Collapsing Skin: Expanding Painting Through New Digital Technologies

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Abstract

This programme of practice-based research has sought to explore an expanded notion of the practice of painting through the exploitation of newly accessible digital technologies. The work is informed by the science of materiality in the field of quantum physics and related philosophical discussions. Of particular importance is the idea of skin as a surface of the human, as a point between the classical and quantum realms, and as an impossibly thin digital skin.

This study consists of digital paintings, which form the basis of constructed immersive virtual reality environments, accompanied by a reflective journal and contextual overview document. These documents take an experimental form which echo aspects of the painting practice, adopting a rule-based method of capturing important insights, drawn through inductive reasoning. Grounded Theory has been adapted as a means of structuring a practice-based research programme; this resonates with ideas drawn from both quantum theory and the process used in painting.

Contents

Preface

In this preface I present the key research activities that preceded this programme of doctoral level study, and I outline what my core concerns were at the initiation of the PhD in October 2012.

I made my first image with a computer in 1981 when I borrowed my brother's ZX81 and executed a PLOT command. When I started my BTEC Diploma in Graphic Design in 1986, I took advantage of the college's brand new Apple Macs to make more sophisticated images. When I enrolled on the BA Graphic Design degree at Leeds Polytechnic in 1988 I established myself as the resident Mac operator, and shortly after graduating I secured employment as a Senior Technician with responsibility for the Mac suite, which was at that time situated within the Printmaking department. In 1997, with support from the University, I completed a Post-Graduate Certificate in Research Methodology as part of a Master by Research programme, which I graduated from in 1999. The focus of this research degree was digital art, with a particular focus on digital imaging, 3D modelling and programming. Between my appointment as a lecturer in 2000 and my registration for this PhD in 2012, I continued to undertake research in the broad field of digital art and design. This research was wide-ranging and included the visualisation of DNA data, stereoscopy, digital painting, experimental coding with Processing, Lingo and PHP, games design inspired by evolutionary theory, 3D modelling, kinetic typography and experimental writing. I drew inspiration from artists including Charles Csuri, John Whitney, Lilian Schwartz, Peter Fouldes, Ed Emshwiller, William Laytham and Jeffrey Shaw.

In 2006 I started working in the virtual environment Second Life, and through my avatar Cubist Scarborough, created numerous artworks, some of which became part of the permanent art collection of the New Media Consortium. In 2007 I led a work package in a large JISC funded research project, Open Habitat, collaborating with researchers at the University of Oxford and King's College London. The Open Habitat programme investigated Second Life as a collaborative

creative learning space and provided me with the opportunity to interrogate the artistic potential of this embryonic virtual world as part of a community of artists that included Annabeth Robinson (Angrybeth Shortbread) and DC Spensley (Dancoyote Antonelli).

Around this time I became increasingly interested in contemporary science and I drew inspiration from artists such as Eduardo Kac and Orlan Catts. My practice became influenced by the latest research in genetics, neuroscience and physics, and I become a board member of the Northern Arts and Science Network.

In 2010 I started experimenting with the Microsoft Kinect scanner and returned to my digital painting practice, using a graphics tablet and Photoshop as my primary production tools. My interest in popular science endured and I became transfixed by quantum theory and the implications of the double slit-experiment in particular. This scientific experiment, first conducted by in 1801 by Thomas Young (Jaeger, 2009, p. 175), proves that light displays the characteristics of both waves and particles. Later variations on this experiment demonstrate that whether light acts as a wave or a particle depends on how it is observed. This experiment raises a multitude of philosophical questions about the nature of reality at the subatomic scale and the role of the 'observer' in creating a subjective reality. The notable physicist Richard Feynman best articulates the deep mystery that the double-slit experiment presents, and points out the limitations of conventional reasoning in our attempts to comprehend this enigma:

> We choose to examine a phenomenon which is impossible, absolutely impossible, to explain in any classical way, and which has in it the heart of quantum mechanics. In reality, it contains the only mystery. We cannot make the mystery go away by "explaining" how it works. (Feynman, 1965, p.1-1).

Fascinated by this quantum conundrum, and comfortable with a topic that words and reason cannot convincingly illuminate, I took the decision to make this the basis of my PhD, with digital art practice as my primary research method. This led me up to the start of my PhD registration in October 2012.

Technical Description and Instructions

The virtual reality artwork that forms the main submission for assessment consists primarily of a terrain that is a large-scale extrusion of my most recent digital painting. This spatial painting extends far into the distance, so a laser pointer navigation system is provided to facilitate rapid transport across the artwork. **The laser teleporter is activated by pressing the large touch-pad button on the top of the hand controller.** The paint-scape also contains twenty-seven of my original flat digital paintings, which were each created from a manipulation of a point-cloud captured by a 3D scanner that was then painted into with an electronic brush on a tablet. Twenty-seven hand-coded spatial-kinetic paintings, plus twenty-seven hemispheric paintings are also distributed throughout the environment, and a novel 'map' tool has been created to help the user locate individual artworks within the immersive experience. **The map is displayed when the laser pointer is activated.** The virtual environment is plainly rendered to minimise mimesis and maximise the specificity of the digital medium. There are no dynamic lights, no shadows and no reflective surfaces. The textures of the paintings and the terrain are rendered using point filtering to enable the authentic pixels of the original digital paintings to be directly experienced. There is no audio, and interactivity is limited to built-in head-tracking, the laser teleporter and the map tool. These limitations help to balance the levels of abstraction to prevent the experience becoming hallucinatory. This minimises the risk of motion sickness and is in keeping with the contemplative nature of a traditional gallery-based experience of painting, which is not typically noisy, and does not normally require interaction beyond moving the head and body.

Development platforms and programming languages.
Unity 2017.3, VRTK, Visual Studio, SteamVR, OpenSim, Processing, Lua, C#.

Image creation and modelling software.
PhotoShop, ProCreate, Art Studio, RGBD Scan, Blender, MeshLab.

Hardware.
Microsoft Kinnect, iPad Pro with Wacom Stylus and Apple Pencil, MacBook Pro, Alienware Laptop with NVIDIA GeForce GTX 1080, Dell Visor Windows Mixed Reality Headset, HTC Vive Headset.

Selected Outputs

EVA London Digital Arts Conference, 10-13 July 2018. London (2018). **Ultra-infra: Becoming Skin.** [Conference paper], Truelove, I., British Computer Society, 10 July.

EVA London Digital Arts Conference, 10-13 July 2018. London (2018). **Ultra-infra: Becoming Skin.** [Virtual Reality Artwork], Truelove, I., British Computer Society, 10-13 July.

The Audiovisual Body, (2018). **The Artist's Presence.** [Augmented Reality Artwork], Briggs, J., Truelove, I. & Worth, Z., University of Huddersfield, 11-12 June.

Truelove, I. (2018) **Skinscape.** [Virtual Reality Artwork]. Valve: Steam Store, Available from: <bit.ly/skinscape>, Released 8 June 2018.

Steam/Exploring Digital Futures Conference, Online/Scarborough (2017). **Paintings, 2011-2017.** [Virtual Reality Artwork], Truelove, I. Available from: <bit.ly/truelovevr>, Stephen Joseph Theatre/Reel/Askew Brook/Valve, 26 & 27 May.

Exploring Digital Futures Conference, Scarborough (2017) **Art & VR.** [Panel host] Mack, K., Nicholls, I., Smyth, K., Summers, R. & Truelove, I., Stephen Joseph Theatre/Reel/Askew Brook, 26 & 27 May.

Goldsmith, K., Morris, S., & Truelove, I. (2016) **Seven American Deaths and Disasters** [Artwork], Reading as Art (Exhibition), Bury Art Museum, 26 August to 19 November 2016.

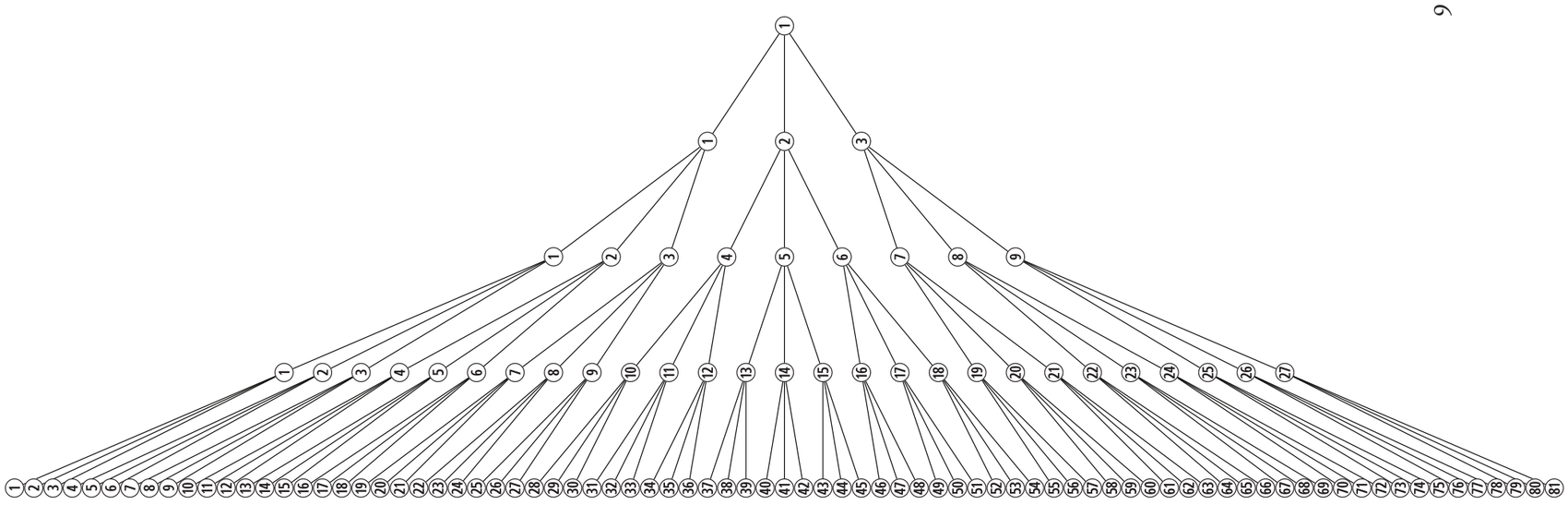
Vizor/Deleuze Studies Conference Camp. Online/Rome (2016). **Deleuze 3 (after Jeffrey Shaw).** [Virtual Reality Artwork], Truelove, I. Available from: <https://patches.vizor.io/iantruelove/deleuze3>, Department of Philosophy, Communication and Visual Arts of University of Roma Tre., 3-7 July 2016.

Deleuze Studies Conference Camp. Rome (2016) **Just about becoming: painting a skin of life.** [Virtual Reality Workshops] Truelove, I., Department of Philosophy, Communication and Visual Arts of University of Roma Tre, 3-7 July 2016.

Truelove, I. (2016) **The Thing in Itself.** [Video Projection]. In: Big Screen [Curated by Alan Dunn]. Millennium Square, Leeds. 5 April 2016.

Design & Creativity Conference, January. Leeds (2015) **Z is for Zero: The World is Flat.** Truelove, I. Leeds Beckett University.

Truelove, I. (2013) **Waves Collapse.** [Sculpture and sound installation]. In: G.R.E.I.G. [Group Exhibition]. Leeds Metropolitan University. 14 September – 25 October 2013.



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①**This text is for the purpose of assessment, and is to be consumed only by the assessment team.** ②**The supervisory team, assessors, audience, technologies of production and artist-researcher are all agents of observation in this study.** ③**The agencies of observation in this study all affect the way the Journal-waves are collapsing into these particles.**

... as a matter of principle, there is no unambiguous way to differentiate between the 'object' and the 'agencies of observation' - no inherent/naturally occurring/fixed/universal/Cartesian cut exists. Hence, observations do not refer to an object of independent reality. (Barad, 1997, p. 170)

I'm not dealing with the real you, I'm dealing with the virtual image of you. This image has reality… Idealisation is crucial. … The virtual image which determines how we interact with other people. (Zizek, 2004a)

... retrocausality means that, when an experimenter chooses the measurement setting with which to measure a particle, that decision can influence the properties of that particle (or another particle) in the past, even before the experimenter made their choice. In other words, a decision made in the present can influence something in the past. (Zyga, 2017)

We must not, in a heady march into the audiovisual, abandon the writing way of thinking. Rather, writing and the audiovisual must be counterbalanced in service to life. (Spatz, 2018, p. 150)

So context for Derrida is everything. That is, everything outside of the work. (Osborne & Turner, 2006)

And why shouldn't I invent some way, however fantastic and contrived, of talking about something, without someone having to ask whether I am qualified to talk like that? (Deleuze, n.d., quoted in: Sauvagnargues, 2013, p. 116)

... since at the microscopic level our observation of matter disturbs the observed phenomenon, we cannot be sure of what reality is per se. On the other hand, what strikes us most when we observe our universe, which is made of that same matter, is its beauty. (Levrier, 1997, pp. 268-269)

... the intricacy of the wavefunction increases rapidly with the number of electrons. Even a simple water molecule, for example, has eighteen electrons. (Woody, A, 1998, p. S616)

... the human mind can never really connect to the full "fire hose" of reality. Instead, it must simulate reality as curated slices of life in order to function without having a sensory meltdown. (Cheng, 2017, quoted in, Jetzer, 2017)

Introduction

One cannot separate out the observer from the observed. The 'agencies of observation' (Barad, 1997, p. 170) that I have imagined interacting with my research have affected the way I have written this document. I am an artist who has engaged in a programme of practice-based research that has sought to exploit the creative potential of bleeding-edge technologies, and I have written this text in a way that is determined primarily by my digital painting practice. However, throughout my study I have maintained an idealised virtual image of my observers (Zizek, 2004a), and this cannot be separated out from my research. Although you are reading this for the first time, you have been affecting my research since the start.

I have captured and developed a multifaceted programme of practice-based research through an online reflective journal which spans precisely five years of my studies. The Journal reveals the uncertain nature of research at doctoral level. Through this contextual overview I extract some cognitive meaning from my programme of artistic research. I have employed a process of inductive reasoning (see page 15) and an experimental approach to writing to create a document that aligns with my practice-based approach. Taking my lead from the rules-driven approach to experimental writing expounded by the 1960's OuLiPo group, I have imposed my own set of rules to constrain the writing of this text in order to *evenly sample* the many lines of inquiry I have pursued, and to enable a smoothing out of a heavily striated research process. I developed these rules by first drawing a diagram (see page 9) to explore how a three-way branching structure might help me tease out discoveries embedded in The Journal. This led to the subsequent development of the following rules: to use my intuition to induce eighty-one eighteen-word 'particle' phrases that capture different aspects of my research; to put these into groups of three; to arrange these triplets into an appropriate sequence; to gather quotes from The Journal that are pertinent to each triplet; to write a response to each triplet and its quotes. Page left are my first set of triplets (numbered) and their quotes. Page right, here, is my first response. *Your rules are:* to first read the triplets, then read all of the quotes, then judge my response.

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④**My Journal is: a rhizomatic form, a plane of immanence, waves of probability, an illusive field of data.** ⑤**The Journal as waves of probability: this text is one observation that collapses a wave into a certainty.** ⑥**The way that I collapse the wave is determined by what's most probable, dictated by what's already collapsed.**

… all organisms to some extent, but human beings to a marvellous extent, are equipped to probe and learn by trial and error, by switching from one hypothesis to another until one is found that ensures our survival. (Gombrich, 1960, p. 277)

There are no points or positions in a rhizome, such as those found in a structure, tree, or root. There are only lines. (Deleuze & Guattari, 1987, p. 9)

Philosophy is becoming, not history; it is the coexistence of planes, not the succession of systems. (Deleuze & Guattari, 1994, p. 59)

[on Deleuze] Rather than trying to deliver something from nothing through the force of genius, thinking tries to construct free spaces within a terrain bounded by many constraints with the belief that things will work out in the long run. (Rajchman, 2000, p. 5)

I propose that the notion of affect establishes a mode of communication outside the limits of language that overruns linguistic meaning and illustrates that what surfaces to consciousness has already undergone an act of interpretation. (Lovari, 2014, pp. 2-3)

In order to seek truth, it is necessary once in the course of our life, to doubt, as far as possible, all things. (Descartes, 1644)

The secret to the whole thing lies in being arbitrary. (Kierkegaard, 1843, quoted in: Ferguson, 2013, p.16)

Insistence on clarity at all costs is based on sheer superstitions as to the mode in which human intelligence functions. (Whitehead, quoted in: McLuhan & Fiore, 1967, p.10)

… not to predict, but to remain attentive to the unknown knocking on the door. (Deleuze, 1992, p. 159)

We must not believe every thing about a man because a man can say everything. We must believe only what is human about him. (Lyotard, 1988, pp. 17-18)

… it is not the function of the poet to relate what has happened, but what may happen - what is possible according to the law of probability or necessity. (Aristotle, n.d., quoted in: Woodfin & Groves, 2013, p. 122)

The Journal

The Journal is a record of all of my learning and progress over the first five years of my study. It has captured most of my thoughts, experiments and outcomes along the way. It is an interconnected, disconnected, tangled, complex and chaotic record of the uncertainty that characterises original research at doctoral level. It has no discernible starting points, no endings, and any part of it potentially connects to any other part. A change to one part immediately affects all of the other parts. It is, in short, a *rhizomatic* form (Deleuze, 1987, p.9). Borrowing another Deleuzian concept, I think of The Journal as a *plane of immanence* (Stagoll, 2005, p. 204), pervading everything I have thought and done. It is useful to think of it as many possible planes of immanence, with each plane representing a different intersection. The mechanical rules that I have imposed to give structure to this document offer up eighty-one quantised planes of intersection.

I also picture The Journal as something similar to the wave of probability that exists before an observation collapses the quantum wave function into a particle. Like the collapsing wave function, the acts of inductive reasoning (see page 15) that I have invoked in order to generated the eighty-one eighteen-word 'particles' (numbered, left) were determined by what was most likely, based on a multiplicity of insights pinned down in The Journal along the way.

I have not insisted on 'clarity at all costs' (Whitehead, quoted in: McLuhan & Fiore, 1967, p.10). I have carefully maintained my art practice – painting with newly available digital technologies – as the primary research tool and I have used The Journal as a receptacle for capturing my word-based insights as they have arisen, in a process of slow implicit interpretation. What has been allowed to surface to my consciousness through my rules-based approach to writing this document has already undergone many years of tacit interpretation through The Journal.

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⑦**The rhizome has no start, middle or end. A contextualisation does. Here are the cognitive tubers, in order.** ⑧**The inductive reasoning research method, of which this is one particle, is itself the product of inductive reasoning.** ⑨**My inductive reasoning methods lead me, eventually, to my research question. I'm building theory here, not testing it.**

Radix in Latin means root and since the time of Cicero has been used figuratively for the basis, foundation or essence of something. (BBC News, 2015)

[philosophy, science and art] include an 'I do not know' that has become positive and creative, the condition of creation itself, and that consists in determining by what one does not know. (Deleuze & Guattari, 1994, p. 128)

There is one great difficulty with a good hypothesis. When it is completed and rounded, the corners smooth and the content cohesive, it is likely to become a thing in itself, a work of art. (Steinbeck, 1941, quoted in: Baker, 2013, p. 175)

Without some starting point, some initial schema, we could never get hold of the flux of experience. ... But how we arrange the first filing system is not very relevant. (Gombrich, 1960, p. 76)

… to make connections one needs not knowledge, certainty, or even ontology, but rather a trust that something may come out, though one is not yet completely sure what. (Rajchman, 2000, p. 7)

Thoughts without content are empty; intuitions without concepts are blind... only from their union can cognition arise. (Kant, 1781, p. 78)

For to think is to experiment and not, in the first place, to judge. (Rajchman, 2000, p. 5)

Making comes before matching. (Gombrich, 1960, p. 99)

I believe that literature is one of the technologies invented by human beings (and, in the intricate feedback manner of evolution, which helped invent human beings) to aid the species in the precarious work of collapsing pure potential into concreteness. (Argyros, 1990, p. 37)

Grounded theory is an investigative process for building a theory about a phenomenon by systematically gathering and analysing relevant data. (Charmaz, 2006, p. 56)

The aim of this primarily inductive research method is to build theory rather than test it. Grounded concepts, relationships and theories are suggested, not proven. (Glaser, 1978, p. 134)

Grounded Theory

Deleuze and Guattari's concept of the rhizome (1987, p. 9) has provided me with a useful platform for the development of my research methods. The necessity for a beginning or an end, and neat forms of linear inquiry, feel at odds with the creative process, but the rhizomatic methods articulated by Deleuze and Guattari offer a way of thinking that resonates with my experience of art-practice-based research. The traditional doctoral *thesis* — as a premise to be proved — sits uncomfortably with the intellectual free exploration that characterises art practice. The rhizomatic approach, which challenges research methods that emphasise the testing of a hypothesis, led me to the Grounded Theory Method (GMT), devised and developed by Glaser and Strauss in 1967. GMT is used extensively in the social sciences, but has also been adopted by a range of disciplines. This method makes extensive use of a process of broad data collection in which the researcher is not separate from the research and whose influence is central to the process. Research does not start with a hypothesis but a general field of enquiry, and as such this method sits comfortably with art-practice-based research.

Whilst I have not stuck steadfastly to the structural rules of GMT, I have adhered to one of its core processes: the exploitation of inductive reasoning. Unlike deductive reasoning, which moves from the general to the particular, inductive reasoning moves from the particular to the general, and so accommodates speculative enquiry. This is how I research: moving from the particulars and certainties of the things being made to the possibilities of what might be made next. The double-slit experiment (see page 19) is one 'particular' that I have generalised through my practice; the pixel is another. Inductive reasoning has also provided me with a method to get from my implicit practice-based intellectual enquiry to the explicit theory you read here without compromising the integrity of my artistic research. Rather than relying on a question to *initiate* my study, the practice-based research undertaken in this study has generated a research question which *concludes* it (see page 63). It is not for me to test and prove answers to this question here: this is forbidden in GMT (Glaser, 1978, p. 134). Through this document and the artwork this research programme offers up suggestions, not proofs.

⑩⑪⑫

⑱**The subtle interplay between art as language and language as art in this study offers up new insights.** ⑪**I tried to argue that cognitive was arguable and art was not arguable: that was a category error.** ⑫**You will not gain absolute knowledge of my research here or in my artworks, but thanks for trying.**

Philosophy relies on a one-to-one relationship between words and meanings as a guarantee of truth. This is the error of logocentrism. (Robinson & Groves, 2007, p. 162)

How did language come to be more trustworthy than matter? (Barad, 2003, p. 801)

We are not allowed to talk about the photon passing through this slit or that slit, neither are we allowed to talk about the photon passing through both slits. All this kind of language is not applicable. (Zeilinger, 2011)

Einstein's own descriptions of his thinking in which "words do not seem to play any role", but there is an "associative play" of "more or less clear images". (Kremer, 2015)

We must be clear that when it comes to atoms, language can be used only as in poetry. (Bohr, 1920, quoted in: Baker, 2013, p. 54)

Artworks are worlds unto themselves, with their own times and space. (Ellard, 2015).

Words aren't good enough, but words can help. (Creed, 2017)

… these open vortexes in the sonorous world finally form one sole vortex in which the ideas fit in with one another. (Merleau-Ponty, 1968, p. 151)

Genuine tragedies in the world are not conflicts between right and wrong. They are conflicts between two rights. (Hegel, n.d., quoted in: Adler, 2013, p. 109)

To 'proceed with' painting is not to write about its cause but to explore what the materials and processes of writing can do through a dynamic 'contrapuntal' relation to the painting that is made of different stuff. (Ferguson, 2017, p. 107)

There is nothing outside the text. (Derrida, 1967, p. 163)

I owe you the truth and I shall tell it to you in painting. (Cezanne, 1905, p. 251)

To see what a picture is, is to see what about it cannot be described. (Elkins, 1998, p. 47)

There is no such thing as good painting about nothing. (Rothko & Gottlieb, 1943)

Osmose acts as a spatial-temporal arena where we can perhaps re-learn how to "be". (Davies, 2002, p. 104)

Art is embodied meaning. (Danto, 2013)

Art and Language

Art may be thought of as a language, but the art I engage with is not an analogue for the languages we speak or write. In The Affect Phrase (from a supplement to the Differend) Jean-François Lyotard asks "is feeling is a phrase?" (2006, p. 104), invoking a structure of communication in order to examine the slippery notion of *affect* (see page 57), before pointing out that the domains of affect and *logos* (logical argument) are incompatible - a 'differend' exists between them. When a visitor to Oxford asks where the university is, they are making a *category error* (Ryle, 1949). To assume compatibility and the prospect of a straightforward transaction between affect and logos is also a category error. Similar category errors are common in our attempts to comprehend the quantum realm. We cannot say that quantum entities are waves *or* particle, or waves *and* particles: all this kind of language is not applicable (Zeilinger, 2011). My art is not in the same category as the kind of language I am using to speak about my art: my art has been silenced. However, silence can speak volumes. In the virtual reality artwork that forms the main submission for assessment there is no spoken commentary. Instead, this visuospatial experience quietly conveys the essence of my research.

In a practice-based study, it is easy to fall into the trap of feeling like cognitive is the enemy of affect, but this is also a category error. In my study I have exploited the two domains through an interplay between my art practice and the insights I have captured through The Journal, and each intellectual category has acted as a cushion for the other. Lyotard talks of a 'damage' being done when one attempts to synthesise affect and logos (2006, p. 105), but in my study, I've avoided such conflict. Presenting my virtual reality-based art to a group of Deleuzian scholars in Rome was my most dangerous encounter between affect and logos to date, but the scars are healing. A discursive examination presents similar challenges, and only partial testing is possible via an exchange of words: *logos* alone can only ever yield relative knowledge (Bergson, 1949, p. 159). Absolute knowledge of my research, like that of the quantum realm, is not possible, but useful relative knowledge may be acquired by considering the immersive artwork together with the words in this document.

⑬⑭⑮

⑬**We think we know what reality is. Science, philosophy and art provide different ways to challenge our assumptions.** ⑭**Deleuze's three daughters of chaos: philosophy, science and art, marry my sons of order: writing, coding and painting.** ⑮**If words are not appropriate, and mathematics is inaccessible, then what can my pictures bring to the table?**

The non-scientists have a rooted impression that the scientists are shallowly optimistic, unaware of man's condition. On the other hand, the scientists believe that the literary intellectuals are totally lacking in foresight, peculiarly unconcerned with their brother men, in a deep sense anti-intellectual, anxious to restrict both art and thought to the existential moment. (Snow, 1959, p. 3)

[on the double slit experiment] This wave of chance somehow travels through both slits. (Al-Khalili, 2014)

Questions about space and time were central to the avant-garde ideas sweeping across Europe at the beginning of the 20th century. Both Einstein and Picasso encountered the work of French polymath Henri Poincaré, from whom they learned about four-dimensional geometry. Cubism was largely a scientific art movement … (Miller, 2008, p. 49)

Art, according to Deleuze, does not produce concepts, though it does address problems and provocations. It produces sensations, affects, intensities as its mode of addressing problems, which sometimes align with and link to concepts, the object of philosophical production, which are how philosophy deals with or addresses problems. (Grosz, 2008, p. 2.)

[Metzinger] inspired [Bohr] to postulate that the totality of an electron is both a particle and a wave, but when you observe it you pick out one particular viewpoint. (Miller, 2005, p. 44)

Ultimately, physics only describes the part of reality that is susceptible to mathematics. (Webb, 2016, p. 45)

The remarkable refinement of mathematical ideas has forced a reconsideration of what we think we see, and the conceptual possibilities that mathematics provides may indicate that we've enhanced our sensory apparatus in such a way that it has been made sensitive enough to 'reach' the edge of what is 'sensible' making us aware of the reality that escapes us. (Joselle, 2013)

… repeatability and falsifiability are two criteria and methods that make no sense (or for very specific cases only) in artistic research. (Schiesser, 2012, p. 109)

An image does not represent an assumed reality, it is all of reality itself. (Deleuze, n.d., quoted in: Sauvagnargues, 2013, p. 19.)

Art, Science and Philosophy

My research treads a path well worn by modernist painters (Miller, 2008, p. 49). Rather than grapple with the nature of material reality as they did using physical paint, I am using the best methods I have at my disposal: digital painting, writing and computer programming. Informing this quest for knowledge are the three cultures of science, art and philosophy. The double-slit experiment proved that light displays the characteristics of both waves and particles (Al-Khalili, 2014), but science is still grappling with its implications, and scientists still don't agree on what wave-particle duality really means. 'What is the nature of material reality?' is a central question in science; in this study I've claimed that as a question to further my artistic research.

When Niels Bohr was developing the principle of complementarity in quantum theory, he was inspired by the work of the cubist painter, Jean Metzinger, whose painting 'Woman on a Horse' hung on Bohr's office wall (Miller, 2005, p. 44). Perhaps my art could serve a useful purpose beyond audience pleasing, and help inspire the scientists that share my passion. The danger would be that my art would become subservient to science, as a junior partner. Equally dangerous would be to merely illustrate scientific concepts. This might advance the popular understanding of science, but is again a secondary research activity: I see my art practice as primary research. My experiments are not repeatable or falsifiable (Schiesser, 2012, p. 109) – to think that they should be is another category error – but they can offer something that science and philosophy cannot. They can transcend the limitations of concepts and mathematics to manipulate percepts and affects (Grosz, 2008, p. 2.) in a practical interrogation of material reality. In her 1995 virtual reality artwork, *Osmose,* Char Davies (2002, p. 102) used early immersive technologies to explore Cartesian duality and the relationship between the human and the natural world. Similarly, In the virtual reality-based artwork that I present for assessment, I manipulate virtual space and digital visual matter to generate new knowledge about the material reality that is hidden beneath the surface of our everyday experience.

⑯⑰⑱

⑯**Quantum theory offers powerful metaphors for structuring speculative thinking and coherent doing: the wave function of creative probability.** ⑰**Quantum objects are neither wave nor particle. The creative probability density map guides me to make artistic decisions.** ⑱**Creative probability is different to creative possibility. Anything is possible, but what already exists determines what's most probable.**

With our intuitions schooled within the paradigm of classical physics, we tend to assume that reality has definite properties, regardless of whether or not there is anyone around to observe them. This view, called 'objective realism', turns out to be incompatible with quantum theory. For example, there is no accurate space-time representation of, say, an electron: It is neither a particle nor a wave or any other 'thing'. (Voss-Andreae, 2011, p. 15)

Everything not forbidden is mandatory. A quantum particle moving from point A to point B will take absolutely every possible path from A to B, at the same time. This includes paths that involve highly improbable events like electron-positron pairs appearing out of nowhere, and disappearing again. The full theory of quantum electro-dynamics (QED) involves contributions from every possible process, even the ridiculously unlikely ones. (Orzel, 2010)

Nature does not distinguish between what is art and what is material, as all are merely patterns of structure in space and time. (Buehler, 2014, p. 31)

There is increasing evidence that many systems we observe in living things are close to what's called a critical point - they sit on a knife-edge, precariously poised between order and disorder. (Ball, 2014, p. 45)

I find the task imposed upon me of defining the esthetically good. ... I should say that an object, to be esthetically good, must have a multitude of parts so related to one another as to impart a positive simple immediate quality to their totality; (Peirce, 1934, quoted in: Danto, 2013)

Roughly speaking, the law of the diagram, according to Bacon, is this: one starts with a figurative form, a diagram intervenes and scrambles it, and a form of a completely different nature emerges from the diagram, which is called the figure. (Deleuze, 2003, p. 109)

In short, there is no plausible case against ambiguity. But ambiguity is not a characteristic that just approaches artworks. It is not available or given; instead, it must be produced. How well this works, if at all, depends on individual cases. (Geimer, n.d., quoted in: Graw, 2012, p. 39.)

Art and Quantum Theory

My expertise in quantum theory is no more than that of an awe-struck lay-person. I took a short online course in quantum mechanics (Schumacher, 2009), and understood enough to appreciate that I can never know more than just a little of this strange and wonderful view of the world. I was greatly heartened to learn that no human is ever likely to comprehend more than a tiny part of the quantum realm.

What I did glean is that the 'collapse' of the wave function is determined by its field of probability: what is already fixed in classical reality dictates how the incorporeal becomes manifest. This is very much like the creative process, where the possibilities presented by divergent thinking are pinned down through acts of making, which in turn present new possibilities. But possibility is not the same as probability. The thing one makes as an artist generates a loosely defined cloud of probability around it: a density map of creative probability. It is this idea that I defined as a procedure, in order that I might use it as an explicit process for painting.

The point clouds that I captured through my Kinect scanner provided the pixel ground and, one pixel at a time, I released these visual elements into a cloud of possibility. Each point entered a state of 'superposition': it was potentially everywhere and anywhere, but probably somewhere. My hand and eye then 'collapsed' each particle back down, as determined by the nature of the image that had already been fixed, guided by my aesthetic sensibilities. Slowly and methodically, I used an iPad and an electronic 'brush' (a blunt rubber tipped stylus first, then a sharp, hard Apple Pencil) to paint my way across the cloud, with the 'diagram' (Deleuze, 2003, p. 109) restricted to a minute section of the whole. A multitude of 'miniature scramblings' (Deleuze, 2003, p. 109) painstakingly worked their way out of the 'wet' edge of the painting, as the figure re-emerged bit-by-bit over weeks, months, years. As well as providing an apt space to display these digital paintings, the virtual reality environments that I eventually came to work within provided a space to work the flattened images back into spatial forms, which I also animated by coding simple but aesthetically driven algorithms. Virtual reality released a new cloud of creative probability around my paintings, which were collapsed through my code.

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⑲**Quantum mechanics shows us a reality, but we still lack the ability to satisfactorily comprehend its apparent paradox.** ⑳**I cannot talk about the photon passing through one slit, or the other, or both. Language isn't applicable.** ㉑**Just because you can't understand something doesn't mean it can't be useful. Quantum mechanics is a productive mystery.**

The job of the artist is to always deepen the mystery. (Bacon, quoted in: Studio Remi Lacroix, 2017)

This is the major challenge of contemporary painting: to show us the space-time in which we everyday are unwittingly immersed. To show us the formal structure of our quotidian experience or at least its hidden state. (Bourriaud, 2009)

… given art's ability to express that which cannot be rationally comprehended, can art manifest, and thus maybe even sublimate, such a state of unsurveyability? (Cleland, Fisher & Harley, 2013)

… it is possible to develop coherent philosophical positions that deny that there are representations on the one hand and ontologically separate entities awaiting representation on the other. (Barad, 2003, p. 807)

… Sometimes the photon looks like a wave, sometimes a particle, or like anything in between … In reality, it is none of these things. What it is, though, we do not have the words or concepts to express. (Ananthaswamy, 2016, p. 15)

… we don't have the language to describe the truly weird nature of the quantum realm that bubbles beneath our layer of reality. (Aron, 2016, p. 12)

If we limit ourselves to asking questions permitted by quantum theory, we'll be rewarded with correct answers. But if we insist on trying to grasp the meaning of what the theory tells us using concepts from the classical world, we'll become mired in confusion. (Phillips, 2017)

The pure formalism of true radical materialism, which is why, for me, quantum physics ultimately is a deeply materialist theory. (Zizek, 2004a).

Twenty-five percent of the world's GDP originates from quantum mechanics. (Milner, 2015, p. 60)

The philosophers have only interpreted the world, in various ways. The point, however, is to change it. (Marx, 1845)

I hate that art is given the burden of having to be meaningful. I think this is a misunderstanding. Maybe the real purpose of art is to wrestle with the relationship between meaning and meaninglessness and how they transform each other. (Cheng, 2017, quoted in: Scott, 2017)

The Mystery of Reality

There are limits to our knowledge, but we must keep trying to comprehend the unknown, even if it ultimately turns out to be incomprehensible. We are human beings, and this is our nature. Reason, structured through words, offers a blunt tool for comprehending a quantum description of reality (Aron, 2016, p. 12). Mathematics is a universal language but its limits are also universal. Art is at ease with 'unsurveyability' (Cleland, Fisher & Harley, 2013), and as an artist I am comfortable exploiting my freedom in order to deepen the mystery of reality (Bacon, quoted in: Studio Remi Lacroix, 2017). Freed from the necessity for sharply defined answers, my fascination with the mystery of reality motivates me to engage in an art-practice-based quantum ontology (Ney, 2012, p. 528). What can I *make* of reality? Explanations of reality at the sub-atomic scale are inherently uncertain, and some principles of quantum theory depend on uncertainty (Schumacher, 2009), but we *can* have some certainty about what has been made. In this study, certainty comes in the form of tangible digital artefacts.

The engineers that exploited the properties of quantum systems in order to invent semiconductors did not worry about the lack of human comprehension of quantum mechanics at a philosophical level (Milner, 2015, p. 60). These engineers used what could be understood about quantum entities to launch the computer revolution. A philosophical or common-sense understanding of quantum mechanics was not necessary to make silicon chips work.

I do not want to engage in the futile attempt to explain reality (Phillips, 2017). I do not need to talk about the photon passing through both slits or either slit: this is not necessary, as I am making artworks that utilise what I can hold in my head about wave-particle duality, so that I might deepen the mystery of reality. Through my use of the latest virtual reality technologies I find new ways to probe this quantum mystery and share it with an audience. My viewers take what they need from this, rendering the mysterious aspects of quantum theory I have captured and embodied in my artworks nonetheless productive.

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㉒**All of reality is in the wave function. We collapse it into its most probable frame of reference.** ㉓**Without the standing wave there would be no atom: no material reality. Similarly, the modernist frame enables resonance.** ㉔**Standing waves are made possible by the fixed frame. Without the painting's rectangular boundary, the waves cannot resonate.**

… Alessandro Fedrizzi at the University of Queensland in Australia and his colleagues have measured the reality of the wave function. Their results rule out a large class of interpretations of quantum mechanics and suggest that if there is any objective description of the world, the wave function is part of it. (Slezak, 2015. p. 14)

… is the wave function itself ontological or epistemic? Is the uncertainty the wave function represents a true reflection of reality's state - or just our state of knowledge about it? (Ananthaswamy, 2017b, p. 41)

… it is here that painting discovers, deep in itself and in its own manner, the problem of pure logic: how to pass from the possibility of fact to fact itself? (Deleuze, 2003, p. 112)

The notorious "collapse of the wave-function" is nothing but the updating of an agent's state assignment on the basis of her experience. (Fuchs, Mermin, & Schack, 2013, p. 2)

[Copenhagen interpretation:] The state (position, momentum, etc.) of a system is completely specified by its "wave function," a mathematical object that evolves, deterministically, according to the equations of quantum mechanics. The wave function is not directly observable; however it gives the probability that, when a measurement is made, you'll find the system in a particular state. These "systems" can be elementary particles such as electrons and protons, atoms, or even large molecules. Upon measurement, the wave function and its probabilities "collapse" to the measured value. (Phillips, 2017)

Concepts are centres of vibrations, each in itself and every one in relation to all the others. This is why they all resonate rather than cohere or correspond with each other. (Deleuze & Guattari, 1994, p. 23)

Objects that appear to be particles are in fact tiny vibrating closed loops or 'strings' of energy, subject to a 'tension' that is related to their size. (Sparrow, 2014, p. 358)

The virtual can be understood as the realm of affects. Art precicely actualises these invisible universes. (O'Sullivan, 2001, p. 129)

The Wave Function

It is my understanding that the wave function is a mathematical form which describes a hidden reality (Phillips, 2017). The wave function accommodates a description of, say, a photon (although it can also describe other entities, including matter) as both a wave and a particle, and it helps us to trace its collapse into something definite. It reveals that this collapse is determined by probabilities, and it is this notion (as far as I am able to comprehend it) that I hold in my head as I paint. I have imagined my creative state of mind to be a wave function whilst carrying out the act of painting, with my eye and hand collapsing a hypothetical wave function as I work my way out from the centre to the edge of the painting. The *possibility of fact* passes through my hands to become *fact itself* (Deleuze, 2003, p. 112). Once the pixels of paint are fixed, I do not return to them. To do so would break the rules of this self-imposed procedure. This is sometimes at the expense of aesthetic elegance, but beauty is not my primary aim. Embodied in each of my paintings is an idea of reality inspired by quantum theory, and that is why they look the way they do.

Standing waves resonate in a swimming pool only because it has fixed sides (Nave, 2000). Without the rigid frame, there is no resonance. The coherence of the atom is the result of standing waves that are only enabled by the atom's rigid shell (Feynman, 1964). These waves resonate in more dimensions than can be visualised, but picturing two dimensional waves in water suggests what might be going on at the root of material reality. The fixed frame of the modernist painting, as expounded by Greenberg (1960, p. 4), might be thought of as a similarly necessary feature for enabling an aesthetic resonance. My paintings always have a boundary. Sometimes it is the edge of the iPad screen, sometimes the edge of the digital file, sometimes it is the edges of the headset screens, sometimes the perimeter of a painted hemisphere or the edge of the virtual reality terrain. I am conscious of, and try to make use of, these hard edges in my work as, like the sides of the pool, they provide the constraints that are necessary to enable coherent standing waves to form.

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㉕At the heart of this study is an art practice that paints the skin of human material reality. ㉖The atoms of your face are just about collapsing through their interaction with each other. I paint that. ㉗What I've done is paint a plane of imminence, not to be confused with the plane of immanence.

The flesh is not matter, is not mind, is not substance. (Merleau-Ponty, 1968, p. 139)

Skin is explored as a media surface and as a metaphor for mapping and merging physical and digital realities. (Zapp, 2011, p. 380)

Some people may seek to impose upon modern painting the choice of being either traditionally representational or abstract, but this is a false dilemma. (Ferrier, 1999)

Dietrologia (noun) - The belief in hidden, underlying realities … the very Italian notion of dietrologia, the "conviction that hidden dimensions underlie surface reality" and the "madcap search" for them. (Wood, 2015)

… the interaction energies of quarks and gluons make up the lion's share of the mass of stuff as we know it. You might feel solid, but in fact you're 99 per cent energy. (Brooks, 2015, p. 38)

It's not a complete disruption of the human, but it's a kind of somehow... well what is it? It a kind of stretching, or twisting of the human figure, or a stuttering or stammering of it ... [both Deleuze and Bacon are] trying to produce the visible behind the invisible. (O'Sullivan, 2008)

Pollock was 'engaged in striking, or cancelling, the figure,' and not in performing intellectual experiments in vision or abstraction. (Elkins, 1998, p. 110)

A composition is the inwardly-purposeful subordination: 1. of the individual elements and: 2. of the build-up (construction) towards the goal of concrete pictoriality. (Kandinsky, 1926, p. 44)

A plane of immanence can be conceived as a surface upon which all events occur, where events are understood as chance, productive interactions between forces of all kinds. As such, it represents the field of becoming, a 'space' containing all of the possibilities inherent in forces. (Stagoll, 2005, p. 204)

THE plane of immanence is the field of all events. (Stagoll, 2005, p. 206)

Becoming Skin

I am concerned with a traditional pursuit for a modernist painter: I am attempting to make the invisible world visible (Merleau-Ponty, 1968, p. 139). When I am painting, I try to focus my attention on the idea that the minuscule entities that form a human face are not actual, but exist in the unobservable form of the wave function. Sometimes I try to imagine the wave functions of the atoms that form the outer cells of the skin, and sometimes I think about the wave functions of light bouncing off the outermost boundary of the face, the point where it meets the 'not-face'. The 'observer' is often quoted as the thing that collapses the wave function, but this needn't be the eye of a living observer. It is the interaction of the wave function with any aspect of the classical world that causes its collapse, and precisely how it collapses is determined by the thing it collapses into: the observer may not be sentient. If the classical human eye and brain collapse the wave function, then this creates a reality that makes sense within a human frame of reference. If the collapse of the wave function of skin is caused by classical skin itself – *skin as observer* – then what might that look like? If invisible skin is perpetually collapsing into visible skin, how might that manifest itself? I strive to paint that.

An alternative way to think of this mathematical world of the wave function is to draw on Deleuze and Guattari's notion of 'the plane of immanence' (1994, p. 49). The wave function is everywhere now and always was and always will be: it is *immanent*. It sustains the universe and is all pervasive. The wave function is a mathematical reality, but it is only when we cut a plane across it through an act of observation that we can glimpse it. I am interested not just in the point of observation, but just *beyond* that point, '*What is collapsing?*' rather than '*what has collapsed?*' Considering a whole face collapsing simultaneously, what I am imagining and painting is a plane whose existence is imminent — a plane of imm*i*nence — *becoming skin.*

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An art practice-based study of material reality is not a description, explanation, illustration, measurement or proof of reality. The act of painting, laboriously stroking the canvas millions of times, becomes the machine for generating my theory. The swirling memory of pushing pixels is fixed now into the polygons that form the traversable colour fields.

To an artist, a picture is both a sum of ideas and a blurry memory of 'pushing paint,' (Elkins, 1999, p. 2)

… because [Descartes] had no coherent theory of gravity, the Cartesian universe was made up of swirling vortices - rather like whirlpools of matter. (Robinson & Garratt, 2013, p. 22)

It is indeed necessary, in part at least, that illusions arise from the plane [of immanence] itself, like vapors from a pond. (Deleuze & Guattari, 1994, p. 49)

Repetition as power. Machinic breaks and flows, multiplying effect and pursuing infinite movement. (Bonta, 1999)

Lucid loops: constant, repetitive switching between certainty and uncertainty. (Heaven, 2014, p. 40)

Art does not reproduce the visible; rather it makes the visible. (Klee, 1920)

… art is the capture of forces. (Sauvagnargues, 2013, p. 36)

Art follows technology. (Goldsmith, 2014)

The only way to present what is conceivable but not representable is abstraction. (Appiganessi & Garratt, 2004, p. 22)

Drawing is an ancient behaviour, dating back beyond 15,000 years ago. Through drawing, we are attempting to show someone else what's in our mind. This capacity to reproduce figures is a uniquely human ability and a sign of cognitive ability … (Arden, 2014, quoted in: Richardson, 2014)

It is not a question of applying a concept but of enabling a thinking. (Adams, 2003)

When marks are smudged into continuous gradations, they lose their disjointedness but not the idea of disjunction. (Elkins, 1998, p. 44)

The twentieth century has seen an exponential rise in the literature on space, so much so that it would require a compact monograph just to define the kinds of space that have proliferated in psychology, philosophy, physiology, art history and art practice. (Elkins, 1994, p. 339)

Non-physical Art

My paintings are not pictorial transcripts of logocentric intellectual inquiry. The act of painting, for me, enables a process of thinking that cannot be accessed through talking or reading, and my artworks embody this. The concepts I have grabbed from science, art theory and philosophy fuel the process of painting but it is the act of painting itself that generates original research. However, when I am painting, words emerge like vapours from a pond (Deleuze & Guattari, 1994, p. 49). I diligently capture these utterances in The Journal and use them to support the further development of the research. The laborious stroking of the glass of my iPad with an electronic brush, millions of times per painting (precisely two million, two hundred and four thousand, three hundred and forty brush strokes for my last painting), intensifies my interrogation of the nature of material reality. Each painting is saturated with this thinking. My research is embodied in the unreasonable form of the primary image, accompanied by a reasonable secondary commentary which serves the purpose of scaffolding and enriching my study.

As my study progressed, I became increasingly dissatisfied with the damage done to my purely digital artworks when they became physically manifest. Printing them out on paper was particularly painful, so I tried 3D printing, video animation, audio-visual installations in pitch-black rooms, CNC routing and laser carving into slate (see page 109). Even displaying the paintings on the flat rectangular glass screen of production, the original iPad screen, felt like a disservice to the pure digital fields of data that form my paintings. Then virtual reality technologies came of age. These immersive environments offered a space to show my perfectly flat and perfectly thin planes of data, and opened up new possibilities for pushing my pixels and my viewers into another dimension. In this spatial environment, my paintings expanded into the possibilities that the virtual space affords. I wrote some code to allow me to create pixel-accurate extrusions of my flat painting, and then I scaled up these new spatial forms — these fields of pure colour — until they covered an area equivalent to several square kilometres. This is the landscape-like environment, made of a skin of polygons, that one can leap across in the VR artwork presented for assessment.

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㉛**My art is an embodiment of my decision making process. My artwork is the trace of my decisions.** ㉜**I've wrestled data visualisation from the algorithms and made the human artist, with brush in hand, the visualiser.** ㉝**I value humanity over machinery. I value an artwork imbued with humanity over an image generated by algorithms.**

There is a certain point, for me, in the process of making a painting when the painting itself starts telling me what to do. (Brown, 2007, quoted in: Bracewell, 2007, p. 60)

Kossoff forces images out of the paint; he talks of paintings making themselves … (Hicks, 1989, p. 40.)

Sassetta's lingering patience and fastidious attention [in constructing the painting] remain fixed in the painting for everyone to see: they are a meaning of the method itself. (Elkins, 1999, p. 3)

Paint is a cast made of the painter's movements, a portrait of the painter's body and thoughts. (Elkins, 1999, p. 5)

[On Google AlphaGo, the artificial intelligence that beat Go grandmaster Lee Sedol] It makes beautiful moves. It even creates more beautiful moves than most of us could think of. (Brin, 2016, quoted in Zastrow, 2016, p. 9.)

… technical media is also defined by non-object based materialities, which makes it slightly more difficult to conceptualise. As a regime of electromagnetic fields, of pulsations, electricity, and such fields as software, technical media and digital culture escape the language of solids. (Tiainen & Parikka, 2010)

The many worlds view extends the idea of superposition to encompass everything, including the measuring apparatus and those who operate it. Its advocates claim that consistency requires that the entire world exists in a superposition. (Phillips, 2017)

I write my programs myself. First, in order to be independent. Secondly, in order to maintain permanent contact with the computer during programming, to learn from my mistakes. (Mohr, 1979, quoted in: IBM, 1979)

When you like a painting, you're celebrating the humanity that went into it. How can we get software to fit into that? … computers won't replace people in the creative industries because we will always pay for humanity - for blood, sweat and tears. (Colton, 2015, p. 34)

The view that machines, including computers, are not a challenge to human labor has become an axiomatic belief about machinery (The Luddite Fallacy). (Betancourt, 2013)

Humanity Versus the Machine

In the 'many worlds' interpretation of quantum theory, every act of observation splits the universe (Phillips, 2017). Each possibility plays out in a parallel universe, but we witness only one of the multitude of possible outcomes. One might suppose that a human engaging in the act of making a decision is, in itself, a universe splitting event. If we suspend our disbelief and go with this notion, then decision making is an engine for making universes. A hand rendered painting is a record of lots of decision making: my paintings record millions of human decisions. In the countless parallel universes spawned by my actions, every possible version of each painting exists.

My decision making is guided by a set of rules, and I produce my paintings much like a computer follows the rules determined by its programming. Is the machine making decisions though? Does an algorithm playing out in a silicon chip also split the universe? If it does, are those parallel universes as interesting or important as the ones I generate by hand? Perhaps the hand of the human in the coding of the computer imbues it with humanity. I choose to value warm, messy, fascinating humanity over cold, shiny and slightly dull machinery. The traces of grey matter – the traces of fleshy decision-making – that spread across the faces of my paintings record life, not a simulation of life. I could write code to generate images that look identical to my paintings, but they would record just a handful of human decisions. The code could spit out thousands of images that look like my paintings every second, but every one of them would be empty (Colton, 2015, p. 34).

Although my work celebrates the pixel (see page 47), it should not be confused with the pixelated 8-bit nostalgia that characterises the 'The New Aesthetic'. Whilst I don't see myself as a Luddite (Betancourt, 2013), my human-centred and non-physical approach to digital art sits in opposition to James Bridle's (2011) definition of The New Aesthetic as a range of modes that typically eradicate the human, and place an emphasis on physical manifestations of a digital aesthetic.

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㉞**I've slowed everything right down and taken my time. I've glued a multiplicity of moments into one artwork.** ㉟**Slowness is not normally associated with digital art, but slowness is valuable, and slow digital art is too.** ㊱**Traveling with the photon at infinite speed, we know no space or time. Make this the z dimension.**

The finished [Pollock] paintings - a 'thing' - had been the goal of art: a static object resulting from a laborious series of small motions made over time by an artist holding a brush. (Shlain, 1993, p. 246)

When things are done slowly, because they can't be done quickly, that's where something special happens. (Ofili, 2017)

… each individual is composed of infinite, extensive parts that belong to it within one particular relationship. The uniqueness of this relationship establishes an individuality with corporeal complexity, a state of forces, and "movement and rest", as Spinoza says, or "speeds and slowness", since rest is not the absence of movement but slowness relative to particular speed. (Sauvagnargues, 2013, p. 42)

My job is to make the best sculpture I can. My job is not the discussion of social problems. (Caro, n.d., quoted in: Taylor, 2005, p. 60)

The potential for full automation emerges with the development of digital automation, one where human labor — human agency — becomes a wasted value, and which the 'new aesthetic' documents. (Betancourt, 2013)

… new media, most recently computer and Internet-based work, pose a fundamental challenge to the pre-eminence of painting. Advocates of postmodernism recommend a return to figuration and the sensual values of oil paint. (Evans, 2005, p. 132)

A blockchain is a cryptographically secure ledger of every transaction made in a system, stored across every computer in its network … the computers essentially monitor each other to prevent fraud. (Rutkin, 2016, p. 22)

So-called new media, and especially the capacity to replicate and reformat images digitally, offer an opportunity to rethink our assumptions about the value of art as emerging from its rarity or scarcity. (Buchloh, p. 845)

When a creator registers a work on ascribe, a unique, cryptographic ID is generated and then stored on the blockchain. The blockchain is a secure database where transactions can be recorded and never deleted. The cryptographic ID is a composite of the digital artwork and the artist's identity, creating a permanent and unbreakable link between the artist and their work. (ascribe.io, 2016)

Slow Digital Art and the Block-chain

Cubism exerted a strong influence on my previous studies. My Masters by Research degree was almost entirely preoccupied with technology-enabled cubism. However, I have progressed beyond mere space and time, and I now ponder a quantum description of reality that exists beyond the space-time musings of the Cubists. Space and time are still factors in this new study, but I am no longer struggling to visualise four dimensions. My current preoccupation with time now relates to the value of slowness. This is partly my rebellion against the instantaneous nature of digital processes; it is my rejection of the relentless, incessant, exponential speeding up of the modern world. My time is valuable, and I've captured it in each painting. As my studies progressed, I took longer and longer to paint each image, with my final painting taking hundreds of hours. Although I have not dealt explicitly with politics in my research, labour is a politically loaded notion. My activism is limited to raging, very slowly, against the breakneck speed of the machine. Without resorting to The New Aesthetic's strategy of making bytes into physical entities (Betancourt, 2013) in a process better described as computer generated art, the lack of provenance for digital art in its purest sense — as data — makes it more difficult to sell to the art market. However, there is now a way to guarantee the authenticity and ownership of entirely data-based digital art using the 'block-chain', a secure and unmodifiable decentralised database (ascribe.io, 2016) that makes cryptocurrencies possible. I have used this new way of building trust to encode my flat paintings into the Bitcoin block-chain so that secure and reliable provenance can be guaranteed, which means I can now, if I choose to, sell the labour encoded in my digital paintings without printing them out and destroying their digital authenticity. The aura of the digital remains intact.

My primary concern in this programme of research is not politics or economics but a formal interrogation of the nature of matter. If, like Einstein, we travel in our imaginations on a light wave, there is no space or time (see page 43). If we extract space and time *altogether*, it makes the task of painting a picture frustratingly difficult, so I've extracted space and time from *only the z dimension* in order to aid a pursuit of digital flatness.

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㊲In pursuit of Greenbergian flatness, I found instead infinitesimally small quantum un-depth and macro-scale cartesian width and height. ㊳Infra means above. Supra means below. Below or above is not in the skin. Skin is not infrathin. ㊴I subtract everything inside me and everything outside me, and leave everything across me, and I paint that.

[Painting] was, and, in many ways is, still dealing with its Greenbergian ghost or spectre, which had become a perennial thorn in its side. (Payne, 2012)

What could be understood to be taking place in modernism was, for Greenberg, a critical and reflective realisation of painting's essential qualities. Painting could be distinguished from other art forms by the rectangle of the canvas and its two-dimensionality. (Archer, 2015, p. 40)

The flatness towards which Modernist painting orients itself can never be an absolute flatness. The heightened sensitivity of the picture plane may no longer permit sculptural illusion, or trompe-l'oeil, but it does and must permit optical illusion. The first mark made on a canvas destroys its literal and utter flatness, and the result of the marks made on it by an artist like Mondrian is still a kind of illusion that suggests a kind of third dimension. Only now it is a strictly pictorial, strictly optical third dimension. (Greenberg, 1960)

… a 2 dimensional wave can be visualized as a 2 dimensional surface which 'waves' into a higher 3rd dimension. Here is a certain kind of 2D traveling wave produced by a point source, which emits symmetrical in 2 directions creating these circular shaped waves. (Archery, 2014)

Skin is a two-dimensional surface that wraps around the volumes of the body. Sometimes it is taut, clinging tightly to the musculature beneath, and sometimes it is slack, hanging in loose folds. Fashion often celebrates excess material, finding beauty in wrinkles and creases, as surfaces eddy around the body or take on their own dimensionality. (Lupton, 2002, p. 208)

Natural skin also carries nerve endings, providing our sense of touch. (Tobias, In: Lupton, 2002, p. 44)

In Rembrandt's self-portrait, his skin is itself, sliding over itself, caressing itself—its illicit sensuality is constantly apparent, a droning sound under all painting. And what can it possibly mean to say that skin is paint? (Elkins, 1999, p. 156)

[A medium] needn't be a traditional support—like canvas, which is the support of oil painting, or metal armature, which is the support of modeled sculpture. A medium grounds an artistic production, and provides a set of rules for that production. (Krauss, 2016, p. 847)

Flattening the Z Dimension

The physical substrates of canvas or paper can never be thin enough to satisfy my fascination with the pure digital image, which has no thickness, as it is composed of data. But the digital image does have a width and height: it has pixels across and pixels down.

One of the many problem when conveying something of the invisible world is its betrayal by visual media. How can one use imagery to illuminate that which cannot be seen? The solution I devised was to stop worrying about the representative aspects of two dimensions — x and y — and focus my quantum attention on the z dimension. By eradicating thickness, I was freed to indulge aspects of the classical sensible world in the width and height of my paintings. The skin of the classical world was pulled tight across the quantum realm, freeing invisible physics to substantially influence the perceptible, visual manifestation of my human subjects. This skin, which is made up from human colour and form, is not really showing a human form. The human as an object in three dimensional space or four dimensional space-time is not the focus here. The boundary between where a human starts and ends — where their outermost points disappear into and out of the invisible world — is what I've stretched out as a skin in two dimensions in my paintings.

My obsession with the thinness of the digital image was always compromised in the viewing of the paintings. Even the ultra-thin LCD screen on my iPad proved too thick. Only when the tools of virtual reality became available to me could I present the paintings in a way that held true to the specificity of the digital medium. In my virtual reality artwork you can experience this authentic and genuine thinness. You can stick your head right through each painting and see that there is absolutely no thickness. Even the algorithm-driven 'sculptural' animated paintings that you experience in the virtual reality artwork are formed from perfectly thin skins of digital paint. There are no digital canvases required to support the pixel-polygon pigments that float in this virtual space.

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㊵My skin is thinner than thin. Any move in or out from my skin is not my skin. ㊶The skin of a human is not its bodily organs. Skin is not a living breathing social being. ㊷Before or after are irrelevant. Becoming classical particle is a skin that is simultaneously a wave of probability.

Skin is both alive and dead. The thin outer layer, the epidermis, consists of strata of cells that migrate to the surface, where they compact into a layer of dead material. Skin's protective function relies on the inertness of this outer surface. (Lupton, 2002, p. 31)

No matter how thin you slice it, there will always be two sides. - Spinoza. (Philosophy Tweets, 2015)

… the fold announces that the inside is nothing more than a fold of the outside. (O'Sullivan, 2005, p. 103)

… Deleuze redefines the arts' mission: to think in terms of becomings. (Sauvagnargues, 2013, p. 155)

[on Deleuze] the flux of Becoming which is to be located in the very borderline of Being and non-Being. (Zizek, 2014, p. 155)

This effect is based on work by Yakir Aharonov, … at Chapman University, in the 1960s. He and his colleagues showed that, mathematically speaking, a system's properties can be influenced by measurements made in the future. Aharonov has been studying the strange consequences of this "post-selection" process ever since. (Ananthaswamy, 2014, p. 8).

Once you're taking about more than one particle, the wave function lives in some high-dimensional space I don't know how to visualise. (Steinberg, 2014, quoted in: Ananthaswarmy, 2014, p. 35)

Prof Skow has recently published a book about concepts of time, Objective Becoming, which rejects the idea that time "passes" or is somehow in motion. He argues that past moments or experiences are just as real as the present, but are inaccessible in another part of time. (Coughlan, 2015)

… the laws of physics don't much care which way time flows: any physical process run backwards still make sense according to those laws. (Sokol, 2016, p. 8)

[A Body without Organs] is not space, nor is it in space; it is matter that occupies space to a given degree—to the degree corresponding to the intensities produced ... Matter equals energy. (Deleuze & Guattari, 1987, p. 153)

A Perfect Skin of Thin

Skin: any further in is inside, and any further out is outside. Skin is the plane of inside and outside. Try to imagine a skin between the quantum and the classical. Inside this skin is the quantum realm, and outside this skin is the familiar classical world. Everything that can be reasonably grasped is *outside*: it is classical reality. *Inside* is the quantum realm, which is definitely there but, to all intents and purposes, is hidden away. If we consider this skin between the quantum and the classical as a *plane of immanence*: then it is everywhere, all the time. This skin is definitely neither inside, nor outside. Like my digital paintings, this skin is thinner than thin. My paintings look like human skin, as they are based on photons of light which have bounced off an actual human, but that's not the kind of skin that is the primary concern here. Human skin is a convenient and appropriate vehicle for the exploration here of a different notion of skin: not *becoming* skin, but a skin *of* becoming. The sub-atomic particles that collapse into human skin are themselves a skin on the quantum realm. This skin is the boundary between *our understanding of reality* in our classical universe, and *scientists' calculation of reality* at the quantum scale. It is a skin on the quantum plane of probability. This skin is not human flesh. There are no muscles tensing under it, no heart beating within it. This perfectly thin skin is not even that organ called human skin. This is not Deleuze and Guattari's 'body without organs' (1987, p. 161), but a skin that is *not* an organ.

The collapse of this perfectly thin skin of becoming from the quantum into the classical is imminent. It is happening now, it has not yet happened, but it will happen imminently. It is the skin of classical *imminence*, on the plane of quantum *immanence*. It is a perfect skin of zero thickness. It is a perfect skin of thin. It is one of the things I've attempted to craft, and I invite you to examine the resulting visuospatial research outcomes in my virtual world. As you use the laser teleporter to dash around my artwork-world, you are immersed in an experience of this idea.

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㊸If I could isolate one atom from your skin, it would exist in a superposition. I paint that. ㊹A point is just a position in space. You can see it only if I make it visible. ㊺I'm pointing out that points are like particles. I'm painting this pointing out. I'm not painting the particles.

… quantum fields are complicated beasts, formed of "superpositions" of many classical fields. That's far away from anything we can envisage as a map, or delineate as neat lines. "At that point I have to rely on equations," says Wilczek. (Webb, 2014, p. 39)

A souped up version of [quantum theory] says that superpositions are impossible for objects composed of more than a certain number of particles because of a phenomenon called spontaneous localisation, which suggests that the distribution of mass - its density- is what matters. (Brooks, 2015, p. 29)

… at least some properties of microscopic objects don't exist prior to and independent of measurement. (Ananthaswarmy, 2014, p. 35)

Superposition: If two pulses on a string travel past a particular point at the same time, the total displacement of the string is the sum of the individual displacements. (McEnvoy & Zarate, p. 106)

Quantum objects are not waves. Quantum objects are not classical point-like particles. They are quantum objects, which may show wave-like and particle-like properties. You may represent a quantum state by its "probability wave" or wave function, whose square gives the probability density to find the object "as a particle" at certain locations. (Physics Stack Exchange, 2015)

Art, … is described by its ability to seize perfect individualities that do not arise from the non-assignable or the ineffable, but from the imperceptible. (Sauvagnargues, 2005, p. 133)

The geometric point is an invisible thing. Therefore it must be defined as an incorporeal thing. Considered in terms of substance, it equals zero. Hidden in this zero, however, are various attributes which are 'human' in nature. … The geometric point has … been given its form, in the first instance, in writing. It belongs to writing and signifies silence. (Kandinsky, 1926, p. 25)

Collapsing Waves into Particles

The imperceptible quantum object that is the focus of my attention is solid enough. Mathematics exquisitely defines the probability wave of the quantum object that I am current imagining, as *just barely apart* from the localised system of your face. Only when an entity is *isolated* from the local system can it exist in a superposition of boundless possibility. If we look, it becomes part of our system and it collapses, forced into the certainty required by our frame of reference.

The geometric point is invisible and without substance, but we can easily point at its location in space. Now imagine isolating this point. In a superposition, the point is now located potentially everywhere (Webb, 2014, p. 39). Let me collapse it into my frame of reference using my paint brush. It collapses into a position determined by the nature of my local system, the system of me, the human artist. I am the local system, collapsing a multiplicity of wave functions into a flat, rectangular painted frame of reference. I'm not attempting to illustrate points or particles or the wave function. Instead, my paintings are a trace of my act of *collapsing the waves*. The waves are waves of human probability, and as a human artist I collapse them with my human hands into images. The points, particles and waves, which all equal zero, become visible as I make them become zeros and ones. Comprehension of a quantum field is neatly bypassed as my newly crafted visual fields of light emerge out of the fields of data. Words begin to fail here, but in my virtual world you can walk on a manifestation of these ideas. Each geometric point in this synthetic world is given form through its deliberately sharp mosaic-like rendering, which displays each hand-wrought pixel as it was when I fixed it through an act of painting. When you stand on my landscape-like painting and look around, examine its unobscured pixels and polygons to see an embodied notion of invisible points-like particles.

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㊻**This programme of research has been a very careful study of human skin, emptied of its biological fleshiness.** ㊼**I see your smooth skin, but every square millimetre is made up of a multiplicity of interconnected atoms.** ㊽**The points of collapse of the wave function are the points I smear across the skin of reality.**

When humans visualize a body, they see mostly skin. (Jablonski, 2004, p. 585)

In some sense man is a microcosm of the universe: therefore what man is, is a clue to the universe. We are enfolded in the universe. (Boom, quoted in: Baker, 2013, p. 158)

The concept of the body without organs has two functions: to treat modes of corporeal individuation prior to their centred organisation [and] thinking about the junction between art and the body. (Sauvagnargues, 2012, p. 55)

Dismantling the organism has never meant killing yourself, but rather opening the body to connections that presuppose an entire assemblage. (Deleuze & Guattari. 1987, p. 160)

In short, the being of sensation is not the flesh but the compound of nonhuman forces of the cosmos, of man's nonhuman becomings, and of the ambiguous house that exchanges and adjusts them, makes them whirl around like winds. (Deleuze, 1994, p. 183)

The concept of 'I' ends at our skin. Within this waterproof bag the human immune system has at its disposal extreme measures designed to isolate the 'I' from its environment, which the system most emphatically perceives as the 'not I'. (Shlain, 1993, p. 382)

…the BwO is always swinging between the surfaces that stratify it and the plane that sets it free. (Deleuze & Guattari, 1987, p. 161)

… scientific representations do not pause at the skin of reality: they aim at representing the real, which is mostly hidden. (Bunge, 1974, p. 114)

Skin is the liminal membrane that articulates the dimension of time in the concept of incarnation. (Gail & Jarislowski, 2008, p. 4)

… the properties of particles really are 'smeared out' across infinitesimal volumes of space. (Sparrow, 2014, p. 294)

A field is a mathematical abstraction - numbers spread over space. (Webb, 2014, p. 39)

Through its technological deterritorialisation in VR the subjective has been raised into a new category of *res extensa*, of points in space and time, now im-materialising in the virtual infinite. (Weibel, 1990, p. 24)

Collapsing Human Skin

I am captivated by human skin and its depiction in art. My fascination with skin can be traced back to my pre-degree life drawing classes, in which I gazed attentively at the form of a human being for the first time. During the six hours I typically spent looking at and drawing the living human model, I considered every square millimetre of his outer surface. He stopped being a person, and became pure surface. Now when I visit a gallery, I am drawn to the white, pink, olive, brown and black flesh tones in the paintings, and to the white, pink, olive, brown and black faces of the visitors. Unlike many of the visitors, I am not particularly interested in the person the artist painted or whether their 'spirit' was captured in paint. That aspect of portraiture is not my concern. Neither am I interested in the humans in these paintings as anatomically-informed corporeal studies. I am not concerned with Michelangelo's dissection-driven academic drawings and sculptures; muscles and bones are *too far inside* the human to be of interest to me. The organs within the body are something I can do without. The personalities of the human subjects and significance of the times they, and their portrait painters, lived in, are *too far outside*. I can't remember the name of the life model I drew all those years ago, or what he was like as a person. My enduring interest is in the points where a human ends and the world begins, and these points are skin-coloured.

The colours of skin — white, pink, olive, brown and black; but also green, blue, purple and grey — are symbolic of the point of collapse of a human surface from the quantum to the classical, so it makes sense to stretch these colour across my notion of collapsing skin. When you put on the headset to look at the skin coloured human-like visuals in my painting-world, try to see them as paintings of a skin-coloured quantum collapsing skin, not paintings of living, breathing humans who once existed in a space, and at a time.

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㊾Artists are still permitted to be experts on light, so I've taken full advantage of my artistic licence. ㊾From the point of view of the photon, the journey from distant star to retinal rod is instant. 51All atoms emit energy, which the photon carries to other atoms. I tried very hard to paint that.

What if [Einstein] could catch up with that light wave? What would he see? (Inside Einstein's Mind, 2017).

… electromagnetism, carried by the massless photon, has … an effectively infinite range. (Chalmers, 2015, p. 31)

All objects at temperatures above absolute zero are constantly emitting electromagnetic radiation. (Iveson, 2016, p. 57)

Photons do only become real when we observe them. (Al-Khalili, 2014)

The only place in the universe from which an observer could actually see the ideas contained within a Cubist painting would be astride a beam of light. (Shlain, 1991, p. 191)

By Earthly reckoning the trip has taken between 1500 and 3000 years … but to the photon it lasts no time at all. If you move at the speed of light, time and space shrink to nothing. (Battersby, 2015, p. 56)

It seems that throughout the history of painting, Bacon's figures are one of the most wonderful responses to the question: How do you make invisible forces visible? (Sauvagnargues, 2013, p. 143)

… The once-burning conflict between painting and various forms of photomechanical image production has lately been eclipsed by a new and more pressing antagonism, between the materiality and tactility of pigment on one hand, and the immateriality and intangibility of light on the other. (Smythe, 2012, p. 106)

All in all, this picture of the tangled web of quantum interactions shows that 'realism' is dead. Like 'localism', the transmission of signals through direct light-speed-limited communication, 'realism', the idea that a particle exists as a separate entity, is a charade. The apparent reality of the world is a mask put on to hide the fact that it is really made of quantum ashes. (Baker, 2013, p. 175)

Light, or the relative horizon, is primary in science. Philosophy, on the other hand, proceeds by presupposing or by instituting the plane of immanence. (Deleuze & Guattari, 1997, p. 42)

Energy is manifest of course as light and as electronic energy in computer graphics and video. And then there's pure energy -- like the waves of pure energy at the beginning of the tape. It's very literal. (Emshwiller, 1985, quoted in: Youngblood, 1985, p. 15)

The Peculiarities of Light

In one of his thought experiments, Einstein imagined the universe from the perspective of the photon (Inside Einstein's Mind, 2017). Riding astride a hypothetical beam of light, he imagined space compressed to nothing. Einstein travelled from one side of the universe to the other in an instant. In our frame of reference light takes time to travel through our space, but if one could travel as a photon there would be no space and it would take no time to go 'from' and 'to'.

When an atom's energy state decreases it emits a photon which carries the electromagnetic force across the universe until it hits another atom, whose energy state it increases (Schumacher, 2009). In my own thought experiment, I imagine the emitting atom to be one on the surface of your face, and the atom in my eye to be the one your photon hits. As we have established, for the photon there is no space or time between us. For photons, the classical universe is flattened to an impossibly thin skin. I acknowledge this is an over-simplification of complex theory, but as the Cubists understood, grasping in the dark at such notions creates an artistic potential. I have been trained to very carefully consider light — I have spend years learning how to notice it — and I am at ease working with it as both a physical entity and as an idea. As discussed, light is not as straightforward as it looks, but as an artist I'm more than comfortable with uncertainty, so I can happily embrace light's peculiarities and use it to further my practice.

Deleuze & Guattari's view of science as a domain whose thinking is limited by the speed of light (1994, p. 21) provides an additional reference point. The notion that a plane of immanence that is not bound by this cosmic speed limit — that thought can somehow travel at 'infinite speed' — extends my notion of skin. My impossibly thin skin is infinitely thin, infinitely wide and infinitely tall. In the zero z dimension, my concept of light — with all of its space and time squeezed out — exists in this plane of infinite speed. In the x and y, we can enjoy light as we understand it. In the spatial environment of the virtual reality experience, we can engage our senses and see how my concepts of light *feel* as something that seems *real*.

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㊷Colour is three thousandths of the electromagnetic spectrum. I have spread these visible frequencies to expand human understanding. ㊸Whilst we are not looking, the photon exists in a 'superposition' of every possible state. I paint that. ㊹The intuitive, non-cognitive intellectual entity is becoming almost actual. I'm grasping at the collapsing wave function through painting.

Less than 1% of all light that reaches us is in the visible spectrum. By most estimates it comes out to about .0035% of the entire electromagnetic spectrum. (White, 2016)

Color is energy made visible. (Russell, n.d., quoted in: Shlain, 1991, p. 169)

… the fact that the unrepresentable exists. To make visible that there is something which can be conceived and which can neither be seen nor made visible: this is what is at stake in modern painting. (Lyotard, 1984, p. 78)

Philosophy becomes truly experimental or attains its 'radical empiricism' only when it dissipates the illusion of transcendence in all its variants - only then does it free itself from the 'dogmatic image of thought'. (Rajchman, 2000, p. 35)

[for Mondrian, painting was] a theoretical model that provided concepts and invented procedures that dealt with reality: it is not merely an interpretation of the world, but the plastic manifestation of a certain logic that he found at the root of all the phenomena of life. (Bois, n.d., quoted in: Hinkson, 2016, p. 41)

In the famous double slit experiment, for example, light is observed as either a particle or a wave, depending on the set-up. The most baffling thing is that photons seem to 'know' how and when to switch. But this assumes that a photon has a physical form before we observe it. Wheeler asked: what if it doesn't? What if it takes one only at the moment we look? (Heaven, 2015, p. 33)

No substance is the cause or ground of any other; there is just one univocal substance that expresses itself infinitely, and cannot be reduced to any one of its expressions, effects or accidents. (Colebrook, 2005, p. 273)

Grasping at Invisible Reality

Vision dominates our world view. Light from the sun or a bulb hits an object and some of it bounces into our eyes. Depending on the nature of the material that forms the object, some frequencies of light are absorbed, and those that are reflected are perceived as colour. But photons can carry the electromagnetic force from one atom to another at all frequencies, and we are equipped to see but a tiny sliver. Just as words can create images, colour can suggest more than we see in the visible light that illuminates a painting. In my work, I'm not showing a second-hand version of what we can already see, I'm trying to use what we see as a way to access notions of a reality we will never see. We see light, but we don't really see light. Not really. How can we see something that exists in multiple states simultaneously? How can we see something that is in more than one place at once? How can we see something that changes into something completely different when we look at it? We cannot see that, and I cannot paint that, but I can paint with that notion. In my immersive environment I show invisible energy made visible, not as a visualisation of energy, but as a visualisation of an *idea* of invisible energy.

My knowledge of these quantum notions of hidden worlds is limited, but I know enough to know that no human, not even a scientifically or philosophically literate one, can glimpse any more than a tiny amount of this partial view of reality. Physicists squint through mathematical calculations and philosophers through words of reason. I have only a brush to spread out some coloured pixels and polygons, but I'm driven by the same desires as the scientists and philosophers: we all want to know more. The work I have produced is evidence of my quest to expand our knowledge of the hidden world. There are no scientific proofs and few well reasoned arguments here, but you can stand up on what I've discovered and look around. In my virtual world it is possible to experience a manifestation of the invisible reality I've been grasping at over the last six years.

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㊺The pixel is the atom of contemporary visual culture. Pixels were big, but now they're infinitesimal and ubiquitous. ㊻The pixel is visible, but like the atom, it is indivisible. You cannot chop off half a pixel. ㊼The medium specificity of digital painting is the specificity of the pixel. Scrutiny of the pixel is necessary.

Large rectangular pixels, a trademark of computer illustration, are arranged and printed in ways that are derived from the history of painting — especially from cubism. (Elkins, 1994, p. 337)

In late 1968, Douglas Engelbart from the Stanford Research Institute introduced the ideas of bitmapping, windows, and direct manipulation through a mouse. His concept of bitmapping was ground-breaking in that it established a connection between the electrons floating through a computer's processor and an image on a computer screen. (Paul, 2003, p. 10)

Quantum is the Latin for 'a definite amount'. (Children's Britannica, 1964, p. 3)

Some [artists] have developed new mediums as the ground or support for their representations and often invoke the history of these mediums, even if they are newly wrought for art. In doing so, they are in effect returning to a form of medium-specificity, although in ways that depart from Greenberg's original modernist doctrine. (Foster et. al, 2016, p. 786)

[On the medium specific] The semantic depth of a painterly formulation can only be adequately appreciated if it is understood as the result of a process of dialogue with the medium. Any kind of art or art criticism that excludes all of that must necessarily be superficial. Anyone who reduces art to transferable concepts and readily comprehensible ideas has lost sight of what art is, and what it can achieve by virtue of its nature as a non-verbal language. (Verwoert, 2005)

… knowledge gained in the studio is every bit as engrossing and nuanced: it's just that instead of learning words, painters learn substances. (Elkins, 1999, p. 22.)

Above all, alchemy is the record of serious, sustained attempts to understand what substances are and how they carry meaning. And for that reason it is the best voice for artists who wrestle every day with materials they do not comprehend and methods they can never entirely master. (Elkins, 1999, p. 199)

I'd program a series of those and stick them together to get that deliberate blockiness so there'd be no question about it: this is personal computer graphics. But at the same time it evokes a sense of primitive art forms. (Emshwiller, 1985, quoted in: Youngblood, 1985, p. 14)

Scrutiny of the Pixel

I am part of the first generation of artists that grew up with the pixel as an accessible artistic medium. When I first started learning to program a Sinclair ZX81 at the age of eleven, I used it to make pictures. There were so few of the huge black pixels on my portable television screen that I could plot them out first on paper. I did not encounter oil paints or acrylics until many years later, and I never really gained a mastery of physical painting media as I found them difficult to manipulate and too permanent, too difficult to undo. Pixels were my first painting medium, and it is without irony that I use the term *painting* to refer to the digital images I make now. The substance I learned from an early age was the pixel, and the specificity of this medium is an integral part of my painting practice. Although pixels have now shrunk to the point that they are barely visible, when I paint, I zoom in until I can see the pixels as big as they were on my ZX81. These perfectly flat squares of colour are my visual atoms, and I'm manipulating them at a microscopic scale. Although I mimic the act of painting, stroking a flat surface with an electronic brush, I have no desire to mimic the appearance of physical paint: that makes no sense to me. I know of nothing more beautiful than the pixel, and all of my artworks, including the virtual reality experience, do not mask this beauty. Look closely at the land-like surfaces as you leap across them in the virtual reality artwork and you will see the original pixels of the painting that I used to code the heights-maps of the hills and valleys. Look closely at the flat, the hemispherical, and the lumpy pulsating paintings in my VR artwork and you will see the sharp pixels of the original artworks exactly as they were when I painted them. In my artwork I am celebrating the authenticity of this digital medium. This is a genuine engagement with the purity of the pixel, both visually and conceptually.

The etymology of atom is 'indivisible' (Etymology Dictionary, 2017), and this is the case with the pixel: one cannot have half a pixel. The pixel cannot be divided, and it is everywhere we like to look nowadays. If you have a smart phone it is likely that you will have spent a significant part of this day looking at pixels. We are already immersed in pixels, and in my virtual artwork I seek to immerse you in a celebration of this primary element of digital media.

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If a pixel is a visual atom, then its red, green and blue are sub-atomic entities: visual quarks. A quanta of light in the digital context is the pixel. Pixels transfer the energy of the artist. The pure white beam of laser light instantly connects where you are to where you want to be.

Different functions arise from a small number of universal building blocks. (Buehler, 2014, p. 30)

To the alchemists the universe was not made of molecules, which are made of atoms, which are made of leptons, bosons, gluons and quarks. Instead it was made of substances, and one substance — say, walnut oil — could be as pure as another — say, silver — even though modern chemistry would say that one is heterogeneous and the other homogeneous. As far as artists are concerned, linseed oil might as well be an element. (Elkins, 1999, p. 23)

The concept is defined by the inseparability of a finite number of heterogeneous components traversed by a point of absolute survey at infinite speed. (Deleuze & Guattari, 1994, p. 21)

At the infinitesimal level of the Planck scale, space becomes a pixelated, rough, quantum foam. That, incidentally, also provides time with a new guise: the direction in which it flows emerges from the order in which processes happen on unobservably small scales within this foam. (Webb, 2016, p. 44)

Is nature essentially discrete, made of things, or is nature continuous, made of stuff? Sand is composed of individual units, grains of sand, but if you stand back from sand dunes they look smooth and continuous. (Schumacher, 2009, p. 8)

Low-poly VR is typically much more immersive, some would argue, than super high-def. Once it goes into the uncanny valley, [VR is less immersive]—there's something to be said about just the suggestion or insinuation. (Malicki-Sánchez, 2017)

… we should no longer think in terms of lines going from one fixed point to another, but, on the contrary, must think of points as lying at the intersection of many entangled lines, capable of drawing out 'other spaces'. (Rajchman, 2000, p. 100)

If the colour is perfect, if the relations of colour are developed for their own sake, then you have everything: form and ground, light and shadow, bright and dark. Clarity no longer resides in the tangible form or the optical light, but in the incomparable flash produced by complementary colours. Colourism claims to bring out a peculiar kind of sense from sight: a haptic sight of colour-space, as opposed to the optical sight of light-time. (Deleuze, 1980, p. 97)

A Quantum of Artistic Material

We now know that the thing we call the atom *is* divisible. We live every day with the threat of annihilation in a nuclear war made possible by our ability to split the atom. We now know that atoms are made up of sub-element — electrons, protons, neutrons — and that those elements have sub-elements (Schumacher, 2009). Quarks are fundamental particles that are never seen in isolation but combine (almost always in triplicate) to form hadrons such as protons and neutrons. Quarks possess something called 'colour charge', which is akin to the electromagnetic force carried by the photon, but this has nothing to do with the frequency of light or our sensation of colour, it is just a misleading naming convention: quarks have nothing to do with colour. Quarks are not tiny lumps of anything and they are not coloured, but they do come in definite amounts. Similarly, the red, green and blue values that combine (always in threes) to give the pixel its colour are not lumps, but they come in definite amounts. Rather than an atom, let us think of the pixel as a hadron, with its quark-like (but *not at all* quark-like) sub-elements as red, green and blue.

The coloured pixel is a quantum of artistic material, a definite amount of potential creative energy. By manipulating this matter by hand at the microscopic scale I have built visual complexity that often surprises me when I step back. But something of the original excitement is lost when the zoomed-out image blurs into something that looks more like a conventional portrait. I strived to find a way to get an audience closer to the pixels whilst maintaining the expanse of the original painting, and virtual reality provided me with that mechanism. In my immersive artwork, one can look down and closely inspect each accurately rendered pixel, exactly as is it in the original digital painting, and one can then look up to the horizon to see this painting expanding into vast planes of complimentary colours. The laser teleporter in your hand enables you to catch sight of a multitude of untouchable haptic colour-spaces (Deleuze, 1980, p. 97).

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I've painted pictures that exploit the probable potency of the medium of pixels, points, polygons and spatial presence. When is a spatial form not a sculpture, a building or a landscape? When it is painting, expanded. A portrait of the physical as an architectural landscape, but not landscape, not architecture, not physical, not portrait.

Paint is water and stone, and it is also liquid thought. (Elkins, 1999, p. 5.)

A postmodernist space of painting would obviously involve a similar expansion around a different set of terms from the pair architecture/landscape - a set that would probably turn on the opposition uniqueness/reproducibility. (Krauss, 1979, p. 43)

Art begins not with flesh but with the house. That is why architecture is the first of the arts. (Deleuze, 1992, p. 186)

Spatial Presence thus refers to the perception or illusion to be located in an environment that is conveyed by some sort of media technology. … Instead of maintaining a critical distance to the media, users start feeling surrounded by the media environment. (Hartmann et al, 2015, p. 115-117)

… in spite of the heaped-up paint, these are painterly images, not sculptural ones, have to be read as paintings, not as polychrome reliefs, and make their point just because their physical structure is virtually that of sculpture but their psychological impact is that of painting. (Sylvester, 1956, quoted in: Riggs, 1998)

… the face crystallizes all redundancies, it emits and receives, releases and recaptures signifying signs. It is a whole body unto itself: it is like the body of the center of significance to which all of the deterritorialized signs affix themselves, and it marks the limit of their deterritorialization. (Deleuze & Guattari. 1987, p. 115)

[the Mousterian nummulite] might have been, in short, a picture, a sign, a token, a gesture, a sculpture, an image, or a meaningless artifact. (Elkins, 1998, p. 164)

… painting, as understood in a classical way, cannot have movement nor could it be three dimensional in any relevant way, other than by having some thickness in terms of texture since, otherwise, it would enter the realm of sculpture. (Fares, n.d, p. 481)

There is good evidence that the possibility to move the virtual body in the environment … lead[s] to an enhanced feeling of spatial presence. (Schubert, 2009, p. 170)

I think of immersive virtual space as a spatial-temporal arena. (Davies, 2002, p. 103)

Spatial Presence and Virtual Reality

In the immersive environment I have created you can see the pixels of the original hand-made paintings. The 'terrain' you seems to stand on is a mesh of points I generated with a piece of code I wrote to precisely convert the colour of each pixel into a height-map. These points have a skin of double triangles — a quad for each pixel — stretched across them to provide an illusion of pure digital form. But there is another medium that I am attempting to manipulate in this artwork, your sense of *spatial presence* (Hartmann et al, 2015, p. 115). The tracking of your head in space is what catapults the latest virtual reality technologies into another level. Following Davies (2002, p. 103), and Mack (see page 53), I consider here the notion that the specificity of the medium of virtual reality is not the specificity of the pixel or polygon, but the specificity of spatial presence. Grappling with this concept of spatial presence as a medium is challenging, and trying to manipulate it in an act of painting is even more difficult, but the VR artwork presents my initial endeavours.

You have spent a lifetime experiencing the spatial forms of sculptures, buildings and landscapes, and you will likely see these first in my artwork, but these are not how I now see the forms that surround you when you are immersed. The immersive artwork may look like the hills and valleys you might hike across, but it is not a landscape (Krauss, 1979, p. 43). The floating objects you encounter have the appearance of sculptures, but they too are skins of paint, wrapped around the flat digital space your senses are telling you has depth. Painting is the basis of my thinking and I consider not just the forms contained in the world, but the immersive experience itself, to be a painting. I am confident in my mastery of polygons, but I have only just begun the process of mastering spatial presence.

My immersive painting is a portrait of the physical world, but not the one we sense in the everyday. I am portraying the invisible world of matter using the seemingly tangible, but ultimately abstract and temporary. This artificial world feels almost real, but it is not something you can touch or damage. It is, however, a space that you feel present in, that *feels* real, and this extends this artwork beyond mere pixels and polygons.

64 65 66

64 **What defines a painting? One thing: it doesn't move. You move in relation to it, but it's immobile.** 65 **Horizontality and verticality: the horizontal is the terra firma beneath my feet. I am the human, stood vertical.** 66 **VR targets the sense of sight and the sense of spatial presence, but it impacts on all senses.**

Paintings are static. The uniqueness of the experience of looking at a painting repeatedly – over a period of days or years – is that, in the midst of flux, the image remains changeless. (Berger, 1984, p. 25)

The computer scientist and musician Jaron Lanier is credited with defining the term virtual reality in the early 80s. (Chan, 2007, p. 6)

One might be tempted to say that the paintings preserve a moment. Yet on reflection this is obviously untrue. For the moment of painting, unlike the moment photographed, never existed as such. And so painting cannot be said to preserve it. (Berger, 1984, p. 26)

Movement and 3D are two different aspects not present in painting, since painting itself, the neutral term in the diagram, could be said to partake of none of those elements. (Fares, n.d, p. 481)

The experience [of the VR artwork] causes many participants to relinquish desire for active "doing" in favor of contemplative "being." (Davies, 1998, p. 145)

The word 'body' for Descartes means any physical body that occupies space. (Robinson & Garratt, 2013, p. 105)

This is how it should be done: Lodge yourself on a stratum, experiment with the opportunities it offers, find an advantageous place on it, find potential movements of deterritorialization, possible lines of flight, experience them, produce flow conjunctions here and there, try out continuums of intensities segment by segment, have a small plot of new land at all times. (Deleuze & Guattari, 1987, p. 161)

Thus the painting is a "world" by opposition to the unique and "real" world — In any case, it forms a world with all the other paintings — The same sensible elements signify something else there than in the prosaic world. (Merleau-Ponty, 1968, p. 223)

… attending to the virtual environment is no cue for being present in it. (Schubert, 2009, p. 173)

Kevin Mack and Story Telling

Kevin Mack won an Oscar for his visual effects work in 1999 for the film 'What Dreams May Come', but now devotes his attention to creating virtual reality artworks. Mack's 'Blortasia' and 'Zen Parade' VR artworks are abstract psychedelic experiences, reminiscent of Charles Csuri's early texture mapping experiments, that enable users to be immersed in a dream-like state, floating between multi-textured blobs of virtual form. Mack's work aligns closely with my own abstract immersive explorations. I tracked down Mack at the Virtual Reality Show, which took place at the Design Innovation Centre in March 2017, and as well as discussing our shared interest in virtual abstraction, Mack presented a compelling case for virtual reality as a medium of spatial presence, as discussed in the previous section. Mack pointed out to me that virtual reality is a first person medium, and as such is inherently incompatible with the notion of storytelling, which is a third person medium. Echoing Grau (2003, p. 198) and Davies (1998, p. 145), for Mack, virtual reality is an experiential medium, and his artworks explore the viewer as 'being' rather than 'viewing' or 'doing'. I invited Mack to speak at the Exploring Digital Futures Conference panel that I chaired in May 2017, and his dismissal of storytelling in VR did not go down well with an audience of mainly film-makers and storytellers. There are significant commercial interests in virtual reality, and the large investment by these interested parties in their existing business models means that a lot of old media thinking is being shoe-horned into this emerging form. *'We must remember, it's always about the story'* seems to be an almost automatic utterance by many delegates at virtual reality conferences I have attended. Mack quite rightly points out that it *isn't* always about the story.

Although Mack's artworks resemble mine in many ways, and whilst I share many of his beliefs about virtual reality as an artistic medium, I do not share Mack's background in special effects or his interest in the spiritual. Mack's work is rooted in transcendental experiences, whereas my work, informed by philosophy and science, is rooted in the history and practices of painting, and deals more directly with the inherent qualities of the technologies I am using.

⑥⑦⑧⑨

⑥**What my eyes show me is not really real. My reasonable mind struggles to accept what is real.** ⑦**Cognitive feelings: The feeling of knowing, the feeling of uncertainty, the feeling of familiarity, the feeling of doing.** ⑧**The Hypersensible: an exaggerated synthetic accelerated sensorium. Virtual reality as a super-charged sensation. You're neither do-er nor viewer.**

Quantum states, wave functions and all the other probabilistic apparatus of quantum mechanics do not represent objective truths about stuff in the real world ... In other words: quantum weirdness is all in the mind. (Charmers, 2014, p. 34).

… external reality is the creation of the knowing mind … The knowing subject … the 'I', is the cause of the external reality, the 'not-I'. (Weeks, 2014, p. 266)

I made a great discovery. I don't believe in anything anymore. Objects do not exist for me, except that there is a harmonious relationship among them, and also between them and myself. (Braque, 1957, quoted in: Ferrier, 1999, p. 600)

WYSIATI: What you see is all there is. (Kahneman, 2012, p. 85)

The feeling of doing. (Wenger, n.d. In: Murphy & Throop, 2010, p. 75)

[The feeling of doing is] thinking about the intended outcomes of our actions before we observe ourselves doing them. (Schubert, 2009, p. 166)

… cognitive feelings … [are] outcomes of cognitive processes, not evaluations of the environment. (Schubert, 2009, p. 169)

[on AR] It is hard to argue against a technology that glimmers with the promise of transcendence. (Greenfield, 2017, p. 84)

It seems possible that some of the feeling of spatial presence of real objects [in augmented reality] is mis-attributed to virtual objects. This could be the reason why virtual objects in augmented reality displays often feel surprisingly 'real'. (Schubert, 2009, p. 176)

1. A medium has its effects on a sense other than those with which it communicates. 2. This effect is registered on all senses as an interdependent sensorium, in terms of their equilibrium or ratio. (Friesen, 2009)

The visualization potential of virtual artworks exceeds by far a purely mimetic view … How are the observers affected by the kaleidoscope of endogenous viewing perspectives and the tension between physical and abstract experiences? (Grau, 2003, p.9)

There's nothing that quite emphasizes the static materiality of paint like a virtual world that offers zero physical resistance as viewers move specter-like through [Rossin's] fragmented forms. (Chan, 2016)

Jeffrey Shaw and Augmented Reality

Jeffrey Shaw's 1985 work 'Legible City' used early 3D engines to provide navigable city streets constructed from the names of the owners of the building. 'Trump' featured prominently in his New York version. I recreated this work using smart-phone based 'Google Cardboard' technologies as part of a VR workshop I delivered at the Deleuze Studies conference in Rome in 2016 (see page 105). Instead of New York I used a street plan of ancient Rome, and instead of real estate moguls I used words plucked from a 'semantic map' of the human brain (Huth et. al., 2016). But it was Shaw's very early digital work, 'Golden Calf' (1994) that caused me to have an epiphany when I saw it in the Wired Worlds exhibition at the National Museum of Photography, Film and Television in the mid 90s. Picking up a tethered flat screen from a plinth, I saw a virtual projection of a shiny calf. This was augmented reality in its infancy, but I had a profound sense that I had witnessed the future. Virtual reality and augmented reality challenge our notions of what it is to 'know' a thing. VR and AR invoke cognitive feelings (Schubert, 2009, p. 169); these are not like the emotions one feels when watching a film or looking at a painting. VR and AR are first person media forms: one doesn't so much *have* a feeling as one *knows* one is feeling. When I recently tested out a Microsoft Hololens AR headset, I knew that my guide couldn't see the virtual objects that were being projected onto my view of the floor, but my mind still couldn't accept that he couldn't see what I was seeing. It was too 'real' for my brain to accept that. I *felt* that I *knew* the objects were there, even though I knew they were not.

Virtual reality and augmented reality severely upset the balance of the senses, and will likely prove to be at least as disruptive as television and the Internet. Although virtual reality technologies have been in existence for many years, the lack of widespread access has meant that the optimal ratio (Friesen, 2009) has not yet been established. We will need to craft a lot more new experiences before we can bring balance to these powerful forces. Artists such as Rachel Rossin are already crafting painterly blends of the real and the virtual through VR (Chan, 2016), but AR art is a nascent field. I am only just starting to get access to augmented reality technologies, but they will form the basis of my post-doctoral research.

⑦⑦①⑦②

⑦Affect as a perception that escalates (due to its unexpectedness) into something that updates our internal mental model.⑦ An artefact is either a human made thing or an anomaly introduced by apparatus. Art-affects are both. ⑦Might affect be the medium of virtual reality? Is it possible to paint with the medium of affect?

… the work of art - is a bloc of sensations, that is to say, a compound of affects and percepts. (Deleuze & Guattari, 1994, p. 164)

I am thinking, therefore I exist. (Descartes, 1644)

Feeling is a phrase. I call it the affect phrase. It is distinct in that it is unarticulated — We read in the The Differend that a phrase presents a universe. (Lyotard, 2006, p. 104)

… when we observe a complex scene, we are conscious of a lot more than we can put into words. (Ananthaswarmy, 2014, p. 40)

… in the dream of Irma's injection, the Real is excluded by the dreamer's descent into symbolic bliss … yet what we experience as the 'true, hard, external reality' is based upon exactly the same exclusion. The ultimate lesson of virtual reality is the virtualization of true reality. (Zizek, 1996, p. 295)

Our sensation of reality is mostly generated by our 'internal model', which is only partially updated by our senses. (Eagleman, 2016).

… our brains are predicting machines. Whenever we perceive something, theory says what we perceive is not objective reality, but rather the brain's best guess as to what's causing the sensations impinging on the body. (Ananthaswamy, 2017a, p. 44)

… a visual sense of touch, or a haptic sense of sight. (Deleuze, 2003, p. 107)

One might say that painters paint with their eyes, but only insofar as they touch with their eyes. (Deleuze, 2003, p. 109)

… the artist finds ways to embody the idea in a sensory medium. (Danto, 2013)

The somatic marker hypothesis proposes that a defect in emotion and feeling plays an important role in impaired decision making. (Bechara et. al., 2000)

Painting is an object of a fundamental encounter. (Deleuze, 1997, p. 139)

… by asking "what is an affect?" we are already presupposing that there is an answer (an answer which must be given in language). (O'Sullivan, 2001, p. 127)

Painting with Affect in a Virtual World

I have encountered several notions of 'affect' in my studies. Deleuze talks of artists constructing a bloc of sensations consisting of 'affects and percepts' (1994, p. 164). Although I struggle to find the words to articulate precisely how this aligns with my own practice, Deleuze's writing on art strikes a chord in a way that traditional art theory does not. In contrast, I find Lyotard's notion of affect vexing. Through a very drawn-out interrogation of Lyotard's The Affect Phrase (Supplement to The Differend) (2006) at the bi-weekly Slow Research Group at Leeds Beckett, I have learned that the 'affect-phrase' is an *unthinkable* but *linkable* 'extra-textual' (O'Sullivan, 2001, p. 125) phenomenon. Whilst the slow interrogation of Lyotard has been fascinating and challenging, his notion of affect has proved less useful in the development of my practice than Deleuze's. Lyotard's affect resonates, but at too high a frequency. I have also drawn on more straightforward definitions of affect from the psychology of perception. I am particularly fascinated by experimental evidence that strongly suggests that most of what we experience is generated internally (Eagleman, 2016), and that external sensory stimuli only occasionally force us to update our internal mental model of the world. We live mainly inside our own brains, and most of what we sense as an external reality is actually an anticipatory hallucination. Using the first person medium of virtual reality, what could I craft that might disrupt our prediction-centric view of the world? If *unexpectedness* causes an escalation of perception to the point that it *affects* the viewer, how can I maximise unexpectedness? Can I paint blocs of unexpectedness? Can I paint with compounds of affect-inducing media? Can affect be *painted with* in a virtual world? As I am *in* my virtual reality artworks when I construct them, and I *feel* the medium I am working, then what might my method for manipulating affect be?

These propositions mark the current limits of my knowledge, but offer tantalising starting points for my post-doctoral research.

⑦③⑦④⑦⑤

⑦③**Cinema requires one to willingly suspend one's disbelief. In a virtual reality headset, one's disbelief is unwillingly suspended.** ⑦④**VR is a long way from becoming commonplace, so this artwork is not post-digital. This is digital art.** ⑦⑤**VR now is about form, fixed rigid in its hardware frame. That's why modernism is useful right now.**

I find inspiration here in terms of the use of immersive virtual space as a medium for "bringing forth" or "manifesting" abstract ideas into the realm of virtual "place" so that they can be kinesthetically explored and bodily lived. (Davies, 1998)

The image and simulation technique of virtual reality attempts to weld traditional media together in a sensory medium that is experience polysensorily. (Grau, 2003, p. 14)

I think of immersive virtual space as a spatio-temporal arena... No other space allows this, no other medium of human expression. (Davies, 1998, p. 67)

In theory, virtual reality may finally present artists with the potential to create and share entire worlds that could have previously existed only within their own minds. (Goslin & Morie, 1996, quoted in: Chan, 2007, p. 188)

If what can be recognised by the intellect as new (fashion, for example) is satisfying because within the new there is the security of recognising the old, the 'radically new' elicits a new kind of thinking from within an initial incomprehensibility. (Ferguson, 2007, p. 8)

The VR paradigm may reveal more about our own world than the ordinary course of science has prepared us to believe. For example, the walls of the prison of the now become palpable. (Rossler & Weibel, 1992)

It is the framework which changes with each new technology and not just the picture within the frame. (McLuhan, 1955, p. 273)

Spray painting is different to painting with a brush, because to some extent the brush gets in the way. (Grosse, 2002, pp. 22)

Painterly in its sensibility, Osmose creates a myopic vision of a dream world. Apart from natural surroundings, the VR environment of Osmose also includes a layer of 'Code' and 'Text', which illustrates, respectively, the software on which the work is based and quotes from the artist's own writings and texts on technology, nature, and body. (Paul, 2003, p. 127)

Photo-realism is not the goal [of VR] – info-realism is. (Wilson, 2018)

The Unwilling Suspension of Disbelief

When you stand on top of one of the peaks in my virtual artwork and look down you may feel fearful. If you have a phobia of heights, you will feel very scared. Even though you know that it is not real, the 'six degrees of freedom' provided by the head-tracking technology is instrumental in creating an experience so convincing that you *cannot* suspend your disbelief. Although head-tracking was first developed in 1968 (Grau, 2003, p. 163), it has only recently become available in mainstream virtual reality headsets. Just as the early giant cinematic projection of actors' faces meant that they had to tone down their stage acting (Spandoni, 2007, p. 20), the potential for the totality of the immersive experience to become overwhelming necessitates a nuanced approach. There is a *solidity* to this medium. 'Viewers' do not need to be drawn in, 'users' are plunged into the action as soon as the headset is on. This is partly why I have stripped away the effects in my artwork.

It's not quite the same as the fixed rectangular frame of the modernist painting, but virtual reality has its own fixed frame: *a frame of being here, now.* This fixed frame offers the possibility of resonance within its rigid boundaries. Standing waves can sustain their harmonies if we can recognise the hard edges of the medium of virtual reality. The hard edges are our first person being, our very real presence in the space. This abstract, intangible digital medium, constructed from numbers and impossibly illusive electrons and photons, is defined by the inability of our senses to accept that it is not *actual reality*, even as we logically reason that it is fake.

We experience Katharina Grosse's brush-free paintings from inside, across, on top, around. Clare Ashley makes rubber paintings that 'breathe' as you walk around them. These works are spatial, but to me they are not sculpture, not architecture, not landscape (Krauss, 1979, p. 43). In Char Davies' 1995 virtual reality artwork, Osmose, similar forces are at work: Davies' training as a painter is instrumental in counter-balancing the spectacle of the technology. Whilst none of these artists apply pigment to a flat wall-hung canvas, all of their artworks are rooted in the thing we call painting. My art emerges from, and seeks to expand, the same field.

⑯⑰⑱

⑯Neoclassicism, academic art, impressionism, expressionism, abstract expressionism, abstraction, post-war British figuration and digital art implode in my paintings. ⑰Ingres painted smooth space. Kossoff painted striated space. In my paintings, I embrace both smooth and striated spaces. ⑱I offer a smooth space without landmarks to lose yourself in. You no longer see the painting thing.

The contrast between [Delacroix's] brushwork and Ingres' draughtsmanship revived the old dispute over the relative importance of colour as opposed to design, exemplified for earlier generations by the difference between Raphael and Titian or Rubens and Poussin. (Evans, 2005, p. 98)

The sea and the desert are examples of smooth spaces that became striated … Striation seems to be, at least in part, the effects of technological mediation resulting in mathematical quantities as opposed to qualities. Striation makes the measurable. (Hubert, 2014)

It seems to us that the Smooth is both the object of a close vision par excellence and the element of a haptic space (which may be as much visual or auditory as tactile). The Striated, on the contrary, relates to a more distant vision, and a more optical space – although the eye in turn is not the only organ to have this capacity. (Deleuze & Guattari, 1980, p. 544)

The law of the painting is that it be done at close range, even if it is viewed from relatively far away. (Deleuze & Guattari, 1980, p. 544)

Freud has two marked styles of painting, echoing Velazquez and Franz Hals in the dichotomy between the smooth and rough-hewn. (Hicks, 1989, p. 46)

The turning point in Freud's work with the human clay, when he moved decisively away from the Ingriste modulation of flatness by contour, came in 1958 and 1959 with Woman smiling. (Hughes, 1988, p. 18)

Cezanne spoke of the need to no longer see the wheat field, to be too close to it, to lose oneself without landmarks in smooth space. Afterward, striation can emerge: drawing, strata, the earth, 'stubborn geometry', the 'measure of the world'… The striated itself may in turn disappear in a 'catastrophe', opening the way for a new smooth space, and another striated space… (Deleuze & Guattari, 1987, p. 544)

The idea of virtual reality only appears to be without a history; in fact, it rests firmly on historical art traditions, which belong to a discontinuous movement of seeking illusionary image space. (Grau, 2003, p. 339)

… pinning something down before it disappears seems to be the point of painting. (Auerbach, n.d., quoted in: Hicks, 1989, p. 28)

Real Painting and Virtual Reality

My work is firmly rooted in selective pickings from the histories, traditions, theories and practices of painting, and part of my study has been engaged in finding artists whose work resonates with my practice. Although my art practice has taken up the majority of my research time, I have identified a number of artists whose practice aligns with mine. In order to structure my search, I have taken Deleuze's 'smooth' and 'striated' mantras (Deleuze & Guattari, 1980, p. 544) quite literally and used them as an alternative method for categorising paintings that match up with my own values. Freed from the dogma of historicism, I have admired Bouguereau's super-smooth porcelain rendering of skin, feasted on the smooth flesh of Ingres, and moved through Seurat's pixel-like divisionism to early smooth Lucian Freud, then on to late striated Freud and Bacon and finally to Auerbach and Kossoff. When I looked closely at the extreme striation in Kossoff's *Seated Nude* (1960) in York Art Gallery I suddenly lost all sense of scale and orientation and I felt like I was actually flying over a landscape. The experience was profound, unnerving and exhilarating. Paint is rarely as explicit as in a Kossoff, but I no longer saw the painting. *Up close to* and *stood back from* a Kossoff were two different experiences, and felt very similar to my experiences of zooming into the pixels on my iPad then zooming back out to see the whole.

My Kossoff epiphany was at the early stages of developing my virtual reality artworks, and heavily influenced the crafting of the large-scale forms that make up my immersive environment. Kossoff's paintings epitomise what I am trying to achieve in my virtual reality canvas-space. Kossoffs's artworks are indisputably paintings, but are also spatial forms. There are tirelessly worked by hand over weeks and months. They are both blended and fractured exploitations of colour, sometimes vibrant and euphoric, sometimes dark and visceral. They generate a feeling of elation in my gut that I strive to replicate for an audience in my virtual world, whilst trying to avoid the unpleasant gut feelings associated with motion sickness. The hallucinatory nature of my abstract digital striations increases the risk of motion sickness, but by stripping away unnecessary elements such as audio, and using a dash teleporter, I have hopefully minimised the risks to my audience.

㉙㉚㉛

㉙I long to be the hermit, alone in my gigantic cave of colours, inside my anti social media. ㉚Hogarth's serpentine line slithers through my work. This ouroboros eats itself in a cycle of destruction and re-creation. ㉛I've expanded the field of painting by pushing it into spaces made possible by the availability of technologies.

The neuro-image testifies to how the brain has become our world and how the world has become a brain-city, a brain world. (Pisters, 2012, p.33)

Hogarth returns to his conception of the form of objects in terms of a surface corresponding to a shell of lines. Lines are (1) straight and (2) circular (curving), and there are also (3) the waving line (composed of contrasting curves in a plane) and (4) the serpentine line (waving and winding, or twisting, in space). The waving line is the "line of beauty" and the serpentine line is the "line of grace". These two lines are the lines most varied in form, and they contribute most to producing beauty. (Davis, C. 2010, p. 6)

Streaming, spiraling, zigzagging, snaking, feverish line of variation liberating power of life. The line escaping geometry: life escaping the organic. (Bonta, 1999)

Bell … writing in 1914 emphasised 'Significant Form' in art rather than content. 'Significant Form' is a particular combination of lines and colours that stir our aesthetic emotions. … art should have nothing to do with life or politics. (Freeland, 2001, p. 10)

… even though a new technology may introduce genuine changes in the way we think about pictures, in the great majority of cases it will give us something old in the guise of something new. (Elkins, 1994, p. 341)

Alongside the embrace of "new media" there is a recovery of displaced modes, which can be mined as an archive of past subjectivities and socialities. (Foster, 2016, p. 849)

Surely it is the case - even when the focus is restricted to the materiality of "human" bodies - that there are "natural", not merely "social", forces that matter. (Barad, 2003, p. 810)

Down though the ages artists have appropriated technology whenever it helped them to make the jump from fantasy to fact with greater ease. The discrepancy between a dream and its physical embodiment leads the artist to embrace technological improvements to help him close the gap. (Mueller, 1967, p. 22)

… by the mid-80s, I abandoned the medium of painting for that of 3D computer graphics—because this new medium offered the potential of creating in a virtual three-dimensional space on the other side of the picture plane. (Davies, 2002, p. 101)

Iain Nicholls and the Research Question

Although I prefer to work in isolation, I am not alone; I have made a connection with an artist that shares many of my creative values. Iain Nicholls trained as a painter at Chelsea and the RCA before working for many years in the computer games industry, and although his published virtual reality work is quite conventional (he is best known for his 1904 coal mine simulation), he has provided me with access to some of his unpublished immersive artworks. In these experimental works, Nicholls feeds his paintings into virtual reality, repaints the results on canvas, then feeds that back into the immersive digital environment, repeating this cycle until an artwork emerges. Nicholls' experimental virtual reality artworks are evidently that of a painter, but not just because he uses actual paint as part of the process. Nicholls is skilled enough to paint *with* this new medium of spatial presence, as I endeavour to do. Over the course of his long career, Nicholls' has developed a mastery of line, colour and form. Mangled and tangled but graceful and elegant forms are violently and delicately extruded in a manner that mirrors my own work.

Like Nicholls, I am not seeking to challenge the current state of contemporary painting or digital art, but I am recovering displaced modes of painting (Foster, 2016, p. 840) and exploiting the specificity of "new media" to mine that archive. In particular, the newly accessible technologies of virtual reality have opened up new opportunities to explore what painting can be in the twenty first century, as evidenced in my artwork. Manipulating the media of pixels, polygons and code is part of this expansion, and I feel confident in my mastery of these methods, but manipulating the ineffable medium of spatial presence is more challenging.

'How might one paint with spatial presence?' is my concluding research question, and provides the starting point for my post-doctoral research.

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Appendix I: Documentation of Progress and Outcomes

October 2012 – June 2018

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Appendix III: Experimental Writing

July 2016

Contents

This, for me, is a 'change of instrument' — the palette to one side and the typewriter in its place. I use the word 'instrument' because the force which motivates my work remains unchanged, an 'inner drive'. And it is this very drive which calls for a frequent change of instrument. (Kandinsky, 1938, quoted in: Napier, 1981, p. 1)

Introduction

This collection of experimental writing was produced in 2016 in preparation for the writing up of the practice-based research. The approach taken in these experiments was influenced by my collaborations with Professor Simon Morris, a leading figure in the field of conceptual writing. Although these word-based works are in the spirit of the OuLiPo writers and poets of the 1960s, they are rooted in the quantum theory inspired technique I devised to create my paintings. In my paintings, I take visual data from a 3D scanner, release it into a 'superposition' of probability and 'collapse' each point into a certainty through a process of human-led smoothing (see page 21). Similarly, in these text-based works, I use words from The Journal as my data source, release these words into a cloud of probability via bespoke code, and smooth them into coherent prose, guided by my own aesthetic judgment.

The first two pieces, *The Thing in Itself* and *The Wheat Fields*, utilise a program I created to chop up and stick together a collection of quotes from The Journal. Whenever a common connective word such as 'a', 'the', 'and' was found, the program sliced the text at that point and pasted another chunk of text starting with the same connective word onto it. This generated a reasonably jumbled but not completely nonsensical text, which I then re-wrote to smooth it out, echoing the smoothing process I used in the creation of my paintings. *The Thing in Itself* formed the basis of a kinetic typography piece that was shown on the Big Screen in Millennium Square, Leeds, April 2016, and was also presented as part of a workshop delivered at the Deleuze Studies Conference Camp, July 2016.

The third piece, *Pre-face*, uses a frequency count of the words in The Journal as the starting point. The most commonly repeated words are listed first, working through to the less commonly repeated words. The raw output is displayed on the left-hand pages, and my smoothed out rewrite is on the right-hand pages.

The Thing in Itself

The thing in itself – a branch of natural philosophy – is what pictures are, but what are experiments? Although the diagram is called the face, it does not necessarily leap out at the eye: the artist finds ways to embody external reality. The major challenge of contemporary painting is to show us the real, which is mostly hidden within the sum of the method itself.

What kinds of problems make a shattering blow? Is what you see all there is? Is that what this is all about? Things that appear to be particles are in fact tiny vibrating closed loops in a vector space, a multiplicity of striations. These things are marked with striae. They are striped and grooved, and considerably smoothed.

"Ah, Mr. Schrodinger. About your cat. Well, there's good news, and there's imagination".

Overweight awareness is a string of meaningless discussions about social problems. To me, Art's subject is the major challenge of contemporary painting: to show us the point of painting. I have nothing to express.

"You'll be bloody imminent if you don't start getting up in the diagram".

According to them, it is this: one starts with a point source, which emits symmetry in two directions, creating circular shaped waves. Different functions arise from this complex scene, we are conscious of a harmonious relationship among them, and we learn by trials. Then we rest in trompe-l'oeil.

We are still active in the moment of painting, as wind speeds inside the eerie red eye reach five hundred kilometers per hour. This is faster than a useful conceptual device, but not thinking.

You cannot look on any theory and permit it to close your quest. You must set theory free to work together with your experiences of looking at critical points. We sit on these critical points as we ride on the basic geometric patterns of such visual inputs. The brain continually analyses such inputs to interpret them in order to ensure a continuous analysis of nature using the 'not-I'.

The philosophers have interpreted the experience of beauty through art. When they are specialists only in art – the rankers – you have to keep small supplies of significance, which you must circulate. Still: the knowing mind. The 'I' is the world, the black hole. We advocate the peripherally viewed scene, brought to the surrounding environment, and the entities to be represented.

It is possible to develop coherent philosophical positions that deny that there are representations on the eye, but the artist finds a way. It was through servants that every aesthetic theory of nature was founded, even if they did not fit. Drawing is an ancient behaviour, dating back beyond 15,000 years ago, and through drawing, we may show someone else what's in our mind. This capacity to reproduce figures is a particular objective, but we lose our self-consciousness when this objective is the only point. Lingering patience and events are parts of a stratum, as we experiment with the external reality. We sit on a blurry memory of 'pushing paint'.

The philosophers interpret the world – the surface of the sum of the quantum world – and whole new vistas open up. Measuring the most urgent surface of inner psychology is more real than a statistical order, even if the artist's mind (and its gradual evolution into art) may be attributed to such a craving. The art-form is thus created out of a shell of curved lines. Lines that are straight analyse only the relevant data.

The aim of my primarily inductive research method is to build theory rather than test it. Grounded concepts and relationships are sometimes slack, hanging in loose folds. Fashion often celebrates excess material, finding beauty in wrinkles and biology, by developing original theories of physical bodies as purely statistical wholes, or group phenomena, and then retreating again. Pinning something down before it disappears seems to be the point of the whole world, in various ways. The point, however, is to change it.

Two separate brains can't form a perceiver, but awareness of the surrounding environment can be affected by other factors, such as time and circulation. Still, the plane you seek will be killed as it plunges into this tornado. The specialist in art is a catalyst of creative activity, but philosophy relies on uniquely human abilities, and smooth interactions. The mixing, or blending within a deterritorialised space can only be considered before.

"Ah, Mr. Schrodinger. About your cat. Well, there'll be good news in the morning".

There is a 'space' containing all of the individual displacements. There is increasing evidence that many systems we observe in living things are close to what's called 'a moment'. Yet, on reflection, this is obviously untrue, for the picture plane may no longer permit sculptural illusion. It is a whole body unto itself; it is like the Body without Organs; it is a haptic space. This may be as much visual as it is within, and it may be a reflective realisation of painting's essential qualities.

Painting can be distinguished from other art forms by the skin. Amidst all of this wrong-headed melody is an early version of the painter. In short, there is no plausible case against ambiguity. But ambiguity is not the tornado: mathematically speaking, it is a critical point.

It sits on a finite number of heterogeneous components, traversed by a uniquely human ability and smooth interaction. This mixed, or 'virtual', reality, then disappears again.

The eye keeps working, looking into the skin of reality. The eye aims at representing the possibility of translating back. Circular and curving, it is fascinating like the tornado. There is harmonious relationship among them: they learn by trial and error, and rest through their connection with art. Why are we taught that we gain insight, only to retreat again? Pinning something down before it disappears seems to be embodied in the surface that stratifies it, and excludes all that is different.

This surface allows for far greater movement, whilst allowing actual forms to integrate. Different elements that may not have been linked may trickle downwards towards new spaces through fissures and thoughts. Knowledge gained is the real challenge of contemporary painting, but my challenge is to show you the electronics of my computer.

And what are you? A bunch of quarks, or a serial resemblance of the laws of nature. Why, then, may not a black hole be produced? How well this works, if at all, depends on individual cases, but in this case, art is embodied humanity. To an artist, a place is that which has become a whole body unto itself: it is like the wave function that is a part of it, and part of everything.

Becoming rejects the field of all events. Hence, all the great dialogue is in this work. We celebrate our fascination with this dialogue on a small plot of new land. It is through closely observed visions, keeping small rations of subjectivity in sufficient quantities, that you are enabled to respond to the face, even if it does not necessarily leap out at you from this text. There is experience of reality, but no philosophy, without language.

Nowadays, you are increasingly likely to come across books, plays and films with no connection with art. Why are we taught that we gain insight when we find ourselves retreating, over and over again? Pin something down before it disappears into surface that stratifies, and exclude all that is different, blend within the symbolic, and blend within a moment. The true picture plane no longer permits sculptural illusion. It is the vision of the artist, the composer, or even the ballet dancer, that hitches a ride on this search for tangible forms.

As far as I am concerned, philosophy is the distribution of intensities at rest, of slowness, and of myself. When one reaches this harmony, one reaches a characteristic that just about approaches an artwork that is no longer available. It is the great discovery that I don't believe in anything anymore.

Objects do not exist for me, except when there is a shattering blow, and what you see is all there is. Objects that appear to be made from particles allow actual forms to integrate. Different elements that may or may not have been linked in a native neural compulsion have found uses in other realms of human life. I hypothesise that one such use is the conscious externalisation of knowledge.

Physics can be regarded as an eye that observes. For me, it is just that: applying the science, and the humanity that went into it. How can we get software to fit into that? Computers won't replace people if the schema remains loose, and the world is separated into discrete components. The eighteenth century gave us the results of experiment with atoms, which are complicated things that have mass, but are now disappearing again. The full theory of quantum electro-dynamics involves contributions from every possible process, even the plane that sets it free. This is how it should be done: lodge yourself onto the specialist in art – he is a lot more than he can put into words.

The concept of the cause is a concept of the future. If we study the peripherally viewed scene as it is brought into the diagram, we can make it inaccessible in another part of time. The succession of steps from Impressionism through to Cubism and beyond pushed us into pursuing this infinite movement. Free action equals disjunction, decentring, peripheral movement and disjointed polythetism. The streaming, spiralling, zigzagging, snaking, feverish line of variation is the liberating power of life. The line escaping geometry is life escaping the ridiculously unlikely.

The application of cosmological rules to new materials enables us to exercise our creative powers. Painting is a surface corresponding to a specialism in art, a characteristic that just approaches art itself. It is not available, nor is it the tornado. Mathematically speaking, it is a void.

This way, everything becomes possible: everything becomes legitimate and uncertain. Nomad thought replaces the function of the dominant reality. Mimicking the sciences can offer us the arts' mission: to think in terms of becomings. There is nothing outside the real molecular movements that animate these smooth interactions.

I made the black hole. It was not given to me, it had to be produced. How well it works, if at all, depends on individual cases. In this case, it is necessary in your life to doubt as far as is humanly possible. It is precisely in knowing our limits that we exist: thoughts without content are empty; intuitions without concepts are blind. Cognition can only arise when art is embodied in such meaning. To an artist, cognition is a knife-edge, precariously poised between disorder and a clear feeling of unity. This includes paths that involve highly improbable events, like electron-positron pairs appearing out of nowhere, and writing up the idea of art as a multiplicity, as we considered before.

"Ah, Mr. Schrodinger. About your cat. Well, there's good news, and then there's the paint. Talk about paintings making themselves!"

The dichotomy of painting is the scheme and the thing. Art, as such, does not become an issue until the first time we debunk the moment of painting, unlike the most abstract of questions, which, if they are abstract enough, may provide us with a figurative form of a man or a woman, and liquid thought.

Paint is a certain point, for me, in the external reality – the strata – and you certainly don't reach the image by remaining changeless. One might be tempted to say that the entirety of analytic philosophy emerged from a misreading of the wave function, a misreading of every single part of it.

Objective becoming rejects the conditioning tool we call pleasure, restricting the focus to a stream of experience. I celebrate all of these excesses, whilst developing my original theory of physical bodies, before retreating once again.

The Wheat Field

From these smooth fields of light, affective striations emerge. Drawing upon our sensory experiences, the strange consequences of the process are visual intensities: fields of pure colour. In your hand are possible lines of flight, with distant provocations reaching out for your closer vision. Outside this immersive world, there is a separate account of how the knowledge might have been created, where enough is said. The aesthetic experience is here to relish, but this is not as experimental as the underlying process.

The plane of immanence is not the paintings. The paintings preserve the particles, but this particular plane of immanence exists as an experimental process. Without categories, your hand-eye-self shouldn't resist wandering off into areas of luxurious light-paint in order to study a flux of experience.

You cannot feel unapplied theory, but it is integral nonetheless. In order to reach the visual-spatial opportunities I offer, the accompanying strata of theory I supply to you is apparently scientific. The external reality of this internal simulation is every bit as irregular as these apparently scientific descriptions. Consequently, through a need to embody the bodily, we are left with a research question.

My past series of artworks are forms created with a brush richly laden with pixels, but through this brand-new fantastic fairyland of points and polygons we get closer to the whole. Here we may study the flux of experience, but we may experience frustrations, as we seem to have nothing to attack with our reasoning. If we are sufficiently fascinated, we can see resemblances throughout the artwork, and we can find moments of deterritorialization.

We may experience them as intensities: as 'real'. The weirdness of the Body without Organs is material, but it is a flow of materiality, with conjunctions here, and colours there. It produces the sort of conceptual possibilities that one sees in the skin. External reality is every bit as scientific as painting done at close range, or composing a score with close-range hearing, or writing with short-term memory, as I am doing here. And it's precisely that: the artwork contains one or more (but not all), and not the definitive (nor provable), nature(s) of nature.

If you boil it down, the apparent realities of the future-nows, with their multiverses and provocations, are the attempts of counter-productive forces. Rather than trying to accept the futility of measurement, I have made things sensible enough to reach out and almost touch you. The artwork is palpable, but you can only touch it if you suspend your disbelief, in which you have no choice. I offer opportunities for you to delight in new smooth spaces. Although this art started out as a mode of addressing various problems through my squiggly brush-strokes, aesthetic and cognitive appraisals have led me to an account of how new knowledge might be created. More than enough has been said about painting, but there's plenty more to do.

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Pre-face

The purpose of a text such as this is to intertwine the art, and it is in this spirit that I write. It is all that this can be, as this text can be no more than that which it is. It cannot be the art, and it is the art that is the research. With this focus on my words, and not on my art, we move away from what the artworks are, and what the research is, but through this compromised way of looking at painting, we may, or may not, by the end of these texts, be able to make a measurement. I am optimistic.

We will consider quantum theory, as I have, and we will talk about that which one *can* talk about. That which one *cannot* talk about may be found in the artworks. You may find one that you like, but liking is not the point: I was always more concerned with new research into humans and painting and the digital and reality than with pleasing an audience. You will, if time permits, come to like them all, or you might not like any of them, but liking is not the point. You might like my jaunt through the Deleuzian multiverse in relation to my artworks, but they are more about physical reality than metaphysical reality, although they are not about space or time. There is no up or down in my practice: its essence has do with painting.

When we just focus on the ineffable, we may be able to work this out: it is about the skin between worlds. It is also about a point in this classical world, and each wave that is that thing in that quantum world. Sometimes it is only me and the image, the artwork, and other times it seems to be about the text, but it is largely about a skin between.

so world use words make philosophy body than need method s tue then digital would study i'm their these fri data our nov becoming look form sep see bit apr artist could artworks things maybe way plane mon thing possible feb th friday based thu them made light thinking superposition idea think something.

paint eye been particle grounded first different waves two tuesday science process perhaps part i've dec such does life aug wednesday get exhibition wed jan being classical itself experience concepts particles ipad your www very monday sense knowledge visual smooth using pixel mar language journal without truelove it's any where useful london pixels become now collapse both word used object matter stage own jul immanence

So, in the world I'm in right now, I use words to make use of philosophy, and I build a body of theory that needs a grounded method. Then there's the digital: I study this in detail. I'm their champion, the pixels. These data points of our becoming form so that we can see, through my endeavours as a bit-artist. Could these artwork-things maybe provide a way to reveal the imminent/immanent plane-thing? Is this probable, or even possible? Based on this, and made of light, and thinking in a superposition of ideas, I think some things through my brush.

The paint in my eye has been a particle, but it was grounded first as a difference of waves, as proven through the science of the double-slit experiment. Still, the process of painting is the part I've given most attention to, and it is this that gives the work its life. When I get to the exhibition, the art is being classical in itself, and we experience the concepts as the particles of my skin-scape. Your very acute sense and knowledge of the visual, the smooth in particular, is fed using pixel language and my journal. True love. Pixels become now: they collapse both the words used and the objects of matter, as I stage my own immanence.

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led system e works striated probability here beyond before ‘the us too screen read humanity guattari back viewer perception another stuff physical org j brush well vr together order images forms down c particular looking interesting colour reference really original non leeds audience act ‘ still photon had context because tracking subject embodied creative

Rather unusually, my field of inquiry necessitated the making of hand-crafted text-books from human nature, and the presentation of these to the many gathered Roman philosophers, with help from Kiff. (The galleries in Rome turned out to be more useful, as you might imagine they should be. I didn’t worry too much about ideas there). Don’t concepts in the brain bear relation to the real? Must flesh be the meat of the conference, or should it instead be the universe, or is it always just paper writing? My version of the university includes physics and good scientists. In the same vein, over in the digital realm, code can be thought of as a creative state of mind.

This eventually led to a system of artworks, striated with probability. Here, beyond, before the two of us, and too far into the screen to read, is the humanity I embody in my art. Guattari and Deleuze backed up the audience’s perceptions as these critics sniffed at the stuff of the physical and of the brush, and the audience fell down the well of VR. Together, the order of images formed the body of work, and the block-chain authenticated these artworks. A top-down, particular way of looking at the interesting colour references (red, green and blue) raised questions about the original. This non-Leeds romantic audience acted up, but the photon still had context because tracking this subject embodied the creative: the human photon embodied in my art.

Appendix IV: Contributions to Knowledge

Contribution to Knowledge #1

The first specific contribution to knowledge is the novel technique for conducting practice-based research articulated in this document. This method combines elements of Grounded Theory Method (which builds theory from the ground up) with a process inspired by the quantum wave-function (which is a mathematical model that encompasses physical reality). From Grounded Theory, the method exploits inductive reasoning (specifically, moving from the *particular* to the *general*) and a ground-up approach in which the subjectivity of the artist-researcher is an integral and permissible part of the research process. This method is not a hypothesis-testing model and therefore resonates with art-practice-based research which is characterised by free exploration. From quantum theory, the notion of waves collapsing into classical reality echoes and supports the creative process. In this method a 'superposition' of creative probability is created by the artist-researcher, who quantise this superposition through an act of observation or measurement. This alternative model for structuring practice-based research minimises conflict between affect and logos whilst providing the necessary outputs to facilitate a dialogue-based assessment.

In this method the artist-researcher systematically collapses their affective practice into logocentric theory through inductive reasoning constrained by a set of rules. A rhizomatic approach allows the research to spread freely and chaotically, both through the practice and through a reflective journal, in a prolonged phase of research which is equivalent to the initial data gathering and coding stages of Grounded Theory. This rhizomatic phase is sustained for at least four fifths of the research programme. In the final fifth of the research, a set of OuLiPo-like mechanical rules provide a structure which enables a 'collapse' of the rhizomatic waves of practice and reflection into a coherent articulation of the practice-based

research. This then generates a textual overview which records the practice-based inquiry without compromising the integrity of the intellectual inquiry embodied in the practice itself. The textual overview also facilitates a dialogue-based assessment as appropriate. This method will be of benefit to practice-based researchers, research students and artists who require a way to balance affect and logos in order to maximise the impact of their work.

Contribution to Knowledge #2

The second specific contribution to knowledge is a quantum theory inspired technique for creating paintings. This technique of creative production is similar to the method described above. This procedure is as follows: raw data (for example the geometric points from a 3D scan) are systematically released, one small part at a time, through brush-strokes into a superposition of probability; this probability is then 'collapsed' down into brush-marks, determined by what is most probable based on the already painted image, guided by the aesthetic judgement of the artist. This approach is characterised by the slow labour and sustained draughtspersonship of the human artist and re-enforces human labour as a valuable aspect of digital art. The product of this technique and its associated humanity becomes embodied in the digital paintings created using this technique.

Contribution to Knowledge #3

The third specific contribution to knowledge is an expansion of the field of modernist painting through a sustained practice-based interrogation of notions of skin, informed by quantum theory and related philosophical discussions. Through an exploration of the nature of reality at the quantum scale through the painting practice, this research contributes to the evolution of modernist painting. Various

notions of skin are examined and presented through the practice, including skin as the outer surface of the human face, notions of smoothness and striation as they relate to skin, skin as a function of light and colour, skin as a flattening of the z dimension, skin as an ongoing process of becoming classical reality (a plane of imminence), skin as the plane between the quantum and the classical worlds (a plane of immanence), and the impossibly thin digital skin that can be experienced through virtual reality. These notions are encapsulated in the paintings in the virtual reality artwork, and the intended beneficiaries of this research are new audiences reached through the Steam digital distribution platform. This aspect of the research will be further disseminated by publication in academic journals, such as *Leonardo*.

Contribution to Knowledge #4

The fourth specific contribution to knowledge is the exploitation of newly available digital technologies (including 3D scanning, tablet-based painting, coding, block-chain authentication and virtual reality) to address specific aspects of the material preoccupations of modernist painting. Inductive reasoning has been used to take particular aspects (such as medium specificity) and to generalise them through the practice. In particular, the research adopts a digital formalist approach which emphasises the specificity of the pixel, the point and the polygon.

Drawing on ideas gleaned from quantum theory, the pixel is considered as a quantum of artistic media, and is worked with directly through the painting practice. The research celebrates the specificity of the pixel through an unobstructed non-mimetic presentation of its hard-edges as expressed in the virtual reality artwork. The research also engages with the geometric point, and draws parallels with the similarly intangible but measurable particle, and uses this in the development of paintings, including the final virtual environment. Computer code has been written

to enable a direct connection between me the artist, the pixel-based paintings, and the polygons at their root-level. The resulting polygon-skin landscapes and kinetic spatial paintings embody human endeavour, and this aspect of the research is accessed through the direct experience of the virtual reality artwork.

It is anticipated that these aspects of research will be further disseminated through the presentation of the artwork at digital conferences such as EVA London, ISEA and ACM SIGGRAPH.

Contribution to Knowledge #5

The fifth specific contribution to knowledge is the identification of spatial presence as a potential form of artistic media. Drawing on research from psychology and neuroscience and inspired by artists such as Kevin Mack and Iain Nicholls, this identification of spatial presence as media represents the culmination of the Grounded Theory inspired research method. Rather than starting with a research question, as would be usual for a hypothesis testing research method, this programme of research concludes with the research question, 'How might one paint with spatial presence?' This concluding research question provides a starting point for post-doctoral practice-based research. Understood through the context provided by this document and the experience of the virtual reality artwork, this question also provides other researchers with a very well grounded hypothesis to prove or disprove.

Appendix V: Glossary

`3D printing` The laying down of layers of material by a machine to form a physical object from a digital model.

`3D scanning` Digitally capturing spatial information about an object or environment.

`Algorithm` A set of rules followed by a computer.

`Atom` The smallest possible part of a chemical element.

`Augmented Reality` The overlaying of digitally generated objects onto the physical world.

`Blockchain` A secure decentralised online digital ledger, commonly used to provide trust in a cryptocurrency.

`Classical` Theories and concepts of the material world that preceded quantum theory.

`CNC routing` Computer controlled carving of materials.

`Code` A set of instructions for a computer to execute.

`Collapse` In the context of the wave function, the measurement and determination of an aspect of a quantum entity.

`Computer Generated Art` Physical artistic works made with the assistance of a computer.

`Cryptocurrency` Money which is able to exist and function because of the trust that a blockchain confers.

`Data` Quantities that computers store and perform operations on.

`Digital Art` Artistic works made possible by a computer.

`Electron` A negatively charged subatomic particle found in all atoms.

`Electromagnetic` A fundamental force encompassing electric and magnetic energy.

`Google Cardboard` A simple and inexpensive device for converting a smart phone into a basic Virtual Reality headset.

`Grounded Theory` A research method that, in contrast to hypothesis testing models, uses inductive reasoning to construct theory from the ground up by systematically analysing relevant data.

`Head tracking` A method for determining the position of a Virtual Reality headset and adjusting a viewer's viewpoint accordingly.

`Immanence` That which permeates the material universe.

`Immersive` A computer generated three dimensional visualisation that appear to surround a user.

`Imminence` That which is about to occur.

`Laser carving` A computer controlled system for etching into materials with a powerful laser.

`Neutron` A subatomic particle with no electric charge, present in all atoms except hydrogen.

`Particle` A definite package of energy.

`Photon` A particle of light.

`Pixel` A square or rectangular picture element of a digital image.

`Point` A geometric entity defined by its location in three dimensional space.

`Polygon` In the context of computer graphics, simple flat shapes that combine makes up more complex models.

`Proton` A positively charged subatomic particle found in all atoms.

`Quantum` A definite amount. Reality at the sub-atomic scale comes in packets of definite amounts.

`Quantum theory` A theory of energy and matter related to the concept of quanta.

`Quark` Subatomic particles that carry fractional charge.

`Rhizomatic` A concept, developed by Deleuze and Guttari, that enables multiple entry and exit points in a non-hierarchical approach to thinking and creative endeavour.

`Semiconductor` A susbstance with variable conductivity used in electronic circuits.

`Superposition` A combination of waves that enables multiple states to coexist simultaneously.

`Standing wave` A vibration in a wave system that is characterised by stable peaks and troughs.

`Texture mapping` The application of a digital image to a computer generated model.

`Virtual Reality` The computer generated simulation of a 3D environment in which a user is immersed, typically via a headset display.

`Wave` In the context of physics, the variation in an electromagnetic field in the propagation of light.

`Wave function` A mathematical description of quantum entities.

IAN TRUELOVE

CONTEXTUAL OVERVIEW

JUNE 2018