

Choreographing Time: Developing a System of Screen-less Animation

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DECLARATION

I hereby declare that except where explicit attribution is made, the work presented in the thesis is entirely my own, including all diagrams and pictures.

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ABSTRACT

The *Diasynchronoscope* is an experimental medium that draws on tropes from animation, film and Gestalt grouping principles to create the perception of screen-less apparent motion. Each developing artwork reveals more formalisms and boundaries inherent to the medium. Through documentation and discussion of selected artistic case studies this research interrogates the *Diasynchronoscope* as an emergent new medium. Formalisms are developed through studio practice and tested in exhibited artworks. The results of these evolving interactions are observed and contextualised using existing frameworks from Film Studies and Psychology.

Inside the *Diasynchronoscope* static objects are grouped according to Gestalt laws and animation principles to create sequential visual cues that, when lit with projected light, demand selective attention; thus creating the illusion of animated movement. The animation is immersive, sharing the same space as the observer so that they perceive a continuous flow of movement that resembles, at a physiological level, interaction with a real-life moving object. The technique has been named the ‘*diasynchronic*’ technique and the system; the ‘*Diasynchronoscope*’. The name combines diachronic, (the study of a phenomenon as it changes through time) with synchronous and scope (view). In being so named, it evokes the early animation simulators such as the *phenakistoscope* and the *zoetrope*, regarded as direct ancestors of the project as they too function both as art objects and experimental media.

This research intends to show that the *Diasynchronoscope* is a new medium for experiencing apparent movement, and as such, it offers an opportunity for updating some theorisations in Visual Studies. It is a further conjecture of this thesis that as a system capable of producing replicable experiments of enactive perception of apparent motion the *Diasynchronoscope* could provide a useful new tool for perceptual psychologists and that some discoveries made in this hybrid study may provide potential useful cross-over areas of study.

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My family's unflagging support has been above and beyond anything I could hope for. Both my parents have been inspirational - it is a great sadness to me that my father died in 2010 and so will never read this thesis or see the final artworks; I humbly thank my mother, Ruth who has never failed to encourage me and generously proof-read so many drafts of dense and impenetrable prose. She offers this helpful hint to the reader: Because the name '*Diasynchronoscope*' is such a mouthful to read, she suggests substituting '*D-Scope*' throughout. I think it is a good suggestion.

Thanks to all my friends for being interested and taking part in the journey, including all those who helped with the artworks and special thanks to Martin Kemp and John Kennedy for their continued support and enthusiasm for the D-Scope. Further thanks to Agnieszka Piotrowska and Etienne B Roesch and my brother Rob MacGillivray for their all-round expertise and generosity in agreeing to read my work, for Paul for his encouragement at the final hurdle and to my examiners Ernest Edmonds and Nick Lambert for their helpful suggestions at the viva.

Finally a very special acknowledgement to my son Sam, who has had to suffer the indignity of having a student mother whilst he himself is a student...

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1. INTRODUCTION – EXTRACTING THE ABSTRACT

*It is not important what goes on each frame of film; it's the spaces between frames that are important.*¹

Norman McClaren, 1987

When we watch a movie we perceive what happens on-screen as apparent motion, experiencing the film running as a continuous event, not as a series of stills, even though what lies between each still - fully half of what we see - is a series of blanks. As the Canadian animator, Norman McLaren points out these invisible in-between spaces are crucial to the art of the animator, and this research is in a way, a study of these spaces; how they can be constructed away from the screen and the role they play in our perception of events. In this sense it is a thesis that seeks to frame itself outside of the box, and so perhaps it is not surprising that as the work progressed, the frame itself became first problematic and then something to rebel against.

In the *Diasynchronoscope* the temporal spaces that generate perception of change are made manifest in space, and objects are positioned to carry the eye on a journey of visual attention allowing embodied perception of apparent movement. The research is a hermeneutic phenomenological study that documents the evolution of creative practice using the *diasynchronic* technique as an artistic medium. It chronicles how an emergent grammar is developed through application of extant audio-visual theories combined with observation of the affective nature of exhibited artworks. The tacit theories created through praxis and observation are discussed in relation to formal theories in Audio Visual Studies and Psychology in a reflexive cycle graduating towards conceptual emergence of a unique grammar for the *Diasynchronoscope*.

The thesis documents the creation of this new, experimental medium in choreographed time and explores its potential both as new medium and as a prototypical tool for empirical spatio-temporal experiments in Gestalt perception.

¹ Canadian Animator, Norman McLaren in interview (Solomon, 1987, p. 11)

Because no single strand of theoretical or empirical literature encompasses the constructivist nature of the research, this study is transdisciplinary in its truest sense.² It seeks not only to identify new ways of connecting established Gestalt Theory with the principles of Animation through real-world, embodied engagement, but also to draw together theoretical understandings of movement from the wider areas of Film Studies and perceptual Psychology in an attempt to develop a panoptic understanding of how apparent motion is perceived from an embodied perspective.

In this introduction, I will situate my position as researcher by describing my history and motivations and provide an overview of the scope of this study alongside the hypotheses, research questions and the methods of investigation I have chosen to use. I also provide a broad overview of studio practice.

1.1. ARTIST PRACTITIONER RESEARCHER

The biggest premise underlying this doctoral study is that investigation *through* creative practice is a legitimate means of creating a framework for research (Edmonds E. A., 2008). This premise derives from my background working as a practitioner in film and animation for twenty five years, and has, to a large extent, provided motivation for this study: The essence of this research is an attempt to synthesize theory with practice and make a strong advocacy for this as a legitimate and productive form of academic study.

The case-study artefacts documented in this thesis have been made collaboratively with Bruno Mathez, and the discovery of the technique is shared and documented in this study. However the investigative driver behind the development and theorisation behind the medium, which I contend forms the essence of this thesis; originate from the author's research. All contextual reading, written papers and analysis of data and subsequent theorisation have been undertaken solely by the author.

² What sets transdisciplinary studies apart from cross, inter or multidisciplinary studies is an emphasis on engagement, investigation, and participation in addressing present-day issues in a manner that explicitly destabilizes disciplinary boundaries while respecting disciplinary expertise. They are built around three key concepts: transformative praxis, constructive problem-solving and real-world engagement. I am using transdisciplinary in this sense as laid out in the manifesto adopted in 2002. See Basarab Nicolescu, Manifesto of Transdisciplinarity (Nicolescu, 2002).

It is necessary if this work is to be of value to others that it provides an honest account of the practice of creating artworks collaboratively, and this requires that I focus on my individual experience and personal accounts to better explain my relationship to the practice component. Consequently, I cannot approach this research without using the first person pronoun, although I am aware that this runs contrary to traditional scientific research and can lead to allegations of self-indulgence. The approach I have taken is an autoethnographic one after Bochner and Ellis (Bochner & Ellis, 2000) who present a wide array of categories that fit under the autoethnography umbrella. These categories include: 'narratives of the self, ethnographic memoirs, confessional tales, first person accounts, lived experience, personal writings' and others (ibid.: 739-740).

I am by inclination an empiricist, subscribing to the idea that '*practice is the best of all instructors*', so it struck me as curious and surprising when I came into Higher Education teaching at a mature age that practitioner knowledge, although generally much appreciated by students, is rarely received with the same enthusiasm by theorists in the academy. I observed that although we teach students of digital arts and animation at a rough ratio of 75% practice and 25% theory, the academic weighting for research is quite reversed. I still find this curious particularly because the way this doctoral research has evolved closely parallels the processes undergone by an artist in the act of creation.

The American pragmatic philosopher and psychologist, John Dewey in his classic book, *Art as Experience* wrote:

Irrelevancies arise that are tempting distractions; digressions suggest themselves in the guise of enrichments. There are occasions when the grasp of the dominant idea grows faint and then the artist is moved unconsciously to fill in until his thought grows strong again. The real work of an artist is to build up an experience that is coherent in perception while moving with constant change in its development.

(Dewey, 1934 (reprint 1989), p. 16)

Dewey could easily be describing a researcher as much as an artist. Both roles require a shaping and answering of questions and a stoic tenacity in study and problem-solving in order for there to be an outcome.

As an empiricist, I am more naturally inclined towards the experiments of Wertheimer and Goethe conducted after Francis Bacon's scientific method rather than the pure theory of French cultural theorists such as Deleuze, Virilio or Derrida. It has been a

journey for me to learn to appreciate the beauty of deep thinking, debate and framing and re-framing that lies in pure theory. For this reason, the biggest challenge for synthesis in this research has not been between the traditionally opposed disciplines of Arts and Sciences; but between theory and practice. I have taken a reflective and a phenomenological approach, focusing on the nature of the experience, and the underlying structures and organizing principles that give form and meaning to the art as well as situating it in wider media theory.

The hands that type this thesis are the hands of a practitioner who in a pragmatic, hermeneutic sense (after Heidegger³) investigates the world in a basic, intuitive way drawing on embedded practitioner knowledge. Influences and assumptions arising from my experience are not always conscious, and can often only be traced post hoc. In this manner even for the artist, as Heidegger remarks in his essay on art; '*the 'origin' of a work of art is mysterious and elusive, seemingly defying logic*' (Heidegger, 1975). In seeking to provide an exegesis I have tried to unpeel the praxis and play of studio development, and expose the essences of the art structures as they move from inception to realisation so that they may appear in the consciousness of a percipient. In short, I hope to render the invisible as visible. (Kvale, 1996) (Polkinghorne, 1989).

1.1.1. ANALOGUE ROOTS – ONE THING AFTER ANOTHER

Although this research has been carried out in a department of computing, I come to this field of study as a digital immigrant, and my roots as an analogue practitioner are clearly reflected in the perspective I have taken in this thesis, for this reason I feel a brief history of my professional background is pertinent.

My first animation - a claymation talking head - was shown on BBC 1's current affairs programme *Nationwide* in 1975 whilst I was still finishing my A levels. Although both my parents were doctors of medicine, it seemed natural for me to enter the film industry and for the next twenty years I was fortunate enough to work successfully as a freelance film maker and animator. In those pre-internet days, animation was learned

³ (Heidegger, *Being and Time*., 1962 (Original work published 1927)) Heidegger adopts an ontological stance to hermeneutics, stating that there cannot be a distinction between the individual and their experience, interpreting them as isomorphic and unable to exist without each other.

from devouring books, films and articles wherever they could be found, but these sources were scarce and I mostly learned through trial and error and ‘on the job’. Film was expensive and it was not worth developing anything less than two minutes worth (from a ten minute reel). As animating (even my somewhat guerilla-style of animating) was, and is, a painfully slow business, I often would not see the results of any labour for a week, and I still remember the keen anticipation coupled with trepidation of receiving these early films back from *Ranks* laboratories, and the corresponding thrill at seeing a model spring to life – often accompanied by the agony of seeing a forgotten pair of pliers left in shot on the animation table.

My primary practice was that of a film editor who specialized in documentary and pop videos. I liked these two areas in particular because of their unscripted nature; both were constructed in the cutting room, and I very much enjoyed the challenge of finding the most economic and powerful narrative thread for carrying an audience. In the 80’s the field of pop promos (as they were then called), was a joyous, experimental one. I worked with three other animator/directors (one of whom was my brother, Rob) under the name ‘*Giblets*’. Directors and artists sought out and trialled new techniques and ideas in media and animation, turning around films that synthesized visuals to music in ever more fascinating ways.

For most of my years as an editor, cutting film was still a physical skill: Cuts were made in 16mm film with a joiner and the shots spliced together with clear tape. Resulting cut reels were viewed on flatbed *Steenbeck*, with a rough sound track that was later track-laid and dubbed. The final cuts were marked up with a white chinograph pen and sent to laboratories for the negative to be cut in A and B chequerboard and final graded prints created that were married to the sound.

There have been times in my career as a film editor where I have felt artistically ‘at one’ with the material; the best I can describe this feeling is that I felt as if I was ‘painting’ in time with the film as my palette of colours - only this palette allowed me to paint not just with colour, contrast and tone, but with dynamic graphic matching of focus and camera movement, internal motion and direction of elements, speed and dynamic expectations layered with sound and/or music. This sensation of being at one with the medium gives a heady feeling of transcendence, of channelling creative thinking perfectly in tune with, and in command of, one’s craft. I imagine this is how athletes and dancers feel when they give their peak performance. These were times when I was

editing that I felt I could direct a viewer's gaze: picking up a viewer's attention and taking it on a journey by directing the gaze in a visual momentum that flows around the screen, rather like tracking a falling leaf then switching to another as their paths cross, or riding a symphony of sound.

An experiment in audience attention made by a team from Leeds University, (Marchant, 2009) chronicled a study conducted over 2 years with people attending a touring art exhibition on artistic responses to Hitchcock's *Vertigo* (Hitchcock, 1958).⁴ Using eye-tracking technology on individuals, the team assembled enough data to create metrics for the dynamic visual fixations of 'audiences' of 238 people for one scene and 163 for another in the film. The team then created thermal heat maps of these fixations and overlaid them on the original scenes. The results were compelling; a large commonality of attention was highly apparent. The study led the lead researcher, Paul Marchant to conclude:

The visual experience, or where the attention is drawn, appears to be highly controllable or subject to manipulation through directorial techniques such as the use of deep/shallow focus, approaches to editing, graphic matching and camera movement.

(Marchant, 2009)

Hitchcock was a master film maker and he is on record as observing (in this case about his 1960 film *Psycho*):

...Psycho has a very interesting construction and that game with the audience was fascinating. I was directing the viewers. You might say I was playing them, like an organ.

(Truffaut, 1984)

Hitchcock started out as film editor and I think that this may well be the source of his profound ability to direct where an audience's gaze will fall. There are ways of directing where an audience looks in a film, and increasing their holistic comprehension through editing. I had felt this instinctively, as part of my auto-ethnographic background, now I had seen a scientific demonstration of it.

Already in love with editing and animation as a medium, I started to read practitioners and theorists and became influenced by the early Russian montage theorists, Kuleshov (for whom the edit was the essence of cinema) and then Eisenstein's more general contemplations on film, perception and animation - this was the beginning of my fascination with the 'gap' in editing - how a cut can carry us far beyond the simple

⁴ The multimedia exhibition 'Repossessed', took place in 2006/7, during which over 400 members of the public watched scenes from Hitchcock's 'Vertigo'. I had attended an early preview of the exhibition at the invitation of a co-exhibitor, so I had participated in the experiment myself.

juxtaposition of two shots and across large metaphorical leaps. At the same time, in discussion with my father (who was a neurologist), I became interested in not only what we see, but *how* we see, and the differences between what we see and what we perceive.

In the early nineties directors started to shoot on video and soon the tools changed from celluloid film, splicers and flatbeds to digital editing on computers using software such as *Avid* and *Final Cut*. These were technologies that I embraced and learned, but ultimately it was this change that made me switch careers. The new medium had an immediate impact on life in the cutting room and my craft as an editor. The shooting ratio leapt up from 12:1 to 100:1, cheap sensationalist content became king and reality TV started to take root. The days of the considered, researched and crafted documentary were numbered and pop videos became fast cut visual kaleidoscopes of pouting pop stars. The cultural changes in mass media which we enjoy today are attributable to changing politics and proliferation of channels, but were also fuelled and perhaps even predicated on the technological change that took place in the medium. I became increasingly disillusioned with the way television was emerging as a mass medium and felt I wanted to move away from it. I chronicle this experience, in part to demonstrate why I am at heart a McLuhanist who cannot accept that the medium is a neutral tool.

A major turning point came when, in 1996, I was invited to teach editing at the Royal College of Art, where they have an ethos of using practitioner teachers. This period kindled a love of teaching and research and I felt I had discovered a new calling. A year later I won an AHRC award to study on the cutting-edge *MA Digital Moving Image* course at London Guildhall. It was there that I learned 3D computer visualisation and animation. I went on to publish a text book on the same; *'3D for the Web'* (Elsevier) in 2005, and then joined the academic world as a lecturer.

I decided to study for a PhD based on interrogating how the gaps between frames influenced animated movement in 2008, and gained a methodological breakthrough when I attended the Lansdown symposium – *Completing the Circle* at the British Computer Society in London in 2009.⁵ Alongside the keynote, two papers delivered here influenced me strongly: The first was Marchant's study of audience attention and the second was a paper by Micahel Hohl: *Designing The Art Experience: using Grounded Theory to Develop a Model of Participants' Perception of an Immersive Telematic Artwork* (Hohl,

⁵ The invited keynote at this conference was Ernest Edmonds and this was also the first time that I encountered his work relating to theory, practice and evaluation in practitioner research.

2009). Hohl used social science methods to evaluate an art project in an attempt to systematically measure the effectiveness of a work and improve its performance. This paper not only introduced me to Grounded Theory, but also I was impressed that here was a modern artist who had collected empirical evidence that his audiences did not ‘get’ much of the interaction in his interactive computer-based art, and was brave enough to show this research and use it to build a better system. This held a logical appeal to me, and I felt it might be a methodology that I could adapt for use with my art projects to refine my hypotheses on movement.

1.1.2. CLOTHES PEGS AND PRATFALLS

The *Diasynchronoscope* was born in the summer of 2011 when, already some way into my doctoral studies, I undertook a series of summer classes in *Processing for Artists* run by Dr Eleanor Dare at Goldsmiths. Dr Dare invited Bruno Mathez (then an MA student and feeling at an artistic impasse) to present some of his work in projection mapping to the class. Bruno is a digital native and his work, which married sound and image closely, was visually stimulating and fascinating to me as it reminded me of my days in pop promos. It was clear that we shared artistic interests, so we arranged to think about collaborating - originally on synchronising sound with image. At our next meeting, Bruno showed me a brief film he had made the previous night of projection mapping white light on some clothes-pegs in a series. As he showed the footage which scanned back and forth along the line of clothes pegs, Bruno said it was a shame he could not make them move. Even as he said this, the film changed to include three clothes pegs in an arc and a clothes-peg turned through 90 degrees, lying on its side – what the animator in me saw was a clothes-peg taking a pratfall! ‘*I can make it move*’, I said, and so began our collaboration on the *Diasynchronoscope* project.

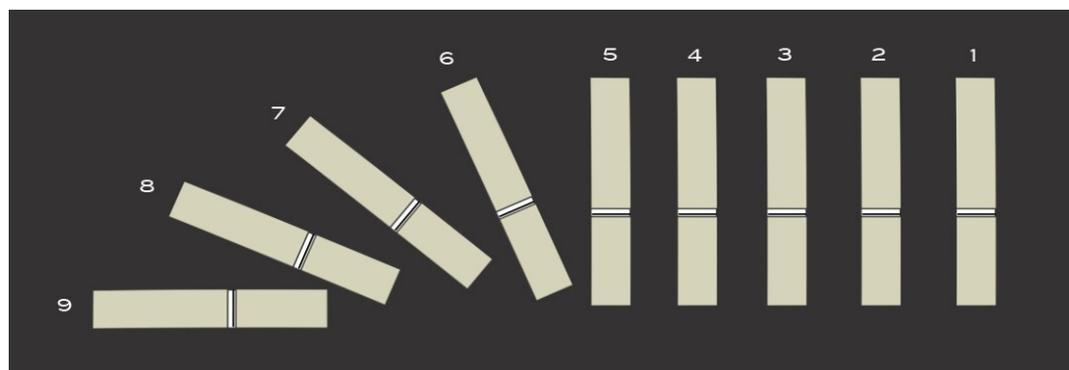


Figure 1 Diagram of the sequenced illuminated clothes-pegs

1.2. SCOPE AND AIMS OF THIS STUDY

All of a sudden it hit me, why not just movement? If there was such a thing as composing music, there could be such a thing as composing motion.

Len Lye 1974⁶

I originally came to this doctoral study armed with the hypothesis drawn in part from Neuroaesthetics that movement is a key signifier in perception and that it is a major factor in delineating boundaries when we ‘chunk’ events for storage in our memory, particularly if we perceive movement alongside other confirming stimuli such as sound.⁷

The original aim was to create studies of ‘composed motion’ in order to explore this hypothesis and to interrogate it using artworks drawn from practice. Given my background, I naturally started these explorations as screen-based animations, and swiftly encountered two investigative problems; the first was how to suppress culturally coded interpretation of symbols when animating - my aspiration was to animate so that movement was the primary stimulus perceived and not the semiotic content of the object itself.⁸ The second problem I encountered was the screen itself: The problem with developing a system for investigating perception of movement is that it takes place in four dimensions; time being the fourth dimension. Time adds a metaphorical parameter which forces us to move away from realism to a constructivist view of the universe.⁹ So perception becomes paramount and perception is somatic; borne of the body and the psychophysics of the mind. For any annotation to be meaningful, the qualitative dynamics of a movement, i.e. its inherent quality, phrasing, embodiment and intentionality are integral and should be included as parameters. Movement takes place in

⁶ From Ray Thorburn's *Interview with Len Lye* (at his studio, New York, September 1974) which was published in the New Zealand journal, *Art International*, April 1975.

⁷ Cognitively segmenting continuous activity into discrete events is called “event perception” or “chunking” where events are separated semantically and spatially as well as temporally. (Lowe, 2008)

⁸ It should be noted that at this stage I had not encountered Max Wertheimer’s description of ‘phi’ movement being sometimes described as ‘pure’ movement because the viewer’s attention is focused on object-less apparent motion.

⁹ There is significant philosophical discussion of this in George Lakoff and Mark Johnson’s 1999 book: *Philosophy in the Flesh: The embodied mind and its challenge to Western thought*. In chapter 10, which is devoted exclusively to the subject, they investigate the concept of time and conclude: we cannot conceptualize time without metaphor; all of our understandings of time are relative to other concepts such as motion, space and events and that there is no ‘*objective metaphysics of time*’ (Lakoff & Johnson, 1999, p. 168).

3D and our personal experience of it is both aesthetic and *primal* - for the latter to be investigated I needed to create apparent movement that was an embodied experience.

These two problems appeared to be unresolvedly opposed: I hypothesised that if I was interested in movement that was affective and engaging, I would be using character animation, relying on a viewer's empathy through mirror neurons to provide evidence of embodiment.¹⁰ But if I was to use empathy as a measure; I was using biological movement, and any biological movement perforce acquired coded interpretation either in the shape of assigning motivation to a character or in interpreting causality due to natural causes (such as wind blowing clouds or balls bouncing due to gravity). I decided that I needed to create non-biological movement, i.e. movement that was not 'natural'. This would obviously go some way to solving the coding problem, but I needed the motion studies to take place in the 'real' world, permitting environmental affordance.¹¹

Defining these problems led me to reframe my investigations away from the screen, and my first exhibited artwork for the study took place in 2010 in the shape of '*Bolt*', an interactive kinetic sculpture that moved in highly unpredictable arcs.¹²

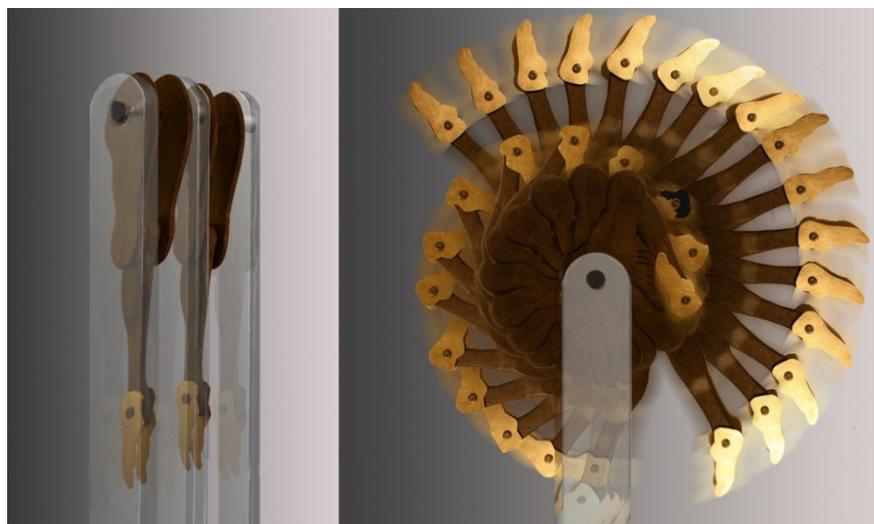


Figure 2 '*Bolt*' 2010 Wood, Metal, Perspex

¹⁰ I had a notion of using the WiFit technology which held four very sensitive scales to measure affection through movement in the participant's Centre of Mass. I theorised that small movements towards and away from art objects would provide indicators of engagement.

¹¹ A term coined by US Psychologist, James Gibson to describe the interrelationship between an animal and its environment.

¹² As an artwork, *Bolt* was very popular and successfully toured many art galleries in the UK. Although it is no longer of great pertinence to this thesis, a description with visual recordings of Bolt is included in Appendix B.

The exploratory idea behind '*Bolt*' was that the unpredictable movement that involved apparently chaotic changes of speed and direction would be highly engaging. Observations of audiences interacting with *Bolt* confirmed that I should indeed try to keep my explorations off the screen – the level of engagement with the movement was significantly greater than seeing screen-based movement - but I still felt that I had not managed to solve all of my criteria for study as, although the movement was deliberately not biological, the moving objects were obviously based on human anatomy. Furthermore, although *Bolt* offered a multi-sensory experience in terms of being tactile, I felt synchronized sound was integral to appreciation of movement and *Bolt* was silent.

I began exploring robotics as a potential medium; however robotics studies tend to be either mechanical or about simulating biological motion. As an animator I felt that mechanical movement alone was too difficult to isolate without becoming disengaging and so was unlikely to provide sufficient exploration of the hypothesis that movement was the key signifier in event perception. Plus I wanted to explore non-biological motion, arguing that the purer the motion, the better my research would be. It was at this stage that Bruno and I made our first test in screen-less animation. The result was something of an epiphany. Even in a half black-out, and shot at a coarse frame rate and with compromised positioning, we could see it worked. In fact it did more than work; it looked like magic. It was an exciting moment for me as I realised that the handbook for what works and doesn't work in animation may need to be rewritten.

Although my hypotheses have evolved over time, the discovery of how to animate without using a screen went some way to solving both of my previous problems. In the *Diasynchronoscope* the objects (which, in early incarnations tended to be platonic solids hewn from polystyrene and painted black) are simple and surprising, they look 'a bit like' several things but also often bring no single cultural reference to mind. Further, by lifting animation off the screen and into the same environment as an audience, and restricting it to non-biological apparent movement in an ecological environment, I could use empiric investigation to examine the influence of embodied cognition on human appreciation of movement.

It is the aim of this research to chronicle the development of the *Diasynchronoscope* as a new artistic medium, record how viewers respond to it and articulate new grammars that evolve as we become more adept with the medium. In doing this, the thesis will also reflect upon the aesthetic differences between the *Diasynchronoscope* and screen-based

media and contextualise the potential uses of the *Diasynchronoscope* as both a young medium and a prototypical perceptual research tool. It aims to create a new set of principles for non-biological apparent motion in an ecological environment through application of discovery derived from using the diasynchronic technique. Because screen-less animation is a new technique, it is hoped that it will offer a deeper understanding of how kinetic perception works in the medium and beyond, ultimately confirming and extending some parameters for perceptual shortcuts in three-dimensional apparent motion based on global Gestalt properties and animation principles.

1.3. HYPOTHESES AND RESEARCH QUESTIONS

The two main hypotheses in this research are: That the *Diasynchronoscope* offers a new medium for experiencing apparent movement – I hope to demonstrate this both concretely and by contextualising the *Diasynchronoscope* with other media – and that the spatio-temporal nature of the *Diasynchronoscope* offers a unique framework for creating principles of non-biological apparent motion in an ecological environment. A major part of this thesis devotes itself to the question: Does medium impact significantly on the qualia of experiencing movement? I hope to defend the McLuhanist stance that; ‘*the medium is the message*’ (McLuhan M. , 1964), and that therefore the *Diasynchronoscope* experience is a new one. Alongside this question is the rider: If the *Diasynchronoscope* is a new medium, what is its emergent grammar and context? This thesis makes the case that the newness of the medium and the fact that the movement is non-biological and takes place without a screen means that the *Diasynchronoscope* offers a new mediated grammar that may be explored and a new set of aesthetic rules to accompany these rules. The practice-based research question that bookends the case studies within the thesis is simply; Can animation be experienced ‘in the round’?

Combining discussion of focal theories from Visual Studies and Psychology, this thesis investigates and empirically documents how application of animation principles, Gestalt theory, and embodied cognition have helped us refine and develop participant appreciation of the *diasynchronic* technique. This application of theory runs parallel to multi-modal practical research, problem-solving and experimentation as the *Diasynchronoscope* evolved from a single viewpoint to dynamic installations that could be walked around and appreciated through 360 degrees.

1.4. METHODS AND GROUNDED THEORY

As tools for recording the artistic process, in keeping with autoethnographic methodology, I have employed reflective diaries, photographs of process and commentary on a project website combined with continued documentation for exhibition and video representation. Although I have always kept reflective diaries, I did not refine using them as a research technique till I undertook my PGCE in 2005 when I encountered Donald Schön's seminal 1983 book, *The Reflective Practitioner* (Schön, 1983) and here I have combined his notions of looped learning with John Dewey's observations on reflective art practice (Dewey, 1934 (reprint 1989)).

As Sullivan suggests art research frequently moves beyond discipline boundaries '*and into areas of inquiry that interact and intersect and require new ways to conceptualise forms and structures*' (Sullivan, 2005). The final research sits under the umbrella of Mixed Reality and synthesises three focal theories: Animation principles, Gestalt theory and sensori-motor theory to create emergent new theory. The choices of foci and boundaries for this thesis have emerged through detailed research in a cyclical manner, combining continued studio play and practitioner knowledge, wide-reading and participant observation combined with semi-structured interview.

Because the technique's strength relies on somatic (of the body) experience, video representation of the *Diasynchronoscope* is perforce a compromised reproduction creating a challenge in documenting audience experience for this thesis. Our current practice is to use non-participant observation and semi-structured interview of participants.¹³ (Candy & Edmonds, 2011)

Videod face-to-face interviews seemed an appropriate way of gaining insight into participant's response to the artworks. It generated rich data, allowing me to analyse the depth of meaning and other potentially significant data such as personal language used and repetition of response; the record provided by face-to-face interviewing is important when the research is primarily focused in gaining insight and understanding of cognitive response. The interviews were situated in the same public space location as artworks and conducted immediately post-viewing.

¹³ A technique developed from discussions in a PhD workshop conducted by Ernest Edmonds at Goldsmiths in 2011

The research's aim was to acknowledge the importance of immediacy in understanding participants' perceptions and the main purpose of the interview was to use conversation and questioning of participants to provide insight into how the artworks were perceived. Primarily the research concentrated on examining if there was a sense of qualitative difference between seeing a diasynchronic artwork and seeing screen-based media, and also the extent of Gestalt phenomenological experience.

The interviews were loose but constructed around key questions. Because the intention was not to lead, but probe the response to the artworks, the questions had to be phrased carefully to remain open-ended and avoid leading the interviewee.

These open questions were:

- *What was going on?*
- *How would you describe it?*
- *If you saw this on a screen or TV, would it be the same?*
- *Do you feel you were looking at multiple objects or a single entity?*
- *Anything else?*

Sometimes even these simple questions were quite difficult to word; for instance, the question: '*Do you feel you were looking at multiple objects or a single entity?*' went through several incarnations to keep it neutral.

The success and validity of an interview rests on the extent to which the respondent's opinions are truly reflected; the interviewee's "voice", communicating *their* perspective, however one weakness in this method was that people could be responding differently depending on how they perceive me (the artist) as being the interviewer, and this awareness that it would be hard for interviewees to give impartial qualitative feedback to the artist motivated me to move to short, written feedback instead for the last case study.

It is important to note that much of the chronicling of the story of the *Diasynchronoscope* has taken place collaboratively with my co-creator of the technique, Bruno Mathez. Populating the project website with films, photos and discussion of emergent techniques in the studio, in order to promote the *Diasynchronoscope* to a wider audience has been a joint enterprise. However all written analysis, contextualisation and theorization has been made by this researcher.

The methodology is primarily autoethnographic using the Glaserian Grounded theory of interview of self and memo, this is combined with and refined through empirical experimentation and exhibition. Although the research is practice-based, and as such the artefacts play a significant role in that research, the new knowledge that this study pursues is not found in the artefacts in and of themselves, but in chronicling the formalisms for this new medium as they are discovered, and then contextualizing these formalisms with other practice. Defining a position for this research has been the major challenge, and it has been a challenge undertaken by this researcher as an individual, not as a collaborative enterprise.

There are three main iterative processes involved in this study:

Practice:

Research placed in an art context through the creation of experimental artefacts. The plastic form of play that occurs in the studio, where anything (including sound) may be used as a formal raw material, in answer to both unconscious and conscious needs, is the heart of this study. The thesis also documents how research into animation principles, Gestalt grouping principles and theories of perception of apparent motion informed the art practice and uses case studies of specific artefacts to anchor these investigations and discuss how each process created new areas for investigation.

Theory:

Analysing the *Diasynchronoscope* as a new analogue medium using media frameworks as tools of contextualisation. Constructing an emergent grammar for the medium and translating this new knowledge back to principles of animation and Gestalt Grouping and creating new principles for audio-visual media in the context of screen-less animation.

Findings:

Recording empiric observation of the affective nature of artefacts on subjects, organising, analysing this and documenting the development of subsequent new frameworks for investigation using the *Diasynchronoscope*. The study reflects on the problems of how to represent the ephemeral in an age of screen-based mass media, offering multi-layered online testimony as one solution. Some processes begun as art practice using the *Diasynchronic* technique have crossed over into other fields such as

perceptual psychology, media theory and technology meaning that the art is starting to contribute to research in other fields in a concrete way.

The study's methodology is to take a constructivist approach using classical (Glaserian) Grounded Theory (GT) (Glaser B. G., 2001) combined with interrogation through experimental kinetic artworks.¹⁴ The thesis documents cyclical refinement of theory and kinetic models based on empirical evidence drawn from case studies of three artefacts, *Gestalt Circle, One, Two, Three...* and *Stylus*.¹⁵ Because GT contains both inductive and deductive thinking running in parallel in a constant comparative method, the process is continuously iterative with theory generation occurring simultaneously with practice.

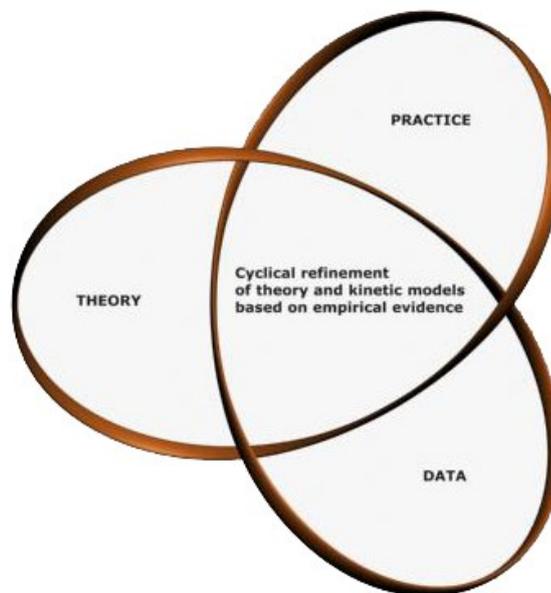


Figure 3 Cyclical refinement of theory and practice using Grounded Theory method

The research has been dynamic and has evolved according to practice-based methodologies (Edmonds E. A., 2008) (Gray, 2004). Although the methodology for information gathering and analysis came from social science, in particular grounded theory, there has been a strong influence from the empiric nature of the experiments in perception made by the early Gestalt psychologists such as Max Wertheimer (Wertheimer, 1912).

¹⁴ The intent of a grounded theory study is to generate or discover a theory, an abstract analytical schema of a phenomenon, that relates to a particular situation (Cresswell, 1998, p. 56).

¹⁵ Discussed in detail in Chapter 5.3.

1.5. CONTRIBUTIONS TO KNOWLEDGE

This research contends that that the *Diasynchronoscope* itself is a new medium for experiencing apparent movement and secondly that the spatio-temporal nature of the *Diasynchronoscope* offers a unique framework for creating principles of non-biological apparent motion in an ecological environment. It hopes to create a contribution to Transdisciplinary research through this study that combines Art and Science, Practice and theory and Analogue and Digital media.

The nominal title for this transdisciplinary research is a practice-based PhD in Arts and Computational Technology: The contributions to Art are primarily in the form of exhibited artworks and are listed in Appendix A. The contributions to Computational Technology are varied, but can be encapsulated under the heading Mixed Reality (MR). MR is a subverted subset of Virtual Reality (VR) related technologies that involve the merging of real and virtual worlds somewhere along a "virtuality continuum" which connects completely real environments to completely virtual ones. By creating a taxonomical link between the *Diasynchronoscope* and Mixed Reality, I hope to create future connections between 3D printing and our work that will open whole new avenues of exploration where craft is synthesised with the digital.

In summary, this is Practice in a Research Context which involves:

- Inventing, developing and experimenting with a new artistic medium that provides intra-filmic experiences without a screen.
- Deducing an emergent grammar for these immersive art forms through experimentation and exhibition.
- Generating new theories that hold significance for the impact of technologies on visual and audio studies through investigation of apparent motion in an enactive environment.
- Offering improved insights into Gestalt phenomena by updating the original empirical experiments of Max Wertheimer (1912) into three-dimensions in the real world.

1.6. STUDIO PRACTICE

The *Diasynchronoscope* takes old techniques of experimenting with apparent movement and brings these to the digital age by relying on three modern software tools: a 3D content generator (currently *Autodesk's 3DS Max*); an image manipulation tool (currently *Adobe Photoshop*); and a digital movie management platform (currently *Adobe After FX*).

Artworks are viewed in an architectural black-out, where prepared 3D objects are arranged in paths such that they change incrementally in shape and/or position. Although nothing in the space actually moves; the objects are revealed through serial illumination in the dark room, sequenced using the technique of projection mapping. The effect is not of flashing lights or of objects lit stroboscopically, but of continuous motion of objects. This technique enables creation of a dramatization over time, encouraging the common perceptual shortcuts of a participant to create sequences and a narrative from static abstract objects.

The unique skill set that brought about the project requires some contextualization. For this creator, who comes from a base of sculpture, traditional animation and film editing combined with previous research in virtual 3D construction and animation, the practical skills have been developed from a base of sculpture and studio claymation work. Both creators have developed skills in variously crafting sculptural objects, reflective qualities of paint and refining techniques for hanging the objects in space according to a virtual 3D template. The technique of projection mapping onto specific objects was developed by Bruno Mathez, who has a technical audio-visual background. Bruno has considerable musical skills in sound creation software, and as the *Diasynchronoscope* is a synesthetic experience, we have included original sound in the artworks, and it is an area that holds much potential for future investigation.

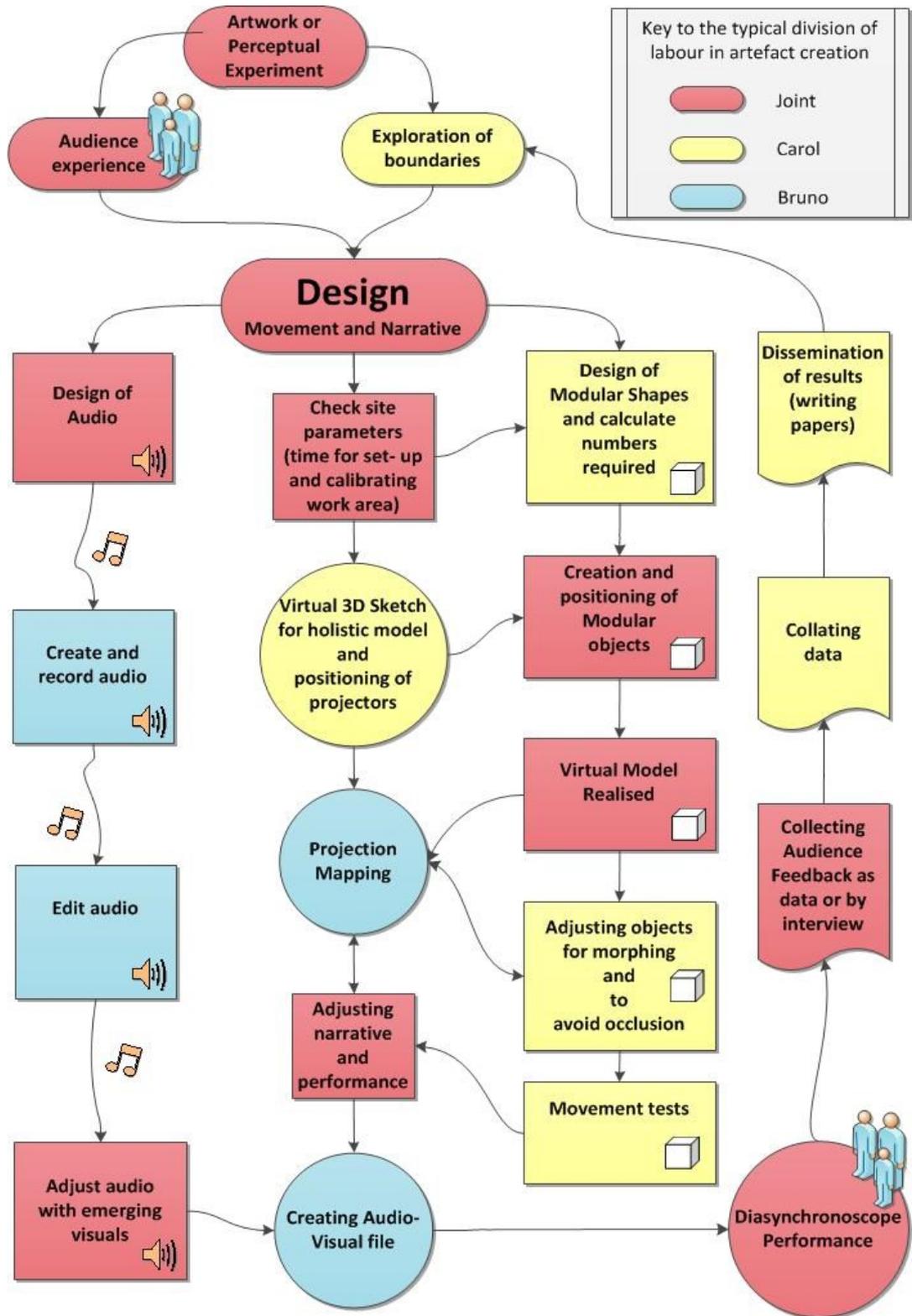


Figure 4 Overview of the Diasynchronous process with key to labor division

Figure 4 lays out a broad overview of the current studio process with a key to how the labour is divided between us in the collaboration. Because the work is collaborative, I

shall use the plural pronoun ‘we’ when discussing technical developments and explorations in this thesis, but the diagram depicts a typical division of work.

There has been a rich variety of information gathering and selection in creating the artworks. Because they are sculptural, analogue and digital, the processes have overlapped and been supported by sketching and concept mapping, experimentation, observation, and reflective refinement using digital software, sculpture and varied materials.

Because the *Diasynchronoscope* uses projected light, it is essential that the animation takes place in a black-out space, and a basic craft of the *Diasynchronoscope* lies in the creation and positioning of objects in this black-out environment. As no object can really be construed and labeled as ‘abstract’, an early challenge was to design objects that deliberately emphasized movement and were less likely to be culturally loaded and recognizable. After some experimentation it was decided that the optimum material for creating objects was white, medium-density polystyrene cut to shape. The polystyrene has then to be painted black so that it will be invisible to the viewer in the blacked-out space; this creates an ambiguous object in terms of texture and shape. As we have progressed as artists, we have started to use other materials, and indeed are now able to animate using colour and intricately shaped objects.

The artworks require the dimension of time to be translated into spatial dimensions; this is often difficult to test, so usually works are made first using 3D visualization. Because each version of the *Diasynchronoscope* is site-specific, and the projector positions, objects and structural support are solid, testing and adjusting animations in 3D using virtual 3D software first was at first essential as it helped eliminate some problems before concrete realization. With experience, as the formalisms inherent to the *Diasynchronoscope* evolve, we are becoming increasingly adept at shaping layouts straight into space.

The technique of projection mapping has been slightly refined from the early days, but it is still an arduous combination of creating masks in image manipulation software (*Adobe Photoshop*) and then animating the masks to run in a digital movie management platform (*Adobe AfterFX*) to create a *QuickTime* movie of animated masks with a soundtrack that will run on a loop. The rendered movie is then output straight to the projector, with the parameters adjusted so that the movie playing onscreen or if the feed

needs to be split to two projectors, we use the *Matrox* graphic expansion hardware, *DualHead2Go*, to play simultaneously through both projectors. Usually each object is lit for 12 - 24 frames per second (roughly 40-80 milliseconds) but the timing for these films is adjustable and there are frequent trials to determine the best timing for lighting the objects to achieve believable animation and an effective narrative.

Sound is recorded and a soundtrack created separately. Sometimes the animation is created to fit the sound and sometimes the sound is adjusted to synchronize with the animation. It is an iterative process. The sound is delivered by stereo speakers nested inside the artwork, or in the case of the all-round artwork, *Stylus*, through four speakers to give the impression of 360 degree audio.

1.7. HOW IS THE DIASYNCHRONOSCOPE EXPERIENCED?

All in all, 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 qualification and thus adds his contribution to the creative act.

(Artist, Marcel Duchamp, 1971)¹⁶

Artworks are viewed in an architectural black-out, where prepared 3D objects are arranged in paths such that they change incrementally in shape and/or position. Although nothing in the space actually moves; the objects are revealed through serial illumination in the dark room, sequenced using the technique of projection mapping. This technique enables creation of a dramatization over time, encouraging the common perceptual shortcuts of a participant to create sequences and a narrative from static abstract objects. Because the perception is of movement within the shared space as the viewer, the *Diasynchronoscope* is a new tool for investigating the expressive power of embodied screen-less animation. That the audience experience is other than seeing screen-based animation is tangible in several ways; firstly, because the works are site-specific, there is a sense of ‘*authenticity*’ as defined by Benjamin; of being in the presence of something

¹⁶ Although the context of this statement came through considering how an artist may gain a place in posterity of art history, it exactly parallels the important contribution an audience brings to the diasynchronic experience.

new, 'real' and immediate.¹⁷ This authentic nature of an original *Diasynchronic* installation in an age replete with reproductive media, is further confirmed by Benjamin's definition of 'aura' over reproduction:

Even the most perfect reproduction of a work of art is lacking in one element: its presence in time and space, its unique existence at the place where it happens to be.

Walter Benjamin 1936 (Benjamin, 1936 (2008))

Because every installation is site-specific and, so far, has been effectively a palimpsest, with each new installation replacing a previous version, anyone witnessing a version of the *Diasynchronoscope* is privileged to see something that is currently unique. The aura of each artwork is also increased because testimony of the labour-intensive nature of each *diasynchronic* artwork creation is often made manifest in complex installations, either through showing a holistic of the entire artwork or through the viewer's eyesight becoming accustomed to the levels of dark in the environment, thus gradually revealing an installation's underlying formalism and complexity.¹⁸

The environmental black-out adds a sense of mystery to an audience's experience. Renaissance artists resorted to dark backgrounds when they wanted to defy the picture plane and evoke an eternal and indefinite space. The contained space of the *Diasynchronoscope* provides a haven where attention is focused and directed. The movement is picked out in white or coloured light in stark contrast, separating foreground from background and creating a sense of unification between the molecular iconic objects although they appear variously in time. The solid forms we show seem tangible, but also disappear into the void, creating a sense of immateriality.

Professor of Philosophy, Tom Leddy of San Jose State University has written extensively on John Dewey, and his 1934 text on art and experience. In this article taken from *The Stanford Encyclopedia of Philosophy* he writes an almost prescient diagnosis of what happens inside the *Diasynchronoscope*:

¹⁷ "The presence of the original is the prerequisite to the concept of authenticity." (Benjamin, 1936 (2008) Chapter II)

¹⁸ This was particularly true of the installation 'Stylus' which forms the final case study in this thesis.

This sense of wholeness conveyed by the work of art distinguishes the work from the background in which it sits. Evidence of this idea of the artwork standing apart from its background is “our constant sense of things as belonging or not belonging, of relevancy, a sense which is immediate.” Yet the background represents the “unlimited envelope” of the world we live in, and the work of art, though seen as a discrete thing, is intimately connected with the larger background. We intuit this connection, and in this process there is something mystical. “An experience becomes mystical in the degree which the sense, the feeling, of the unlimited envelope becomes intense – as it may do in the experience of an art object.”

(Leddy, Spring 2013) Quotes from John Dewey (Dewey, 1934 (reprint 1989))

This distinction of foreground from background is fundamental to the *Diasynchronoscope* experience. The clear contours of objects, delineated by the masked projected light, imbues objects with the same clarity as a block-painted contour line drawn in cel animation. There is no drop-off towards the edge and all objects are cleanly defined away from a background.

Sometimes a spectator hesitates and has to be coaxed into their first encounter the *Diasynchronoscope* in exhibition, they have a sense of trepidation, entering unknown territory and feel they may be vulnerable to something unexpected happening. This is hardly surprising: because the name is unusual, the concept of ‘screen-less animation’ is strange and a spectator has to commit to entering the blacked-out space. So far we have chosen not to exploit this trepidation, it would be easy to ‘spook’ people with the unexpected, or play on this fear aurally, however the sound we construct is looped to reassure rather than shock. We want people to experience an immediate and necessary relationship between what they see and what they hear.

Sean Cubitt provides accounts of the birth of cinema quoting from reviews by *La Poste*, the edited letters of the Lumiere brothers and Maxim Gorky’s writing at the time (Cubitt, 2004, pp. 14-15). These accounts of the first public projections in Paris by the Lumieres in 1895 struck an immediate chord with my own auto ethnographic notes taken after our first public outing for the *Diasynchronoscope* when ‘*Gestalt Circle*’ was shown over three days at *Kinetica Art Fair* in 2012:

Diary entry 08/02/12: *“We were positioned out of the way and we did not have many visitors for the first day. The catalogue has not been printed, and no journalists were brought to our little room - we felt very tired and rather abandoned. Perhaps because the entrance was a bit shabby and it was hard to describe what lay behind the velvet*

curtains. Cursed my invention of the stupid, pompous name... The other exhibitors took pity on us and those that came to visit were complimentary - and also generous, telling others to come... By Saturday the queue at the end was eight deep and on Sunday, such was the word of mouth, that people waited up to half an hour to see our installation - and this kept up all day. It was so exhausting we had to limit participants' time to 3 mins with a stop watch. Lots came back bringing family and friends because they did not know how to describe it to them..."

This promotion of a new medium by word-of-mouth provides a distant echo of Cubitt's re-quotation from the letters of the Lumiere brothers:

"Shown in the festive period between Christmas and New Year, with twenty sessions a day between 10am and 1:30pm, the cinematograph attracted a crowd of flaneurs from the Boulevards. Clement Maurice recalled, 'What I remember as being typical was some passer-by sticking his head round the door, wanting to know what on earth the words Cinematograph Lumiere could possibly mean. Those who took the plunge and entered soon reappeared looking astonished. They'd come back quickly with a few friends they'd managed to find on the boulevard'." (Cubitt, 2004, p. 14).

New sensations invoke a sense of wonder, and although it would be ridiculously grandiose to compare the impact of the *Diasynchronoscope* with that of cinema and the birth of the screened moving image, on an individual level, the sensation of wonder evoked in the flaneurs of Paris witnessing, for the first time, a photograph spring to life, was also echoed in a small way by people experiencing the *Diasynchronoscope* for the first time, ironically enough because this time there was *no* screen. In the *Diasynchronoscope*, a sense of wonder is generated by the viewer's perceptions of beholding something new, but without any intervening mediation. Another commonality of experience with the diasynchronic artworks is that they induce a quale of revelation with comments like, 'Wow!' 'Blown away' and 'Alien God object'. (MacGillivray & Mathez, Stylus, 2014)

The screen today is so pervasive in the form of cinema, television, computers and personal mobiles, as psychosociologist Sherry Turkle laments, it is now virtually impossible to find an audience that is not culturally-shaped by screen-based imagery. Indeed it is difficult for a modern audience to assimilate that the *Diasynchronoscope* is an embodied experience and that there is no screen or proscenium arch. The default fall-back for a

participant is that what they are seeing must be a hologram, because the idea that the objects are real and concrete is quite a novel idea.

When the frame is unclear and there is a blurring of the line between reality and unreality, according to Sigmund Freud we enter the world of the uncanny: *'an uncanny effect is often and easily produced when the distinction between imagination and reality is effaced, as when something that we have hitherto regarded as imaginary appears before us in reality...'* (Freud, 1919 (reprinted 1990), p. 367).

Tropes from the uncanny identified by Freud are: Dismembering, repeating and doubling (ibid.: 368-9). Freud makes much of the roots of the word uncanny translated into the German as *"unheimlich"* (literally unhomely), and its opposition *"heimlich,"* which can mean both familiar and concealed. He points out that according to the *Oxford English Dictionary*, a similar occurrence can be noted with the English word canny, *"which may mean not only 'cosy', but also 'endowed with occult or magical powers.'"*¹⁹

In his last published work, *Passions of the Soul*, Descartes values the feeling of wonder that arises when we encounter something we do not know, something surprising and unfamiliar. Thus he writes:

When the first encounter with some object surprises us, and we judge it to be new or very different from what we formerly knew, or from what we supposed that it ought to be, that causes us to wonder and be surprised; and because that may happen before we in any way know whether this object is agreeable to us or is not so, it appears to me that wonder is the first of all the passions.

(Descartes, 1649 (republished 1989))

It is curious that the man who stands for Cartesian dualism (ie. the separation of mind and body) should write so enthusiastically about something that to the modern sensibility seems so visceral and sensational (in the sense of full of sensation). Wonder feels very much to be an embodied sense – the eyes widen and there is an automatic redirection of focus to the new stimuli, often people describe their jaw dropping as they are 'dumbfounded' by a spectacle of wonder, the heartbeat quickens and the body is alert and tense. This *'first of all passions'* combines physiological indicators with the

¹⁹ Because 'Magic' is a frequent description given by those experiencing the Diasynchronoscope, I investigated this further in an upcoming book chapter on film and psychology: *Pinning a Tale: The Screen, the Donkey and the MacGuffin*. (MacGillivray C. , 2015)

intellectual knowledge of something being new to our experience and beyond our world schematic.

In the *Diasynchronoscope*, the wonder is generated by the viewer's perceptions of beholding something new, but without any intervening mediation. We are very used to perceiving apparent motion on a screen, but apparent motion that eliminates flicker and is veridical, in terms of perspective, focus and parallax is a new sensation. If we consider the screen as a boundary and demarking barrier between the real and unreal, then the *Diasynchronoscope* removes that boundary and we enter the uncanny – not in the sense of encountering something fearful but in the sense of wondering at the inanimate springing to life. It is indeed at once familiar and new; “heimlich,” and “unheimlich”. The tropes of dismemberment, repetition and doubling identified by Freud for the uncanny are entirely present in this medium. Dismembering can be equated to the way the objects often fall, disintegrate then reassemble, the works all use repetition in the shape of looping visuals and audio and the idea of doubling as a *Doppelgänger* motif where attributes of power and autonomy are handed to the one who is in control of the gaze, considered by Freud to be one of the most prominent themes of the uncanny (Freud, 1919 (reprinted 1990), pp. 354-6) are of course fundamental to the *Diasynchronoscope* where we animate through attention.

Another aspect of the *Diasynchronoscope* that seems to hold appeal for modern art visitors is that the installations allow for individual opinion and interaction on something that has more than one formal identity. Because the artwork has different points of access (often as a time-based study *and* as a static art object that combines the time-based objects holistically), the two states inform each other. Paradoxically, the holistic artwork could be conceived as though the participant is a camera on a very slow shutter speed, receiving two seconds of data in a single moment. This, coupled with the embodied 3D element, is a new and surprising sensation. We are so familiar with the tropes of a camera changing speed or playing in reverse, we accept the same tropes in ourselves, but experience it as ‘magical’.

Thus it can be seen that there are many paradoxical elements to the *Diasynchronoscope*:

- Nothing moves, but the artworks are constructed around movement.
- It uses projection, but there is no projected image
- It controls attention but participants have freedom of movement

- It is perceived as real and analogue, but time is elastic and reversible
- Objects are concrete but cannot be touched
- The black void creates a space that is at once embodied but unknowable

Above all there is always the potential of entering the uncanny – objects that appear stable and that act according to natural laws can transform into the unnatural. Materiality and solid relationships can dismember and escape into immaterial relationships: artworks call up both transcendent and immanent planes of aesthetic experience: impressions and apperceptions that invoke the intensity of the present moment combined with the ineffable. These paradoxical elements will be explored further in the case studies.

The notion of creating an ‘embodied’ experience that brings an audience into a shared space and explores how audiences interact with an artwork is a major part of the *Diasynchronoscope*. We wanted the experience to be somatic, of the body, one of ‘being there’. This leads to a pragmatic and semantic problem of what to call someone who is inside the *Diasynchronoscope*. The semantic consideration of labelling the spectator/subject/audience/viewer/reader/user/participant/receiver meets a pragmatic difficulty as the *Diasynchronoscope* experience is not only one where visuals are intertwined with sound, but it is also somatic. In his extended essay on the ‘*Techniques of the Observer*’, art historian, Jonathan Crary attempts to redefine spectatorship through marking historical constructs, which leaves him mourning the separation of the haptic from the optic. Crary makes a deliberate semantic distinction between ‘observer’ and ‘spectator’ taking it back to its Latin roots of: “‘*observare*’ [which] means ‘*to conform one’s action, to comply with*’, as in observing rules, codes, regulations and practices. (Crary, 1992, p. 6).²⁰ To this author, both nouns hold connotations of passivity that are unsuitable for describing the experience of someone in the space and they also underscore a supremacy of visuals over sound that is not the intention of the *diasynchronic* experience. This thesis has chosen to adopt the noun ‘participant’ from now on to describe the level of interaction that comes with ‘being there’ when the *Diasynchronoscope* is running.²¹ From early on, it was an ambition of the

²⁰ Media theorist, Lev Manovich also addresses this in *The Language of New Media* (Manovich, 2001, p. 205) where he suggests renaming a subject as ‘viewer’ then ‘user’.

²¹ The artwork ‘*Stylus*’ was shown to a distinctly ‘techy’ audience amidst many other installations and activities in music-making that were full of direct interaction. Feedback from participants on *Stylus* was collected on post-it notes and the one dissenting note was ‘*it would be better if it was interactive*’. This is discussed in the *Stylus* case study in chapter 5.3.3.

Diasynchronoscope to challenge the use of passive nouns to describe participants such as ‘user’ or ‘audience’ or ‘viewer’; instead artworks ask that participants recognize their true position to be that of active ‘exegetes’, reading and interpreting the gaps in space and time. Without their attention; nothing moves, without their movement; there are no depth cues. It is a participant’s interaction with the work that provides narrative meaning, transcending the static and hidden to create a Gestalt systemic whole, making each participant a truly immersed co-creator in the art systems. Without having a participant engaged in an audio-visual contract with the artworks and constructing movement using their individual perceptual shortcuts; there is no artwork.²²

The idea of depicting this ‘exegete’ role of the spectator was something that we investigated in an experimental artwork ‘*Prism*’, where the *Diasynchronoscope* was constructed to travel ‘through’ participants, the idea being that as the objects (or ‘iconic signs’ to use media taxonomy) travelled through the participant, there would be a transformation. Thus the spectator becomes the eponymous ‘prism’.

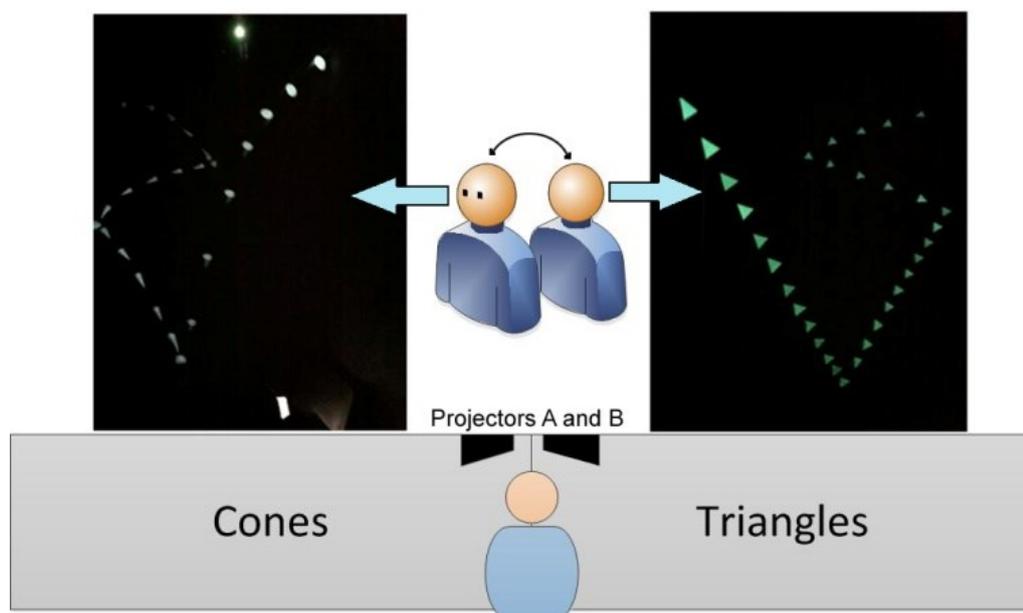


Figure 4 *Prism* (exhibited in the Nowhere Exhibition Sept 2012) The plan at the bottom shows the long, thin black out space and two projectors – Projector A illuminated organic bouncing cones and projector B illuminated triangles in straight lines There was a transition between the two above the participant’s head.

²²A parallel idea of ‘the viewer as exegete’ can be found in Kevin O’Regan and Alva Noë’s ideas on sensorimotor perception where they state: ‘*Visual perception can now be understood as the activity of exploring the environment in ways mediated by knowledge of the relevant sensorimotor contingencies.*’ (O’Regan J. K., 2001, p. 943).

The quality of the iconic signs and movement changed as they passed through and slightly above the viewer; with triangles moving in equally spaced straight lines (as laser particles) on one side - and the more three-dimensional cones bouncing in an organic manner (ie using the animation tropes of arcs and squash and stretch) on the other side. In the end *Prism* proved to be conceptually stronger than the execution of the artwork, and we overreached ourselves. The idea was dictated in part by the space (which was long and narrow and had a middle entrance) and in part from reading about the different approaches taken to theorizing on colour by Newton and Goethe. In this sense it was an autobiographical piece for me as I wanted to say something about the comparative approaches of Art and Science.²³ The intention was to use two projectors for the first time and also introduce colour, but for pragmatic reasons this proved over-ambitious: the colour was too weak with the quality of the projectors, and the set-up time for the projectors was too short for fine-tuning of the artwork experience. We did however manage to make participants turn with the animation, so there was a modest observable interactive element achieved.

It has become evident from observation over time that the threshold of perceptual engagement in the artworks by individuals has variations. Appreciation of apparent motion (with sound) appears to be perceived across a psychophysical spectrum. This is not an argument for subjective relativism, as nearly all participants report that they perceive movement and empirically it is evident that for the most part, perceptual short-cuts are a common, shared phenomenon. However a rare few reported that they did not see movement, and for these people, their experience is 'other' than what most see.²⁴ For these reasons, any discussion of the artworks must include an iteration of audience feedback.

One additional reason for audience reports of enjoying the experience of viewing the *Diasynchronoscope* comes from the medium's unique ability in combining animations with precisely synchronized sound. Sound is treated as a formal raw material that is

23 I was researching into the nature of 'after-image' which was empirically observed at this time by Goethe and it struck me as ironic that in 1810 the poet (Goethe) adopted a more empirical approach than Newton, although the (probably apocryphal) story of the scientist postulating gravity from observing an apple drop is one of science's great empirical stories.

24 Out of an approximate total diasynchronic audience of 8,000 we have had two reported cases. There was no noticeable difference in their visual physiology which was adjusted to normal (both wore spectacles) and the difference may have been purely psychological. One conjecture is that it results from attention functionality. It is an area that might prove interesting for future psychological experiments.

morphologically equivalent to the iconic objects placed and lit in the *Diasynchronoscope*. This means that sound and visuals are intertwined in a way far beyond that of most screen-based media and this makes for a unique and comforting gestalt experience. This synthesis of sound and vision is a primary element of much of animation's appeal, and was investigated at length by Michel Chion who coined the term for it of 'Synchresis', defining it as:

The forging of an immediate and necessary relationship between something one sees and something one hears.

Michel Chion (Chion, 1994, p. 5)

In the *Diasynchronoscope* we are constantly challenging ourselves to create 'bonds of inevitability'²⁵ between audio and visuals so that we create an added dimensionality to the way artworks are perceived. This is an original trope from animation, as observed in 1930 by the film maker and theorist, Sergei Eisenstein in a lecture at the Sorbonne where he concedes that the future belongs to sound film; '*...Particularly Mickey Mouse films. The interesting thing about these films is that sound is not used as a naturalistic element./ They look for the sound equivalent of a gesture or a plastic scene, i.e. not the sound that accompanies it in reality but the equivalent of this optical fact in the acoustic domain*' (Eisenstein, 2006)

The enormous success of Disney and sound film was naturally viewed with suspicion and a certain amount of jealousy by skilled practitioners and stars of silent movies. Charlie Chaplin rather petulantly observed on first experiencing the frame accurate synchronisation of Disney's Silly Symphonies (1929): '*Its not fair they don't have to breathe!*' But it was this innovative nature of using sound in precise synchronisation that made Eisenstein embrace Disney, hailing Walt Disney's Snow White and the Seven Dwarfs (1937) as '*the single greatest film ever made*'. (Eisenstein, 2006) Media theorist Sean Cubitt makes the point that this exploration of non-realism through juxtaposing sound and image held great attraction for Eisenstein:

For Eisenstein the power of the cartoon soundtrack is that it has no need to resemble or anchor the animated gesture in reality. Synchronization he had feared as overly depictive: here he could hope for a dialectic between sound and image.'

Sean Cubitt (Cubitt, 2004, p. 116)

²⁵ 'bonds of inevitability' is a quote from film editor, Walter Murch's foreword to Michel Chion's *Audio Vision: Sound on Screen*. (Chion, 1994, p. xvii)

Philosophers, Psychologists and Media theorists when discussing perception of reality or popular screen-based media are keen to distinguish the differences between conscious and unconscious perception, whether we give something covert or overt attention, or, to put it another way if our perceptions are active or passive. Chion makes the point that there are ‘*no eyelids for the ears*’ (Chion, 1994, p. 33) and goes on to extrapolate from this that ‘*sound more than image has the ability to saturate and short-cut our perception*’, remarking that:

The consequence for film is that sound, much more than the image, can become an insidious means of affective and semantic manipulation.

(Chion, 1994, p. 34)

The audio visual contract that a participant enters into in the *Diasynchronoscope* is one where both sound *and vision* saturate and short-cut perceptions, as due to the lack of other stimuli and through overt demands made on eye direction, the attention of the percipient is highly controllable.

1.7. DATA COLLECTION

Audiences are invited into the space either individually or in groups of up to ten and the animations are run either as continuous loops or as separate narrative experiences. Performance times vary, but usually run for about three minutes. Audience response can be recorded by observation, written feedback and/or recorded interview. There are two methods used for data collection using the *Diasynchronoscope*;

i) For the artworks this study has used empiric observation of participant response and semi-structured interviews alongside written feedback. These are communicated in multiple photographic and video diary formats on the project website. <http://www.doc.gold.ac.uk/diasynchronoscope/>

This thesis is a critical exegesis of how practical experimentation in the creation of artefacts using the *Diasynchronic* technique has advanced understanding of ways that perception codifies apparent motion in an ecological environment through phenomenological study. The artefacts have been created with the chief artistic paradigms of exploring narrative, synchronous sound and embodied audience perception.

ii) The artefacts use applications of animation tropes such as squash and stretch, morphing of successive objects, arcs and secondary motion; they also include explorations that echo Gestalt founder, Max Wertheimer's 1912 empiric experiments in seeing motion using a tachistoscope. However in the *Diasynchronoscope* the stimuli are real three-dimensional objects, and typically the designs employ a series of stimuli rather than stroboscopic events.²⁶ The explorations have included:

- a) variations of time intervals between visual stimuli
- b) variations of stimulus duration
- c) variations in arrangement of stimuli, in terms of inter-object distances and orientation in space
- d) variations in shape, colour and size within invariant objects
- e) Introduction of additional objects as attention-based stimuli and as occluders
- f) variations in coding of stimuli
- g) multiple attentive objects

There has been a marked interest from psychologists in the *Diasynchronoscope* but there are some limitations to using the *Diasynchronoscope* in its current state as a perceptual psychology research tool, particularly in terms of accurate replication of experiments. Whilst we can make very accurate measurements of durations and number and luminance of objects lit, temporal measurement in movement is only half the story: In the *Diasynchronoscope*, movement usually takes place in space (I use the term 'usually' as change in luminance or colour can occur over time but in the same space, on the same object). The spacing of the objects for the artworks so far has been decided upon in an organic process through prior knowledge of animation principles and trial and error. This is also true of changes in orientation, and 'morphing' to include animation tropes such as squash and stretch. Clearly to develop the technique as a research tool for experiments that generate more data than simple, empiric observation, we would need to enhance replication and accurate measuring, perhaps by changing scale or lighting objects internally using diffuse light emitting diodes (LEDs). This is an area for future exploration and Trope has a UK patent pending on '*Illuminating the diasynchronic system with electroluminescent materials*'.

²⁶ Although Wertheimer's experiments were mostly stroboscopic, he did include some brief study of series of stimuli where 3 or 4 stimulus objects were presented using the tachistoscope, (Wertheimer, 2012, p. 66) particularly after taking into account discussions with Karl Marbe whose doctoral thesis "*Zur Lehre von Gesichtsempfindungen, welche aus successiven Reizen resultieren*" had been on successive stimuli and visual sensation.

Refining methods of data collection in the project has run in parallel with the craft and technique of emergent studio practice, technical challenges and developing an artistic voice, but further developing this side requires resources and a skilled understanding of psychology that is beyond this doctoral student. A project website has been built and maintained and there has been some collaboration with cognitive psychologist Dr Etienne B. Roesch of Reading University, with two papers having been written in partnership. It is hoped that this will lead to fruitful further collaborations.

1.8. FRAMING THE FRAMELESS

The hybrid nature of the *Diasynchronoscope* is reflected in the diverse crafts that it draws upon, and it is a challenge of this thesis to synthesize these crafts within a defining area of study. This has undeniably been a difficult process, with many blind alleys and wrong-turnings.

There are obvious parallels between the *Diasynchronoscope* and the history of cinema, making it a useful conceptual lens for mapping it as a new medium, whose strengths (and weaknesses) are now coming to the fore. The heart of this thesis is a study of the formalisms in the *Diasynchronoscope* and for this reason I have turned to the writers who have looked at the formalisms of film and audio for guidance. In particular I have used ontologies described by Rudolf Arnheim and Michel Chion as springboards for discussion.

Technologically, the current *Diasynchronoscope* system is undoubtedly a compromised one in terms of reproducing veridical vision outside of a black-out space - and in long-term research terms this would be an aspiration - but I hope that the reader of this text finds honesty in the rawness of the medium, and beyond that I hope that this exegesis will provide a deeper truth to the art. For the purposes of the research so far, I subscribe to Eisenstein's and Rudolf Arnheim's belief that art should not strive to be simply an imitation or selective duplication of reality, but rather a translation of observed characteristics into the terms of a medium and it is this more modest claim that I hope to make for the *Diasynchronoscope* as an artistic medium.

There is an underlying assumption to this thesis that the technique can be developed considerably in time and it takes some solace in these words from the French philosopher, Gilles Deleuze, here writing on how cinema initially imitated natural

perception, before evolving its own grammar through using techniques of montage and the mobile camera:

*The essence of a thing never appears at the outset, but in the middle,
in the course of its development, when its strength is assured.*

Gilles Deleuze²⁷

So far I have provided a broad overview of the history and motivations behind this practice-based research and discussed the hypotheses and research questions that underpin this thesis. I have given a general overview of studio practice and the participant nature of the audience. The next chapter will start to address the question of whether the Diasynchronoscope is a new medium for experiencing apparent movement by examining its similarities and differences to the practical and theoretical tools that the art system draws upon. The thesis aims to demonstrate that the emergent grammar of the *Diasynchronoscope* is unique and that this proves that it is a distinctive medium in its own right.

²⁷ French Philosopher, Gilles Deleuze in *Cinema 1: The Movement-Image*. (page 3) (Deleuze, 1986)

2. FOCAL THEORIES

Analysis of the praxis of creating perceptions of apparent motion using the *diasynchronic* technique draws on three focal areas: Animation, Gestalt psychology and the overlapping field of embodied cognition. It is a conceit of this thesis that the entire study itself forms a *Gestalt* study as its core premise is that the final perceptual whole is different to its constituent parts. The following three sections offer an overview of how these focal constituent parts fit into this research, using early examples of the first experiments with the technique.

2.1. CHANGE MADE MANIFEST - THE THEORY AND PRACTICE OF ANIMATION

Catch that and paint it green!

Animator Tex Avery²⁸

For much of my life as an animator, animation has been considered a practice unworthy of academic study, condemned as an immature medium made only for an audience of children. Yet from the very outset of film as a medium there has been a strong overlap between ‘live action’ film and animation. Indeed it could be argued that animation is a more tangibly creative and formative medium than film as it is less a slave to realism, and carries more evident authorship. Today cinema marries animation and live action so seamlessly that new media scholars such as Lev Manovich have argued that, far from animation being a subset of film, all film is ‘in fact’ animation in that it is frequently manipulated on a frame-by-frame basis (Manovich, 2001).

With the publication of *The Illusion of Life: Essays on Animation*, (1991) animation finally grew up as an area worthy of study, with editor Alan Cholodenko arguing in his introduction that the profound issues that animation raises ‘*challenge, even suspend, certain axioms of film theory and Film Studies*’ (Cholodenko, 1991, pp. 9-10), not least by highlighting the distinction between representation and simulation. Besides, as Cholodenko points out, ‘*animation film not only preceded the advent of cinema but*

²⁸ Said to be cried out by the creator of *Bugs Bunny* and *Daffy Duck* each time he broke wind (Wells, 1998, p. 150).

engendered it' (Ibid.: p.295). This is discussed further in Chapter 3.2, where the *Diasynchronoscope* is contextualized in terms of the history of 'devices of wonder'.

The field of animation studies has been further boosted by organisations such as the *Society for Animation Studies*, and an animation journal edited by Paul Wells²⁹, so that now works of scholarship have begun to be produced on the subject and it has emerged as a legitimate area for academic enquiry.

Because the digital revolution has opened up animation to the tyro practitioner and artist, the boundaries are constantly blurring and being tested. Unlike film, theorists in animation are often practitioners, so the practice of animation as an art form has emerged from the niche realms of Len Lye scratching directly on film and visual music to becoming a legitimate and accessible form of expression. In short, it has grown-up. One supporter of animation as a form of time-based, moving art is animator Alexandre Alexeïeff who argues that to define animation '*just because it moves*', via the medium of film is reductive, remarking it could just as well be '*painting, drawing, engraving or even sculpture in movement.*' (Bendazzi, 1995, p. xix) Animator Philip Kelly Denslow, (whose work in computerized animation tries to eliminate the biological creator) remarks in *A Reader in Animation Studies*: '*All definitions of animation have to be re-thought in the context of changing technology*' (Denslow, 1997, p. 2) and animating within the limits and opportunities offered by the *Diasynchronic* technique does indeed seem to offer some new ways of framing the practice of animation and give cause to rethink some basic tenets of animation.

Reflection on the impact of the new technique of screen-less animation has been additionally sharpened by the fact that during this study I undertook some teaching of 3D animation to first year students. One of the most striking illustrations of this rethinking of basic animation techniques came early on, when having decided to using a bouncing block rather than a ball, I took the same idea to my students. It is usual to introduce students to animation through demonstration, discussion and replication of animating a bouncing ball as it demonstrates many of the twelve basic principles of animation.³⁰

²⁹ Animation Practice, Process & Production published by Intellect Journals (visual Arts) (Ed. Paul Wells)

³⁰ A serendipitous by-product of animating with a block was that I discovered it was a far better pedagogical tool for introducing students to animation than the more usual bouncing ball, because the rotation of the block is clear and it is easier to calculate consistent volume. After I disseminated this, my experience was confirmed by other teachers of animation.

The animation practice of creating the illusion of movement cannot be discussed without referring to the twelve animation principles first espoused by the Disney studios in the 1930's. An updating of the principles by translating their application to 3D computer animation was explored by John Lasseter in his much cited 1987 *Siggraph* paper (Lasseter, 1987), and the fact that the twelve animation principles have stood the test of time and have been adapted successfully to new methods of animating in 3D Computer Graphics and even utilized as enhancers to motion capture, means that many of them are still pertinent today.

Although the principles here are specifically for character animation, I will list them all and then discuss the ones that are relevant to the *Diasynchronoscope*. Some of the principles deal precisely with expressive quality of movement, some with how to direct an audience's attention and some with how to animate economically. They are meant to be used in parallel (but not exhaustively) and so any animation would expect to benefit by employing some of them. For the animator they are a useful checklist in creating believable and characterful animation.

The twelve principles are:

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

It would be useful to look at these with the first experiment that was made using the *diasynchronic* technique. As already discussed, the first thing animated using the technique was, in the best tradition of animation, a bounce.

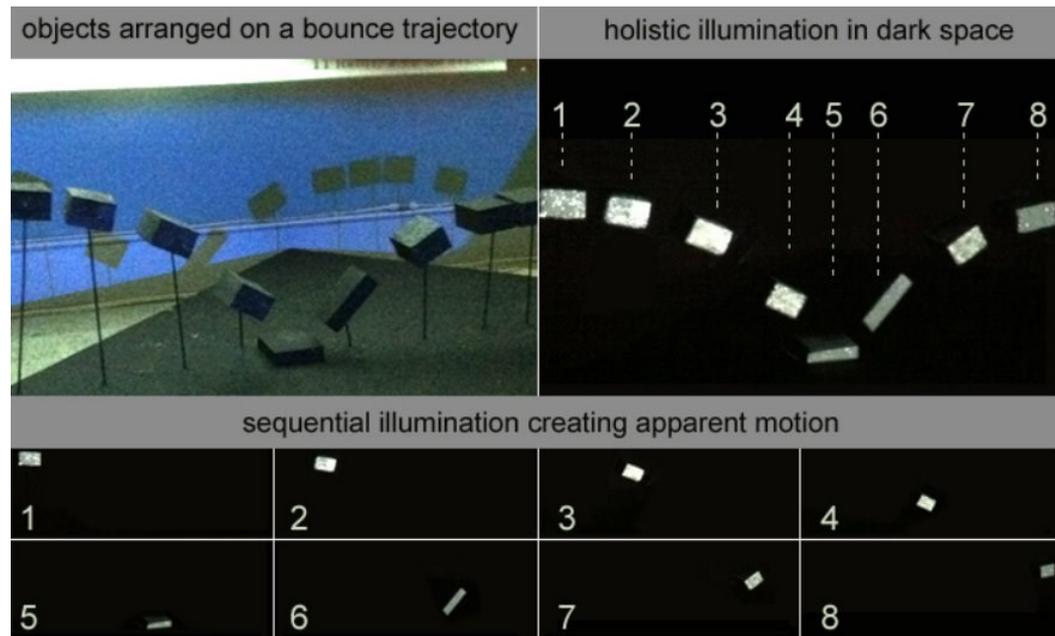


Figure 5 Design of the first Diasynchronoscope animation representing a single bounce with a block as the ‘hero’ object. The figure on the left shows the whole installation, and on the right, the camera view (with all the objects lit) is depicted. During the animation, each object is lit sequentially, leading the observer to perceive the continuous motion of the block in the environment.

We chose to animate a block as our ‘hero’ object³¹ and not a ball because the angles would reflect the 3D nature of the object better and because they were easy to make. The block is made from polystyrene painted black and skewered on wooden sticks for ease of arrangement.

The first and generally acknowledged most important animation principle is that of ‘**Squash and Stretch**’. In his *Siggraph* paper, the animator and founder of Pixar, John Lasseter discussed this principle not just as a desirable, indeed essential, principle for animating facial movement but also for the way squash and stretch can be used by an animator to relieve the disturbing effect of strobing that happens sometimes in depicting very fast motion. ‘Strobing’ occurs in cel (drawn) animation if the distance an object moves between frames is so great that there is no overlap and the eye begins to perceive separate images. These traditional observations held interesting repercussions for the *Diasynchronoscope*, where at first I expected it to be a major concern: It is also generally held in model and clay animation that one should always leave an overlap between perceived silhouettes of models between movements – this was rarely an issue with

³¹ In animation the essential basic character or object being animated before any transformations is called the ‘hero’ object, (a taxonomical rewrite of ‘iconic object’ from semiotics).

characters, but could occur when animating vehicles for instance. There are a number of ways an animator would deal with this problem – in computer animation we would add blur, in model we would never move an object beyond its previous silhouette from the camera’s point-of-view and, as Lasseter indicates, in clay and drawn animation we would stretch the figure (Lasseter, 1987). In the *Diasynchronoscope* the objects *have* to have distinct silhouettes and initially this was a major concern for me as an animator. This first experiment of the bouncing cube demonstrated it was not the problem I had anticipated; the cube definitely was perceived as being in apparent motion and appeared to bounce, despite there being no overlap.³² It was not until much later that I found a potential explanation for this in Wertheimer’s studies and in more recent work by neuroscientists using fMRI scanning.

In **Figure 5**, it can be seen that the cube undergoes ‘**squash**’ at the of the base of the bounce (no. 5) where it flattens, and ‘**stretch**’ in the following object (no. 6) where it kicks up after the bounce. Although when seen as stills, these deformations look extreme, when viewed in sequence, they appear perfectly natural. It should be noted that in employing squash and stretch, the volume of an object should be maintained to sustain believability. Lasseter and many other animators believe in stretching an object towards a bounce as well as stretching it after the bounce (see **Figure 6**). It is my contention that the stretching of a ball as it descends towards the base-line squash as shown in numerous animation books and articles is an anomaly³³. As an animator, I would argue that the second bouncing ball has greater ‘kick’ and is more believable. It is a contention of this thesis that the pre-bounce stretch has been brought about in order to avoid strobing because the stretch covers the gap between animated objects, to quote from Lasseter’s paper:

If motion is slow, then the objects overlap between frames and the eye smoothes out the motion. But if the motion is too fast, such that there is no object overlap, then the eye sees separate images and the object appears to strobe. A solution is to stretch the object to retain the overlap and smooth motion.

(Lasseter, 1987)

³² In substantiation of this claim, film of this first experiment can be viewed at <http://www.doc.gold.ac.uk/diasynchronoscope/early-experiments/>

³³ For a traditional example see ‘*Timing for Animation*’ (Whitaker & Halas, 1981)(p.35), the incomparable bible for animators, still studied over 50 years and ten editions by Preston Blair (Blair, 1997 (1st ed 1949)) and <http://www.idleworm.com/how/ann/01b/bball.shtml> (key frame 6) for computer *Flash* users.

The issue of overlap is not an essential concern today in animating in 3D computer graphics where, to facilitate realism, blur would be added. Even if the pre-bounce stretch is a hangover from the days of drawing on cels, it is a modest consideration when viewed in the light of greater techniques of animating for weight and character. In an animation paper, published in 2007 (MacGillivray C. , 2007), I took on a re-analysis of the bounce and further discussed it in relation to the *Diasynchronoscope* in a recent paper. (MacGillivray, C., Mathez, B., 2013)

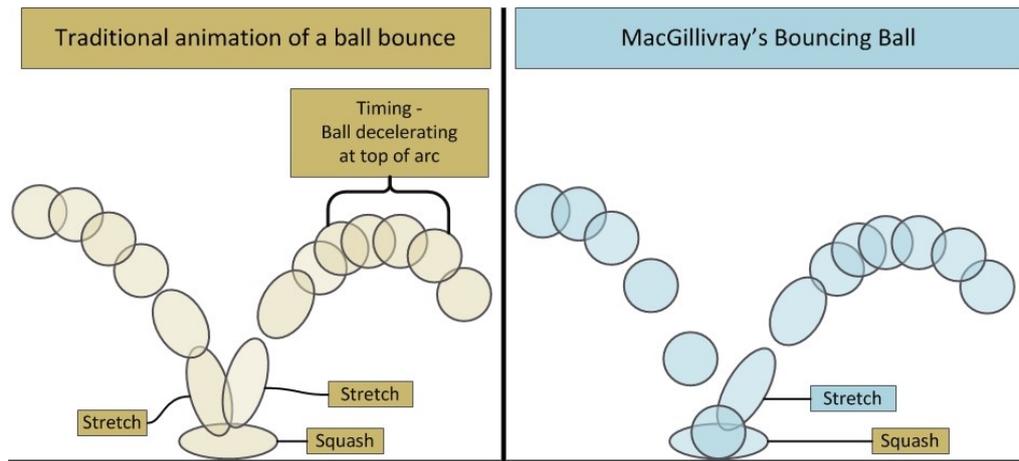


Figure 6 Demonstration of the difference between a traditional stretch and squash in a ball bounce and the author's version. (MacGillivray C. , How Psychophysical Perception of Motion and Image relates to Animation Practice, 2007)

The second principle, **Timing** (also occasionally appended with '**and motion**') is the defining category for the expressive quality of any movement, and it is also demonstrated in this first experiment (**Figure 5**). The animation runs at 24 frames per second (fps) where each frame represents 41.6 milliseconds. The typical rate for film viewed on UK television is 25fps, and it has always been the case that animators work to 24fps because of its easy divisibility. In keeping with another animation trope, this animation was shot on 'twos' where each block is generally lit for two frames. Because in the *Diasynchronoscope*, lighting a block is isomorphic with a frame of animation, by lighting an object for two frames we are effectively economizing on the number of animated stimuli required.³⁴ Here the first four blocks and the last two blocks are illuminated for 83.2 ms (2 fps), block five (the squashed block) is lit for 124.8 ms (3 fps),

³⁴ As animation is an arduous process, animators have always looked for short-cuts. It is common for less expensive TV animation to use 'shooting on twos' or double up each frame, as animation will mostly still read at this speed and the sacrifice in quality can be perceived as negligible against doubling an animation budget. It also means that you can be flexible in places where 12fps is too coarse and change up to 24fps for specific fast movements.

and the sixth block for 20.8 ms (1 fps). This is one use of timing that is crucial to an animator's art, but it is only one way of manipulating timing. When time is translated into space, another dimension to timing is distance. Where time = t and d = the space between objects, $t = 1/d$. Objects that are positioned closer together will move more slowly than objects that are spaced further apart (illustrated in **Figure 5**). This common understanding in animation of the relationship of time and space in visuals has been studied in other sensory modalities particularly as an aural and a tactile experience by psychologists where it is known as the '**Tau**' and '**Kappa**' effect. Our perception seems to be altered when time based phenomena are experienced as spatial phenomena. The Tau effect describes dependence of spatial judgments on the temporal context, whereas the Kappa effect is a corresponding dependence of temporal judgments on the spatial context. In the Kappa effect the elapsed time between two stimuli can be made to appear shorter (or longer) by decreasing (or increasing) the distance between the two stimuli. This mutual alteration of the perception of time and space could give new insights into manipulating viewer perceptions in installations such as the *Diasynchronoscope*, where time and space are inter-connected. I discuss this in greater detail in Chapter 6.

The third principle, '**Anticipation**' is not demonstrated here, but versions of it have been attempted using sound, light and spatial proximity. In character animation it can be defined as the way a character prepares to move, frequently by moving *in the opposite direction* before any action. This has two effects. The first is that for a character to overcome inertia and to generate the impetus to move, it is usual for any action to be anticipated by a gathering of energy.³⁵ This first effect does not yet have relevance in the *Diasynchronoscope*. The second effect is one of drawing attention from the audience to the character. In animation, movement is costly, and so it is essential that the viewer's eye is directed towards any movement. It is important not to waste frames moving a character if no one is looking. The question of how to direct a viewer's attention prior to animated action was one that occupied us quite a lot in developing a grammar for animating successfully in the *Diasynchronoscope*. As will be discussed, we have used directional sound (in *swing and bounce*), and spatial proximity (in *One, Two, Three...*) and light (in *Stylus*) to direct an audience's attention to a specific place in space before an action happens.

³⁵ To illustrate this to students, I would get a class to stand up and try to jump without bending their knees. That it was impossible never failed to surprise some students.

The fourth principle, '**Staging**' was also of major importance in the *Diasynchronoscope*. As with anticipation, an important objective of staging is to lead the viewer's eye to where the action will happen so that they do not miss anything. This means staging actions theatrically so that the action is in silhouette and using high contrast between a figure and its background. Staging is fundamental to composing a camera shot so that an action is easily readable. With the *Diasynchronoscope*, there are two sorts of staging: i) for the viewer (in replacement of the camera) and ii) for the light source (the projector) In the bouncing block example of **Figure 5**, the action runs virtually perpendicular to the 'camera' for maximum readability (because at the beginning we were focusing particularly on exploring movement and not particularly interested in exploring depth), but for our first public installation we wanted to use depth as it was a major strength of the technique. We also were aware that the objects became more readable if they presented an edge to the viewer and more than one plane was lit. This has major repercussions for orienting the objects and positioning the projector. Moreover because the viewer is not constrained to a single viewpoint (and with each installation audiences are increasing in numbers and are able to move with increasing freedom), this is an area of continuing experimentation. With the artwork *Stylus*, for instance where the audience could walk all around the installation, the stage as a proscenium arch disappears entirely and staging brings whole new challenges.

Although grouped together in Principle five, '**Follow Through and Overlapping Action**' are two distinct ideas in animation. The first is essential for creating expressive movement in characters. Any sports person who plays with a racket or a club will recognize the importance of following an action through past hitting a ball, and any dancer knows the importance of finishing a gesture to the end of their fingers and toes. This is a difficult concept to demonstrate using the diasynchronic technique, although there are some ways of approximating it through diminishing scale and timing. Overlapping action is more of a hint to animators not to leave any 'dead' moments on screen and this is most certainly true of animating using the *Diasynchronoscope* where a 'dead' moment would lead to total black-out. As we have become more sophisticated with the technique, we try to catch successive waves of attention, and hold them while introducing others, often using sound as a bridge between visual motifs. In essence, here the technique more closely resembles music using looped visual motifs and building on them to create a visual 'symphony'.

‘**Straight Ahead Action and Pose-To-Pose Action**’ are two contrasting methods of animating. ‘Straight Ahead’ means animating movements in sequence and it is the only way to animate in claymation for instance where each filmed frame is a palimpsest, wiping out the previous moment in action. Traditional drawn animation more frequently employed Pose-To-Pose Action; here the lead animator would create ‘key’ frames of extreme action and dictate timing, and a junior animator would learn the craft by creating the ‘inbetweens’ to the key frames. In modern 3D computer graphics the keyframes are ‘inbetweened’ by the computer with the animator having a number of extra Bézier controls to tweak timing and curves of action. With the *Diasynchronoscope* we combine both methods: we tend to animate initially using Straight Ahead animation, but we also modify this with some Pose-to-Pose and often construct arcs of action as continuous events between ‘key’ frames. So for the bouncing block animation in **Figure 5**, we first placed block 5, the base of the bounce, as the ‘key’ and then rapidly positioned the other objects which had been pre-made. In many ways the method we employ is different to any other animated method as the objects have to be pre-made before positioning; leading to a more fluid way of animating that can be tweaked in situ.

Principle seven, ‘**Slow In and Out**’ is also known as ‘Ease-in and Out’ in computer graphics, where it is used to control Bezier curves such as to slow speed of movement as at the top of the bouncing ball’s arc. More generally it refers to more appealing ways of creating any movement by a character and also ways of moving a camera (ie easing in and out of a pan) so that they appear more natural and less jerky to the viewer’s eye. In this sense it is too subtle for use in the *Diasynchronoscope*.

Principle eight ‘**Arcs**’ is a simple directive to animators to remember that all natural movement is in arcs. Arcs are crucial not only to create believable movement as nothing in nature moves in a straight line, but also to please a viewer’s eye. When the attention path of a viewer follows an arc it is usually in smooth pursuit and not being directed in saccadic jumps.³⁶ When the eye is in smooth pursuit or ‘tracking’ an object, there is evidence that our gaze moves in a predictive path ahead of the stimulus, as when we predict where to catch a ball (Cavanagh P. , 1992) (Cavanagh P. , 1994), We have made extensive use of arcs in the *Diasynchronoscope* as keeping the eye in smooth pursuit is a

³⁶ Saccades are the jumps between fixations of the eye. This darting around occurs at a rate of about 3 per second, is involuntary and critical to vision because the brain edits out the moves and keeps updating the environment through saccades. Smooth pursuit is where eyes move in a continuous path without any pauses or jerks as when tracking a moving object. I discuss this further in Chapter 3.

great aid in making the animation read well. The nature of the arcs in the *Diasynchoscope* tends to be purer than the arcs usually created in 3D computer graphics because they are often created on splines. The revealed arcs of motion hold an aesthetic beauty of their own which is one reason we often choose to reveal a static sculpture of diasynchronic pieces where all the motions in time are revealed holistically to cap the experience of the *Diasynchoscope* installation.

Principles nine, eleven and twelve of ‘**Exaggeration**’, ‘**Appeal**’ and ‘**Personality**’ are more to do with caricature and character animation and so are not relevant to the *Diasynchoscope*.

Principle ten, ‘**Secondary Action**’ describes any action that directly results from another action, such as billiard balls hitting each other or a scarf flapping behind a moving character. It is important one for the *Diasynchronic* technique because one way of communicating properties of a hero object is to have it affect another object. Experiments with causal effect were investigated by a Belgian psychologist Albert Michotte, who found such strong evidence for it amongst subjects in interpreting his experiments with colour blocks that he erroneously concluded that the attribution of causal effect was innate. (Michotte, 1963)³⁷ The idea of causal effect is investigated further in the section on Embodied Cognition in chapter 2.3.1.

	Animation Principles	Common to the Diasynchoscope	Dysynchoscope Tropes
1	Squash and Stretch	Yes	Improves veridical perception/increases believability. Overlapping not as necessary as thought in traditional animation.
2	Timing	Yes	Time is directly transposed to space and the speed of apparent motion is: distance between objects (d) / (t) time of illumination. Where d = variations of distance between visual stimuli (concretely visualised in space) and t = variations of stimulus duration
3	Anticipation	Yes	Not as for character animation, but the <i>Diasynchoscope</i> can use sound, lighting effects or spatial proximity to anticipate movement.
4	Staging	Yes	Very important in construction for the light source (the projector). Interesting tropes revealed as the mobile spectator replaces the camera (discussed in Chapter 6)
5	Follow Through and Overlapping Action	Yes	In the <i>Diasynchoscope</i> it is even more vital that there is no ‘dead’ space in the animation as this leaves the audience in the dark - so we use successive waves of movement pick up from each other in a sort of visual melody

³⁷ In his 1945 book, *The Perception of Causality*. Later disproved by (amongst others) Darren Newtson who found that expectation strongly affects action perception because viewers must be prepared to see an action in order for them to see it. (Newtson, 1976)

6	Straight Ahead Action and Pose-To-Pose Action	Yes	Both are used. Demonstrated by concrete construction of supports for objects being positioned in space
7	Slow In and Out	Yes	Limited use of this - not as nuanced as for character animation
8	Arcs	Yes	Arcs suppress saccadic eye movements, and the viewer follows movement in 'smooth pursuit'. Aesthetic beauty of arcs revealed in holistic views – the arcs closely parallel the Gestalt principle of 'Good-continuation'
9	Exaggeration	No	The <i>Diasynchronoscope</i> is not easily adapted to character animation (although squash and stretch is a version of exaggeration)
10	Secondary Action	Yes	This translates as causal effect in perceptual psychology, and is an essential trope in the <i>Diasynchronoscope</i> for reading fast movement in space
11	Appeal	No	The <i>Diasynchronoscope</i> is not easily adapted to character animation, yet does maintain much of animation's immediate appeal.
12	Personality	No	The <i>Diasynchronoscope</i> is not easily adapted to character animation

Table 1. A comparison between the Diasynchronoscope and Animation Principles.

Taken as a group, the Animation Principles offer one starting framework for investigating the emergent grammar of the *Diasynchronoscope*. One drawback is that they do not include two major tropes of animation; **Looping** and **Synchronous Sound**.

Looping is a principle that which has become even more important since the advent of computer animation. Loops or cycles have always been used to cut down an animator's workload: the typical walk cycle, for instance, involves animating a character taking just two steps and then repeating these over a moving background to give the impression of camera tracking a walking character. Computer animation software, such as *Macromedia Flash* encouraged using nested loops to create animations for formulaic and economic reasons, and animated gifs used in motion graphics required simple loops to keep the file sizes as small as possible. However, the biggest use of loops is in Computer Gaming, where the gamer can make a character walk or run in any direction interactively. It is also invaluable for the motion graphics of non-character animation, in games such as *Tetris*. The *Diasynchronoscope* makes much use of loops, partly for the very pragmatic reason that it saves on space needed and so reduces the number of objects in an installation.

The *Diasynchronoscope* also makes much use of **Synchronous Sound**. This is probably not noted as one of the fundamental traditional principles because the practitioners for whom they were originally written were unlikely to be involved in sound

creation and worked to pre-constructed soundtracks, but it does seem to be a significant omission in terms of the modern animator. Many animators work across sound and image equally now and it is commonly part of an animator's education to learn about sound recording and mixing alongside creating accompanying visuals. The second framework for this investigation, which is Gestalt psychology, includes (at least nominally) investigation in sound, still image and movement. The concrete nature of animating inside the *Diasynchronoscope* reveals how closely animation principles parallel Gestalt laws of 'prägnanz'.³⁸

2.2. THE GESTALT OF GESTALT

One sees motion: an object has moved from one location to another. One describes the physical facts: Until time t_1 , the object was in position p_1 . From time t_n on, it was in position p_n . In the interval between t_1 and t_n , the object was successively, continuously in space and time, in the intermediate positions between p_1 and p_n , through which it arrived at p_n . One sees this motion.

Max Wertheimer, 1912³⁹

Thus starts the seminal article that gave us the foundations of Gestalt psychology. Wertheimer hypothesizes that 'a subjective completion' must have somehow occurred between one stationary event and the next and goes on to identify pure, objectless motion in the form of the *phi* phenomenon, taken by many to be one possible explanation for why, given these circumstances, 'One sees this motion'.

The prominent founders of Gestalt theory are Max Wertheimer, Wolfgang Kohler, and Kurt Koffka. Kurt Koffka joined the Psychological Institute in Frankfurt am Main in 1910 where he met Wolfgang Kohler, and together they joined Max Wertheimer in his laboratory studying motion perception. The three of them became lifelong partners and together established the school of Gestalt with a view to redefining approaches to psychological research through a set of theoretical and methodological principles. The guiding theories were that of Totality; that conscious experience should be considered globally, by taking into account all the physical and mental aspects of the individual simultaneously, and more controversially, the theory of psychophysical isomorphism;

³⁸The closest translation from the German would be 'pithiness'

³⁹ (Wertheimer, 1912) From the start of his ground-breaking article in *Zeitschrift für Psychologie*. Translated in the book edited by Lothar Spillman (Wertheimer, *On Perceived Motion and Figural Organisation*, 2012)

that there is an exact correlation between conscious experience and cerebral activity. The Gestalt school founded its methodology on subjecting observable phenomena to real experimentation. The founders took experimentation on subjects out of the lab and attempted to conduct experiments in natural situations and in real conditions to produce a greater fidelity to the real world. In this respect they are closely allied to more recent work in Embodied Cognition and sensorimotor accounts of visual consciousness. Although all three founders studied motion, the ground-breaking motion study credited with founding Gestalt psychology was Wertheimer's discovery of *phi* movement in 1912. Media theorist and perceptual psychologist, Rudolf Arnheim (who studied with Wertheimer in Berlin in the 1920's) later extrapolated many of the Gestalt principles to create a new comprehension of film theory (Arnheim, *Film as Art*, 1958).

The most important notion in Gestalt is that the whole carries a different and altogether greater meaning than its individual components, highlighting the deficiencies in atomistic theoretical approaches. As an illustration imagine how a film is so much more than a sum of its parts: shots, scenes, montages, sound, music, dialogue, actors, film stock, projector and light. In viewing the "whole," a cognitive process takes place – the mind makes a leap from comprehending the parts to a meta-realization of the whole. Gestalt thought continues to have impact because it confounds mechanistic models of human perception: We visually and psychologically attempt to make order out of chaos, to create harmony or structure from seemingly disconnected bits of information. How we best could receive this information and arrange it is governed by a fundamental to Gestalt theory; the 'law of Prägnanz'. Prägnanz is a German word that translates roughly as salience, incisiveness, conciseness, impressiveness, or orderliness or as previously remarked 'pithiness'.⁴⁰ Gestalt theory offers us several Gestalt laws or principles of perceptual organization that offer insights into how we perceive and group information in our minds according to Prägnanz. They are not limited to static visuals, but include motion, and auditory Gestalt. The principles are listed here with a brief discussion of their relevance to the *Diasynchronoscope*:

Figure/Ground articulation

This principle denotes our perceptual tendency to separate whole figures from their backgrounds based on one or more of a number of possible variables, such as contrast, color, size or movement. The opposite of this articulation is the camouflage adopted by a many animals in natural settings. Everything that is not 'figure' or 'foreground' is

⁴⁰ It is sometimes translated in English design terms as the 'Law of Good Form'.

ground, or negative space. Some art such as traditional Japanese art for instance brings the ground to the fore, conferring an equal weight to the negative space as to the figure. The animation principle of **Staging** could be mapped to the figure/ground articulation principle. By lighting objects crisply in white against a black background in the *Diasynchronoscope*, we are demanding an observer's attention through Figure/Ground articulation. When this is accompanied by apt and synchronous sound, there is a Gestalt marriage. This is the only principle that deals with separating out a stand-alone object – all other Gestalt principles concern grouping.

Similarity Principle

Things which share visual characteristics such as shape, size, color, texture, or value will be seen as belonging together or 'grouped' in the viewer's mind. Repetition of forms or colors in a composition is pleasing in much the same way as rhythm is pleasing in music. The forms need not be entirely identical – there may be variety within the repetition - yet the correspondence will still be discernible and similarity or repetition in an image often brings connotations of harmony, rhythm and movement. Animation use of squash and stretch means that we carry the continuity of an object through, although it may be morphing in shape. Use of similarity in composition can impart a new meaning to the viewer that is independent of the overt subject matter of the constituent composition.

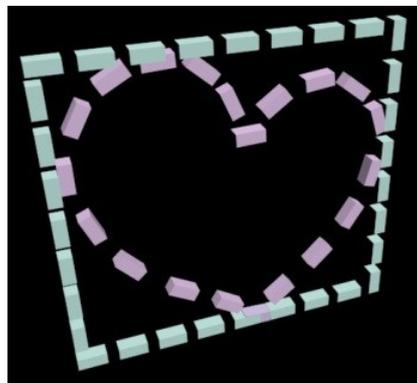


Figure 7 A heart and square made from similar blocks – the two remain distinct even if animated as beta movement one block at a time in rotation. The holistic is also read in time because the square and heart are simple and iconic. For this reason these would both work for phi movement too.

Proximity Principle

When objects appear close to each other, we tend to form them into a conceptual group. This is also implemented in the *Diasynchronoscope* when rotating objects in apparent motion. As observed by Wolfgang Metzger in his 1934 paper on Gestalt influences on motion; '*an object followed by another that rotates less than 180 degrees*

will be perceived as having rotated the shorter distance'. One way of understanding this is to imagine animating a clock hand from 12, if we move the clock hand to 8 in order to animate it, it will be perceived as going backwards through the acute angle rather than travelling clockwise from 12 to 8. Metzger directly attributes this to the '*law of proximity*'.⁴¹

Common Fate Principle

Elements tend to be perceived as being grouped together if they move together. This is an extrapolation of the visual grouping of the similarity principle to movement, and so is often left out of design books that are purely interested in visuals, not dynamics. Dynamic versions can be found in the pleasure we find in watching waves break or the wind sweeping across a field of wheat. Other examples are a line of chorus girls/dancers moving simultaneously or the skilled choreography of battle scenes of Kurosawa. Viewpoint is crucial to good interpretation of common fate – for instance many big stage numbers in Busby Berkeley Musicals would be meaningless without the overhead camera wide-angle, top shot. In movement, the principle of Common Fate corresponds to the animation principles Follow Through and Overlapping Action and Secondary Action.

Good Continuation Principle

This governs how oriented units or groups are integrated into perceptual wholes if they are aligned with each other. We tend to continue shapes and lines beyond their ending points, and so meet up with other shapes or lines, particularly if the path followed by our eyes is smooth. This is crucially very similar to the use of arcs in animation and is fundamental to much of the *Diasynchronic* technique, where objects are aligned to create smooth flowing arcs. An illustration of how important it is to marry ends of lines or objects in good continuation is shown below.

⁴¹ Translations of Metzger's work are rare, but Robert Sekular has published an online translation of chapter 16 of his major work from "Von gesehener Bewegung" (On seen motion), from Metzger's *Gesetze des Sehens* (2nd edition, 1953, Frankfurt am Main: Kramer Verlag). The translation was prepared by Ulric Neisser (Cornell University). <http://people.brandeis.edu/~sekular/metzgerChapter/MetzgerChapter16.html> and this quote comes from section 9. Modes of Appearance of Movement.

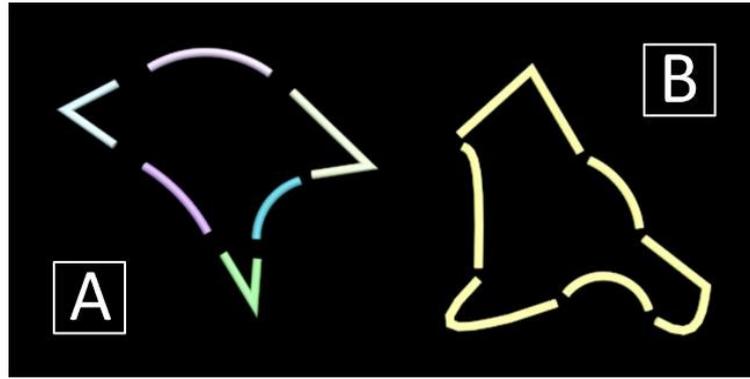


Figure 8 an illustration of the good continuation principle. The figure on the left, A, has good continuation although it is an unusual shape and the elements are different colors because the edges of the lines are aligned and the figure lines flow easily towards each other. Some research has shown that we perceive dotted lines in the same way as continuous lines. In the second figure, B, the flow of the figure is disrupted and it would be difficult for a viewer to reproduce from memory.

Closure Principle

Closure is the satisfying effect of recognizing a pattern. Our brains are so drawn to patterns that we tend to see complete figures even when part of the information is missing. Closure occurs when elements in a composition are aligned in such a way that the viewer perceives that the information could be connected, and the eye understands something as being part of the composition even though there is “nothing” there. The most famous example is the Kanizsa illusion where a triangle is defined by absent acute angles in smaller circles. Film and animation audiences suspend their disbelief and immerse themselves in a two-dimensional experience enhanced only by sound. Viewers of animated films not only accept that still images move, they also happily accept that elephants can fly, giant apes scale the Empire State Building and sponges have personality. To quote the film theorist and perceptual psychologist, Rudolf Arnheim:

In order to gain a full impression it is not necessary for a film to be complete in a naturalistic sense - all kinds of things can be left out which would be present in real life so long as what is shown contains the essentials.

(Arnheim, 1974 (first ed 1954), p. 5)

One example Arnheim gives is of viewing a black and white silent film: how if all the colour were to be drained from our world we would be shocked; yet audiences have happily participated in and enjoyed the spectacle of black and white (and silent) movies. In the *Diasynchronoscope* patterns are recognized and interpreted, and most importantly, smooth movement is strongly perceived although nothing actually moves. It should be

observed here that because of the craft aspect of creating multiple objects by hand for animation in the *Diasynchronoscope*, the objects are not as consistent as they might be in terms of texture, size and shape. However, because they appear to be ‘good enough’ for apparent motion to occur, it is fair to assume that with the *Diasynchronoscope* we are witnessing the principle of **Closure** at both micro and macro levels.

Past Experience (familiarity) Principle

Elements tend to be organized together if they were grouped together in the past experience of the observer. With the *Diasynchronoscope*, we observed examples of this in the different schemas brought by viewers to hero objects in interview after viewing an installation, and it is a powerful influence both at a micro and macro level (MacGillivray & Mathez, 2012). In psychology tests a micro version of **Past Experience** is sometimes deliberately created through ‘priming’ a subject prior to them undertaking a test. Priming has a big influence on many global Gestalt phenomena as will be seen in the following description of key global Gestalt phenomenological properties in perception: **emergence, reification, multi-stability** and **invariance**.

According to Gestalt theory, understanding of psychological phenomena such as perceptual illusions cannot be derived by merely isolating the elementary parts for analysis, because human perception may organize sensory stimuli in any number of ways, making the whole different from the sum of the parts. That perception exhibits certain ubiquitous, Gestalt properties such as emergence, reification, multistability, and invariance and that these phenomena are difficult to account for either neurophysiologically, or even in computational terms algorithmically, should mean that they are relevant to this research; certainly the Gestalt school held that study of these phenomena was relevant as they revealed ways of investigating fundamentals of perceptual mechanisms.

However the study of many of these illusions has also been criticized by ecological psychologists such as J.J. Gibson as being erroneous because they tend to rely on a monocular and static rendering of space and ignore time completely. Jennifer Matey, Associate Professor of Philosophy at Florida International University, recently published a paper that focuses on amodal visual perception and presents a counter-example to the idea that active-externalism can account for amodal perception (Matey, 2013). The counter-example involves the experience of so-called ‘impossible objects’. She defines impossible objects as: ‘objects experienced in perceptual character as having geometrical

properties that no physically real object can have.’ and uses the example of the Penrose triangle to counter Alva Noë’s defense of active-externalism or sensori-motor perception which assumes that acquiring sensorimotor knowledge requires physically engaging with one’s environment (Noë, 2004)

The Penrose triangle is a specific paradoxical shape, similar in nature to the Necker cube in that it is a two-dimensional representation of an object that is perceived as voluminous but impossible. The flaw in Matey’s refutation of Noë’s theory comes early when she defines the triangle thus:

‘Assuming as is customary that we can only perceive objects as they would appear in Euclidean space, we experience the Penrose triangle to be an object with a three-dimensional shape that no object could really have. The shape that we see it to have is a shape that could not exist in Euclidean space.’ (Matey, 2013, p. 189)

Matey makes the subtle argument against active-externalism that because we know the triangle cannot exist in the real world, we should not be continuously fooled by it – in other words that we should learn to read it as an illusory object.

‘The fact that learning the construction’s true shape has no impact on how we resolve the visual information suggests that the mechanism responsible is automatic and resistant to influence from higher-level cognitions such as beliefs.’ (ibid.,:196)

In other words we are experiencing a bottom-up, physiological response to the representation of a physical object. This is entirely consistent with many Gestalt illusions and includes trompe l’oeil’ painting and much screen-based imagery where we happily resolve a depiction of something beyond our normal physical interactions as an intangible oddity and therefore may be intriguing - but not baffling. The point being that such representations *do not* exist in our shared Euclidean space, and that this shared space is qualitatively different as it allows for affordance (after Gibson) and intention of tangibility. Matey reaches her final conclusion that:

‘Insofar as the impossible object’s shape is physically impossible, there is no conceivable system of behavior that would enable one to experience it to have the impossible shape. The inconsistencies in the apparent geometry of the object would dictate incompatible courses of movement to go through or around it. How then could seeing the Penrose triangle to have an impossible shape depend on sensorimotor knowledge? The impossible object counter-example therefore

demonstrates that even the weakest form of the view cannot adequately account for the phenomenon of amodal perception.
(*ibid.*: 205)

Here Matey appears to be deliberately missing the point that the Penrose triangle is *not* an impossible object, but a representation of an ‘impossible object’: In other words - although undoubtedly the triangle does act as a stimulus - it not an *object* at all! The Penrose Triangle, like many of the perceptual illusions that have undergone Gestalt investigation is meaningless in an ecological environment.

In the Gibsonian world of affordance where we are physically engaged in the world and when there is an anomaly between physiological encounter and top-down comprehension of what is possible in the real world, we are held in thrall. This accounts for ‘fairies at the bottom of the garden’, why live performance of magic remains popular - even when we know we are being tricked, and surely adds to the fascination that the *Diasynchronoscope* holds for audiences when palpably real objects appear to animate of themselves. The *Diasynchronoscope* artworks and experiments bear out Gibson’s challenge that simple diagrams in and of themselves create Gestalt illusory phenomena. Introduction of depth, focus, and parallax in an ecological environment reduces these illusions to being drawn phenomena and literally ‘tricks of the eye’.

As Gibson remarks with some hauteur: ‘*A line drawn on paper is not a stimulus*’⁴². Translating some of these phenomena to the *Diasynchronoscope*, gives support to this view and this is also confirmed in my close examination of the Gestalt phenomenon of Multistability in relation to the Necker cube in the following chapter.

2.2.1. GESTALT PHENOMENA

Although the four properties of **emergence**, **reification**, **multistability** and **invariance** are the global Gestalt phenomena commonly held up for investigation, as a set of phenomena they are the product of varied functional shortcuts in visual processing combining abstraction through eliminating and compressing information (bottom-up processing) and top-down construction or completion of visual data to fit a likely

⁴² ‘*A line drawn on paper is not a stimulus*’ (Gibson, *The Senses Considered as Perceptual Systems*, 1950) (p.313). The term Ecological Psychology was coined by Gibson in his 1979 book, *The Ecological Approach to Visual Perception*. (Gibson, *The Ecological Approach to Visual Perception*, 1979)

hypothesis of what is being seen.⁴³ This section considers each of these phenomena in relation to the *Diasynchronoscope* and extends the discussion to include the *phi* phenomenon and briefly introduce **Audio**.

Emergence is the Gestalt property of perception of figure/ground articulation. One example often used by vision enthusiasts is the black and white ‘Dalmatian in the park’ picture. Here an assemblage of disparate, black shapes cohere into a compelling picture (to most people) and once ‘emerged’ the recognized picture (of a Dalmatian dog in dappled sunshine) remains clear on subsequent viewings. This evidence of ‘learning’ a percept indicates that it is a top-down process, also indicative of this is that without prior knowledge of what a Dalmatian dog actually looks like, the visual coding of the stimulus would remain a mystery.

That emergence is also evident in the perception of animals, is shown by the ubiquity of camouflage in nature. Most species have evolved coloration in keeping with their environment to hide from predators. In addition, many animals have distinctive designs on their bodies that help conceal them; for example, zebras inhabit areas with tall, vertical grass and have long, vertical black and white striped markings. Since lions are colour-blind, it doesn't matter that the zebra and surrounding environment are completely different colours, and indeed a good example of emergence for most people would be the Ishihara colour blindness test. **Figure 9** shows an adaptation of the test by the author.

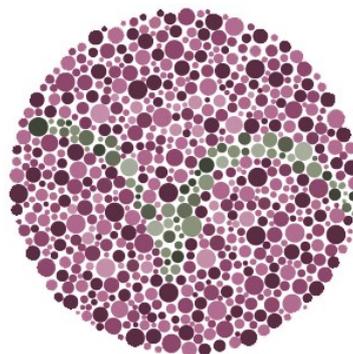


Figure 9 In color tests like this one (after Ishihara) a figure of equal tone is created in a different colour. If you are not red/green colour-blind, you should see the path of a bounce (or a bird in flight).

Much of the phenomenological property of emergence is dependent on silence and immobility. (A zebra that moves against a stationary background and makes a noise is

⁴³ There is a wider discussion of this in 1.5.3 Embodied Cognition

significantly more vulnerable to attack.) Because the *Diasynchronoscope* uses spatio-temporal stimuli and also uses sound and embodied perception the phenomena of emergence is limited to the ‘emergence’ of a holistic sculpture at the end of some of the artworks, where all the temporal elements of a piece can be seen. From viewer response, it seems that a complex shape using multiple objects that also incorporates a lot of depth, renders decoding of this stimulus impossible, although for simple, iconic shapes (such as the heart and square as in **Figure 7**) the shape is decoded by the viewer. Although currently the phenomena of emergence is not something we have made much use of in the *Diasynchronoscope*,⁴⁴ It may be that using colour as in the Ishihara tests would be interesting artistically, and in terms of technique we hope to experiment with using a shared ‘noise’ between foreground objects and the background so that the viewer’s movement causes emergence of shapes through parallax. This could be one way that we might adapt the *diasynchronic* technique to work beyond a black-out space.

Reification

One of the most familiar Gestalt illusions is the Kanizsa triangle, where a 2D figure is filled in perceptually from pertinent corner clues to create a full illusory boundary of a triangle. Much of the early work in Gestalt centred on the study of the cues and processes that cause such phenomena concentrating on the modal completion of 2D structures in visual perception. Using occlusion and manufacture of non-objects in the *Diasynchronoscope* is entirely viable, (see **Figure 10**).

Such artistic exploration would be for creating static objects and employing the mobility of the viewer to decode the figure from disparate stimuli. However, the effect is usually stronger if the foreground /background is reversed, ie. if the objects are black and the background is white, and the real 3D quality of depth makes the shapes less vivid.

⁴⁴ One undesirable by-product of painting all underlying structures matt black so that they are not immediately evident means that these unwanted structures ‘emerge’ as viewers’ eyes become accustomed to the dark. In the artwork ‘*Stylus*’ we moved this emergence from being ‘undesirable’ to becoming an ‘enhancing’ part of its aesthetic appeal. This is discussed further in chapter 5, case study 3.

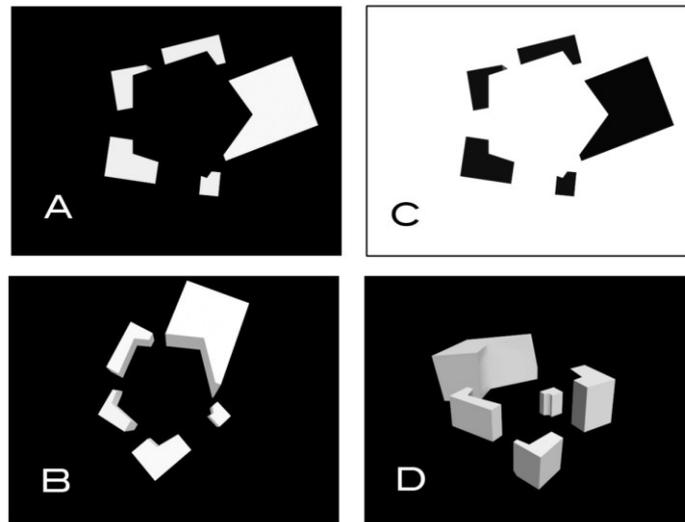


Figure 10 A sketch made in virtual 3D of a pentagon shape hewn from objects in 3D space. A is an orthographic (2D) view, B shows the pentagon if viewed from a particular perspective. In Diagram D, the same objects viewed from another angle. In C, the foreground and background in A has been inverted.

There are several ways that the *Diasynchronoscope* can use occlusion. One way would be to explore the way a spectator would fill in a contour or mass from surface edge clues. This comprehension of planes was illustrated by perceptual psychologist John Kennedy in his keynote speech at the CAe conference identifying six elemental kinds of figure-ground surface edges.⁴⁵

If time is factored into event perception, it is apparent that the phi phenomenon also represents a form of reification over time. Filip Pizlo makes a good demonstration of this in an online ARVO demo applet of what he has coined ‘magni-phi’ (Pizlo, 2000).⁴⁶ Pizlo also offers a demonstration of Magni-Phi where timing and duration can be altered (their optimum is for a “Delay(d)” of 205 milliseconds and a “Delay (t)” of 294):

⁴⁵ Computational Aesthetics Conference (CAe) held in Annecy, France. June 2012

⁴⁶ Wertheimer’s 1912 monograph on perception of apparent motion included his discovery of ‘phi’ movement as being distinct from ‘beta’ movement but, due to mistakes in translation, this phenomenon has proved fairly elusive to replication over the years. There is an excellent discussion of this history by Robert Steinman and Zygmunt and Filip Pizlo (Steinman, Pizlo, & Pizlo, 2000) The authors felt it was significant that controversy still surrounds the differences between these two phenomena, *phi* and *beta* movement in media literature and psychology papers, and list a number of erroneous textbook examples. The two are however demonstrably distinct in visual terms and probably distinct in physiological terms.

Magni-phi is produced by N disks on the circumference of a circle. At each moment of time $(N-1)$ disks are "on". The position of the "off-disk" changes in the clockwise direction. Change a delay setting and watch the disk step slowly around the circle. Then, use the "Magni-phi default" button, which resets the switching speed to where you will see "pure" movement again. "Delay (d)" refers to the time it takes the "off-disk" to change position. "Delay (t)" refers to the time it takes the "off-disk" to make one full revolution around the circle. "Pure" movement is determined by "delay (t)" rather than "delay (d)". So, when you change the number of disks, "delay (t)" is kept constant.

(Pizlo, 2000)

The object of attention in phi movement is always the colour of the background. Moreover, Pizlo puts forward the argument that it has no contour and hence no shape, claiming that properties of the inducing stimuli do not affect how magni-phi appears. (Pizlo, 2000) This makes *phi* movement seem very distinct from what we understand as reification in static objects, however, he also remarks that it 'pops right out' a property often associated with Kanizsa illusions.

According to Pizlo, *Phi* paradoxically has the property of a background object as it shares its colour, but also has the properties of a foreground object as it appears to occlude the other inducing stimuli (relegating them to the background).

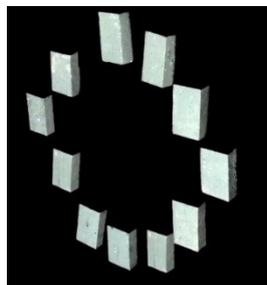


Figure 11 A holistic view of a trial version of a Diasynchronic Gestalt circle which takes Pizlo's idea of Magni-Phi as inspiration. The inducing stimuli are polystyrene blocks (each about 10cms high), painted black and lit with white light from a projector.

This foreground/background paradox was explored in our centennial 2012 Diasynchronic artwork, 'Gestalt Circle', where slower Phi movement (when the "Delay(d)" was at a similar rate of 250 milliseecs, but the "Delay (t)" was 2500) was interspersed with switches to, and from, Beta movement.

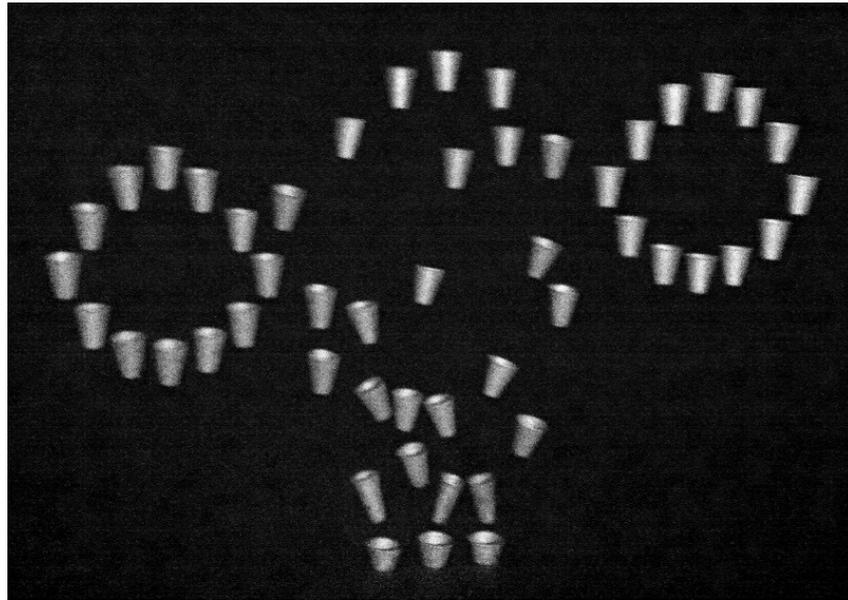


Figure 12 A holistic lighting of all of Gestalt Circle as installed at *Kinetica Art Fair 2012* (not shown to an audience)

The two physiological functions (*Phi* and *Beta*) included synchronization with audio and allowed for embodied phenomenological observation. In *Gestalt Circle*, the three-dimensional quality of the stimuli (which consisted of real polystyrene cups) appeared to make the object of attention retain the contour of the inducing stimuli, in other words the gap between the cups consisted of ‘not a cup’ rather than ‘not a circle’ of light. However this is by no means a conclusive experiment: The motion was slower than Pizlo’s optimal Magni-Phi movement and there was but one shape, but initial observations are that with the *Diasynchronoscope*, there were sufficient depth clues provided for there to be no foreground/background paradox accompanying the *Phi* effect and what was seen could compare to a moving form of reification.

Multistability

The most important notion in Gestalt is that the whole may carry a different and altogether greater meaning than its individual components, and the ambiguity of visual images such as the Necker cube (**Figure 13**) or the duck/rabbit illusion (**Figure 17**), afford a way of studying dynamic changes of meta-realization within our perception. Meta-realization characteristically flips from one perceptual comprehension to another and both illustrated illusions involve visual tricks that allow two cognitive interpretations. These two ambiguities are intriguing, but not as similar as one might first think. The Necker cube is dependent on a ‘flip’ in perspective indicating it is physiological whereas the duck/rabbit illusion involves a conceptual flip between icons indicating a top-down cognitive involvement.

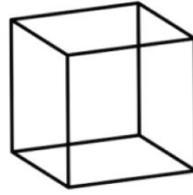


Figure 13 The Necker cube.

The cube can be perceived to ‘flip’ its direction; although one can only hold one interpretation at a time, both look plausible. However, it should be remembered that this two dimensional drawing is an orthogonal projection that eliminates all depth clues, and hence its plausibility is questionable as it does not exist in reality. Indeed adding a surface to the cube reveals how uncanny the representation is.

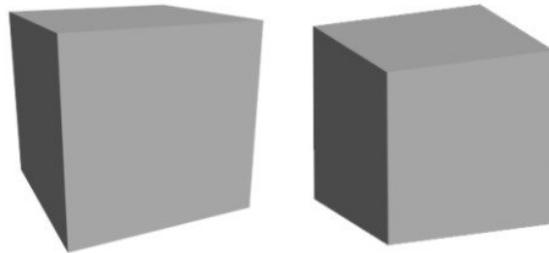


Figure 14 Depicting Non-Orthographic and Orthogonal views of a cube side by side with solid surfaces increases the ability to distinguish the ‘real’ from the unreal.

The Necker cube in many books is drawn from a 2d orthogonal view, although **Figure 15** could easily be seen as a 2D graphic, with the contextual prompt of the previous cubes (the familiarity principle), we might still interpret this as a 3D object, but a non-orthographic view reveals how many depth perceptual clues such as line width and z-axis deformation have been removed in order to fool our eyes. (**Figure 16**).

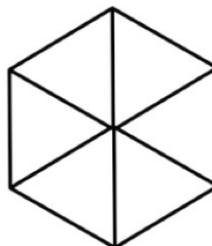


Figure 15 Orthogonal Cube (no depth clues)

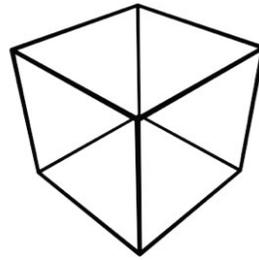


Figure 16 Non-Orthographic Cube – this is the same view of the cube in Figure 15, both built in virtual 3D, but here the camera is non-orthographic, allowing focal depth clues.

Much of our perception is spent translating 3D reality to the 2D of the retina and then back to 3D in our mind's eye. Because such an intensive process leaves opportunities for interpretive mistakes, we are unconsciously searching for depth clues all the time and the *Diasynchronoscope* provides these depth cues. This means that many of the perceptual illusions that have undergone Gestalt investigation are meaningless in an ecological environment. (MacGillivray C. , 2009)

One Gestalt illusion that we had more luck with was multistability that employs top-down processing. The duck/rabbit illusion is also a line drawing, but here the multistability is of the referent type. The sign standing for two different icons, and again the perceiver experiences a switch between each icon, (assuming they have a prior awareness of what a duck and rabbit look like). We experienced a version of this multistability with an early experiment with the *Diasynchronoscope*.



Figure 17 Is this a picture of a duck facing right or a rabbit looking left? The duck-rabbit illusion is a typical Gestalt illusion of ‘multistability’

With the *Diasynchronoscope* ‘swing and bounce’ experiment⁴⁷, most spectators first described their experience as having seen ‘a ball bouncing’, but on subsequent questioning, and without further viewing, they acknowledged that the ‘hero’ object was not a ‘ball’ – the apparent movement seemed to override their sense of form. Interviews revealed that each participant was bringing their own schema to the movement and that the piece was appreciated with three different ‘modes’ of perception; as a ‘moving’ object in time, as a series of individual objects and as an holistic ‘single’ object. These

⁴⁷ This experiment is discussed in detail in Chapter 4, Studio Practice.

viewings revealed a similarity to the Gestalt illusion of multistability. It is striking that the three models are at once compatible and incompatible perceptually. Rather like the Duck/Rabbit illusion, it seemed that we had created a piece that for some participants embodied a ball/sponge/dinosaur spine illusion. (MacGillivray & Mathez, 2012)

Although we are aware of many empiric examples of images resolving themselves (such as mirages or shadows on clothes in a child's bedroom), these illusions are usually a psychological one-way street. Examples of multistability where visual concepts shift back and forth across time such as in the 'swing and bounce' experiment are rare. The automatic default by spectators in interpreting the object via its movement as 'a ball' may be a result of the perceptual movement pathway being faster than the perceptual shape pathway or it could be attributable to there being a definable hierarchy of modal perception. Perhaps the inductive reasoning expression, '*If it looks like a duck, acts like a duck and quacks like a duck, then it is probably a duck*'⁴⁸ ought to be reshuffled to '*If it acts like a duck, quacks like a duck and looks like a duck, then it is probably a duck*'.

Invariance

Psychologists have established that our visual cortex divides and processes four separate parallel pathways of perception: form, colour, movement and depth. Gestalt principles, animation and film techniques rely on our systems endowing a continuity of perception to objects that displace within corresponding graded constraints of shape, colour, motion and mass. Invariance is the term used by psychologists to describe our perceptual ability to recognize an object regardless of its rotation, translation or scale. Invariance is an essential component of the *Diasynchronoscope* and much of this practical research has been into testing the constraints needed to bring about invariance.

Using Gestalt principles as a framework for aesthetics been revisited and renegotiated not only by artists and designers such as Tufte (Tufte, 1997), but also cognitive neuroscientists over the years, including the neurologist Ramachandran who created his own nine laws of aesthetics (Ramachandran, 2011) and the founder of neuroaesthetics, Semir Zeki, who turned to aesthetics after his studies in integration in visual agnosia. (Zeki, 1993) (Zeki, 2002)

⁴⁸ Attributed to US author James Whitcomb Riley

	Gestalt Principles	Common to the <i>Diasynchronoscope</i>	<i>Dysynchronoscope</i> Tropes
1	Prägnanz	Yes	Holistic models
2	Figure/Ground articulation	Yes	Vital. We demand an observer's attention through Figure/Ground articulation.
3	Similarity	Yes	Provides continuity of an object as it travels in space/time
4	Proximity	Yes	Used for rotations and keeping distances between objects close enough for similarity to work
5	Common fate	Yes	In movement, the principle of Common Fate corresponds to the animation principles Follow Through and Overlapping Action and Secondary Action
6	Good Continuation	Yes	The Gestalt principle of 'Good-continuation' can be translated into the arcs typical of our work in the <i>Diasynchronoscope</i>
7	Closure	Yes	A useful perceptual shortcut
8	Past Experience (familiarity)	Yes	A perceptual short-cut
9	Symmetry	No	Symmetry is the enemy of narrative. Order and structure are useful, but stability and consistency are there to be broken
10	Phenomena of emergence	No	Apart from gradual emergence of objects as eyes become accustomed to the dark
11	Phenomena of reification	Only with time	Only as a version of Phi with time
12	Phenomena of multistability	Possibly	It appears that movement may be a pre-eminent perceptual cue over shape.
13	Phenomena of invariance	Yes	Essential for creating a sense of apparent motion

Table 2. A comparison between the Diasynchronoscope and Gestalt Principles and phenomena.

Audio and materiality

Although Gestalt theory is explicitly pan-sensory, studies that examine and apply its principles are often less so. The Gestalt of audio has been studied in the field of Musicology, but (with a few notable exceptions) audio is rarely studied alongside visuals. Because audio is such a strong sensual component of the aesthetic of the

Diasynchronoscope, and indeed is used by us to deliberately enhance or change visual constructs by taking advantage of cross-modal verification, it is worth mentioning the work of Gestaltist Wolfgang Metzger, who was a student of Wertheimer. As far back as 1934, Metzger noted in his article; *Beobachtungen über phänomenale Identität*,⁴⁹ that: ‘two identical visual targets moving across each other can be perceived either to bounce off or to stream through each other’ (Metzger, 1934). The follow-up to this study did not come until 1997 when Sekuler et al. demonstrated that a brief sound at the moment the targets coincide biases perception toward bouncing. (Sekuler, Sekuler, & Lau, 1997)

It is fundamental to the *Diasynchronic* technique that the sound and visuals are creatively intertwined and installations have implemented both these findings from Gestalt to alter the qualia of perception of objects both causally and in terms of material; however they were introduced not from research in the field of psychology but from extant knowledge of audio-visual design in the co-creators. As discussed in Chapter 1.7, the seminal text on combining visuals with audio is not written by a Gestaltist, but by a practitioner from Film Studies: film-maker and composer, Michel Chion, whose *Audio-Vision: Sound on Screen* (Chion, 1994) has formed a useful framework for discussing how sound formalisms from screen-based media are adapted in the *Diasynchronoscope*.

In the real world, sounds are synchronised and objects are three-dimensional and we expect to be able to change our point-of-view. This means that there is no processing or decoding required for sound and image to be synthesised by participants, when encountering the *Diasynchronoscope*. The artworks are first appreciated at an unconscious, primal level, as perceptually isomorphic with real life. In perceptual terms this is called ‘bottom-up’ perception, and denotes perceptions that are swifter and automatic in comparison to top-down processing.

Philosophers, Psychologists and Media theorists when discussing perception of reality or popular screen-based media are keen to distinguish the differences between conscious and unconscious perception, whether we give something covert or overt attention, or, to put it another way if our perceptions are active or passive. Chion, having made the point that there are ‘*no eyelids for the ears*’ goes on to extrapolate from this, that ‘*sound more than image has the ability to saturate and short-cut our perception*’, (Chion, 1994, p. 34). The audio visual contract that a participant enters into with the

⁴⁹ A work described by Robert Sekuler as: ‘One of the most important papers ever published on the perception of visual motion’, but translations are not available at this moment in time.

Diasynchronoscope is one where both sound and vision saturate and short-cut perceptions, as due to the lack of other stimuli and through overt demands made on eye direction, the attention of the percipient is highly controllable. In the *Diasynchronoscope* we are, in effect, animating through attention.

It is difficult to untangle how ideas in audiovisiology have informed the genesis of the *Diasynchronoscope* and, in turn, how formalisms developed in the *Diasynchronoscope* may inform current audio-visual practice. Certainly, the *Diasynchronoscope* has eschewed the colour/music analogy common to many early audio-visual creations and instead adopted Dadaist Kurt Schwitters paradigm of 'Merz'; bringing every conceivable material together for artistic purposes, with each individual material (both aural and concrete) contributing to the same effect in equal part.

Schwitters is best known for his sound poems and as the creator of the Hanover Merz-bau at his house in Germany. The three-dimensional immersive artwork spread through several rooms, and construction spanned fourteen years from 1923-1937. Various materials included detritus collected from the street, snatches of conversations from trams and trains, songs, glasses, letters, and locks of hair. At the same time, in the 1930's Mary Ellen Bute and Joseph Schillinger were also combining eclectic materials, (ping-pong balls, combs, colanders) with moving light and mathematical models of music for synchronization of sound-image onscreen. The musical system was part of Schillinger's larger system of synaesthetic art that was modelled on permutations of Aristotle's five senses, as described here by music historian Warren Brodsky:

'This permutational approach to the arts (forty years before the computer era) defined eighteen different art forms involving sound, mass, odor, flavor, light, pigment and surface relation to general components of time and space. He spoke of synthetic and multisensory associations, as well as about the fusion of sensations, which we referred to as "colored hearing," "sound seeing" and "kinesthetic temperature / texture reactions" of tone quality. Schillinger also raised the question of transformation and coexistence of optical forms based on musical patterns.'

(Brodsky, 2003)

Computer art raises thorny aesthetic issues for art historians, (Boden, 2010), (Lambert, 2012) with the indexical nature of catalogue entries attributing huge conceptual ideas and massively varied art forms to 'Computer hardware and software'. As Nick Lambert points out in discussing the computer as a platform for art in his thesis:

'Art created through the agency of a computer may be termed "Computer Art" and distinguished from all other forms of visual art by its computational basis. Computer Art is a significant development in the visual arts because the computer operates simultaneously as medium, tool and context, in addition to its organisational and interactive elements.' (Lambert, 2012)

Although all computer, and particularly interactive computer art offers an arena for debate when it comes to discussion of materials used, the *Diasynchronoscope* raises some particularly interesting questions about 'What is material? Because here not only is 'every conceivable material' pressganged into use for artistic purposes, but also the 'immaterial' is fundamental to the artworks.

Take as an example the first case study in this thesis, Gestalt Circle (Chapter 5.1.)

Most obviously this artwork is made from polystyrene cups, but it is also was made from:

- Polystyrene cups (which are painted black, but perceived as white) - plus
- Sequenced projected light
- Speakers and audio
- Foam, wood, cloth (to make the underlying structure)
- Computer hardware and software

In addition it could be argued that further relevant 'immaterials' are that the multiple polystyrene cups are:

- Arranged 'diasynchronically'
- In a blackout space, and
- Require participant observation

These 'immaterials' are fundamental because in the *Diasynchronoscope*, the gap is not absence - it is its pure structural essence, and it is through embodied perception of these gaps that participants perceive/create Apparent Movement. In *Gestalt Circle*, during the depicted phi movement, participants are following the immaterial gap and not a material cup, thus we have an example of 'Meta-Merz' where the material (conceivable anything) is combined with the immaterial (conceivable nothing) and the inconceivable (what you see is not what you get).

In the *Diasynchronoscope* inspirations and materials are fluid – sound and visuals are generally developed in parallel - sometimes sound is created to match visual

expectations, and sometimes visuals are inspired by the sound – frequently we adopt both approaches in turn, planning and experimenting with both in synchrony to the point of feeling confident that the resulting combination ‘works’ or more frequently until we are content that the idea will work if assembled onsite.

This research deals primarily with the visualisation side of the *Diasynchronoscope* not just for reasons of focus, but also because it is my primary interest and audio is the primary interest of my collaborator, Bruno Mathez. The complexity of working trans-media in the modern age mitigates against the idea of the lone artist; art that traverses known genres is often collaborative or relies heavily on technical support or audience participation. In this way, audio-visual art is moving towards film-making, performance-based or design-based media by becoming a collaborative medium that integrates the skills of artists from various backgrounds and invites audiences to be part of a performance.

2.3. EMBODIMENT – W.Y.S.I.N.W.Y.G.

“When principles of design replicate principles of thought, the act of arranging information becomes an act of insight.”

Edward R. Tufte (Tufte, 1997)

The term ‘neuroaesthetics’ was coined by Professor Semir Zeki of University College of London who set up the Institute *Vislab* some years ago to study the biological foundations of aesthetics. The institute explores visual art in relation to the known physiology of the visual brain and advocates three suppositions (Zeki, 2002):

- that all visual art must obey the laws of the visual brain, whether in conception or in execution or in appreciation;
- that visual art has an overall function which is an extension of the function of the visual brain, to acquire knowledge;
- that artists are, in a sense, neurologists who study the capacities of the visual brain with techniques that are unique to them.

There is a useful extrapolation to be made from Zeki’s essentially constructivist aesthetic suppositions; that the closer visual art comes to echoing the physiology of the visual cortex, the ‘better’ it is. This fits well with the visual Gestalt theory propounded by Wertheimer et al which advocates design principles of perception such as

Figure/Ground distinction and **Closure**, and has been much used in artistic design since. The charge of over-simplification has been levelled at neuroaesthetics, and such critics do have a point, because although it moves the perceptual debate of how we see from the workings of the eye to the workings of the mind, segmenting vision from other perceptions is reductionist and although extensive unconscious information processing does occur, the evidence that it this occurs *prior* to conscious information processing and not in parallel is questionable.

Tentative conjectures derived from observation of the effective nature of the *Diasynchronoscope*, are: a) it seems unlikely that there is any such thing as a static mental model, and b) as there are many multi-modal sensory patterns, they do not have to emanate from functions of the visual brain.

To the novice coming from outside the field, there appear to be almost as many theories on vision as there are cognitive neurologists, but further reading in cognitive psychology has informed many of the ideas behind the case studies, so this thesis has attempted to gather these threads into a coherent review of current ideas. There are concepts that are ubiquitously used but not so readily defined in psychology and neuroscience literature, for instance, the concepts of ‘bottom-up’ and ‘top-down’ perception, furthermore these concepts are often renamed in various ways from one sub-discipline to another⁵⁰. This seems to indicate that there are still many things left to find out. In fact the issue of how much cognitive processes contribute to interpretation of shape, colour and motion is still being debated – despite innumerable experiments and theories, not much has changed in the field since Francis Crick,⁵¹ ruefully noted in 1995: ‘*We don’t know how we see*’. (Crick & Koch, 1995, p. 120)

2.3.1. EMBODIED COGNITION

A brick and a block of gelignite may look and feel much alike, but they will behave very differently.

Richard Gregory, 1977⁵²

⁵⁰ Also called direct and inferential or indirect, psychophysical, physiological and schematic, first order and second order and also in terms of various levels of coded and decoded information.

⁵¹ Nobel prize winner, Francis Crick after discovering the molecular structure of DNA with James Watson turned his hand to theorizing on neurobiology, and in this book takes a long look at the physiology of vision when searching for the seat of the soul in humans.

⁵² (Gregory R. L., 3rd edition: 1977 (original 1966))

We define objects not by their appearance, but by their uses and their causal characteristics. It is the position of this thesis that our perceptual powers are inseparable from our embodied experience. Support for this position comes from philosophy, neuroaesthetics, many fields of psychology and empirical physiology. The transdisciplinary nature of this study is nowhere more apparent than in the taxonomic challenge created by the varied and wide-ranging approaches that these disciplines have taken in re-examining (and rejecting) Cartesian dualism.

There has been a recent upsurge of interest in embodied cognition and the effect of sensorimotor affordance in artificial intelligence and cognitive computation where ‘enactive’ processes are being discussed. A seminal paper by French physicist turned psychologist, Kevin O’Regan and US philosopher Alva Noë took a strong stance on this, making a case for what they call a ‘sensory motor response to the world’ contingent on cues derived from how we perceive where we are in it. Thus they propose that ‘seeing is a way of acting. It is a particular way of exploring the environment’. In this way the paper follows early pioneers of enaction such as the phenomenological philosopher, Maurice Merleau-Ponty, who is generally acknowledged as one of the fathers of ‘enaction’, having written the much-cited *Phenomenology of Perception* (Merleau-Ponty M. , 1962) Here Merleau-Ponty lays out his ideas on sensory experience; “*Our own body is in the world as a heart is in the organism: it keeps the visual spectacle constantly alive, it breathes life into it and sustains it inwardly, and with it forms a system.*” (Ibid.:235). As a phenomenologist, Merleau-Ponty subscribed to many of the scientific principles expounded by Gestalt psychology, believing that: ‘*The perceiving mind is an incarnated mind*’ (Ibid.:14) and pragmatic philosopher and psychologist, John Dewey was also persuaded by the idea of embodiment, writing in his 1934 classic *Art as Experience*:

*Without external embodiment, an experience remains incomplete...
The act of perception proceeds by waves that extend serially
throughout the entire organism. There is no such thing in perception
as seeing or hearing plus emotion. The perceived object or scene is
emotionally pervaded throughout .*

(Dewey, 1934 (reprint 1989), p. 16)

Two enaction theories that have divided philosophers are direct and indirect perception. Indirect perception holds that input from the world we perceive consists of meagre stimuli, and that cognitive processes intervene in a constructive way to shape our interpretations of the world. This is the view of experimental psychologists such as

neurologist Semir Zeki, and cognitive psychologists Robert Solso and Richard Gregory and there are many good arguments for it. The human eye is a remarkable instrument, but what it sees at each moment in time is remarkably little and there is a massive drop-off of focal acuity away from the centre of attentive vision. This indicates that we build a picture of the world from very little input, and there seem to be strong indications that we bring personal schemas to our view of the world, constructing, our version of the world through, as Gregory puts it, '*predictive hypotheses*'.⁵³

Intelligent behaviour is not possible without prediction. Predicting from hypotheses derived from meagre data is the hallmark of perception, intelligence and science. Science is shared perception.
(Gregory R. L., 3rd edition: 1977 (original 1966), p. 224)

With his ecological theory, US psychologist, James Gibson reformulated the idea of stimulus away from low-level physical variables, taking the position that we should reject the idea of the impoverished 'retinal snapshot' that he feels is inherent to indirect theory and look instead at the 'optical flow', at affordance, and a stimulus as 'information' about the world. (Gibson, 1950)⁵⁴ Fundamental to Gibson's theory (and controversially) he concludes that visual perception is rich and accurate. This thesis agrees cautiously with Gibson's contention of environmental considerations of considering time, and his rejection of the retinal snapshot, in favour of perception through 'chunked' events. However Gibson also contends that knowing *is* perceiving and he separates rational anticipation, planning and expecting in the spectator from imagining wistfully or fearfully, or daydreaming. This runs contrary to what artistic practice reveals about the importance of narrative and emotional involvement in our perceptions of the world, and so does not accord with arts-based research or a structuralist approach. Structuralism states that:

Despite appearances to the contrary the world does not consist of independently existing objects, whose concrete features can be perceived clearly and individually, and whose nature can be classified accordingly. In fact, every perceiver's method of perceiving can be shown to contain an inherent bias which affects what is perceived to a significant degree.

(Hawkes, 1997, p. 17)

⁵³ Another synonym for 'Top-down' processing

⁵⁴ In this sense, Gibson's ideas chime strongly with those of Rudolf Arnheim's version of dynamic vision and the idea of 'perceptual forces' expounded in his classic 1954 book *Art and Visual perception* (Arnheim, 1974 (first ed 1954)) and also with some of the work on ecological cinema written by the constructivist visual psychologist, Julien Hochberg.

O'Regan and Noë's paper acknowledges a considerable debt to Gibson, but offers another way of considering enaction, namely that far from holding an internal vision based on rich and accurate percepts, we treat the world as an outside memory store⁵⁵ and that:

'Visual experience does not arise because an internal representation of the world is activated in some brain area. On the contrary, visual experience is a mode of activity involving practical knowledge about currently possible behaviors and associated sensory consequences. Visual experience rests on know-how, the possession of skills'.

(O'Regan J. K., 2001, p. 946)

O'Regan and Noë also argue that one consequence of sensory motor contingency is the binding problem disappears⁵⁶, because our practical know-how of the world tells us that an experience that involves visual contingencies such as cues derived from changes caused by the movement of the object versus movement of the observer:

'Having the knowledge of seeing a stationary object consists in the knowledge that if you were to move your eye slightly leftwards, the object would shift one way on your retina, but if you were to move your eye rightwards, the object would shift the other way. The knowledge of all such potential movements and their results constitute the perception of stationary.' (Ibid.:946)

Having demolished the binding problem the pair then add a swift kick to the basic apparatus used in so many visual experiments in psychology, remarking:

'Seeing involves testing the changes that occur through eye, body, and attention movements. Seeing without such movements is, under the theory, a subspecies of seeing: an exception. This would appear to be a rather dissident claim, given that psychologists studying visual perception have devoted a significant part of their energy precisely to the use of tachistoscopic stimulus presentation techniques, where stimuli are displayed for times shorter than the saccadic latency period of about 150 msec required for an eye movement to occur'.

(Ibid.:947)

Nonetheless, O'Regan and Noë make a good case for their 'dissident claim' and the case they argue is generally supported by phenomenological evidence in using the

⁵⁵ The outside world acts as an 'external memory' store, where information is available for probing by means of eye movements and shifts of attention (O'Regan, 1992)

⁵⁶ Thus neatly sidestepping a long held debate between and amongst perceptual psychologists and philosophers. 'The binding problem' is a term used by cognitive science and philosophy to describe the as yet unexplained way the brain integrates multi-modal input into a single experience. In other words, how do we know that *x* sound belongs to *y* event?

Diasynchronoscope. It is true to say that nearly all visual perception experiments conducted in psychology are screen-based and tend to be stroboscopic. Several psychologists have been interested in the way that the *Diasynchronoscope* could create replicable experiments that include a somatic element. This has led to collaboration with Dr Etienne Roesch of the Centre for Integrative Neuroscience and Neurodynamics at the University of Reading, who is interested in using the *Diasynchronoscope* as a tool for embodied perceptual research, and a co-authored paper delivered to the AISB.⁵⁷

2.3.2. TOP-DOWN AND BOTTOM-UP PERCEPTION

Much visual perception research has centred on the nature of saccades and attention, the physiology of where we look and the cognitive-psychology of where we choose to look. In Psychology, perceptual processing has been divided into two categories historically: Bottom-up and Top-down perception. Bottom-up means we are at the mercy of our common physical systems and their evolutionary quirks. Top-down means we decide what to look at, where and when according to our personal schemas. More recent thinking in psychology has questioned the binary validity of these concepts and also suggested that the terminology may be unhelpful in terms of conceptualising how perceptions are processed.

Our bottom-up perceptions are predicated on the physiology of the eye and how foveal, parafoveal and peripheral receptors work together to produce our entire visual perception. Detailed visual information can only be obtained by the concentrated nerve endings in the centre of the retina, so we actually only see an astonishingly small amount of the world as high resolution images, receptors in the fovea and parafovea are limited to the acute vision angle of approximately 15 degrees. It is from foveal fixations through this small keyhole interspersed with ballistic saccades that we (one way or another) extrapolate a picture of reality. Ballistic saccades are jumps between foveal fixations, but we see nothing during the ballistic movement, piecing together our view of the world from a jigsaw of foveal fixations. Because the ballistic saccade is measurable in milliseconds, a number of interesting tests have been created to study what is happening during saccadic movement.

⁵⁷ *Situating enactive processes or placing the observer back in the scene: a case for the empirical study of perception*. Paper presented at AISB (The Society for the Study of Artificial Intelligence) and the Simulation of Behaviour.) in Exeter, UK on the 6th April 2013. (Roesch, MacGillivray, Mathez, & Fol Leymarie, 2013)

Change blindness is an interesting phenomenon that mimics the blindness caused by ballistics. When two pictures with quite significant differences are interrupted by a mask, we have difficulty spotting changes that would be simple without the mask. The mask is mimicking the ballistic jump of a saccade. However many change blindness tests we do, we never learn to get better at spotting the changes (apart perhaps from those of us that can guess likely changes as they are easy to make in *Adobe Photoshop*). The change blindness phenomenon is a common and necessary physiological quirk that allows us to negotiate the world without it leaping around as we move our eyes.

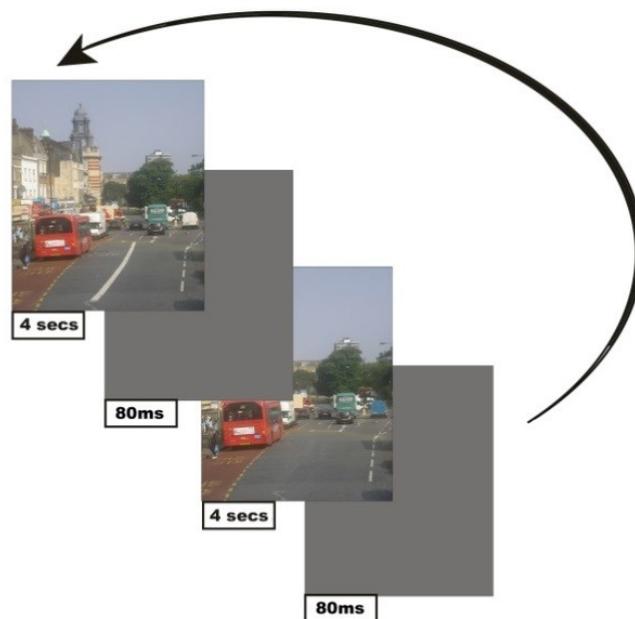


Figure 18. The change blindness test is looped

Often discussed alongside the change blindness test, are tests for inattentional blindness; a related but nonetheless distinct phenomenon fundamental to many conjuring tricks designed by magicians. Change blindness originates from the way we construct our representation of the world and pertains only to change that concerns transitions between quantities. Inattentional blindness on the other hand, as exemplified in Simons' '*Gorilla in our midst*'⁵⁸ test, demonstrates how divided attention can cause an observer to miss significant unexpected data because of conscious attendance to something else. Although some argue for these two sorts of blindness to be considered together because both

⁵⁸ A video sequence shows a basket ball game. You are supposed to count ball passes of either team. Both teams are clad in conventional sports clothing. After doing the task it is revealed to you that during the action a guy in a gorilla suit walked all the way through the scene, stopping in the middle and waving at you. When you run the video a second time you find it hard to believe that you actually missed this. Most (say nine out of ten) people do. (Squire, Bloom, McConnell, Roberts, Spitzer, & Zigmond, 2003)

involve an inability to report visual stimuli that are obvious once attended, this research contends that they are physiologically distinct, and also that the tests create exceptional results because the stimuli are usually screen-based. Furthermore the fact that performance in inattention blindness tests can be improved by learning to look for unexpected data and correcting for it, but that we can never learn to improve our performance in change blindness tests viewed for the first time, clearly indicates that the two phenomena are distinct processes.

*The nature of attention is still unresolved, the nature of conscious perception is still a mystery – and their relation to each other is not clearly understood.*⁵⁹

Jakob Hohwy 2012

Attention is also a thorny problem in psychology. Some psychologists even contend that there is no such thing.⁶⁰ The process of how we select where to look is guided by a variety of higher level processes, including attention, memory, and expectation. To make matters more complex, we also can attend without looking (usually for social reasons – it is rude to stare) and we can also look without attending (such as a daydream state when we drive the car along a familiar route and don't recall the journey). However, in a recent review of literature on the subject, Giorgio Marchetti discusses the problem of separating consciousness from attention and draws the conclusion that they cannot be disassociated. (Marchetti, 2012)

Examination of perception tends to look at senses in isolation, but with the *Diasynchronoscope* we treat perception as an embodied synaesthetic experience. The *Diasynchronoscope* creates transient visual cues that, when combined with sound, demand selective attention. The brain parallel processes material essence and concept in parallel – content and understanding fire off synapses and the motor cortex is activated

⁵⁹ *Attention and conscious perception in the hypothesis testing brain* (Hohwy, 2012)

⁶⁰ *There is no Such Thing as Attention* (Anderson B. , 2011)

“A general fault of psychology is its predilection to binarize empirical phenomena; we try and shoehorn everything into being either this or that. As a result we construct and pursue false dichotomies. A more specific error is that we misuse the word attention. Attention has been plurally defined and this leads to inconsistent usage and confusion. More importantly, attention has been reified; it is used as a concrete concept that can act in a causal fashion, e.g., “Attention helps optimize the use of our system’s limited resources...” (Carrasco, 2009). This logical fallacy leads to misplaced empirical efforts. In fact, attention never causes anything, because there is no such thing as attention.” (Anderson B. , 2011, p. 98)

directing the eyes to follow salient cues (Alexander, 1990). Because the installations take place in a black-out, an audience is given little choice of where to look; their attention is being drawn deliberately to either particular objects or sequences of objects in isolation, or to carefully constructed ‘symphonies’ of attention: the *Diasynchronoscope* is effectively animating through attention. We use sound and vision to maintain this effect leaving no time for wandering eyes or thoughts. This may be one reason why many observers remark that they find the artworks ‘*hypnotic*’ or ‘*mesmeric*’.

Evolution has developed cognitive mindsets in humans that are usually useful but under new circumstances when confronted with real, modern world problems, may lead us to self-deception, there are many examples of how we can be fooled in terms of our generic architectural shortcuts and embedded evolutionary perceptions. For instance our innate ability to search for underlying patterns leaves us susceptible to suggestion and superstition (this is also present in animals). Similarly as Ben Goldacre points out in his popular book, “*Bad Science*”; we have an innate aversion to randomness, and a misplaced belief in regression to mean. We also carry the baggage of prior beliefs that prejudice our immediate experience and a weighted bias towards positive evidence. (Goldacre, 2008)

Just as we have evolutionary cognitive mindsets that are usually useful but under new circumstances may lead us to self-deception, Gestalt psychologists have demonstrated how we are susceptible to visual physiological illusions such as multi-stability and reification and some of the Gestalt principles such as the past experience principle and the closure principle demonstrate that both sets of illusions can be synthesized in a psychophysical combination. Another example of this common susceptibility is found in magic tricks, where combinations of these universal physiological and psychological perceptual traits are exploited for entertainment.

Neurologists Stephen Macknik, Susana Martinez-Conde and Sandra Blakeslee spent a considerable amount of time with magicians (eventually learning enough to become members of the Magic Circle themselves) for their book: “*Sleights of Mind: What the Neuroscience of Magic Reveals About our Everyday Deceptions*”. The book empirically proves that our perceptions are ‘hackable’ by demonstrating tricks that exploit our intrinsic properties of perception both psychologically and physiologically (Macknik, Martinez-Conde, & Blakeslee, 2011). They describe their excitement when early on in

their research, a magician who specializes in the art of pickpocketing, Apollo, described a detail of attention misdirection they had not considered as neuroscientists:

“In years of doing shows... I noticed that the eye is more attracted to arches than to straight lines.” He starts patting George’s pockets again, George looks on with interest. “If I want to take something out of his pocket, I can keep his eyes occupied on my free hand if I move it in an arc. But if I move it in a straight line, his attention will snap back to my other hand” like a rubber band, he explains.

(Ibid.:76)

The two hand movements represent the two main ways our eyes view the world. When the hand moves in an arc it is followed by our eyes in a continuous uninterrupted path: This is called ‘smooth pursuit’, and is how we track a moving object like a cricket ball. It is, of course, also one of the twelve animation principles. Apollo’s account also explains why magicians use a magic wand with a white tip waved in arcs to distract a punter’s attention. The second way we view the world is in jerky ‘saccades’. Our eyes take in an astonishingly small amount of information in fine detail at any one time, and we use saccadic jumps to fill in information to achieve a whole picture. As Macknick et al put it:

‘Your eyes are constantly darting around the world like a hummingbird on meth. Your brain edits out the motion blurs and integrates the small bits of information received from each fixation in order to present your visual awareness with a detail-rich, stable-seeming portrait of the visual scene before you.’

(Ibid.:77)

That Apollo’s use of arcs is an example of a physiological shortcut can be demonstrated by a simple experiment: Hold out your two hands in a double thumbs up salute about a foot apart and ask someone to slowly track their eyes from one thumb to the other. You will observe their eyes moving in jerks, but ask them to follow a thumb as you slide it to meet its partner and you will see their eyes move smoothly. That they cannot learn to do this any differently means that it is a quirk of the visual system, not our minds.⁶¹

⁶¹ There are examples of how a magician can manipulate you psychologically too. The ‘cigarette drop’ is a simple example of inattentive blindness. Using eye tracking tools, Gustav Kuhn and Benjamin Tatler studied observers of the cigarette drop and concluded that they were deceived not by their gaze, but by their attention (Kuhn & Tatler, 2005). The neuroscientists, Macknick et al go on to observe that: “Magicians know that multitasking is an urban myth and so they use a ‘divide and conquer’ approach with attention: they split your attention so you cannot concentrate fully on any part of the stage at a given time”.

For quite sound evolutionary reasons, we are also at the mercy of physiological, low-level responses to automatically attend to stimuli if it comes from our peripheral vision. The evolutionary logic is this: We are hard-wired to detect movement as a survival instinct. If something moves on the periphery of our vision; we need to know, ‘*Is it food, or does it think I am?*’ (Solso, 2003) The edge of the human retina is sensible only to movement because it has no light sensitive cones, this is economic: If something is flying for your head, you don’t wait to decide if it is a rock or a daffodil – you duck first, then you look.

The veridical nature of new objects capturing attention has led to the not unreasonable, long held belief that the onset of a new object inevitably captures attention through being picked up parafoveally, triggering saccadic jumps and attentional fixation (Yantis S., 1984). But current evidence leads us to think that attention is not captured by novel objects per se, but to the transient events that frequently accompany new objects (Franconeri, Hollingworth, & Simons, 2005). Optical experiments by this group prove that not only do transient events play a central role in attention capture but that new objects do *not* reliably capture attention without a sensory transient. It is these ‘second-order’ *transient* changes ie. abrupt or large changes in brightness, form (including size), motion or colour that are critical for attention capture (Franconeri, Hollingworth, & Simons, 2009).⁶²

To offer a simpler proof, let us return to the change blindness test: Changes are quite apparent if the mask is eliminated and we *jump cut* from one scene to the changed scene because we are creating easily observable transient changes. In fact transient changes are a fundamental part of the seduction technique of film, acting as low level sensory triggers that implicitly and effortlessly encourage attention.⁶³

⁶² because our visual cortex divides and processes four separate parallel pathways of perception: form, colour, movement and depth

⁶³ Video of this online: http://www.youtube.com/watch?v=AqI6PXU8_uA



Figure 19 The change blindness test does not work if the mask is removed. (The 7 changes are: bus size, road markings eliminated, green cupola eliminated, white van becomes blue, van loses red UK logo, CAE signage introduced and vulture flies over London)

In the *Diasynchronoscope* participants must be paying attention, for without their attention nothing would move. Therefore it seems reasonable to suggest that this research could contribute to the direct/indirect debate through empirical tests using the *Diasynchronoscope*, contending as this thesis does that the *Diasynchronoscope* reveals a new way of conceptualizing apparent movement in an ecological environment.

The new tropes that we find in the *Diasynchronoscope* do not entirely fall within the discipline of psychology, and in its current form, the *Diasynchronoscope* is not a good research tool in terms of accuracy, although it has several differences to the screen-based stimuli frequently used in psychology for experimentation. For example, no flicker, no screen (so allowing embodied perception of depth and veridical environment) and multi-modal interpretation in space, the only current accurate measurements for visuals are durations and number and luminance of objects lit. It would be very interesting to create a version of the *Diasynchronoscope* that could be used for accurate experimentation, and this is an aspiration for the future.

As mentioned at the start of this section, some psychologists such as Damasio (Damasio, 1989) have suggested that the top-down and bottom-up binary definitions of perception are unhelpfully and this is supported by studies in other disciplines such as biomedicine where it is suggested that our specific enhanced ability in recognising biological motion utilises a psychophysical level of perception (Das, 2009). Further support is offered in a fairly old but frequently cited experiment held at Princeton

University, which sought to establish the order in which different levels of form are recognized in a visual image. (Kinchla, 1979). The experiment conducted was a screen-based one and was designed to assess how images with competing global and local components were perceived in order. In this way the images (typically a large capital letter ‘H’ constructed from smaller ‘E’s) resemble the component and holistic interpretations of a typical diasynchronic artwork. The conclusion reached by Kinchla and Wolfe was that:

The results suggest neither an invariant "top-down" (gross shapes first followed by lower-order details) or "bottom-up" (the opposite) sequence. Rather, they seem to suggest a sort of "middle-out" sequence: forms at some intermediate level of structure having an optimal size or spatial-frequency spectrum are processed first, with subsequent processing of both higher and lower levels of form.

(Kinchla & Wolfe, 1979)

This correlates to phenomenological observations of participants in the *Diasynchronoscope*, which seems to suggest the possibility of an intermediate psychophysical level of perception⁶⁴ where we make a subjective assemblage of information from expectancy. In some ways this hypothesis creates a redefining of the top-down category that resolves some of the conflicts between attention and consciousness, because although there is clearly some difference between culturally-shaped perceptions and universal, automatic perceptions, there is also a significant area of common ground in perception that is psychophysical in nature. An extrapolation of this conjecture for vision processing is shown in the table that follows:

	Bottom-up	Intermediate	Top-down
Processing	Physiological	Psychophysical	Psychological
Memory	Memory free	Working memory	Semantic memory
Attention	Non-cognitive	Selective attention	Attention and Cognitive awareness
Generality	Universal	Common biases	Individual/cultural
Reflex	Automatic	Predominantly non-reflective	Entrenched
Perceptual Control	Perceived using Foveal, parafoveal and peripheral cones and rods in retina	Can be covert or overt, but attention is necessary to perceive transient change	Overt. Consciously controlled – particularly in deciding not to look

⁶⁴ Or middle-out processing as defined in: The order of visual processing: "Top-down," "bottom-up," or "middle-out" (Kinchla & Wolfe, 1979)

Phenomenological consequences	Visual perceptual quirks such as foveal fixations, saccades, flinching, waterfall illusions etc	Subjective assemblage of information from expectancy. • Selected cognition from certain personal cues. eg will pick out one's own name. • Willingly seduced by transient cues	Confirmation of bias Reframing of reality by applying entrenched prejudices
Perceptual Examples	Change blindness	Inattention blindness Gorilla in our midst Magic tricks	Reading movement Left to Right (western) metaphoric resonances eg: red colour=danger Nuances of green if jungle dwelling.
Test	Can't improve with experience (apart from infant-to-adult learning)	Can learn with experience	Needs conscious retraining to change
Diasynchronoscope	Yes, demonstrated in arcs, synchronized sound etc	Full attention	Can be confounded, creating sense of magic

Table 3. A comparison between Bottom-up, Top-down and intermediate perceptual processing

Robert Solso's lively book *The Psychology of Art and the Evolution of the Conscious Brain* carries forward many of Gregory's ideas, taking an evolutionary look at the development of art and mind. (Solso, 2003) Solso discusses peripheral vision as being the 'searching, questioning' part of visual perception and emerges with a unique idea that our brains have evolved to make us 'AWARE'. That our cognitive and sensory system have adapted to perceive the world in a proto-isomorphic manner, using top-down and bottom-up processing. He then extrapolates this to put forward the idea of three levels of appreciation for art; the third being beyond surface, and beyond semantic interpretation; a comprehension as much a feeling as a cognition. It is transforming: the Tao of art - at once primeval and sophisticated. Solso's idea of 'AWARE' closely echoes the idea of intermediate processing expounded above,⁶⁵ and because this middle ground houses both magic tricks and the *Diasynchronoscope* it is an attractive idea. In later versions we have animated real objects (such as a hook on a chain in '*Conversio*' 2013), here we confounded the participant by merging analogue and digital so that a perceived real object swinging in space suddenly developed a digital glitch and the hook separated from the chain, teasing it till it is 'caught' again.

⁶⁵ Solso's middle ground is an idea that has some correlation to the stages of visual perception developed by David Marr (and others) in Marr's seminal work *Vision: a computational investigation into the human representation and processing* (Marr, 1982)

Carrying forward Kinchla and Wolfe's study of top-down and bottom-up perception (Kinchla & Wolfe, 1979) to three dimensions with objects that hold either suppressed or equally weighted semiotic interpretation would be a very interesting area for future study. Not least because although the debate for how we perceive objects per se is ongoing, there is even more mystery involved in how we see things move and further the thorny question of *why* we see things move that don't move, as evidenced in Apparent Movement.

2.3.3. APPARENT MOVEMENT

To set the scene for the *Diasynchronoscope* as a research tool, it is necessary to define and summarise the current thinking on apparent motion or AM. AM is the experience of motion derived from successive stimuli at different locations (Wertheimer, 2012) (Metzger, 1934) (Anderson & Anderson, 1993). Wertheimer tested whether apparent motion depended on some form of cognitive influence, presenting apparent motion and real motion side by side. His finding was that: "*in most cases, the actual and the 'apparent' motions were entirely indistinguishable.*" An idea later tested and proved by De Silva in 1929 (De Silva, 1929), (Muckli, 2005) and also more recently confirmed by data taken in fMRI imaging by MIT cognitive neuroscientists who found that noticeable filling-in takes place in the primary visual cortex, showing firstly that:

...given two successive images of a scene, the visual system identifies corresponding parts of the two images as successive views of the same objects. Second, when the "correspondence problem"⁶⁶ has been solved, the system computes the motion intervening between the two presentations. Finally, for each pair of views of the same object, the computed motion trajectory is filled in by generation of a sequence of visual representations of the object in successive positions along the path from the position indicated by the first image to the position indicated by the second one—a sequence of representations similar to those that would have been generated if the object had been viewed in real motion over the trajectory.

(Larsen, Madsen, Lund, & Bundesen, 2006)

However, as Robert Sekuler points out in discussing this topic, this isomorphism between real and apparent motion depends upon a careful choice of stimulus parameters,

⁶⁶ The correspondence problem, which is essentially screen-based, refers to the problem of ascertaining which parts of one image correspond to which parts of another image and if differences are due to movement of the camera, the elapse of time, and/or movement of objects. This is not an issue in the *Diasynchronoscope*, where nothing actually moves but the spectator.

not least that real three dimensional objects are used in experimentation (Wertheimer, 2012, p. 106). Indeed Wertheimer concludes his account of his experiments with this astonishing statement:

'In some cases... the two types could finally be correctly distinguished from each other, not by designating one as motion and the other as non-motion, but by stating a qualitative difference in the kind of motion perceived... Very often there were statements like, "One motion looked different from the other in that it was so strong, energetic, the best motion of all," and this in regard not to actual motion but the apparent motion produced by two successive stationary stimuli'.

(Wertheimer, 1912, pp. 173-174)

Sekuler's commentary notes that: *'Wertheimer was intrigued by the fact that non-moving stimuli produced clear and compelling motion'* and attributes this to: *'...the limited spatial and temporal resolution of the visual system. The visual system is blind to spatiotemporal variations falling outside these limits'*. (Wertheimer, 2012, p. 107)

Wertheimer then conducted a number of painstaking experiments to explore the in-between stages of motion.⁶⁷ This filling in of gaps between motions was also investigated by Larsen et al who finish their paper with the following conjectures:

Long-range apparent motion that looks like real motion implicates activity in the primary visual cortex along a path connecting the representations of the stimulus locations. The strength of the illusion increases with the extent of this filling-in. Apparent motion over large visual angles is generally weaker than motion over small angles, but there are cases in which vivid apparent motion is experienced over large spatial separations, and such cases are distinguished by noticeable filling-in in the primary visual cortex.

(Larsen, Madsen, Lund, & Bundesen, 2006)

That both Wertheimer and the MIT scientists use terms such as *'best motion of all'* and *'vivid'* although nearly a century separates their observations, seems to indicate that under certain circumstances, perhaps on the borders between 'real' and 'apparent', there may be a richer visual experience available to subjects than observing movement in real life. This is a very exciting opportunity for research using the *Diasynchronoscope*.

⁶⁷ These experiments and their findings are discussed in Chapter 2.1.1 on attention and apparent motion

Apparent motion is the replacement term for what was once described, particularly in film literature, as '*persistence of vision*'. Persistence of vision is an idea that can be traced as far back as to Euclid (where it may be rather more related to afterimage theory (Nichols, 1980)) and more recently can perhaps be more simply put down to an explanation for '*the eye's inability to tell a steady light from one that flickers faster than fifty times a second*' (Ings, 2007). It has been proven that the idea of attributing perception of motion entirely to the physiology of the eye and 'build-up' of images on the retina is a myth (Ings, 2007) (Nichols, 1980) it is, however a myth that is still perpetuated in some film and animation writing as noted by some authors. (Anderson & Anderson, 1993) (Williams, 2001, p. 13).

There are two attributed sources for the myth; a paper on optical deception given by Peter Mark Roget (creator of Roget's thesaurus) to the Royal Society in London in 1824. (Roget, 1825). Although Roget's thesis was based upon an empirical observation of the wheels of a locomotive seen through the slats of a fence, film historians Terry Ramsey (in 1926) and Arthur Knight (1956) adapted his real life concept to film and cited the paper erroneously renaming it '*Persistence of Vision with regard to moving objects*'. The other suspect for coining '*Persistence of Vision*' comes from France; Joseph Plateau in 1829. Plateau, the inventor of the *Phenakistoscope* in 1830, is credited by the film historian, Georges Sadoul in his seminal '*Histoire générale du cinéma: L'invention du cinéma*' (Sadoul, 1948) with the notion of retinal fusion. At this point, it should be noted that alongside many other modern scholars, this thesis is deliberately disregarding flicker fusion as an interpretation of persistence of vision, because the shutter that was necessary for cinema projection is no longer a factor as it does not form part of most modern viewing on screens.

The first mention of Apparent Motion predated the birth of cinema by twenty years, and was made by the Viennese psychologist, Sigmund Exner in 1875 (Exner, 1875), when he published a paper on apparent motion suggesting that we have an evolutionary bias towards fusing stationary dots by filling in the gaps, because we are always alert for a predator stalking behind trees, or stalking prey ourselves. Exner also remarks on peripheral vision recording empiric studies of motion being sometimes perceived at the edge of the eye as a pure phenomenon without shape or color.

The idea of apparent vision was also mooted by the remarkable US perceptual psychologist, George Stratton in a 1911 paper, (Stratton, 1911) and a year later the

founding father of Gestalt psychology, Max Wertheimer, (who had undertaken post-doctoral research with Exner) published his seminal paper on phi movement that launched Gestalt psychology (Wertheimer, *Experimentelle Studien uber das Sehen von Bewegung*, 1912). In this paper Wertheimer split apparent motion into phi movement and beta movement and discussed them as distinct phenomena; the former being labelled 'pure' motion by him as it did not centre on an object of attention. Beta is defined as the apparent motion perceived when an object is displaced in space and time sequentially.⁶⁸ Both phi and beta are variously held up as being the reason we interpret a television film running at 25 frames per second as a 'movie', and not a sequence of stills.

A student of another Gestalt founder, Kurt Koffka, the German psychologist, Korte, published some general laws of apparent movement in 1915 based on projected lights being switched alternately:

ϕ (Phi)-movement: pure movement from pairs of flashing lights.

β (Beta)-movement: movement of an object from one position to another.

α (Alpha)-movement: change of size with successive presentation

γ (Gamma)-movement: expansion or contraction with increasing or decreasing illumination.

δ (Delta)-movement: 'reversed' movement occurring when the later stimulus is much brighter than the earlier. This movement is in the opposite direction to the order of presentation. (Korte, 1915).

Korte's laws refer to the time interval and separation of alternating pairs of stimuli for giving optimal apparent movement and are listed here as described by the editor, Richard Gregory in *The Oxford Companion to the Mind* with the qualifier: '*Perhaps, though, 'laws' is too strong a word for such variable effects*' (Gregory, 2004 (2nd Ed)) and indeed because some forms of apparent motion would seem to be absent, such as animated colour or morphing forms, Gregory's point is well made from an animator's viewpoint.

The theory of apparent motion (AM) was classically split not just between beta and phi motions, but also between short-range and long-range AM. The distinction here being between small elements moving small distances and larger elements moving larger

⁶⁸ Further discussion of Phi and Beta are addressed in this thesis in relation to the centennial case-study from 2012; *Gestalt Circle* a *Diasynchronic* artwork that invited audiences to meditate on these two forms of apparent motion.

spatio-temporal distances. (Anstis, 1980) (Braddick, 1980) J. Timothy Petersik in his 1991 paper (Petersik, 1991) used the '*Ternus*' display to illustrate a claim that these two stimuli are subject to different processes (first and second order), his point essentially being that short-range AM is processed early, perhaps entirely on physiological level by directionally selective neurons in the primary visual cortex (first order), and that the long-range AM system takes place in the brain. This is called 'second order' as it integrates significant 'top-down' processing, taking into account all available (visual) information and generating the most likely interpretation.⁶⁹

A study by Harvard psychologist, Patrick Cavanagh in 1991 challenges the very idea of there being clear distinctions between short-range and long-range AM (Cavanagh P. , 1991), also questioning whether they are subject to two separate processes. Instead Cavanagh proposes an attention-based order for motion categorization of first order and second order stimuli in AM. (Cavanagh P. , 1992) (Lu, 1995a) It has now been suggested that there is a third order (intermediate) level of visual perception that integrates movement at a psychophysical level, incorporating both top-down and bottom-up processing (Lu, 1995b) (Marr, 1982) (MacGillivray C. , 2007)

It can be seen from this potted history that although we have been happily consuming screen-based media for well over a century, the debate as to why we actually see moving pictures when we go to the cinema, and furthermore, how we should label that experience is still a progressive one. Studies in perception of Apparent Movement have tended to be discipline specific; Visual studies of movement in Psychology rarely draw on the knowledge-base of practitioners of cinema and animation⁷⁰, and as pointed out before, Cinema and New Media studies rarely cite the contributions made by Gestalt psychologists and cognitive neurology to perception.

There is also a historical tendency towards different opinions between the various disciplines for instance that of Media where the paradigm is one of continuous smooth movement and that of perceptual psychology, where a typical test is stroboscopic,

⁶⁹ So this could include other visual information such as textures and occlusions too. (second order)

⁷⁰ A paper from the Max Planck Institute (Tse, 2002) on the duration of 3-D form analysis in transformational apparent motion (TAM) carries over 200 references, none of which are from animation and media, despite the fact that the paper decides to coin a new term (TAM) for analysing how observers perceive objects that morph and travel. These objects are called 2D and 3D, but are all observed on a screen 57cms from the observer's eyes.

consisting of alternate frames of flickering dots - Although both disciplines tend to draw on screen-based phenomenological experiments.

This thesis argues that because the *Diasynchronoscope* is a screen-less experience of animation, it offers a fresh experience to audiences that is closer to veridical perception in some areas. This is because it affords an embodied reaction to perception, carrying the physiological stereoscopic depth cues of accommodation, convergence, and parallax which feedback information via the eye muscles and vestibular (sensory system of balance and orientation) feedback.

This chapter has discussed the differences and similarities between the principles of three focal theories Animation, Gestalt and Embodiment in relationship to the *Diasynchronoscope*. There are many cross-overs, but some important disparities. In particular dependence on character animation and older technologies indicate that the animation principles would benefit from an update. The tendency of Gestalt phenomena to be demonstrated on a flat page also means that in direct translation to the *Diasynchronoscope* these phenomena change in nature. The embodied nature of the *Diasynchronoscope* means that it offers, in effect, an intra-cinematic experience without a screen – a paradox for screen studies that needs further contextualisation.

3. CONTEXTUALISING THE DIASYNCHRONOSCOPE

This chapter provides a conceptual overview of the *Diasynchronoscope*, starting with a discussion of the ancestry of *Diasynchronoscope* and contextualising it in terms of the history of optical devices particularly from the nineteenth-century. The *diasynchronic* technique is then contextualised with other modern hybrid media from a scientific perspective and from an artistic perspective.

Artistically the research has drawn inspiration from a variety of sources; the early Russian pioneers of formalism in film, Eisenstein (Eisenstein, 2006) and Vertov, and constructivist kinetic sculptors such as Naum Gabo and László Moholy-Nagy, and modern mechanical or robotic devices that explore movement. Inevitably major influences have been ground-breaking animators; from abstract innovators such as Hans Richter, Mary Ellen Bute and Len Lye to popular trail-blazers like Walt Disney. After discussing how the work of other artists has informed my own practice, I return to the basic premise of this being research *through* practice and defend this premise by drawing on wider theories of research. Generally this thesis has not felt the need to refer to the French philosophers and others who have written so much media theory during this last century, as their non-concrete meditations are not conducive to the pragmatic nature of the study, preferring instead to turn to literature that combines discussion of the formalisms of emerging media with audience perception, starting with Munsterberg (Munsterberg, 1916) and Arnheim (Arnheim, 1974 (first ed 1954)) through to McLuhan (McLuhan M. , 1964) Lev Manovich (Manovich, 2001) and Sean Cubitt (Cubitt, 2004). These texts have helped inform synthesis of ideas and provided frameworks for analysis. The chapter concludes with an in-depth discussion of the emerging grammar of the *diasynchronic* technique using frameworks drawn from gestalt psychologist Rudolf Arnheim's formalisms of film and montage in his influential book; *Film as Art* written in 1932 and updated in 1958 (Arnheim, 1958)⁷¹.

3.1. THE ANCESTORS OF THE DIASYNCHRONOSCOPE

In the words of Getty Museum curator Barbara Stafford: current modern technologies often “*glimmer with mysterious and sensual ancestors*” (Stafford & Terpak,

⁷¹ Updated as Arnheim's discussion of 'pantomimic' form by Ian Verstegen in his 2005 discussion of Arnheim's writing: 'Arnheim, gestalt and art: a psychological theory'(p.57)

2001) and the *Diasynchronoscope* is no exception: the name *Diasynchronoscope* evokes early animation simulators from the early 19th century such as the *phenakistoscope* and *zoetrope*, which this thesis regards as direct ancestors of the research in that they too acted as both art objects and experimental media. It is notable how popular various exploratory devices were in the pre-cinematic age, where each new optical toy was as thrilling as the content it held. Looked at from a modern perspective, the urge to share experiences through conjured movement seems to run like a thread through humanity, from Palaeolithic man to modern anime Otaku. Although the *diasynchronic* artworks are digital in construction, relying on software and computer visualizations, the artworks are in effect ‘backwards engineered’ as they are concretely constructed in space and appear firmly analogue. For audiences, it seems to evoke sensations similar to descriptions of encounters with devices of wonder from days of pre-cinema and even further back.

Stafford’s *Devices of Wonder: From the World in a Box to Images on a Screen*, and Crary’s *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* have been primary texts for this research. The starting point for many of the following notes on pre-cinematic history are drawn from Barbara Stafford’s thorough compendium of historical and modern interactive devices which she drew together in an exhibition at *The Getty Research Institute* in November 2001. (Stafford & Terpak, 2001)

In his extended essay, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*, art historian, Jonathan Crary offers a redefinition of spectatorship through marking historical constructs that encouraged subjective sensory divisions (Crary, 1992). Following a trail from Goethe’s empirical experiments with colour to Gustav Fechner’s quantitative sensory work, Crary gives a critical review of the history of emerging visual technology that embraces Schopenhauer’s interlacing of scientific and aesthetic discourse and challenges, ‘any simplistic opposition of nineteenth-century art and science as discrete and separate domains.’ (Crary, 1992, p. 76)⁷²

Many of the mechanical devices in these books represent a synthesis of science and art that is entrancing. Crary introduces Benjamin’s claim that in the nineteenth century, technology ‘subjected the human sensorium to a complex kind of training’, only to reject it as a false premise because with devices such as the phenakistoscope, Foucault’s opposition between spectacle and surveillance had collapsed into one when:

⁷²In some ways the *Diasynchronoscope* is a response to my having read these books and I am indebted to my supervisor Janis Jeffries for recommending them

... a new public consumed images of an illusory 'reality' was isomorphic with the apparatuses used to accumulate knowledge about an observer. In fact the very physical position required of the observer by the phenakistiscope bespeaks a confounding of three modes: an individual body that is at once a spectator, a subject of empirical research and observation, and an element of machine production.

(Crary, 1992, p. 112)

These books by Crary and Stafford demonstrate that objects of wonder that employed embodied perception were qualitatively different from mediated screen-based media, and this fundamentally fuelled my desire to move away from the screen for my explorations of movement. They inspired me to create *Bolt* which, in turn, gave me confidence to imagine the *Diasynchronoscope*. These books with their detailed descriptions of nineteenth-century devices form the backbone for the following three sections on heritage, supplemented by multiple sources found during this research.

In order to more clearly contextualize the hybrid craft of the *Diasynchronoscope*, where animation, 3D and projection are all combined, the thesis divides the history of devices of wonder into three natural and converging lineages of enquiry:

- i) The history of animation
- ii) The history of projection
- iii) The history of simulated 3D

It should be noted that by-and-large this research is trying to maintain a formalist approach, examining the poetical structural and ontological nature of ancestors to the *Diasynchronoscope* rather than examining the cultural concepts that underlie such work. In this respect it gives a nod to David Bordwell's and Tim Smith's urge for film theorists to take a cognitive approach (Bordwell, 1997) (Smith, 2012); both believe that studies in perception and cognition could create a new paradigm for film theories of spectatorship. Although this is a relatively easy approach to take for the formalism's belonging to animation and 3D, it is very difficult not to adopt an audience-centred approach when looking at the history of projection and screen-based mass media in general, indeed from Munsterberg onwards this has been the approach of many film studies.

In his book, '*Audiences*', Ian Christie of Birkbeck University identifies differing approaches to understanding the modern audience for film, and particularly forefronts one issue with taking an audience-centred approach – namely do we discuss the audience

for a particular event in time, or an audience for cultural event (ie a particular film) *over* time? (Christie, 2012) This brings the idea of performance to mass media and it is this experiential aspect that is discussed in the section on the history of projection.

3.1.1. THE ANIMATION HERITAGE OF THE DIASYNCHRONOSCOPE

If recent discoveries by Marc Azéma regarding Palaeolithic wall paintings in the La Marche caves of central France are to be believed, the history of animation stretches back 30,000 years. The French student of palaeoanthropology has shown through animated re-illustration of Paleolithic depictions of horses and goats, that the rendered multiple heads, tails and limbs attached to the body of the animals could be viewed as animated looped sequences of movement if lit by firelight. In a recent paper, he claims to have found fifty-three such examples (Azéma & Rivère, 2012).

This is actually the first thing that strikes an animator when confronted by a cave wall images of a wild boar with four pairs of legs – clearly the artist was depicting motion, and it is easy to hazard that because the artist had no tools for transparency he or she would discover that a flickering fire could create apparent movement. The great animator, Richard Williams in his definitive animation guide book: *The Animator's survival Kit* remarked on this a decade ago (Williams, 2001) (p.11)

More support for animation being an ancient art comes from Dr Mansur Sadjadi, who noticed five images of a goat inscribed on pottery goblet from Persia dated 3,000 years BC, and realised if the vessel was rotated it would create an animated sequence of the goat jumping up and eating a tree branch. There is an architectural example from Egypt in 1600 BC, the goddess Isis was depicted in progressive movement on 110 columns of a temple built by Rameses II. Williams theorizes that the goddess would animate as a passing charioteer or horseman rode past (Williams, 2001, p. 12).

The first animation which worked as a unit to create simulated movement was an early 'zoetrope' invented in China by Ding Huan in the late Han dynasty, (202BC – 220 AD). It used convection from a lamp to turn vanes attached to a round drum of translucent paper panels on which sequential pictures of flying birds and other animals had been painted, the lamp illuminated the pictures as the drum rotated, creating an illusion of movement, much as children's rotating night-lights do today.

The *zoetrope* is frequently cited as a direct ancestor of animation and indeed of cinema. It has a rich history in Europe, going through several incarnations in the 19th century and replacing Joseph Plateau's model of the *phenakistoscope* (1829), whose name was also derived from Greek origins and can be translated as 'eye deceiver'. Plateau had constructed the device to incorporate his research on 'persistence of vision'⁷³, and used viewing slits to segment the images. Unlike the *zoetrope*, the *phenakistoscope* used flat discs of 10-16 pictures, could only be seen by one viewer at a time and needed a viewing mirror. In fact, the *phenakistoscope* was in many ways really the device that led to cinema when it was combined with *Magic Lantern* projection in 1860. (see section 3.1.2)

The name 'zoetrope' comes from the Greek, 'Zoë' (life) and 'tropos' (turn) and is usually translated as the 'wheel of life'. Although the *zoetrope* is frequently cited as a precursor to cinema, this paper would contend, that as it lacks projection, it belongs as a device for viewing looped animations. It was a popular parlor toy from 1833 when William George Horner customized it as the 'Daedalum' or 'the wheel of the devil' and strips of pictures (usually 15) that fitted in the drum were sold commercially. This version was popular until 1877 when Charles-Emile Reynaud created the improved *praxinoscope* which allowed for longer shows and produced a clearer, brighter less distorted image than the *zoetrope* when in action. Muybridge's *zoopraxiscope* built on this, and it is well-documented how he used a series of trip wires set at regular spaces on a series of cameras to record a horse running. The resulting drawings are held up as realistic animations⁷⁴, although it is worth pointing out that the spacing of the pictures was due to distance and not time, and if it had been recording a slower or more uneven motion, it would perhaps be noticeable that the timing of the animations is not realistic.

A closer precursor to the *Diasynchronoscope* is Marey's photographic gun which recorded birds in flight (1882). To get these remarkable pictures, Marey also worked in a blackout space. Hanging black velvet drapes inside a shed at the Physiological Station in Paris, and used a photographic 'rifle' to follow white birds in flight. The images were recorded on discs with radial slots to act as shutters between pictures. This use of white against a black velvet background and progressive animation that is attended to (by the rifle sighting) is close to the animation by attention that we try to achieve in the

⁷³ Discussed in section 2.3.1, Apparent Movement

⁷⁴ The animations were drawn, rotoscoped tracings of the photographs not the actual photographs.

Diasynchronoscope. However it should be remembered that Marey's primary motivation was scientific; he was trying to discover secrets of biological motion.

From 1886, every wealthy home in Britain had a *Kinora*. This was a device for making short home movies (up to 25 secs long) and it worked like a flip book on a wheel. The English company, Kinora Ltd., offered a camera that shot rolls of 25.4mm paper or celluloid which were then processed and made into reels by the company. They also sold ready-made movies for people to buy or rent. Even with the invention of cinema by the Lumière brothers, in 1895, the *Kinora* remained a hugely popular gadget until 1914, as it was deemed socially unacceptable to go to the cinema.⁷⁵

3.1.2. THE PROJECTION HERITAGE OF THE DIASYNCHRONOSCOPE

This research is looking at the history of devices of wonder from a scientific and artistic perspective and not a cultural one, however the response and perceptions of the audience is also pertinent in terms of context. The pre-cinema age was a gift to entrepreneurs who were quick to see the commercial advantage of these popular parlour devices. It was inevitable that there would be a desire to exploit the magical quality of apparent motion in a theatrical setting so that the experience could be shared with others as a spectacle for an audience. A detailed discussion of this cultural angle can be found in in Sean Cubitt's *The Cinema Effect*, (Cubitt, 2004)) also (Stafford & Terpak, 2001) and (Crary, 1992). With every new device, audiences were filled with wonder, some attributing magic properties to these manifestations of new technology.

A means of throwing images onto screens or walls using mirrors and lenses in a semblance of Plato's cave was originally achieved using firelight shining through the aptly named *Magic Lantern*. From 1600, these were hugely popular: Peck and Snyder sold at least 47 different varieties of *Magic Lantern*. The most popular was the Electro Radiant no 2, which was sold with bundled software of 12 x 7" slides. They were lit (hazardously) with oil, gas, or kerosene and came complete with a smoke stack! The projected images from slides were 8ft in diameter, allowing for a sizable audience and a major selling point was to encourage entrepreneurial boys to get one and sell tickets. Apparently skilled projectionists could create a semblance of movement by moving

⁷⁵ A modern version of these mechanical flipbooks made as triptychs, were exhibited by Californian Artists Mark Arnon Rosen and Wendy Marvelwere at *Kinetica Art Fair 2013*. In a talk at the fair, the pair described how unexpectedly popular they were with modern audiences as gifts. Their work can be seen at <http://xraydreams.com/>.

swiftly from one slide to another. The same ability was reported in accounts of the *tachistoscope* experiments that Wertheimer (1912) and Metzger (1934) made when comparing real and apparent motion.

The audience came to enjoy the magical properties of the lantern in two ways; as instruments of illusion and also as replicators of reality. The slides could be used to promote the wonders and beauties of the world, or summon up phantasmagorical multi-media experiences. This bifurcation of education and desire was evident from early on: In 1646, Athanasius Kircher published a paper “*Ars Magna Lucis et Umbrae*” (*The Great Art of Light and Shadow*) on projection experiments with mirrors and lenses, stressing the need for a demystifying approach to be taken when showing projected images and warning exhibitors that they should take great care to inform spectators that such images were purely naturalistic, and not magical in origin. In 1668 English scientist Robert Hooke published an article on the *Magic Lantern* in *Philosophical Transactions*:

It produces Effects not only very delightful, but to such as know the contrivance, very wonderful; so that Spectators, not well versed in Opticks, that could see the various Apparitions and Disappearances, the Motions, Changes and Actions, that may this way be presented, would readily believe them supernatural and miraculous.

(Hooke, 1668)

By 1780, Kircher’s warnings were cheerfully ignored and Hooke’s observations became prophetic when, following the industrial revolution, a fascination with occulted, pseudo-necromantic technology was in the ascendant. Robertson’s *Phantasmagoria*, Seraphin’s *Ombres Chinoises* and Guyot’s *Smoke Apparitions* all offered multi-media illusions that exploited the magic of projection and combined it with blood, spooks and percussion. Audiences were ushered into a dark room for between 1-2 hours and a master of ceremonies would conjure up spirits of dead people using a rich combination of performance, ritual and technological innovation such as mounting the lanterns on rollers behind screens so that the image could grow and shrink.

In 1862, at about the same time as physicist Gustav Fechner coined the term ‘*psychophysics*’ for the idea of measuring between stimuli and perception, Victorian Civil Engineers, Henry Dircks and Prof John Pepper created a theatrical projected illusion based on an angled mirror called ‘*Pepper’s Ghost*’, which was used to effectively

showed a ghostly figure on stage in Charles Dickens' *The Haunted Man*. Although complex to set up, it was a great success as a theatrical illusion, creating a projected apparition of an actor playing a ghost onstage that could be walked through.

The gothic extravagances of theatrical magic detailed above could not hold a greater contrast than to the restrained, domestic realism of the first films of Auguste and Louis, the Lumière Brothers such as '*Mammy washing her child*' and '*The Gardener playing the Hose*', in 1895. The following year, in Britain, Robert Paul regarded his '*Theatrograph*' films such as '*A Rough sea at Dover*' and '*Shoeblick at work in a London Street*' shown at Olympia as being a 9-day wonder, but these '*slice of life*' films went on to run in theatres for 4 years (Stafford & Terpak, 2001, p. 42). In fact they were so successful, and there was such a shortage of operators that limelighters were recruited, making £4 a week for just a few minutes work a day. Paul was personally running the operation of the *Animatograph* (as the *Theatrograph* was renamed) in eight theatres.

In 2003, *Musion* patented an updated version of the *Pepper's Ghost* effect where a metalized film (replacing the original mirror) is placed across the front of the stage at an angle of 45 degrees towards the audience; hidden below the screen is a bright image supplied by an LED screen or powerful projector. When viewed from the audience's perspective, the reflected images appear to be on the stage, creating the illusion of life-size, full colour, 3D moving images. The illusion can be spectacular, but the optimum field-of-view for the audience is limited and there can be problems with wrinkles in the large piece of film which create distortion of the image. It also requires a lot of projected light (typically 8,000 plus lumens) for the effect to avoid a milky hue emanating on the film which destroys the '*screen-less*' illusion.

3.1.3. THE HERITAGE OF 3D DEVICES OF WONDER

Fundamental to the *Diasynchronic* technique is the idea of using projection to illuminate three-dimensional objects thereby preserving features of perspective, focus, depth perception and parallax. There is no doubt that this contributes enormously to the veridical nature of the apparent movement. Again, there are ancient precedents: French historian Michel Lorblanchet suggests that Palaeolithic paintings were painted on naturally occurring bulges and ridges in the wall and these would contribute to the animated effects of movement when lit by fire or torchlight. There were many devices of wonder that explored how to create the illusion of 3-dimensions ranging from crafted,

optical toys to the embodied and immersive spectacles of moving scenery for a perambulating audience.

One small crafted device was the *zograscope* from the 1740's which was a means of curving a scene in a bowl-like way away from the viewer, so suppressing flatness in favor of depth cues, rather like the 'spherify' effect in *Adobe Photoshop*. When the *zograscope* was held at arm's length, the scene would 'pop' into a life-like facsimile. Another device was the *Lithophane* of 1822, where an image was carved in low relief into a porcelain plate and backlit to produce an image of 'great depth and realism'.

These crafted artefacts contrasted with the embodied idea of spectacle offered by revolving sceneries which displayed *Panoramas* named from the Greek *pan* (all) and *horama* (view) popular in 1820 in America, and Louis Dageurre's *diorama's* from the same period. Here an audience could move in an immersive environment with the content. This idea of embodied experience is inherent to the *Diasynchoscope*, where we do not need to rely on devices or effects for 3D as the apparent motion takes place with real objects in space.

The third way of bringing three dimensions to a viewer was through stereoscopic devices. In 1849, David Brewster invented the lenticular stereoscopic which resembled opera glasses for viewing paper prints or stereographs. Queen Victoria very much admired Brewster's *stereoscope* as a tasteful and didactic tool at the 1851 Great Exhibition, and such was its ensuing popularity that within six years the *London Stereoscope Company* has produced 100,000 stereographs. In 1890, Joseph Charles d'Almeida had the idea of using two *Magic lanterns* to project from and put a red filter on one and green on the other. A whole new visual of 3D was exhibited to an entire audience wearing spectacles with one red and one green lens. By 1922 this was a cinematic experience and it has recently had resurgence in popularity, with 3D screen technology being promoted in cinema, TV and for personal devices. It does however come with some problems. On small devices, the effect is limited and can produce severe headaches as the brain tries to resolve the depth cues with the constantly perceived screen frame and the absence of motion parallax (Howarth, 2011) and vergence accommodation depth conflicts (Hoffman, Girshick, Akeley, & Banks, March 2008) caused by the need to focus on the screen instead of a virtual point in 3D space also can make the experience unpleasant for some spectators. The current need for vision glasses in cinema means that

Almeida's contribution has not been significantly modified despite an intervening century of development.

The mechanical devices of this pre-cinema age were gradually replaced by screen-based content, and the screen has reigned supreme for most of the last century. In 21st century, the closest practical examples for the *Diasynchronoscope* are the *3D zoetropes* created by *Pixar* and *Studio Ghibli*. Here a rotating turntable is lit by strobe lighting to give the illusion of 3D characters as real objects performing in loops in a real space. The artist Gregory Barsamian beat both studios in creating artworks that employed 3D figures lit stroboscopically on a turntable to achieve apparent motion. Barsamian exhibited a large-scale *3D zoetrope*, *Die Falle (The Trap)*⁷⁶ at *Kinetica Art Fair 2013*. The review by Mathew Tucker in the *Huffington Post* noted:

Barsamian's exhibit at the Kinetica Art Fair uses strobe lighting to create jerky mesmerising movement... Taking on the visual illusion known as 'persistence of vision',⁷⁷ the sculptures are perceived in real time but appear within a dream world.

(Tucker, 2013)⁷⁸

Although the movement is 'jerky' with the *3D Zoetrope* because of the strobing required, and although the illusion relies on a turntable so there is no narrative or synchronized sound, just looped action; *3D Zoetropes* are objects that create great wonder in modern spectators. This thesis points to this as emerging testimony that medium does impact significantly on the qualia of experiencing movement and that there is something special or, to use Chion's phrase, 'value-added' about seeing 3D unmediated by screen or camera.

As Crary pointed out, in the nineteenth century the hybrid nature of the device (machine) and observer (participant) and the mobility and influence of each on one another in time is often categorised by mechanical history rather than the many different drivers that shaped these explorations (Crary, 1992)(p.119-130). The devices of wonder in the nineteenth century found an audience that was ready and willing to be both observer and observed, consumer and participant, becoming part of a system that blends science, art and spectacle.

⁷⁶ The work is Jungian examination of a man's reality in dream-time.

⁷⁷ Again the myth of 'persistence of vision' is promoted.

⁷⁸ http://www.huffingtonpost.co.uk/2013/03/01/kinetica-2013-art-fair_n_2789402.html

This thesis argues that mediums such as the *Diasynchronoscope* that can harness these same qualia still create a sense of wonder with modern participants, and that it is a seam of investigation that lies at the cusp of entertainment, art and science.

3.2. MODERN CONTEXT – NEW HYBRIDS OF IMMERSION AND INTERACTION

The idea of combining stereoptics with an immersive environment is a natural progression from the early devices of wonder and the interactive devices that employ Virtual Reality (VR) or Virtual Environments (VE) today could be seen as natural successors to these devices of wonder. In a virtual reality environment, a user experiences ‘*immersion*’, or the feeling of being inside and a part of that world and is also able to interact with his environment in meaningful ways.⁷⁹ This combination of a sense of immersion and interactivity is called *telepresence* and its effectiveness is measured by the extent to which one feels present in the mediated environment, rather than in the immediate physical environment.

For immersion to be effective, a user must be able to explore what appears to be a life-sized virtual environment and be able to change perspectives seamlessly, so they wear a Head-mounted Display (HMD) and suit. In VE, three-dimensional images appear to be life-sized from the perspective of the user, and the user's motions, particularly head and eye movements, are calibrated and the images are adjusted on the user's display correspondingly to reflect as changes in perspective. Although the experience is immersive and interactive, there are some current problems: The environment is shown at 24 fps and because the data can be massive, there is frequently latency in it updating, causing a feeling of seasickness in some users, and destroying the sense of immersion. The Head-mounted Display and suit are currently cumbersome and for one user only, prohibiting shared experience. Then there is the display's resolution, and the generalized audio. In the real world the human perceptual system automatically uses all available depth cues to determine distances between objects and to have all these depth cues

⁷⁹ Input devices in VR systems range from button controllers and joysticks to electronic gloves, body suits and treadmills to gesture reading and voice recognition software. Most virtual environment experiences prioritize visual and audio components over other sensory-stimulating factors, but there is some research going on into creating haptic systems that incorporate a users' sense of touch.

available in a VR system some kind of a stereo display is required to take advantage of the binocular depth cues.

Other VE systems use rear projection to project images on the walls, floor and ceiling of a room. These are called Cave Automatic Virtual Environments (*CAVE*). *CAVE* displays are very expensive and require more space than other systems. Users can move freely but wear special glasses to complete the illusion of moving through a virtual environment. *CAVE* displays give users a wide field of view, and allow a group of people to share the experience at the same time, but because the display can only track one user's point of view, others in the room are reduced to being passive observers.

Tele-Immersion allows a viewer to see a 3D environment, but not to interact with it. In the US, in 2000, researchers at the University of North Carolina and the University of Pennsylvania reached a milestone in the technology of Tele-Immersion. A user sitting in an office in North Carolina, was able to see lifelike, three-dimensional images of colleagues hundreds of miles away, one in Philadelphia and the other in New York, however the scenes being projected are only refreshed three times per second.

There are other new hybrid 3D and projection systems such as the one developed at the University of Arizona in Tucson by Dr. Peyghambarian recorded an image using an array of 16 cameras arranged as for motion-capture, rendered the images into holographic pixels, and recorded the information on a new "photographic" polymer developed by the California research labs of *Nitto Denko*, the Japanese electronic materials company. The plastic that can be erased and rewritten in two seconds and the prototype device has a 10-inch monochrome viewing screen where the picture refreshes every two seconds, too slow to convey natural movement but the researchers are confident that, now they have proved the concept, it will be possible to develop a full-color system large enough to capture the human body and fast enough to give smooth movements.

A very recent new virtual reality gaming device, The *Omni* launched a funding campaign on Kickstarter (the crowd-funding site) and, in a matter of hours more than doubled its goal of \$150,000, with a view to producing units by early 2014.

Omni is person-sized platform with an upper stand that allows users to walk or run in place wearing a special belt, shoes and headset. The inventors state that the *Omni* affords:

Real life movement [that] translates directly into any keyboard-compatible game. Used in tandem with the Oculus Rift and motion

controllers like the Razer Hydra, it potentially offers a previously unseen degree of realistic virtual reality gaming. “We are in the midst of a revolution in virtual reality. Moving naturally in virtual reality creates an unprecedented sense of immersion that cannot be experienced sitting down. That’s why we developed the Omni.”

Graduates of the Massachusetts Institute of Technology’s (MIT) Media Laboratory, founded the 3D holographic Imaging company, *Zebra Imaging* in the US in 1996⁸⁰. It has so far accrued 30 patents, with ‘*many more pending*’:

Zebra exists to create innovative digital holographic products and technologies for enhanced communication, captivating entertainment and compelling analysis and decision making. With support from our customers, employees and investors we are delivering the most advanced 3D visualization and collaboration solutions in the world.

Although Zebra’s visualisations may be layered in time, they do not yet include an ability to create immersive movement. Development of ‘*3D visualization and collaboration solutions*’ of biological movement is a very attractive proposition for advertisers and entrepreneurs in terms of business and entertainment, and it seems likely that as technology advances, the next step for the general consumer may be *Tele-immersion*, where we will be able to see lifelike, three-dimensional images of friends and family hundreds of miles away.

These hybrids currently involve a lot of expensive technology and so, for the most part, remain unexplored regions for artists to operate in. It is hoped that some of the considerations and discoveries made in this study can be adapted to contribute to the explorations of future artists using these technologies.

3.3. ARTISTIC HYBRIDS

Using computers has brought a whole new arena to art, creating artistic hybrids that are complex and multi-layered. The once fairly defined lines between mass media, and ‘high’ art are now blurred as technology and interactivity have taken art from being an aesthetic, story-telling medium to more of a conceptual, puzzle-posing one. This shift has also softened the divisions between theory and practice and science and art because the skills required are multifarious. However, hybridity carries repercussions.

⁸⁰ <http://www.zebraimaging.com/>

Goethe's experiments with colour in the early 19th century created quite a stir with artists and in the next century many colour organs were made which attempted to make coloured visualizations of music. (Daniels, 2011, p. 11). The second Color/Sound Congress in 1930 in Hamburg was attended by psychologists, scientists and cultural studies scholars as well as artists, pointing to its true hybrid nature and for a whole decade, several color organs were demonstrated at this series of Color Music Congresses. But all this dedication to hybridity did not result in longevity for either the tools or the artworks, and Dieter Daniels documents a shared destiny for them all:

These hybrids between instrument, work of art, and media device, however, all shared a similar fate: they were dead ends. The complicated apparatuses could only show their creators compositions, and not one established itself as a standard instrument. These artifacts are the complete opposite of universal machines: highly specialized, individualistic devices, which therefore – metaphorically speaking – die together with their inventors and are forgotten.

(Daniels, 2011, p. 18)

Daniels asserts that Audiovisiology's aim is to not create a new discipline, but to outline a model for dealing with something of genuine hybridity and yet there is an inherent problem to hybridity, because if it is not a new discipline, where does it sit in our taxonomical world? It would be foolish to think that this does not hold repercussions, as Daniels points out:

The indissolubility of this hybridity is also the main reason for what one could describe as being lost in interdisciplinarity. On one side, this concerns the cultural and scientific evaluation of individual phenomena (artworks, devices, theories), which depending on their location within an art genre (music, painting, sculpture, film and so on), in media technology, or in science, are subject to entirely different evaluation criteria. It also concerns the absence of an audiovisual historiography and, therefore, the handing down of knowledge and the formation of cultural and intellectual traditions. This is the reason why many color organ inventors believed that they were the first to have the idea of linking hearing and seeing in an apparatus.

(Daniels, 2011, p. 20)

This could be read as a dire warning for the *Diasynchronoscope*, and if it were our aspiration to create a new mass medium, it would indeed seem catastrophic. However it has not been the aim of this research to create a new mass medium, rather more humbly to create good artworks, disseminate the technique and see if anyone else can use the idea

of embodied apparent movement fruitfully. This thesis will hopefully contribute to these last two aims, and so in itself forms an answer to the question: where does it sit in a taxonomical world? One answer is here; in a practice-based doctoral thesis and in the demonstrations, talks and papers we have delivered at conferences. The world does not change overnight, but by increments.

Some artists hope to create something that have never been seen or heard before; art forms that travel beyond known genres. Such art forms are constructivist in nature, relying on new technologies or new combinations of technology to break new ground. Pioneers who take on these new instruments of communication face pragmatic questions of feasibility alongside those of aesthetics, frequently necessitating a transformation of their role from ‘artist’ into the dual role of ‘artist-inventor’. An example of this is Mary Ellen Bute:

We need a new kinetic, visual art form - one that unites sound, color and form. We can take a mathematical formula and develop a whole composition exactly synchronized - the sound and the color following a chromatic scale. Or we can take two themes, visual and aural, and develop them at times in counterpoint.

(Bute, 1936)

Audio-visual media could be described as combining a time-based medium (sound) with a localised (spatial) visual medium using various data as inspiration. Sometimes sound provides the primary inspiration for the final creation such as animated interpretations of known music, examples being Norman MacLaren’s *Boogie Woogie*, and Disney’s *Fanatasia*. Sometimes image takes precedence, as in Klee’s polyphonic paintings, Oskar Fischinger’s Ornament Sound Experiments or Julian Engels’ animated work where the graphic composition precedes the musical composition. Although the ‘absolute’ films made in the 1920’s by Ruttmann, Viking Eggeling, Hans Richter have shared our aspiration of creating an audio-visual marriage, it is relatively rare to design sound and image experiences in parallel as we do in the *Diasynchronoscope*. Although Mary Ellen Bute started as an illustrator of sound, she is the animator with whom I feel the greatest affinity because she is a woman who worked collaboratively and inventively with others. Originally a film-maker, Bute started working with the musician Joseph Schillinger, who had developed an elaborate mathematical theory about musical structure. Russian-born, Schillinger was primarily a music teacher and theorist who started by connecting mathematics to musical composition and then wanted to extrapolate these formulae to visual forms. These attempts to codify art influenced Mary Ellen Bute in their early collaborations and continued to hold sway with her work afterwards – some

would say to her detriment, accusing Schillinger's formulae of being reductive and removing tonal nuance. But in many ways this interpretation is of itself reductive: Schillinger defended his mathematical approach as being a theory of kinetic art that embraced all the possible forms that can be evolved in space and time would appeal to all of the senses at once. His ideas certainly did not exchew tonal quality, in fact, he proposed futuristic cross-modality and multisensory configurations of art where he felt keenly there could be a fusion of sensations, which he referred to as "colored hearing," "sound seeing," and "texture reactions" of tone quality, furthermore he expounded the idea that certain cross-modal aesthetics would be pleasing to a spectator without their explicit perception of these satisfactory qualities. Well before Russian filmmaker Andrei Tarkovsky suggested similar ideas through advocating rhythm editing in 'Sculpting in Time', Schillinger established a theory that objects were capable of directly stimulating the senses by the number of frequencies and proportions present in the artistic media and not just associative psychological forms and images. Therefore, aesthetic pleasure correlates directly to frequencies of stimuli and a beautiful composition would result from the harmonic relations of harmonically developed spatial and temporal components.

Between 1930 and 1940, Schillinger was able to cross disciplines and make intellectual connections that had never before been conceptualised. For instance, he felt that notated music was compromised because it did not portray the temporal mode of music: The notational record is not a musical work in itself but is merely a static schematic and hence cannot transmit the most essential property of music, ie its motion. These ideas were used for training composers of note (he is known as having been an influential teacher to George Gershwin and Glenn Miller amongst others). The film collaboration between Schillinger and Mary Ellen eventually foundered because the ambitious visuals she envisaged, which were reminiscent of Kandinsky's complex paintings, would have taken a lone animator years to redraw.

Mary Ellen Bute is less well known than other early film animators such as Lye, Hans Richter, Viking Eggeling or Oskar Fischinger, but to my mind is in many ways she is more remarkable because of her interest in expressing the formal propositions of mathematics and science in filmic form and because of the inventive way she used mixed media, mixing cartoon animation alongside film of a variety of household items such as combs, coffee and colanders to create her visual abstractions - In this she can be seen as a

forerunner to Jan Švankmajer's concrete animations - Bute's style is freer than that of either Richter or Eggeling, and her shapes more fluid.⁸¹

Parabola (1937) epitomises with Bute's affinity with our diasynchronic works. The film considers the parabola as a mathematical structure visible across nature and also as a form of Modernist sculpture. A subheading at the start of the film describes it as 'nature's poetry', and the 'path of every ball and bullet / Headlight's curve and Bridge's cable / Fountain's jet and falling star'. The film uses a wooden parabolic sculpture by the American abstract artist Rutherford Boyd as its subject, bringing a sculptural dimension to the images onscreen. Boyd's artwork is seen in different angles, lights and iterations, the film shows the parabola to be as much an example of nature's immanent beauty as Modernism's ability to recoup or represent it: the parabola is a seashell but also the beam of the headlight, and the Chrysler building.⁸²

There is an inspiring rhythm that Bute found in shapes and forms that provides half-realised allusions beyond specifics through free-flowing animation to create metaphysical wholes, as she aspired to make audiences 'see sound'. Bute's short films combined mass entertainment and novelty and played before Hollywood features at Radio City Music Hall, New York. One of her first films shown there, *Rhythm in Light* (1934), announced its aims in the programme: 'This film is a pioneer effort in a new art form – it is a modern artist's impression of what goes on in the mind while listening to music.' She was evidently a woman of some eminence in her time and it is a shame her work is not more widely known today. Again we are perhaps seeing verification of Daniels' assertion that hybridity does not last or carry the status of works by single artists to make it into the Temple of the Muses.

This has not stopped many artists who work across hybrid artforms from echoing Bute's claim to creating a new art form. These artists that aspire to create all-embracing artworks are perhaps working towards composer Richard Wagner's *Gesamtkunstwerk*⁸³; a synthesis of all genres of art to create an unconditional, direct representation of perfect human nature. Film examples include *cinéma concret*, a term coined by engineer and

⁸¹ Sometimes literally so: to make *Mood Contrasts* (1956), a film of shifting and dissipating colours, Bute poured black coffee and milk into a fish tank and filmed their intermingling. *Melissa Gronlund writing in Frieze* [Issue 118](#), October 2008

⁸² Boyd claims authorship too

⁸³ "The Artwork of the Future" ("Das Kunstwerk der Zukunft") essay written by Richard Wagner, first published in 1849 in Leipzig.

composer, Pierre Schaeffer to describe the films he made in collaboration with composer Pierre Henry which led with musical composition and used visuals as a counterpoint to an audio track. Finally there are long-form attempts at Wagner's *Gesamtkunstwerk* through stage-based performances, such as the collaboration between Robert Wilson and composer Philip Glass, resulting in the monumental opera, *Einstein on the Beach* (1976). That these works are collaborative is not surprising, in his essay of 1849, Wagner notes that creating such *Gesamtkunstwerk* would prove an impossible task for an individual and would necessarily have to be conceived as a joint work by the people of the future. There may be a bridge here between what Roy Ascott has coined 'Edge-Life' where virtual data and the real world meet as 'mixed reality' in interactive art and Wagner's concept of *gesamtkunstwerk*. British telematic artist and theorist, Ascott feels that out of our current technological complexity with its capacity to engage the intellect, emotions, and sensibility of the observer, there will emerge a new synthesis of the arts:

"We are re-defining completely our identity, our social structures, and our picture of the world, here at the edge of the Net where the virtual flows seamlessly into the actual, the transient into the fixed, and the metaphysical into the material." He calls this 'Gesamtdatenwerk'; the integrated data work. (Ascott, 2000)

When Wagner wrote this essay he could not have envisaged the enormous impact that screen-based media and digital technology would have on synthesised art. However, this impact has had a profound effect on an area that Wagner would have taken for granted; that of embodiment.

With the profound exception of interactive art, for practical, curatorial and economic reasons, modern audio-visual media tend to take a timid approach to embodiment, equating it to staged human performance or using screen-based images, it is relatively rare for it to be realised as a real three-dimensional work where the audience itself is invited to be mobile. However there are some installation works where the audience are encouraged to move, and where that movement creates a change in appreciation: examples are *The Forty Part Motet* by Jane Cardiff at the MOMA (New York, 2001) and *RE-RITE: Be the Orchestra*, by the Philharmonic Orchestra's Digital Residency. In both these works the focal inspiration is sound.

Another example of embodiment in audio-vision is Light Art: the creation of light spaces that address not only the sense of vision but that of hearing as well. Works by James Turrell and Danish-Icelandic artist Olafur Eliasson have explored audio alongside

the architectural properties of light. These works permit the viewer to move about within a lit space, thus re-perceiving it through their own motions, and achieving an increased understanding through self-perception. However in Light Art, as the name suggests, the focus is light-based and architectural rather than aiming for a synthesis of sound and vision. It is, of course, hard to create narrative if people move freely.

The constructivist Bauhaus teacher, Moholy-Nagy is regarded as one of the instigators of Light Art. His *Light-Space Modulator* (1922–30), with motorized perforated metal discs and grates, combines moving sculpture with light; spotlights shine on the sculpture, casting continuously changing shadows and reflections on the surroundings. Here Moholy-Nagy demonstrates a synthesis of Light Art combined with Kinetic Art.

Other kinetic sculptors who have combined sculpture with sound include US artists Alexander Calder and Bill Fontana. Most kinetic art tends to use sound created by moving machinery or sound created by chance such as elements moving in the wind. However another way of introducing embodiment to sculpture is through interaction where the installation becomes an instrument to be played. Here the process coupled often with haptic feedback becomes the thing, as the exploration of interactive experience is usually more the focus than searching for a traditional aesthetic outcome.

New technology has brought new artforms in the shape of interactive installations and will surely bring other new media. However, as Margaret Boden remarks in the final chapter; *Esthetics and Interactive Art*, in *Creativity and Art: Three Roads to Surprise*:

...[because] interaction does not figure as a consideration in traditional esthetics... there's no established esthetics associated with it.

(Boden, 2010, p. 210)

Ernest Edmonds, a true pioneer in computer art, has been making the same point since the 1970's. How can aesthetics remain stuck in tradition when the world is in constant flux? Unless all that has to be said has been said, (in which case we may as well all give up right now), we need to keep finding new ways to express ourselves and consequently develop new ways of discussing how we experience these new art forms.

Simon Shaw-Miller's differentiation of inter-, cross-, trans-, and multidisciplinary hybridity of different arts genres (Shaw-Miller, 2002) tries to tease the complex subject of hybridity apart, but it is perhaps small wonder that any art form that carries so many nuanced variables from the outset will find itself marginalised. However this does not mean that the humanities should ignore new forms of art and new media: Studies by neuroscientists have shown that the brains of digital natives (ie young adults who have grown up with the computer as an integral part of their life) change with persistent use of technology strengthening some brain activity patterns. In the face of such increasing evidence that our brains are plastic and that neural connections are strengthened in response to cultural changes (Turkle, 2011), it surely behoves us to face these cultural changes and try to find ways to and address them even as they are in flux. We are 'of our own time' and need to respond to things contemporaneously. The next section demonstrates this point through discussion of theories written by man who both did and did not deal with media in his own time: film theorist, and perceptual psychologist, Rudolf Arnheim, who published seminal works on film from 1933 that were reprinted with revisions up to 1974, and is in fact still being translated and published.⁸⁴

3.4. ARNHEIM AND THE ONTOLOGY OF FILM ⁸⁵

Let me start my discussion of film theorist and perceptual psychologist, Rudolf Arnheim with a story of a study that indicates the impact of film. It draws on the idea of the plastic nature of our brains and in particular Gerald Edelman's theories of *Neural Darwinism* (Edelman, 1987). The implications underlying this study are significant. They indicate that the medium may be more than the message; it may be the redesigner of our unconscious.

In the 1950's there were a number of studies of dreams that concluded that a middling to large majority of those surveyed, dreamed in black and white. Eric Schwitzgebel attempted to replicate these surveys and found that in contemporary groups this was now reversed, with a large majority claiming to dream in colour. (Schwitzgebel,

⁸⁴ The latest edition being in Spanish in 2012: *Cinema como Arte. As técnicas da linguagem audiovisual*. (Transl.: Marco Bonetti) Niterói: Muiraquitã.

⁸⁵ This thesis is using the term 'ontology' to describe something that is fundamental to film and thus characterises the medium in both a concrete and conceptual sense.

2002) He concludes that the overwhelming influences responsible were movies and television:

Black and white movies had other advantages over the competing media of the time that may have compelled comparison to dreams. They integrated visual imagery with movement and narrative as no other medium previously had been able.

(Schwitzgebel, 2002)

Rudolf Arnheim was percipient enough to engage in the aesthetics of film from early on, and some of his most interesting writing comes from these times when he was developing an understanding of the formalisms of the period when film was relatively new, black and white and silent. His book: *Film* (printed in England by Faber and Faber in 1933) has been revisited and revised in *Film as Art* and has been reprinted several times since.

Arnheim studied under Max Wertheimer and Wolfgang Kohler at the Psychological Institute of the University of Berlin as they were laying down the theoretical and practical foundations of Gestalt theory. Although Arnheim argues the case for formalism⁸⁶, and new formalisms do appear as media changes (such as the introduction of sound), he feels the closer film moves to realism, the further it moves from art and writes in 1957:

The talking film is still a hybrid medium, which lives from whatever fragments of the visual language were salvageable and from the beauty of the creatures, things, and thoughts it reproduces; the colour film, incapable of controlling its multidimensional instrument, has never gone beyond tasteful 'colour schemes'; the stereoscopic film is still unrealizable technically... the wide screen, finally, has gone a long way toward destroying the last pretences of a meaningfully organized image.

(Arnheim, *Film as Art*, 1958, p. 14)

When *Film* was first published in 1933, Arnheim took the stance that film should take a rightful place in the temple of the Muses because it was a medium that resembled painting, music, literature and dance. He maintained it had a place because, like these art forms, film did not reproduce reality mechanically, but was the product of a number of

⁸⁶ R. Arnheim. *Art and Visual Perception: A Psychology of the Creative Eye*. Berkeley and Los Angeles: University of California Press. 1954/1974.

deliberate artistic decisions. He then outlines these artistic decisions or formalisms and goes on to discuss practical examples where these formalisms were put to artistic use.

In writing this thesis, it is hard not to feel an affinity with Arnheim's close discussion of the grammar of film-making and the Gestalt perspective that he brings to understanding its formalisms.⁸⁷ His list of film tropes, which concentrate specifically on how film concepts differ from real life, runs thus:

- The Projection of Solids upon a Plane Surface
- Reduction of Depth
- Lighting and Absence of Colour
- Delimitation of the Image and Distance from the Object
- Absence of the Space-Time Continuum
- Absence of the non-visual world of the senses

It is informative to look at Arnheim's ontological properties of film as art and examine them in terms of the *Diasynchronoscope*, which provides in effect an intra-film experience without there actually being a camera or screen.

Arnheim defines '**The Projection of Solids upon a Plane Surface**' as the artistic decision made as to where objects are placed before a camera (in those days it was more usual to move a scene than to move a camera which was very heavy) and also where the camera is placed. He illustrates this by describing how one might tilt a cube towards a camera to maximise the sides viewed, arguing that seeing 3 sides made a cube 'truer'. This 'truer' nature of a cube is something that we consciously have tried to create in the *Diasynchronoscope* for the purposes of projection mapping. Each lit side provides a further clue to the true 3D nature of a cube, and so we try and position each cube to achieve at the minimum two lit sides and preferably three. As Arnheim points out: '*In*

⁸⁷ Arnheim's ontologies have been chosen over those of philosopher Stanley Cavell who also wrote a seminal book: *The World Viewed: Reflections on the Ontology of Film* (New York, 1972) because while this thesis takes ontology to mean something that is core to all film (eg It is screen-based), much of Cavell's book discusses generalisations drawn from particular films. Further because Cavell takes the stance (alongside Erwin Panofsky and Andre Bazin) that film derives from a photographic basis and captures reality or 'the world', it contravenes Noë and O'Regan's notions of enaction and sensori-motor feedback, and thus runs contrary to the thinking of many other critical commentators on film, eg. Deleuze, and certainly obviates any discussion of animation as belonging to the category of film.

order to understand a work of art, it is essential that the spectator's attention should be guided to such qualities of form.'

The second film trope is '**Reduction of Depth**', where, because a film is neither '*absolutely two-dimensional or absolutely three-dimensional, but something inbetween. Film pictures are at once plane and solid.*' (Ibid.: p.20) Arnheim shows that result of this is that film is not veridical, and '*that sizes and shapes do not appear onscreen in their true proportions, but distorted in perspective.*' (Ibid.: p.22) He remarks that '*thus the lack of depth brings a very welcome element of unreality into the film picture*' and uses Pudovkin's *The End of St. Petersburg* to illustrate how Pudovkin plays artistically with the way film does away with the constancies of size and form to create the impression of two peasants and a statue related as 'ants to a colossus' through forcing the depth focus, although in reality they are close to the same size. This is an ontology of the screen that the *Diasynchronoscope* cannot replicate as it comes from the flattening of three dimensions into two.

In Arnheim's third trope '**Lighting and Absence of Colour**', he describes the '*reduction of actual colour values to a one-dimensional grey series*' as '*a welcome divergence from nature*'. Adding; '*This is one of the most important aesthetic properties of film. The primitive but always effective symbolism of light versus darkness, white purity versus black evil, the opposition between gloom and radiance, is inexhaustible.*' (Ibid.: p.30) It is also one of the most important aesthetic values in the *Diasynchronoscope*, particularly in early versions of artworks where we had yet to conquer colour. In fact, in some ways I have some sympathy with Arnheim's slightly snobbish sentiments on non-colour being '*a welcome divergence from nature*. Colour is an easy crowd-pleaser and I like to think that the *Diasynchronoscope* artworks emphasise that colour has a significant - but not critical - role in visual art. However, I am of a generation that grew up with B&W television and films so perhaps my brain has been shaped along the same lines as Arnheim's?

'**Delimitation of the Image and Distance from the Object**' is Arnheim's fourth trope and it is interesting that he runs them together. By '**Delimitation of the Image**' he is referring to the screen as a defined rectangular frame to film and he draws on the idea of echoing horizontal and vertical lines that are essentially 'painterly' in origin. I have already said much about how important the removal of the screen is to experiencing the *Diasynchronoscope*, but it is interesting to contemplate how our artworks echo and play

with the one true line available in the void; that of gravity. Gravity creates a sensorimotor virtual plumb line for participants and we exploit this in animating objects. However when we change the axis for, say, falling objects - it generates feelings of the uncanny. The '**Distance from the Object**' affords an opportunity for Arnheim to discuss the relative uses of the range of focal framing selections in film from close-ups to wide-shots. A trope that fundamentally removes film from a theatrical experience by allowing differentiation of emphasis and focus, though, in essence the camera being the effective eye of the spectator.

'The film artist has the best possible control of his audience's attention; for by placing the camera just where he wishes, he brings onto the screen whatever is of greatest importance at the time.'

Arnheim (ibid,:77)

Again, this has been something we have found we can use as a trope in the *Diasynchronoscope*. In fact modern audiences are so used to the grammar of film that introducing screen tropes to a non-screen environment is not unnerving. The idea of an 'edit' from close-up to wide shot or vice versa in a narrative is easily assimilated. For instance, the large blue molecular shape of the diamond in the artwork *Stylus* is readily taken in at the same time as the physically smaller 'dripping' diamonds although outside of metaphor, the sizes would be reversed. In the artwork *Prism*, we used a shifting framing selection to make participants turn within the artwork, physically creating an embodied camera-pan. This is one of the most pervasive and unexpected tropes of the *Diasynchronoscope*, as touched upon when the thesis discussed 'staging' in Animation Principles.

'This relativization results, on the one hand, in the possibility of making things of quite different sizes appear the same size, and thus of being brought into connection one with another.'

Arnheim (ibid,:77)

Participants can alliterate and make connections of differing scales. Arnheim continues: '*On the other hand, particular effects may be induced by the spectators being deceived as to the real size of what is shown*' Arnheim (ibid,:78) Here we have a difference between the *Diasynchronoscope* and film as Art. The embodied nature of the *Diasynchronoscope* makes scale a trope that may be played within smaller parameters than a film. Parallax and depth perception means that we could not fool an audience into believing a doll's house is house, (Arnheim's example) as without the flattening

properties of the mediating screen, any shift in the position of the participant would reveal the trick. However we can (and have) introduced optical illusions on the z-axis that play with relative ideas of depth. Eg. We can make a perceived object appear nearer or further away by cheating the scale.

Although we have barely scratched the surface in the case studies here, the possibilities of varying the full range of an image, and changing the subjective participant's perspective as a consequence, would offer a potential rich seam of exploration for future artworks, particularly if we make the artworks interactive. In film we are familiar with the camera becoming the eye of the spectator, in the *Diasynchronoscope*, modalities are reversed, and the mobile spectator replaces the camera. This means that all camera film tropes are potentially translatable to the *Diasynchronoscope*, although it is worth stressing that this would probably only be effective with an audience who has been shaped by screen-based media over a life-time.

Arnheim's fifth trope, '**Absence of the Space-Time Continuum**' discusses the artistic potentialities of montage. The Russian theorists regarded montage as the foundation of film art, the tropes of cutting and cross-cutting jumps in time and/or space, to interweave and condense narrative were seen as core to the writing and practice of Pudovkin and Eisenstein. Pudovkin laid down five methods of montage and Timoshenko gave fifteen principles. However, Arnheim regards both as unsatisfactory, '*incomplete and unsystematic*' preferring to introduce his own scheme which incorporates some of the ideas mooted by Pudovkin and Timoshenko.

Because I come from a film editing background, Arnheim's principles of montage have undoubtedly some relevance to tropes of the *Diasynchronoscope* and this thesis would like to discuss them in the light of this, however, although by Arnheim's own admission they are non-exhaustive and subject to revision there are some difficulties in usefully translating his principles of montage back to the *Diasynchronoscope* as they deal specifically with shot footage. Arnheim gives scant discussion to Pudovkin's earlier five methods of montage as he regarded them as unsatisfactory, '*because the classification refers partly to the manner of cutting and partly to the subject matter, and these two factors are not kept separate.*' Arnheim (ibid.,:82)

Arnheim's own stance is very much shaped by his umbrella argument; that film is art, reasoning that the closer film gets to realism (eg by introducing colour and sound) the

further it moves from being a legitimate art form. As an animator, teacher and craftswoman of mixed media, it is hard not to hold some sympathy for this stance, however it does hold some inherent flaws, not least that Arnheim's principles deal with 'photographic' footage shot in 'real' time, ironically making Arnheim's categories more dependent on the 'real' than the 'abstract'. His first principle; '**Cutting**' is divided into two: a) Rhythm of cutting and b) Scene montage. There is no substantial difference here between montage of film and staging a diasynchronic installation, apart from the 'shot footage' element.

Arnheim's categories seek to distinguish predominantly between the film edit as an attempt to achieve seamless continuity, and the film edit as an aesthetic decision in its own right. The second of these choices is clearly Film as Art by implementing what I would call '*the cut as metaphor*', (and which Arnheim divides between **Synchronism**, **Space Relations** and **Relations of Subject Matter**) The edit as metaphor is a wonderful thing and one can convey an enormous amount of implicit data in an instant; take for instance the journey in audience cognition in the edit often hailed as the 'best cut in cinema history'.⁸⁸ It comes early in Stanley Kubrick's *2001: A Space Odyssey* (Kubrick, 1968) where an australopithecine 'killer-ape' commits the world's first murder, slaying his brother with a femur, then hurling the bone skywards. The camera follows the bone, and in a single cut we travel many millions of years to an orbiting nuclear spacecraft. The cut occurs in silence, and in this fleeting gap the audience is transported not just through time and space but also into a rich cognitive awareness of man's progress through violence and tools. *The Blue Danube* starts on the soundtrack and we are filled with awe and wonder. Small wonder that Arnheim favours the edit as metaphor, however, he also deliberately eschews ideas of rhythm where the audio is the driver and concentrates on visual montage alone, because it serves his argument for admitting film to the Temple of the Muses. The principles he advances are not so useful for the modern age because several new formalisms have entered screen-based imagery – these are new arenas that would have been impossible for Arnheim to imagine and write about, even in the revised text of 1958 - the digital age has brought a succession of formalisms all of its own, such as the broken freeze, the digital 'stutter' cut, scrubbing back and forth through time, layering of media, dissection and multiplication of the screen as a frame and, of course, interactivity. There are new ways of bringing the screen to unexpected places too, projection mapping and augmented reality now allow 'onion-skin' layering of the imaginary or text over real spaces and objects. This works both ways – we can learn from

⁸⁸ Although it is contravenes many design aspects that would make it an aesthetically 'good' edit.

previous formalisms and embrace new ones. Indeed as Lev Manovich points out in his iconic book, “*Today’s digital designers and artists use only a small set of action grammars and metaphors out of a much larger set of all possibilities*” (Manovich, 2001).

Much of modern film (and animation) has opted to sacrifice some metaphorical analogies through pursuing aesthetics closer to realism. However there are interesting new options available on the horizon. For instance the supernaturally ‘real’ tiger in *Life of Pi* (Lee, 2012), is animated. It would not be impossible for that ‘real’ tiger to (for instance) turn inside out or smoothly transform into a teapot. This blurring of real and virtual makes another fascinating artistic journey, we sacrifice traditional metaphors of the screen, but are freed to explore other things such as the uncanny and notions of how our conscious and unconscious elide – it is not so much a ‘lesser’ art as ‘different’ art.

Arnheim’s sixth and final trope is ‘**Absence of the non-visual world of the senses**’, and again this runs contrary to the *Diasynchronoscope* experience as he points to the lack of a sense of balance and other kinaesthetic experiences as being a major reason (alongside silence) for considering film as art. This view is not only contentious, but also does not withstand scrutiny in the modern age, however, it has a delightful clarity when he writes:

‘People who did not understand anything about film used to cite silence as one of its serious drawbacks. These people regard the introduction of sound as an improvement or completion of silent film.

This opinion is just as senseless as if the invention of three-dimensional oil painting were hailed as an advance on the hitherto known principles of painting.’

Arnheim (Ibid.: 92)

Naturally, Arnheim had to revise some of his ideas as the nature of film changed, and he does regret some of his more ‘*quixotic*’ statements, but he clung to these fundamentals, standing his ground and deriding critics for ‘*shifting their standards with the times*’. His feelings on sound being added to film are made clear in the final chapter of *A New Laocoon* written in 1938, where he does more than question whether artistic composites are valid as art, stating unequivocally that the ‘talkies’ create a sense of ‘unease’ that would not evaporate with time. This interestingly dogmatic approach is, I would suggest, partly borne from Arnheim’s own subjective love of film when it was sans colour or sound. Perhaps his close study and understanding of this era meant that he was unable to reconcile his mind to these new tropes, or indeed perhaps he was right, and

in its striving towards realism, film lost its claim to sit in the temple of the Muses. Perhaps Arnheim would not have enjoyed the *Diasynchronoscope*, at all, though I like to think that his deep grasp of formalisms, might have converted him.

4. PARTNERSHIP AND STUDIO PRACTICE

The next two chapters form the narrative of the practice part of this study. They are written in a more informal manner and draw on reflections from diary entries at the time using the methodology derived from Grounded Theory's 'memoing'. Because the three case studies have been made in partnership, and involve subjective artistic decision, it is impossible to write these chapters without resorting to personal pronouns. The aspiration behind this hermeneutic approach is that it will aid the narrative by retaining some of the flavour of 'being there'. I hope the text is sufficiently integrated, flows and makes some sense.

4.1. PARTNERSHIP

The complexity of working trans-media mitigates against the idea of the lone artist and art that traverses known genres is often collaborative. As described in Chapter 1.5 the *Diasynchronoscope* has been developed in artistic partnership with Bruno Mathez. Although we seem like an unlikely pairing, the partnership has, by-and-large, been a smooth one. This may be attributable to us both coming from industry where we frequently worked collaboratively, and also we both had developed individual exploration in art at Goldsmiths. Our interests overlap in our fascination with synchresis, delight in crafting an embodied audience experience and a shared general work ethic. However the unique skillset that has spawned the *Diasynchronoscope* comes from our bifurcating interests, and the art creation is often informed by the tensions and challenges of bringing our different perspectives together. Our differences are many: Bruno is male, French, younger and focused in modern audiovisiology. He approaches the artworks from a musical perspective and as a digital native, whereas my perspective is aesthetic, analogue and informed by my knowledge of art history and reading a wide-range of transdisciplinary literature. The differences in our approach mean that it is often clear who will take the lead at particular times. As joint inventors, there is a level of confidence in each other's talents, built up from practice, and we communicate a lot and

have a mutual trust in the other's abilities. The artworks emerge from myriad influences brought to fruition in praxis and play in the studio.⁸⁹

4.2. ESTABLISHING STUDIO PRACTICE WITH *SWING AND BOUNCE*

To paraphrase from art critic and essayist Walter Pater:⁹⁰ Who knows whence inspiration springs? Ideas come from anywhere – the sound of Gaffer tape ripping, the sparkle of sunlight on a drip from a tap, the molecular structure of life.

A sudden light transfigures a trivial thing, a weathervane, a windmill, a winnowing flail, the dust in the barn door; a moment – and the thing has vanished, because it was pure effect; but it leaves a relish behind it, a longing that the accident may happen again.

(Pater, 1873)

Ideas may be purely aesthetic or be derived from "*intellectual excitement*", in philosophy, science and the arts. As Pater suggests, we should "*be for ever testing new opinions, never acquiescing in a facile orthodoxy*". Because of the site-specific nature of *Diasynchoscope* installations, I also find inspiration from researching places, histories and cultures specific to where we will exhibit. However the inspiration is not the most time-consuming element in creating a diasynchronic artwork. There are three practical stumbling blocks in creating every artwork from the first to the latest:

- 1) The need for near perfect blackout
- 2) The need for space for the projector's throw
- 3) The time for setting up

To a large extent none of these problems has disappeared although we have found ways to ameliorate their effect, and they are substantially being addressed in recent bids made to the Technology Strategy Board.

Studio practice has been developed in artistic partnership with Bruno Mathez and began with our first public outing for a sculpture prosaically named '*swing and bounce*'

⁸⁹ I am using the term studio to denote the space where art occurs – we now have a studio near to Goldsmiths where we work, but prior to getting that we worked from my house using it as a studio. I was lucky to be blessed with sufficient room (and lack of house pride) to do this.

⁹⁰ Pater, Walter (1873), "Conclusion", *Studies in the History of the Renaissance*, London.

which was shown to a group of friends and family in a gazebo lined with black velvet and erected in my living room.⁹¹ The idea of an internal gazebo providing a structure to hang blackout curtains and sculptural objects was a good one, if rather lacking in aesthetic value. We have used the gazebo in a variety of settings and still find it useful for creating curtained entrances etc. Our methods have refined somewhat as we gain skills and knowledge, but our fundamental methodology has barely changed since this first public outing for an installation.



Figure 20 The internal gazebo

The original ideas for *Swing and Bounce* were hopelessly over-ambitious. Excited by the potential narrative ability of the medium we embarked on a two character scene. As with so many art projects, construction was a time where the project alternated between frustrating dead ends and problem-solving break-throughs, studio practice is all about experimenting with an open mind and a level of confidence in one's abilities to 'find a path'.

As no object can really be construed and labeled as 'abstract', an early challenge was to design objects that deliberately emphasized movement and were less likely to be culturally loaded and recognizable as objects of themselves. This led to considerable debate about the character/object. We also originally wanted the objects to be stand-alone beautiful – made perhaps from plaster and importantly divorced as much as possible from

⁹¹ Link to online discussion on website: [Experiment 1: Swing and Bounce | Diasynchronoscope Project](#)

semiotic context - we wanted to explore 'pure' movement and so needed to suppress visual clues. Aside from practical considerations, we were very clear that we did not want anything that resembled either a ball or a 3D pixel, partly because we had decided we want to include certain animation tropes such as squash and stretch.

The first discovery was that the plaster took too long to cast, had to be painted black anyway, and was far too heavy for our needs. After some experimentation it was decided that the optimum material for creating the objects was white medium density polystyrene cut to shape as it was a light, easily carved material. The polystyrene had to be painted black so that it would not be visible to the viewer in the blacked-out space.

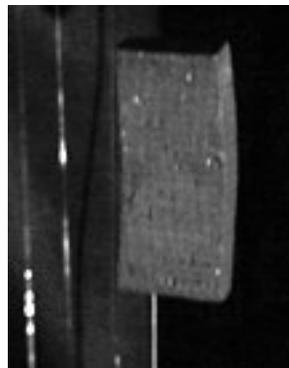


Figure 21 A single polystyrene 'hero' object from the sequence

Diary entry 30.07.2011: *Perhaps the objects won't be stand-alone beautiful, but they are practical...*

Because the artwork required the dimension of time to be translated into spatial dimensions, we were very dependent on using 3D visualization to create our early work. Of course all animation requires the animator to translate the dimension of time into that of space, but this phenomenon is rarely made visible to the consumer, who only receives the data when it is translated back into time. Animators automatically switch between time/space when animating, always aware of how, for instance, higher speeds translate to greater gaps between objects in space. Because the objects were solid and the movement was so rapid, it would have been very difficult to have accomplished a reasonable animation without testing and adjusting it in 3D first.

Diary entry 30.07.2011: *'We know that the bounce movement is working, so we're experimenting with a new type of movement: climbing-up. We assembled a simplified 'wall crawl' animation (just 6 frames) and have made a sculptural form that combines*

three overlapping objects, each to be revealed for two frames. (An animation of 1/6 of a second – pretty fast but probably enough to tell if it works). This is moving the object off a single plane... I am going to build a 3D mock-up.'

In these early days, we were hoping to create something akin to character animation, and for nuanced character animation you need objects that move with an overlap. Firstly, I made a virtual 3D model of our hero block 'climbing' a wall.⁹² After watching the 3D model animation path, we constructed a polystyrene shape to match: a long wavy object that was uncut internally. The idea being that this could be lit sequentially in mattes and we would have no internal fissures.



Figure 22 Bruno with the ill-fated wall climber

The experimental animation didn't prove realistic enough.⁹³ This is mainly because we lost the side of each block, since they were all embedded in the same shape and could not be lit in a meaningful manner. The overlapping planes are too readable when viewed in real life. Depth in real life (or the *Diasynchronoscope*) is much stronger than on screen.

Diary entry 06/10/2011: *'We need to know if larger, more sculptural change will work otherwise we will have to rethink having any movement that is not large and distinct (distinct in that it avoids any occlusion through overlap). If that is the case, we will have to let go of all smaller movements and that makes characterisation very hard. Also if we must separate each object, then all movements will be performed fast and the final 'reveal' less attractive as there will be no new sculptural objects where time is condensed in*

⁹² <http://vimeo.com/37146000>

⁹³ <http://vimeo.com/37145920>

translation to space. The space is going to fill up very quickly and our piece will be very short making creating a narrative even more challenging!

Still wedded to the idea of a narrative, even a simple one, I wanted to construct an animation of two characters: A predator and its prey, although of course both would be blocks, I was hoping to convey their character through movement. I tried a virtual 3D mock-up of the little character trembling,⁹⁴ and we attempted a filmed version by flickering the projector light on a block. This proved disastrous.⁹⁵ Bruno and I were dismayed at the lifeless flicker on the block – it was like putting an animated mouth on a corpse.

Diary entry 07/10/2011: *‘The tremble movement is unsuccessful. It looks like a flickering light on a dead object (which it is) the result not only lacks any ‘magic’ but is strangely depressing if you consider the object beneath to have had life – essentially making it a corpse that is trying to be brought to life artificially. If it was a face and we had animated moving eyes and lips on it, it would be in Uncanny Valley territory... and so because we know the potential liveliness of the object beneath, it is sad to look at. It is ersatz movement – a theatrical sham. We now know that it is the synchronisation of the object with the light that creates magic.’*

My notes from the time continue to scratch at the problem:

Diary entry 08/10/2011: *‘It is possible that when the viewer’s attention is already travelling in an arc, they will forgive a lot of semi-decent objects and ignore lost edges and strange internal shapes. It is equally possible that their perceptions will be less forgiving...’*

Diary entry 10/10/2011: *‘We are left with a dilemma: How to animate the little character? Tried out a few ideas in virtual 3D. He cannot bounce, walk or roll – all involve occlusion. In order for a narrative to occur, we are hoping for two characters (at least) and differences in the way they move... This now looks like the narrative idea is in jeopardy.’*

⁹⁴ <http://vimeo.com/37146106>

⁹⁵ <http://vimeo.com/37146128>

In discussion Bruno and I decide that perhaps we feel hide-bound by the ‘block’ character and we discuss the idea of the hunted character being a fish. We believed that we could indicate movement through splashes and ripples as well as in the character moves and allow the ‘static’ turnaround elements to happen off-screen (underwater) and decided that the fish shape would be a hydra.

Diary entry 17/10/2011: *‘Notes for starting to work out the 2 character animation:*

Predator block and fish.

Get the floor (water), Ripples (plaster or perhaps plasticine?), Drops (shards)

Create narrative - dope sheet the narrative

Q: Moon and reflected moon? Predator may enter as a silhouette against the moon using occlusion.

Predator swings and bounces

First animations to test: One fish bounce. One fish ripple. Predator swing in

Fish swims (slides), dives and jumps. Does not morph at all.’

We decided to run an experiment on the fish to see if the animation described above read would read as believable, but:

Diary entry 19/10/2011: *‘...First fish swimming is not a success: Due to an error, the bodies are not cut at the right angle, so that they are difficult to create light mattes. Also the arc is too smooth; it reads as a ‘scurry’ not a swim...’⁹⁶*

Our morale was beginning to plummet, although it is worth noting that the seeds for ideas for future elements such as ripples were sown here, so we opted to just ‘do something’ and settled on making the two simple arcs of the swing and bounce, animated with a polystyrene block about the size of a cigarette packet. Again I created a mock-up in 3DSMax. Because the objects were solid and the movement was so rapid, it would have been very difficult to have accomplished a reasonable animation without testing and adjusting it in 3D first.

Diary entry 01/11/2011: *‘I first worked out the sequence in Autodesk’s 3DS Max at 12 frames per second (fps). The normal rate of film in the UK is 25 fps, but there is a long tradition in model animation and claymation of animating on 12 fps and holding each frame for 2 frames to make up a second’s worth of animation. This is clearly less labour intensive and we trusted it not to look too jerky if the animation held an optimum path. We also could not ‘overlap’ action frames, so we*

⁹⁶ <http://vimeo.com/37164271>

knew that the animation would have to consist of fast movement and that we could not stay on one plane but wanted to explore all axes of the 3D space.'

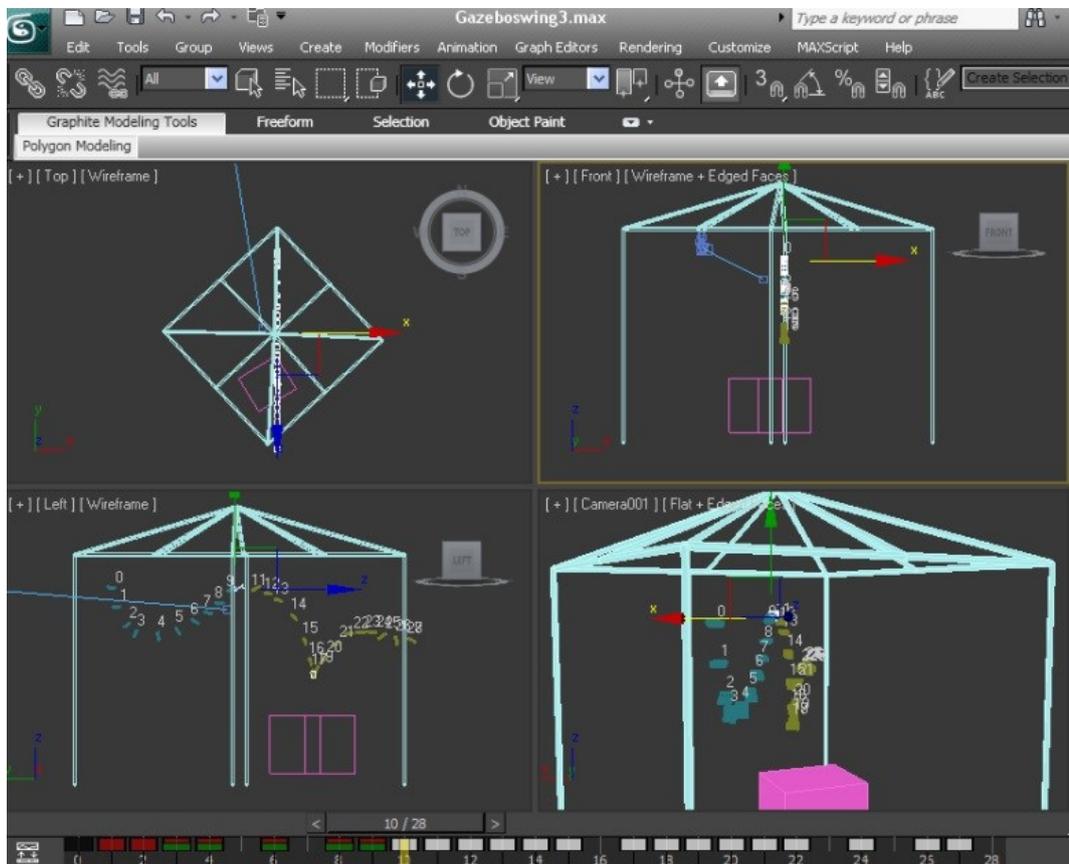


Figure 23 Four view template of the first model from with ‘ghosted’ objects showing in 3DSMax included the gazebo structure. The installation travelled the whole distance of the diagonal of the 2200 sq mm gazebo.

Because of space restrictions, the animation was kept very simple and short using just 23 objects that translated into exactly two seconds of animation (objects 10 and 17 were held for 3 frames). Inserting a 3D camera into the scene in *Autodesk 3ds Max* meant we could select the best position for placing viewers. This point-of-view (POV) was critical in the early versions as we were limited to a narrow range of deviation on the x and y axes for the viewer’s POV. Another consideration that determined the viewing angle was how the video-projector illuminated the objects: in order to avoid lighting a single flat plane and thus lose the effectiveness of using real three dimensional objects, we tried not to position the objects perpendicular to the light beam because only one side of the object would then be illuminated. Best positioning occurs when the video-projector illuminates three sides of the object, revealing the three dimensionality of the object in space.



Figure 24 A closer view through the camera of the 23 blocks of *Swing and Bounce* (made in 3ds Max)

Once the viewing angle had been chosen, we exported the animation path from *Autodesk 3ds Max* as a still image where each position of the object and its morphing shape was visible along a path. This was done using the ‘show ghosting’ option in *3ds Max*, which also allowed us to number each block. These images served as our template for our model and for creating the individual objects that would be lit in the *Diasynchronoscope*.

The dimensions of the objects were calculated by comparing the maximum size of the black-out space with the maximum length of the animation path. Working backwards from the animation template in the gazebo, we finally settled on a basic ‘hero’ object/blocks measuring 60 x 100 x 30mm. We numbered each object according to its position along the animation path and cut smaller blocks from large 6 inch thick blocks of polystyrene, using a hot-wire cutter to create a standard hero block and also create more organic, bent block shapes that included animated Anticipation, Follow-through and Squash and Stretch principles. After the cutting process the objects were painted with matt black paint, to make them invisible unless lit.



Figure 25 The virtual animation recreated using polystyrene blocks –many of the blocks were curved to create more believable animation. (The sticks provided vertical orientation cues)

Using the template images as a guide, the numbered objects were arranged in the black-out space with a variety of positioning techniques. Some polystyrene blocks were hung in place using fishing line. This was fiddly and required each block to be tethered to the top, bottom and side of the gazebo to achieve stability using combinations of carpet tacks and plasticine. We fitted a vertical and horizontal fishing line through each object in order to stabilize them and make them look as if they were floating in the space. A more efficient second technique for the objects close to the ground was to spear them onto wooden sticks - painted black to be rendered invisible.

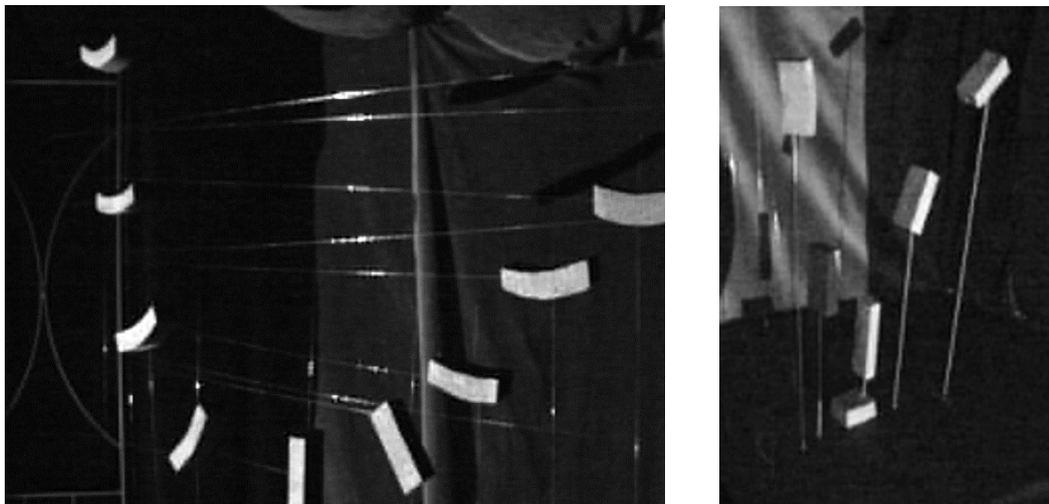


Figure 26 Objects ‘floated’ in space on fishing line and suspended on black sticks

We fixed the sticks in place by inserting them in a thick layer of black-coated insulation foam on the floor.⁹⁷ The sticks and fishing line were also painted black. This process, although it sounds simple, provides real testimony to our faith in the idea, because it took ten full days to set up just the animating objects for this simple idea, and we still had not shown the *Diasynchoscope* to anyone.

Diary entry 08/11/2011: *'We have to avoid hanging the 3 dimensional objects perpendicular to the projection, as only one side would then be illuminated. The optimal positioning is where 3 sides are illuminated; emphasizing the 3d effect, but this is not possible for every block - If only we had two projectors, we could have used one as a 'key' light and the other to act as a 'fill' light – It has been a marathon and Spike (my cat) has been less than helpful at times... Pretty happy with the block positions, although there is maybe only one place that they can be viewed from... Bruno has started the light projection using a sequence of mattes animated in Adobe After FX. This had to be done with much precision as the position of each pixel is crucial; too few and the definition of the object is lost, too many and the light spills around the object and bleeds onto the black backcloth.'*

The technique of projection mapping has been slightly refined from the early days, but it is still an arduous combination of creating .png masks in *Adobe Photoshop*.

Diary entry 12/11/2011: *'During the mapping it is very hard to see as everything is black, and the Photoshop cursor is black too. We're now placing a white board behind the object. This helps us see the cursor and masking the shadows in a better way. We're using a polystyrene board which is highly reflective and expands the bleeding. By deleting the bleeding we gain precision, and when we remove the white polystyrene the bleeding definitely doesn't show anymore.'*

Originally, we expected to create the movie of masks running in sequence in *Final Cut Pro*, but we ran into distortion problems with the output.

Diary entry 14/11/2011: *'There are big problems of bleeding, since the mapping images from Photoshop (.pngs) are slightly distorted in Final Cut Pro... The best way is to*

⁹⁷ Later we became bolder with our use of sticks and we also used blocks of insulation foam fixed vertically using horizontal sticks to hold the objects.

import them in AFX to animate them. AFX is more faithful to the original format; it doesn't distort.

Bruno ran the masks in *Adobe AfterFX* and the rendered movie was output straight to the projector as a *QuickTime* movie, with the ratios adjusted so that the movie playing onscreen matched the projection in the *Diasynchronoscope*.

Running the movie for the first time late at night, we felt we had finally achieved our (rather modest) goal. The animation was working – but it was all over in two seconds! We both hoped that we would find ways of speeding up the process, because the labour/output ratio was very wide indeed. We readjusted a few blocks, relit and then recorded some audio: We created an indeterminate ‘scrabble’ effect and I vocalised a ‘whoosh’ and ‘bonk’ – this rough audio track was added to the movie to be relayed via stereo speakers. The sound was designed to draw attention and synchronize but not to provide a solid identification for the objects as signifying objects or characters.

The ‘*Swing and bounce*’ was to be our first public experiment with the *Diasynchronoscope* medium. As we were interested in it primarily as an embodied experience, we decided to show it to a varied group of people, and record their individual responses to the artwork using observation and semi-structured interviews. We did not quite know what to expect or if we had overcome enough practical problems for the medium to ‘read’.

Video of the non-participant observation and semi-structured interview can be seen on the *Diasynchronoscope* website.⁹⁸ The viewings revealed that the medium was ‘reading’ well, and subsequent analysis of the interviews led to some new exploratory questions and ideas for art, particularly in linking it to Gestalt theory.

4.3. DATA COLLECTION

‘The same subject seen from a different angle gives a subject for study of the highest interest and so varied that I think I could be occupied for months without changing my place, simply bending more to the left and the right’

Paul Cezanne (Post-impressionist artist)

⁹⁸ Also at <http://vimeo.com/37661442>

The restricted space of the blacked-out gazebo meant we could only accommodate one viewer at a time placed on a particular spot so that they might best view the work's 3D form. Each viewer was shown the two second sequence three times, interviewed, and then asked to turn around so they might experience the whole art object as a holistic sculpture. Participant responses were recorded as they watched the animation and they were then asked a number of questions.



Figure 27 Holistic view of swing and bounce

For this first phase of the project, the 10 participants were drawn via open invitation to friends and colleagues. The participants (whose ages ranged from 25 – 81) were: Juliet - a Jazz singer (and tennis player), Janet - a tennis player, Ruth – a retired doctor, Clem – a graphic designer, Peter – a web designer, Rob T – an actor and writer, Rob M – a film director, Livia – a music therapy teacher, Joseph – a painter (and tennis player), Lucie – a lecturer in digital media. Individual responses to the artwork were recorded on film at the time of viewing, then the participants were asked some open questions such as: ‘*What are your first impressions?*’ and ‘*What was going on?*’ The final question I asked was, ‘*Is it - or are they - multiple objects or a single one?*’ The individual questions were followed by a filmed plenary discussion.⁹⁹ The showing took place on 16th November 2011.

Generally audience responses could be divided into three areas: response to the animation, response to the holistic artwork, and influence of personal schema. This last proved particularly interesting as it yielded the strongest sense of co-authored narrative,

⁹⁹ Participants were given an intervening supper with wine as an incentive for participating, unfortunately this rendered the plenary session vocal, but unusable.

and was most satisfying for both artists and participant. It also shed interesting indications on the way personal schemas or memories are laid down, offering potential for further research.

The animation evoked a variety of responses from *'Is that it?'* to *'Wonderful!'* to laughter. All participants read the movement as movement and were content that it felt 'natural'. The majority felt that the action was that of a ball bouncing. The animation had been designed to give the impression of a swing and bounce, with sound that served both character and object, so this was what we expected. Where participants did not agree was whether the object was an object or a character, i.e. what it was or whether it was a single object or a multiple one. However this did not seem to cause confusion in most. To some it felt very like a digital animated experience and to others it felt very different and 'real'. This could be attributed to the nature of the embodied experience as some moved their heads more than others and so would have achieved a sense of depth and a level of parallax. The people who moved most were non-digital artists and those who played tennis.

Participant responses to the revealed whole artwork were also recorded. Responses to this were extremely positive, eliciting comments such as: *'Like a dream'* *'Tactile, I want to touch it'*, *'Magical!'*, *'Looks larger than life'*, *'Fabulous!'*, *'Oh yeah!'* The unlikelihood of the objects hanging in space without visible support, and the new knowledge of the previous movement made the holistic artwork a satisfying experience for all of the participants. One question we asked everyone while they viewed the holistic artwork was: *'Would you describe what you are seeing as a single object or multiple objects?'* Responses were evenly divided with four of the participants choosing it as clearly representing a single entity, and four being equally emphatic that the piece consisted of multiple objects. Two participants were happy to conclude that it was both multiple and single at the same time without seeming to find this paradoxical.

The artwork was a sincere attempt to isolate movement by suppressing the contexts of shape, mass and colour. Thus the shape was a block constructed of no immediate contextual dimensions, and of no indicative material. Although the mass had continuity, the size was indeterminate as there was no reference point to gauge size against. The colour was suppressed, deliberately neutral in context and consistent. However it became rapidly obvious that all participants imbued the experience with interpretations drawn from their personal schemas; often holding contradictory beliefs at the same time with apparent ease.

Juliet and Livia, both from musical backgrounds were primarily drawn to the audio, using their interpretations of the sound as a springboard for their interpretation of the whole artwork. Peter and Lucie, both working in the digital domain, drew digital interpretations first of all, before expanding their experience to other areas. Joseph, Janet and Juliet who were all regular tennis players interpreted the object clearly as a tennis ball despite the contradictions of it being a) a block and b) having the sound of a scrabbling creature. The movement of the objects elicited a number of ball responses from the participants, with Ruth (aged 81) interpreting the movement as being ‘just like the Dambusters’ film. The synchronous nature of the sound and the ‘cartoon’ quality of squash and stretch elicited laughter from Rob T and Rob M (both used to performance). The designer Clem was much drawn to the holistic art object rather than the movement. Several of the participants described the object as bringing to mind a ‘kitchen sponge’. This could be because of the ‘squashy’ nature of its mass or be indicative of the prevalence of domestic associations in their lives. Many described the final holistic object as resembling a dinosaur spine, and there seemed to be no problem for four participants to interpret the whole artwork as ball, sponge and dinosaur spine within the same contextual description.

Diary entry 16/11/2011: *‘It became clear that each participant was bringing their own schema to the movement and that the piece was appreciated with three different ‘modes’ of perception; as a ‘moving’ object in time, as a series of individual objects and as an holistic ‘single’ object. The viewings revealed a remarkable similarity to the Gestalt illusion of multistability. It is striking that the three modes are at once compatible and incompatible perceptually. Rather like the Necker cube, or Duck/Rabbit illusion, it seemed that we had most commonly created a ball/sponge/dinosaur spine illusion!’*

Although this experiment was our first attempt at gathering data on our invention, the methodology established here for subsequent studies has not varied too much. It is generally a six stage process:

- 1) We make an art work and exhibit it.
- 2) We record what we can of the process and final artwork photographically and on film and audio. (The results of this are often unsatisfactory in terms of conveying the hybrid and embodied nature of the artworks, and because these media are usually regarded as ‘realistic’ depictions, they do a disservice to the diasynchronic medium. More latterly, I have taken to making drawings that reinterpret the artworks in different ways; these

drawings have developed as a form of ekphrasis through my increased understanding of the medium)

3) We make filmed interviews that take in the perspectives of participants in the moment. (Again, it is not always easy to do this and because we as artists are asking the questions, participant feedback is scarcely objective. In an ideal world we would get truly critical and anonymous feedback. The closest we have come to this is asking for written feedback on post-it notes for *Stylus* – I discuss this in 5.3)

4) We publish pictures of process, some audio and some visuals of the artwork alongside filmed personal testimony extracts on our website with an accompanying commentary and any official reviews. (We now try and use social media such as twitter and Facebook too).

5) I evaluate and analyse findings in the light of perspectives from existing analytical frameworks, theories and practices. I reflect on these ideas and then write up some selected ideas and publish if appropriate, leaving other ideas in my journals for further review.

6) Together, we review successes and challenges for ongoing art practice. Ideas bring forth further ideas for studio experimentation and practice in an iterative process.

4.4. PLAYING WITH DATA

Evaluation of data takes several forms. Because we are always aware that the embodied nature of the artworks is difficult to understand, and because they are all palimpsests, we know we must record what we can for this study, but if it is demanding on us as artists to create and curate artworks and collect data when everything is so new, it is even harder in some ways to marshal such hybrid data into suitable coherent research papers. My journals typically overflow with cross-contextualisation and ideas for further study. For instance the varied interpretations of the piece given by participants experiencing ‘*Swing and bounce*’ led me to reflect on a number of new ideas ranging from differences between creativity in art and science, salience and memory, and practical ways of shortening set up through different construction. The extracts below illustrate these speculations.

Diary entry 18/11/2011: ‘Never want to use fishing line again! There has to be a better way...’

Diary entry 20/11/2011: ‘Is the Diasynchronoscope project about making works of art or is it a scientific experiment?’

Margaret Boden defines creativity as ‘the ability to come up with ideas or artefacts that are new, surprising and valuable’ (Boden, 2010). This clearly allows for scientific experiment to be both creative and interpretable as Art. Because the artwork had different points of access (as a time-based study and as a static art object that held the time-based object inherently within itself), the two forms informed each other. Paradoxically, the holistic artwork could be conceived as though the participant is a camera on a very slow shutter speed, receiving two seconds of data in a single moment. This is interesting as participants become an actual part of an intra-film experience - but there is no film! I can’t think of many other multistability examples that take place across time and this could be an area worth exploring. All great artworks work on more than one level and if the three modes were artistically linked, perhaps we could achieve a sort of Gestalt oneness - a prägnanz for future experimental artworks – an ambition for the future?’

Diary entry 24/11/2011: ‘Speculation on personal schemas and memory

The [participant] interpretations reveal how varied personal schemas are in individuals when they approach abstract stimuli, this is quite different to what I expected with my experience of film and as an animator, where I know they can be led about the screen... Perhaps this is because they are not an audience but co-authors in a narrative? I wanted to create something abstract, and now I am binding because I expected everyone to see the same thing. They are all seeing a ball, but the ball was not there... ...it suggests something interesting about on how memories may be laid down to create our personal schemas. What is highly salient and suggestive to one person may well be of no interest to another, but what triggers saliency when the stimuli is deliberately abstract? People usually respond to music in similar ways, don’t they? And music is meant to be the most abstract of art forms...

Change can only be perceived through attention, and attention can intrude on conscious perception because attention is drawn to an unexpected stimulus on an involuntary basis. So arachnophobics can spot a spider in a room before anyone else - their awareness antenna for seeing a spider is up, and it is most pertinent to them. It is obvious that personal schemas are highly influential in shaping our attention through salience. Salience brings a stimulus to consciousness, and immediately we set about selecting associations from our personal schema to interpret the stimulus. Because [in swing and bounce] the stimulus was abstract and open to interpretation, it seems likely that we store memories dynamically with confirmatory sensory input increasing their likelihood of

truth. Add synchronised sound to a visual and it is truer... This is at odds with the frequently used analogy of our minds as indexical filing cabinets; how likely is a static mental model of anything if we can associate so freely, riffing mentally between dinosaur bones, sponges, balls and bombs in consecutive moments? Memories cannot be stored indexically but must be stored dynamically, i.e. when movement is interpreted in an abstracted manner, we access mindful connotations that are not drawn upon through taxonomy, but through metaphor and metonym. Neurologically, we need to access events/objects with a degree of intrinsic abstraction, so we store memories dynamically. Hence art, poetry and metaphor and metonym are simple manifestations of the way our brains work. This relates to the existing concept of neuroaesthetics - that artistic models that echo the psychophysical architecture of the mind are best for depth of communication and qualia of experience.'

Modified versions of these journal entries and the swing and bounce experiment were condensed and found their way into the first paper written about the *Diasynchronoscope* delivered at *Desform* in New Zealand. (MacGillivray & Mathez, 2012).

The filmed interviews were also condensed for the website¹⁰⁰: We selected very short sections that focussed on the idea put forward by participants that the object was a 'ball' and also on the holistic reveal, as these seemed the most interesting two clusters of results from the experiment. We cut out much of the effusive and generous praise for the experiment, (evidently compromised by the participants being friends and family) and lost the discussion as it was too convoluted for any real analysis (its meandering nature fuelled by alcohol intake).

We found that the best pictures of the artwork were made by using a hand-held camera, although the quality was quite poor, this 'rawer' footage intercut with the participant interviews gave the best 'flavour' of the experience.

Over time we have found that there is an inherent tension between objective recording of data for this thesis with its accompanying academic project website and promoting the *Diasynchronoscope* as Art. This has led us to create a separate design

¹⁰⁰ <http://vimeo.com/37661442>

website for artworks made beyond Stylus and for promotion of our artistic partnership as ‘Trope’.¹⁰¹

The bottom line for all this data was that all participants were perceiving apparent movement in three-dimensions, and that even though their viewpoint was limited and the animation was a mere two seconds long, the experience was a new one. The experiment ‘*Swing and bounce*’ opened up the way for us to attempt more ambitious artworks. It also gave us a practical goal; that of achieving animation in the round.

¹⁰¹ www.trope-design.com

5. THREE CASE STUDIES OF THE DIASYNCHRONOSCOPE

This chapter chronicles the practice element of this doctoral study. It documents our artistic growth as our understanding of the creative potential of the *Diasynchronoscope* developed, and in parallel how the gathering and organisation of research data improved as we set about introducing the medium to the academic and art worlds. The three case studies documented are *Gestalt Circle*, shown at Kinetica Art Fair (Feb 2012), *One, Two, Three...* shown at *Kinetica Art Fair* (Feb 2013), and *Stylus* commissioned by the Music Tech Festival, and shown at Ravensbourne University in May 2013 and at Goldsmiths, University of London in July 2013.

5.1. CASE STUDY ONE: *GESTALT CIRCLE*

Gestalt Circle was shown to about 1500 visitors at the *Kinetica Art Fair 2012* in London, UK. Film of the artwork is online on the *Diasynchronoscope* project website and at <http://vimeo.com/36820900>.

Description: *Gestalt Circle* is a meditation on animating through selective attention and forms an architectural extension of Gestalt founder, Max Wertheimer's experiments in phi and beta movement. In this centennial meditation, the humble polystyrene coffee cup is transformed from detritus to ephemeral beauty. Multiple cups are arranged in space, then lit in sequence to create apparent movement in two ways: beta and phi. The individual (beta) movement – free, organic and playful – breaks away from the regimented and replicated (phi) mechanical movement and then returns to it in a continuous cycle. *Gestalt Circle* synthesizes digital and analogue technology: the non-recyclable coffee cups are resuscitated and reframed by digital technology, allowing the artists to re-animate throwaway objects in a unique, ghostly ballet, using the diasynchronic technique.

5.1.1. BACKGROUND

Gestalt Circle was a centennial piece conceived as an architectural extension of Gestalt founder, Max Wertheimer's experiments in phi and beta movement. It was a hybrid of experiment and art, conceived very late as we were offered a space at *Kinetica*

art fair only late in January - about two weeks before the fair opened. Because of money, time and space limitations, we were stretched in every way.

We had made some experiments already that looked at Max Wertheimer's Phi movement. It was very interesting for me as I was keen to explore ways of suppressing cultural and contextual content in order to favour pure movement and Wertheimer had dubbed Phi as 'pure' movement because the perceiver's attention does not centre on a concrete object, but rather the absence of object. As discussed in section 2.2.1 of this thesis, many commentators consider perception of Phi movement to be distinct physiologically to beta perception, of movement. We had done some experiments with various beta movements using simple objects in lines and circles in the *Diasynchronoscope*¹⁰² and we had made a circle of blocks lit to create phi movement¹⁰³; we decided that combining the phi circles with some beta movement would be a good starting point for taking the *Diasynchronoscope* to *Kinetica*. Essentially we thought we would combine a bounce with a phi circle – it was half an artistic consideration and half a pragmatic response to the constrictions on time we were facing. We also were very aware that a two second animation would not make a satisfactory experience for an art fair, so decided that the animation must loop. We eventually opted for creating two phi circles with a single object bouncing in beta movement between them.

5.1.2 TECHNICAL METHODS

There was time for two days preparation on-site at *Kinetica* for an installation. In these two days we would have to create a complete black out, install the projector, create the installation, map the installation, adjust it and make the quick-time movie with sound. We resigned ourselves to some very long days but also reasoned we would have to bring in a ready-made installation as there would be no time to set up and map. In this knowledge we decided that fishing line was out of the question, and such was the time constraint we also felt that cutting a number of custom polystyrene blocks was a problem too. We alighted on the idea of animating polystyrene coffee cups as they were cheap, very light and ready-made.

¹⁰² Films are published on the project website here: <http://www.doc.gold.ac.uk/diasynchronoscope/experiments/experiment-2-phi-movement-circle/>

¹⁰³ <http://vimeo.com/34744341>

We made a quick lighting test of a cup painted black in my living room. Initially we were concerned that the rounded nature of the cup and the diagonal sides might cause mapping problems, but the hollow tops to the cups helped in creating a defined volumetric shape. The finished design was pretty simple and barely explored depth, although one circle was situated about 30cms behind the other. There was not really time for creating a 3D mock-up – I ran one test to see if the cups looked good bouncing and stacking – but we could find no way of stacking them, so abandoned this idea¹⁰⁴. Because we were looping the action, we realised we would need more pathways as the transitions from phi to beta were tricky, so I drew some sketches on paper to use as a rough template. In fact this all happened so swiftly that the sketches were also thrown away and I rescued them from the bin some time later (hence their rather crumpled state).

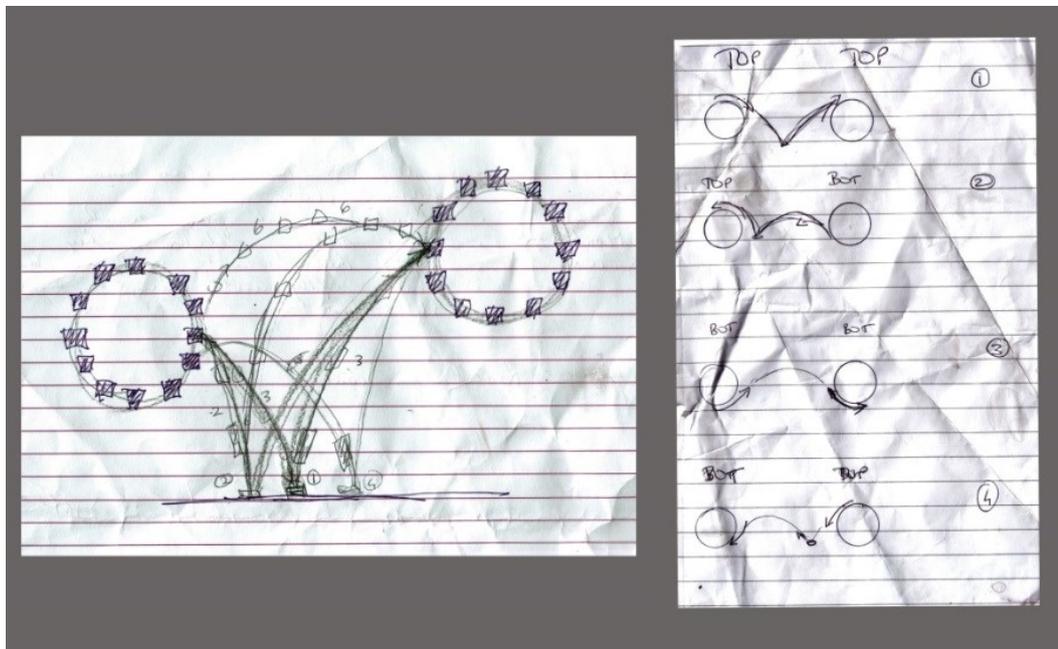


Figure 28 Paper sketches for Gestalt Circle (rescued from bin)

The cups for the two circles were easy to position on foam insulation boards using sticks painted black and using larger coffee cups, I manufactured 3xstretched versions (by cutting out a vertical segment at the back and re-joining the edges) and 3 x squashed versions (made using olive pots from the local delicatessen, and adding an artificial rim). The beta cups had to be positioned in situ, and we used the paper templates to work out the paths. In the end, the paths were not very distinct as some overlapped – it quickly became quite complex.

¹⁰⁴ Test can be accessed here: <http://www.youtube.com/watch?v=Dg8HgpD4fqU>

We were situated in a smallish room at the back on the balcony at Amika P3 the exhibition space for *Kinetica*. We painted the room black and set up a squashed version of the gazebo in the space so that the light from the doorway would not interfere with the black-out. Positioning the projector was a challenge as it had to be steady enough not to be knocked and we had no stand. In the end we put it on a filing cabinet on a chest and added a lot of gaffer tape and wedges to try and hold it in place. Because the space was so tight we were worried about it shifting when participants were viewing, so we roped the area off with yet more gaffer tape. We had to make a gap in the Gazebo hangings for the projector beam, and the sculpture was sat upon boxes draped in velvet. Unlit, it was not a pretty sight and the curators at *Kinetica* were understandably unhappy with the amateurish look of the set up. They situated a large noisy robot on the balcony in front of us and tried to forget we were there.

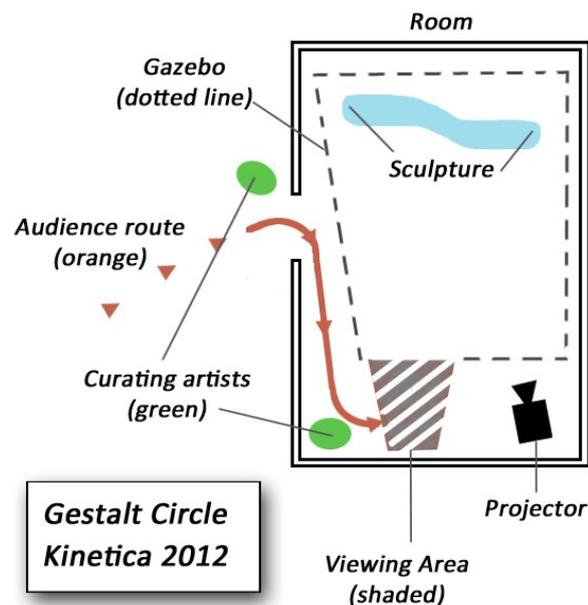


Figure 29 Plan of the final installation at *Kinetica* 2013

At the end of an exhausting day of set up we took a photograph of the sculpture and I went home to work out the animation paths, for the artwork while Bruno worked on the sound and got some rest, as it was looking likely that he would have a difficult time mapping.

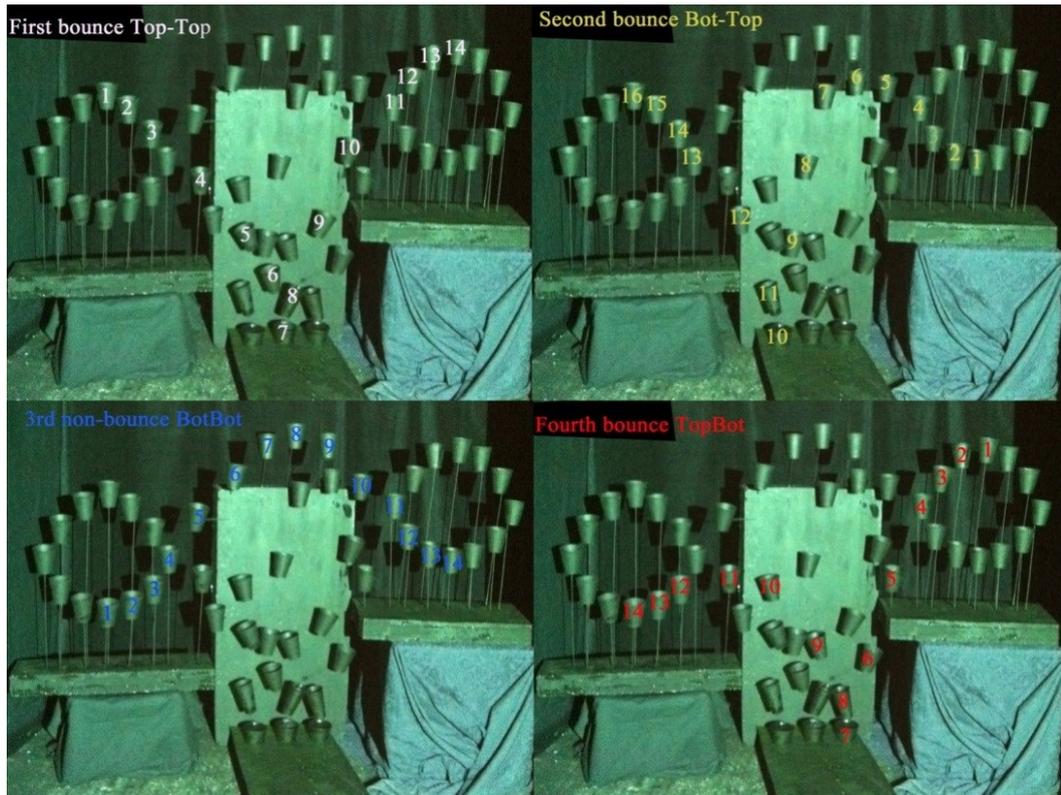


Figure 30 The four individual pathways labelled in *Adobe Photoshop*

I planned the animation paths using coloured numerical overlays on the photograph as it seemed like the easiest way for me to delineate the paths, and sent them to Bruno. I remember feeling an upsurge in confidence when I put the pathways together and replaced the cups with a blackout: The animator in me could see that the cups would animate – the pathways had an aesthetic integrity and were beautiful to me.

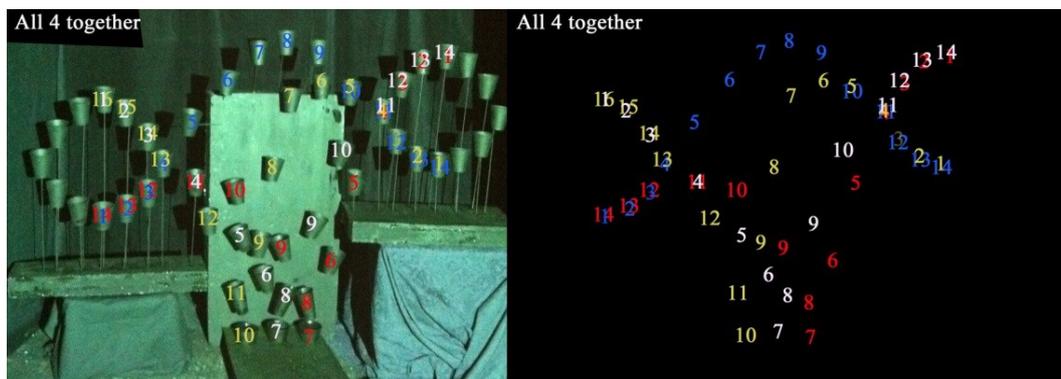


Figure 31 the final pathways showing against black

The next day while I created the signage and wrote accompanying blurb for *Gestalt Circle*, Bruno mapped the cups using *Adobe Photoshop*. In the afternoon he started

creating the sequenced movie in *Adobe After Effects* using my numerical overlays, and this went comparatively smoothly (for a technique created on the fly). Pressed for time, we reused some of the ‘whooshes’ and the ‘bonk’ from ‘*Swing and bounce*’ to carry the beta movement and using sample castanet sounds from *Reason* software, Bruno manipulated the pitch and velocity to create four varieties of ‘clicks’ for the phi movement. The animation ran for about 3 minutes and we finished just in time for the press previews at *Kinetica*.

5.1.3. REFLECTIVE OBSERVATION

The first day was something of an anti-climax as no press were brought to see Gestalt Circle that morning. In fact no press were brought by the organisers at all, as they thought the set-up for the artwork looked shabby (they did not see it in action till the third day) and also we were barely paying them for the privilege of exhibiting. The giant robot was whirring away, with lots of action and flashing lights, rendering us for all purposes, invisible. I went and bought some white gaffer tape and stuck arrows on the floor, but still our only visitors were other exhibiting artists and friends.

Bruno and I sat and watched the work, and felt it was nice to watch, and I gave an explanatory talk to our few visitors. Soon after I wrote down the monologue from memory for the project website, and it is reproduced here:

‘There is no screen and no actual movement occurs in the chamber. Instead real three-dimensional objects (polystyrene cups) are placed in the scene and then lit selectively and sequentially by white light from a projector. The cups have been arranged by translating motion in time, to position in space. When a cup is lit, we cannot help but give it attention. When the cups are lit sequentially; we cannot help but perceive movement. This is because our brains are geared towards perceiving movement, so our brains fill in the gaps. In Gestalt Circle the brain fills in the gaps in two ways; as beta and phi movement. Beta movement is where the eye attends to a cup travelling in a smooth arc. This is exactly the principle of Gestalt continuity that governs the way we perceive animation and film running at 24 fps as ‘moving pictures’. Phi movement is where the attention is drawn not to a cup, but the gap between the cups. Because this is object-less perception of movement, it was dubbed ‘pure’ movement by Wertheimer, although it is far from context-less as although the object of attention is not-an-object, the gap is contextualised by the surrounding objects (in this case, cups).

You can identify phi movement by the clicking sound that accompanies it. Here you are following not-a-cup or the gap between cups in phi movement. Although the two ways of perceiving movement may appear superficially similar, the two states of perceiving movement are physiologically distinct; we cannot follow/attend to a cup and follow/attend to not-a-cup at the same time, so like the Necker cube, we are caught in a multistable perception of movement. Multistable perception is the tendency of ambiguous perceptual experiences to pop back and forth unstably between two or more alternative interpretations. The artwork highlights the perceptual transitions made by the brain as it travels from phi to beta and back again.

One major difference in perceiving phi movement is that it is experienced as a sequence of stills rather than as a continuous moving image – the cups appear to make staccato leaps across a gap rather than travel smoothly. This is consistent with Wertheimer’s published monograph on apparent motion in 1912 and Steinman’s re-examination of the phenomena published in 2000.’

That it did not occur to me to write this down at the time or just let the artwork speak for itself displays our uncertainty regarding whether *Gestalt Circle* was an artwork or an experiment. We did not feel confident enough yet to believe in the artwork in its own right. This also could be put down to a potential inherent confusion that accompanies practice-based research. The researcher part of me was at that time in ascendance and the artist side, particularly in a newly forming partnership was tentative and full of trepidations.

I have already reproduced some of my diary from the time in chapter 1.6 in this thesis, but there are two other contemporary narratives may yet influence the future of the *Diasynchronoscope* and a narrative that explains how *Gestalt Circle* marked the true beginning of the artistic partnership, Trope.

The first narrative comes from the first day at *Kinetica* (which lasts three days, four if you count the press day). I had insisted that we had two chairs for participants because this meant we could stack viewers two deep – in fact the viewing area was so narrow, we could never really fit more than six people in at a time, a modest increase on the single viewpoint afforded by *Swing and Bounce*.

Diary entry 08/02/12: *‘A rather grey woman approached me and asked if there was a chair anywhere, and I said ‘Yes’, but she would have to watch the artwork to sit in it. ‘I*

just want to sit down', she said, so she came in and sat and watched the Circle. I asked her if she wanted to know anything about the artwork, but she said she just wanted to sit, so I left her to it. She was in there for about ten minutes, when I checked on her. Then I went through my description of phi and beta and left her again. Five minutes later she emerged all smiles. 'Do you know, I had the most awful migraine attack, but now it has completely cleared away? When I used to get teenage migraines, I know that I could not have sat in front of a screen or anything where the lights flashed or strobed. So beta or phi, in the Diasynchronoscope there is definitely no strobing, the motion is different to screen-based.'

Here was confirmation that we were creating non-flickering apparent motion. Also it could have been a coincidence, and it could have been the chair, but perhaps the meditative quality of the *Diasynchronoscope* could prove to have therapeutic value? It is something to speculate on in the future.

The second narrative is from the last and busiest day of *Kinetica* - the Sunday. By this stage, we were both very tired – the incremental increased popularity of *Gestalt Circle* meant that we were dealing with a continuous queue that was twelve-deep, we were admitting people in bunches of five on a timer of three minutes, one managing the queue and duration (using stopwatch on our phones) and one giving the phi/beta talk inside. My voice had almost vanished, we had not eaten anything and even a toilet break seemed an impossibility. Eventually we put a chair at the back of the queue saying that we would take a twenty minute break when we got to the chair.

Diary entry 08/02/12: *'We finally worked our way down to the chair, and I was just about to close down when three men came along begging to come in. By then I was so far gone, that I actually swore at them, luckily my voice was so croaky, maybe they did not hear... 'Go away', I say, 'I need a break - go look at something else, there's lots here - We will open again in twenty minutes. The older guy starts begging and wheedling: 'We've seen everything else here already, everyone says yours is the work to see, please let us in.' I look at them again, the younger guy is wearing very trendy glasses – maybe he is a journalist or something? I go in and tell Bruno, who is about to shut down the projector. 'You do it', he says and slopes off for a cigarette. I show in the three men and give my talk in very bad grace. Oddly, they seem to like it. We go out and I start to shoo them away, when the older guy says: 'I am Nicholas Logsdail, and I run the Lisson Gallery, this is my assistant' – he points to young Trendy Glasses, 'And this is Anish*

Kapoor', - he points to the smallish man who hasn't said a word – and I look at him. In my head I think, 'I know that name, that name means something to me', but I am so tired, I can't think straight, and all I can manage is a non-committal Neanderthal grunt, and then my friend shows up behind these three characters and starts waving, and I barely hear the next line which is: 'We really like your work and I would like to see everything you have done.' Only when they have gone does it actually penetrate who Anish Kapoor is, that I have a sculpture of his as a screen-saver on my phone and that the friend waving was the friend I took to the RA show of Kapoor's work!'

Although the story above demonstrates how strenuously we had worked to make showing *Gestalt Circle* a reality, this final narrative establishes it even more keenly. I had driven to Marylebone in my car, because we had to de-rig and get everything out as soon as *Kinetica* closed at 6pm (we could just squeeze everything, gazebo included into my little Ford Fiesta). I had found it very hard to find a place to park in Marylebone (even though it was Sunday) and had had very little sleep. At 6pm we took down some of the drapes etc and then Bruno suggested I go and get the car.

Diary entry 08/02/12: *'I had dropped a pin on where I had parked the car on my Google map, so I set off towards the pin... I walked and walked and got almost to Selfridges, but the pin kept jumping about. Whenever I got near it, it leapt to another road. It was so frustrating. After 40mins, Bruno rang; Where was I? 'I don't know! I can't find it.' He suggests I come back and that we go and look for it together. We walk for over an hour with me half-remembering the journey and the shops I passed when walking in, it gets ridiculous, and I phone the police, perhaps it has been stolen? But it appears that if I report it stolen, I can't get it back from that status...' We decide to give it one more go. Bruno suggests walking in a spiral along every street. After nearly another hour I reach for my phone. 'I will have to call it in as stolen'. Then as if we have entered the coincidental world of a sit-com, Bruno points behind me; 'Isn't that your car?'*

It was Bruno's level-headed gentleness over this incident, when anybody else would have wanted to at least question my complete inability to locate my own car, that convinced me that we could work together. It is an absolute testament to his good nature when things go awry.

5.1.4. OUTCOMES

Gestalt Circle could be classified as a success on several levels and it is an installation that I am proud to have as a marker not only of our first artwork but also of the beginning of us deciding to work together more permanently as an art partnership.

It became a very popular artwork at *Kinetica* and as there was no programme or promotion of us by the curators, that popularity was achieved entirely by word of mouth. Even though it was not introduced to journalists, it had achieved approbation from doyens of art like Nicholas Logsdail and Anish Kapoor - and *Kinetica* did ask us back the following year. Still people say to us: ‘*Oh you made the coffee cups!*’ So it was a memorable artwork, too.

Many people were fascinated by the talk. Although to my frustration, I was nearly always interrupted half-way through it by someone saying: ‘*What is it then? Where is the screen? Is it a hologram?*’ and I realised that the concept of something not being on a screen was as difficult for most people as me recognising Mr Kapoor. Because it is an idea that is so novel to modern experience, stating that there is no screen once is not enough; it needs much reiteration.

Our data collection for *Gestalt Circle* was weak. It took us by surprise and we had not really established our practice at this stage. We did learn from this, and a chief outcome was for us to aim for artworks that needed less curation – we now try and let the artworks talk for themselves. There was no time to film reactions or gather written feedback at *Kinetica 2012*, as we were at full stretch the whole time, and we had not fully articulated how important embodiment was to the medium at this stage. It is only lately, having had time to reflect that I have found myself returning to the artwork, trying to find a way of rendering its aesthetic beauty to others through ekprasis. This has led me, in turn, to attempt new ways of depicting our other recent artworks, and I have found the questions this asks of me as an artist very fulfilling. Here are three of the drawings I have made that try and bring the analogue/digital nature of *Gestalt Circle* to life.



Figure 32 Gestalt Circle 1

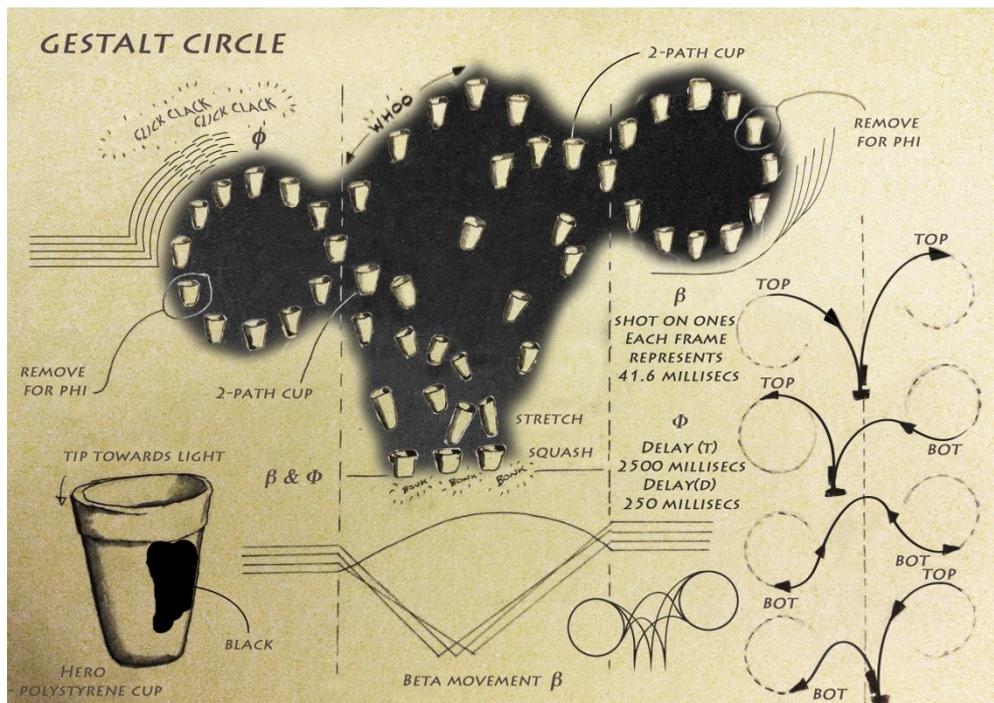


Figure 33 Gestalt Circle 2

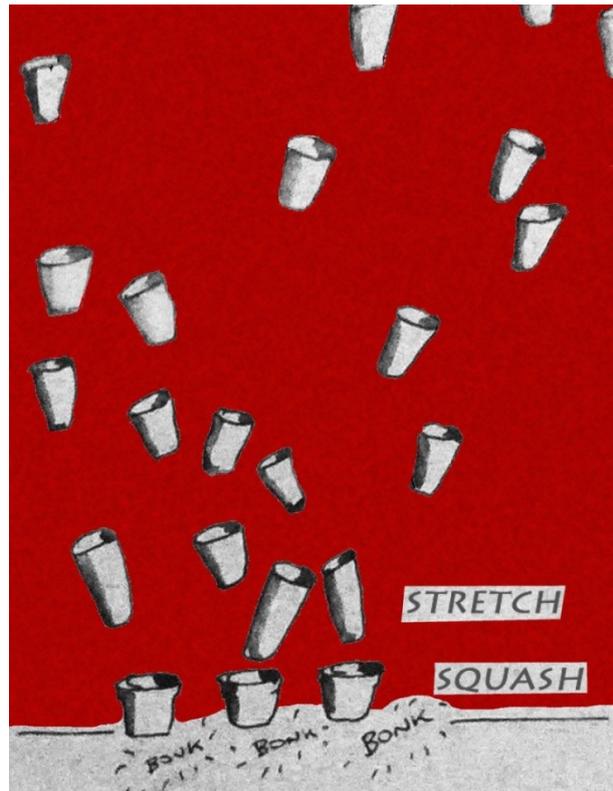


Figure 34 Gestalt Circle 3

5.2. CASE STUDY TWO: *ONE, TWO, THREE...*

'*One, Two, Three...*' was shown to about 4000 visitors at the *Kinetica Art Fair 2013* in London, UK. Records of the artwork are online on the *Diasynchronoscope* project website at <http://www.doc.gold.ac.uk/diasynchronoscope/artworks/artwork-one-two-three/>

The genesis for *One, Two, Three...* came from me reading a lot of perceptual experiments in visual psychology which were screen-based and used two objects of attention, the experiments often examining the lengths of flicker between these binary components. I reasoned that they should not be treating such perceptual data as veridical, because stroboscopic phenomena are relatively rare in real life, and wanted to use three as a motif. Fundamental to the *Diasynchronoscope* is that two objects are not enough to establish a direction for the eye to follow, however three objects create a direction, starting the eye off in smooth pursuit. The simplicity of enunciating these three objects and playing with the space created and the order they were shown in became the seed for *Arc3*, with *Arc3* itself forming a part of a future, bigger art installation for *Kinetica* in

Choreographing time: Developing a system of screen-less animation, March 2014

February 2013. Bruno constructed a beautiful sound track using his voice and the vocal talents of Minna Nygren, a music student at Goldsmiths.¹⁰⁵

Description: All diasynchronic artworks are site specific and ‘*One, Two, Three...*’ was made for the space at *Kinetica*. The piece celebrates the idea of animation as the ‘spark’ of life. There is a sense of cell division and evolution, but also of water and ripples. The simple motif of ‘three’ was arrived at through our desire to move beyond the binary and digital to something analogue and flowing. Two points in space are just flashes that can be joined by an imaginary straight line; but with three points, an arc can be created, starting the viewer’s eye on a journey. This visual journey is accompanied by rhythmic vocal chants incanting variations on ‘*One, Two and Three...*’ These lend a meditative mood to the piece. Although it seems surprising that flashing lights could create a feeling of calm; this is a commonly reported feeling. Partly because the medium’s unique ability in combining animations with precisely synchronised sound makes it an appealing gestalt experience, and partly because of the contained environment providing a haven, but probably the major factor is that, unlike screen-based imagery, there is no flicker in the *Diasynchronoscope*.

5.2.1. BACKGROUND

In the summer of 2012 we found a studio at *ASC studios* based near to Goldsmiths in New Cross Gate. I took my doctoral upgrade, and there I was advised to drop my more general interests in studying movement (with the *Diasynchronoscope* being only one of three planned case-studies) and concentrate instead on just the *Diasynchronoscope*. This meant a major U-turn in my studies, as *Bolt* had taken 18 months of work with touring, gathering data and conducting workshops. My thesis title went from: *Extracting the Abstract: The Contribution of Kinetics to Communication* to the title of the thesis now: *Choreographing Time: Developing a system of Screen-less animation*. On top of this we created the more conceptual artwork *Prism* for the Goldsmiths post-graduate show (discussed in chapter 1.6 of this thesis). Because of technical difficulties, this artwork was not what we had hoped for. It was a time when we were both beginning to feel doubts about the *Diasynchronoscope*.

¹⁰⁵ In an ideal world Bruno and I would have split the vocals, but I have the voice of a walrus in pain and I contented myself with the dubious honour of being able to reply to inquiries about the composition, that ‘*Bruno did the music, but I wrote the lyrics!*’

All we had were stories from *Kinetica 2012*, but no concrete evidence that our artworks were a) any good and b) original. In a deliberate attempt to bolster our confidence and see if we could develop as artists, we decided to create a diasynchronic artwork, installation, *Arc3*, (the prototype for *One, Two, Three...*). To help strengthen and direct my research, we then showed *Arc3* to a number of academics and psychologists and filmed their responses. We were keen to see if they found the *Diasynchronoscope* project interesting and worthwhile, and indeed if we could make something that qualified, in a more sanctioned sense, as art. Because we now had a studio it was possible to work with greater attention to detail, and build through an artwork to improve it generatively. My blog from the website records the more official background to *Arc3*:

Overview and Background: We finished our last experiment, (*Prism*) with the technique with the words: “*To make good art using the medium, we need to be in command of it.*” This is what we set out to do in *Arc3*. As our confidence grew with our technique, we became keen to test some of our artistic abilities with the medium. *Arc3* represents a real attempt to create art that is more layered and has a deeper contextual content than previously. We had already decided that the sound would be integrated better if we started with audio and then animated to it, there is a rich history of this in animation, from *Silly Symphonies* and *Fantasia*, to the visual music of Norman McLaren and Len Lye. We had also established that simple forms were better for carrying our ideas and explorations in this new medium. The major themes that we were keen to exploit were a full use of sound-track that integrated with our visuals in space-time, and the power of three.

5.2.2. TECHNICAL METHODS

We started with a sound track that explored the rhythms of a single voice (Bruno’s) singing ‘*One, Two, Three*’, and after the sound grew organically to a pleasing rhythm (ie one that we were happy with), we set out to animate cubes (the simplest diasynchronic platonic form) to this sound track. There was an immediate pleasure in being forced to fit the visuals in space to a conceptual form already present in the audio. We started with dropping a larger cube and had it bounce and break up into progressively smaller cubes (three each time), using the animation trope of **squash and stretch** to help the eye’s journey. There was an ambiguous mix between the animated bounce which generates a veridical level of perception and the break-up of a cube into three other smaller cubes –

we guessed that the animation trope would carry this mix of imagined, almost cellular division through the concept, particularly as it was reinforced with the sound.

Technically the ripples are of great interest because they are not platonic solids, instead they function more as painterly circular 'splines'. Also, as with *Gestalt Circle*, they carry attributes of transference from one object (the cube) to another (the graduated ripples), in an illustration of the animation trope of **secondary action**.

We developed *Arc3* slowly over a period of weeks, and this allowed us much more time for experimentation and play in the studio. The ripples came about through play when I had been left in the dark while Bruno was mapping. I started to cut foam insulation hosepipe into strips, initially just for the haptic pleasure of cutting foam with scissors. After I had cut a few strips, I joined the ends and then started to join more in progressive sizes just to see what they looked like.



Figure 35 Making the ripples

Although the ripples were difficult to map, they added new literal, tonal and conceptual dimension to the artwork. The ripples were the first objects that we used in the *Diasynchronoscope* that were not painted black. On the plus side, this meant that they 'popped' visually, making them appear more painterly, however this also meant that they were hardest to hide and first to appear when the participant's eyes become accustomed to the dark.



Figure 36 Arc3 set up in the studio

With the installation, *Prism*, we had experienced a lot of trouble with the ‘black pixels’ from the two projectors; Bruno’s projector, a *BenQ ws710-st* and a borrowed college one. The *BenQ* had been a great boon and we knew it was the best short-throw projector we could have, but the spill from the black pixels was beginning to compromise our artworks, particularly if we wanted to achieve saturated colour. It was also becoming increasingly clear that we would need more than one projector if we were to get to our goal of achieving animation in the round.

One thing we were hoping to achieve with *Arc3* was a more stable and supporting structure for the component pieces that could also be dismantled for transport purposes. We built the supporting structure from pre-galvanised steel channels and brackets. The base was a square garden parasol base which fitted the channels perfectly and locked into place. We also learned how to use a spot-welder and created arcs of copper wire with spaced spikes for the polystyrene blocks to be stuck on. This left us sufficient flexibility for adjustment when we saw the animation.¹⁰⁶

We reasoned that creating a more stable structure would be the first step towards developing a more automated mapping system, and we ran some experiments with various mapping tools such as *Kinect* to see if we could get anywhere near to a photographic representation of what the projector ‘saw’. But the multiple objects and the complexity of depth perception proved too much for us to gain any viable results.

¹⁰⁶ The parasol bases, like the gazebo have become standard equipment for our sculptures and we have since purchased our own spot-welder.

The animation for *Arc3* ran at 25fps. Each cube was lit for a single frame except for the 'squash' cubes which were held for three frames. The ripples were more of combination of phi and beta movement (rather like the triangles in *Prism*) where each ripple was held for six frames with a filmic fade-in and fade-out so that they overlapped with the descending cube and also each other as the ripple 'expanded'.

Now we had our studio we felt we could finally ask people to come and see an artwork as it progressed. Conscious that we might be too close to the work, we were keen to get in experts from various fields to see if all our ambiguities were working as well as we thought and to record a genuine, visceral response to the medium.

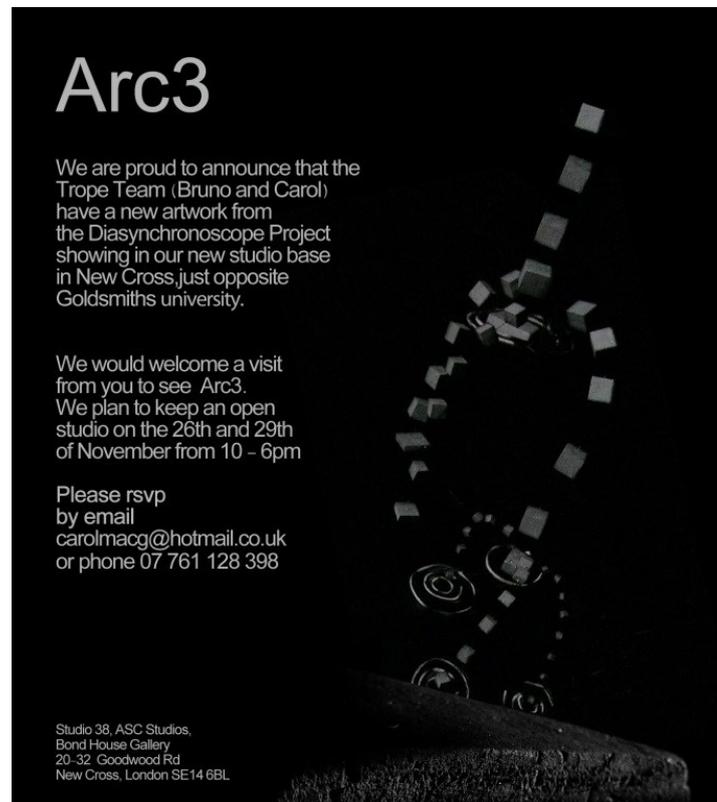


Figure 37 The invitation to Arc 3

We sent out an invitation to many academics at Goldsmiths and to curators and other experts we had met at *Kinetica* and elsewhere. At this time we were involved in writing a bid for the project to the Leverhulme Trust (appendix D) and we were keen to get some expert opinions on possible research avenues. Overall, we had eleven experts visit the studio and we managed to film most of them giving responses immediately after they had

seen *Arc3*¹⁰⁷, it. We edited these and put them on the project website alongside some written quotes.

Diary entry 30/12/12: *'As always with the Diasynchronoscope we have discovered more things. The mixture of ripples and cubes has added a new dimension, and it feels as though the integration of sound and visuals in space has brought a new sophistication to our work, and opened up new opportunities for investigation. We will now use Arc3 as a basis for our artwork at Kinetica: 'One, Two, Three...'* There is an interesting new area to be explored in terms of Types and Tokens, of naming objects and subverting the naming through juxtaposition of sound and visuals, or sound and space. To me it feels great to finally be running the experience as a narrative (instead of in a loop as in *Gestalt Circle*) and I love the idea of subverting space through integration of retrotopic movement.'

Overall, we felt we had been successful in surmounting enough of the problems we had set ourselves in *Arc3* to push both sound and medium further in making *'One, Two, Three...'*, the final art installation for *Kinetica 2013*. As the new artwork progressed, it was beginning to feel like we were working *with* the medium, and not fighting it. We recorded some more sound with Goldsmiths music student, Minna Nygren to add levels of light and shade. As always we were keen to preserve the embodied assets of the medium in the sound by using predominantly vocal sounds for the track. Minna did a great job, providing ambiguous 'breathy' notes for the ripples that sounded both ethereal and embodied at the same time.

Once we had these new sounds, we wanted to build on our initial visuals. We added iconic objects in the form of Roman Numerals depicting I, II and III so that we could sustain some longer notes and we also decided we could afford to play with the film trope of 'retrotropic' movement¹⁰⁸. We combined this with reversed gravity and that allowed us to use another animation trope of reversing exploded graphics to convergence.

¹⁰⁷We also had a dozen MA students, however it was not possible to film the students as they came all at once, and there was only room for four people at a time to view the artwork.

¹⁰⁸ I had coined the term 'retrotropic' for a paper delivered at a Media and Senses conference in May 2011 at Goldsmiths *'Running Backwards: What the Retrotopic Reveals about Perception'*, intending it to describe how a subject perceives a reversal of time's arrow specifically through running various experimental film clips backwards. I wanted to make a distinction between time being *perceived* as running backwards and the film practice of running audio and visuals backwards. This was before my upgrade and I had made a number of studies on this.

We spent a day at *ProjectorPoint* in Teddington comparing projectors, and were so impressed by the quality that the *JVC BlackMagic Technology* gave to creating super black pixels that we bought a heavyweight projector, the *123 - JVC DLA-RS46* which weighed in at 15kgs and produced 1000 lumens in brightness. Now we had two projectors for showing *One, Two, Three...* at *Kinetica* and that would surely mean we could expand our horizons.

5.2.3. REFLECTIVE OBSERVATION

The idea of animation embodying a 'spark of life' is a fundamental one, and in *Arc3* we had pursued this concept of 'spark of life' in two ambiguous but complimentary paths. Firstly, the idea of a simulating literal sparks as in arc welding, with the cubes move in arcs as sparks do,¹⁰⁹ and secondly as the building blocks of life.¹¹⁰

At the time of production of *Arc3*, I was a bit worried that the semantic ambiguities of creating cubes that were at once particles that sparked *and* bounced *and* fell into a 'soup' creating ripples, was stretching the object's credibility, so I was relieved when the experts not only 'bought it' but were so fulsome in their praise.

Diary entry 01/12/12: *'The anomaly was, were we dealing with sparks, platonic solids, cell division or 'soup'? Because the only true reality in the medium is the one that we create, we added ripples, indicative of the 'soup' element at each bounce. Again we were trusting to the medium's unique ability of combining animations, synchronised sound and veridical perception to carry a viewer through without questioning this ambiguity... It appears that we are beginning to master the medium as this did indeed prove to be the case. No-one questions that cubes divide into cubes, or that objects both bounce and subside into ripples or indeed that the ripples are on different levels'*¹¹¹

¹⁰⁹ Looking back I perceive that an inspiration for this may have been that I could see night welders from my hotel room in Beijing, when I went there on vacation and the sparks trailed down in beautiful arcs. Also, of course, we had started using a spot-welder with this art work.

¹¹⁰ I had been reading about Rob Marv's 'Primordial Soup' theory where simple organic compounds are created spontaneously from inorganic precursors. In particular, I was rather taken with the Miller Urey experiment in 1953 where the three-fold mixture of methane, ammonia and hydrogen under conditions posited by the Oparine-Haldane hypothesis form amino acid, a building block of life. Here was life sparked by the power of three.

¹¹¹ And later on, in *One, Two, Three...* no one questioned that the cubes defied gravity, rebuilt themselves or travelled backwards.

The data collection for *Arc3* and *One, Two Three...* whilst by no means perfect, was certainly an improvement on *Kinetica 2012*. Filming the experts really helped our confidence and creating *Arc3* meant we were more prepared for *Kinetica*.

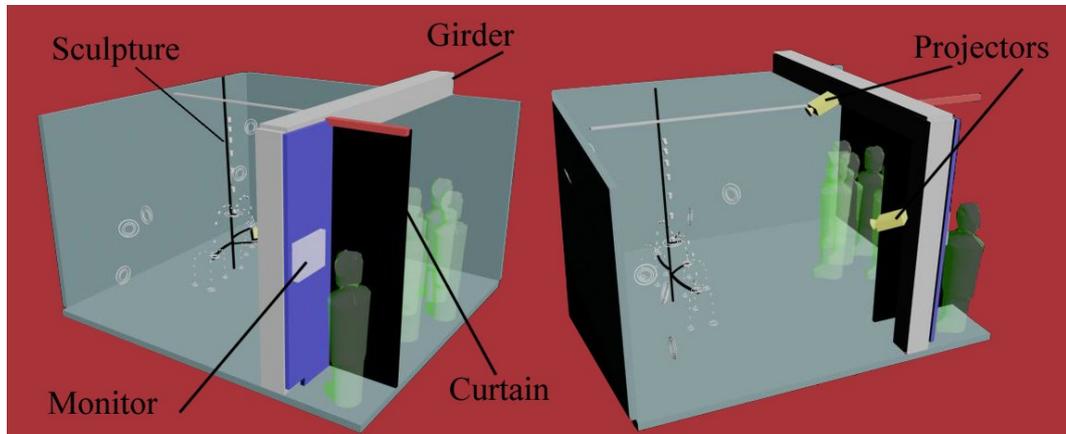


Figure 38 Plans for installing *One, Two, Three...* at *Kinetica*. Learning from our previous exhibition there, we worked hard at making the set up more professional. We made the entrance at a right angle to the projection, so that we could increase the viewing area admitting up to twelve participants at a time.

Because we had built most of the artwork in the studio, Bruno was able to prepare the *Adobe Afterfx* files and plot the *Quicktime* movie sequence ahead of time using the existing mattes already created. They all still needed manipulation, but at least the animation was fairly well planned. We also were given a better space at *Kinetica* on the ground floor which we reseed extensively.

Even with all our planning, we found that we had to swap the two projectors as the JVC projector did not have a wide-angle lens, so it needed a longer throw than we thought. In fact we ended up with our expensive new piece of kit lighting just a diagonal strip in front of the sculpture, designed to stop people stepping over and trying to touch it and also to redirect some light to their eyes so that the poor black pixels from the *BenQ* did not illuminate hidden objects. After the artwork played, we revealed a holistic of the artwork (minus the Roman numerals) before returning to the top of the animation. The piece ran for just under three minutes in total.



Figure 39 Holistic of ‘*One, Two, Three...*’

5.2.4. OUTCOMES

Exhibiting ‘*One, Two, Three...*’ was a good experience. We had prepared well for it, and came to the exhibition buoyed up with confidence from the expert feedback for *Arc3*.¹¹² The experts had given us some wonderful quotes for the website, such as:

“[It is] just a different kind of embodied visual experience that isn’t part of your everyday life – that’s what made it interesting to me as a theorist about embodied motion and embodied perception – full stop!” and *“For me it invokes a sense of magic, of other worldiness, that I haven’t seen or experienced in an artwork before.”*

Prof Mark Bishop, Professor of Cognitive Computing, Goldsmiths, University London

¹¹² Snippets of this feedback was up on our website at:
<http://www.doc.gold.ac.uk/diasynchronoscope/artworks/artwork-arc-3/>

“The big problem with screen based media is that the work has been done really (although still exciting etc) you are doing something which I think needs to be – one which is exploring a physical aspect of visual music and audiovisual composition – because you’re thinking about space, which is much more interesting, embodied and exotic.”

Dr Mick Grierson, Experimental Artist, Real-Time Interactive Audiovisual Research, Goldsmiths, University London

“It felt like a water-colour; a painting experience coming alive”

Irini Papadimitriou, Head of New Media Arts Development, Watermans; Digital Programmes Coordinator, V&A

“I thought it was beautiful, completely unexpected, I was confounded by it because sometimes the linguistic information contradicted what I was seeing visually... It seemed more sophisticated as a piece, as an entire theatrical cinematic experience; something between a theatrical and an animated experience.”

Dr Eleanor Dare, Fine Artist, Lecturer at Goldsmiths, University of London and Skillset Media Academy

“In a world of digital animated special effects we’re expecting the highest quality of experience, so to be in a room with something so analogue and so physical was a total surprise... Your biggest powerful move here is foreground and background, because in animation on a screen, however clever it is at pretending to have depth; it’s flat. Whereas here, as those objects move towards me and back I felt that!”

Prof. Andrew Shoben, Artist, Greyworld; Fellow of the Royal British Society of Sculptors; Fellow of the Royal Society of the Arts

Filmed feedback from participants was also reassuring, with feedback such as: *‘tremendous’, ‘so beautiful’ ‘don’t know how you did it’, ‘awesome’, ‘intelligently playful’, ‘hypnotic’, ‘very beautiful’, ‘like stepping into another dimension’, ‘favourite [piece] at the exhibition’.*¹¹³

¹¹³ Filmed interviews can be seen here on the project website or at this link: <http://vimeo.com/61266884>

Dr Agnieszka Piotrowska, a film-maker and academic wrote to us afterwards that she found it: *‘A combination of art and philosophy. A profound reflection on the nature of life and a superb aesthetic experience!’*

This time we also got to show the work to journalists resulting in good reviews from the architectural magazine, Blueprint who wrote:

“It has a virtual reality feel but actually comprises real, solid objects lit in sequences, and the effect is hypnotic”

Kat Austen, New Scientist CultureLab editor conducted an interview with us, writing in an article under the heading: *“Kinetica comes into its own with illusory adventures”*¹¹⁴

“[One, Two, Three...] Designed by artists Carol MacGillivray and Bruno Mathez as part of the [science cum art] project, the piece is used to investigate how our brains construct a continuous visual stream from discrete objects. “Most perception experiments use screens,” says Mathez, “but a screen is not reality. We can represent reality in a much better way by positioning the viewer within a room and playing with space and depth. We can control the experiments very precisely.” They will be investigating apparent movement – the way that we perceive frames of a film to be a continual flow of information. Everyone consumes movies all the time, MacGillivray says, but most of us don’t really know why we see them move, or what the thresholds are to seeing movement. One, two, three... is a stunning piece of art in its own right. It combines audio-visual elements that nod to MacGillivray’s experience in animation with a sculptural element that brings the projections into the realm of the real.”

There were other, longer term outcomes from exhibiting *‘One, Two, Three...’* On a pragmatic level, it led to us being invited to make several new artworks: We were invited to exhibit at Music Tech festival, received our first proper commission for an artwork to premiere at the Frequency Festival in Lincoln¹¹⁵ and thirdly, we received an invitation to show an artwork at TenderPixel Gallery in London’s West End.¹¹⁶

¹¹⁴ March 1, 2013, Full review at the following link:

<http://www.newscientist.com/blogs/culturelab/2013/03/kinetica-artfair.HTML>

¹¹⁵ The artwork, ‘Conversio’ <http://www.trope-design.com/exhibited-artworks/conversio/>

¹¹⁶ The artwork, ‘Gaffer’ <http://www.trope-design.com/exhibited-artworks/upcoming-exhibitions/>

We had learned much about refining our process and creating a professional-looking product. We had also purchased another projector, and learned how to link the output to two projectors in a more streamlined way. We had established a less onerous mode of curating and increased our participant's angle of view from about 25 degrees with *Gestalt Circle* to about 150 degrees with 'One, Two, Three...'

In terms of forwarding the emergent grammar of the *Diasynchronoscope*, we had managed to create expressive qualities from mixed semantic forms, providing further confirmation of the structuralist approach adopted in this research.

As artists we were beginning to enjoy exploring the expressive and ambiguous nature created by our structuralist elements more than using images loaded with contextual meaning. We had used Types and Tokens in the form of the Roman numerals, and, although these had been so simple to make and synchronise with corresponding words, they were so forgettable that not a single person has ever remarked on them, or noticed their absence in the holistic. It appeared that with these symbols we were not distinguishing between Pierce's Types or Tokens, but were rather reducing our participants to 'viewers', passively receiving constructs that raised no questions and that could be universally accepted. This is clearly a blind avenue for artistic exploration and we have never returned to creating such objects.

There were several observations I made through watching participants and reflecting on their feedback. One was that by accident we had produced a filmic 'fade in'. This came about because the tape holding up blackout drapery around the projector started to unpeel and the drooping drapery gave us a partial soft fade in on the first block. Although serendipitous, it was a nice way to initiate the animation from a void.

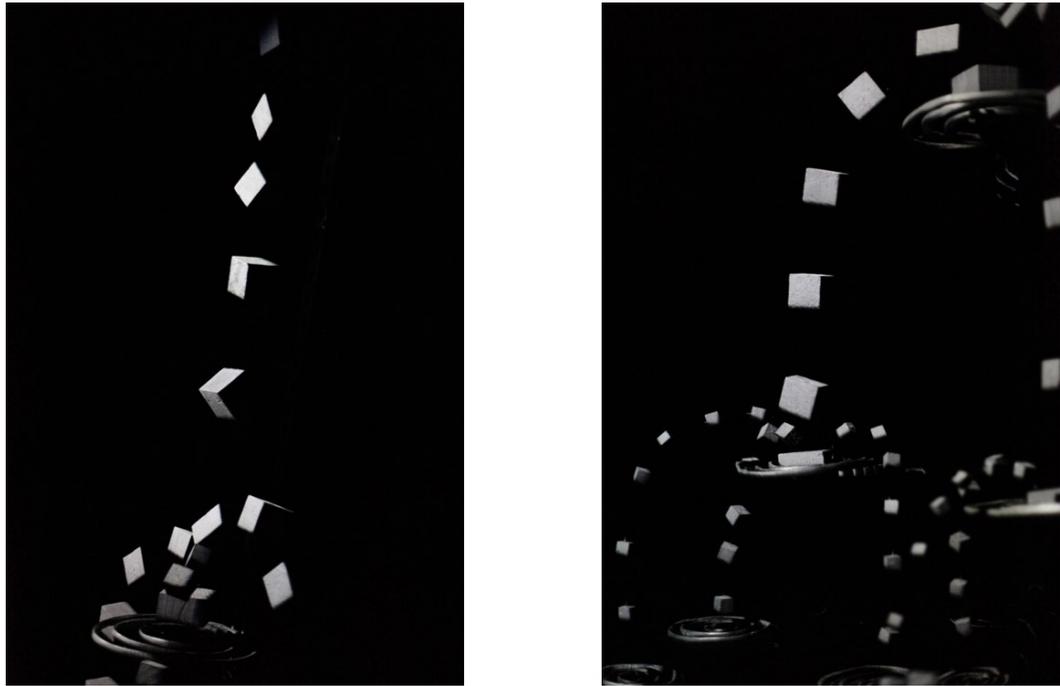


Figure 40 *‘One, Two, Three...’* The picture on the left shows the accidental faded in first block and the picture on the right shows the smallest blocks that ‘dance’ in a holistic view

The second observation came as much from personal experience, and monitoring how I felt as participant, as from watching others. It was that the smallest dancing cubes seemed to induce a sense of wonder, and I wondered if perhaps this came about through somatic feedback - because they made people’s eyes dance. I had read some research that put forward the idea that looking upwards automatically lifts one’s mood. Watching the small cubes was like watching fireflies blink into existence and flit around. Using an infra-red camera we had filmed our own eyes watching the artwork in the studio, as I wondered if it would create some interesting data on varied perception. In the final event, it just proved too much to create such an experiment at *Kinetica*, also I felt it would be better if a psychologist helped to design any perceptual experiment we made along these lines. It did seem a potentially fruitful future area for research into attention and embodiment and pointed to a way that experiencing apparent movement in an ecological environment could be readily distinguished from experiencing apparent movement on a screen.

‘One Two Three...’ is a complex artwork, the multiple objects defy representation in drawn form and the actual visual information afforded to the participant is minimal. Even now a year on, I am revisiting ideas brought up by the artwork through ekphrasis.

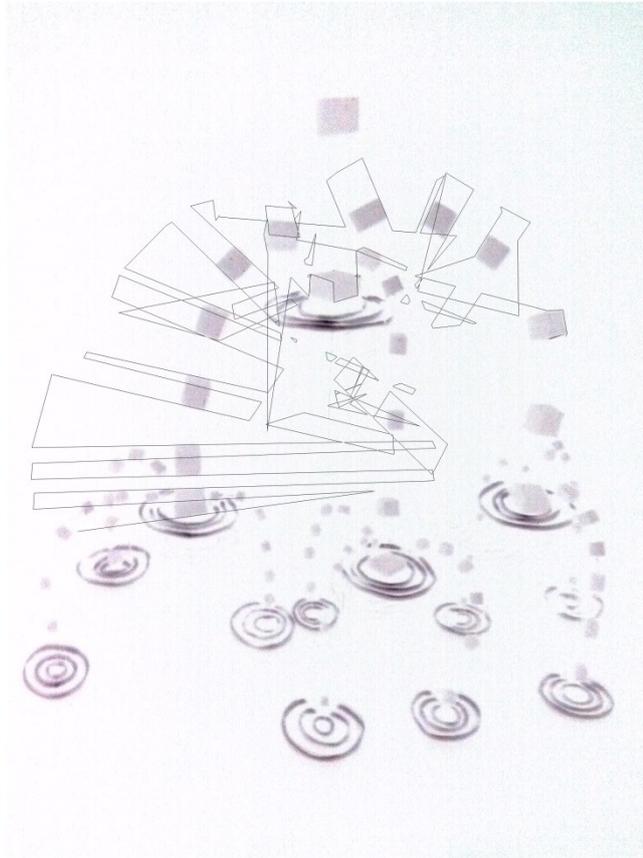


Figure 41 A study of visual information, eyelines and perspective in 'One, Two, Three...'

5.3. CASE STUDY THREE: *STYLUS*

Stylus was a site-specific artwork created for the Music Tech Festival at Ravensbourne, 17th-19th May 2013, where it was shown to about 400 people. We exhibited it a second time for ten days in July 2013 in Drama Studio 3 at Goldsmiths, this time in collaboration with Martyn Ware who enhanced the piece with his 3D sound system from *Illustrious*. This is the first *Diasynchronoscope* art installation that could be experienced in the round.

Description: *Stylus* is an attempt to combine sound and vision in perfect synthesis. Simple looped patterns of visual music building to a complex and melodic kinetic sculpture where the conceptual resonance and counterpoint between image and sound are bonded in a way that the audio visual contract feels inevitable. *Stylus* is about sound and image and perception. The main, permanently lit part of the sculpture is a hanging cube, created (ironically) from acoustic foam. Vinyl records were played using a diamond

stylus that ran through grooves, picking up the tiny ridges and indentations to reproduce sound. The hanging cube resembles a large diamond, and with the ridged profiles also looks like a diamond at huge magnification. As with other diasynchronic artworks, Stylus takes place in an immersive environment, but for the first time, participants can walk all around the sculpture, taking an embodied journey of meditation as their senses become accustomed to the space. Creating an embodied experience has always been a fundamental of the diasynchronic technique and to achieve a work where both the audio and visuals can be appreciated in the round marked a real milestone in our development.

5.3.1. BACKGROUND

The starting point for all artworks is to test the boundaries of the medium and we were determined to make an artwork that could be appreciated in the round. The following quote comes from one of the founding fathers of thinking on perception and embodiment, philosopher, Merleau Ponty who continually emphasised that he *'could not grasp the unity of the object without the mediation of bodily experience.'* (Merleau-Ponty M. , 1962) The following passage is from his 1945 book, *'Phenomenology of Perception'*:

'From the point of view of my body I never see as equal the six sides of the cube, even if it is made of glass, and yet the word 'cube' has a meaning; the cube itself, the cube in reality, beyond its sensible appearances, has its six equal sides. As I move round it, I see the front face, hitherto a square, change its shape, then disappear, while the other sides come into view and one by one become squares. But the successive stages of this experience are for me merely the opportunity of conceiving the whole cube with its six equal and simultaneous faces, the intelligible structure which provides the explanation of it. And it is even necessary, for my tour of inspection of the cube to warrant the judgement: 'here is a cube', that my movements themselves be located in objective space and, far from its being the case that the experience of my own movement conditions the position of an object, it is, on the contrary, by conceiving my body itself as a mobile object that I am able to interpret perceptual appearance and construct the cube as it truly is.' (Merleau-Ponty M. , 1962, p. 236)

The time when we were designing *Stylus* coincided with me researching more deeply into the roots of embodiment, and it is certainly possible that Merleau-Ponty's 'tour of inspection' of a cube had been a factor in the making of *Stylus*, although it was not a factor that I was conscious of at the time. I found it in rereading after we had

exhibited *Stylus* and was very taken by the synchronicity between this account and how *Stylus* had been viewed. If it is hard for an artist to provide exegesis of how an artwork came about, it is doubly hard if it is made in an artistic partnership. However here the underlying principle of creating an artwork that is site-specific was definitely the leading factor: The site would allow us to create an artwork in the round for the first time and because the exhibit was for the Music Tech Festival, we felt that the artwork should be music oriented and shaped by audio. Bruno had an idea for the audio that built on something he had been working on in his MA: that of creating simple looped rhythms as elements that build to create a melody.

After ‘*One, Two, Three...*’ I had been observing anomalies between matter and metaphorical matter in real life. In one specific instance, an inspiration for the artwork came about through observing a dripping tap in the morning sunlight. As the drip formed, it sparkled brighter than any diamond and then fell. What if the sound it made when it dropped was the sound the visual suggested: That of a hard diamond? Bruno’s early audio tests were enchanting and we used sound created by dropping various screws, bolts and washers onto a layer of bricks in the studio to get an effective basic sound. (I have a long history of creating Foley sounds from my days as an animator).

The sculptor in me was beginning to feel unhappy with creating artworks from polystyrene – the surface was rough and unpleasant in a tactile sense, and painting it black was tedious and aesthetically questionable. I had begun investigating tight black foam as an alternative, and with Music tech being offered as a venue, I ordered a few tiles of acoustic foam, perhaps because it recalled for me times past spent in sound studios creating Foley sound effects but also partly because I thought that it may be fun to create sound from symbols of silence. The idea of sound appearing to be created from foam that deliberately absorbs and deadens sound appealed to me. The way light played on this new texture was exciting, and brought to mind the rough surface of a record groove shown at huge magnification.

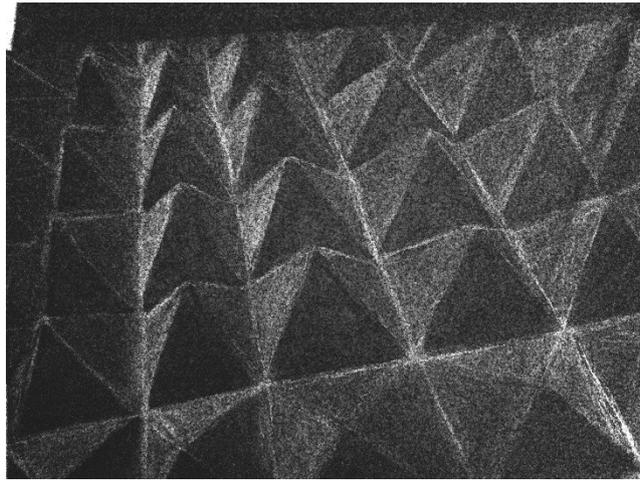


Figure 42 A drawing made in white chalk on black paper of the acoustic foam texture, I find the swift changes in perspective brought about by observing a simple pyramid fascinating.

Bruno wanted five sounds to build from and so we alighted on the idea of a diamond and the name, *Stylus*. After that everything seemed inevitable. We would create five ‘drops’ and a surface that would have ripples. Dripping sounds and coloured ripples provided audiovisual counterpoints to the hard ‘diamond’ looped digital sounds that built to create melody in the artwork. The ripples were reminiscent of a record disc and we hoped to create a round disc-like surface for the ripples to be on. On a deeper level, the elemental nature of a diamond (being made from carbon), and water (made of hydrogen and oxygen) appealed to me because of their resonance at a primordial level. They are the fundamental elements that gave birth to life on our planet, and we are composed mostly of these elements. Again the concept of animation epitomising the ‘spark of life’, though hardly original, felt appropriate for our new medium.



Figure 43 This picture taken in our studio demonstrates the scale of the diamond/cube

There are several layers to experiencing *Stylus* and, as each percipient is different, as many different messages to decode. As artists, a main part of what we were trying to

explore in the artwork is that of decoding and discovering what is already there, but invisible. In this sense, *Stylus* is intended to celebrate the miraculous way that a diamond stylus materialises sound from a disc. It is impossible for a person coming new to these objects to backwards engineer sound from each component part, and yet they both exist and were created for that purpose: The stylus and the disc form an inevitable marriage that is required to decode and uncover something ethereal that is at once there, but not there. This extraction of something from nothing through perceptual revelation echoes how I feel about the diasynchronic medium as an art form, and its essentially Gestalt nature.

5.3.2. TECHNICAL METHODS

This was the first time that the embodied and screen-less nature of the *Diasynchronoscope* experience was explored in the round, making it something of a technological breakthrough as it required multiple projectors and very careful conceptualization, because in the round, there is nowhere to hide wires or structural devices. This meant we returned to stringing objects on fishing line. The objects were pyramids of foam cut from an acoustic tile – they were light and I felt they resembled a stylus.

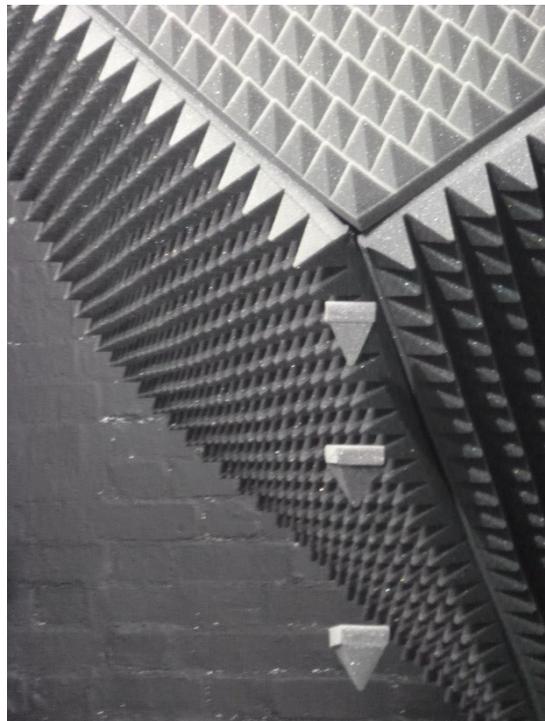


Figure 44 A ‘drip’ of stylus-like pyramids from a corner, strung on fishing line

The cube was constructed of a wooden frame covered in lightweight plastic sheeting and the acoustic tiles. It weighed about 6 kilos, so was relatively easy to hang, but to stop it spinning we had to add ‘guy ropes’ of fishing line attached to other parts of the ceiling.

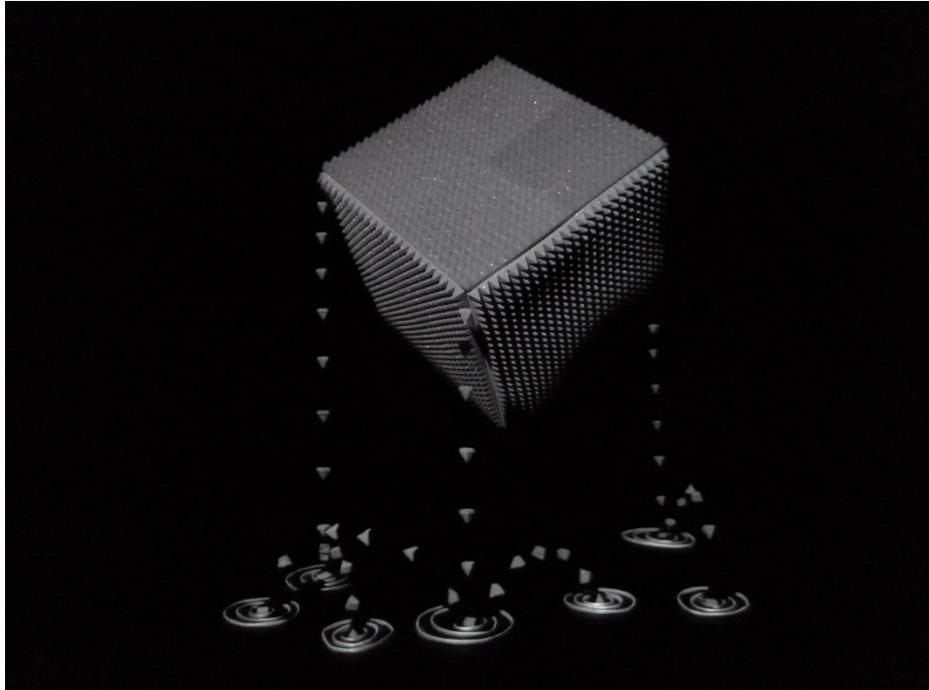


Figure 45 Stylus nearly constructed. In the final piece each drop could bounce two ways and we readjusted the bounces so that the ‘point’ of the stylus always led as this made the apparent motion more believable.

The audience walked in a doorway and along a curtained wall before they saw the artwork. The hanging cube provided a focus and we put eight white drain pipes holding lighted torches pointing up around the artwork to protect it. I covered the torches with blue cellophane and blocked the drainpipe ends. This was to act as a barrier to stop participants getting too near the artwork and accidentally moving it, and actually became almost an integral part of the artwork, I regret that we did not film them when creating a video of the experience.

The decision to use colour was a conscious one as the strong black pixels of the JVC Projector allowed us to create much more saturation. We chose blue for the cube and for the first time used a number of lighting tricks to help focus attention. Each drip was preceded by a lighter patch travelling across the cube’s surface, as though liquid was gathering, so that the eye was drawn imperceptibly to the right drip – the duration of each drip was short, between 6 and 8 frames so it was important that they were picked up right away.

5.3.3. REFLECTIVE OBSERVATION

Above all else, the *Diasynchronoscope* is an embodied experience. It is about being there. There is no substitute for this, artworks are conceived to be experienced in a shared space and the experience is a somatic one. When shown at the Music Tech Festival, we were interested to see if people would move around the artwork or stop still to contemplate it. In fact people did both and many stayed for a long time.

Diary entry 18/05/13: *‘When people enter the space, they are uncertain, they take small steps in the dark – first (at 3 o’clock) they see flashes of pixels, and hear primitive sounds of a cave, of drips – as they circumnavigate the space, (to 6 o’clock) the movement becomes apparent and the sound builds to melody. Their steps become more confident as they begin to comprehend the space. As they reach 9 o’clock the sculpture has revealed its mysteries – the underlying structures that create the sound and vision are revealed at a molecular level. People are sure of the space and move with ease, deciding to stay or leave.’*

It is interesting how much time this has taken. Most visitors spent about 5 mins in the environment. Their attention was held and their knowledge and experience developed over this time. Here, on an embodied perceptual level, *Stylus* does indeed represent Merleau Ponty’s ‘tour of inspection’ of a cube or Cezanne’s observation that ‘*the same subject seen from a different angle gives a subject for study of the highest interest*’. One of the feedback notes stated: ‘*it would be better if it was interactive*’. and of course it is certainly possible for Diasynchronic artworks to be made that are directly interactive,¹¹⁷ however, as discussed before (in chapter 1.6), I believe that the artworks are already interactive in many ways and in the case of *Stylus* the act of perambulation, of simple embodied action through conscious or unconscious decisions made about where to stand or walk, and for how long to stay in the shared space makes that interaction manifest. So the work is interactive in an indirect way; not in the sense of it changing in response to the spectator, but in asking that the spectator change in response to the artwork, and by anticipating, rewarding and responding to these changes. In this last way it is a different and more immersive experience than walking around a sculpture in a gallery.

¹¹⁷ As demonstrated with our later artwork ‘*Gaffer*’

5.3.4. OUTCOMES

Collecting the feedback on *Stylus* using post-it notes was useful as it enabled me to quantify the feedback as well as gain deeper understanding of its qualitative communication. Many of the notes remarked on the hypnotic and mesmeric nature of the artwork and it generally produced a sense of peace and well-being. The quotes were better than we could have thought up and some I particularly liked were: ‘*Stunning Alien God object*’, ‘*It’s better than a diamond – playfully articulated*’, ‘*Entranced by this. It’s a beautiful piece*’, ‘*A raindrop cube? Can I describe it as that, with mesmerizing sounds – beautiful*’, ‘*Loved it very much! Could watch it all day*’, and ‘*Nature and Technology beautifully “sung”*’.

Allowing participants to gradually get accustomed to the environment was a new experience for us, it took away our control of timing an encounter and allowed a deeper understanding of how the works was constructed. We improved on this experience for the Goldsmiths exhibition by having a surface for the ripples that integrated with the artwork as a whole, in the form of a giant disc. This made me more relaxed about showing the construction of the art and is something that we have investigated more in later art works that cannot be in total blackout.

Stylus was the first time that we were able to work collaboratively with others, and this is something we hope to do more. Working with Nicky and Martyn was a good experience for us. Martyn brought the sculptress Cathy de Monchaux to see *Stylus* and we are in discussion about creating a collaborative artwork together.

We were also beginning to think of artworks in musical terms, of creating works that fulfil Michel Chion’s ‘*Audio-visual contract*’. Much of our work explores the hybrid marriage of digital and analogue representation. In a simplistic representation, *Stylus* is built from visuals that are analogue and concrete and the sound design is looped and digital in origin. But in fact the two are interwoven. The visuals are also digital and looped repetitively, and the sound is experienced in real space and so analogue. In *Stylus* we experience sounds and visuals in synchrony. The diamonds falling out of the cube have been composed to behave as audiovisual objects. Each object has been animated in an identical way, using two animated bounces synchronised with two different water sound effects coupled with two marimba notes. Each of the five falling diamonds has two distinct notes, and they share exactly the same simple rhythmic pattern. Because they

start at different times, the accumulation of their different patterns results in a complex rhythmic composition - rather like minimalist music, where a simple music loop is duplicated and builds up into a rich and complex musical composition. Here, the musical effect is coupled with the diasynchronic visuals, resulting in a hypnotic visual melody, following the tradition of screen based visual music compositions.

The artwork *Stylus* created the impression of a sort of pre-existing harmony between the two perceptions of sound and image, where, in the words of film maker, Robert Bresson, audio and visuals form a bond '*like strangers who make an acquaintance on a journey and afterwards cannot separate*'. (Chion, 1994)

Above all else, on a practical level, with *Stylus* we managed to achieve animation in the round. When we started on the diasynchronic journey, it seemed that this was a distant and perhaps unachievable goal. It had been an uneven pilgrimage, but we did finally achieve our objective; however as so often happens, having scaled this single peak, a new vista is laid out before us, and one occupied by other, perhaps taller peaks to conquer. The next chapter sums up the achievements of this research and then chapter 7 offers indication of some of these taller peaks lying in wait.

6. SUMMARY, EVALUATION AND SIGNIFICANCE

This chapter examines the results of my research and draws conclusions in terms of the research questions. It makes the case for the project representing an original contribution to knowledge and discusses ideas for future experimentation using the *Diasynchronoscope*.

6.1. TRANSDICIPLINARY RESEARCH

All of the research has been based on the premise that transdisciplinary study is valid. In fact, truth be told, at this level transdisciplinary research is both valid and risky. Here are many limitations to transdisciplinary research:

- 1) The study has been mostly self-directed
- 2) Because of the ‘silo’ framework of much of academia, it has been hard to find mentors or readers with the requisite wide knowledge set
- 3) Case study artworks were made over time, so enabling supervisors and examiners to encounter the artworks was a logistical issue
- 4) Defining differing taxonomies across disciplines can be a minefield
- 5) Established objectives emerged relatively late, meaning that much of my earlier work does not fall in the scope of this study
- 6) The charge of spreading my research net too wide is ever-present, so condensing material and illustrating the relevant ideas concisely has been a major part of this study

However the very fact that this study is transdisciplinary has had benefits:

- 1) It has held my interest and enabled me to learn across new areas
- 2) Synthesising theories across disciplines through the prism of the *Diasynchronoscope* reveals new patterns
- 3) It has enabled me to meet interesting people from many different fields
- 4) Practice has informed theory, but equally theory has informed practice, making this a satisfying artistic exploration
- 5) I have had to be inventive and collegiate to get the story of the *Diasynchronoscope* out to a wider audience through dissemination and exhibition

There have been two main hypotheses that I have tested in this research, firstly that the *Diasynchronoscope* itself is a new medium for experiencing apparent movement and secondly that the spatio-temporal nature of the *Diasynchronoscope* offers a unique framework for creating principles of non-biological apparent motion in an ecological environment.

6.1.1. IS THE DIASYNCHRONOSCOPE A NEW MEDIUM?

The *Diasynchronoscope* is, at this early point, most assuredly not a mass medium, but is it a medium at all?

The first hypothesis that the *Diasynchronoscope* is a new medium has, this research contends, been demonstrated concretely by creating and exhibiting artworks that have taken the audience point-of-view from a single person with one viewpoint to achieving 3D animation in the round. Evidence of this achievement and audience reaction has been provided by filmed testimony on the research website. By contextualising the *Diasynchronoscope* with other media, this research has offered various contexts that back up the statement that the *Diasynchronoscope* is an emergent new medium. These include framing the contextual study into three different heritages; animation, 3D and projection and providing a modern background through discussion of audio-visual hybrid art. Further it has sought to establish a reference point for the medium by looking at early film as discussed by Media theorists through historical account and ontological discussion.

The paramount authority on media is Marshall McLuhan, whose definition of a medium emphasizes technology over the messages and codes that are delivered by the technology, making it an appropriate tool for confirming if the *Diasynchronoscope* is a medium. The research looks in particular at McLuhan's test of a medium outlined in the laws of the Tetrad of Media Effects. (McLuhan, 1989) McLuhan designed the Tetrad as a pedagogical tool, phrasing his laws as questions with which to consider any medium. The laws of the Tetrad exist simultaneously, not successively or chronologically, and can be applied to a wide range of media.

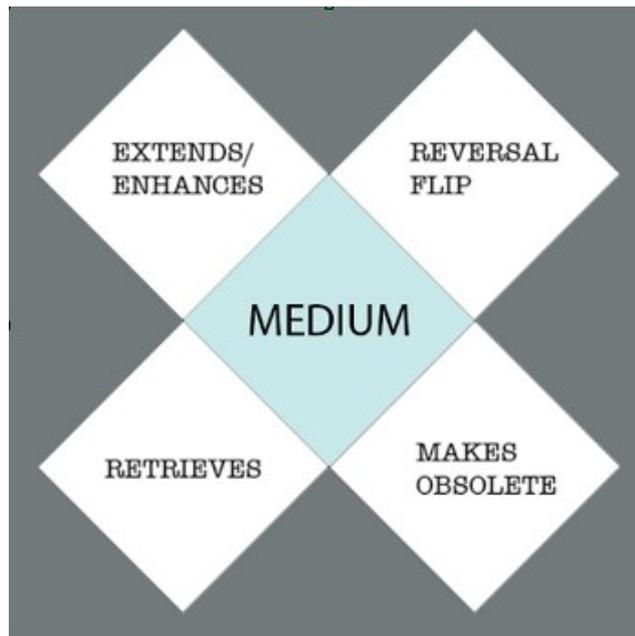


Figure 47 An overview of Marshall McLuhan's Tetrad of Media Effects.

- a) Extension/Enhancement: Every technology extends or amplifies some organ or faculty of the user. What does the medium enhance or intensify?
- b) Closure/Obsolescence: Because there is equilibrium in sensibility, when one area of experience is heightened or intensified, another is diminished or numbed. What is pushed aside or 'obsolesced' by the medium?
- c) Retrieval: The content of any medium is an older medium. What media does it retrieve?
- d) Reversal: Every form, pushed to the limit of its potential, reverses its characteristics. What does the medium flip into when pushed to extremes?

Application of Tetrad laws to the diasynchronic technique would be:

- *a) The *Diasynchronoscope* heightens comprehension of movement over form, intensifies synchronous sound, and enhances multi-modal and enactive sensory perception. It also brings an enjoyment of repetition.
- *b) The *Diasynchronoscope* reduces the importance of heavily mediated abstract visuals synchronised with sound. It diminishes screen-based visual interpretations of sound – after the *Diasynchronoscope* art films seen on a small screen tend to look rather 'small and flat'.
- *c) The *Diasynchronoscope* returns us to the magic of zoetropes, early projected film and other devices of wonder.

*d) The *Diasynchronoscope*, at extremes, flips from veridical perception of movement to non-sequential, serried viewing of individual objects. Because of its mesmerising effect, at its worst, ie. If the *Diasynchronoscope* were to become ubiquitous, it could flip from being art to commercialised, attention-grabbing animation exploited by anything from burger-vendors, to casinos and Christmas lighting.

According to Marshall McLuhan's definition of a medium using the tetrad, where the emphasis is placed on technology over the messages and codes that are delivered by the technology, the *Diasynchronoscope* could be viewed as a close match for McLuhan's definition of a 'cooler' medium, where viewer involvement is key.

On the basis of the above, the research supports the *Diasynchronoscope* being a new medium and because this thesis takes the McLuhanist stance that; 'the medium is the message' (McLuhan M. , 1964), the follow-up question is surely 'What is the message of the *Diasynchronoscope*?'

6.1.2. MEDIUM RARE?

Each art has a medium and that medium is especially fitted for one kind of communication. Each medium says something that cannot be uttered as well or completely in any other tongue.

(Dewey, 1934 (reprint 1989), p. 211)

This research contends that the spatiotemporal nature of the *Diasynchronoscope* offers a unique framework for creating principles of non-biological apparent motion in an ecological environment, in other words that the medium comes with its own grammar, in the shape of formalisms which have been developed through studio practice and tested in exhibited artworks, some of them are new and some of them, as has been detailed in this thesis, can find their roots in formalisms of early film and the three focal theories of Animation, Gestalt theory and Perceptual Psychology.

6.2. CONTRIBUTION TO ANIMATION

The practice-based research question that bookends the case studies in the thesis is simply; "Can animation be experienced 'in the round'?" The answer to this is 'Yes', but with the addendum – 'currently within fairly strict limitations'. Limitations in such a new

technique are to be expected, in fact rather more surprising is that the limitations, particularly in relation to occluding objects, do not destroy the illusion of apparent movement for participants.

One conjecture that I have for this is that participants may not be watching the lit objects in focus, but parafoveally. This means that their eyes are leading the action, which is a common occurrence in smooth pursuit. It also can be found in the way we read words on a page, where we read 14-15 letters ahead (to the right if reading English, to the left if reading Hebrew) using parafoveal information. This allows us to ‘preview’ what lies ahead to see if it is a word or not. The duration of this access is 50-150 milliseconds. (Wolf, 2007). We start to explore our semantic comprehension of a word later, from 200-500 milliseconds (Ibid.:157). Extrapolating back from this to the *Diasynchronoscope*, where one frame is equal to 41.6 ms or 83.2 ms (if running at 2 fps), it is perfectly possible for participants to be picking out up to three objects at once when moving at 1fps – even though the objects are being lit sequentially. This is consistent with our demo of a bouncing block at EVA, where we noted that we had the sensation of seeing multiple blocks at a time. This would also explain why occluding objects in ‘*Stylus*’ do not inhibit seeing apparent movement. We can afford to miss one or two objects and still perceive movement. It may also, in part, explain why the *Diasynchronoscope* is often described as ‘hypnotic’ – it could well be the effect if participants are not actually focussing on anything at all, but having a visual experience that is entirely parafoveal. If this is the case it would be interesting because we would be achieving a new form of parafoveal attention using installations where nothing moves. Rather than the participant’s gaze perceiving a new onsetting stimulus parafoveally and then tracking it, which is usual in perceiving movement and is considered a physiological (bottom-up) phenomenon, in the *Diasynchronoscope*, the perceived stimuli that are seen as apparent motion would be ‘behind’ a participant’s gaze which is travelling ahead along a predicted path. Because such perception would be top-down this supports the argument made in the thesis that, rather than being passive receivers, participants have exegete status when viewing objects strung in arcs within the *Diasynchronoscope*. However, as will be shown, this does not eliminate the likelihood of bottom-up perception also being present.¹¹⁸

¹¹⁸ Another conjecture I have made on why occlusion does not carry the impact we hypothesised, is that it is a form of hysteresis as noted in Wertheimer’s original experiments (Wertheimer, 1912) and by De Silva (De Silva, 1929). (Discussed in 6.3)

Examining animation principles through the lens of a non-biological movement in an ecological environment has additionally given an opportunity for deeper discussion in this thesis of ways of updating the animated bounce, and offered up the advantages to animating a bounce with a cube or block over the usual ball as a revised pedagogical tool. It has also suggested updating the principles to include **Synchronous Sound** and **Looping**, and here I want to make the case that both increase ‘appeal’ in animation.

Although **Appeal** as an animation principle is usually discussed in terms of character animation, few would deny the compelling nature of animation’s appeal in general, and by removing the idea of character animation and considering animation as a whole medium (of apparent movement), it can be seen that **Appeal** could be redefined, moving from its primary animation focus of good character design, to being about good design in general, creating several correspondences to the Gestalt idea of **Prägnanz**.

It would be simple if the principles of animation mapped in clear correlation with Gestalt laws because the two doctrines have overlapping end results, and whilst some do have close parallels, namely **Staging** with **Figure/Ground articulation** and **Arcs** with **Good-continuation**, the distinctions made by the differing interests of the disciplines renders a straight mapping exercise meaningless. It is more useful to tease out the continuities of design that both adhere to, and this is facilitated through new knowledge arrived at through the *Diasynchronoscope*: Animating in the round sheds light on the pertinence of both sets of design laws for apparent movement. This thesis has looked at the animation principles in parallel with Gestalt laws alongside the embodied nature of the *Diasynchronoscope*, and in doing so would like to suggest some other potential factors that contribute to animation’s appeal.

The clean contours and bright block colours that are typical of cartoon animation make **Figure/Ground articulation** effortless, and with the *Diasynchronoscope* we have noted that clean and equaluminescent contours also contribute a lot to facilitating communication.¹¹⁹ This idea of a clean silhouette is where **Staging** correlates strongly with **Figure/Ground articulation**. In taking **Appeal** to be synonymous with good design or **Prägnanz**, we come to the idea of enhanced salience with an economy of information processing. This is the idea of Tufte, and Zeki where ‘*principles of design replicate principles of thought*’. It is an idea echoed by Margaret Boden who uses a linguistic

¹¹⁹ We had made some experiments using internal LEDs in blocks at one stage and the fall-off to the edge of the object destroyed the illusion.

paradigm to make the same point, replacing salience with relevance. She defines relevance in terms of cost-benefit: weighting effort against effect. The more information-processing effort it would take to bear *x* in mind in the context of *y*, the more costly it would be: high cost bringing low relevance (Boden, 2010, p. 103).

This thesis has already pointed out the perils of taking too simplistic a view when considering aesthetic models as corresponding to mind models, however the idea of ‘**Appeal**’ in animation does seem to indicate that, when present, it is tapping into some universal principles of low information-processing effort and high relevance. The elimination of non-important clutter that comes with good **Staging** in animation and **Figure/Ground articulation in Gestalt laws** could therefore be classed as ‘appealing’.

O’Regan and Noë’s sensory motor contingency provides a solution to the binding problem, and this makes **Synchronous Sound** an affirmation of multi-modal sensory knowledge. In other words, it is the contention of this thesis that combined sensory input increases saliency and so reduces information-processing effort. We do not need to actually see a hammer hit a nail if we hear it and can intuit the object from a swing of an arm or from a context.

The lower the information-processing effort, the closer it is to bottom-up perception, and this thesis has, when describing the appeal of arcs attributed part of this appeal to being a result of top-down processing combined with bottom-up processing. One way of resolving this apparent disparity is to look at a third design trope used commonly in *Diasynchronoscope* – and it is one that is more commonly considered outside of visual studies but is prevalent in music. This trope is one the thesis has touched upon in terms of **Looping** in animation and also as a trope of the uncanny, that of **Repetition**. Broadly speaking repetition reduces processing from cognitive, conceptual thinking to more basic motorial and automatic physiological responses. **Repetition** is a topic of daunting size¹²⁰ and also is primarily a trope of music, an art form that this thesis has deliberately sidelined, by concentrating on the visual and embodied aspects of apparent motion. However it would be remiss not to point out the obvious parallels between Music and the

¹²⁰ When Rudolf Arnheim set about expanding his work on *Film as Art* to creating a Gestalt template for the dynamics of all forms of art in the eighties (Arnheim, 1986) he included an essay on the dynamics of musical form that includes repetition, but the main authorities until recently on the subject have been philosophers; Kierkegaard, Nietzsche, Heidegger and Deleuze. A mixed bunch not known for commonality of opinion, however all agree that repetition is closely allied to the idea of recollection, memory and the unconscious.

Diasynchronoscope (where repetition is core practice), and it should be noted that it is the temporal and abstract nature of musical stimuli that creates this parallel. A recent book by Elizabeth Hellmuth Margulis, entitled *On Repeat: How Music Plays on the Mind*, makes a study of the appeal of repetition in music (Margulis, 2014), and in many ways this study points to there being a direct map from auditory stimuli to the apparent movement stimuli commonly found in animation or games (Stickgold, 2000). Margulis points out that:

Repetition allows for the re-experience of meaningful elements that could not be sufficiently represented in memory, and for the shifting of attention from one level to the other, such that multiple rewarding musical associations can be appreciated.

(Margulis, 2014, p. 25)

It is a deep subject, but Margulis has no problem in suggesting that repetition in music is both a ‘comforter’ (low processing), a tool for learning (working memory) and also is used as a tool for increased participation in the hearer as they listen with ‘expectation’, filling in the silence with either overt (in the case of joining in) or implied participation (mentally predicting phrases and sequences). This last is clearly a top-down ‘hypothesis testing’ process. So we find a strong correlation with the discussion on **Arcs** in this chapter, namely that *all* levels of attentive perception can be found at once in the *Diasynchronoscope*.

Margulis suggests that repetition is ‘*a worthy subject for more theoretical and empirical attention than it currently receives*’ (Ibid.:25) and the very recent publication of her book indicates that this could not only be an interesting, but also timely space for future research.

When animation is good, it is captivating in the same way as music can be, and this thesis makes the case that not only are multi-sensoral experiences mutually enhancing by creating Gestalt marriages between different stimuli such as by using synchronous sound, but also that the *Diasynchronoscope* seems to demonstrate a way of perceptions converging between visual and auditory systems. In other words in experiencing the

Diasynchronoscope, participants ‘hear’ visuals and ‘see’ sound, to some extent.¹²¹ This research contends that this is attributable to the embodied nature of the medium.

Summary of this research’s contribution to Field of Animation:

- Creating animation that is experienced in the round.
- Re-examining Animation Principles through the lens of a non-biological movement in an ecological environment to redefine **Appeal** in animation in alignment with the Gestalt principle of **Prägnanz**.
- Advocating the benefits of cross-over knowledge between perceptual Psychology and Animation.
- Creating a revised pedagogical tool that updates the animated bounce using a block instead.
- Updating Animation principles to include **Synchronous Sound, Looping and Repetition**.

6.3. CONTRIBUTION TO GESTALT LAWS AND PSYCHOLOGY

As mentioned before, it is a conceit of this thesis that the study in itself is a Gestalt study because a of the underlying premise that the perceptual whole of the *Diasynchronoscope* is somehow qualitatively different to the constituent parts that make it up, ie focal theories, other media and artistic practice. The *Diasynchronoscope* itself is a Gestalt system because of its paradoxical nature in creating perception of movement through static objects.

Gestalt Founder Max Wertheimer created dozens of original experiments which investigated apparent motion in 1912, and the ingenuity he brought to designing these wide ranging perceptual experiments is impressive. This model of wide empirical experimentation combined with close observation is in itself fairly transdisciplinary, but as perhaps could be said of this thesis; it has its downsides, occasionally falling somewhere between science and speculation.

¹²¹ Thus providing a back-up for studies in neuro-plasticity (Doidge, 2007) (Benton, 2000) (Bachy-Rita, 1972) which suggest that a localizationist view of our mental processes is erroneous. (Doidge, 2007, p. 13)

It should be remembered that Wertheimer's experiments were predominantly made using a tachistoscope and his experiments were concerned mainly with the phenomenon of AM between two stimuli. However, he did conduct some experiments where three or more elements were used and where he concluded that the movement between two elements is strongly influenced by the presence of neighbouring elements. More evidence of the cross-over between this study and animation principles.

Until MIT Press released its centennial retranslation, Robert Sekuler points out that Wertheimer's original monograph has rarely been read and many secondary sources are unreliable (Wertheimer, 2012, p. 102).

Two areas of Wertheimer's study that exactly correlate to discussion in this thesis and certainly warrant further investigation are the influences of attention in apparent motion and the influence of previous percepts (hysteresis), where he noted that for a short time after a stimulus changes or is omitted, observers continue to see the original motion. Shifts in an observer's attention altering the characteristics of Apparent Motion are also noted (Wertheimer, 1912, pp. 208-211). He concludes that where an observer is attending establishes precedence for later perceived movement. Another of Wertheimer's observations was that in his studies of interstimulus intervals (ISIs), where good AM could be seen, that there was a spectrum of experience of perceived motion, making it misleading to offer fixed values for timings for optimum Apparent Motion. Wertheimer also attributed this to hysteresis, and as such it could be seen as testimony to the subsequent craft of animators. However, as this spectrum in perceived motion in participants was also something that we observed in the *Diasynchronoscope*, it may be that conducting experiments with a wider range of participants (Wertheimer only had three) could point up some interesting correlations with varied rates of attentional orders.

The 3D nature of the *Diasynchronoscope* constructs its main contribution to Gestalt theory and perceptual psychology. As remarked by several psychologists, the *Diasynchronoscope* could provide an excellent tool for research into embodied perception. It certainly could provide a three-dimensional platform for revisiting Wertheimer's tachioscopic experiments in apparent motion, and it already offers some new empirical insights into this, such as the way depth clues eliminate the foreground/background paradox accompanying the *Phi* effect making it perhaps a moving form of **Reification**.

The guiding theories behind Gestalt that conscious experience should be considered globally, taking into account all the physical and mental aspects of the individual simultaneously, and taking experimentation on subjects out of the lab in an attempt to replicate a greater fidelity to the real world is certainly something that chimes with the *Diasynchronoscope*, with its freedom of movement for participants and use of sound in a 3D environment.

The analysis of Gestalt laws through the prism of the *Diasynchronoscope* in chapter 2.2, whilst in some ways providing confirmation of many of the laws, does point up how many of the phenomenological Gestalt properties such as emergence, reification, multistability, and invariance are dependent on medium, and so do not necessarily reveal ways of investigating fundamentals of perceptual mechanisms. Several of these illusions are not illusions at all if viewed with depth, parallax and freedom of movement.

Our observation of multistability over time detailed in the feedback on *Swing and Bounce* is thought-provoking (MacGillivray & Mathez, 2012), and it would be interesting to create further experiments and artworks that explored this. Initial conjectures based on phenomenological observation are that it seems unlikely that there is a) any such thing as a static mental model and b) that there are many multi-modal sensory patterns that seem to derive not just from functions of the visual brain. However, this is observation in its infancy and thus highly speculative.

The way forward for experiments may well lie in finding a way to integrate notions of movement defined by **Tau** and **Kappa**. The tau effect concerns spatial judgments, normally judgments of length, in a temporal context, whereas the kappa effect is a corresponding dependence of temporal judgments in a spatial context. Both effects have been noted multi-modally in vision, hearing, and touch.

The kappa effect where the elapsed time between two stimuli can be made to appear shorter (or longer) by decreasing (or increasing) the distance between the two stimuli directly correlates to the *Diasynchronoscope* where temporal separation is translated to spatial separation. The kappa effect remarks on how an observer tends to base their judgments of the temporal separation between each stimulus on the spatial separation between each of these stimuli. We tend to experience the kappa effect when observing a sequence of stimuli (it applies to sound too) in which the duration between each stimulus is constant, but the distance between each of the stimuli varies.

It is important to grasp that I can find no cross-over of the notions tau and kappa in media theory or animation theory, so, not for the first time, what is common knowledge to an animator is regarded as phenomenologically relevant in the field of Gestalt psychology. In fact, without conscious acknowledgment, this could serve as another way of describing how we distribute objects in space in the *Diasynchronoscope*: We are using the tau effect in order to position and time animations, and taking advantage of the kappa effect to create effective motion. To an animator, it comes as no surprise that even when the length of elapsed time between stimuli in a sequence is kept the same throughout the sequence, we tend to overestimate the amount of time between each stimuli when the distance between them is longer, and that equally we tend to underestimate the amount of elapsed time between each stimulus in a sequence when the distance between them is shorter. This is called **Timing** in animation.

In the *Diasynchronoscope* temporal separation *is* spatial and the observer bases their judgments of the temporal separation between each stimulus on the spatial separation between each of these stimuli. So the findings of Jones and Huang (Jones, 1982) which attempts to account for this temporal illusion through algorithms based on a constant velocity hypothesis may be flawed, however there are some other interesting observations that do correlate to the *Diasynchronoscope*, namely that the Kappa effect demonstrates the tendency of the observer to apply their previous knowledge of motion to a sequence of stimuli and that in a screen-based study with vertically arranged stimuli, the Kappa effect was stronger for sequences that moved downward. This can be attributed to the expectation of downward acceleration and upward deceleration and is consistent with how we arranged falling and bouncing blocks in the *Diasynchronoscope*¹²². One might conjecture that this last effect may well be more demonstrable in the ecological environment of the *Diasynchronoscope*.

Summary of this research's contribution to Field of Gestalt and Psychology:

- Demonstrating that the D-Scope® could provide a three-dimensional platform for revisiting Wertheimer's tachioscopic experiments in apparent motion from 1912. Corroborated speculation that the D-Scope® could be adapted for use as a screen-less research tool in perceptual psychology.

¹²² As an interesting aside, the fact that these effects can be observed in sound and touch too provides more evidence for convergence between perceptual systems over localizationism. The tactile version - the wonderfully named '*cutaneous rabbit illusion*', was discovered in the 1970's by Frank Geldard and Carl Sherrick at Princeton University.

- Identifying on the potential benefits for perceptual Psychology in utilizing cross-over study of theories from animation, with particular reference to the Phi effect and the Tau and Kappa Effect.
- Re-examining Gestalt illusions, incorporating depth, parallax and freedom of movement
- Providing some corroboration for the presence of intermediate mental processing alongside the conjecture that there is no such thing as a static mental model.

6.4. CONTRIBUTION TO SENSORIMOTOR EXPERIENCE OF MEDIA

Film and Media studies are treated as synonymous and frequently defined as ‘screen studies’ because the screen is ubiquitous in modern society. When we invented the *Diasynchronoscope* and embarked on this research it was with an expectation that our discovery of animating without a screen would rock the world of Media Studies because the *Diasynchronoscope* provides, in effect, an intra-film experience without there actually being a camera or screen. However, this has simply not been the case. In fact we have been unable to persuade many writers in Media Studies to experience the *Diasynchronoscope*. Perhaps this is because we have styled ourselves as art practitioners, perhaps it is because there is no obvious social content or perhaps it is just pure bad luck, however despite several attempts engagement from this discipline has been vanishingly small. The only written dissemination I have achieved in this area is in the chapter, *Pinning a Tale: The Screen, The Donkey and the MacGuffin*, written for an upcoming book entitled ‘*Embodied Encounters: New Approaches to Psychoanalysis and Film*’ (edited by Agnieszka Piotrowska) which discusses the ontology of the screen.¹²³ With this notable exception, I regret to report that the world of Media Studies has remained untouched by the *Diasynchronoscope*.

Apart from the sheer anarchy of removing dependence on the screen for apparent motion, two particular contributions I had hoped this thesis might make to the discipline of Media studies was to add another nail to the coffin of ‘persistence of vision’ as an explanation for apparent motion, and to introduce the idea of the ‘participant as camera’.

¹²³ (MacGillivray C. , 2015)

In Media Studies, the camera representing the eye or mind of the perceiver has often been noted, but this raises questions; if we perceive film as we perceive life, why do we not suffer dizzying disorientation when a film cut jumps through time and space? It seems that we have made a ready assimilation of some of the grammar of film. Take the instance of perceiving time running in reverse (the term I have coined for this is *retrotropic*). Before the ubiquity of video in the mid-eighties, we would rarely see film run backwards. In fact then it was a certain test for identifying those outside the industry that they would laugh when they saw film run backwards at speed. People gabbling unintelligibly and squeezing backwards into trains furnished a whole new way of perceiving that was a thaumatropical delight.¹²⁴ It is evident from the early audience responses to film being played in reverse or changing speed that this is learned behaviour. In the *Diasynchronoscope*, in a reversal of cinematic tradition, the audience can become the ‘camera’, rather than question the strange veracity of this; it is treated as an accepted yet ‘magical’ trope. My conjecture is that screen-based media have made us so familiar with tropes of cinema, and in particular cameras changing speed or reversing, we accept the same tropes in ourselves *although there is no mediating lens or screen*.

Because the diasynchronic artworks often have different points of access (often as a time-based study and as a static art object that combines the time-based objects holistically), the two forms inform each other. The holistic artwork could be conceived as ‘the participant as a camera’ receiving many seconds of data in a single moment on a very slow shutter speed.

A perceived antipathy in many writers in Media Studies to practice has already been noted in this thesis, but it is disappointing as I believe that the *Diasynchronoscope* has much to contribute to this discipline. Of course we have had film for a long time, so perhaps it is not unreasonable for scholars of film to want to turn to other mass media rather than look at a niche emergent medium such as the *Diasynchronoscope*. The inclusion of Arnheim’s Gestalt perspective on the ontologies of early film in this thesis (Chapter 3.4) highlights the affinity between Arnheim’s close discussion of the grammar

¹²⁴ A whole film was dedicated to this: In the 1952 film, *Belles on their Toes* (Levin, 1952), Myrna Loy raises 12 children after the death of her husband, as she is an expert in efficiency. Her well-meaning agent looks to get the family some publicity by running documentary footage of the family at 10 x speed, The cinema audience is much amused by speeded up action, and then when the film runs backward, they split their sides laughing. It is doubtful this would even raise a titter (or twitter) today.

of film-making and the understanding of its formalisms with the approach we have taken to constructing a grammar for the *Diasynchronoscope*, this is discussed more in the next section.

Summary of this research’s contribution to Sensory-motor experience of non-biological media:

- Creating an intra-cinema experience that does away with the screen.
- Introducing the concept of ‘the participant as a camera’ (That screen-based media have made us so familiar with tropes of cinema, and in particular cameras changing speed or reversing, we accept the same tropes in ourselves although there is no mediating lens or screen).
- Comparing the marked affinities of the ontology of early film (after Arnheim) with the ontology of the *Diasynchronoscope*.
- Chronicling the creation of an emergent grammar for a new medium.

6.5. THE EMERGENT GRAMMAR OF THE DIASYNCHRONOSCOPE

This chapter assembles all of the emergent grammar of the *Diasynchronoscope* chronicled in this study. These tropes are the results of evolving empirical practice, observed audience interaction and have been contextualised and discussed using existing frameworks from Art, Animation, Gestalt Theory, Film Studies and Psychology.

	Dysynchronoscope trope	Ancestral Root	Explanatory note
1	Synchronous sound	Film, visual music, early cartoons and veridical (real life) perception	In the <i>Diasynchronoscope</i> the sound can be synchronised in time <i>and</i> space. Small speakers can be sited near objects so the spatialisation effect is enhanced
2	Timing: a) through distance, b) through duration	Animation Tau and Kappa effects	Time is directly transposed to space and the speed of apparent motion is: distance between objects (d) / (t) time of illumination. Where d = variations of distance between visual stimuli (concretely visualised in space) and t = variations of stimulus duration
3	Illumination (quality of and attention demand)	Gestalt Principle of Foreground/Background	Eisenstein attributes much appeal to the way Disney animation used a black contour to divide

Choreographing time: Developing a system of screen-less animation, March 2014

		d distinction. Staging for Theatre, Puppetry and Animation, where a clean silhouette reads best.	and distinguish shapes made of solid colour. This clarity of distinction between foreground and background increases readability.
4	Arcs	Animation, Magic and the Gestalt Principle of Good continuation.	The issue of whether the eye is in smooth pursuit or following something in saccadic jumps is interestingly something that has received little attention in Psychology. Possibly because most experiments are stroboscopic and saccadic fixations are much easier to measure.
5	Secondary Action	Animation and Psychology	Eg: Ripples etc This translates as causal effect in perceptual psychology, and is an essential trope in the <i>Diasynchronoscope</i> for reading fast movement in space
6	Repetition and Looping motifs	Borrowed from Music, also Animation and Games	The <i>Diasynchronoscope</i> makes ample use of modular harmonies both visually and aurally. 'Dead' moments would leave an audience in the dark. We often use proximity to segue between motifs, so the viewer's eye can easily pick up the next thing to look at.
7	Shape choice and orientation	Animation Staging, lighting techniques, painting and veridical perception. Gestalt Principle of clear foreground/background distinction.	Early artworks have tended to stick to simple platonic solids for pragmatic reasons and to emphasise movement over semiotic content. Objects with hard angles oriented towards the light create the best reading. (We are now using the shadows as objects too.)
8	Audience as film camera tropes eg: Reversals, freezing, holistics etc.	Film and Games	Discussed in paper. It is our conjecture that the idea of an edit and a switch of camera position would also be acceptable to an audience.
9	Embodied experience and somatic elements	Veridical perception, fairground rides, immersive environments such as aircraft simulators	The form of embodiment that the <i>Diasynchronoscope</i> gives is unmediated by lenses or screens this means that proprioception feedback of where the ground is, a sense of gravity and depth, along with what participants may do eg sit, walk, interact etc. has much impact on the experience.
10	Iconics	Film, theatre, painting, illustration. Equates to the Gestalt principle of Past Experience.	In 'One, Two, Three...' corresponding roman numerals were used synchronised with a voice singing the number. This binding of context, image and audio was very powerful. We have now started to animate using real objects. These carry strong veridical attributes and contexts, so

			subverting these gives a surreal sensation.
11	Continuously lit 'anchor' objects	Veridical perception	In the artwork, <i>Stylus</i> the central cube remained lit throughout so that audiences could orient themselves as they walked around.
12	Phi and Beta movement	The two forms of apparent movement discovered in Max Wertheimer's 1912 experiments that launched Gestalt Psychology	There is much about this discovery that is relevant to animators. Beta Apparent Movement (AM) equates to Animation almost directly, and there is some evidence that it is in fact more vivid than veridical motion. Phi movement or 'pure' movement, and how it is perceived in 3D is discussed in the thesis.
13	Apparent movement and stylized movement	Animation and Illustration. Equates to the Gestalt principle of 'closure' and the 'reification' phenomenon	Animation is laborious. Animation in the <i>Diasynchronoscope</i> can be doubly so, so it borrows time saving techniques from animation to balance pragmatic use of time against reading of text
14	Scale	Veridical perception, Sculpture	Scale affects movement considerably more in the <i>Diasynchronoscope</i> than onscreen as participants perceive it relative to themselves.
15	Analogue/Digital	Digital Video/computer glitches	Glitches can suddenly be added to perceived analogue movement, creating a frisson between veridical and digital.

Table 3 The emergent grammar of the *Diasynchronoscope*

As Steve Dixon points out: *'The spectator of live performance is not in the same state of 'distanced contemplation' as they are for screen media'* (Dixon, 2007, p. 563) Because it has to be experienced to be appreciated, it is impossible to replicate the embodied Gestalt in mass media - the difference can be analogised to the difference between visiting the Rothko Chapel and looking at thumbprint sketches of his paintings on a computer screen. I am investigating reinterpreting the artworks through ekphrasis, drawing on latent drawing skills, rediscovering my skills as a sculptor and combining these with my knowledge of digitally constructing images in virtual 3D, as videos and as flat images for the page. I have also explored artworks through words, writing papers and book chapters for various disciplines. We have created testimony from participants and used our skills as editors to try and convey the *Diasynchronoscope* experience via the websites and by dissemination. Communicating the unique properties of the *Diasynchronoscope* to those who have not experienced our artworks and demos is an ongoing challenge.

Although we all live in a 4D world, critics and scholars tend not to appreciate forces but the indexical signs of these forces. Because we can measure, label, archive and cross-reference these signs, we favour the dominant conscious perception of content or visual imagery over the ephemeral and unconscious. This research has been an exploration in immersive apparent movement. It is a new aesthetic, a new audio-visual medium that integrates sound and vision that surely holds potential for further research. Because in the *Diasynchronoscope*, the gap is not absence, it is its pure structural essence. It is both medium and message. The aesthetics of the *Diasynchronoscope* are still waiting to be discovered, and it is hoped that critics and theorists from Art and Media will engage with our work. I would wish that more theorists could adopt Theodor Adorno's defense of 'illusion' in his posthumously published *Aesthetic Theory*. (Adorno, 1997). The book is the culmination of a lifelong commitment to modern art which attempts to revoke the privilege aesthetics accords to content over form and contemplation over immersion.

7. CONCLUSION AND FUTURE RESEARCH

The narrative of this thesis chronicles my PhD journey from first ideas on movement, to my collaboration with Bruno and the inception of the *Diasynchronoscope*, to us becoming confident artists refining a new medium. Of course there is still so much more to explore, however as a benchmark, this thesis and our website documents that we made artworks that were exhibited to about 8,000 people and in doing so, gained appreciative testimony from participants of all ages, experts, reviewers in art and science and also from other artists. These we have documented through making concise videos for our website. We have gained two commissions, and an invitation to exhibit in a West End gallery. In August 2013, Bruno and I formed an artistic partnership called Trope that is functioning as a new business.

Mixed Reality offers a new landscape of transdisciplinary design which explores user immersion and interaction using concrete manifestations of computing interfaces, allowing ambiguity between digital and analogue interpretations and I feel I have found my niche here; through combining digital with analogue. I have learned many crafts: how to weld and work with new materials to create abstract objects, real objects and ersatz real objects. I have invented new ways of moving these at a modular level and ways of

supporting the resultant multiple shapes in space. I have explored the use of repetitive motifs in audio and vision much more deeply than ever before, and in doing all this have become convinced that embodied experience is more affective than screen-based media and that this is where the *Diasynchronoscope* can contribute to art and science. There is so much more to explore with the *Diasynchronoscope* and I hope to continue my investigations with it for many years to come.

The transdisciplinary nature of this research means that it has several potential avenues for future research: as art or an immersive medium, as a potential tool for perceptual psychologists and also as a catalyst for new technical ideas that have been thrown up by practice.

The artworks themselves have evolved since ‘*Stylus*’ to include interactivity, more use of colour and animation of real objects. In the partnership Trope, we continue to grow in confidence as practising artists, and have gained our second commission for an artwork in a church by the Diocese of Lincoln. We are gaining a track-record of exhibitions and this helps when writing bids for commissions. Now we have integrated interactivity we look forward to collaborating with dancers to create integrated digital performances, something along the lines of the model of *Laterna Magika*, because the timing of the *Diasynchronoscope* is exact, it should lend itself well to stage production and the use of stage lighting would be an enormous boon. Later in the year, we intend to look at other potential venues for the *Diasynchronoscope* as an immersive medium for areas such as theme parks, training and experiential marketing.

We have had some marked interest from perceptual psychologists regarding the potential of using the *Diasynchronoscope* for perceptual experiments and given talks and co-authored a paper exploring this concept with Dr Etienne B Roesch of Reading University (Roesch, MacGillivray, Mathez, & Fol Leymarie, 2013). In the *Diasynchronoscope* participants must be paying attention, for without their attention nothing would move. Therefore it seems reasonable to suggest that this research could contribute to the direct/indirect debate through empirical tests using the *Diasynchronoscope*. The conjecture is that there may be possible therapeutic applications (attention, migraine, dyslexia) for the system.

On the technical front, in order to streamline our practice there are some interesting areas we could develop, we are investigating partners to help in multiple

object recognition, 3D printing and creating combined Projector/cameras. One aspiration is to see what happens if the *Diasynchronoscope* is taken out of a black-out and this is an area we think is sufficiently interesting to have taken out a pending patent on '*Illuminating the Diasynchronic system with electroluminescent materials*'.¹²⁵ Trope are in the process of writing a bid for a feasibility study to the UK Government Technology Strategy Board for their call for proposals on *Emerging Imaging Technologies* with Dr David R. Selviah of University College London,¹²⁶ and we have gained a small grant to work on streamlining our system with ICT-Art-Connect.

It is the contention of this research that it demonstrates that the *Diasynchronoscope* is a new medium for experiencing apparent movement, and as such, it offers an opportunity for updating some theorisations in visual studies. The thesis also defends the idea that that because the *Diasynchronoscope* is a system capable of producing replicable experiments of enactive perception of apparent motion, it could provide a useful new tool for perceptual psychologists.

Above all, this thesis argues that the discoveries made in this hybrid study demonstrate the value of undertaking transdisciplinary research by practice. It contends that there can be benefits to all disciplines through such study.

¹²⁵ UK Patent Application No. 1316576.6

¹²⁶ Reader in Optical Devices, Interconnects, Algorithms and Systems, Optical Devices and Systems Laboratory, Photonics Research Group. Department of Electronic and Electrical Engineering. UCL

DEFINITION OF TERMS

Affordance A term coined by US Psychologist, James Gibson to describe the interrelationship between an animal and its environment.

Animation Various defined, literally 'life' but for the purposes of this thesis my own definition of 'Change made manifest' seems best.

Animation principles The twelve principles of animation were first espoused by Disney Studios in the 1930's. Some of the principles deal precisely with expressive quality of movement, some with how to direct an audience's attention and some with how to animate economically.

Apparent Movement (AM) (Also Apparent Motion) Originally a Gestalt term. Korte, published some general laws of apparent movement in 1915 , but they are not exhaustive. In terms of Psychology Apparent Movement stands for the perception of motion where nothing is actually moving eg Film.

Autoethnography A form of self-reflection and writing that explores the researcher's personal experience and connects this autobiographical story to wider understandings⁴

Beta Movement Beta movement is perceived when transient change in pictures or objects are sufficiently close and incremental to create an impression of apparent movement. The principle of Gestalt continuity that governs the way we perceive animation and film running at 24 fps as 'moving pictures'.

Bézier curve A term from vector graphics, Bézier curves are used to model smooth curves that can be scaled indefinitely.

Cel animation Animation created by drawing on and then filming consecutive multiple transparent sheets of celluloid. A laborious studio process that built the Disney empire and is still popular in Japanese and French animation.

Device of wonder Mechanical means of producing apparent motion or robotic motion from days of pre-cinema and even further back. From Barbara Stafford's *Devices of Wonder: From the World in a Box to Images on a Screen*.

Diasynchronoscope A modern device of wonder for experiencing immersive apparent Motion. The name combines diachronic, (the study of a phenomenon as it changes through time) with synchronous and scope (view).

Diasynchronic technique The grouping of multiple objects according to Gestalt laws and animation principles to create sequential visual cues that, when lit with projected light, demand selective attention; thus creating the illusion of animated movement.

Ekphrasis Reinterpreting an artwork through another medium, eg creating a painting of a sculpture.

Embodied cognition (Also Enaction) Knowing through the body, ie. including physiological feedback from all senses (and being free to act upon them).

Ecological Environment Psychological term derived from J.J. Gibson to describe the relationships between an organism and its environment.

Empirical Based on sensory observation and experiment instead of theory

Gestalt Perceptual grouping according to the notion that the whole carries a different and potentially greater meaning than its individual components.

Gestalt laws Gestalt theory offers several Gestalt laws or principles of perceptual organization that offer insights into how we perceive and group information in our minds according to Prägnanz.

Grammar Fundamental rules and structure that increase communication.

Grounded Theory From B. Glaser, and Social Science. Research through iterative application of theory to experience towards emergent theory.

Hero object or character From animation. The basic character model at rest.

Hysteresis (Psychology) A response in percipient that is changed by past or prior percepts.

Interstimulus intervals (ISI) Measured interval between events.

Invariance Gestalt term used by psychologists to describe our perceptual ability to recognize an object regardless of its rotation, translation or scale.

Kinetics Dynamic movement.

Phenakistoscope An early animation device, where a rotating disk with images is viewed, creating Apparent Motion.

Phenomenological A philosophical doctrine proposed by Edmund Husserl based on the study of human experience in which considerations of objective reality are not taken into account.

Phi movement (Also Pure movement) The perception of movement without a perceived object of attention.

Perceptual Psychology A subfield of cognitive psychology that is concerned specifically with the pre-conscious innate aspects of the human cognitive system.

Projection mapping Spatially mapping a projector light onto a real environment shape using software to get the projector to fit any desired image onto the surface of that object.

Proprioception The unconscious perception of movement and spatial orientation arising from stimuli within the body.

Qualia A sense-datum or feeling having a distinctive quality.

- Reification** Modal completion of a structure from clues that create impressions of wholes eg. the Kanisza triangle.
- Retrotopic** The perception of time running in reverse.
- Saccade** Ballistic jumps between foveal fixations, where we see nothing during the ballistic movement.
- Smooth pursuit** Describes when the eye tracks an object (often in an arc) and saccades are suppressed
- Spatiotemporal** Having both spatial and temporal qualities
- Spline** A line in a smooth curve
- Strobing** Characterised as jerky perception of individual still images when perceiving apparent motion, accompanied by flicker.
- Structuralism** The assumption that structural relationships between concepts vary between different cultures and languages
- Synchresis** Michel Chion: ‘The forging of an immediate and necessary relationship between something one sees and something one hears’.
- Tachistoscope** A device that displays an image for a specific amount of time, (a bit like a slide projector).
- Tetrad** Pedagogical tool created by M. McLuhan that tests a medium via the four laws of Media Effects
- Transdisciplinary** Destabilising disciplinary boundaries while respecting disciplinary expertise, using three key concepts: transformative praxis, constructive problem-solving and real-world engagement.
- Veridical** As real-life
- Zoetrope** A mechanical device of wonder that device that produces the illusion of motion from a rapid succession of static pictures placed on a rotating drum and viewed through slits in the drum

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APPENDICES

APPENDIX A. Public dissemination.

Websites with documentation of artworks and films:

Diasynchronoscope research website: <http://www.doc.gold.ac.uk/diasynchronoscope/>

Trope website: <http://www.trope-design.com/>

ResearchGate Profile with links to publications:

https://www.researchgate.net/profile/Carol_MacGillivray/publications/

Papers:

2013. MacGillivray, C., Mathez, B., Fol Leymarie, F. & Roesch, E. R.

The Diasynchronoscope: Bringing a new dimension to animation. Published proceedings, Confia, (International Conference on Illustration and Animation), 29-30th Nov 2013, (p 367-379) ISBN: 978-989-97567-6-2

2013. MacGillivray, C. & Mathez, B. *Screams of an Acorn - The Diasynchronoscope and new ideas in the morphology of audiovision*. Proceedings of Seeing Sound Symposium, Bath, UK: Nov 2013

2013. Roesch, E. R., MacGillivray, C.; Mathez, B. & Fol Leymarie, F. *Situating enactive processes or placing the observer back in the scene: a case for the empirical study of perception*, AISB Symposium, Exeter. UK: March 2013 .

2012. MacGillivray, C. & Mathez, B. *Developing a system of screen-less animation for experiments in perception of movement*. Leonardo Electronic Almanac – LEA Volume 18 No. 3, Touch and Go Volume. Editors: Lanfranco Aceti, Janis Jefferies and Irini Papadimitriou.

2012. MacGillivray, C., Mathez, B. & Fol Leymarie, F. (2012) *Developing a system of screen-less animation for experiments in perception of movement*. Annecy, France: CAe International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging. June 2012. D. Cunningham & D.H. House (eds.), Eurographics, 71-80.

Choreographing time: Developing a system of screen-less animation, March 2014

2012. MacGillivray, C. & Mathez, B. *Co-authored Narrative Experience: Affective, embodied interaction through combining the diachronic with the synchronistic.* Wellington, NZ: Desform, 62 – 69.

2009. MacGillivray, C. *Slices of Time - Appraising the use of Dynamics in Design. IEEE IV09: DAViz - Design and Aesthetics in Visualisation.* Barcelona: IEEE Computer Society, 2009. 598-604.

Other Writing:

2014. Book Chapter: *'Pinning a Tale: The Screen, The Donkey and the MacGuffin'* A discussion of the ontology of the screen. In an upcoming book published by Routledge, entitled *'Embodied Encounters: New Approaches to Psychoanalysis and Film'* (edited by Agnieszka Piotrowska)

2014. Book Chapter: 'Triangulating the Arc: An interdisciplinary comparative study of techniques for recognising, annotating and reproducing specific models of movement'. (Co-authored with Frederic Fol Leymarie.) For upcoming publication: *'Movement Capture in the Arts and Humanities: an interdisciplinary investigation'*, (Presented, 19-20th January 2012 at The Theory, Practice and Art of Movement Capture and Preservation symposium at London Knowledge Lab).

2011. July Article: Commissioned for CCI exhibition catalogue on artwork *'Bolt'* for publication in best of CCI exhibition catalogue

2011. Presented Paper: *'Running backwards: What the Retrotropic Reveals about Perception'*. Presented at Goldsmiths Media and Senses Conference. May 2011

2010. Presented Paper: *'The Darwinian rise of Urban Kinetics'*. Presented at the Society of Animation Studies Conference, July 2010 in Edinburgh

2008. Poster, *'W.Y.S.I.N.W.Y.G.'* Presented at the Society of Animation Studies Conference in Bournemouth July 2008

Choreographing time: Developing a system of screen-less animation, March 2014

Talks:

2013. (Nov) Talk (with Bruno Mathez) '*The Diasynchronoscope and Conversio artwork*' at Frequency festival, Lincoln

2013. (July) Demo: '*The Diasynchronoscope Project: Investigations in Screen-less Apparent Motion*' Authors: MacGillivray, C., Mathez, B. & Fol Leymarie, F. Delivered at EVA (Electronic Visualisation and the Arts) At the BCS, London

2013. (May) Talk: '*The Diasynchronic Artwork, Stylus*' Given by Carol MacGillivray and Bruno Mathez as part of the Music Tech Festival, Ravensbourne University, London

2013. (Feb) Talk: '*How the Diasynchronoscope could be used as a research tool by perceptual psychologists*'. Delivered with collaborator Bruno Mathez and Dr Etienne Roesch of Reading University at at Kinetica, Marylebone, London

2012. (May) Workshop: '*Bolt*' as a Research Tool' V&A Digital Futures

2012. (May) Talk: "*The Diasynchronoscope project*" Given by Carol MacGillivray and Bruno Mathez for Dorkbot at the Walker Space, Ravensbourne.

2013. (April) Talk: '*One, Two, Three... reviewed*' Given by Carol MacGillivray and Bruno Mathez. at Wolf Ollins, (International brand consultants), London.

2012. (Feb) Panel Discussion: International Festival of Digital Arts 2012– Seminar series on issues arising from new media arts and interactivity. *Seminar 2: New media geographies / space, architecture and technology* Chaired by Saul Albert – with Ugochukwu-Smooth Nwezi & Emeka Ogboh (One Room Shack Collective) in conversation with Evelyn Owen and Carol MacGillivray & Bruno Mathez at Watermans Gallery for New Media, London.

2012. (Feb) Talk: '*Gestalt Circle and the Diasynchronoscope Project*'. Given by Carol MacGillivray and Bruno Mathez at Kinetica, Marylebone, London

Choreographing time: Developing a system of screen-less animation, March 2014

Exhibits:

2013 (Nov- Jan 2014) ‘**Gaffer**’ exhibited at the TENDERPIXEL gallery in Central London.

2013. (Nov) ‘**Conversio**’ A site-specific artwork commissioned by the Frequency festival for Posterngate in Lincoln. <http://frequency.org.uk>

2013. (July) ‘**Stylus**’ Studio 3, Goldsmiths University. (In collaboration with Martyn Ware)

2013. (May) ‘**Stylus**’ Part of the Music Tech Festival, Ravensbourne University

2013. (Feb) ‘**One, Two, Three...**’ Kinetica Artfair, Mayfair, London

2012. (Sept) ‘**Prism**’ at the Nowhere exhibition, Goldsmiths, London

2012. (June) ‘**Gestalt Circle**’ (video) Annecy, France: CAe International Symposium on Computational Aesthetics in Graphics, Visualization, and Imaging.

2012. (Feb) ‘**Gestalt Circle**’ Kinetica Artfair, Mayfair, London

2012. (June/Aug) ‘**Bolt**’ Perspex, metal and wood. Kinetic Sculpture and prints at the James Hockey Gallery in Farnham

2011. (Oct) ‘**Bolt**’ selected for ‘best of CCI’ Tour The exhibition tours five venues across the south east in the months in the lead up to summer 2012. venues on tour include Herbert Read Gallery, Canterbury, and University Centre, Folkestone

2011. (Feb) ‘**Bolt**’ Kinetica Artfair, Mayfair, London

APPENDIX B. The artwork Bolt as a Research tool

Weblink to the Bolt artwork research:

<http://carolmacgillivray.wordpress.com/category/experiments/>

APPENDIX C. Copy of participant consent form

Release Form

From: *(name of individual)* of *(address)*

To: *TROPE* (*"The company"* which shall include *it's successors, assigns and licensees*) of Studio 38, ASC Studios, Bond House Gallery, 20-32 Goodwood Road, New Cross, SE14 6BL

Dated:

(Diasynchronoscope Arc3) (the "Film")

1. In consideration of the sum of £1 (*or any other amount*) now paid by the Company to me (the receipt of which I acknowledge) I warrant, confirm and agree with the Company that the Company shall have the right to exploit any films, photographs and sound recordings made by the Company for the Film in which I feature, or any literary, dramatic, musical or artistic work or film or sound recording created by me or any performance by me of any literary, dramatic, musical or artistic work or film or sound recording included by the Company in the Film in any and all media by any and all means now known or invented in future throughout the world for the full period of copyright, including all renewals, revivals, reversions and extensions.

2. I irrevocably and unconditionally grant to you all consents required pursuant to the Copyright, Designs, and Patents Act 1988 Part II * or otherwise under the laws in force in any part of the world to exploit such performances.

3. I irrevocably and unconditionally waive all rights which I may have in respect of the Film pursuant to the Copyright, Designs and Patents Act 1988 Sections 77, 80, 84 and 85**.

4. I consent to the use by the Company of my name, likeness, voice and biography in connection only with the Film.

5. The Company may assign or licence this agreement to any third party.

6. This letter shall be governed by and construed in accordance with the law of England and Wales and subject to the jurisdiction of the English Courts.

(signature of the individual)

* *the "Performers Rights"*

** *the Moral Rights of an author*

APPENDIX D Copy of the Leverhulme bid (First stage)

**First stage LeverHulme bid from May 2012
(Descriptive Text only)**

Summary

Background:

Our world today is filled with flickering screens: they carry media so seductive that we frequently forget that we are experiencing the world mediated by a flat rectangle [14,7]. As psychosociologist Sherry Turkle laments, it is now virtually impossible to find an audience that is not used to screen-based imagery [20]. Historically, experiments in movement perception have relied predominantly on observing participant response to screen-based phenomena.

There are a number of inherent problems with this method (even if stereoscopic viewing methods are adopted [16]) as it involves flicker, ignores depth perception and bypasses the proprioceptive system; in short it is psychophysically distinct from dynamic real life perception [8].

Other devices have been produced in the past that can offer seeds of ideas for alternatives to the flat screen. In the words of Getty Museum curator Barbara Stafford: current modern technologies often “glimmer with mysterious and sensual ancestors” [18; p.1]. Famed 19th century artefacts operated somewhere between game and emergent technology. Examples include the zoetrope—a rotating cylinder with slits, whose inner walls covered with animation frames create the illusion of perpetual movement—and Pepper’s ghost—a piece of glass angled towards the viewer reflecting floating objects positioned in another hidden copy-cat room not seen by the viewer—.

Simultaneously, the theater stage was being reinvented; pioneers such as Adolphe Apia integrated dynamic lighting with 3D forms, e.g. in his scenic version of Wagner’s Ring cycle, breaking away from the tradition of using flat painted panels as static backgrounds, and, later, the painter Giacomo Bella gave form to Stravinsky’s music for Fireworks using controlled electric lighting of large 3D geometric shapes [17]. More recently, artists such as Piero Fogliati have also explored combining automated lighting systems with various geometric shapes and materials to create a form of kinetic art where movement is induced by light used as a kind of dynamic painting brush [6].

The Diasynchronoscope recalls these objects of wonder and early kinetic light-based art designs by creating a novel, screen-less medium in choreographed time. We take time-based animation techniques [9] and convert these to the spatial domain, grouping static objects according to principles known from perception studies, such as similarity, proximity or common fate [23]. By lighting the physical objects in 3D space selectively and sequentially, we are able to animate through selective attention [12,21,5]. Our preliminary work shows that it is possible to create screen-less animation in such a way that the observer perceives a continuous flow of movement, supporting a communication

with their environment that demonstrably resembles, at a physiological level, interaction with a reallife moving object. This not only makes the created artworks a new and attractive phenomenon for viewers [4], but also holds implications for perceptual experimentation and training.

Aims&Methodology:

The Diasynchronoscope takes early techniques of experimenting with apparent movement and brings these to the digital age by relying on three modern software systems: (i) a 3D content generator, (ii) an image manipulation tool,

and (iii) a digital movie management platform. Although the software packages we have used thus far are off-theshelf standard systems, we plan to replace these with simpler dedicated open source software (that we will develop) thus increasing the availability and flexibility to larger communities of researchers, artists, designers. The hardware we are currently using essentially involves controlled video-projectors and a sound system. After constructing an animation in virtual 3D, a concrete system is built where physical 3D objects are placed in a blackout space and projection mapping is used to light the objects selectively and sequentially.

We propose to significantly refine this initial “platform” and explore its evolution towards greater customisable flexibility via new and recent technologies provided by: (i) 3D printing to create complex aesthetically pleasing morphing 3D shapes [22], (ii) third generation display technologies to possibly replace the lighting provided by video-projectors (e.g. with organic or quantum dot LEDs) [19], (iii) surfaces of varying transparency (digitally controllable) to avoid occlusion artefacts [24], and (iv) simple robotics to allow for the rapid transformation of one staged experiment to another by controlling the position of each artefact in 3D space in a small neighborhood [1].

Artworks function on a number of levels: our pilot experiments found that the Diasynchronoscope was perceived by the audience in three different ways as (i) multiple artefacts, (ii) animation synchronised with sound and (iii) holistic, sculptural wholes [11,10]. Because the technique’s strength relies on somatic (of the body) experience, there is a current curatorial problem [15], and we are keen to discover the best practical way to document our work for a global audience. Our current practice is to video and interview participants (www.doc.gold.ac.uk/diasynchronoscope) [11,10].

Potential outcomes/significance/dissemination:

Although only at the beginning of exploring this new system, we already have had two papers published in peer reviewed international conferences [11,10], and shown one artwork to great acclaim to over 1500 people at the Kinetica Art Fair in London (Feb.2012). We are also starting to generate interest from psychologists in perception in meetings at conferences and locally in London.

If funded, the project will allow us to take our early experimental research and artworks to another level and we have a wealth of ideas that need exploring as researchers across disciplines, as technicians exploring boundaries of the medium, and as artists creating entrancing new artworks and performances using this experimental platform.

Specific objectives are:

- (i) exploring and disseminating the diasynchronic technique as a new medium/artform through exhibitions, events, workshops, publications;
- (ii) evaluating and trialling new technologies to create scaled best practice models for widespread, replicable screen-less experiments in perception by psychologists and others;
- (iii) using the medium to re-conceptualise media theory for moving image and interactive media [13] by creating new empirical multimedia experiments mixing physically correct 3D animated movement correlated with realistic state-of-the-art sound effects [2,3]. In combination with such sophisticated sound and other visual effects (e.g. projected textures) we shall be able to stage seemingly magical effects.

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