Reality is merely an illusion, albeit a very persistent one.

- a practice based investigation.

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Question - How can sculpture respond to the quantum mechanical theory of wave/ particle duality, in the context of the observer effect?

Dedication –

I would like to thank my family for their support throughout this process and my Academic Supervisor, Rodney Forbes for his continued advice and encouragement.

Declaration of originality

I, Lorraine J. Marchioro, declare that this thesis is my own work and has not been submitted in any form for another degree or diploma at any university or other institute of tertiary education. Information derived from the published and unpublished work of others has been acknowledged in the text and a list of references is given in the bibliography.



Lorraine Joy Marchioro

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Abstract

This exegesis explores how the quantum theory of the *observer effect* and quantum mechanical models of reality (for example wave/particle duality), can be used as inspiration for the construction of sculpture. After briefly summarizing the observer effect and quantum physics, I discuss how artists have been influenced by science and in particular quantum physics to create work which challenges our view of the world. I discuss how the act of perception is a subjective experience and go on to analyse my own experiments in sculpture using the concept of the Observer effect as a conceptual paradigm.

Keywords

Art, sculpture, Quantum Physics, Observer effect, wave/particle duality, subjective, transparency, consciousness, reality, light, spirituality, Eastern mysticism

Introduction

Several years ago I experienced the death of my father. For some time previous, we had often engaged in philosophical discussions about what might happen after we die. My father said he would let me know when he got there, but I decided to do some investigation for myself. These were the circumstances that took me on a convoluted path, through the philosophy of Eastern mysticism and into quantum physics and how it affects the reality we inhabit, beginning a journey which not only influenced my artistic career but formed an enduring personal paradigm.

For several years I have been conducting research into quantum physics as a conceptual construct and platform on which to base my sculptural practice. Gradually I refined my focus to the theories of Heisenberg, Schrodinger, and the Copenhagen Interpretation, otherwise known as the Observer effect. Simply stated the Observer effect postulates that the observer, whether it be a human, animal or a mechanical detector is able to affect the occurrence of the reality before them. [1]

The way a person sees the world is determined by their cultural environment, where they live and the things they have experienced and no two animals see the world in the same way. The act of observing a thing is not new, but the idea of the observer being able to affect the thing that they are observing is a recent one, and this concept forms the central idea in this research project.[2]

[1] Observer effect – Einstein was said to comment, “no reasonable definition of reality could be expected to permit this.” In a paper he co-authored in 1935 with Boris Podolsky and Nathan Rosen. In the Copenhagen Interpretation of quantum physics wave function is said to collapse upon observation, as in the famous Schrodinger’s cat thought experiment. This means that the “reality” of a situation is not fixed until it has been observed.
"The Quantum World," *New Scientist - The collection* vol.3, no. 3 The Quantum World (2016). p. 13

[2] Ken Wilber, *Quantum Questions* (Shambhala Publications, 2001). p.80

Several questions arise in relation to this research –

- Is it possible to encourage the viewer through the use of sculpture to see the world with a different perception?
- Who are the artists who have used scientific theory to question notions of reality in the context of quantum physics?
  How can sculpture respond to the quantum mechanical theory of wave/ particle duality, in the context of the observer effect?

Viewing the world through the lens of quantum physics enables an alternate look at the reality around us, a glimpse down the rabbit hole to a world which doesn't act quite like we might like it to. The possibilities open to interpretation for an artist are enormous. This research project adds to the conversation of those artists who are questioning traditional interpretations of reality. By exploring the connections between Eastern Mysticism, quantum physics and perception, by expressing a personal interpretation of the research data expressed in sculptural form, a gap in our understanding of the observer's role in the creation of reality may be decreased, the transformation of ideas into visual form offering new ways of understanding these concepts.

In Chapter 1 I outline the source of my initial interest for embarking on this research project. Here the theory of the Observer effect and the philosophical parallels between quantum concepts and Eastern mysticism are discussed. Chapter 2 provides a general outline of what the Observer effect is, its main proponents for and against and where I place myself within this discussion. Chapter 3 details aspects of perception and the collective consciousness in relation to concepts such as morphic resonance and field theory. A more complex discussion of the subjective nature of perception and Ramachandran's theories on the blind spot in vision are discussed in Chapter 4.

A brief overview of artists in the twentieth century whose practice was influenced by quantum concepts and contemporaneous scientific theories is covered in Chapter 5, while selected contemporary artists

who are engaging with the concepts of science and spirituality and their subsequent influence on the research project are examined in Chapter 6.

The exegesis methodology, the role and relationship of the creative artefact to the academic texts as well as conclusions arrived as a result of the research are considered in Chapter 8. Chapter 9 provides an over view of the exegesis. Outcomes and discoveries made whilst engaging with academic texts and the resulting sculptural artefacts and conclusions derived from the research process are examined.

1. Quantum physics and Eastern mysticism

I had long felt a deep desire to find answers to the deeper questions of existence which went beyond the controlled dogma available to me in my youth. In order to do this I looked to many sources, forming a personal paradigm comprised of a variety of disciplines. I felt it necessary to look beyond the religious and began to test these beliefs against scientific principles finding resonance with the theories of quantum physics and the Observer Effect.

Many physicists postulate that we live in a mechanistic world, a clock work universe, a concept which in essence seems to negate the presence of free will. Pioneer of quantum physics, Erwin Schrodinger asks the question, if this is the case, "who winds the clock?"[3]

In the early 1920's, an atmosphere of heated controversy ignited between non-Dualists[4], Werner Heisenberg and Wolfgang Pauli who found a commonality between quantum physics and Eastern religion

[3] Erwin Schrödinger, *What Is Life?: With Mind and Matter and Autobiographical Sketches* (Cambridge University Press, 1992). p. 29

[4] Non-Dualists have a philosophical, spiritual, and scientific understanding of non-separation and a fundamental oneness. https://www.scienceandnonduality.com/about/nonduality/

and Dualists[5], Albert Einstein and Max Planck, who both rejected the possibility of a subjective mysticism in relation to scientific concepts. Einstein famously commented, "Physics should represent a reality in time and space, free from spooky actions at a distance".[6] Here he decries Pauli's evolving philosophical outlook which proposed a "synthesis embracing both rational understanding and the mystical experience of unity'.[7]

Increasingly the argument of including consciousness as an extension of quantum theory[8] became a viable possibility for interpretation. Heisenberg supported Wolfgang Pauli's 'mystical' hypothesis', in which he reconciles the scientific 'idea of material objects that are completely independent of the manner in which we observe' with 'Asiatic philosophy and Eastern religions [where] we find the complementary idea of a pure subject of knowledge'.[9] Pauli's quantum field theory found a direct relationship with Eastern mysticism's concepts of unity and oneness, giving consciousness a role at the fundamental level of the material world. The observer and the observed not merely related but One.[10]

Schrodinger too, felt the need to create an interpretation which negated the necessity of dualism, one which supported both his philosophical and scientific thesis. He believed the only solution to this dilemma lay in the assumption that the "I" and the laws of nature are

[5] In the philosophy of mind, dualism is the theory that the mental and the physical—or mind and body or mind and brain are separate, believing the Universe works in the manner of a giant machine. http://plato.stanford.edu/entries/dualism/

[6] Max Born, Albert Einstein, and Irene Born, *The Born Einstein Letters: 2Correspondence between Albert Einstein and Max and Hedwig Born from 1916 to 1955 with Commentaries by Max Born. Translated by Irene Born* (Basingstoke, Macmillan Press, 1971). p. 158

[7] Juan Miguel Marin, *Mysticism'in Quantum Mechanics: The Forgotten Controversy*, European Journal of Physics 30, no. 4 (2009). p.809

[8] Ibid. p. 810

[9] Werner Heisenberg, *Physics & Beyond: Encounters & Conversations* (Harper, 1970). p. 85

[10] Peter J Bussey, *Eastern Religions and Modern Physics-a Further Examination*, *SCIENCE AND CHRISTIAN BELIEF* 11 (1999). p. 121

one and the same.[11] This concept of a *Universal Self*, is a view which was echoed by Indian, Vedanta philosophy.[12]

The central aspiration in Eastern religions, whether they are Hindu, Buddhist or Taoist is to transcend the notion of an isolated individual self and to identify oneself with the ultimate Universal reality.[13] Buddhist philosophy seeks to show that anything definable lacks reality because it exists only in relation to something else.[14] Concepts such as formlessness[15] and the void[16] abound in both disciplines. The fact that some physicists used the writings of ancient Eastern mystics to clarify and inspire their thoughts in a cross disciplinary approach is unsurprising. As Isaac Newton famously uttered, "If I have seen a little further it is by standing on the shoulders of Giants".[17]

The knowledge that Nobel Prize winning physicists such as Niels Bohr (1922), Werner Heisenberg (1932) and Wolfgang Pauli (1945) found an affinity between the Eastern concepts of Unity and a connectedness

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[11]Ernst Peter Fischer, *We Are All Aspects of One Single Being: An Introduction to Erwin Schrodinger*, Social Research 51, no. 3 (1984). p. 834

[12]The word Vedanta literally means the end of the Vedas – the Vedas being the scriptures of the Hindus. Even Buddhists and Jains will quote passages from Vedanta with authority.
*, *The Vendanta Philosophy*, Graduate Philosophical Society of Harvard University.

[13] Fritjof Capra, *The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism* (Shambhala publications, 2010). p. 6,7

[14] Bussey, *Eastern Religions and Modern Physics-a Further Examination*. p. 126

[15] Buddhists insist that the ultimate nature of Reality is Sunyata, which means "empty"- not in the sense of being a vacuum, but rather in the sense of being empty of any sort of substance or form of its own. Hindu sage Shankara, says: "There is but one Reality- changeless, formless and absolute."'
Joel Morwood, *From Form to Formlessness*, Centre for Sacred Sciences (1996).
Quantum theory states that until wave function has collapsed, "reality" exists only in a state of possibility (or formlessness).
Marshall, Zohar, and Peat, *Who's Afraid of Schrödinger's Cat?: All the Science Ideas You Need to Keep up with the New Thinking*. p. 258

[16] The "great void" is not separated from the material world. The latter depends on the former. The nature of Sunyata in Buddhism highlights the "great void's" non-obstructive nature.
Translated by Lim Yang & Shi Neng Rong, *Sunyata (Emptiness in the Mahayana Context*, Teachings in Chinese Buddhism (1996).

[17] Massimo Franceschet, *Pagerank: Standing on the Shoulders of Giants,* Communications of the ACM 54, no. 6 (2011). p. 3

between all life acted as an affirmation of my own observations and subsequent conclusions. I had begun this research project with the intent to use the knowledge acquired to imbue a deeper meaning into my sculptural practice, expressing a personal paradigm comprised of a mixture of spirituality and physics which would create a framework for experimentation with materials and form. The sculpture acts as a conduit helping to distil and contemplate the accumulated information.

2. Quantum physics and the Observer effect

Exploring the Observer effect, or manners of perception in relation to artistic practice is not a new endeavour. In fact to see a work of art asks the viewer to suspend their traditional way of seeing. The theory of the *Observer effect* or Heisenberg's Copenhagen Interpretation[18] and its relationship to the perception and cognition of the world play a large part in my creative process. This theory states that the reality of an object, is affected and in fact brought into being by the act of being observed. How does the way we view the world inform us about the reality we inhabit?

In the early 1920's Neils Bohr and Werner Heisenberg proposed a quantum theory which suggested a holistic Universe, in which the observer is as much a part of the experimental setup as the object which is supposed to be studied.[19] The presence of the conscious observer in Quantum theory is a hotly debated topic in scientific circles, having many supporters on either side of the field. One side of the debate has eminent physicists such as John Wheeler, Richard Feynman and Murray Gellman, state that the Universe has its own agenda and is totally unaffected by "some person, some animal or some computer".[20]

[18] Ben Best, *The Copenhagen Interpretation of Quantum Mechanics,* http://www.benbest.com/science/quantum.html
[19] Jan D. Kucharzewski, *"There Is No 'There' There": Gertrude Stein and Quantum Physics,* Amerikastudien / American Studies 49, no. 4 (2004). p.502
[20] Michael Nauenberg, *Does Quantum Mechanics Require a Conscious Observer?*, Journal of Cosmology 14 (2011).

In opposition are physicists such as Fred Kuttner, Bruce Rosenblum and David Bohm who believe that the intrusion of a conscious observer is necessary for the collapse of *wave function*[21] into a state that we call reality.[22]

The understanding of the concept for the purposes of the research project falls with the latter group of physicists. In accordance with Bohm's observations, instituting the Quantum theory of the observer into our understanding of reality allows us to combine the study of the mind and physics, creating an interdependence of all systems acting in harmony with one another.[23]

When critical thinkers Alois Regal and Ernst Gombrich formulated the idea of the beholder's share,[24] they had in mind that a picture is not complete without the viewer's reaction. Similarly Heisenberg's *Uncertainty Principle,*[25] states that it is the observer whose interaction collapses quantum particles. These particles normally exist in a state of potentiality, only appearing in our perception of reality upon observation.

This ability to create the reality around us by the act of observation offers powerful inspiration for the creation of art, in particular sculpture which encourages viewer participation in the form of simultaneous images existing in one work or semi-relief sculpture whose appearance changes depending on the reflection of light and viewer position.

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[21] Wave function – Quantum objects exist in two states, the wave and the particle, that can be observed singly, but never together. Niels Bohr, Danish pioneer of quantum physics called this the complimentary principle. The Quantum world, New Scientist

[22] Fred Kuttner and Bruce Rosenblum, *The Conscious Observer in the Quantum Experiment*, Journal of Cosmolgy 14 (2011).

[23] David Bohm, *A New Theory of the Relationship of Mind and Matter,* Philosophical psychology 3, no. 2-3 (1990).

[24]Eric Kandel, *The Age of Insight: The Quest to Understand the Unconscious in Art, Mind, and Brain, from Vienna 1900 to the Present* (Random House, 2012).

[25]Heisenberg's Uncertainty Principle or The observer effect - According to quantum mechanics, the more precisely the position (momentum) of a particle is given, the less precisely can one say what its momentum (position) is.
Jan Hilgevoord and Jos Uffink, *The Uncertainty Principle,* The Stanford Encyclopedia of Philosophy Spring 2014.

The state of matter, (therefore everything in the Universe in its wave/particle duality), lies in a state of superposition[26], meaning all particles remain in a state of possibility until being affected by the act of observation, at which point they collapse into a state of being. To some extent the observer sees what he or she looks for.

3. Perception, consciousness and their relation to the quantum theory of the observer effect

In his work, *The Visible and the Invisible*, Maurice Merleau-Ponty states, "Perception is not first a perception of things, but a perception of elements, (water, air…) the rays of the world, of things which are dimensions, which are worlds." [27] Here he speaks of becoming aware of aspects of reality which lie beyond the realm of normal vision. Requiring an extension of the mind to reach beyond the everyday necessity to record and process the mundane and become aware of a deeper level of existence. The act of perception is one of consciousness. We do not see what is out there. Rather, we project our preconceptions onto each situation, so a particular reading depends on our unique expertise, and also our culturally conditioned worldview.[28]

Einstein's special theory of relativity created doubt about the notion that the world outside our consciousness is an objective reality. If space and time are relative, then within the malleable grid of the objective world the sequence of events, the colours of objects and shapes of

[26] Quantum superposition is a fundamental principle of quantum mechanics that holds that a physical system—such as an electron—exists partly in all its particular theoretically possible states (or, configuration of its properties) simultaneously; but when measured or observed, it gives a result corresponding to only one of the possible configurations. wikipedia, "Quantum Superposition."

[27] Maurice Merleau-Ponty and Claude Lefort, *The Visible and the Invisible: Followed by Working Notes* (Northwestern University Press, 1968). P. 218

[28] Professor Allan Snyder, Director, Centre for the Mind, *Blinded By Your Expertise*, http://www.med.usyd.edu.au/research/conf2000/speech.html

forms would acquire a certain plasticity dependent upon the observer.[29] Einstein's observation supports the conclusion that the individual creates their own reality dependent upon their focus of attention.

How is it that we manage to live together in a world where reality is dependent on the observer? Many philosophers believe in the existence of a collective cognizance. Émile Durkheim in his *Rules of Sociological Method,*[30] posits that the collective conscious is one of a learned experience. The effect of the trained individual—through the process of becoming a subject, or member of society, an individual learns to be common: to dress, speak, and act like their neighbours,[31] This explanation goes some way to explain our commonality of experience and can be seen to an extent in the experience of being a member of a national identity.

Carl Jung goes further with his theory of the *Collective unconscious*[32], stating that the unconscious is the portion of the self of which the individual is unaware, yet which still exerts control over the behaviours, desires and drives of that individual. As such, unconsciousness is never entirely divorced from the consciousness within the individual, and one necessarily informs the other. The Jungian *collective unconscious* is important because it suggests an original set of archetypes common to all members of a group, and out of which they formulate meanings, contexts, and patterns within the group.[33]

This type of phenomenon can be seen in nature, swarming of bees, murmuration of starlings and schooling of fish, where species memory is inherent. Each individual draws on this data base and contributes to

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[29] Leonard Shlain, *Art & Physics, Parallel Visions in Space, Time and Light* (New York: Quill, 1993). p.136
[30] Emile Durkheim, *The Rules of Sociological Method: And Selected Texts on Sociology and Its Method* (Simon and Schuster, 2014).
[31] Anna Piepmeyer, *Collective Consciousness,* The University of Chicago: Theories of Media: Keyword Glossary *(2007).*
[32] Carl Gustav Jung, *The Concept of the Collective Unconscious,* Collected works 9, no. Part I (1936).
[33] Piepmeyer, *Collective Consciousness*.

it. This would tend to explain why we as humans have similar expectations of what we see - green grass, blue sky and so on. Physicist, David Bohm holds similar views with his theory of Wholeness and the Implicate Order. [34] Bohm's theory states, "The world cannot be analysed into independently and separately existent parts. The essential feature of this idea was that the whole universe is in some way enfolded in everything and that each thing is enfolded in the whole".[35]

Regardless of the name of the theory it seems that scientists agree there is an underlying field or base of knowledge that is accessible to all humans, which unites them in being able to experience the world. This knowledge is accessed through the filters put in place by means of cultural and educational conditioning as well as by the interest and ultimately the attention of the individual. Awareness of these parameters within the human psyche can be used to advantage when creating works of art which encourage the viewer's engagement on a deeper and more elemental level.

4. The subjective experience of visual perception

The age old questions such as, "Do you see the same shade of red as me?" opens the inquiry, do we all see the same reality? Richard Gregory puts forward the idea that perceptions are a *hypothesis*, implied by the fact that retinal images are open to an infinity of interpretations and the observed phenomenon of ambiguity.[36] Giovanni Battista della Porta first described the way images are received by the

[34] David Bohm, *Wholeness and the Implicate Order*, vol. 10 (Psychology Press, 2002).
[35] *A New Theory of the Relationship of Mind and Matter.*
[36] Richard L Gregory, *Eye and Brain: The Psychology of Seeing* (Princeton university press, 2015). p. 10

eye as similar to the *camera obscura,*[37] perfect in colour and form but upside down.[38] Physiology indicates that the human eye actually projects three reflections: two large but dim images and a small, bright but upside-down reflection positioned at the back of the lens. These are called Purkinje images.[39] Information received from the eyes is constantly being fed into the brain, two slightly different viewpoints sorted and simultaneously rejected or collated to create a facsimile of the world around us.

Human perception of an object can be influenced by subjective knowledge acquired and stored as interpretations and memories in the brain. This view is coloured by background assumptions which are related to the observer's life experience and expectations and influenced by cultural conditioning[40] and intellectual knowledge.[41] The brain has evolved a preference to use internally sourced schemata to shortcut the need for detailed perception, only moving past this insularity when prompted by information which disturbs its preconceived notions of how things should be.[42]

This subjective interpretation is not the only obstacle to our view of the world. The presence of a blind spot was first proposed by Edme Mariotte in 1667. The blind spot is located in a position corresponding to the optic disc, the place where the optic nerve exits from the back of the eyeball, a black hole in vision which remains undetectable to the visual field. It has been postulated that the brain fails to notice the absence of neural signals,[43] Ramachandran proposes that we do indeed fill in the blind spot, stating, "We may conclude, therefore, that the

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[37] Camera obscura - a darkened box with a convex lens or aperture for projecting the image of an external object on to a screen inside, a forerunner of the modern camera.
[38] Gregory, *Eye and Brain: The Psychology of Seeing*. p. 34
[39] Ibid. p. 39
[40] David Suzuki interview with David Bohm, https://www.youtube.com/watch?v=r-jI0zzYgIE
[41] Richard L Gregory, *Knowledge in Perception and Illusion*, Philosophical Transactions of the Royal Society of London B: Biological Sciences 352, no. 1358 (1997).
[42] Philip Cam, *Insularity and the Persistence of Perceptual Illusion,* Analysis 50, no. 4 (1990).
[43] V. S. Ramachandran, *Filling in Gaps in Perception: Part I,* Current Directions in Psychological Science 1, no. 6 *(1992).*

visual system is able to complete the gaps even in relatively complex types of patterns". [44] Research into consciousness studies take the view that the mind is highly active, constructing perceptions from the very inadequate information received from the senses,[45] having much more to do with the act of seeing than previously thought.

It can be seen then, that the act of visual perception is at best a subjective one, a dynamic process which is constantly evolving to suit the purposes of the observer. The more the object of interest attracts the attention of the observer, the more intense the experience of the object becomes.

5. A synchronicity between art and science.

Throughout history the relationship between artists and scientists has been a symbiotic one. In his book, "Art and Physics", Leonard Shlain, [46] discusses how the artist can often synthesise and pre-empt important scientific discoveries in a non-verbal context. Similarly, Robert Hughes,[47] sees the artist as a precursor, one who prepares society for future discoveries.

Many artists use their creative output as scientific research, the freedom of the visual medium allowing for expression not bound by the misinterpretation of words. In his revolutionary landscape painting, Constable was influenced by the scientific refraction of light,[48] stating, "Painting is a science and should be pursued as an inquiry into the laws of nature. Why, then, may not landscape painting be considered a branch of natural philosophy, of which paintings are but experiments?"[49] In a similar vein, Picasso commented, "Paintings are

[44] Ramachandran, *Filling in Gaps in Perception: Part I.*
[45] Gregory, *Eye and Brain: The Psychology of Seeing*.
[46] Shlain, *Art & Physics, Parallel Visions in Space, Time and Light*. p.19
[47] Robert Hughes, *The Shock of the New* (Knopf, 2013).
[48] Arthur I Miller, *Aesthetics, Representation and Creativity in Art and Science,* Leonardo (1995). P186
[49] Ernst Hans Gombrich et al., *Art and Illusion: A Study in the Psychology of Pictorial Representation*, vol. 5 (Phaidon London, 1977). P. 175

but research and experiment. I never do a painting as a work of art. All of them are researches".[50]

During the 20th century artists continuously pushed the boundaries of their practice with explorations that mirrored and in many cases was inspired by the work of great scientists and philosophers of their day. By using their art to test theories and delve into the way we perceive the reality around us, they yielded a new awareness and complexity to our understanding of some of these theories. The viewer, by observing the thought process of the artist in a visual manner is given free rein to process the information in a way which extended and enlarged their perception, allowing the concepts to filter through into their larger view of the world.

In the late 1800's, artists such as Monet,[51] Turner[52] and the Impressionists were reviled and ridiculed by their contemporaries for their movement towards a liberation of colour and light.[53] In their pursuit to capture a fleeting moment in time within their painting they employed techniques which created the illusion of the optical qualities of luminescence. Their work changed the way we see the world through the lens of painting. Where previously the natural world was coloured by the sombre shades of burnt umber and sienna, now it blazed with contrasting shades of blue, yellow and violet straight from the tube.[54] Similarly, Georges Seurat used his *Pointillism* technique to explore the effects of light and atmosphere in a manner which holds an uncanny similarity to the proliferation of quantum particles which make up the illusion of reality. During this period the investigation into *quanta*, as particles of light was central

[50] Arthur I Miller, *Insights of Genius: Imagery and Creativity in Science and Art* (Springer Science & Business Media, 2012). P. 433
[51] John S Werner, "1. Aging through the Eyes of Monet," *Color vision: Perspectives from different disciplines* (1998).
[52] Joseph Mallord William Turner 1775-1851
[53] Rogers D. Rusk, *Optics and Modern Painting,* The Scientific Monthly 38, no. 5 (1934). p. 461
[54] Reutersv, xe, and Oscar rd, *The "Violettomania" of the Impressionists,* The Journal of Aesthetics and Art Criticism 9, no. 2 (1950). p. 106

to the theory of the photo electric effect and early investigations into quantum physics by Albert Einstein and Niels Bohr.[55]

In a parallel timeframe, Marcel Duchamp began using a mosaic of personal symbology inspired by innovations in science and technology which he incorporated into his work, naming them, *Pataphysics*. These works were investigations into non-Euclidean geometries, concepts of 4th dimensional space, x-rays, radiation, and electro-magnetism. Later developments in quantum mechanics[56] in particular with its notions of breaking down of assumptions concerning the predictable, rational behaviour of the world[57] led to the creation of works such as *The Bride Stripped Bare by Her Bachelors, Even* or *The Large Glass* where he played with a number of ideas borrowed from physics regarding changing states of matter.[58] In Duchamp's later years, Heisenberg's theories of the Observer effect, were to strongly influence his work. During a speech to the American Federation of Artists in 1957 he said, "The creative act is not performed by the artist alone; the spectator brings the work in contact with the external world by deciphering and interpreting its inner qualifications and thus adds his (her) contribution to the creative act."[59]

In the 1930's, Andre Breton and later the Surrealists used Heisenberg's theories as a philosophy which underpinned their artistic investigations into the nature of reality. These images of a soft and flexible world become a recurring theme in the works of Salvador Dali. Using the quantum concepts of reality in a state of potentiality or undecidedness to great effect in works such as *Persistence of Memory,* 1931, which famously depicts a barren landscape dotted with melting watches, sliding through space and time. In his later work, *Galatea of the*

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[55] Arthur I Miller, *Colliding Worlds: How Cutting-Edge Science Is Redefining Contemporary Art* (WW Norton & Company, 2014). p.16
[56] Jonathan Williams, *Pata or Quantum: Duchamp and the End of Determinist Physics,* Tout-fait: The Marcel Duchamp Studies Online Journal 3 (2000).
[57] Ibid.
[58] Linda Dalrymple Henderson, *The Large Glass Seen Anew: Reflections of Contemporary Science and Technology in Marcel Duchamp's "Hilarious Picture",* Leonardo 32, no. 2 (1999).
[59] Williams, *Pata or Quantum: Duchamp and the End of Determinist Physics.*

Spheres, 1952, (fig. 1),[60] particles appear to hover in space, the image implied by the partial rendering of form. The completion of the figure is left to the viewer's imagination, in direct correlation to Ramachandran's theories of the blind spot. Dali commented in his Anti-Matter Manifesto, "Today, the exterior world — the physical one — has gone beyond the psychological one. My father today, is Doctor Heisenberg".[61]

Dali exploited Heisenberg's theories of the quantum particle concept in combination with the *Observer effect* in a way that is reminiscent of Ramachandran's theory of neurological phenomena called *the pop out*, in which visual information which has been extracted from the pictorial field is automatically filled in by the brain of the viewer, rendering the image as recognisable.[62]

It can been seen that by investigating scientific concepts in both formal and indirect ways, the work of these selected artists was provided with a focus which led them into areas which enriched their practice and in many cases allowed a deeper understanding of the reality in which they existed.

[60] Salvador Dali, *Galatea of the Spheres,* Dali Theatre Museum (1952).
[61] *Anti-Matter Manifesto* (1998).
[62] Ramachandran, *Filling in Gaps in Perception: Part I.* p.200

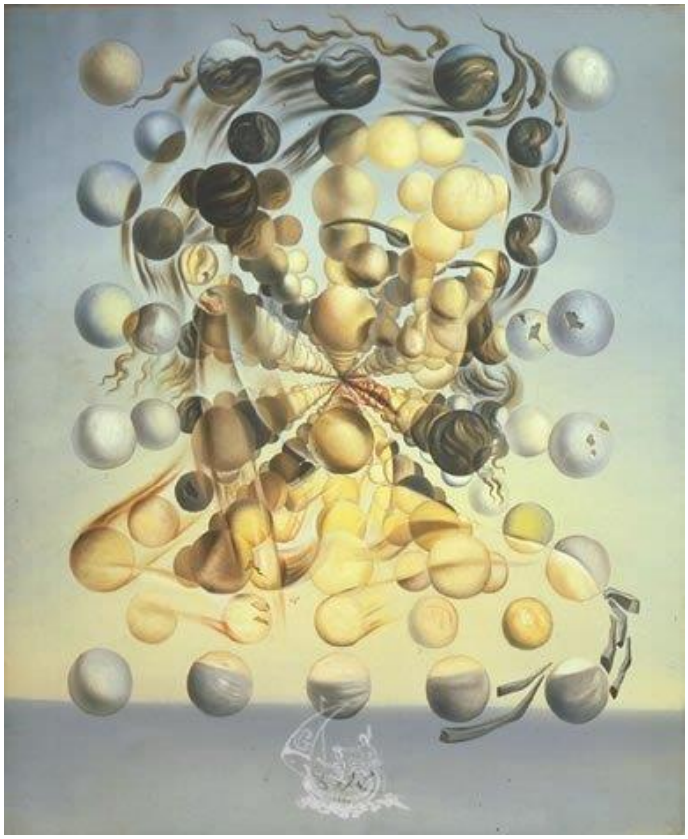


Figure 1 Salvadore Dali, *Galatea of the Spheres* 1952

1952 65 x 54 cm, Oil on canvas, Dali Theatre-Museum

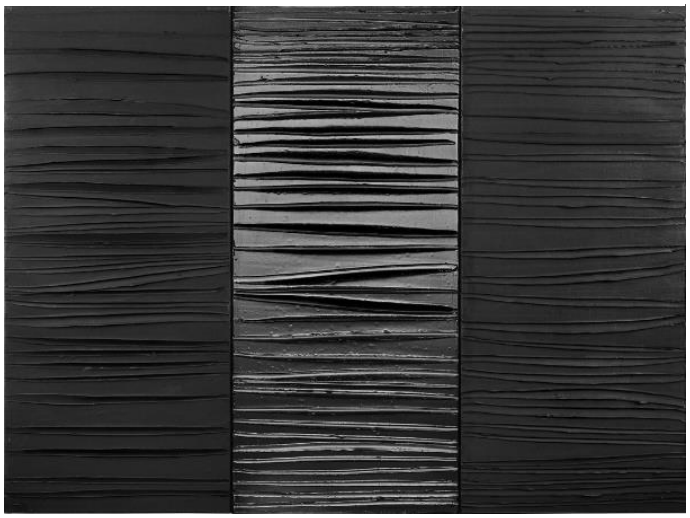


Figure 2, Pierre Soulages, Peinture, 2009

Oil on canvas, 181 x 244

6. Surveying the field - contemporary Artists working with art and science concepts.

In the 21st century, mainstream Western thinking finds itself in the middle of a paradigm shift, moving from a fixed view of reality governed by the previous generation of scientists and philosophers to a new way of thinking. This is a world where individuals and communities act as the creators and observers of our reality, not only in a physical sense but increasingly in a political and global sense. Mainstream media is becoming involved with spreading the message that perhaps the world is not quite the stable and predictable place we all assumed it to be.

Contemporary scientists and philosophers are striving to build upon the foundations of our well known beliefs about the world, trying to understand the world we live in. Many artists too, feel the need to look to these sources to help them understand their world, while others simply work in a more intuitive manner to push the boundaries of their practice.

6.1 Manipulating the Observer effect

In a similar manner to the early physicists, many artist look to align their interests in science and religion. This potent combination of concepts fuels the imagination for the creation of art which seeks to understand the world in a deeper way.

As a proponent of Vipassana meditation, sculptor Antony Gormley developed an awareness to the timeless relationship of the presence of the body and its function as the site for the flow of events surrounding him. [63] Experiencing feelings of dematerialization during states of meditation led Gormley to look to the field of quantum physics to

[63] Thomas McEvilley, *Seeds of the Future: The Art of Antony Gormley,* (1993).

explore the relation between the human form and theories of materiality.[64] With his series, *Quantum Cloud*, 1999-2009, Gormley became one of the first artists to directly investigate quantum theory within his sculptural practice. Works such as *Quantum Void VIII*, (Fig. 3) investigate ways of representing the human form as an emanation of energy interacting and merging with space and time Gormley attempted to create form through the creation of a seemingly chaotic juxtaposition of elements representing energy particles or aether.[65]

With a similar desire to exploit the malleability of form, sculptor Tony Cragg uses the plastic energy of the material to evoke an impression of an object existing in space unconstrained by the laws of gravity. His sculpture morphs in space, as if unsure of its eventual form, truly echoing a sense of quantum undecidedness.

In opposition of the desire to create form, Indian born artist Anish Kapoor's sculpture, (Fig. 4) exhibits a tendency to totally negate materiality, the focus of much of his work centering on the void, or nothingness. The observer is key to Kapoor's sculpture and it is his opinion that the work is not complete until it is observed, [66] stating, "Inevitably, everything is subjective and subjectivity is vital", deceptively simple forms embody his belief that it is the subjective view of the observer that consummates the vision. He declares, "The work doesn't exist without the viewer, without somebody looking at it. To a large extent, all work is incomplete. It's completed by the person who is looking at it." To look at many of Kapoor's sculptures leads the viewer to a contemplation of the immensity of eternity.

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[64] Ian McEwan, *Ian Mcewan & Antony Gormley: A Conversation About Art and Nature,* Kenyon Review (2006).
[65] Antony Gormley, *Physics and the Art of Antony Gormley.*
[66] Ameena Meer and Anish Kapoor, *Anish Kapoor,* BOMB, no. 30 (1989). p. 41



Figure 3, Antony Gormley, Quantum Void III, 2008

5mm square section stainless steel

212 × 247 × 213 cm



Figure 4, Anish Kapoor, *Sky mirror red*, 2009
Stainless steel and lacquer
274×290×146 cm.
Kensington Gardens

The Ultra-black paintings of Pierre Soulages (fig. 2) also rely on the viewer's contribution to complete the work using the presence of ambient light. In the short film *Outneoir*, Soulages discusses his relationship with the painting. "It's a triple relationship, between the thing, the painting, the man who creates it and the viewer"[67]. The *Outneoir* series exploits the materiality of light reflecting off the textured surface of the painting to define form, the painting's surface carved and manipulated by palette knife creating a surface which reflects the density of illumination. In this way, Soulages paints not with the pigment but with light, the reading of the work becoming subjective to the aspect of the ambient lighting[68].

The work of these artists provided a way marker for possibilities of expressing concepts about science and spirituality in ways which were subtle and thought provoking and avoided being overly sentimental. In particular the work of Kapoor and Soulages can be seen purely as contemporary abstract artworks to the uninformed observer. It is only those who are informed who realise the profound basis which acts as a foundation for these works. This quality was one which I attempted to assimilate in my own sculpture. The sculpture should be able to stand by itself as an artwork, without the necessity of a detailed explanation to back it up.

6.2 Using the dot and the line to create form

In an attempt to evoke a sense of ephemerality to their works many artists have employed the device of suspending their sculpture in an installation setting. This enables space to become an essential component of the work and allows for a shift in the conceptual reading of the work. This format works particularly well in conjunction with the exploration of forms associated with the quantum qualities of

[67] Barbara Anastacio, *Pierre Soulages, Outrenoir Video.*
[68] Zoe Stillpass, *Pierre Soulages,* Interview Magazine (2014).

wave/particle duality, the suspension element and the material working together to create a visual metaphor.

Creating sculpture which appears to be an extreme magnification of reality in particular form. With his sculpture, *0121-111-=106102.* (fig. 5) Korean artist Lee Jaehyo creates an immersive space where he suspends the unlikely material of heavy stone to produce a work which appears as an explosion of matter escaping from the bounds of gravity which seemingly defies its materiality.[69] His work is strong and bold, and has a sense of masculinity whilst depicting a quality of an Eastern sensibility, it seems to be a suspension of a moment in time.

A similar aesthetic inhabits the early charcoal suspended installations by Seon ghi Bahk. Finding inspiration in the natural world, Bahk explores ideas of visual perception, exploiting the nature of his work to allow the viewer to become almost part of the sculpture. Recently Bahk has experimented with transparent components to make work which rather than absorbing the light, reflects and transmits light in an ethereal manner. In his sculpture *An aggregation 1506*, (fig. 8) a seemingly solid shape is presented, it is only upon closer observation it can be seen that the object is created from the scattering particles of light merge together to create the impression of solid materiality.

Another example of this phenomenon can be seen in Thomas Heatherwick's mammoth hanging work, *Bleigessen*, (fig. 6). [70] Created by suspending thousands of dichroic glass beads threaded onto lengths of wire which span the 8 story building. With the work twisting and undulating into the full height of the building, views are at times veiled by the reflections of sunlight on the wire. The viewer brings their own perceptions of the world into play in reading the structure. Heatherwick's sculpture represents this form at a monumental scale, the viewer unable to perceive the whole at any one time.

[69] Jonathan Goodman, *Jaehyo Lee: The Possibilities of Nature*, Sculpture 28, no. 4 (2009).
[70] Heatherwick and Masie Rowe, *Thomas Heatherwick. Making Ideas* (Thames & Hudson Limited, 2012). P. 251



Figure 5 Lee Jaehyo, 2006, *0121-111-=106102*.
Stone, 250 x 120 x 220



Figure 6 Thomas Heatherwick, *Bleigessen,* 2002
diachroic glass spheres, wire
30 metres tall
Wellcome Trust, U.K.

In contrast, Chris Drury uses a similar schemata on a more human scale in his *Wave particle*, 2014.[71] Using the concepts of wave/ particle duality and the observer effect in a somewhat literal way, the sculpture creates a veil within the space of the gallery which portrays the quantum wave suspended from the ceiling. Also using the device of the suspended form, Rosaline de Thélin uses fibre optics to create points of light, creating ethereal drawings of the figure with which she evokes a sense of being beyond time. Her work exhibits a fragile ephemerality, [72] presenting the viewer with the ghosting of an image, the human form represented as a luminal representation imagined on the edge of consciousness.

With a similar aesthetic, sculptor and taxidermist Clare Morgan uses her unique skills to create gossamer hanging artifices to capture a moment in time in works such as *Gone to Seed*, (fig. 7).[73] Bringing together materials from the ordinary to the exotic to create a sense of the extraordinary.[74] Ephemeral materials such as dandelions and thistle seeds combined with taxidermy are employed creating seemingly solid structures from thousands of individually suspended elements in a process directly in relation to her conceptual concerns of notions of change and the passing of time,[75] enticing the observer in close to examine the minute particles and pushing them back to understand the immensity of the whole.

Using a similar technique on a far larger scale Japanese sculptor, Jacob Hashimoto transforms immersive spaces in installations such as S*uperabundant Atmosphere*, (fig. 9) at the Rice Gallery, Houston, Texas, the viewer finds themselves surrounded by the poetic visualisations of another world. Hashimoto uses individual elements which could be

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[71] Chris Drury, http://chrisdrury.co.uk/installation-oppland-artcentre-lillehammer-norway/

[72] Kinetica Art Fair, 2012, http://www.kinetica-artfair.com/?exhibitors/2013/roseline-de-thelin

[73] S. Dutton, A. Geitner, and Sainsbury Centre for Visual Arts, *Out There: Bogdan Achimescu, Machiko Agano, El Anatsui, Elisa Bracher, Chris Drury, Fiona Foley, Claire Morgan, Ranjani Shettar* (Sainsbury Centre for Visual Arts, 2005).

[74] D. Ambrose, *How to Explain Sculpture to a Dead Owl.*, *APA 6th - American Psychological Association 6th Edition* Antennae 6 (2008).

[75] Claire Morgan, http://www.claire-morgan.co.uk/Biography-and-Statement(226207).htm

seen to be particles or atoms to create shapes which overwhelm the space.

Investigating the genre of suspended sculpture opened possibilities to create sculpture which embodied the qualities of wave/ particle duality. Engagement with the various techniques used by these artists clarified questions of scale, material choice and technique as a means to convey transient concepts such as the wave/particle nature of quantum physics as the conceptual foundation for my sculpture.

By using components, the creation of larger work was made possible. Logistical problems of creating large sculptures in the studio and then moving them are simplified by the ability to wind the pieces into a packable size, which thereby cut down on transport and logistics.



Figure 7, Clare Morgan, *Gone to Seed*, 2011
Carrion crow (taxidermy), thistle seeds, nylon, lead, acrylic



Figure 8, Seon ghi Bahk, 2015, *An aggregation 1506*.
Crystal, acrylic beads, nylon threads, 500 x 500 x 500
Dior Seoul exhibition



Figure 9, Jacob Hashimoto, "Superabundant Atmosphere" at Rice
Dimensions variable
University Art Gallery, 2005

6.3 Multi-layered images

As a result of my existing practice as a glass artist I had been exploring techniques of using the plastic properties of the medium to embody qualities of quantum physics. To do this I looked beyond my field, to artists using diverse sculptural mediums as a method of extending my practice.

One of the first artists I encountered was physicist turned sculptor Julian Voss-Andreae. His *Quantum Man*, 2006 (fig. 10). [76] was pivotal to my understanding of how sculpture could embody the ideas of quantum physics and the observer effect. Depending on the point of observation, the sculpture disappears almost completely only to reappear upon a change of aspect. The viewer becomes an essential part of the work, participating in the experience in a physical manner to expose different alignments of the sculpture. This work came as a revelation to me, as it allows the sculpture to seemingly exist in different states at the same time, acting as a metaphor for the quantum properties of the observer.

Although Nobuhiro Nakanishi's sculpture doesn't directly identify with the concepts of quantum physics, the conceptual premise in works such as *Layer Drawing Sunrise,* (fig. 12) embodies their essence. The repetitive jittering of the image moving into space acts as a slice of the endless possibilities that a quantum particle may choose before being collapsed into reality by the observation of the viewer. Nakanishi states in the catalogue for his exhibition *Breath of light*, that his work is about observing and understanding an object and giving it a new abstract, material body. He advocates using all the senses; visual and tactile experience in the process of perception, not simply looking at something.[77] Nakanishi displays a

[76] Julian Voss-Andreae, *Quantum Sculpture: Art Inspired by the Deeper Nature of Reality,* Leonardo 44, no. 1 (2011).
[77] Breath of Light, Galerie Kashya Hildebrand, Zurich Switzerland, http://www.kashyahildebrand.org/new_site/artists/nakanishi/nakanishi010.html

poetic and beautiful awareness in his view on experiencing the world.

Using similar techniques on a far larger scale, David Spriggs uses the accumulation of layers to create three dimensional works which span the divide between painting and sculpture. The installation, *Axis of power*, (fig. 11) touches on issues such as immateriality, space, time and perception[78]. Spriggs' sculptures present the viewer with a paradox, pushing the two dimensional plane into the third dimension. The viewer must extend their vision to encompass the space between the layers, becoming an accomplice in the completion of the artwork, or as Duchamp wrote, the audience adds their contribution to the creative act.[79]

Janet Laurence also uses the device of layering images, using research into bio-philic science to inform her work. Notions of impermanence and transformation and the transient nature of the material world are juxtaposed as metaphors to evoke the uncertain world of the unconscious and the unseen.[80]

Her works take the form of alchemical explorations, transformations of matter through practice and philosophy, presenting secrets hidden within layers to be decoded by the viewer. Janet Laurence states she uses her work to make scientific research visible, not just as pure information, but transformed through art, into a more playful and poetic expression which is more easily received by the audience.[81] Works such as *Forensic Sublime, no. 2*, (fig. 13) demand a shift in perception and willingness on the part of the viewer to concentrate their attention to absorb the diverse elements of detail which are inserted like cryptographs within the work.

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[78] Benjamin Starr, *Transparent Film: An Interview with Artist David Spriggs, http://www.visualnews.com/2013/09/25/immersive-3d-paintings-layers-transparent-film-interview-artist-david-spriggs/*

[79] Marcel Duchamp, Michel Sanouillet, and Elmer Peterson, "The Essential Writings of Marcel Duchamp Salt Seller= Marchand Du Sel," (1975).

[80] Marie Geissler, *Principles of Uncertainty*, Craft Arts International, no. 65 (2005).Ū

[81] Paula Llull, *Between Evidence and Imagination*, Sculpture 33, no. 2 (2014).

I have accorded particular attention to this group of selected artists who are using multi-layered constructions to create the impression of three dimensionality within their work. This method of layering images offers the ability to present images which seem to move and distort when the viewer changes their observation position. The transparency of the overall composition allows for detail to be represented within the work revealing itself to the viewer only upon concentrated attention. If the viewer is willing to avail themselves, a multitude of variations within the image are possible. The image presents itself as a subjective experience dependant on the angle and attention of the viewer.



Figure 10, Julian Voss Andreae Quantum Man, 2006
Steel, 2500 x 1100 x 500
City of Moses Lake, WA[1]



Figure 11, David Spriggs, *Axis of power.* 2009.
640 x 430 x 214 cm / 252 x 170 x 84 inches
White acrylic paint on layered sheets of transparent film, tee bars, springs, lighting.
Architectural Installation at the Sharjah Biennial 9, Sharjah Art Museum, United Emirates

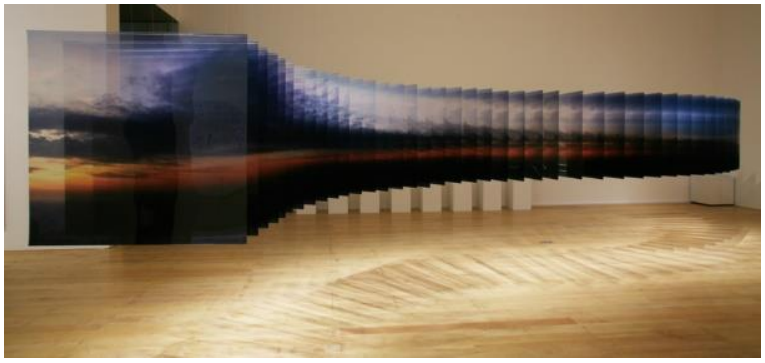


Figure 12, Noburu Nakashi, *Layer Drawing Sunrise*, 2007
inkjet print on film, acrylic plastic, 30 x 30 s 200 cm
installation view Mori Art Museum



Figure 13, Janet Laurence, *Forensic Sublime, no. 2*, 2011,
from Crimes Against Landscape, duraclear and oil on acrylic
and burnt wood
100 x 230 cm

6.4 Outcomes of surveying the field

These artists are asking the viewer to approach the experience of seeing in a different manner, using analogies which challenge the viewer to look with new eyes beyond the simply material, understanding that the space between becomes as important as the material. These sculptors have created works which are made up of components which come together to create a whole. They require an adjustment in vision and perception to comprehend, at one moment forming a recognisable object and the next collapsing into something undefinable. The process of engaging with sculpture which embodied quantum qualities brought an awareness of techniques and possibilities which could be employed in my own practice.

- Antony Gormley's sculpture demonstrates how the figure could be represented as energy and frequency, using thin steel manipulated into lines, almost like a drawing, which formed a minimalistic structure representing the human form. (fig. 3)
- Anish Kapoor uses his cultural heritage to advantage in creating representations of the void which evoke an elemental response in the viewer. His work expresses spiritual concerns whilst avoiding a descent into gimmick.
- Pierre Soulages painting (Fig. 2) creates a sculptural physicality through use of monochromatic, heavily textured surfaces which use light to define form.
- The use of individual components and thread to create the impression of a solid whole as in the sculpture of artists such as Lee Jaehyo (Fig. 3), Seon ghi Bahk (Fig. 6), Thomas Heatherwick.

- Julian Voss Andrea (Fig. 10) and subsequently artists such as Nobuhiro Nakanishi (Fig. 12) and Janet Lawrence (Fig. 13) provided a solution to the problem of pushing the two dimensional plane into the third dimension. By creating an image deconstructed onto several different layers the position of the viewer could disrupt the picture plane.

These conceptual, technical and procedural discoveries shaped the future direction of the studio research.

7. Methodology

For the purposes of this research project, I chose to use a practice based methodology combined with a content analysis of relevant scientific, religious and artistic texts. After a process of assimilation, a personal interpretation of the research material was amalgamated into a framework which allowed for the testing of ideas in a material form.

As a basis for enquiry, the question, "How can sculpture respond to the quantum mechanical theory of wave/ particle duality, in the context of the observer effect?" was developed and a series of aims and objectives set as concepts to be explored.

Aims:

- Identify scientific and philosophical texts which pertain to the Observer effect.
- Identify artists who are using scientific principles as inspiration for creative research.
- Create a body of sculptural work which embodies the qualities of quantum physics as identified by the artist, those of:
    - Wave/particle duality or the dot and the line
    - transparency
    - layering
    - light
    - concepts relating to Eastern mysticism
    - chaos or indeterminacy and spontaneity
    - the subjective view of the observer

Objectives:

- Create a new body of sculptural work which reflects the intention of the academic research.
- Test the sculptural artefacts by means of exhibiting the work in the public realm.

Specific methods:

- Studio experiments – testing various techniques for creating sculpture such as welding, wood carving, manipulation of Perspex and glass. Evaluation of methods for use on final artifacts. The experimentation was carried out in the studio environment.
- Use of tacit knowledge – the use of tacit (intuitive, felt) knowledge as an adjunct to knowledge gained by academic research.
- Emergent methodology - the researcher builds a conceptual framework for the area of study based on scientific theory, emergent design and focus-determined boundaries.
- The research artifacts are formulated using a combination of intuitive knowledge combined with academic texts and the evaluation of test results. [82]

[82] C Gray and J Malins, *Appropriate Research Methodologies for Artists, Designers & Craftspersons: Research as a Learning Process*, (Online publication of the Centre for Research in Art and Design, Grey's School of Art, Faculty of Design, Robert Gordon University, Aberdeen.< http://www2. rgu. ac. uk/criad/cgpapers/cc/cc. htm, 1995).

7.1 Role of the creative artefact.

Throughout the timeframe of the research project, considerable studio experimentation occurred. The development of the conceptual paradigm continuously evolved throughout the process, which was subsequently reflected during the testing of ideas in material form. As the engagement with research information progressed, my practice shifted from creating medium sized painted and cast glass sculpture to larger scale installations.

The creation of the artwork was characterised by periods of intense production interspersed with periods of reflection, critical discernment and evaluation of the aesthetic and conceptual relevance of each piece as it related to the research aims and objectives. Using an intuitive approach, continuous refinement was made within each work, which allowed for a deeper understanding of the subject through a tangible interaction with the materials.

The plasticity of various materials was evaluated to determine the best fit between material and concept. Alongside this came a technical learning curve associated with working with previously unexplored materials. Substantial periods were spent running experiments to solve technical difficulties involved with construction, presenting and exhibition of the sculpture.

This period of experimentation and playing with new materials to express ideas concerned with the research parameters proved to be equally if not more important to the academic research into the theories of quantum physics. As Picasso stated, “all works become researches”.[83] The act of creating the sculptures becomes a type of research in itself, promoting an understanding not only of the subject of study but of my own artistic direction.

[83] Miller, *Insights of Genius: Imagery and Creativity in Science and Art*.

7.2 Relationship of the practical outcomes to the research question.

The progressive creation of the artifacts mirrored the burgeoning understanding of the subject matter and how it might be used to create artwork which embodied the concepts of the observer effect. Initial research continued the theme of glass sculptures which had been created previous to the research project. These also dealt with the subject of quantum physics but in a more general way. As involvement with the academic texts deepened and an understanding of the focus of the work evolved, the sculpture developed both in concept and use of appropriate materiality.

Early works such as *Meditation on a pixelated paradise,* (fig. 17) were directly concerned with using the schemata of the wave and particle in the form of the dot and line. This sculpture was created using a series of square boxes, each component acting as a pixel or particle. The surface of the work was carved in a ripple design, reminiscent of the wave aspect of quantum physics. Texts by authors such as Rupert Sheldrake,[84] and Ervin Laszlo[85] with their insights into quantum physics and consciousness, in combination with metaphysical insights by David Bohm and Krishnamurti,[86] combined with Buddhist concepts of the many becoming one or Unity, provided the foundation of the *Ripple* series. Opinions presented in these texts, such as the quotation by Laszlo from Stuart Hameroff's paper, *Fundamentality*[87], where he concludes that "*at the leading edge of brain research, consciousness is seen as brain activity coupled to self-organizing ripples at a*

[84] Rupert Sheldrake, Terence McKenna, and Ralph Abraham, *Chaos, Creativity, and Cosmic Consciousness* (Inner Traditions/Bear & Co, 2001).
[85] Ervin Laszlo, *Connectivity Hypothesis, The: Foundations of an Integral Science of Quantum, Cosmos, Life, and Consciousness* (SUNY Press, 2010).
[86] Jiddu Krishnamurti and David Bohm, *The Ending of Time*, (1985).
[87] Stuart R Hameroff, *Funda-Mentality': Is the Conscious Mind Subtly Linked to a Basic Level of the Universe?,* Trends in Cognitive Sciences 2, no. 4 (1998).

fundamental level of physical reality",[88] exemplify concepts which lie at the core of this series.

After extended engagement with the research texts, the sculpture began to concentrate more on expressing qualities which had been identified as exemplifying quantum qualities. These included transparency, layering, randomness and viewer interaction. This involved processes such as layering of line work or etching on transparent media and warping Perspex layers to simulate waves, as well as using mirrors to reflect and contort the preceding images. Similar to those employed by Spriggs, (fig. 11) and Nakashi, (fig. 12) were used to create the impression of depth. In addition, Ramachandran's theories of the blind spot and visual perception[89] were brought into play, using mirrors to form an alternate image of the viewer themselves which had been distorted by overlying information.

Further experimentation using fibre optics as a medium exploited the quantum qualities of the wave/particle duality, (fibre optics being a material inherently connected with quantum physics),[90] with Ramachandran's theories on the brain completing missing areas of an image, combined with Gombrich's theories on the ambiguity of images. This was most clearly demonstrated in the work, *Swimming in a sea of potentiality* (fig. 36). The cognizance of the observer is crucial to the completion of the image through literally positioning the dots to create the image of the figure.

[88]Irving Laszlo, *Connectivity Hypothesis, The: Foundations of an Integral Science of Quantum, Cosmos, Life, and Consciousness*. p.48
[89] Ramachandran, *Filling in Gaps in Perception: Part I*.
[90] Özgür E Müstecaplioglu, *Quantum Entanglement in Optical Fiber*, Optics and Photonics News 19, no. 3 (2008).

7.3 Outcomes of the research process

As a result of engaging with the research process I was able to produce solutions which were innovative to my practice in response to the research question.

Objectives realised by the project were:

- Developed a vocabulary of techniques and forms which analogised the quantum qualities
- Developed an understanding of the presiding principles of quantum physics especially the observer effect
- Integrated the primary qualities such as transparency, popping in and out, subjective viewing, disappearance, randomness and scale into the sculptural work.
- Created a new series of artifacts which reflect the qualities of quantum physics.
- Identified and positioned myself in the contemporary sculptural community.
- Informed a personal paradigm supported by scientific theory.

As a direct result of this research project I created sculpture for four solo exhibitions with themes related to the research topic –

- 2016 *The Observer effect*, FutureSpace Gallery, The Science Exchange, RIAUS, South Australia[91]
- 2015 *Reality is an illusion, albeit a very persistent one*, Switchback Gallery, Victoria[92]
- 2013 *The invisible and the visible*, Murray Bridge Regional Gallery, South Australia[93]
- 2012 *Transitory illusions*, Brunswick Street Gallery, Victoria[94]

[91] http://riaus.org.au/art-exhibitions/the-observer-effect/
[92] https://federation.edu.au/faculties-and-schools/faculty-of-education-and-arts/switchback-gallery/past-exhibitions/2015/reality-is-an-illusion,-although-a-very-persistent-one
[93] http://murraybridgegallery.com.au/welcome/displayExhibition/131
[94] http://brunswickstreetgallery.squarespace.com/past-exhibitions/exhibitions-16-29-november/

During the research period I was able to engage with the International sculptural community, exhibiting work related to the research themes in exhibitions such as the Heysen Sculpture Biennial[95] and two consecutive Palmer Sculpture Biennials[96]. A fibre optical chandelier exploring the wave/ particle duality was exhibited in the KIGA, Kirra Illuminating Glass Awards, Victoria in 2015[97]. In a total the artifacts related to the research theme were tested in 15 group exhibitions during the project duration.[98]

In addition to exhibiting the sculptural artifacts, the research skills were applied to a range of other challenges. In 2015 I was awarded a $3000.00 mentorship by Guildhouse, South Australia, to investigate lighting techniques and motion detecting devices. This knowledge was utilized in the technical design of the Perspex wave sculptures.

In 2014 I was awarded a $25,000.00 public art commission by the City of Onkaparinga, for the Frank Hilton Reserve. Whilst the theme of the sculpture created did not directly engage with the themes of quantum physics, the sculpture, *Then and Now,*[99] did convey the theme of the convergence of systems in nature which was a key concept in this project. Skills developed during the research project were utilised during the creation of the work.

[95] See Appendix 3
[96] See Appendix 2
[97] See Appendix 4
[98] See Appendix 1 for C.V. details
[99] http://onkaparingacity.com/onka/discover/arts_culture/public_art.jsp

8. The artifacts – using the theory of wave/ particle duality as inspiration.

After immersing myself in the world of quantum physics, I deemed the construct of wave/particle duality reduced to the visual metaphor of the dot and the line offered possibilities which could be utilised within the sculptural medium.

Experimentation manipulating various mediums led to the creation of the “Ripple” series, large carved wooden wall sculptures. These heavily carved relief sculptures play with perceptions of space and shadow. They utilise light to exploit nuances created by the textural surface. Similar in intention to the semi relief mark making in the paintings of Soulages, (fig. 15). The variations in the surface capture reflected ambient light to draw lines on the surface, capturing a meditative experience, reminiscent of waves, ripples in water, and the ripples of conscious thought or ideas.

This sculpture searches for ways to express the internal light of human feeling and expression. With these works, like Anish Kapoor I examine impulses to explore connotations of the Eastern mysticism, but in contrast to Kapoor’s with its emphasis on death and nothingness, I endeavour to portray a meditative experience.

The Ripple series of sculptures uses wood as a medium. Timber has the ability to be formed, warped and carved to create wall sculpture which acts as a crossover between the disciplines of painting and sculpture. The wood is gouged and bent, using the interplay of light and shadow to create textural interest and form. These works were carved with soft indentations to give the impression of an interior space, the ripples of consciousness connecting and shifting. To achieve carved surfaces, I use a device called an Arbotech, which is an angle grinder converted with a high tensile blade for shaping wood. It is quite a perilous procedure and very physical. Use of the Arbotech allows for immediate mark making, the process of working becomes almost Zen-like. Complete immersion in the process promotes an intuitive approach, the final form of the

sculpture being guided by the physical act of interacting with the material.

Once the carving was completed, the sanding process was used as an alternative mark making technique, softening certain areas in contrast with raw more energetic marks. The sections were then hand rubbed with graphite, resulting in a smooth, velvet finish which reflected the light in a quasi-metallic manner highlighting the sculptural quality of the carved wooden relief.

The dark dramatic paintings of Pierre Soulages provide empathetic resonance with these sculptural wall works. Although the working method is vastly different, Soulages' practice being concerned with painting, the intention of the work is similar. The carved and rubbed graphite surface of the sculpture reflects the light in a similar manner to Soulages' gouged and paint worked surfaces. Whilst Soulages employs the use of a monochromatic black palette (fig. 2), I have chosen to use the softer metallic grey of graphite to give a warmer, less aggressive appearance.

The large homologous expanses employ the play of light to define the surface, encouraging the viewer to spend a few moments contemplating matters beyond the ken of the ordinary world.

The first two works created in the series, *Meditation on a pixelated Paradise* (fig. 17) and *Exaggerated persistence of memory* (fig. 16) use the schemata of the dot and the line to reference wave/ particle duality, subsequent works such as *Come to a land you will never forget,* (fig. 21, 22, 23) and *Alternating states of attention*, (fig. 19, 20) depict the waveform twisting and undulating, presenting surfaces able to be viewed at various angles from different perspectives.



Figure 14, Pierre Soulages, *Peintures* 2013 -2015, detail

The textural and sculptural quality of the mark making of the painting surface, and the way the light reflects to enhance this can be seen in this



Figure 15, L. Wedding-Marchioro, *The luminferous ether,* 2012

Carved MDF, wood, polymer paint

1600 x 1800 x 90

The influence of Solauges mark making techniques can be seen here evidenced in the carving of the surface. Flashes of colour appear on the edges of the sculpture, referencing quantum particles popping in and out of reality.



Figure 16, L. Wedding-Marchioro, *Exaggerated persistence of memory*, 2011

Carved MDF, wood, graphite, 1600 x 1600 x 90



Figure 17, L. Wedding-Marchioro, Meditation on a pixelated paradise, 2011
Carved MDF, wood, graphite, 1600 x 1600 x 90

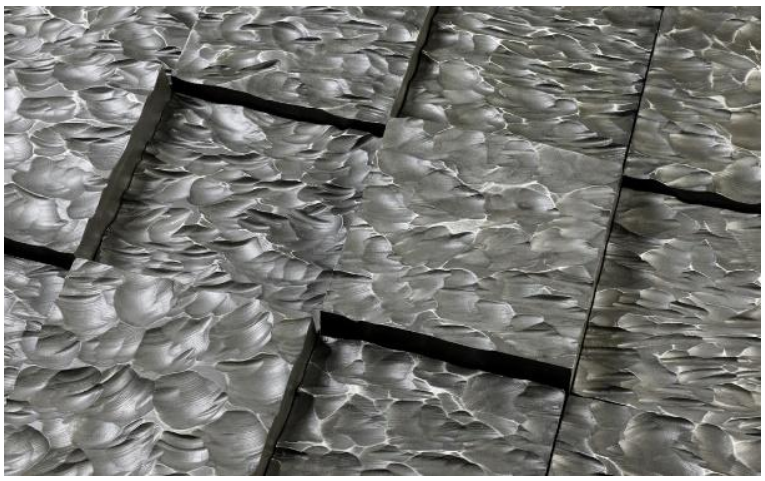


Figure 18, L. Wedding-Marchioro, Meditation *on a pixelated paradise*, detail

Whilst the initial sculptures used a monochromatically graphite palette, as the production of the artifacts progressed, flashes of colour were inserted, in reference to the quantum property of particles flashing in and out of our reality. Salvador Dali's painting, *Galatea of the spheres,* (fig. 1) uses a similar device when he paints the figure deconstructed within a series of dots or spheres popping into space.

Figures (21, 22, 23) illustrate the effect of ambient light on the reading of the work. Texture is revealed in the contours and shadows, the slash of vivid red applied to the outer surfaces of the work defines the curvature of the work, creating a glow of colour which reflects on the surface of the wall behind. *Come to a land you will never forget* references the rolling expanse of interior thought, undulating through the landscape of the mind.

Using a similar technique, the sculpture, *Alternating states of attention*, (fig. 19, 20) makes reference to the presence of rolling waves, created from the memory of a seascape. The sinuous curves are enhanced by carved rhythmic marks interspersed with areas of relative emptiness. Reflected light creates deep areas of shade and light, highlighting the effect of the deep blues and contrasting ochre.

Colour has also been used as a contrasting element in the sculpture, *The Luminiferous ether,* (fig.15). Slices of colour appear at random intervals, referencing the erratic nature of quantum particles appearing in space. Once again the concept of the particle is used to create elements which rise and fall in connection with each other, referencing the random nature of quantum particles popping in and out of space. This work reads as a landscape, contrasting stronger, emphatic lines on the upper section with lighter, rhythmic carved lines.

On completion of the *Ripple* series, time was taken to reflect on the success of the work in regards to its expression of the qualities of wave/particle duality.

- The concept of creating the work as a conglomerate of components was effective in that each unit acted as a metaphor for a quantum particle. It also allowed for a height variation

within each component which furthered the illusion of space. This technique made construction and transportation of the sculpture less demanding.

- The carving technique created textures which simulated the effect of ripples. In addition, the use of a mainly monochromatic palette allowed for light to activate the surface.

The Ripple series was a decisive advancement toward creating sculpture which embodied quantum characteristics. On reflection, the concept of creating various levels of engagement and the reflection of light were the developments which I identified as innovations to be investigated further.



Figure 19. L. Wedding-Marchioro, *Alternating states of attention,* 2012 detail



Figure 20, L. Wedding-Marchioro, Alternating states of attention, 2012

Carved and bent plywood, MDF, wood, graphite, polymer paint

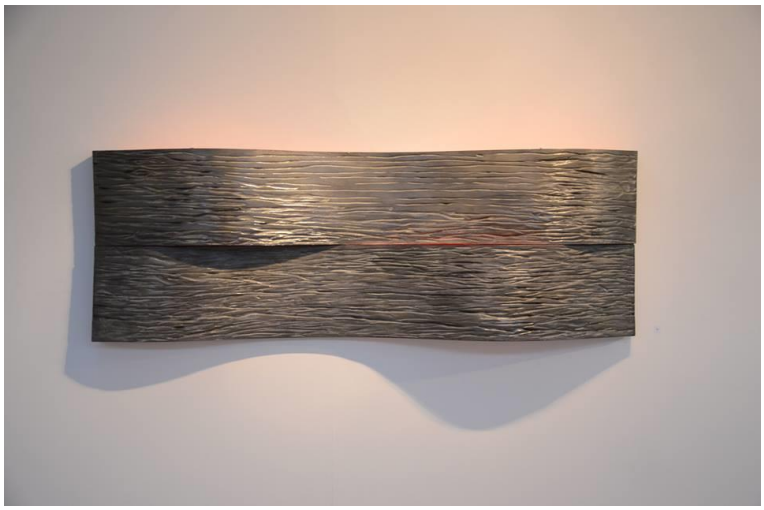


Figure 21, L. Wedding-Marchioro, *Come to a land you will never forget*, 2012



Figure 22, L. Wedding-Marchioro, *Come to a land you will never forget*, 2012



Figure 23, L. Wedding-Marchioro, *Come to a land you will never forget*, 2012

Carved and bent plywood, MDF, graphite, polymer paint

2300 x 900 x 150

8.1 Creating sculpture to convey a sense of the Observer effect.

During the early period of the research project I was involved in a discussion with a friend when the question arose, “If a tree falls in the forest will it make a sound if there is no one there to hear it?” Of course we have all heard this one so many times, but it really started me thinking, does it? This philosophical musing about the role of the observer became the basis for the creation of one of the first sculptures in this series, *Transitory Illusions.*

Elements of Dali’s conceptual device of creating images within images, as in Figure 1, had been used in my early research works. In works such as *Transitory Illusions*, (fig. 24) the image has been deconstructed into 5 layers which, when viewed from a particular angle constitute the image. Then as the viewer moves around the work the image deconstructs, only being read as complete from a single viewpoint. A juxtaposition of narrative is at play within the imagery appearing not only as a treescape but as a neurological scan, requiring a shift of focus on the part of the viewer. Other works created at this time such as *Synapse: Convergence of nature,* (fig. 25*)* and *Looking not seeing*, (fig. 26) explore these themes of a similarity between systems in nature.

I had been impressed with Voss-Andreae’s, *Quantum Man*, (fig. 10) a construction of the human form created as much by the layering of material as by the alternate negative space, similar in form to an MRI scan. Voss-Andreae’s technique was innovative but upon reflection I concluded using transparent layers would add to the feeling of insubstantiality. These layers translate as the wave function of quantum physics. In the sculpture, the image is constructed of built up layers used to create the illusion of depth. When viewed from alternative angles the image begins to disappear and distort. With this work I felt I begin to more fully engage with subjective viewer experience.



Figure 24, L. Wedding-Marchioro, *Transitory illusions*, 2012
painted and kiln formed glass, glass enamels, pate de verre, granite

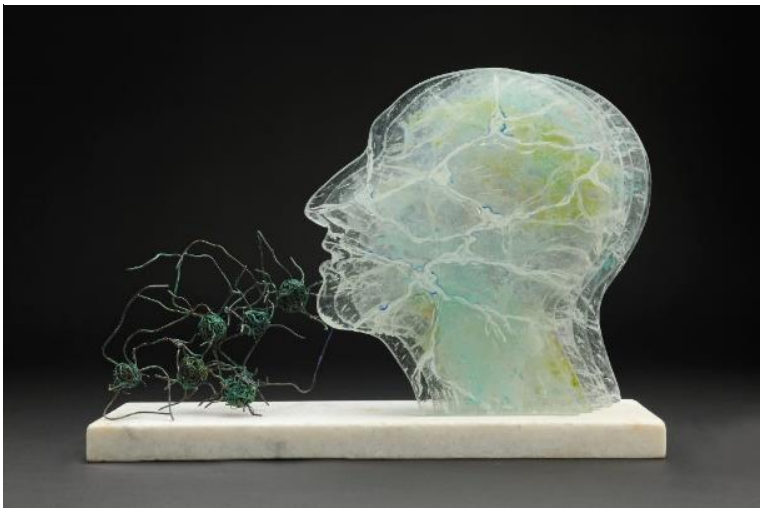


Figure 25, L. Wedding-Marchioro, *Synapse - Convergence of nature,* 2012
painted, and kiln formed glass, glass enamels, copper, marble



Figure 26, L. Wedding-Marchioro, *Looking not seeing,* 2012
painted and kiln formed glass, glass enamels, carved wood

Whilst the use of glass as a material enabled transparent and plastic properties, when deciding to increase the scale of the work, I chose to use Perspex due to issues with weight and ease of working. Working with glass requires firing cycles of up to twenty four hours using complex plaster/ silica molds, whereas manipulating the Perspex required a firing cycle of only one hour. To create undulations in the material, I used branches collected in my paddock as structures over which to slump[100] the perspex.

Reflecting on the *Ripple* series I realised that the conveyance and reflection of light played a significant role in the reading of the sculpture, equal to the manipulation of surface texture and the utilization of multiple levels. As with the glass pieces, I used various layers of Perspex to build up the image, engraving the surface with images of tree branches silhouetted against the sky and wave foam created from the bow of a ship at sea, (see fig.35).

These works use images derived from photographs which look up through winter branches, towards the clear expanse of the sky, (see fig. 28) and white foam swirling through the backwash of waves created by an ocean liner (fig. 30). The work comments on the similarity of the images to neurological images of the neurons and dendrites in the brain, and MRI imagery (fig. 27). The sculptures invite the viewer to make decisions about the work, to ask what are they seeing? Is it a tree branch or are they descriptions of the workings of the brain? In a similar manner to Gombrich's infamous duck/rabbit (fig.31) [101] illustration, the images switch between pictorial representations. [102] These photographs were manipulated in Photoshop then projected onto a large sheet of paper for use as a cartoon. Partial sections of the image were engraved onto each sheet

[100] Slump or bend the material at temperature of 100 degrees in a kiln.
[101] Gombrich et al., *Art and Illusion: A Study in the Psychology of Pictorial Representation*, 5. pg. 5
[102] See image - rabbit /duck (fig. 31)
http://www.news.com.au/technology/online/social/can-you-see-a-duck-or-rabbit-apparently-this-optical-illusion-says-a-lot-about-your-creativity/news-story/c9682010642308d0c4c528ca10f152e4

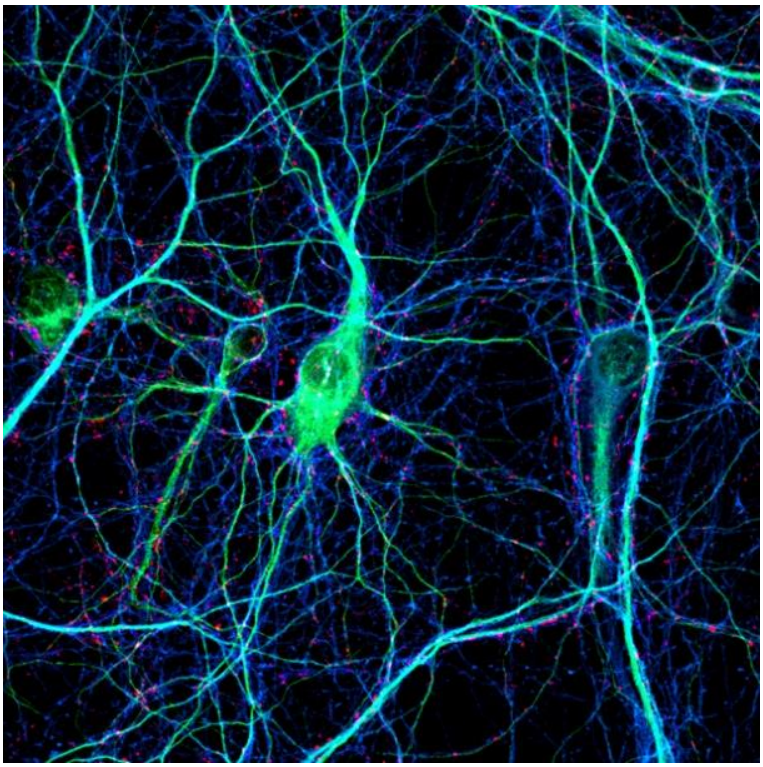


Figure 27, Image of neurons cultured in a Petri dish.

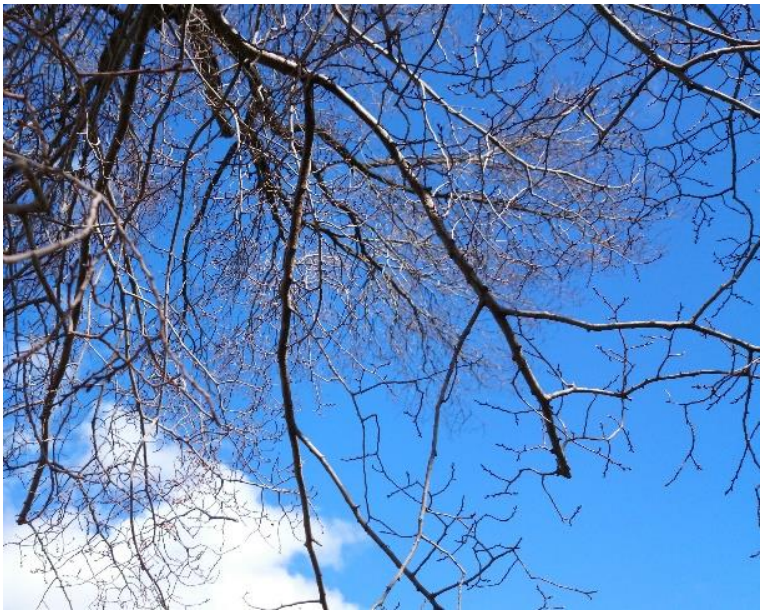


Figure 28, L. Wedding-Marchioro, photograph of winter branches, 2014

Source image for works such as Kalopsia and Metonymy

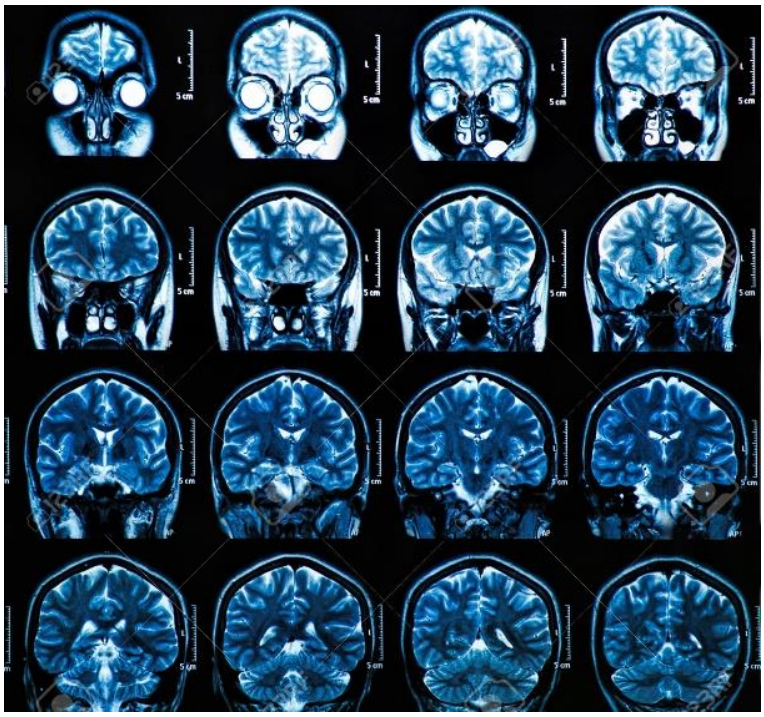


Figure 29, MRI scan of the human brain



Figure 30, L. Wedding-Marchioro, photograph of ocean swell taken from the bow of a large ship. 2014 This was the source image for the sculpture *Implicate Order*.

so that when they were viewed they created a three dimensional image.

The layers were painted with transparent inks on the reverse side, placed at random intervals as a reference to quantum particles emerging into space. Using a similar technique to David Spriggs (fig. 11) and Janet Lawrence (fig. 13), layers of information and stories are overlayed, juxtaposed to create intricate combinations to be interpreted by the viewer.

Behind the layers of images a sheet of mirror was placed to intensify the colour and create depth. The mirror also created an alternate image upon a change of focus, the viewer finding their own image reflected, becoming enmeshed as part of the work. Ramachandran's research on gaps in perception has been utilised as a key element in the creation of this work to embody the essential[103] qualities of quantum physics, the colour was applied in a considered but somewhat chaotic manner. According to many physicists, chaos lies at the core of the Universe, Darwin famously commenting that randomness was *the* fact of nature.[104]

In order to accentuate the presence of random occurrences, the surface of the Perspex was undulated by forming it in a kiln. Ambient light then reflected off the surface, the reflections created changing in relation to the viewers' position. LEDs placed above the work illuminated the layers of colour, creating a juxtaposition which resulted in the formation of new colours and textures.

In considering the presentation of the sculptures, initially they had been presented in a solid frame surrounded with LEDs but this presentation seemed too heavy, opposing the intention of producing sculpture ethereal in nature. Eventually the layers were suspended in a frame with the LEDs only on the top. This was a more satisfactory arrangement as the works appeared more delicate with the undulating surface of the Perspex giving the illusion of floating in space. In this

[103] *Essential,* in terms of my personal definition for the project. Those of the wave/ particle, randomness/chaos, spontaneity/fun, quirkiness, the void or numina, the sublime (according to Kant's definition).
[104] *Proust was a neuroscientist* p. 35

way the works appeared more ethereal, less constrained by cumbersome boundaries.

My experiments with light in the sculpture brought an awareness of how light could change the nature of the sculpture. For a time I concentrated my research on lighting application, educating myself on the technologies and testing many possibilities, including EL wire, LEDs, Neon strips and fibre optics.

After considerable investigation into these various lighting options, I decided to use fibre optics for a variety of reasons. Research indicates that information sent through fibre optics has affinity with quantum entanglement.[105] The construction technique developed to create the sculpture with fibre optics lent itself to the depiction of quantum concepts[106], the strands being able to be read as waves and the beads as particles.

It was necessary to experiment with different optical fibres. The sparkle fibre used on the initial sculpture is impregnated with small cuts to provide the sparkle effect but these promoted brittleness and snapping of the fibres when transported. I eventually decided to use a solid 1.5mm fibre which was strong enough to hold the weight of the beads and provided a good lumen level. Significant experimentation was also conducted to develop the best configuration for the beads. These were all handmade by slumping crystal glass in the kiln at a temperature of 800 degrees, using piano wire to create voids for the optical fibre to pass through.

Several problems associated with the construction of the sculptures had to be overcome. After creating a full scale drawing of the form, it was cut out and placed centrally amongst the hung fibres. I then three dimensionally mapped the form on the hung fibre using plasticine, which was systematically removed and replaced with the crystal beads to create the illusion of the human form. A pulley system was constructed in the studio to assist in the raising and lowering of the structure for ease of working.

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[105] Müstecaplioglu, *Quantum Entanglement in Optical Fiber.*
[106] See page 39

The piece selected to exhibit in the final exhibition, *Swimming in a Sea of potentiality*, (fig. 36) uses the device of the wave and particle to create the human form. As in quantum theory the particles which make up the form are separated by the surrounding space, the beads creating the impression of vibrating energy which holds the particles together. The image is created only in the mind of the viewer, in reality being only a collection of points of light. A similar effect is found in Antony Gormley's *Quantum Void VIII* (fig. 3). The artist produces figures which are seemingly created from a simulacra of swirling creative energy, the materiality of form created by the viewer's perception.

The sculpture *Swimming in a Sea of potentiality,* once again makes use of Ramachandran's theories of the brain[107] and its ability to compensate for the loss of visual information due to the blind spot in the eye. The human figure represented in the sculpture is presented with minimal visual information requiring the viewer to perceive the image of the figure by the use of modal completion.[108] On initial viewing the figure appears as a collection of randomly placed particles and it is only upon closer attention that the human form appears.

The appearance of the figure has a direct correlation to Gombrich's infamous rabbit/duck illustration (fig. 31). Which challenges the way the brain perceives visual information. Once the viewer is able to recognise the figure they find it difficult to see the sculpture as purely a set of dots and lines. This has relevance to the way we view the world around us. Once we have been trained as children to conform to the collective consciousness, could it be that we are never able to see reality as it really is? An environment made up of swirling energies, popping in and out of existence.

I felt this sculpture was a successful result of the research process, as it clearly embodied elements from the theory of quantum physics such as wave/ particle duality and used materials which have been associated

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[107] Ramachandran, *Filling in Gaps in Perception: Part I*.

[108] i.e., the object will have illusory contours as boundaries - Thomas F Shipley and Philip J Kellman, *Perception of Partly Occluded Objects and Illusory Figures: Evidence for an Identity Hypothesis,* Journal of Experimental Psychology: Human Perception and Performance 18, no. 1 (1992). p. 107

with quantum physics. The theory of the observer effect was also apparent in the contradictory interpretation of the work by requiring a change in focus and awareness to perceive the artists intention.

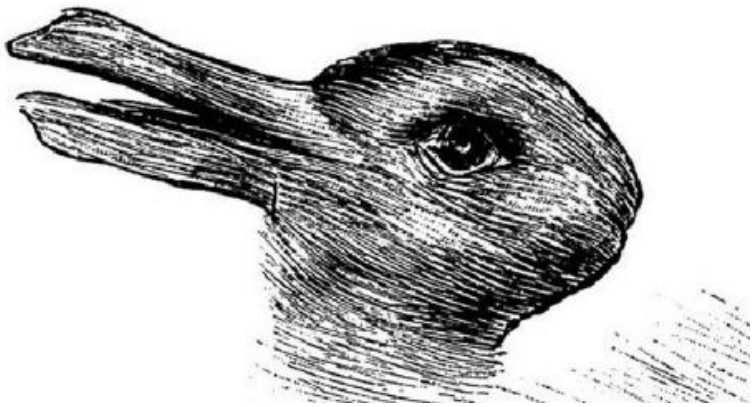


Figure 31, The duck-rabbit drawing was first used by American psychologist Joseph Jastrow in 1899 to make the point that perception is not only what one sees but also a mental activity.

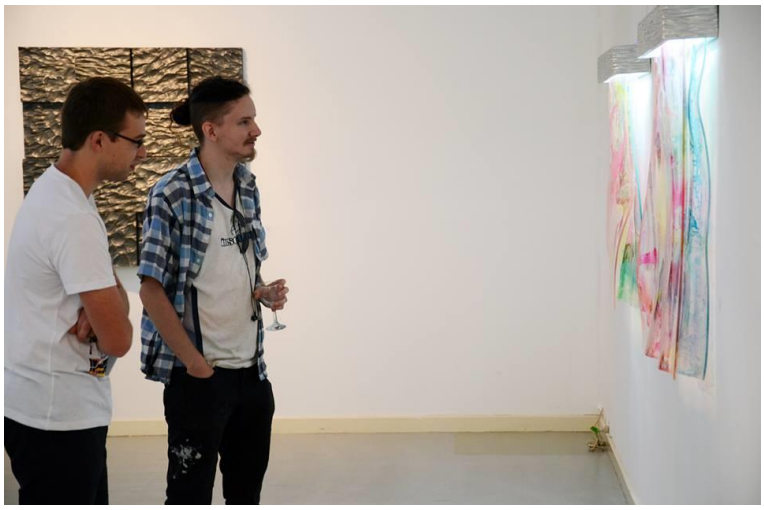


Figure 32, installation view of the sculptures *Kalopsia* and *Metonymy,* showing the undulating surface of the Perspex sheets.

Photograph: Neale Stratford



Figure 33, L. Wedding-Marchioro, *Metonymy*, 2015

Perspex, LEDS, Permanent inks, wood
1000 x 1000 x 90

Photograph: Neale Stratford



Figure 34, L. Wedding-Marchioro, *Kalopsia*, 2015
Perspex, LEDS, Permanent inks, wood
1000 x 1000 x 90

Photograph: Neale Stratford



Figure 35, L. Wedding-Marchioro, *Implicate order,* detail 2015

Perspex, LEDS, Permanent inks, wood 100 x 100 x 90

The scratched engraving on the surface read almost like small graffiti.

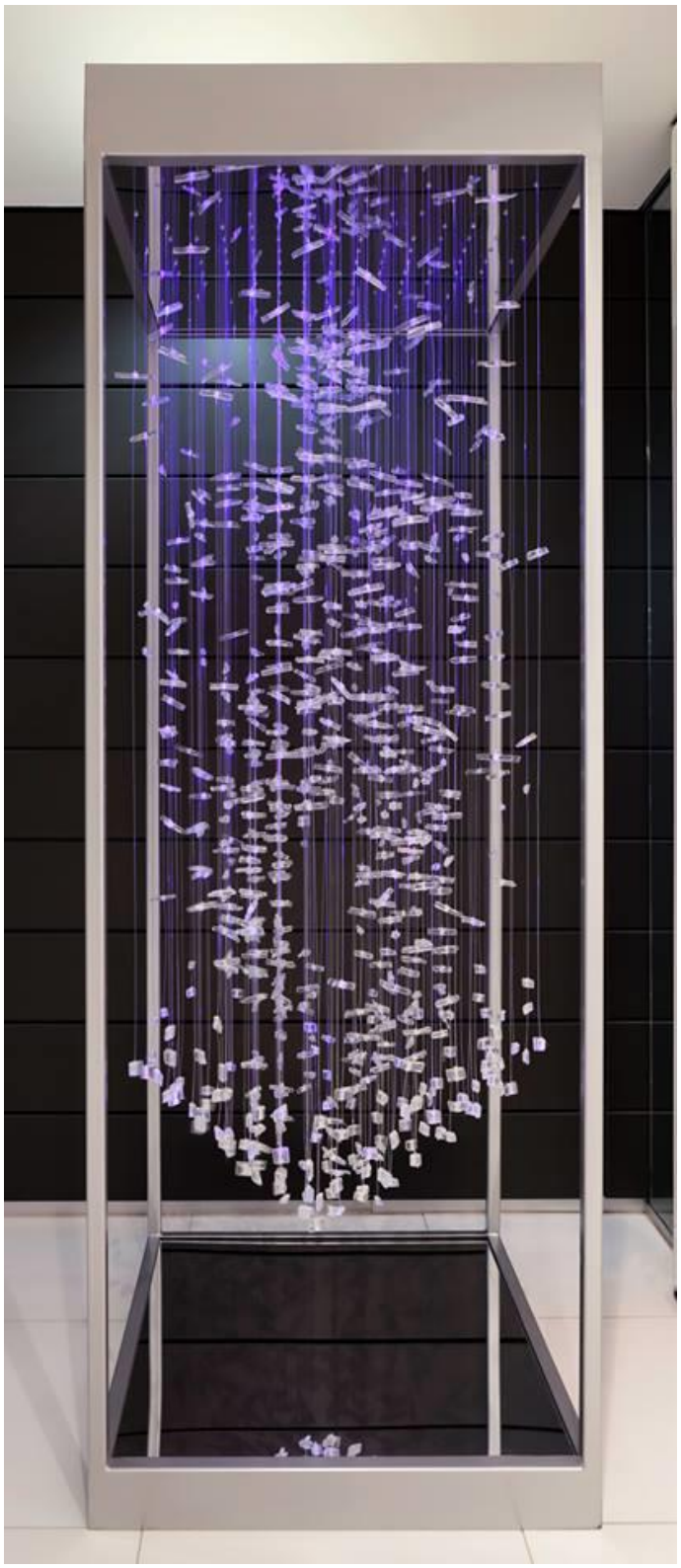


Figure 36, Lorry Wedding-Marchioro, *Swimming in a sea of potentiality*, 2015 Fibre optics, LEDs, glass, mirror, steel 2400 x 700 x 700

9. Reflections on the research project

The process of conducting this research wound its way on a serpentine path through Eastern mysticism, quantum physics and questions of consciousness and perception. The result has been an embodiment of these ideas which provides a foundation for my sculptural practice. One theme which has prominently emerged from the research was that of Unity or the many becoming One, which is a key tenet of Buddhist philosophy and an underlying principle of modern physics.

The main research theme, the quantum theory of the Observer Effect was approached with the intention of becoming aware of aspects of reality which lie beyond the realm of normal vision. Questions regarding how we all understand our perception of the world in similar ways may be answered by Carl Jung's theories on Collective Consciousness and Rupert Sheldrake's theories of Morphic Resonance. Flocking movement exhibited by animals may duplicate a Universal programming of the brain which is connected through a Unified field. Similar is the idea of the conscious observer participating in the creation of their reality. Early quantum physicists such as Neils Bohr and Werner Heisenberg and their concept of the holistic Universe support this.

A personal interpretation of the research theories was applied in both the conceptual and the physical formulation of the sculptural artifacts. The question - *How can sculpture respond to the quantum mechanical theory of wave/ particle duality, in the context of the observer effect?* was examined initially through the identification of artists whose artistic practices interrogate Art/Science connections.

Several artistic and technical discoveries made during this process proved to be influential to the outcome of the research artifacts. The simplification of the theory of wave/ particle duality into the metaphor of the dot and the line was a device continuously employed in the studio practice. Similarly, using the plastic properties of the material to create 3 dimensional ripples within the work, sometimes carved, at others heat formed in a kiln, referenced the wave nature of quantum

physics. The use of components, echoing the particle nature of reality was also a technique which was exploited with many interpretations.

Characteristics such as transparency, layering and juxtaposition of colour and line, were used to embody the qualities identified as quantum properties to be used within the sculpture. These included light, an ambience of mysticism or the sublime, chaos or indeterminacy, spontaneity and the engagement of the subjective view of the observer.

Engagement with academic texts on perception and consciousness brought to notice the theories of Edme Mariotte and Vilayanur Ramachandran, the blind spot and the brain's ability to fill in the blank spots of vision. These theories led to experiments with deconstructing images which could be seen either as views from the natural world or synapses and Dendrons in the brain. Experiments with etching fragments of information upon several layers of Perspex to build up an image, in works such at *Metonymy* (fig. 33) and *Kalopsia* (fig. 34) widened my range of imagery in relation to my theme. I considered the effect a viewer's preconceived ideas as affected by their cultural conditioning and the way they view the world might alter how the work is read. I worked with contriving the physical positioning of the viewer in relation to the sculpture to control the ability to understand the content of the image. These mechanisms drew on the findings of Art historians Alois Regal and Ernst Gombrich with their idea of the beholder's share,[109] also echoed by Heisenberg's *Uncertainty Principle,*[110] which states that it is the observer whose interaction collapses quantum particles into a state of reality.

These ideas were further tested by studio experiments using fibre optics and glass components to create figurative sculptures which at

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[109]Eric Kandel, *The Age of Insight: The Quest to Understand the Unconscious in Art, Mind, and Brain, from Vienna 1900 to the Present* (Random House, 2012).

[110]Heisenberg's Uncertainty Principle or The observer effect - According to quantum mechanics, the more precisely the position (momentum) of a particle is given, the less precisely can one say what its momentum (position) is.
Jan Hilgevoord and Jos Uffink, *The Uncertainty Principle,* The Stanford Encyclopedia of Philosophy Spring 2014.

first seemed to be an abstracted collection of points of light, but upon further observation, constitute an image of a figure. As in the duck/rabbit illustration (fig. 31), once the figure had been seen it was difficult to go back to seeing only a collection of dots. The most successful of these works was *Swimming in a sea of potentiality* (fig. 36).

9.1 Implications of findings

As an ongoing *process*, the artifacts created for this project form but a beginning. As a contribution to the conversation on our understanding of reality and the observer's effect in its creation, the research has had some success in creating discussion and interest in the subject through the exhibitions staged to present the work. I have had positive feedback and interest in the conceptual paradigm and the resulting sculpture from exhibition goers and the online community. Organisations such as RIAUS, The Science Institute have collaborated in the presentation of the research findings and attracted an interested scientific audience.

An original contribution to the field has occurred through the information being filtered through a personal interpretation of the research material. The sculptural findings became a way of transmitting my experience of perceiving the nature of reality to the viewer. By interpreting these ideas in a visual manner the observer of the sculpture is offered a new understanding of the concepts which may act as a catalyst for contemplation of their own place in the world.

As Jon Rubin commented, "Because what takes more fantastical imagination than being able to project yourself into someone else's experience. And as artists we don't do this for ourselves, we seduce the public to take the path toward others, towards ways of seeing that are not our own".[111]

[111] **Jon Rubin,** artist and founder of *Conflict Kitchen, at the Columbus College of Art and Design,* Artnet News,

9.2 Limitations of the research

As is natural for a research project of this nature, limitations restricted the scope of the thesis. The subject chosen is vast in all its possibilities and this project could only offer an overview, compared to the range of depth possible. The temptation to follow tangents resulting from the research process was sometimes difficult to resist, but I overcame this desire by creating a file containing all concepts of interest to be investigated at a later date. Similarly within the studio exploration, many techniques and possibilities for creating sculpture were explored in some depth but it will take time to fully expand these leads to their fullest potential.

Financial resources were also another limitation. Whilst the subject was explored in many connotations the possibility of creating large immersive installations inspired by artists such as Lee Jaehyo, Seon ghi Bahk and Jacob Hashimoto was precluded due to space and material costs. The sculpture produced within the timeframe of the research project formed a strong beginning to research which will continue within my future sculptural practice.

9.3 Future Developments

I embarked upon this research to provide my sculptural practice with a strong theoretical and conceptual foundation. I believe I achieved my objective in this, and have found a subject which will inform my sculptural practice into the future.

One of the results of the research into perception and the observer effect was the idea of light as a metaphor for consciousness. This avenue was not able to be fully explored due to time limitations, but it will form the direction for future studio practice. The LimberUp

https://news.artnet.com/art-world/advice-for-artists-from-2016-commencement-speeches-509483, 10.06.2016

mentorship[112] (see Appendix 3) gave me confidence to begin working with light and motion sensing technology, which was evidenced in the later studio experiments. This direction will be followed combining Arduino computer enhanced technology with large scale suspended installation which responds to the presence of the observer. Negotiations towards this project have already begun.

The knowledge gained has opened up ideas and possibilities and connections which would not have occurred without the research. The road the research took allowed for insights that expanded my understanding of the nature of reality and how the observer may affect their part in it. The sculptural implications of this research have only just begun to be explored. Now comes the task to deepen and refine what has been begun.

9.4 Conclusion

Upon detailed and intense reflection on the theory of the observer effect, I realised that we all have a unique vision and way of seeing things, each person's thoughts and experiences modifying the reality in which we exist, in a way no other will be able to fully comprehend. No one will ever be able to see what I see, which serves to confirm the assumption that we do indeed create our own reality. The research began as a search to justify the scientific basis of a somewhat esoteric personal paradigm and concluded in a deeper understanding of the here and now.

This research project has helped clarify what it is I am trying to communicate with my sculptural practice - a sense that things are more than what they seem. There is a convergence of the appearance of things and it is how we view them that makes them read a certain way. The research has not come up with any proofs or solutions in terms of

[112] Guildhouse, LimberUp mentorship 2015
https://guildhouse.org.au/projects/limber/

science but it has made me better understand my place and view of the world.

In the end the studio research became about discovering techniques and methods to exploit light and transparency in an effort to emulate the qualities I admire in quantum theory.

Some may say artists can never understand the complexities of scientific theories, but I believe this is not the issue at stake. Like scientists, artists are trying to gain an understanding of the world they live in. Using the research of creatives from another field offers artists possibilities to expand their thinking in ways they may never have imagined. Whether or not what they make is a true representation of the theory in which they are interested is irrelevant, the important thing is that their viewer in turn is offered the same possibility of expanding and extending their thoughts to new possibilities.

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Appendix 1

Lorry Wedding-Marchioro – C.V.

Education

2011-16 Masters in Fine Arts, candidate, Monash University, specialisation sculpture
2011 Certificate 4 Training and Assessment, TAFE
2007-09 Masters in Visual Arts, specialisation sculpture, University of South Australia
2006 Certificate 4 in Digital Media, TAFE
1993 Associate Diploma, University of South Australia, major in glass

Commissions and Grants

2015 **Limber Up**, Guildhouse mentorship grant
2014 **Then and Now**, Frank Hilton Reserve, S.A. Public Art sculpture.
2014 **Mansfield ART GLASS Exposition, finalist,** Highly Commended
2000 **Jam Factory Contemporary Art and Design**, Adelaide. Commission
1997 **Arts South Australia**, Arts Development Project Grant.
1996 **Crown Casino, Melbourne**, Australia commission - series of 90 glass artworks.
1992 **Pat Corrigan Artists grant**
1992 **Centennial Park Cemetery** Authority – commission of series of glass wall panels

Exhibitions – Solo

2016 ***The Observer effect***, FutureSpace Gallery, The Science Exchange, Riaus, Adelaide
2015 ***Reality is an illusion, albeit a very persistent one*****,** Switchback Gallery, Vic.
2013 ***The Invisible and the Visible*****,** Murray Bridge Regional Gallery
2012 ***Transitory Illusions***, Brunswick Street Gallery, N.S.W.
2010 ***Can you see what I see?*** Juxtapose Studios, Adelaide
2001 ***Telling Stories****,* BMGArt, Adelaide

Selected Group exhibitions

2016 ***Palmer Sculpture Biennial***, Palmer, South Australia
2016 ***Heysen Sculpture Biennial***, The Cedars, Adelaide
2015 ***KIGA, Kirra Illuminating Glass Awards***, finalist, Kirra Galleries, Victoria
2015 ***Illuminations*****,** Ausglass conference, Worth Gallery, Adelaide
2014 ***Journeys*****,** Light Square Gallery, Adelaide
2014 ***Mansfield ART GLASS Exposition*** **– MAGE 2014,** Vic.
2014 ***Narratives*****,** Kirra Gallery, Melbourne, Vic.
2014 ***Palmer Sculpture Biennial*****,** Adelaide
2013 ***Ruby Ruby*****,** celebrating 40 years of the Jam Factory, Hahndorf Academy Gallery
2013 ***Ensemble***, Ausglass members show, Wagga Wagga
2012 ***Wishlist****,* CraftSouth Gallery, Adelaide
2011 ***Bright Sparks,*** Murray Bridge Regional Gallery, S.A.
2011 ***Objectify, object-deny,*** Glass Artists Gallery, Glebe, Sydney
2008 ***Mitosis***, University of South Australia
2005 ***Incandescence***, Nexus Cabaret Space, Adelaide
2003 ***Flights of Fancy,*** Adelaide Central Gallery
2001 ***Glass State 2001***, Jam Factory Contemporary Craft and Design, South Australia
2000 ***Sand + Fire = Glass***, Aptos Cruz Galleries, Adelaide
1999 ***RFC (Ranamok Glass Prize)*** Volvo Gallery Sydney, Brisbane, Perth, Canberra
1999 **Selected Studio Artists**, Glass Artists Gallery, Glebe, Sydney
1998 ***Du-a-lete***, Joint show Glass Artists Gallery, Glebe, Sydney
1996 ***Gerry King and Graduates- Contemporary Australian Studio Glass*** - Brisbane, Sydney, Wagga Wagga, Hobart, Melbourne, Adelaide, Hamburg, Germany
1995 ***Australian Glass***, Quo Quo Convention Centre, Hong Kong

Selected Publications

Artlink – Art Land, Volume 36
Art Edit – Issue 07, p. 30 – 32
Craft Arts International – no. 94, p. 11
Craft Arts International – no. 88, p. 112
Craft Arts International – no. 48, p. 91
Craft Arts International – no. 41, p. 98
Craft Arts International – no. 37, p. 102
Artlink - Thinking Wholesale, Volume 14, no. 2

Appendix 2

Palmer Sculpture Biennial



Figure 37 -Lorry Wedding-Marchioro, *Trig Point Ascension*, 2014
Steel, copper, wire, wood
2060mm x 450mm x 500mm
Exhibited at Palmer Sculpture Biennial 2014
Photograph: L. Wedding-Marchioro

Trig Point Ascension was the first outdoor artwork I had constructed. It was comprised of hundreds of small copper whirlygigs which spun in the constant winds found upon the highest point of the Palmer landscape. Referencing the wave/particle nature of quantum physics, the components represented the swirling of frequency which is thought to make up the material world in Eastern mystical philosophy. Appearing as random elements, upon concentrated attention the form of a human appears.



Figure 38- Lorry Wedding-Marchioro, *Entanglement*,
Steel, enamel paint, 2300mm x 2600mm x 700mm
Exhibited at Palmer Sculpture Biennial 2016
Photograph: L. Wedding-Marchioro

The sculpture *Entanglement*, (fig. 38) references the quantum concept of entanglement, the theory that everything in the Universe is connected and acts is response to one another. This work was exhibited in the Palmer Sculpture Biennial in 2016.

Appendix 3

Heysen Sculpture Biennial 2016



Figure 39, Lorry Wedding-Marchioro, *Touch*, 2016
Steel, Perspex, motion controlled LEDs, Arduino, solar panels
2 x pieces, 2600mm x 1300mm x 120mm
created in collaboration with software designer Dave Christopher
Photograph: L. Wedding-Marchioro

The sculpture Touch (fig. 39) was created as a direct result of the research into the observer effect. This sculpture was an interactive installation which had sound and lighting reactions which were triggered by motion detecting devices. The intent of the piece was to create a play response in the viewer and as such proved to be very successful.

Appendix 4

Kirra Galleries – KIGA illuminated Art Awards 2016

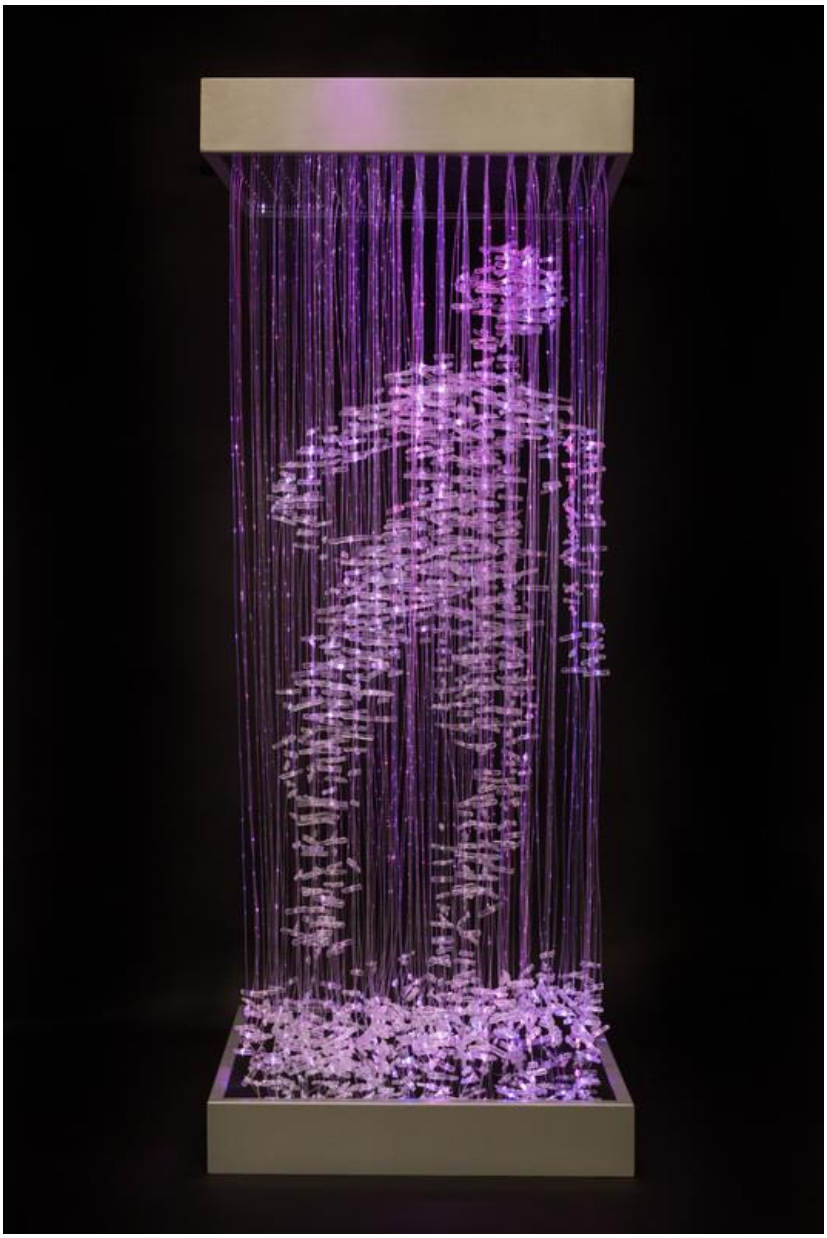


Figure 40 Lorry Wedding-Marchioro, *Letting go,* 2016
Fibre optics, glass, LEDs, mirror, steel 2400 x 810 x 910
Photograph: Denis Smith

The sculpture, *Letting Go* (fig. 40) was a continuation of the series begun with *Swimming in a sea of potentiality*, (fig. 36). Once again inspired by wave/particle duality and Ramachandran's theory of the pop out the work depicts the figure created from particles vibrating in space.