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Animation and the Programmed Abstract Aesthetic

An Exploration into the Impossibly Real through the Medium of Particle System Simulation

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Submission for the degree of Master of Arts by coursework in Digital Animation at Wits School of Digital Arts

University of the Witwatersrand

Letter of Declaration

I, Michal Shachman, hereby declare that this Masters Arts by Coursework thesis is my own unaided work. I hereby state that I submit this work in whole for the Masters of Arts by Coursework in Digital Animation degree at the Wits School of Digital Arts. I hereby state that this work has not been submitted for any previous examination and/or project for any other evaluation at the University of the Witwatersrand, Johannesburg.

Signed, Michal Shachman



10, December 2012

INTRODUCTION

Dealing with realist representation in digital visual work is a common exercise for every digital artist and practitioner. More than this, we welcome proven calculations and experiments of the real that propose a means to the end of portraying a desired reality. However, what constitutes the aesthetics of reality can only remain contested. Thus, in and amongst countless productions and reproductions of reality within the study and industry of Digital Art, there seems to be a point at which the real ends and the impossible begins.

This research project sets out to explore the impossibly real through the style and computational logic of digital abstraction in programmed aesthetics. This study proposes that the idea of the impossibly real is inherent in the role of abstraction. Evidence of this can be found in the computational logic of a digital system, which calculates reality to constitute a simulated visual production. To do this, the reappropriation of the technology of Particle System Simulation in the Softimage 2012 ICE Simulation Engine to address arguments of the impossibly real will be discussed. Exploring the use of intuitive parameter data manipulation in Particle System Simulation will culminate in a re-evaluation of the aesthetics of this method of simulation programming, and framed as Abstract Animation.

In the article, *The Impossibly Real: Green Belting the Imaginary*,(2007) Johnny Hardstaff explains his term the 'impossibly real' as the kind of aesthetic used most commonly in commercial visual productions. Furthermore, the author asserts that the impossibly real as an aesthetic is used as a means for reconstituting reality in extended unjustified, imaginary terms for the spectacle of advertising. Hardstaff's view is that the hasty employment of computer-generated imagery (CGI) in the creative industry, has taken

place without “proper” exploration into its uses. While controversial, this article remains as the impetus for this research project. The political views Hardstaff introduces in his paper are not to be taken up here, however what is of interest is Hardstaff’s suggestion that the general use of computer generated imagery may have more uses in that remain unexplored.

The main task of exploring the concept of the impossibly real in this research project lies in comparing the real and the impossibly real within the use of programmed aesthetics. It is proposed in this research project that a digitally-produced image based on a narrative depicting reality (through the best possible, convincing methods of visual techniques) can be taken as a working definition of the *real*. On the other hand, the *impossibly real* is ascribed to a visual work that is a further extension of that intention to depict reality but to do so with an approach that directly indicates and provides interpretation considering the digital medium in which it was created and is moreover methodological. The impossibly real is not real, unreal, or hyper-real, but it is argued here that it can manifest in programmed aesthetics.

It can be suggested that the value of realism is its semiotic potential. Along with illusionistic qualities, applied to change the aesthetic-technological aspects of digital visuals, within realist representation the resulting aesthetics can then mimic familiar entities. The product of these visuals can be perceived as real through some measure of imagination and subsequently imagination functions to create the illusion of reality. It is proposed that the impossibly real represents a further stretch of the imagination. With an acknowledgement of the abstract integrity of computational logic devoid of illusionistic qualities and familiarities, programmed abstract aesthetics can be used to present a further representation of reality. Hence, the research and debate conducted in this project shows

that where a realist representation alone does not effectively interpret the use of programmed aesthetics, an impossibly real interpretation does.

RESEARCH DIARY

The methodology for research in this project was to take three main points of focus in each chapter. These include: discussion of certain principles and theory of abstraction in Animation; the technology of the Particle System Simulation within the Autodesk Softimage 2012, 3D software platform; and the proposed manifestations of the impossibly real explored in practice as part of the Creative Component of this research project. The information gathered reflects an epistemological approach that focuses on the Animation practices and processes of abstract animation and experimental animation. This is coupled with attention given to popular streams of digital video content in the public sphere, specifically on the *vimeo* site. The research was structured with these components in an attempt to properly engage and debate the digital integrity of the programmed, abstract aesthetic that is now becoming more commonly utilized in visual productions of the industry and practice of Digital Art.

It is worth noting that digitally-created visuals exhibited in the socio-cultural and commercial spheres of society do not need to be *real* anymore to be *convincing* examples of entertainment or exploratory study. Although the attributes of idealistic realism are still a very much sought-after aesthetic in digital productions, there is new resonance that the general viewer finds with the proposed *realism of abstraction*, which deals directly with aesthetic concerns. Therefore the research in this project considers first and foremost the

aesthetics of abstraction, and specifically abstraction in a digital medium - which supports a new implication of perception, relating to the proposed notion of the impossibly real.

In the first chapter, the research explores the relations between abstraction and the 'new film content' produced in the early 20th century, in order to establish a foundation for the study of abstraction. Of interest was the direct link between the experimental film and theories of abstraction of the time. In particular, Modernist artist and experimental filmmaker and animator Hans Richter's idea of *production* is further explored as it presents an exciting theory that confirms a developmental link to the unique qualities of a moving visual medium with the exploration of the abstract to create cinematic, original film work. Focusing on abstraction as style in the process of experimental animation presented a problem during the research process. The enormous amount of literature on the multitude of animator-artists who used the style soon showed that almost all the artists' work was not defined by the fact that the work was abstract but was defined by how the work was created through an aesthetic of abstraction. This made it difficult to present research that could reflect the full scope of the field of abstract animation. However, this research led into the second section of the chapter.

Through steering away from realism, the research process in the second section of the first chapter focused on artists that used the established tradition of abstraction as a function to further explore the computerized medium, starting from the 1950's. Considering Robert Russett's term 'hyperanimation', the selection of artists was based on Russett's idea of animation as digital manipulation that encouraged abstract experimentation and study and the expansion of animation as digital art form. However this approach also presented

problems. The host of digital artists Russett refers to in his book, *Hyperanimation Digital Images and Virtual Worlds* (2009), shows that the general range of digital artist from the 1980s onwards experimenting with digital manipulation with many varied intentions did not necessarily consider the medium of the digital system. Therefore attention was given especially to the theorists and artists who acknowledged the fundamental basis of abstraction inherent in the digital system to which the programmed aesthetic is eternally linked to. A list of functions of abstraction was proposed as means of categorizing certain aspects of the digital system that were of interest to the research as a whole.

The list of functions discussed present theories from selected artists and writers that confirm firstly, the abstract technological aspects of computerized medium as points of exploration and secondly, what these aesthetic concerns mean for the intention and production of digital art. Manipulation of the digital landscape; complicating computational logic; intuitive viewer interactivity through abstraction; self-organizing systems of calculation in Particle System Simulation; and the use of computer-generated high modality cues - were all points of interest within the research that constitute the new proposed perception of digitally-animated work evincing ideas of the impossibly real.

The research process in the second chapter involved looking back at the history of the Autodesk Softimage 2012, 3D software platform and the technology of the ICE (Interactive Creative Environment) Simulation Engine focussing specially on the simulation programming method of Particle Systems. It was interesting to find that the history and development of Softimage dates as far back to 1986, founded by Canadian filmmaker and digital artist Daniel Langlois. The Particle System simulation technology was an aspect of the

software that was continually redeveloped throughout the company's history. However, the technology was initially especially created for the artist under Langlois' "artist-technology" ethos. Therefore, of interest is how this ethos subsequently changed through the decades. Softimage became increasingly fine-tuned for high-end CGI visual and special effects production in mainstream feature movies and the commercial advertising industry and seemingly under-developed in digital art practice and theory.

The final ICE Simulation Engine, created in 2006, was the technological interest in the research process due to the intuitive programming method offered through the software user interface. The intuitive aspect of this form of programming was investigated as the point of artistic experimentation and intervention. Therefore, the research that was collected and discussed presents an exercise of reappropriation of the theory and the practical aspects of the technology, resourced from numerous internet sources and the easily accessible Autodesk *Softimage User's Guide*, hosted on the internet and within the software. This specific simulation technology was chosen in the research process because of the inherent programmed, abstract aesthetic of the computational logic that could be explored and which is indicative of a computerized medium. It is established at the end of this section of research that this technology could be used to control and produce manifestations of the impossibly real, pertaining to the theory featured in the first chapter.

The last section of the second chapter includes a comparison between the real and the impossible, utilising the concept of *ambiguous physics*. This research explores the programming attributes of the ICE Simulation Engine and the data construction procedures involving the calculations of physics of a simulation in the *ICE Tree*. This is then related to

one of the most fundamental aspects of abstraction – that of ambiguity. Ambiguity is considered as an important aspect in this research project because it plays one of the important roles in the constitution of meaning in Abstract Art. The main problem during this research process was that a comparison with a similar simulation technology from another 3D software platform was not performed. Perhaps this would have given a broader scope of technological attributes of particle system simulation. However, the research collected in this section ultimately led to a set of experimental factors to initiate the body of work for the creative component of this research project.

The research process for the third chapter serves the intentions of practical experimentation and exploration of the simulation technology to produce a body of work that presents manifestations of the impossibly real. The name of the exhibition, *Proabsthetics* was formed from the three main topic words of interest throughout this thesis document, namely; “programmed”, “abstract” and “aesthetics”. These three terms carry much weight in this research project. However in this research these terms were used for specific intentions, chiefly amongst these to create arguments for the impossibly real, which is a scarcely used term in general academic discourse. This aspect has created certain problems of definition, description and usage at certain junctions in the theoretical framework presented in this paper. Therefore a brief description of the use of these terms is in order.

The term ‘programmed’ is used and is referred to in this research to any computational scripting and systematic processing of digital data and it also refers to the result of these procedures within the computer medium. Therefore it is used with reference

to the aesthetic-technological aspects of digital visual productions and it refers at times to the methodology of using a digital medium. Subsequently, is used to refer to any digital visual that is created solely by a computational logic without any intervention of other medium not forged within a computerized medium. The term 'aesthetic' refers to visual composition, chiefly to the culmination of elements and formalism that constitutes a digital image. In the research it does not relate to any connotations of the terms of beauty and appeal and it is acknowledged that this term is used in those academic discourses; however, its usage in this research project is not intended to directly address those debates. The term 'abstraction' refers to the abstract and non-representational visual art discourses that define abstraction as a style of art making and an intention of representation in opposition to concepts of realism. The use of these three terms together refers to the main proposed arguments in this research project relating to the validity of the computerized medium within the practice and study of Digital Art and the newly introduced concept of the impossibly real in debates of representation.

The research in this last chapter was collected prior to the production of the series of experiments for exhibition. This was undertaken in order to consciously set up a conceptual framework and then through experimentation attempt to produce the ideas from a number of resources. Fundamental to this research was the role of abstraction. Within this research specific investigations were made that explored and experimented with individual aspects of the programmed, abstract aesthetics that yielded the most interesting results. Lastly, it must be noted that despite problems within the research, the main motivation for the composition of this research project was to propose interesting debate for the relatively new concept of the impossibly real.

CHAPTER 1

APPROACHING THE ABSTRACT

The relationship between early 20th century film and Modernism has meant the development of an extensive set of cinematic conventions used throughout the 20th and the beginning of the 21st century. Along with this, these cinematic conventions have not only encouraged the progression of narrative and representational film works, but have also led to explorations into abstraction. This chapter brings together examples of the widespread use of abstraction, acknowledging the tradition of abstract animation in the process of experimental animation and film. As a whole, this work is brought together in order to reconsider the relationship between the 20th century Modernist approaches to the abstract and the digital programmed abstract aesthetics that depart from realism. In conclusion, this chapter introduces a proposed stance that the impossibly real is an aesthetic concern which involves a fundamental function of abstraction of the real, inherent in the programmed aesthetic.

1.1. The New Film Content and the Advent of Experimental Animation: An Introduction to Experimental Animation and the Tradition of Abstract Animation

In *Experimental Animation: Origins of a New Art* (1988), Robert Russett and Cecile Starr focus on the innovative and exploratory nature of the process of experimental animation (pp. 7-9). This following section further considers the exploratory nature of experimental animation and discusses how the animator-artists working with the technique of animation had engaged with the creation of art on film. Hans Richter's notion of *production* is discussed in order to establish the intentions of abstraction that were explored in the tradition of abstract animation. The significance of this section is in the presentation of the substantial influence the use of the abstract aesthetic had on the field of animation and the advent of experimental animation.

The New Film Content

In his *Film as an Original Art Form*, (1951) Hans Richter states that experimental film is one example of two original filmic art forms[1]. He states that the raw materials of this art form are in the study and use of the aesthetic and photographic aspects of film. Furthermore, he proposes that experimental film has the potential to further and develop 'filmic art' (1951, p. 159). Richter suggests that the *production*[2] of experimental film negated two fundamental aspects – on the one hand, a potentially rational interpretation

[1] The other original filmic art form is the tradition of documentary. Richter suggests the characteristics of an original art form in the documentary genre are apparent in its inherent rationality and factual components. Richter refers to the term 'original' with a to-be-expected theory of original construction. Even though the theory pertaining to originality has changed since this time in Modernist theory, it understood that Richter's use of this term relates to the function that experimental film was created in the medium of film and was not a filming exercise or documentation of a reconstruction or re-enactment of content, which the mainstream genre of film at the time was.

[2] At the beginning of his article, *Film as an Original Art Form*, (1951), Hans Richter poses the question of whether camera based visualizations, or the trend of film as entertainment, is innately a *reproduction* of literature and theatre, or a *production* of visual sensations unique to any other art form. He shows that *reproduction* is the fundamental flaw of film as an original art form; one which the experimentalists were trying to overcome in the *avant-garde* era of film-making in order to reach an original level of *production* (Richter 157).

and on the other, financial gain. When compared to the standard entertainment film practices of the time, this was counter to the mainstream. The main challenge of the concept of *production* was to overcome the notion of *reproduction* inherent to film and thus arrive at an original form of cinematographic expression.

Richter explains that the *production* of film allows for an acknowledgment of film as a unique medium and to initiate the free use of this medium. In *production*, the free use of magic, poetry and irrational qualities are all essentially cinematographic tools (Richter, 1951, p. 159). Here, Richter states, is where experimental film finds its place. The modernist concerns that dealt with abstraction in fine art practices led directly into film and were now discovered in a visual medium of motion.

Furthermore, Richter states that the intention of making film as an original form of *production* leads on to the intention of creating new forms of content altogether. Richter goes on to describe the new film content in many varied terms, from within a vocabulary of abstraction.[3] This list includes; the orchestration of motion in visual rhythms; plastic expression of an object in motion; the dissection and distortion of movement of an object or form, the denaturalization of the object; recreation of objects cinematographically in terms of light; the magic of interpreting the original state of dreams; the liberation of conventional story and chronology; and taking conventional objects out of context (1951, p. 160). All these elements described of new film content not only reflect the appeal of the moving medium of animation was founded upon, but also reflect intentions of exploration into the

[3] Richter mentions that at the time it was still too early to speak of a tradition of this new film content, but that is was a young movement that could be said to have been influenced by developments in Abstract Art and Surrealism (161).

abstract. From here on this chapter discusses certain examples of abstract animation created as experimental animation, which involve these elements of new film content.[4]

Abstraction as a Style within the Process of Experimental Animation

From Richter's statements, it can be suggested that abstraction in animation was used to explore what could be made with animated visuals and concepts of the mind that could not be manifested in painting, photography and other mediums of Art. The results of these experimentations became the unique aesthetic qualities of abstracted animated works in a film medium. Robert Russett and Cecile Starr refer to these unique qualities of the abstracted aesthetic in discussing early abstract animated works throughout their anthology. The authors consider the work of Emile Kohl, and his *Fantasmagorie*, (1908) as part of the early experimentalists of animation. However, the authors begin the period of experimental animation with the work of an early pioneer of abstract animation, Walter Ruttmann. It is noted in the anthology that Walter Ruttmann's first abstract *Opus* series[5] are the oldest extant examples of fine art animation (Russett and Cecile Starr 14). In this series Ruttmann utilised abstraction and showed the vastness of the experience of animated forms through distorted views of painterly abstractions.

[4] It is beyond the scope of this research to offer a comprehensive account of the entire range of abstract animation from the early 20th century. The list of animator-artists who are selected for discussion in the rest of this section is composed on the basis of the approach the artists took towards an abstract aesthetic and the host of unique qualities and aesthetics related to the style of abstraction and the medium of film. This selection will be discussed with regards to the work of the pioneers of abstract animation from Europe and the USA.

[5] *Lichtspiel Opus I* was long presumed lost, until finally found by Dr. Enno Partalas of the Munich Film Museum and shown publically in Frankfurt, Germany as early as 1921. The film was reviewed by Bernhard Diebold in the *Frankfurter Zeitung* under the title *A New Art, the Vision-Music of films* (Starr 40-41).

In referring to the film work of Hans Richter, Martin, F. Norden suggests that the *avant-garde* cinema of the 1920's shows the mark of Suprematism, a movement related to Geometric Abstraction, founded by Kasimir Malevich in 1913 (Norden 111-112). In *The Avant-Garde Cinema of the 1920s: Connections to Futurism, Precisionism and Suprematism,* (1984) Norden states that Richter's works from the 20's, has the same notable interest in pure geometry. Richter's *Rhythm* series (1921-25) was the results of his exploration into abstraction related to the elements of motion over time. Richter found that through the implied progression and manipulation of time in film, his abstractions could be endowed with rhythm, which he thought was the, "chief sensation of any expression of movement" (O'Doherty).

While the chosen abstract aesthetic was common style, animation was also a common experimental task. This is what set experimental animation apart from the commercial animation industry at the time. Whether work was completed by the artists or by hired animation technicians, animation was generally conducted as an exploratory exercise. This was due to the use of the artists' own knowledge of the techniques of abstract art and the translation these artists made with these abstraction techniques and engaging with the integrity of experimental film.

Swedish painter, Viking Eggeling was dedicated to the fundamentals of form in painting and illustration. Eggeling's use of the abstract aesthetic in *Diagonale Symphonie* (1921-1924), was suggested, by art critic Adolf Behne, to be a recognition of the, "…artistic, nonlinearity possibilities and consequences of film with full clarity" (Behne). Len Lye used the painterly abstracted, *direct method* of animation throughout his career in order to

negate the representation of subjects and expressed his fascination in motion directly through paint on film. One example of this can be seen in Lye's *Colour Box*, (1939). Norman McLaren's early work shows his use of abstraction as a means to portray simplistic narrative and character animation as well as the interdependency of animated visuals and synthetic sound, using his extensively developed versions of the *direct method.* In his work *Blinkity Blank*, (1955) a main theme that is evident concerns the notions of sporadic perception, and this piece is indicative of his experiments he performed in a concerted effort to discard realism.

Robert Russet states that up until the 1950's, experimental animation had progressed into two broad directions (Contemporary Imagists 129). In one direction lay the intention of producing representational work, and in the other, abstraction. Furthermore, artists such as, Carman D'Avino, Harry Smith, Jerome Hill, Larry Jordan, Robert Breer, Tony Conrad and Paul Shraits continued the process of experimental animation and specifically intended to produce work *without* the use of programmed animated techniques (Russett, Contemporary Imagists 129). Amongst these Contemporary Imagists, which is worth noting were the Experimenters in Animated Sound such as, Oskar Fischinger, Barry Spinello, Jordan Belson, the collaborative work of the Whitney Brothers and Norman McLaren, to name a few.

Animated Sound or Synthetic Sound was a mechanical process that was pushed to the limits in experimental animation. The processes that constituted the production and synthesizing of sound was directly linked to highly complex regiments of strategic and systematic abstract image creation. In most cases, these creations were drawn directly by

hand or impressioned onto the sound and film track. These productions represented mind-blowing, calculated systems of shapes, tones and composition that portrayed a highly-considered manipulation and exploration of the mechanical processes involved without the intervention of a computer. This field of Animated Sound is vast, and unfortunately this research project cannot delve into the full scope of non-computerized production. However, it will remain duly noted that this field should be acknowledged in the tradition of abstract animation, and that the abstract aesthetic was used extensively by the Experimenters in Animated Sound while upholding the integrity of the medium of film.

Zabet Patterson in, *POEMFEILDS and the Materiality of the Computational Screen* 2010, explains that with the, "close of the mechanical age" (243) and the introduction of the model of the "graphical user interface" (243), the implications of perception for animated works and the aesthetics concerns artists explored were substantially affected. Thus, in the next section it will be discussed that the move into the programmed computerized medium presented a process of abstraction that encouraged the tradition of both experimental and abstract animation of the 20th and 21st century.

1.2. Steering Away from Realism: An Introduction to the Functions of Abstraction in Programmed, Abstract Aesthetics

This last section analyses and supports the use of an abstract aesthetic as opposed to a realist representation. Interpretations of the impossibly real are debated in conjunction with the aesthetic-technological aspects of the computerized programed medium digital

animator-artists used. Given that this research project explores the impossibly real as founded upon digital abstraction, this section will assemble examples of the use of abstraction in the form of a calculation and/or a simulation in a programmable computerized medium by artists who acknowledge the fundamental basis of abstraction inherent in a digital system. The theoretical framework for this is based on research involving a short selection of proposed "functions of abstraction" as a means of artistic intention and expression.

Complication as a Function of Abstraction: Dealing with the Digital Landscape and Computation in Hyperanimation

To begin to consider what kind of digital productions can harbour aesthetics of the impossibly real, this research project considers Robert Russett's term Hyperanimation. From Russett's account in his article, *Animated Sound and Beyond* (2004), Hyperanimation is a method of animation that is based solely on the manipulation of digital data (114). From this description this method of Hyperanimation seems to be used not only to create animated visuals with intentions established in the tradition of Animation but also to create an alternative set of standards of perception of a different kind of realism entirely. The following list of functions of abstraction proposes an analysis of functions of digital manipulation that are achieved through abstraction. Each of these functions of abstraction is then proposed as a product of integration between artistic intention and computation resulting in an aesthetic of abstraction.

The first function of abstraction in programed aesthetics that will be discussed is the notion of *complication*. While introducing, "The Origins of an Emerging Art" in his preceding

book to *Animated Sound and Beyond*, named, *Hyperanimation Digital Images and Virtual Worlds*, (2009) Russet raises a number of issues pertaining to the arrival of Hyperanimation. One of these arrivals is when, "the image essentially became data and the computer [became] capable of manipulating data" (Russett 19). Russett goes on further to say that the artists working within the post-film era and moving into video had further concerns not only involving aesthetics. However this research proposes that what graphical, real-time improvisation and kinetic rendering of aesthetic-technological aspects the artists did have to deal with, involved an idea of *complication* through abstraction. From here Russett also suggests that these works provide new technical and artistic alternatives and could broaden the art, entertainment and communication environments in the future.

In the introduction to his essay, Patterson presents several perspectives on the complication of digital landscapes. Patterson makes an argument for Stan Vanderbeek and computer programmer Ken Knowlton's *POEMFIELDs No.* 2, (1966) part of their *POEMFEILDs* series (1964 -70), stating that this piece is "almost impossible to understand except through the specific aesthetic, cultural and technological conditions of its manufacture" (246). What is interesting is that Patterson explains that the piece is essentially a poem that transfuses understanding of pictorial representation and linguistic meaning and mines a terrain of visibility and invisibility as well as code and picture (247). Patterson continues to describe Knowlton and Vanderbeek's use of a programmed aesthetic as a means to complicate invisible (or unseen) computational processing. This computational processing cannot be seen, however it is fascinating that it can be 'seen' through disruptive perception, flashing and flaring transformations of a programmed abstract aesthetic exhibited in this piece.

An experimental computer animation pioneer that Russett acknowledges in his book is John Whitney and regards his work *Permutations* (1967) as one of the landmarks of the computer films from the late 60's (17). Before this, during the late 50's and 60's, Whitney experimented extensively with optical printing methods and his "animation machine", in which he saw the design of graphics as something to focus on rather than what the camera lens could capture. His films produced before *Permutations* were created with handmade graphics that were printed onto the film track in experimental layered compositions and combinations (Russett, John Whitney 181-183)[6]. However after these processes of art making, it is noted by Russett that John Whitney stated in 1971:

> *It is ironic, to say the least, that most artist experimenters with computer graphics thus far have sought ways to circumvent the imposing fact that all their graphic conceptions must be translated into a number of functions. […]I have come to welcome the mathematical; basis of computer graphics, […] the numerical problems which are natural procedure with my computerized tool. Now I find that this very acceptance has opened the door to a new world of visual design in motion whose true essence is digital periodicity.*
> (From a statement delivered by John Whitney at the 1971 conference for the International federation of Information Processing Society, held in (at the time) Ljubljana, Yugoslavia.)
> (Russett, John Whitney 190)

Permutations, completed under a grant Whitney received from IBM in 1967, was made with this digital periodicity that lay somewhere in-between an experimentation with both mechanical and computational logic. Russet explains *Permutations* is an example of Whitney's meditative abstract works, and employs "complicated forms of visual counterpoint" (Hyperanimation: Digital Images and Virtual Worlds 17). What is of interest in this work is the conjunction between complication and computation of *internal* aesthetics resulting in abstraction. Gideon Engler introduces his article, *From Art and Science to Perception: The Role of Aesthetics,* (1994), by stating that there is no consensus on what the

[6] It was only when he discovered that what he was doing mechanically could be done on a cathode ray tube computer terminal similar to that of an oscilloscope, when Whitney went into developing his own machines (the cam machine) that could alter and calculate graphics in electronically based computerized effects.

essence of aesthetics is, but that there is widespread agreement that it can fall into two categories, *extrinsic* and *internal* (207). Specifically, *internal* aesthetics are the formal aspects of organizations of shape, colour, repetition, symmetry, balance and rhythm (Engler). It is suggested that this set of *internal* aesthetics, explained here by Engler as aspects of formal organizations is what Whitney explored through computation. Moreover, exploration of this digital medium shows his interest in the potential of the computer system as a graphic variational instrument for creating dynamic visual relationships in polygraphic imagery.

Viewer Interactivity as a Function of Abstraction: The Viewer and Computer Image Creation Relationship

In *Animated Sound and Beyond,* Russett's analysis of the artists who work with hyperanimation is chiefly focussed on Animated Sound; however Russett's analysis also follows into debates related to programmed aesthetics. This includes data-manipulation, synthetic expression, transcending superficial use of technology, virtual environment construction and the viewer interactivity experience. Referring to his *Hyperanimation Digital Images and Virtual Worlds,* Russett places further emphasis on the interactive aspect of Hyperanimation – an aspect that digital artists can be found to be dealing with during the last few decades of the 20th century and the beginning of the 21st century. This following section discusses this aspect of viewer interactivity as another function of abstraction. It is proposed that the function of abstraction has come to be both accepted and intertwined into the viewer experience of Hyperanimation. Hence, this should be addressed regarding the perception of the impossibly real in digitally animated work informed by a programmed abstract aesthetic.

In, *The Natural Flow of Perspective: Reformulating Perspective Projection for Computer Animation* (1990), E. H. Blake proposes a synthesis of the theories of perception, image analysis and computer graphics for the further development of realistic computer animation. However what is interesting in Blake's article is the focus he lays upon perspective as a method of computing realistic images and the *viewer-centred* approach, which come together in computer-generated imagery (401). The *viewer-centred* approach is what Blake introduces in his article and he extensively emphasizes the need for such a principle. He states that the manifesto for the *viewer-centred* approach has to do with the following;

> *The basis of a sound theory for realistic computer animation lies in appreciating what is visually important in the environment and integrating this with a theory of how artificial images are perceived* (The Natural FLow of Perspective: Reformulation Perspective Projection for Computer Animation 401).

In an attempt not to dispute what Blake refers to as the importance for realistic computer animation, it is proposed that the same theory for considering what is visually important and integrating this with how artificial images are perceived can be done with a function of abstraction for a basis of viewer interactivity. Furthermore, Russet states that:

> *The computer has indisputably revolutionized the production processes of motion graphics, challenging traditional perceptions about how we visualize and create kinetic imagery*. (Russett, Hyperanimation: Digital Images and Virtual Worlds 19)

Therefore, considering the relationship Blake proposes between the expectation of the viewer and the simulated medium of computer logic, the employment of the function of abstraction could play an important role. Moreover, it is also important that Russett proposes the recognition of the concurrent development in creativity within exhibition display systems today around the world. These developments show the ploysensory

expressive capabilities of Hyperanimation, that is - how it can engage the viewer in unprecedented ways (Hyperanimation: Digital Images and Virtual Worlds 20).

In an example of Organic Animation, artist Karl Sims's early work *Particle Dream*s, (1988) exhibits a "new aesthetic vista" of 3D-generated imagery, created with programmed behaviours applied to particle systems to emulate various natural phenomena (Russett, Hyperanimation: Digital Images and Virtual Worlds 67). Similar to a later work, *Panspermia*, (1990), Sims exhibits software imaging capabilities through particle self-propagation, and procedural computer techniques, based on an intuitive approach to the concerns of aesthetic criteria that best served a satisfying and engaging set of visuals (Russett 67-68). Included in this was the viewer could interact with the visuals and manipulate the resulting generative creation of these visuals.

There is one aspect to note in the above-mentioned works. This is that the abstracted visual elements engaged the viewer's understanding and perception of the technology, yet still addressed concerns of abstraction in a digital art form[7]. Moreover, the exhibition of these organic and interactive software capabilities portrays the Particle System simulation methods in initial abstract, programmed forms; and that aspect is clearly intended.

[7] In an Interview with Karl Sims conducted by Russett, Sims states his intention to exhibit the similar ideas of computer generated imagery of procedural techniques, self-propagating systems and the organic plant growth simulations in both a demonstrative and creative manner (Russett, Hyperanimation: Digital Images and Virtual Worlds 67-68). In notes written by Karl included in Russett's book in this section *Organic Animation,* Sims also states that his attempts in *Panspermia* was to combine the ideas of chaos, complexity, evolution, and the nature of life itself (72). "Nature…", Sims suggests is the, "greatest artist of all in [his] opinion" (68).

Digital interactive and installation artworks have now become a driving force in the mainstream practice of digital art in the past years since the late 90's. Likewise, the use of programmed aesthetics has also become part of the standard modes of production for much of the digitally produced work in both the corporate and independent practice. However, this research has been focusing on certain aspects throughout the tradition of abstract animation and the on-going, ever-changing process of experimental animation that support a proposed additional perspective of the programmed aesthetic used in digital art. This is the exploration of the impossibly real and its extensive use in the motion graphics industry; an Industry that supports the use of abstracted aesthetics in entertainment and information technology.

The Function of Abstraction of the Real for Impossibly Real Aesthetic concerns within a Narrative.

The last section of this chapter dealt with the function of abstraction with the intention of not only negating the real, but doing so within a narrative of impossible events. Pat Power, in his article *Animated Expressions: Expressive Style in 3D Computer Graphic Narrative Animation*, (2010), draws attention to the modality cues used in 3D narrative animation films that serve as an expression of a special, extraordinary concept relative to the narrative plot. Through a stylistic function of abstraction, the abstracted and expressive aesthetic-technological aspects in a digital production can be utilized in a proposed specialized manner. This use of a programmed aesthetic can be suggested to not only manifest the impossibly real in the visual, but also to facilitate a meaningful reading by the viewer.

Power explains that high modality would be ascribed to a generalization of abstraction and is congruent with an expressive style (114). In addition to this, the value that is attributed to high modality cues would be present in a situation that has non-naturalistic qualities and that is suggestive; exaggerated; affective; connotative; and evocative (114). In a digital production for the official music video for *Iron* (2011) performed by Woodkid, the set of high modality cues that can be seen is utilized through the simulation effects featured towards the end of the video. This is where large clusters of what seem to be exploding, smoking debris falls down upon a group of filmed characters running through a decontextualized environment towards some unknown destination. The debris itself looks real and behaves in somewhat real manner, presumably dictated by a calculated set of data of real physics. However, the viewer knows the plot to be impossible yet still convincing.

Hence it is proposed that the reason for this is to emphasize the effect of an extraordinary event within an impossible narrative plot. The viewer knows that the live characters are not really running through this environment and the falling debris is not really falling upon them. This function of abstraction is indirect because the programmed aesthetic can sustain an independent interpretation from the rest of the visuals, however through association adds narrative meaning to the plot. There are a number of additional variables that add to the success of this digital work and perhaps focusing on the programmed aesthetics alone can be reductive. Editing, art direction, set design, performance, filming techniques and the combined efforts of all these processes together do add to the overall convincing effects in this piece. However, this digital production does itself exhibit a whole host of convincing strategies, which makes good use of programmed

aesthetics. In conclusion to this section, this piece mainly achieves its convincing visuals with the additional facet of the imagination. Due to the fact that it involves a stretch of the imagination - it is per se not dictated by a realist representation, this alone cannot suffice. Where an interpretation of the real falls short and ends in this video piece is where the impossibly real begins.

Conclusion to Approaching the Abstract and Steering away from Realism

This first chapter has delved into the relations between the experimental *avant-garde* cinema of the early 20th century and the role of the abstract in animated works of art. With this, an argument has been proposed for the use of the abstraction as a style; with Hans Richter's idea of *production* as an original filmic art form. The process of animation throughout the 20th century has proven to be a milieu that has consistently entertained and expanded the view of filmic art content. This has been done through the emergence of a discourse around iconic abstract animation work done in the process of experimental animation concerning the experimental task of and exploration of animation. In turn, this experimental exploration had led to a host of abstract qualities specific to the medium of film. It has also been acknowledged that the move into a computerized programmed aesthetic in abstract animation was part of the multitude of approaches that continued the process of experimental animation from the 1950's onwards. This can be seen in Animated Sound and the Contemporary Imagists of the 50's; who worked without the intervention of a computerized system.

However, as the digital and experimental animator-artists approached a post-film era and moved into digital video production, the computer interface offered new aesthetic possibilities. Subsequently, abstraction in a new digital age was informed by a programmed computational logic. This chapter concerned the functions of abstraction. This included the complication of the digital landscape and the conjunction between strategic mechanical logic and computational logic; the interactivity of digital work made possible by programmed aesthetics; and abstraction towards the construction of impossible narratives. All the research conducted in this chapter approaching the abstract and steering away from realism has been selected and discussed to frame an exploration into the impossibly real through programmed abstract aesthetics. This exploration and practical initiation follows in the next chapter.

CHAPTER 2

EXPLORING THE IMPOSSIBLY REAL

This chapter looks at the historical development of the Particle System simulation technology featured in Autodesk's Softimage 2012. The intuitive programming interface for Particle System Simulation in the ICE Simulation Engine stands as the primary vantage point for research into the history and development of the company and its software. The second section of the chapter begins by looking directly into the technology of the Softimage ICE Simulation Engine. A comparison is made between the calculated systems of physics established in the ICE Simulation Engine and the proposed values of ambiguity within. It is important in this research project, when considering what is 'real' about 'the impossible', to explore the ambiguity inherent to the methods of simulation involved in digital representation. This introduction includes explanations of a selection of the categories of compounds of parameter data in the *Overview of ICE Particles* featured in the *Softimage Users' Guide 2012,* (2011). This will culminate in a set of factors that contribute towards ambiguity within the simulation technology. These are proposed as means of experimentation - featured in the simulation series of work exhibited as the creative component of this research project.

2.1. History and Development of the Softimage Company: An *Artist's Technology*

A Short Introduction to Today's Softimage ICE (Interactive Creative Environment) Simulation Engine

Simulation in Softimage is defined as the programmed commands that can be given to polygon objects, surfaces and any elements of 3D construction. The Softimage ICE Simulation Engine in Autodesk Softimage 2012 currently incorporates the Particle Simulation or Point Cloud programming procedures. These programming procedures are chiefly used in the production of real life phenomena and advanced visual effects creation. Moreover, Particle System Simulation is a programming procedure that has been commonly used to create digital point-orientated visual productions that could not otherwise be made convincingly enough through the Twelve Principles of Animation. The ICE Simulation Engine also incorporates several categories of programming procedures of simulation. The Particle Simulation procedure is but just one category of this range.[8] It is proposed that the intuitive process of programming in this kind of simulation shows an affinity with the concept of the impossibly real. Therefore, it is within this specific example of simulation/animation technology that the integrity of the abstracted aesthetic should be further explored to propose manifestations of the impossibly real.

The Early Development of SOFTIMAGE|3D® *and the advent of Avid* SOFTIMAGE|XSI 3D *Platform:* 1986-2007

[8] In the *Softimage Users' Guide 2012* simulation is categorized into: Forces, Rigid bodies, Rigid body constraints, Soft bodies and Cloth. Specifically, the ICE Simulation Engine includes (under the general categories stated in the *Softimage Users' Guide 2012*, 2011); ICE Deformations; ICE Modelling; ICE Kinematics, and the specialized technologies, *Lagoa Multiphysics* Simulations and *Syflex on ICE*.

From the initiation of the first 3D software programme launched in the Softimage Company, the artist-technology interdependency was an important factor. In documentation that predates Autodesk's command over the range of 3D programs which it now owns, Wayne Carlson[9] suggests that from the beginning, the impetus for creating Softimage, founded by artists Daniel Langlois[10] and Char Davies, was to produce animation technology that suited the needs of an artist. This included Langlois' vision of an "artist/technology". Langlois hoped that creating this new technology would affect the way the artists and animators working with the technology approached animation. Carlson states that the Softimage Company continuously developed Particle simulation, amongst other special technologies, throughout its history. In 1987, Langlois, along with engineers Richard Mercille and Laurent Lauzon, began the development of the Softimage Company's first 3D application software, called Creative Environment 1.0 launched at SIGGRAPH '88 (Carlson).

Towards the mid 1990's particle simulation technology played an integral role for the reputation of the Softimage Company. This can be seen from 1993 to 1994, with the release of Creative Environment 2.6 and 2.65 along with the partnership that Softimage formed with Mental Images and the merge with Microsoft Corporation and IDEAS (Interactive Developer's Entertainment Authoring Software), to release the "Dynamics" simulation and the 3D Particles Kit. In 1995, taking advantage of the power of the Pentium processor, the

[9] According to the information given on this website at *http://excelsior.biosci.ohio-state.edu/~carlson/history/* Wayne Carlson appears to be a lecturer at Ohio State University and this website explains the course outline for *A Critical History of Computer Graphics and Animation* class*,* for Winter 2007. This website seems to be a very interesting source of information (particularly for undocumented information of the Softimage Company's development and history from 1986-2001 in the official Autodesk Softimage archives).

[10] Carlson states that Softimage was founded in 1986 by National Film Board of Canada (NFB) filmmaker, Daniel Langlois. A notable animated film that Langlois co-directed at this time before the advent of Softimage was *Tony de Peltrie* from 1985 (co-directed by Philippe Bergeron, Pierre Lachapelle and Pierre Robidoux). Langlois remained the President and Chief Technology Officer of Softimage from November 1986 to July 1998.

Softimage Company developed the first high-end product on Irix and Windows NT. This heralded the creation of the company's most popular early software - the release of SOFTIMAGE|3D (Carlson). Carlson states that the company also expanded their software greatly into other production processes through the SOFTIMAGE|3D range.[11] With the completion of SOFTIMAGE|DS (Softimage Digital Studio, 1997), the company had integrated picture-audio editing, compositing, paint, image treatment, special effects, character generation and project management into one complete software environment. Carlson continues the history of Softimage, pointing to the first important change the company went through when the company was acquired by Avid Technology, Inc. in 1998.

In 2001, Softimage continued to collaborate with Microsoft, Linux and Electric Rain to bring various exports to the newly created Avid SOFTIMAGE|XSI platform for its customers and users. Starting from 2002, on *edharriss.com,* Ed Harriss wrote highly detailed reviews, keeping track of the advancements in the Avid SOFTIMAGE| XSI range (based on XSI's appearances at the annual SIGGRAPH conventions). In Harriss's review of XSI 4.0, the advancements made in simulation included the new Rigid Body Dynamics (RBD) and goal based simulation tools. In 2005, Harriss*'s* detailed review for Softimage XSI v.5.0 in a 64 bit processer rate included the new features in the particle simulation engine with the added Dynamics engine, AGEIA™ physX™ previously known as Novodex. With Softimage's increasing popularity in the commercial animation and independent industries, its new branding identity in Softimage XSI 6.0 was released in 2006 with a fresh focus on character

[11] This included, SOFTIMAGE|3D "extreme" version complete with *Osmose*, the new Virtual Theatre created by Char Davies (featuring performance capture and real-time compositing). Produced by Softimage Inc., *Osmose* debuted at the *Musée d'art contemporain de Montréal* in 1995. "This interactive virtual reality installation with live sound is hailed by many critics as one of the very first true virtual reality artworks" (Plohman)

modelling and animation. The greatest development of particle simulation technology came in 2007 with the release of XSI v.7.0.

The ICE Simulation Engine in SOFTIMAGE|XSI 7.0 *and the Latest Softimage Evolution with Autodesk Media and Entertainment Inc.* 2008-2012

In 2008, Harriss wrote an enormously detailed review for XSI 7.0 on *awn.com* specifically for the ICE Simulation technology and all its capabilities. Harris noted, for the users who were familiar with the node-based system of the general Softimage programme, that ICE was controlled by the same interactive process. Harris also explained that ICE:

> *…allows you to use nodes to create interactive tools via a visual programming interface called the ICE Tree. Networks of these nodes can get data from the scene, modify and process it to create tools which can then be used to generate all sorts of effects and changes to the scene. Technically ICE can only be used to create particle effects and deformations, but that's an oversimplification.* (Harriss)

This node-based technology is what Softimage had long been known for. Moreover, the introduction of the ICE Simulation Engine had proved the visually intuitive node-based technology to be highly effective. Early in 2009, Softimage underwent another monumental change, when Autodesk Media and Entertainment Company acquired the platform.

In March 2011, Andrew Price on *3dworldmag.com* gave a positive review of Autodesk's Softimage 2012, entitled, *Powerful ICE enhancements for Softimage 2012.* The review stated that Softimage 2012 had the widest range of new features in the latest round of new releases over Autodesk's various platforms. These included the new technologies; procedural ICE modelling, integrated *Syflex* cloth simulation, *Lagoa Multiphysics* and the ICE FX Builder. The now-integrated *Lagoa Multiphysics* procedures could be used for incredibly realistic simulations, that were previously provided as a separate plug-in for the software

(Price). According to Rob Hoffmann, Senior Product Marketing Manager at Autodesk, the new features were implemented considering the strong urgency of user requests from the Softimage community. Overall, Senior Vice President of Autodesk Media and Entertainment Marc Petit, reached this conclusion about the new version in the Softimage range:

> *In addition to established recent favourite features such as Face Robot and Lagoa Multiphysics, the new version reflects the continued expansion of ICE, as well as the next-generation GigaCore 3D engine.* (Price)

Conclusion to Historical Development of Softimage: An Artist's Technology

In conclusion, Softimage has an extensive tried-and-tested development history. Based on its initial intentions and the growing Softimage community, Softimage has become a powerful 3D software program. The ICE Simulation Engine technology has many competitors nowadays. However, the vast improvements that have recently been made for ICE simulation in Autodesk's Softimage 2012 version can be considered a great contribution to the industry, as well as to the study of simulation in 3D production and construction. Looking ahead, Softimage has begun another long run of success for years to come.

2.2. The Particle System Simulation Technology in Autodesk Softimage

Looking into the Technology of the Softimage ICE Simulation Engine: The ICE Tree and the Compounds in the ICE Tree

The ICE Tree is integral to the construction of a Particle System Simulation in ICE. The Tree presents an intuitive interface in which the user builds a system of node-based hierarchal commands that in effect, programs the commands to produce a simulated production. The given name for this kind of hierarchal system, 'tree', is wholly appropriate for its function in Softimage, as the nodes are indeed connected by branches and signify the evolution of the system of procedural components. The subsequent processes of intuitive 'trial-and-error' computing forms a large part of the initial (and/or experimental) work when producing simulations in ICE. Compounds are categories of nodes that are used to build an ICE Tree in Softimage. Data nodes that make up compounds represent the calculations of forces, states and attributes that constitute the programmed scripting of digital data that result in a simulation. The data in these nodes is also known as parameter data. This is because the data presented in a node is constructed with a parameter range (for example, 0 to 1 in a varied amount of measurement criteria) and the data can be controlled through this range. With a manipulation of the parameters, or set input values of parameters, within any given node of data the overall effects in the ICE Tree can be changed to suit the desired simulation. Overall, this type of parameter data manipulation gives the user a great range of control over the simulation through extensive progressive intuitive use that forms over time and practice of the software and gives way to much experimentation.

Ambiguous Physics: The Real versus the Impossible

When considering the objectivity of computer logic, the real and the impossible can not only be both calculated but can also both be disproven. In turn, the real can be rendered

visually as not real and the impossible can be rendered visually as not impossible at all, which causes an inherent ambiguity. Judith Farr Tormey and Alan Tormey provide logical arguments for ambiguity in their article, *Art and Ambiguity* (1983) and involve the importance of the use of ambiguity in judging aesthetic concerns within artworks. Hence the discussion of the definitive technological aspects of how the programmed aesthetics calculated in Particle System Simulation is conducted in the rest of this chapter with regards to these proposed values of ambiguity and paradox inherent in this specific simulation technology. This exploration into the ambiguous aspects of the ICE simulation technology is not directed towards further obscuring the logic or language of this computerized system. It is conducted in order to investigate parameter data manipulation within the computational logic to discover points at which the ambiguous aspects of real physics within a computerized system can be manipulated and therefore give way to experimentation. This is done in order to find new ways to use the aesthetic of the simulation technology through the compounds of parameter data that control it.

Tormey and Tormey state that ambiguity, “involves the reader in a creative process” (183), that is, through ambiguity the viewer can engage and in the process of ‘working it out’ participates in and judges the aesthetic concerns and qualities presented of the work. From this, Tormey and Tormey regard this aspect of participation and involvement from the readers/viewers as important. The following section takes this into account in discussing certain compound categories that constitute a simulation in ICE. It is proposed that the ambiguity inherent in digital representations of the real is an important component of what programmed, abstract aesthetics can manifest as impossible.

Starting with the compound nodes category for *Forces,* this set of forces is likened to, "… forces in nature, forces in the ICE tree influence the motion of particles. They make particles move according to different types of forces that imitate nature, such as gravity, wind, drag, or coagulation" (Autodesk Softimage). In what can be said to be ambiguous is that the forces calculated are based in programmed data and create aesthetics which are not real, but are possible just by being calculated in the programmed virtual environment. Force is a vital component because if the particles had no force of motion, there would be no familiar or convincing understanding of the default flow of the particles in the simulation at any point in time. Tormey and Tormey confess that even ambiguity is prone to ambiguous construction (183). Their concern with the distinction between representational indeterminacy and perceptual ambiguity introduces the debate on the interpretation that signifies ambiguity. Ambiguity is not based on the amount of possible meanings but on the occurrence of competing, multiple meanings. Hence, it is not because applying a force can invoke an indeterminate amount of possible meanings that marks a force as having an ambiguous quality, but that it is represented as having a real meaning, which in turn competes with the meaning of applying the forces to these virtual particles. Tormey and Tormey also consider impossible forms with the specific value of not necessarily "true" ambiguity, but paradox. While referring to impossible forms, the authors state the following:

> *Although the perceptual experience of some of them, e.g. the Devil's Pitchfork, comes close to the experience of ambiguity, that is, they begin to 'take shape' into competing readings […]. Unlike ambiguous figures that elicit two or more internally coherent readings, paradoxical pictures systematically defeat the attempt to achieve even a single coherent reading of the whole design. They do, however, permit coherent readings of individual, isolated segments (as one can see by selectively covering over parts of the design). It is only when the effort is made to accommodate all of the elements of the picture into a single coherent reading that the paradoxical effect is noticed.* (Tormey and Tormey 184)

This aspect of paradox is possible when applying forces in a Particle System Simulation. It is through the processes of regarding the abstracted aesthetic of these particles that it can be 'worked out' that there is this perceptual ambiguity and/or paradox programmed into the aesthetics of simulation. Hence, this does lend itself towards intriguing exploration and investigation into these (im)possibilities. Lorettann Devlin Gascard in his *Motion Painting: 'Abstract' Animation as an Art form*, 1983 supports the notion of ambiguity in art by proposing that engendering rendering ambiguities provide multiple readings of a work, wherein the viewer can become engaged in the perpetual and conceptual shifts of meaning (293). In non-representational works, ambiguity becomes a game of considering a multitude of meanings - as opposed to narrowing interpretations as is seen in representational artworks. Even in overtly ambiguous and abstract works, meanings can become both unsolvable, as well as be completely open to interpretation (294). The abstract then becomes an aesthetic that can be used to experiment with and intentionally fuel spatial and temporal ambiguities that negate a narrowly selective set of realist interpretations and open up to a variety of interpretations. This implication leads to debates supporting that either the real is no longer sufficient for intentions of representation within Particle System Simulation, or, that realistic representation has been far surpassed by other means of representation, namely the impossibly real.

The compounds for the *Flow* of particles can often be combined with the compounds for *Forces*. Force is the affect a specific attribute has on the overall simulation at different points in time, with different values and in different calculated situations. However, in referring to the flow of a particle system, one is referring to the inherent pattern of events

that the simulation takes on as part of its initial and general existence. In ICE, once a Particle System emission is applied to a surface or objects - without any further manipulation, that emission results in a flow – and has a default, predictable system of movement. Particles are not a system of particle simulation if they do not have an initial emission. Therefore, the process that is named and indicates a simulation, depends on the fact that the simulation is *flowing.* Thus, the flow of a Particle System simulation is what first defines it as a simulation. Accordingly, what attributes are plugged in afterwards, which further define that flow, is what is known as a successful simulation. Softimage has narrowed the endless possibilities with this category of *Flow* compounds.

Rendering procedures can offer an entry point into the ambiguous value in the programmable medium of simulation; however the problem that exists is that this technology is fundamentally constructed not to allow for any impossibility. The two categories of compounds of simulation in ICE related to rendering procedures do not exhibit ambiguity is *Shape Instances* and *Shaders*. The effectiveness of rendering processes serve as a means to eliminate any impossibilities that could occur from translating what is on screen into a video delivery format. Therefore, these procedures do not include many possibilities for undetermined errors - unless the technology is not being used in the ideal way.[12] Manipulating the rendering capabilities of this technology in Softimage could be a potential entry point for this research. However, the goal of rendering out these simulation

[12] There are processes of digital art making that do explore and manipulate video codecs for the intention of a unique programmed aesthetic; however this project will not cover the research into those procedures.

experiments in a coherent and logical format could very well prove to be difficult in the creative component of this research.[13]

Conclusion to Ambiguous Physics: The Experimental Factors of Visualizing the Impossibly Real

To conclude, visualizing the impossibly real for the creative component of this research project will include the following experimental factors - based on the topics raised in this chapter. With regards to the proposed relation between ambiguity and the Particle System Simulation technology featured in Autodesk Softimage's ICE Simulation Engine 2012, the investigation into the impossibly real will include looking at *Forces* and *Flow* Compound Nodes.

The parameter data within the *Forces* compounds will be experimented with in terms of negating the representation of forces as realistic phenomena. The forces applied should be ones that result in an appearance that does not resemble real movement. Moreover, application of the forces that result in a break of the simulation should also be a focus of experimentation, because this could produce interesting results of the impossibly real.

The flow of the particles in the produced Particle System simulations should not be left as the default flow created upon an initial emission. The parameter data within the *Flow* compound nodes should be experimented with on a basis that the particles flow like particles in their abstracted initial states. This should be done in order to retain the integrity

[13] Therefore, further complicating this process might prove to be extremely counterproductive in order to complete the final works for exhibition.

of these particles as points in digital space. Unless the parameters of the initial Emission compound in the ICE Tree allows for procedural shape programming methods, the particles should also not have their shape or texture changed in order to attain realism. The appearance of the 'glitches', indescrepencies, and digital artefacts that could manifest from the incongruent calculation of certain combination interactions will remain a focus in the experimental series.

Finally, complex rendering procedures will only be employed on the basis that the abstract integrity of the Particle System simulations will be retained. This could include some applications of certain nodes that emphasize or increase the value of the particles in their abstracted forms. In order to set up these visual parameters, a general list of Thematic Aesthetics will be contributed to the experimental series. This list of Thematic Aesthetics includes the aesthetics of light, volume/colour and flux. These Thematic Aesthetics hold ranges of aesthetic criteria that are not too distant from each other to counter their relationships to each other, but are also not to close to constitute confusion. The Thematic Aesthetics chosen for exhibition will be discussed further in the next chapter of this research project.

The body of work created for exhibition that is both theoretically discussed and practically explored in this research project is experimental. Lastly, it is anticipated that the success of this thesis report and exhibition will be based on the extent of experimentation and what manifestations of the impossibly real are explored as a result.

CHAPTER 3:

PROABSTHETICS: AN EXHIBITION OF PROGRAMMED, ABSTRACT AESTHETICS OF THE IMPOSSIBLY REAL

The exhibition, *Proabsthetics,* consists of three series of simulation experiments based on the Thematic Aesthetic categories of volume, light and flux. These experiments are performed with the use of a programmed, abstract aesthetic and constitute digital visual productions created as Abstract Animation. In these series, the integrity of the abstract aesthetic of this simulation method is exhibited as a tool for creating digital artwork that proposes a process for visualizing the impossibly real. This body of work is an exercise in composing digital and computing aesthetic-technological elements using a current example of simulation programming technology. This body of work was not intended to be entirely defined only by what manner it was produced but also in how it was received. Presented to the viewer as Abstract Animation, these digital visual productions are meant to encourage the viewer to engage the programmed aesthetic though a further extension of perception of the impossibly real.

The body of work created for exhibition sets out to explore the abstract integrity of the medium in numerous experimental ways that concern what role abstraction has in constituting these visuals. The first step in the process is to regard the visuals as an example of an intended real concept, however to depart from realistic modes of representation and

to illustrate them through modes of abstraction. Hence, the Thematic Aesthetics chosen for exhibition have significance with regards to the processes of experimentation.

VOLUME explores simulated Particle Systems through the lack of control over time. VOLUME is not only described in terms of digital space but also through the excess of the computational logical system which dictates simulation as a producer of perpetual impossible occurrences. FLUX features attempts in strategy, synchronization and symmetry. FLUX manifests as regiments of control over the motion of self-organizing Particle Systems contrasted by states of black and white and gives way to the potential flaws of calculation within the system, indicative of the impossibly real. Lastly, LIGHT considers the emotive aspects of digital abstraction. LIGHT itself is not considered as a source but becomes a product of computational logic that develops and reveals an aesthetic with an emotive value, without reference to the real but to the impossibly real founded upon abstraction. It has been shown that proposing visualizations of the impossible real relies on a comparison with the real. Therefore, as a starting point of exploration, these Thematic Aesthetics are based on the concepts they describe and subsequently present a realistic point of reference. Ultimately, when the concepts of volume, light and flux are explored, they can unveil the abstract or abstracted components from which they are forged. The results of these series of experimental simulations demonstrate the computational logic of the computerized system, to which the programmed, abstract aesthetic is inherently and eternally linked to.

One implication that arises from considering the role abstraction in these Thematic Aesthetics is to suggest that Particle System Simulation produced by computational, command driven procedures can be studied as a non-representational or abstract art form.

They represent similar aesthetics that are both not too different from each other in terms of concept and execution but also signify specific sets of physics which differentiates them from each other. However, these effects can be calculated based on physics, and so through the calculations of computational logic, these visual effects can be constructed in abstraction.

In Autodesk Softimage, Particle System Simulation is based on the instance of an emission. From here the particles are, by default, calculated to keep on emitting from a chosen source, based on the initial default values set for an emission created and prompted by the technology. The timeframe and manner of this initial emission is then only altered through the employment of certain programmed data nodes that "control" the simulation. Hence, VOLUME is explored in this series through the extension of time and the accumulation of particles within the duration of these visual productions. What ultimate volume these particles then have is an effect initiated by no control.

Unlike in the VOLUME series, the FLUX series features an extensive experimentation with control. However, what is also of interest in this series are the flaws that potentially arise within regimens of control. The LIGHT series is a series of more emotional-visual value. Light in its many descriptions and philosophical reasoning can be explained as having no matter at all. So it becomes difficult to explain, compared to the other two series of simulation experiments, that light can be made up of particles. However it is because of the simulation programming and the inherent calculations of physics that is applied to both the control and the flow of Particle System Simulation that LIGHT, using this technology, can be visually manifested using this complex abstract aesthetic. Furthermore, it can be suggested

that the only way to visually manifest light is through some extended measure of abstraction. The role that abstraction then plays is significant, as it can then present results of a programmed, abstract aesthetic which cannot be interpreted through realistic representation but through a further representation of the impossibly real. The abstraction of the visual effects of these Thematic Aesthetics then in effect does not confirm them as real, but as a set of aesthetics that does not depend on realist interpretation or representation but by the logic of the computer which stands as an independent interpretation through abstraction.

Furthermore, the reason for the selection of these sets of aesthetic themes is also due to the duality between the predictable and unpredictable characteristics these aesthetics have for computer-based 3D-rendering purposes. Mike King explains in his article, *Programmed Graphics in Computer Art and Animation* (1995), that it is the combination of the "satisfaction of unpredictability", and the "addiction of anticipation" of computer programmed art that brings something new to artists who explore "algorithmic and arbitrary synthesis" (113). This concept of "algorithmic and arbitrary synthesis" is one highlighted concept that affected both the production process and the results of the experiments.

The computational logic of simulation was an extremely important point of experimentation and exploration in the series. In the VOLUME series, the function of computational logic is what is used to define the overall resulting programmed aesthetics of all the experiments in the series. The initial states of emission are constructed and altered differently for the different experiments within the series, however after the creation of an

initial emission, the particles are left to simulate “on their own”. The resulting aesthetics of this process shows an extended volume dependent completely on simulation, uncontrolled by human intervention and dictated by computational logic of the computerized system.

In the FLUX series, the computational logic of forces is used to exhibit the programmed aesthetic through only motion control data nodes. The main motion control nodes that are used are, "move towards goal" and "flow along surface" (a polygon-mesh sphere primitive is used as the “goal” in this simulation series). What these motion control nodes offer is a flow that has control points based on invisible data. Subsequently, because an added force node of "surface force - with attraction" at a specific amount was programmed to execute every frame of the final state of the simulation, the particles were flung and locked into what seems to be a simulated 'orbit' around the invisible sphere with their initial calculated velocities. The results evident in the rest of this programmed aesthetic are featured in this simulated digital visualization as a function of FLUX of a Particle System calculated only by a computational logic.

What is also advantageous in choosing this set of Thematic Aesthetics is that the production of these aesthetics is encouraged by abstraction for an enhanced visual experience. These aesthetics are considered as point-orientated effects of compounded, multiple forms that as a collection, represent a singular idea. For example, in the LIGHT series, the main rendering procedure of volumetric shading is featured in order to exhibit the collection of particles as a singular volume of light. Therefore the integrity of the individual particles themselves is not of central importance in this series but it is the combination of the flow and volumetric shading that can be used to visually interpret this

aesthetic as a collection. Furthermore, products of these kinds of visual graphics should be reserved for explorations that consider the collection of abstracted forms. Therefore, this lends itself sufficiently to the implementation of Particle System Simulation within a visual production.

In his article, *The Expanding Medium: The Future of Computer Art*, (1987) Herbert, W. Franke suggests that the term 'computer art' characterizes the instrumentarium and that Art is broadly an intellectual process (335) and that the computer would be sure to affect the methodology of the artists and designers that use it (336). Ultimately, Franke suggests that while this 'new' instrumentarium could be used in many different fields in the 'future', mostly, he predicted, for entertainment value, it should not be limited to this function and that there is enormous artistic potential that should be fully exploited (338). Initiating an interdependent relationship with the computer-based medium of digital abstraction through particle system simulation in this exhibition series has followed Franke's statement and has yielded interesting results within this body of work.

The inherent glitch that is part of *FLUX N0.2 Experiment N0.1*, (2012) is an example of the unique input of the computerized medium. This glitch is a series of visible as black squares, some whole and others rendered only partially, that seem to go directly over the most amount of computational data within the rendered frame of the 3D scene. This glitch is assumed to be dependent on rendering procedures and possibly unintended rendering procedural "mistakes", or counter-productive computational data processing. It is interesting that the only logical reason for the occurrence of this glitch is caused by the innate fact that the aesthetic product of this visualization is based purely on a system of

programming dependent on a computational logic. Logic has seemed to reach of a point of counter productivity that then "rendered" the visuals in a computational logic different to the one it was initialized with as a “plan B”. This kind of aesthetic cannot be replicated in other medium and is completely unique to this computer-based medium and circumstance.

The final important point of experimentation during the production process of this body of work for exhibition was the use of high modality cues for visual interpretation of formal elements. Pat Power explains in, *Animated Expressions: Expressive Style in 3D Computer Graphic Narrative Animation,* (2009) that, “… expressive styles play more with the nature of the mind and of perception, emotion, memory and imagination,” and that, “the expressive has many advantages over the realistic…” (109). “‘Notions of incompleteness, imperfection and subjectivity’ invite interactive participation and have expressive value that can surpass [the realistic formal notion of] explicitness” (Terzidis: 2003, 58) (Power: 109). Drawing from Pat Power’s writings, the investigation of colour in the simulation experiments takes into account these aspects of expressiveness, based on the high modality cues Power proposes in his article and the associated concepts that signify these cues.

Colour plays two significant roles of function and stylistic intention as part of the experimental process within the VOLUME series. As a function, colour is used to indicate the transition of the Particle System Simulation states. A fundamental component of the intuitive programming procedure featured in the ICE Simulation Engine is the data nodes, which structure the simulation in terms of “states”. States are the construction of programming that is given to the simulation at defined intervals and progressions. States can change on command of triggers and can be executed once upon entering a state or

every frame of the state. Therefore, the colour indicated in the VOLUME series shows the varied amount of transitions from state to state within the simulations. Because time and lack of control are main features in this series, the colour indicators of these separate states highlight the progression of the exhibited inherent programmed aesthetics and the backend programming procedures which are calculated simultaneously. Because of this conceptual link to the functions of simulation that happen within the visual productions, the colour is also automatically linked to the progression of the simulation. This starts the process of interactivity with the viewer on a formalist value wherein the colour begins to tell "a story" that could lead the visuals and so presents the viewer with interpretation and understanding[14].

Further extrapolating Power's statements, the value that is attributed to high modality cues would be present in situations that have non-naturalistic qualities and that are suggestive, exaggerated, affective, connotative, and evocative, or in some way expressive (2010: 114). In his article, under the chapter of "Creative expressive signification", (2010), Power summarizes the semiotic modality markers or cues in a simple graph titled, *Coding orientation and modality cues*, following Kress and Van Leeuwen's writings (2006: 165). This graph shows the terms that best signify the high modality cues for four specific orientations of intention for animated works, namely; *naturalistic*, *technological*, *abstract* and *sensory*.

[14] It is interesting to note that during the exhibition of *Proabsthetics*, this VOLUME series was considered as the favourite. Moreover, the one defining factor that did separate this series from the other two was the use of saturated and bright hues of colour.

According to what Power has included in the graph, the cues of high modality within an *abstract* orientation are: abstraction; organization; formal design and selective use of colour (Kress and Van Leeuwen: 2006, 165). The same cues within a *sensory* orientation are: expressiveness; connotation; sensory design; caricature; symbolism; defamiliarization and neuroesthetic. Colour in the VOLUME series and FLUX series are considered as experimental opposites based on Power's statements for the use of high modality cues with an *abstract orientation*. Hence, colour is completely eliminated from the FLUX series as a function and as an aspect of appeal. Because flow and movement are the main features when considering the concept of flux, the series is produced using an alternating black and white process. Simple rendering procedures of specular and shadow are also utilized in order to suggest depth of field inherent in a default 3D scene within the Softimage program. The LIGHT series accommodates high modality cues of a *sensory orientation*, in order to invoke an emotional experiential value by means of abstraction. Only the colours of the colour spectrum (a rainbow palette) are utilized in order to serve as a metaphor for the constitution of white light. The function of colour in the LIGHT series was employed in the use of complex rendering procedures to emphasize the volume of light as a hollow, transparent visual with no solid form.

To conclude the use of colour in this exhibition series, colour is used for functional stylistic intentions and aspects of appeal. Considering certain Gestalt principles and the use of high modality cues for the production of 3D generated imagery, colour in these experiments also exhibits: high contrast; bright hues; fluctuating levels of opacity; metaphoric design; and lastly a combination of all these elements for an impactful visual experience

As a whole, the production framework for this exhibition is a series of ideas that sets the stage for experimentation. This framework is also intended to incorporate a multitude of approaches that best serve the purpose for exploring and investigating the impossibly real through Particle System Simulation. Rather than the realistic and idealistic representation of these specific Thematic Aesthetic experiments, the goal is the generation of visualizations. The results remained unpredictable until completion. However it is intended that addressing the aesthetic concerns of these specific concepts can provide ways forward for rendering the impossibly real in digital, abstract animated work.

CONCLUSION

This research project has approached the abstract aesthetic by looking at the tradition of Abstract Animation from the advent of Experimental Animation produced in the early 20th century, an indicative era of Fine Art which features the Modernist concerns for abstraction. By steering away from realism, an analysis is made of the use of the programmed, abstract aesthetic and computational logic within digital abstraction within productions created from a moving, digital visual computerized medium. Investigating the Autodesk Softimage 2012 3D platform software, this research project has discussed reappropriation of the programmed abstract aesthetic of the technology behind Particle System Simulation in search for new ways to use computational logic as a digital visual expression of abstraction and artistic value in Digital Arts.

The series of simulation experiments intended for exhibition for the creative component of this research project, *Proabsthetics*, featured the technological aspects of the Particle System simulated programming method and ultimately developed and created digital visual productions of Abstract Animation. The set of Thematic Aesthetics were significant because these concepts of aesthetics were chosen for exhibition for exploratory and experimental intentions and serve as a significant link to the research and theory that was collected throughout the written component of the research project. These concepts have been extensively explored and experimented with throughout the tradition of Abstract Animation starting from almost one hundred years ago. Photography, the father of Animation and Film, is based on the elements of light and form and what was consequently explored through animation was the added dimension of time which gave way to exploring

rhythm, motion and flux. Throughout the past century the process of Abstract Animation has encouraged analysis and exploration of these elements. Whether through mechanical manipulations; filmed illusions and tricks; handmade strategies of reconstituting moving visuals or digitally capturing computational data; volume, light and flux have been paramount features of much experimentation.

The work of John Whitney is as an inspiration for the series of simulation experiments and Whitney's views on the computer medium and has had a profound effect on the processes of experimentation and the intention of creating this body of work. John Whitney is widely regarded as the "Grandfather of Motion Design" and his work and interests in the computer medium stands as one of the iconic series of innovation and exploration into this digital medium. The production process of the simulation experiments for exhibition was in part motivated the much of the processes that John Whitney speaks of in practice and in theory in his film documentary, *Experiments in Motion Design* (1968). John Whitney explains his intentions to illustrate some of the formal problems and his interests regarding design in motion. Whitney explains that when one deals with computer-based programming and parameters of data, one could soon learn how to control the graphic possibilities of this medium and how the computer could become a powerful figure generator. Whitney sustained that the problem that arises with these kinds of motion based imagery resembles the creative problem of melody writing. This involved, balance, contrast, tension resolution with stresses and attraction that when all brought into play that must encourage a response directly from the viewer in some form or another. While Whitney stated that the computer has the potential to achieve this, more experience and experimentation is needed for this greatly unstudied medium of art. Fortunately it is safe to

say that nowadays this process of experience and experimentation, in the processes Whitney explains and many more, concerning this digital medium of art has gained much momentum since Whitney made this documentary.

One last aspect Whitney comments on in his *Experiments in Motion Design* documentary is the state of technology of computer art at the time and the problems of real-time control during the creative process. He sustains that while the computer could be used to do the job of many artists it was a misconception that the emotive and spontaneity of creation happened as promptly as it could in the production processes of other arts, such as musical composition. Even though many creative aspects and processes constitute the creation of computer art and could be made timeously with much success, for the future, Whitney proposed that study should and would go into computer technology that would reduce the effects of this problem and Whitney suggests that his only problem was one of impatience. Whitney concludes with the goal he had in his work that was to study and present a new compositional language by which an art of graphics and motion might be digitally structured in time. He commented that while computers were getting faster, smaller and cheaper, he stressed that they were not, “fast, small and cheap enough!” for more people to explore the medium as he had. Whitney’s frustrations seemed to be only pacified by his prediction that he expects to see one day the art of graphics is a regular part of daily TV broadcasting and when much researched techniques and technology have gone into making a “television-sized computer” to “take home”.

In a later documentary, *A Personal Search: For the Complementarity of Music and Visual Art* 1992, Whitney now had a computer “to take home” and still encourages a general

sense of exploration of the digital image joined with audio and sound. Whitney states that, “Todays computer remains largely unstudied as a true audio-visual instrument. Yet [his] explorations of the counterpoint between image and sound strongly suggest…” that this is the only instrument capable of a completely new language of Art combining visual and sound. He also added that, “the unison of colour and tone is very special gift of computer technology.” The theory discussed in this research project and exhibition has been inspired and upholds the opinions of computer art by continuing the exploration Whitney encourages. This exploration is commonly referred to in this research project as exploration into the impossibly real. The impossibly real reconsiders the aesthetic concerns implied within digital visualizations. What intentions, uses, or interpretations of the impossibly real that can be applied are up to the creator and the viewer working within the context of today’s concerns of digitally created aesthetics in general. It is expected that this in turn encourages a re-evaluation in this day and age of what is thought to be real, or impossibly real.

Works Cited

A Personal Search: For the Complementarity of Music and Visual Art. SIGGRAPH Special Project Committee. Pyramid Films Corp., Santa Monica, CA, 1992. DVD.

Autodesk Softimage. "ICE Particle Simulations/ ICE Particles/Overview of ICE Particles." *Softimage User's Guide 2012,* 2011. Software data. 8 February 2012.

Autodesk. "ICE Particle Simulations/ICE Particle States/Creating a State System." *Softimage User's Guide,* 2011. Software data. 8 February 2012.

Autodesk. "Surface and Curve Modelling/Fundamentals of NURBS Modelling/About NURBS." *Softimage User's Guide 2012* 2011. Software data. 27 May 2012.

Behne, Adolf. *Die Weld Am Abend.* 23 May 1925. Print.

Blake, E. H. "The Natural FLow of Perspective: Reformulation Perspective Projection for Computer Animation." *Leonardo* 23.4 (1990): 401-409. Web. 16 October 2011.

Carlson, Wayne. "Animation Software Companies and Individuals." *exelsior.biosci.ohio-state.edu.* Ohio State University, 2008. Web. 2 Feb 2012.

Engler, Gideon. "From Art and Science to Perception: The Role of Aesthetics." *Leonardo* 21.3 (1994): 207-209. JSTOR. Web. 26 November 2011.

Experiments in Motion Graphics. The Museum of Modern Art Film Library Film. Pyramid Films Corp., Santa Monica, CA, 1968. Documentary DVD.

Gascard, Devlin. Lorettann. "Motion Painting: 'Abstract' Animation as an Art form." *Leonardo* 16.4 (1983): 293-297. Web. 24 March 2012.

Hardstaff, Johnny. "The Impossibly Real: Green Belting the Imaginary". *Animation: an Interdisciplinary Journal,* Vol. 2(2), (2007): 187–202. Web. July 18, 2011.

Harriss, Ed. "Softimage|XSI 7 Review: Getting a Grip on ICE." *awn.com.* Animation World Network, Wednesday, 3 September 2008. Web. 5 Feb 2012.

Hernández, Maria Lorenzo. "The Double Sense of Animated Images: A view on the Paradoxes of Animation as a Visual Language." *Animation Studies* 2 (2007): 36-44. Web. 26 November 2011.

John Whitney Collection, The. Pyramid Films Corp., Santa Monica, CA, 2009. DVD.

King, Mike. "Programmed Graphics in Computer Art and Animation." *Leonardo* 28.2 (1995): 113-121. JSTOR. Web. 16 October 2011.

Norden, F. Martin. "The Avant-Garde Cinema of the 1920s: Connections to Futurism, Precisionism and Suprematism." *Leonardo* 17.2 (1984): 108-112. JSTOR. Web. 19 January 2012.

Norman McLaren: The Masters Edition. Dir. Norman McLaren and Eric Barbeau. The National Film Board of Canada, 2006. DVD.

O'Doherty, Brian. "Hans Richter." *Catalogue for Retospective Exhibition, Finch College Museum.* 1968. Print.

Patterson, Zabet. "POEMFIELDS and the Materiality of the Computational Screen." *Animation* 5.2 (2010): 243-262. Web. 20 May 2012.

Price, Andy. "Powerful ICE enhancements for Softimage 2012." *3dworldmag.com.* 3D World, 1 March 2011. Web. 5 Feb 2012.

Richter, Hans. "Film as an Original Art form." *College Art Journal* 10.2 (1951): 157-161. JSTOR. Web. 23 Jan 2012.

Russett, Robert and Cecile Starr. *Experimental Animation: Origins of a New Art*. 2nd. New York: Da Capo Press, Inc., 1988. Print.

Russett, Robert. "Contemporary Imagists." Russett, Robert and Cecile Starr. *Experimental Animation: Origins of a New Art*. New York: Da Capo Press Inc., 1988. 129-162. Print.

—. *Hyperanimation: Digital Images and Virtual Worlds*. United Kingdom: John Libbey Publishing, Ltd., 2009. Print.

Russett, Robert. "John Whitney." Russett, Robert and Cecile Starr. *Experimental Animation: Origins of a New Art*. New York: Da Capo Press, 1988. 180-192. Print.

Terzidis, Kostas. *Expressive Form*. New York: Spon Press. (2003). Print.

Tormey, Judith Farr and Alan Tormey. "Art and Ambiguity." *Leonardo* 16.3, Special Issue: Psychology and the Arts (1983): 183-187. JSTOR.Web. 26 November 2011.

Filmography

McLaren, Norman. *Blinkity Blank,* (1954). National Film Board of Canada, Canada. Film. *Norman McLaren: The Masters Edition*. Dir. Norman McLaren and Eric Barbeau. The National Film Board of Canada, 2006. DVD

Cohl, Émile. *Fantasmagorie.* 1908.

Colour Box. Dir. Len Lye. Sound. Visatone Marconi. 1935. Dufaycolor (1937) The General Post Office Film Unit National Film and Television Archive United Kingdom, 1984. YouTube. Web. 28 April 2012.

Eggeling, Viking. *Diagonale Symphonie.* 1921-1924. Essex Films, USA. Ubu Web Film and Video (www.ubu.com). 28 April 2012.

Iron. Dir. Yoann Lemoine. 2011. Perf. Woodkid. Green United Music. Vimeo (www.vimeo.com). Web. 14 August 2011.

Sims, Karl. *Particle Dreams.* 1988. Sound. Robert Moore. Hybrid Arts, Inc. USA. YouTube (www.youtube.com) Web. 21 May 2012.

Tony de Peltrie, co-dirs. Philippe Bergeron, Pierre Lachapelle and Pierre Robidoux and Daniel Langlois. Perf. Ronald France. National Film Board of Canada, 1985.

Vanderbeek, Stan and Knowlton, Ken. POEMFIELDs No.2. 1966. Music. Paul Motian. Publishers: Bell Laboratories USA. Ubu Web Film and Video (www.ubu.com). Web. 28 April 2012.

Whitney, John. *Permutations*. 1968. IBM USA. Film. *Youtube.com*. Web. 17 Nov. 2011.