, food, an trash, all of which enjoy a certain efficacy that defies human will".[344] *Dsy4ia* certainly "defies human will" as it progresses from one vignette to the next with little regard for player aptitude. Indeed, Elise Vist argues that *Dys4ia* should be perceived as a "cyborg game" in which, "the player of a cyborg game is disoriented, unable to take control of the game in the way she expects; as she reaches out to orient herself, the designer limits her control and points her in one of two directions: move forward or quit".[345] Arguing that games such as *Dys4ia* counter the subjects will in order to disorient them furthers the idea of cognitive friction, pushing it – as I suggested – into the affective realms of cognitive discomfort. The 'cyborg' elements, in this sense, are not the technological elements we are enveloped in, but rather into the gender transitional period of the author's life. We are invited to engage in tasks and given the potential to generate an empathetic experience.

I am not suggesting that a game like *Dys4ia* lets us 'feel what it's like to *be* the author' or to 'be' a part of the social group Anthropy aligns herself to. Quite the opposite. Indeed, Vist argues that the game "creates a space parallel but separate from the sexist, racist, ableist and generally bigoted communities of mainstream videogames".[346] Problematically, Vist sees the societal orientation of the player as an important part of the play experience. Viewing *Dsy4ia* this way, Anthropy's programmed restriction of agency has its downsides. In Anthropy's work

[343] Helen Thornham, *Ethnographies of the Videogame: Gender, Narrative and Praxis* (London: Ashgate, 2011), p. 101.
[344] Jane Bennet, "Enchanted Materialism", in Diana Coole and Samantha Frost (eds.) *New Materialisms: Ontology, Agency, Politics* (NH: Duke University Press, 2010) p. 9.
[345] Elise Vist, "Cyborg Games: Videogame Blasphemy and Disorientation", *Loading...* (2015), Vol. 9, No. 14, pp. 55-69, p. 66.
[346] Vist, p. 66.

a player's inability to affect the outcome of the text limits not only our power as viewers but also our ability to engage with the system. From an affective perspective, this limits the potential for realising what we have become a part of. Unlike *QWOP* or *GIRP*, *Dys4ia* does not challenge the human through its interface; only through its subject matter. As such, the game ultimately serves as a closed loop within a larger system, keeping itself isolated from external intervention. In other words, the game's ease of play and, if Vist is to be believed, presumed orientation of player, means that it functions as a site of differentiation for the player. If the player is not aligned to Anthropy's views, this game does not invite them in – so to speak. Rather, it sets a series of tasks that establish distance, by degrees, from the experiences you are asked to live. The level of familiarity or distance from what you are asked to enact, affirms the player for what they are.

It is easy to challenge the assertion that the game becomes a closed loop as it is clearly stated in the opening credits of the game that this is only Anthropy's 'experience' and is not intended to reflect on anyone else. This is most evident perhaps in the remarkably hopeful ending of the game which, though it provides a satisfying finale, serves to cut the game off from other players, particularly those who have had less hopeful journeys through gender reassignment surgery. In the end, though the player engages with the activities in some small, heavily abstracted manner, the game restricts their ability to engage to too high a degree. Had the game been more porous in its design, relying more heavily on the player and allowing for their play within the structure of the game, it is possible it could have provided a wider range of experiences for players.

While *Dys4ia* closes itself off from intervention, *Auti-sim*, an incomplete game that received a great deal of press coverage upon its conception, attempts to impart an evocative experience while remaining open to engagement from users. The intention of the game is to portray the kind of sensory overload often reported in cases of child autism. The game was designed by a three-person team in a short period of time as part of the Hacking Health game jam event held in Toronto in 2013. Although incomplete, currently, the game is free to play on the 'Games for Change' website. The point of the game is made quickly and clearly: you are given a first person perspective of a playground, filled with the distant sounds of children laughing and playing; though you can see a number of children in the distance, approaching them triggers the sounds of children excitedly screaming. In essence, approaching the other children causes

a barrage of distressingly loud and high-pitched noises to be played, accompanied by a form of static that blurs the image. Attempting to avoid the other children reduces the level to which distressing noises sound but does not stop the initial loop of distant sounds from playing. The game does not stop; there is no end state and no goal to be reached. In a similar manner, the space of the game is endless (though also featureless). It is possible to walk away from the playground into an infinite open space. This does not, however, silence the sound of the other children. Although it risks making its point bluntly, *Auti-sim* provides the player with the potential for a distressing experience rather than forcing them to participate or restricting their agency beyond the immediate rules of the game world.

Figure 7: Proximity causing hypersensitivity in *Auti-sim*

As the game engages with real world subject matter it was important for the designers to take every respectful measure they could. Though the team included Krista Howarth, a specialist that works with children with autism spectrum disorder, they noted that they received criticism for not involving any persons with autism on their team. Howarth commented in an interview, "The biggest criticism was that we did not include anyone with autism in our team. I tried explaining that we did not exclude anyone either, we simply could not have timely access to someone with autism for that weekend, and we had to continue on to finish the project".[347] It is perhaps this lack of a specific presence that provides the openness of *Auti-sim*, contrasting the closed system of *Dsy4ia*'s personal narrative. Howarth's knowledge of a particular facet of autistic experience informs this game. This allows it to be a general experience that is open to a player. It does not attempt to portray an individual human being's experience, rather it attempts to use technology to create an experience in the user at the time of play.

[347] Hsing Wei, "Auti-sim: A Short, Overwhelming Look into Autism and Sensory Overload", *Games for Change* (website), April, 2013, <http://www.gamesforchange.org/2013/04/auti-sim-a-short-overwhelming-look-into-autism-and-sensory-overload/> [last accessed 29/01/2016].

From a design perspective however, *Auti-sim*'s representation of autism remains troubling. Just as Sicart noted the use of mechanics to subvert notions of play, the system for engagement here is most similar to survival horror videogames, in particular *Amesia: The Dark Descent*, in which enemies cannot be approached for fear of affecting the play character's 'sanity meter'.[348] In the event that the player does engage an enemy, the screen blurs and eventually the player dies. While this does not happen in *Auti-sim* (as mentioned before, there is no win or lose state) the similarities are unnerving. That autism in any form should be represented in a similar manner to how horror is portrayed in a digital medium seems problematic and suggests an associative link between autism and horror that may not be beneficial. That being said, this is a game contingent upon a player's involvement. Given this, the association with first-person survival horror controls suggests not only a certain outcome to the players but also appropriate responses, such as moving away from the source of pain. This associative link is used to acclimatise players, placing them in a familiar context to more deeply estrange them when the familiar does not occur. The lack of ending here is paramount. Although the game is not complete and it is possible that the designers envisaged an end state for the game, as it exists now, the need for the player to consciously close the simulation prevents the same development of 'flow' that is generated in games with immersive mechanics. That the distant sounds are always heard no matter how far the player wanders from the active area ultimately hammers home the idea that this is an experience meant to be unfamiliar and uncomfortable.

Once again, unending, inharmonious design allows for the ecological engagement to take place between human and machine unabated. The (human) presence of the designers is not felt when the player uses the game as it will last as long, be as loud or as disconcerting as that particular player can tolerate. The game loops will continue in place, playing the same sounds and trigger the same visual artefacts until the player provides the input necessary for the simulation to move forward into a different direction. As there is no end state, the player must similarly decide when they have had enough and choose to stop. It is a game designed with a human agent in mind. However, is does not attempt to make assumptions about the players, does not attempt to tell them something. It only provides one half of a system that the player must complete.

[348] Thomas Grip, *Amnesia: The Dark Descent* [Multiple Platform Videogame] (Sweden: Frictional Games, 2010).

The intention of *Auti-sim* is not to provide the player with an experience similar to that of a person suffering with autism. It is not a virtual reality or multi-sensory simulation that attempts to overlay or overtake the conscious experience of the person playing. Rather, it is a small, discomforting game that, once again, serves to establish the player's distance from the simulation. Using loud, high-pitched sounds and unsettling visuals, *Auti-sim* is an unpleasant or unnerving experience, steeped in the tropes of survival horror games but without the 'jump scares' or potential for victory or defeat that provide catharsis in those games. To 'play' is to be unnerved or discomforted and to establish the unpleasantness of that experience. It is not possible to provide a human being with experience of another. What *Auti-sim* does achieve, however, is a manipulation of software in a manner that allows for a conscious engagement with something intentionally unpleasant. It creates connections that a reach towards specific areas of the human player.

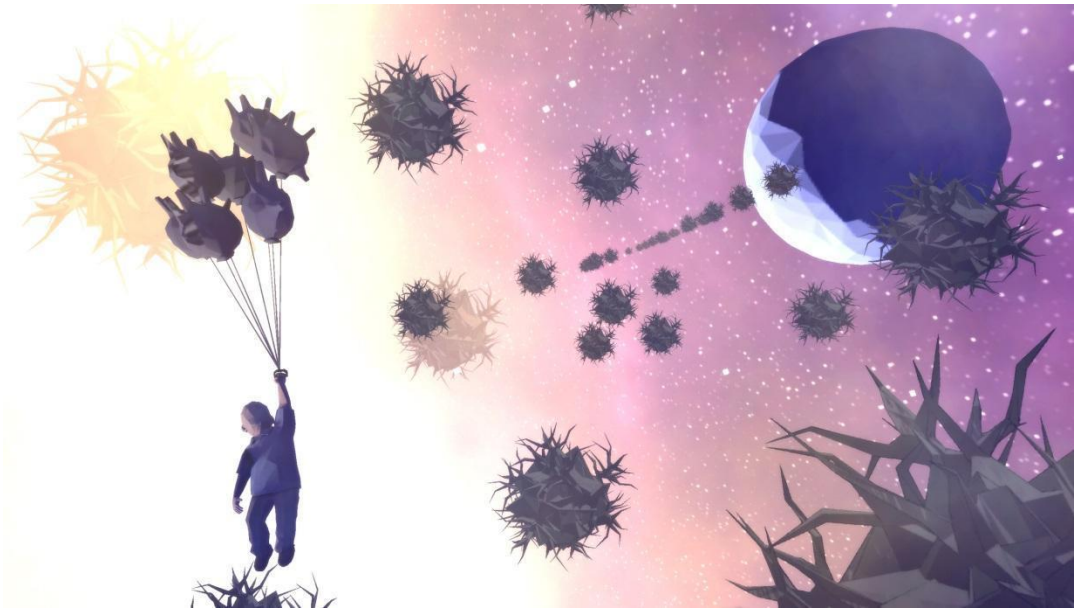

Figure 8. Avoiding the inevitable in *That Dragon, Cancer*

Placing the player at the most distinct remove is the videogame *That Dragon, Cancer*. The unique game relates the tragic experience of the game's designers, Amy and Ryan Green, whose son, Joel suffered with aggressive cancer from an age of only a few months until is untimely death at age 6. Through fourteen separate vignettes that chart the course of Joel's life, the game uses play in a manner that transgresses expectations, inviting interaction though ultimately uses the limits of interaction to great effect. Just as the player cannot ever truly change the game world in which they are positioned during play, in entering the narrative of

That Dragon, Cancer, we are aware of the inevitability of the events that take place. Play, therefore, becomes important for its own sake, for the fleeting joy it can bring. *That Dragon, Cancer* re-aligns play as something of immense importance.

For example, in the second vignette, the player makes their way through a forest park made up of geometric shapes and eventually comes across a small play park. On each of the amusements is a small child, portrayed without a face. It is clear that the child is the same and, to a large extent, represents the Green's image of Joel. Just outside the park a figure resembling designer Ryan Green sits on a bench. Interacting with it by clicking the left mouse button triggers a recording. The figure asks, "What is play without a word for it?". The player can then interact with Joel freely on each of the rides for as long as they desire. After interacting with one version of Joel, the in-game camera points the player in the direction of the next installation and then, eventually, outside the park. If the player chooses to leave, they make their way to a beach where they see a child's hospital bed, becoming enveloped by a group of black spherical shapes. However, the player can spend as long as they wish playing with Joel, putting off the eventuality as long as they desire. It is made clear that in this world, play allows time to loop around itself as each of the interactions can be triggered indefinitely. At the same time, play shapes space as Joel appears on each of the amusements simultaneously; there is no one direction in which the player must progress. Play recreates space as something non-linear and allows time to loop over itself. Unlike in *Dys4ia* where our play is permitted to create a sense of shared frustration between player and designer, here, play provides the player with a sense of something personal, something they cannot hope to share. Just as Joel's face is omitted from the character model, allowing perhaps, individuals to see the character as whomever they wish, at the same time, players are kept distant from the particularities of the Green's experience. Rather than attempted to recount events as they happened, to engage with a sense of what 'really' happened, *That Dragon, Cancer* instead presents a temporally and spatially fractured series of events that are as dreamlike as they are painfully real.

In the same way that the game's visuals and spatial design keep players at a remove, the extent to which we can interact remains extremely limited. Visually, the game is regularly without any kind of interface; on occasion, you will be given certain button prompts to move or act if you are stationary. The moment you act, however, these prompts disappear and you are left to

your own creativity. Most often, input is limited to clicking a mouse button though this is not - as in the case of mechanics based design - linked to any particular command throughout the game. Rather, *That Dragon, Cancer* adopts a contextual approach to input where clicking the mouse can trigger any number of actions. This can leave you with a sense of your place within this digital world as when the game begins, for instance, and you are placed in control of a duck floating on a pond. As you swim around this environment, using one mouse button to move another to quack, it becomes clear that Joel is throwing breadcrumbs. This touching moment is accompanied by dialogue between the rest of the Green's who are heard but never seen.

It is clear that we are here to be an unobtrusive and subtle contributor to this narrative; to listen but not to command. In a similar vein, accompanying a dialogue of Ryan and Amy discussing the inevitability of Joel's condition, the player engages in a simple mini-game reminiscent of the popular *MarioKart* series. Using the mouse, we can move Amy in a small wagon, accompanied by Joel. As per the norm in these titles, going over a 'boost' pad will make the kart accelerate, crashes slow the kart and there a number of objects to collect. However, though we can go as fast as we desire, collect as many items as we can, the items are ultimately recontextualised after the race game ends. Each of the pickups are given their titles as one of the many forms of medication Joel and other cancer patients take in an effort towards treatment. The game, however, is not punishing the player for not being fast enough, or not being able enough. Rather, the mechanics celebrate our ability to play and imagine, in spite of harsh reality. Though our ability to interact, to play, is limited it is most always a brief moment of joy in the face of inevitability, rather than serving to reinforce the inevitability itself. Unlike in *Dys4ia* or *QWOP,* where a lack of ability to guide on-screen action creates frustration or friction, here, our lack of control reflects our inability to change the inevitability of events. Our objective is to enjoy what we can within this tragic setting.

That Dragon, Cancer presents an interesting challenge for viewing interfaces ecologically and intra-actively. The minimalist input the player can provide through their physical actions, limited almost entirely to mouse drags or clicks belies the potential for an affective response from a user. The game stimulates responses through its subject matter rather than its provision of action. It provides the capacity for limitless play in order to make its discussion of mortality more easily bearable. This represents an extension of the techniques used by the designers of

Auti-sim and an entirely opposite approach to Anna Anthropy's intentionally frustrating design. I believe the game represents a uniquely open approach to storytelling, one that seems to adopt intra-activity into its design. The game recognises that players will add an enormous amount to proceedings and that it is the responsibility of the designers to provide an enormous range of possibility in the minute details while keeping a hold of the overall structure. As argued by Colin Cremin, "the videogame is a prepared canvas on which the player paints forces that produce sensations".[349] We can see in *That Dragon, Cancer* that the canvas we have been provided is simultaneously nearly complete, in that is takes the form of a very structured narrative, but still has vast room for input as players are free to intervene without limit. The "canvas" image, however, presents certain issues. To my mind, it still suggests the presence of the author in the work. It seems an enormous backwards step to begin separating a work from its source, invoking post-structural theory. This, however, may not be necessary. Cremin's ideas that the player is able to produce affect when reacting with the game fits perfectly with Barad's ontology. Rather than thinking of the game as a canvas, a pre-existing object, upon which the player produces, we can instead see the game as something that is only produced, that only exists - in a material sense - in the moment of play. The affective qualities, therefore, are assured their originality, their being the product of the play, rather than the design.

For instance, a sequence an hour into the game begins with Ryan holding Joel, asleep on a chair. Joel is connected to an IV-drip, along with a heartbeat monitor. After a brief time, the monitor begins to beep. Though we can look at the monitor and though, by pressing mouse buttons we can make the buttons on the monitor change colour, it is not clear how we are impacting the events. Eventually, the noise stops and it is unclear whether we affected the events or not. This theme of inevitability carries through the game as in a sequence when Ryan dreams of Joel floating through space, supported by balloons made of inflated disposable hospital gloves (figure 8). The visually striking sequence takes on a ludic aspect as the black spheres - perhaps representing Joel's illness - appear and will pop one of Joel's balloons if they collide. By moving our mouse from side to side we can avoid the black spheres and keep Joel aloft. Depending on the player's skill, this can continue for a long time. However, eventually we are outnumbered and Ryan must awake from his dream to the child oncology unit. At these moments, the more panicked play works contrary to the moments of joyful familiarity. In

[349] Colin Cremin, *Exploring Videogames*, p. 156.

these moments, the context sensitive controls make it more difficult for us to have impact upon the digital environment. Rather than simplifying our interactions, the contextual controls withhold information from us so that our ability to act is limited to what we are then allowed to do. In the end, it is clear that this is an experience that was specific to the Green's but still invites and includes the input of the player. Our actions, though restrained by the inevitability of the story, are meaningful.

In an attempt to explore this processual individuation, I held a 'group-play' session of *That Dragon, Cancer* as a part of the Glasgow University Games Group in March 2016. Supported by the lead designer, Ryan Green, the group of ten PhD researchers and Masters students from a variety of interdisciplinary backgrounds played through a section of the game in an attempt to answer a set of specific research questions asked by Green. Throughout the play session different attendees took turns to play the game engaging in different ways as a part of the apparatus. Different levels of familiarity with the system were noted and the group encouraged players that were unfamiliar with the controls. Taking that into account, players nonetheless remarked the difference in empathy and affect they experienced when comparing the experience of viewing the play-session against filling the role of the player. One attendee, a medical student, noted their panic when playing through the section mentioned above when Joel is connected to the IV drip. Though an experienced user of medical equipment, in the context of play such practices became abstracted an unfamiliar. Their immediate reaction was to attempt to intervene, pressing buttons on the control panel though they expressed later a mounting concern from their intervention. The attendee was unsure whether or not the buttons they were pressing were helping Joel or further endangering him in some way. They reflected to the group that the experience of holding the mouse and acknowledging the responsibility of being a part of the game as it developed heightened their emotions. At the same time, they acknowledged that when they had completed their section and could appreciate just how little their actions could affect Joel, they could more clearly empathise with the Green's struggle.

By withholding information and restricting input to the context sensitive controls, players must submit their actions to the abstracting and mediating processes of the game. Though they may press a button with one intention or another their actions are enfolded into the system processes. Their intentions are devalued as the buttons visible on screen correspond to a logical system withheld from them. Players cease to interact with the game system as an

external observe and instead become forcibly aware of their intra-action as their emotions are subjected to the algorithmic triggers hard-coded into the game system. At the same time, however, this intra-activity serves to differentiate them from the proceedings. The moments of heightened connection serve only to emphasise our disconnection when they fade.

In this chapter I have attempted to build on the ideas of ecological, enfolded, posthuman play established in my previous chapters by illustrating the productive effects of the collapse of those conditions. I established in Chapter 3 and distinguished in Chapter 4 that videogames are actively entwined systems, composed of human and non-human agencies, and the degree to which non-human agency makes up this ecological relationship impacts upon the overall experience. In this chapter, I have focused on the potential for these systems to become disrupted. In the initial studies of *QWOP* and *GIRP* I highlighted how games can block a sensation of immersion and allow the particular functions of the human body to impact upon human-computer interactions. Following this, in my exploration of *Ampu-tea* I proposed that non-human agency plays a role in this differentiation by functioning in an almost disinterested manner.

Without non-human agents to ease the process of human-computer interaction, the smooth, immersive practices of computer use that characterise contemporary relationships between organic and technological bodies would not exist. Moving on from that point I argued that through disruption it is not only possible to produce distinctions between biological and technical bodies but also to produce a uniquely affective distinction between the authors or subjects of games and the player. Although many critics, theorists and philosophers have approached these ideas of integration and subsequent differentiation with biological/technical assemblages in the past, I have pinpointed the unique contributions videogames bring to understanding these differentiation practices. At the centre of this chapter is the idea that games can be designed to disrupt the ecological, harmonious enfolding that occurs when bodies come together. This experience of discordant interactivity may be unique to gameplay as no other human-computer interaction could afford to indulge in these disruptive engagements.

Play, by virtue of its residing just on the fringe of societal practices, allows for the exploration of broken engagements and intentionally frustrating design. The chaotic force disorganisation

found in Deleuze and Guattari's concept of the body without organs and the agential-cut of Barad's intra-activity allowed a particularly nuanced contribution to existing bio-technical discourses. Following Deleuze and Guattari, I propose that bodies in technological apparatuses can be seen as engaged in a process that organises the immanent becomings that they are so intent on describing. The organisation of videogame code and interfaces shifts the body of the player into a tightly managed form. However, out of this organisation erupts disorganisation as the human body is apt to fail at the rigid processes of tireless data input at which machines excel. Further nuancing these differential practices videogame play can be viewed as a material-discursive performance within an agential-realist materiality.

The production of difference is both a condition and development of a material assemblage. In videogames such as *Auti-sim* the outcome of the game is entirely dependent upon the realisation of difference from the system that is presented and so the condition that has been abstractly mediated. Difference is assured but also constructive. What's more, the specific difference that is realised – i.e., the extent to which the game resonates with the player, emphasises the specific qualities that define each unique player. This chapter highlights that at their core, however, both immanent and materialist approaches can ultimately be used to place an emphasis on differentiation over assimilation, assemblage and convergence. As Barad states, "difference cannot be taken for granted; it matters – indeed, it *is* what matters".[350] Videogames designed to emphasise the differences between bodies within an assemblage can be viewed as productive of distinct agential cuts, delineating our connections while, at the same time producing the qualities of difference that make us distinct.

[350] Barad, *Meeting the Universe Halfway*, p. 136.

Conclusion

In this thesis I have argued that a select number of independent videogames have qualities that make them uniquely ecological. This quality resonates with agential realist philosophy and highlights the processes of connection and differentiation that underpin everyday experience. Whether looking at games that represent the so-called 'natural' environment in a picturesque manner, as complicatedly entangled systems or as subtle aspects of a wider narrative, each invokes ecological properties. At present, the sect of game studies scholars working in this area adopt a wide range of approaches. Some place an emphasis on the so-called 'natural' environment, while others emphasise the ecological nature of play, perception, code or hardware. I have attempted to bring each of these approaches together in a more holistic manner, elaborating that videogames can make powerful statements about play, aesthetics, entanglement and the nature of humanity.

To bring such a wide range of theories together, I have borrowed from the writing of Karen Barad whose philosophy presents an indispensable vocabulary for discussing the entangled nature of being in the universe. Although not explicitly an 'ecological' philosophy, Barad's agential-realist ontology, to an extent, could be seen as the end point of any ecological theory. Rather than suggesting connections between 'things' Barad undoes the need for solid entities, for subject-object or even actor-network relations, in favour of a world-view that emphasises phenomena. Actions are not performed by agents; rather, a constant flow of activity gives rise to apparent agents through processes of differentiation. Several of Barad's key terms served as the impetus behind important chapters.

'Intra-action', for instance, was particularly useful for reinvigorating current understandings of 'interaction' in game studies and provided the basis for chapter three. Thinking in an agential realist manner encourage me to transcend the limits of a player-computer interaction paradigm and instead enter into a novel ontological framework where player and computer are only apparently distinct parts of an apparatus. Discussing *Shelter*, I explained that games in which players are tasked with controlling parts of an ecosystem can more productively be read as encouraging players to embrace their place within an ecosystem. This is achieved by accepting that our actions within a game world are running alongside a myriad of other coded processes, each as important as those variables we provide. Focusing on approximated code for similar

functions, programmed myself within the Unity game engine – the same environment used to develop *Shelter* itself – I was able to reveal how player activity is a series of filing in gaps in computer systems. Rather than interacting, as a dominant agent, with an obedient, simplistic machine, videogame play is, rather, a complex 'intra-action' born out of complicated entanglements within an apparatus.

Building on the intra-active approach to game play, I then explored how this ecological quality of games could alter the ways in which they represent ecological systems. As games are not bound to the constraints of this everyday world, I argued that there are elements of our intra-active universe they could expose or make more clear. Examining *Superhot*, *Antichamber* and *Manifold Garden* I focused on the aesthetic engagement each of these games had with elements of our ecosystem that are frequently overlooked. For instance, in *Superhot* players are encouraged to engage with a world in which 'time moves only when you move'. Although this initially seems nothing more than a gameplay gimmick, read ecologically, we see how this resonates with ideas of time as part of a productive process of space-time-mattering. *Superhot* depicts clearly that human actions do not need to happen, 'in time' but rather happen with time. Distinctions of past, present and future, while undeniably 'real' are products of materiality, rather than some illusive stage on which the actions of matter are played out. More in common with quantum physics than ecocriticism, these games were said to depict time, space and space-time as entangled with activity. As such, videogames do not only foreground intra-action through play systems but can also foreground this quality through experimental aesthetics.

Finally, I discussed the implications that arise when we discuss the flipside of the intra-active ecology I have proposed. Distinct from the previous case studies where I have privileged connection and similarity, in chapter five I placed an emphasis on how videogames generate feelings of discomfort, distance and separation. This, I explained in accordance with my understanding of Barad's work, is due to the phenomenon of intra-activity producing apparent distinctions between apparent entities. In Barad's words this is known as the 'cut' but I viewed this as simply a product of playing videogames. To elaborate on how this distinction becomes apparent I first examined a number of classic videogames that are known for their 'immersive' quality – their ability to bring players in to the game world and make playing feel intuitive. Setting these up as a clear counter-example, I then studied games that do the precise opposite

and make everything from the game controls, in the case of *QWOP* and *GIRP*, to the game narrative in the case of *That Dragon, Cancer*, deeply troubling. Analysing these games allowed me to interrogate the limits of user engagement, empathy and affect. I suggested that videogames show the combinatory role of intra-action. At the same time the distancing effect it has in the inevitable production of apparent distinction between entities.

Approaching videogames from my intra-active, ecological perspective opens several doors for game studies. Most pressing, leading on from the conclusions of chapter four, is developing new methods for game design. In chapter four, I concluded that game designers acknowledging an agential realist ontology are produce engaging gameplay experiences. While games engaged with time and space in fascinating ways, there are a plethora of avenues to explore in this vein. For instance, focusing on the performative construction of reality, while *Antichamber* and *Manifold Garden* were able to visualise this to an extent, they relied on avant-garde, experimental aesthetics, forging abstract spaces for gameplay. Barad's work, although forged in the teachings of experimental physics, relates to very 'real' worldy spaces. For instance, her reading of the jute mills of India, discussed in chapter two, wherein, "structures are themselves material-discursive phenomena that are produced through the intra-action of specific apparatuses of bodily production marked by exclusions".[351] To those not accepting of an agential realist ontology, it is difficult to express socio-political structures existing in tandem with bodily activities. However, in a videogame, it is possible to dissect the constitution of bodies into various entangled lines of code. For instance, in my discussion of *Shelter* I discussed how the bodies of the badger kits, although visibly singular, solid entities, were entangled on a coded level with their surroundings. In a game world, designed for this purpose, it would be possible to create a world where structures become more or less real based on the activity of playable creatures (and vice versa). Such a game would be an important tool for explaining the ecological facets of game design, as I have in this thesis, but also for explaining the implications of Barad's work in 'real' world situations.

Following on from new directions in game studies, I believe the methodology I have formulated in this thesis for the study of videogames could also grow to be useful in studying a range of media. Chief amongst these is the growing discourse surrounding the 'internet of things'; the process of generating data through wearables and other everyday technologies that

[351] Barad, p. 237.

is then distributed through networks. Although media theorists such as Wendy Chun, Galloway and Thacker and Jenna Ng have already approached this area in their research, my intra-active methodology could open new, avenues for discussion. Although moving away from videogames, I would, nevertheless take the stance that objects do not pre-exist phenomena. As such, the 'internet of things' could be read as a much more global apparatus; the apparent entities produced by this having particular new identities.

As it stands, the methods of analysis I have formulated here have potential for use within the game studies community. Having addressed the implications of an ecological approach to games in terms of the impact on interactivity, aesthetics and affect it should be clear, by now, that there are few features of gaming as a phenomenon that cannot be read productively in this manner.

Appendix: Chapter 3 code transcript

```
<!doctype html>
 <title>Keyboard control</title>
 <canvas width="550" height="400" style="border: 1px dashed
black"></canvas>
 <script>
 var spriteObject =
 {sourceX: 0, sourceY: 0, sourceWidth: 64, sourceHeight: 64,
 x: 0, y: 0, width: 64, height: 64, vx: 0, vy: 0};
//The canvas and its drawing surface
var canvas = document.querySelector("canvas");
var drawingSurface = canvas.getContext("2d");
//An array to store the sprites
var sprites = [];
//Create the black square sprite and center it
var bs = Object.create(spriteObject);
bs.x = 243;
bs.y = 168;
sprites.push(bs);
//Load the image
var image = new Image();
image.addEventListener("load", loadHandler, false);
image.src = "blacksquare.png";
//Arrow key codes
var UP = 38;
var DOWN = 40;
var RIGHT = 39;
var LEFT = 37;
//Directions
var moveUp = false;
var moveDown = false;
var moveRight = false;
var moveLeft = false;
//Add keyboard listeners
window.addEventListener("keydown", function(event)
{
 switch(event.keyCode)
 {
 case UP:
 moveUp = true;
 break;
 case DOWN:
 moveDown = true;
 break;
 case LEFT:
 moveLeft = true;
 break;
 case RIGHT:
 moveRight = true;
 break;
 }
}, false);
window.addEventListener("keyup", function(event)
{
 switch(event.keyCode)
 {
 case UP:
      moveUp = false;
```

```
      break;

case DOWN:
      moveDown = false;
      break;
 case LEFT:
 moveLeft = false;
 break;
 case RIGHT:
 moveRight = false;
 break;
 }
}, false);

function loadHandler()
{
 update();
}

function update()
{
 //The animation loop
 requestAnimationFrame(update, canvas);
 //Up
 if(moveUp && !moveDown)
 {
 bs.vy =- 5;
 }
 //Down
 if(moveDown && !moveUp)
 {
 bs.vy = 5;
 }
 //Left
 if(moveLeft && !moveRight)
 {
 bs.vx =- 5;
 }
 //Right
 if(moveRight && !moveLeft)
 {
 bs.vx = 5;
 }
 //Set the black square's velocity to zero if none of the keys are being
pressed
 if(!moveUp && !moveDown)
 {
 bs.vy = 0;
 }
 if(!moveLeft && !moveRight)
 {
 bs.vx = 0;
 }
 //Move the black square
 bs.x += bs.vx;
 bs.y += bs.vy;

 //Render the sprite
 render();
}
```

```
function render()
{
 //Clear the previous animation frame
 drawingSurface.clearRect(0, 0, canvas.width, canvas.height);

 //Loop through all the sprites and use their properties to display them
 if(sprites.length !== 0)
 {
      for(var i = 0; i < sprites.length; i++)
 {
 var sprite = sprites[i];
 drawingSurface.drawImage
 (image, sprite.sourceX, sprite.sourceY, sprite.sourceWidth,
sprite.sourceHeight, Math.floor(sprite.x), Math.floor(sprite.y),
 sprite.width, sprite.height);
      }
 }
}
</script>
```

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