Aalto University
School of Arts, Design
and Architecture

Raine Ruoppa

Stereoscopic Distortions as an Artistic Practice

Department of Art
Master's Programme in Visual Culture and Contemporary Art

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Thesis supervisors: Professor Harri Laakso
Adjunct Professor Pentti Määttänen

Aalto University
School of Arts, Design
and Architecture

Aalto University, P.O. BOX 11000, 00076 AALTO
www.aalto.fi

Master of Arts thesis abstract

Author Raine Ruoppa

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Abstract

Stereoscopy is a technique for generating a perception of depth using a pair of two-dimensional pictures. Digital technologies of the 21st century have greatly enhanced the possibilities for operating in the field of optical phenomena. Most of the technological problems restraining the acceptance of stereoscopic techniques in the 20th century have now been solved. This allows inexpensive experiments of unnatural visual conditions to be carried out.

The goal of this study is to generate novel experiences through an exploration of ways of visualizing spatial dimensions and to provide new practices for observing shapes and objects in an artistic context. Purposefully challenging our conventions of perception and abandoning the desire for comfort defines the starting point for the structure of the art object created in this study. The careful construction of abnormal stereoscopic conditions can produce interesting experiences through a strong response from the physical and the cognitive structures of a human sensory system. With the art object of this study, the main idea is to construct a virtual environment simulating the process of eyes moving freely from the constraints of a human body. This animation is presented in the format of a stereoscopic video installation.

Though the animation is distinctively a product of the digital age, and would most likely have been impossible to accurately produce without the aid of a computer, the emphasis of the whole study is clearly on the processes taking place within the human body. The most essential part of pragmatistic theory of art applied in this context is the differentiation of art objects from works of art – the former having physical existence and functioning as an initiator for the latter, which is a specific type of experience and not a physical object of any kind. The experience of the brain's struggle to make sense of unusual visual conditions brought upon them by the art object constitutes the work of art in this study.

However, neither pragmatism nor stereoscopic principles can function as a suitable concept for locating an artistic production in the field of visual arts. For this purpose a relationship between the artistic process of this study and optical art movement is established. Also, connections to new media art and minimalist art are explored. In conclusion, it is stated that, as demonstrated in this study, artistic practices applying the specific distortions of the stereoscopic effect have the potential for generating and directing a specific type of experience.

Keywords stereoscopy, experience, pragmatism, minimalist art, installation

Aalto-yliopisto
Taiteiden ja suunnittelun korkeakoulu

Aalto-yliopisto, PL 11000, 00076 AALTO
www.aalto.fi
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Tiivistelmä

Stereoskopia on tekniikka syvyysvaikutelman luomiseen kaksiulotteisen kuvaparin avulla. 2000-luvulla digitaaliset teknologiat ovat huomattavasti parantaneet mahdollisuuksia työskennellä optisten ilmiöiden kentällä. Suurin osa teknologisista ongelmista, jotka rajoittivat stereoskooppisten tekniikoiden yleistymistä 1900-luvulla, on nyt ratkaistu. Tämä mahdollistaa kustannustehokkaat kokeilut epäluonnollisilla visuaalisilla tiloilla.

Tavoitteena tässä tutkimuksessa on luoda uusia kokemuksia tutkimalla tapoja tehdä tilallisten ulottuvuuksien visualisointeja sekä tarjota uusia käytäntöjä muotojen ja esineiden havainnointiin taiteellisessa kontekstissa. Havaitsemisen käytäntöjen tarkoituksellinen haastaminen sekä mukavuuden tavoittelusta luopuminen määrittävät lähtökohdat tässä tutkimuksessa valmistetun taide-esineen rakenteille. Normaalista poikkeavien stereoskooppisten tilojen huolellinen rakentaminen voi tuottaa kiinnostavia kokemuksia ihmisen sensoristen sekä kognitiivisten järjestelmien voimakkaisiin reaktioihin pohjautuen. Keskeisenä ideana tämän tutkimuksen yhteydessä valmistetussa taide-esineessä on luoda virtuaalinen ympäristö, joka simuloi ihmisruumiin rajoitteista vapautettujen silmien liikkumista. Tämä animaatio esitetään stereoskooppisena videoinstallaationa.

Vaikka tutkimuksen animaatio on selkeästi digitaalisen aikakauden tuotos, ja sitä olisi todennäköisesti ollut mahdoton toteuttaa tarkasti ilman tietokonetta, kokonaisuudessaan tämä tutkimus painottaa ihmiskehon sisällä tapahtuvia prosesseja. Tässä kontekstissa käytetyn pragmatistisen taiteenteorian keskeisiä ajatuksia on taide-esineiden ja taideteosten erottelu toisistaan. Edellisellä on fyysinen olemassaolo ja se toimii alkuunpanijana jälkimmäiselle, joka puolestaan on tietyn tyyppinen kokemus eikä fysikaalinen esine. Kokemus aivojen käymästä kamppailusta niiden yrittäessä tehdä selkoa taide-esineen tuottamasta epätavallisesta visuaalisesta tilasta muodostaa taideteoksen tässä tutkimuksessa.

On kuitenkin huomioitava, ettei pragmatismi eivätkä stereoskooppiset periaatteet voi toimia konseptina taiteellisen produktion paikantamiseen visuaalisen taiteen kentällä. Tätä tarkoitusta varten osoitetaan suhde tämän tutkimuksen ja optisen taiteen välillä. Lisäksi tarkastellaan yhteyksiä uusmediataiteeseen ja minimalistiseen taiteeseen. Yhteenvetona todetaan tämän tutkimuksen osoittavan, että tiettyjen stereoskooppisten vääristymien käytössä taiteellisena menetelmänä on potentiaalia synnyttää ja ohjata erityisiä kokemisen tapoja.

Avainsanat stereoskopia, kokemus, pragmatismi, minimalismi, installaatio

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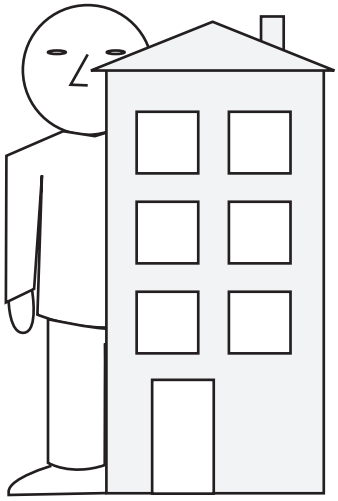
Raine Ruoppa

Contents

1. Introduction

Throughout history, human visual capabilities have been an extensive area of interest to artists and philosophers. Digital technologies of the 21st century have greatly enhanced the possibilities for operating in the field of optical phenomena for many different professionals and enthusiasts. In this study the latest technological opportunities are utilized, but also their cultural origins are acknowledged and made use of in the process of creating novel insight into spatial objects. Prior to the task of rendering historical, philosophical and technical connections relevant to this study, a short overview of the human ability of depth perception is first required. This is particularly important because the so called depth cues – the various ways humans perceive proportions and distances of their immediate surroundings – are often assimilated in experiencing spatial dimensions. Thus in order to study or manipulate only one type of a cue at a time (with the interest of producing a particular phenomena) a differentiation of cues is mandatory. Notable examples of utilizing only certain types of cues to conduct research and demonstrate findings are **Sir Charles Wheatstone** and **Bela Julesz**, both of whom have a dedicated section for their work later in this study. The technical starting point described above is followed by an overview of historical and cultural developments, which outlines the boundaries for the concept of this thesis and also provides background information for the artistic production. The final sections are dedicated to a description of the procedures of developing and setting up the art object and to an analysis of the artistic process as well as its outcomes. The former depicts only the successful or preferred steps taken during the construction of the art object, since a detailed description of all of the mistakes, trivial results, or undesired effects would not be feasible in this context – it would simply take too large a part of this study. For the latter, a diverse approach is more suitable, as the theme of the closing chapter is to contemplate a range of issues varying from cultural intersections to possible future development.



An example of occlusion depth cue

1.1 Basics of Stereo Vision and Depth Perception

There are two main types of depth cues that help human beings to operate in the world. They are called monoscopic and stereoscopic cues. The former are retrieved from a single view and can produce a perception of depth without stereopsis. So in essence monoscopic cues are the kind of features that provide information about spatial relations even when observed with only one eye. These cues include the prior knowledge of the relative size of objects and occlusion. The latter is a situation in which an object is located in a manner that it partially covers another object behind it in the field of vision. Combined, these two monoscopic cues can provide additional information, for example in the case where a three-story house obstructs the view to the whole of a man's figure and both objects appear as nearly equal in height. In this situation one can presume that either the man is a giant or the house a scale model. Monoscopic cues can also be based on texture gradients, shadows, and for example, in the case of atmospheric effect on colour shifts and blurring. In addition, human beings possess the ability to identify visual stimuli in relation to time. This faculty gives rise to the motion-based depth cues that allow us to extract information concerning spatial relations from changes in the position of an object and from alterations in the size of an object. Where as all other monoscopic depth cues emphasize the prior knowledge of things, there is a special case of motion parallax that adds the optics of motion to the formation of a depth cue. **Bernard Mendiburu** defines parallax as "the relative position of an object's image in a set of pictures". (Mendiburu,

2009, 15) There are few different ways of extracting information from parallax. One is the notion that objects further away from the point they are being observed from seem to move slower than those closer to the observer. An example of this is an airplane in the sky. To an observer standing on the ground a plane at high altitude appears to be moving slowly, whereas a plane with equal speed flying at low altitude would appear as moving fast. Another method is point-of-view motion parallax, and it takes place every time one moves his or her head. The changes in the spatial relations of the objects in the field of view are registered by the human visual system. These changes provide cues of distances and sizes. If a person is confronted with conflicting depth cues, human sensory system usually relies on motion parallax overriding other information. (Mendiburu, 2009, 11-17)

Stereoscopic depth cues are closely related to those of monoscopic depth cues of motion parallax, although the former has specific operations of the brain devoted only to them. A special set of neurons within the visual cortex are devoted to discovering and assessing the discrepancies between the two images obtained by the two eyes. These differences, called retinal disparities, are mainly found in horizontal parallaxes and occlusion revelations. In the latter case there is a small part of the background visible to only one eye and that part is a very strong cue to the brain constructing a percept of the surrounding space. Certain types of stereoscopic depth cues can also arise from particular shape changes that are based on the fixed distance between the two human eyes. For example, it is possible for humans to observe different sides of a die simultaneously, whereas a house cannot be viewed in a similar way because the common proportions of building walls exceed the approximate distance of seven centimetres separating the eyes in the physical structure of a human head. Therefore proportions of objects and their relation to the size of the observing biological system provide information upon which an understanding of distances, estimates of sizes, and a sensation of depth can be formed. (Mendiburu, 2009, 17-19) The previous concept of cues based on physical relations has special relevance for the premises and the chosen operations of this study.

In addition to the monoscopic and stereoscopic visual depth cues, there is a special class of proprioception that relies on the reactions of a specific part of the body to an external stimulus. These reactions can also function as an initiator for depth perception. Even if occlusion is accurate in providing information about which object is in front of another, it

tells very little about the distance between an object and the observing individual. However, this information can be extracted from the muscles controlling eye movement in the visual motor system. The closer an object gets to a person the more his or her visual system has to struggle to set the correct convergence, which means proper angles for the lines of sight. Similarly to the aforementioned process, which is limited to a close range, the focusing of the lenses of an eye to an object requires work from the muscles in the visual system. This work offers the brain information arising from ones self-perception. (Mendiburu, 2009, 19-20) Interestingly, the de-synchronization of convergence and focusing is crucial to the whole concept of stereoscopic technology. To put it another way, the ability of the human visual system to focus on a flat plane while simultaneously converging to an object apparently floating in front of that plane enables the current forms of stereoscopic applications. (Mendiburu, 2009, 20-21) To summarize, stereopsis – which means the process of fusing together the two images obtained from the eyes – can take place even in technically different situations.

1.2 Goal of the Study

The goal of this study is to generate novel experiences through an exploration of ways of visualizing spatial dimensions and to provide new practices for observing shapes and objects in an artistic context. The natural sciences, in co-operation with the philosophical approach of naturalism, have provided broad based knowledge on the issues regarding the workings of the human visual capacity. Yet there have been only a few attempts to create different ways of observing phenomena through stereoscopic distortions, and most studies in this area have focused on eliminating visual effects deemed unnatural to human beings. Scientists, and more broadly philosophers, have historically strived to overcome the physiological limits of the natural visual system by developing instruments such as the microscope and the telescope. However, the idea has often been to expand the range of visual capabilities – not to distort them. Despite the fact that stereoscopic distortions and anomalies are generally considered undesirable and might even cause negative physical reactions, the careful construction of such abnormal visual conditions can produce interesting artistic experiences through a strong response from the physical and the cognitive structures of a human sensory system.

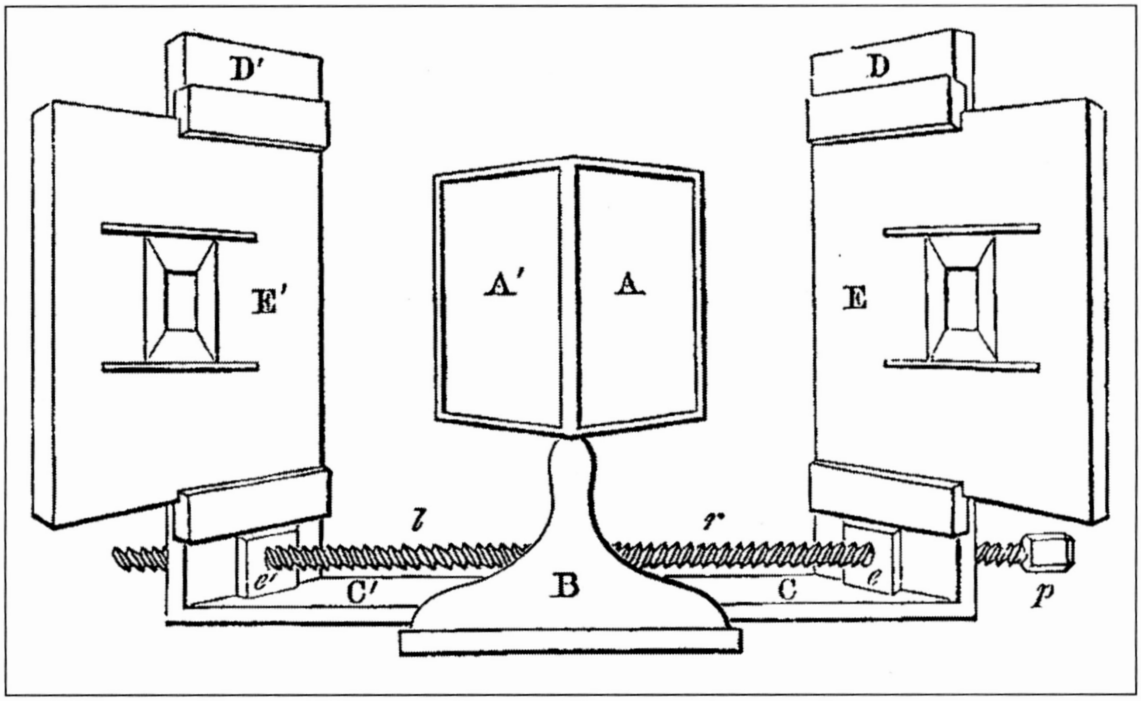
The starting point for the art object constructed in this study can be traced to the notion of the importance of the biological structure of a human being in relation to the quality of the perception of the surrounding environment. From the aforementioned philosophical presuppositions follows the question of 'what if the interaxial distance between the two human eyes was not fixed?' What if the two human eyes could move independently from another in space? How would the human brain react to this kind of unusual visual information and what would the resulting experience be like in an artistic context? It is obvious that it is not possible to accomplish this independence with the parts of an actual human body. However, current digital technologies provide feasible solutions for simulating many unnatural circumstances and conditions. In this study a 3D-animation with an experimental setup of virtual stereo cameras is created and the outcome is projected in a defined space for viewing stereo imagery. For the theoretical outset and the final review of the artistic process, the ideas of philosophical naturalism – and especially pragmatism – are applied as a basis. For the artistic framework, connections to several areas of artistic interest and cultural conventions can be found. Therefore instead of defining one particular approach, an overview of features from several different attitudes towards art are examined and linked to this study.

2. Historical Background of the Study

Separating the cultural, technological and philosophical aspects from one another is particularly difficult, if not outright impossible, when considering the stereoscopic principles. The discovery of these principles undoubtedly had a profound impact on many areas and even generated whole new fields of interest where machinery, art, and epistemology conflated. All of these historical developments, whether technological or social, influence the processes and the outcomes of this study. Therefore, highlighting the key features of significant occurrences is relevant – even if a thorough analysis of events is not feasible in this context. The following outlook into the intertwined historical evolution of theories and practices considering vision and its conventions provides a broad cultural framework to which this study can be reflected upon.

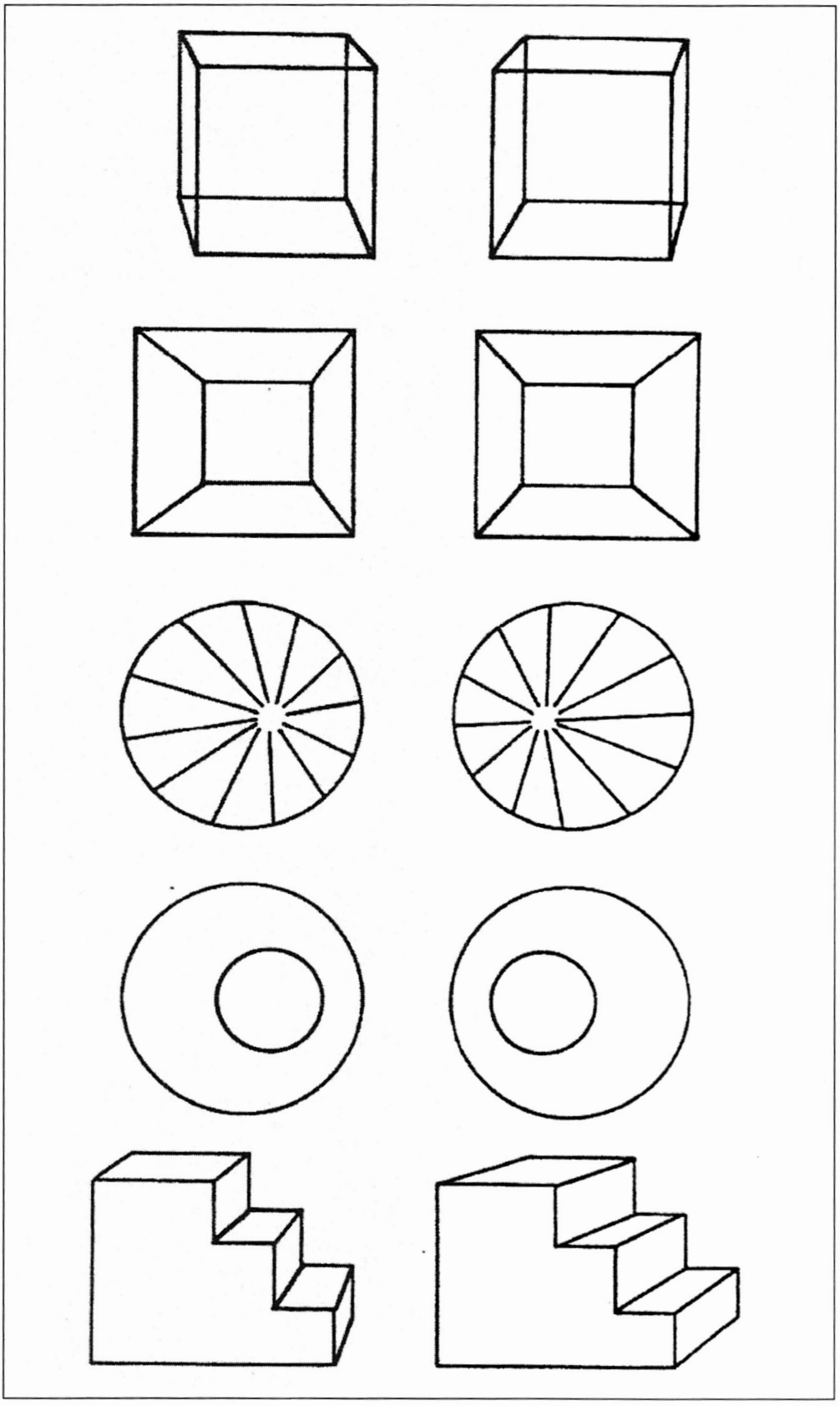
2.1 From Antiquity to the Invention of Stereoscopy and the Apparatus of Stereoscope

Despite the current uptrend in the amount of stereoscopic applications, the principles of stereoscopy and stereo-optics in general are not a recent discovery. **Ray Zone** notes the fact that for centuries there has been a scientific interest towards binocular vision. (Zone, 2007, 5) Zone, for example, points out **Euclid**, who observed the differing views of a sphere produced by the left and the right eye in the third century B.C. – although Zone emphasises that there is no evidence suggesting Euclid understood the stereoscopic effect. Also, in the second century A.D. there was a physician named **Galen**, who analysed binocular vision in his writing *On the Use of the Different Parts of the Human Body*. According to Zone's description, Galen "noted that a person standing near a column and observing first with the left eye and then with the right eye will see different portions of the background behind the column." (Zone, 2007, 5) Discoveries similar to the early inventions made by Euclid and Galen were done through centuries that followed the philosophers of the antiquity.



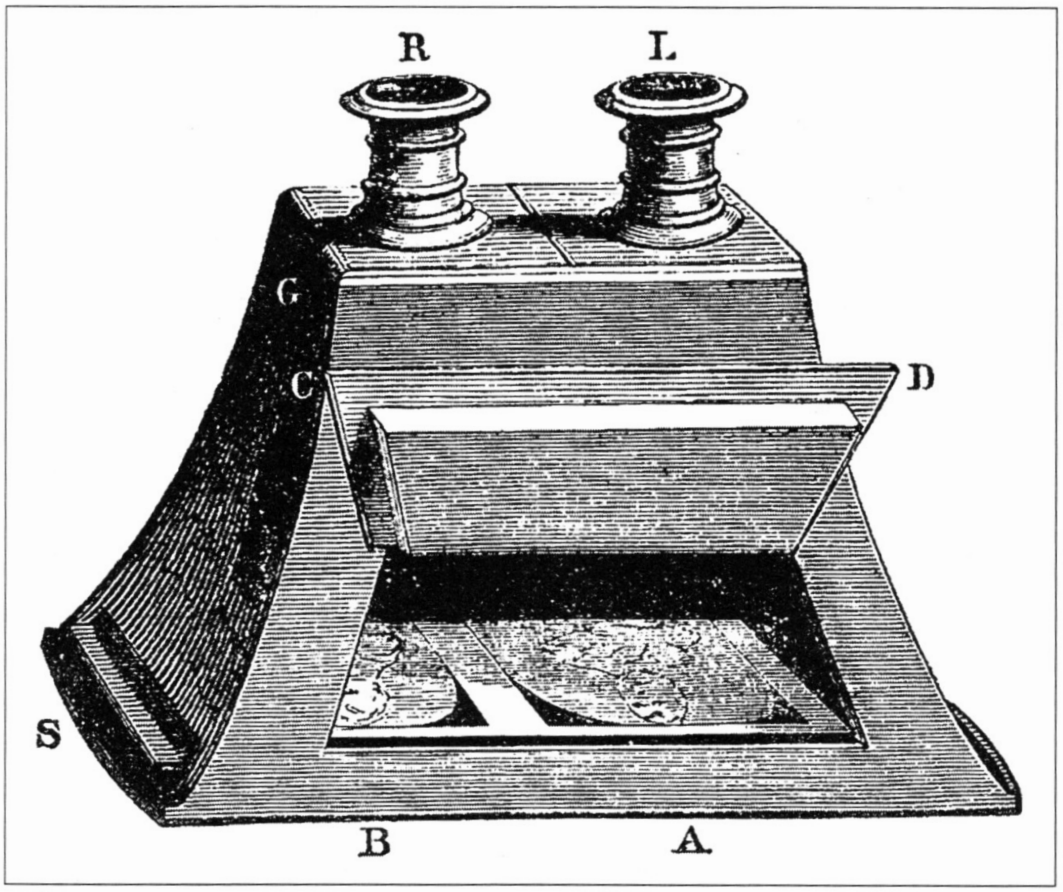
Stereoscope by Charles Wheatstone in 1833 (Zone, 2007, 6)

Even though it is evident, as the above examples demonstrate, that binocular disparity had been acknowledged and studied from the times of antiquity onwards, **Jonathan Crary** argues that it only became a central scientific problem in the 19th century. (Crary, 1990, 118 -119) According to Crary, the researchers of the time were interested in the question of how humans experience a single image when eyes provide two differing images. ”Two alternative explanations had been offered for centuries: one proposed that we never saw anything except with one eye at a time; the other was a projection theory articulated by Kepler, and proposed as late as the 1750s, which asserted that each eye projects an object to its actual location.” (Crary, 1990, 119) In the 1830s arose a need for precise measurement of the human visual capacity. The modern theory of stereoscopy was published in 1838 by Sir Charles Wheatstone when he released his historic treatise called *Contributions to the Physiology of Vision, Part the First: On Some Remarkable, and Hitherto Unobserved, Phenomena of Binocular Vision*. According to Crary, ”Wheatstone’s conclusions in 1833 came out of the successful measurement of the binocular parallax, or the degree to which the angle of the axis of each eye differed when focused on the same



Stereo Drawings by Charles Wheatstone, 1838 (Zone, 2007, 8) In order to demonstrate the stereoscopic effect with out an interference from monoscopic depth cues like shades or textures, he used line drawings of abstract shapes.

point." (Crary, 1990, 119) Importantly Wheatstone also noted that under most conditions human beings were able to synthesize retinal disparity into a single unitary image. (Crary, 1990, 119) In all fairness, Ray Zone notes that the originality of Wheatstone's work was called into question by **Sir David Brewster**, a scientific rival to Wheatstone at the time. (Zone, 2007, 9) Despite the accusations made by Brewster, Wheatstone was able to observe the emergence of sensation of depth within a drawn pair of two-dimensional pictures. (Wheatstone, 1838) The following year saw the birth of still photography and soon after photographs replaced paintings and drawings in devices designed for viewing stereoscopic images. Whereas Wheatstone's reflecting stereoscope had been a scientific instrument making use of pictures intentionally devoid of traditional allusions to depth and unconcealed operating procedures, the systems utilizing common photographs and hidden mechanical structures, such as the lenticular stereoscope developed by Brewster, were commercially more appealing. (Gitelman, Pingree, 2003, 119, 123) These techno-



Lenticular stereoscope by David Brewster, 1851 (Zone, 2007, 11)

logical advances paved the way for cheap and high quality stereoscopic apparatuses to penetrate the mass markets of entertainment in the United States of America and parts of Europe during the latter half of the century.

After the peak of stereoscopic activity in the latter decades of the 19th century, the techniques and the apparatuses began to lose their appeal as a common form of entertainment. Although it is speculated that the close relationship between stereoscopes and ”indecent” subject matter, such as pornography, was in part responsible for the decreasing popularity of the apparatuses, Crary sees other, more profound reasons for the demise of the stereoscopic mode of visual consumption from the late 19th century onwards. (Crary, 1990, 127) Crary refers to certain social changes in the trends of using visual imagery and optical instruments. Stereoscopes of the time were not ”phantasmagoric” enough, meaning that the stereoscopic devices and their operating procedures were too tangible and explicit to the viewers and audiences. The unavoidable physical interaction with the equipment that was designed to produce the stereoscopic effect became increasingly unacceptable. (Crary, 1990, 132-133) Crary makes the claim that due to the fundamental independence of the camera apparatus from the spectator the simple two-dimensional photographs, which seemed to be a continuation of older pictorial codes, defeated the apparatus of stereoscope as a preferred mode of consuming visual imagery. (Crary, 1990, 133-134) Especially for the latter comment it is important to note that Crary’s views have been called into question, for example, by the likes of **Laura Burd Schiavo**. She argues that even if nineteenth century scholars overstated the proximity of stereoscopy and photography to a degree, Crary’s interpretation proceeds too far in the exact opposite direction. According to Schiavo, Crary does not recognize the centrality of photography to the success of stereoscopic applications and fails to see how the distinctions of the two media were entangled in the operations of commercial stereo-photography. (Gitelman, Pingree, 2003, 119, 121)

Despite the differences of opinion regarding the roles and concepts of stereoscopy and photography, both Crary and Schiavo acknowledge the philosophical revolution stereoscopic principles caused within the theory of vision. Though later submerged by the commercialization of stereoscopy, Schiavo claims that the initial objective of Wheatstone’s stereoscope was to bring up fundamental questions concerning the reliability of vision

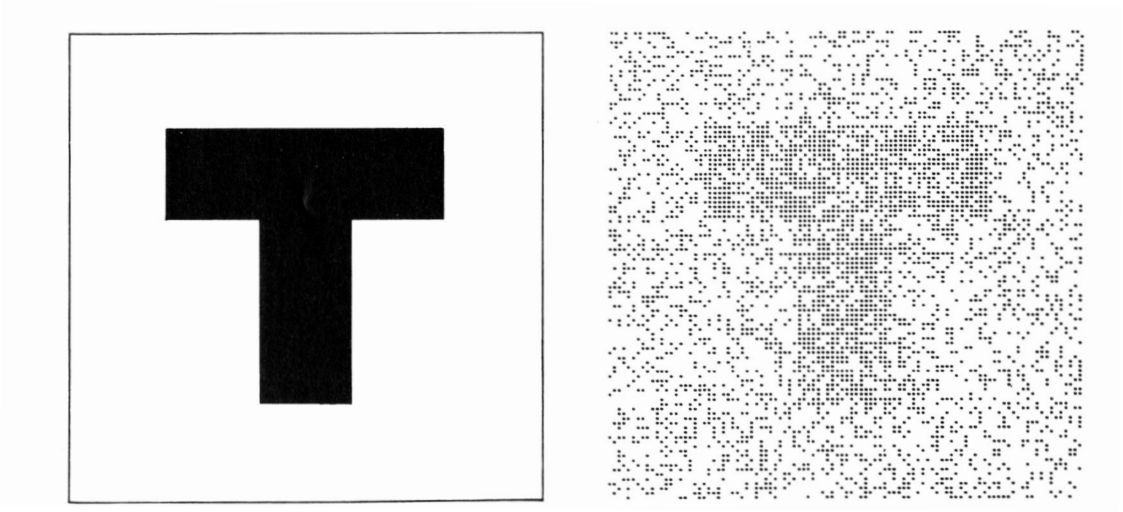
and the premises of prevalent theories constructed centuries ago. Based on Wheatstone's work, mid-nineteenth century gave rise to an autonomous discipline known as physiological optics. Instead of concentrating on the mechanical aspects of light and optical transmission, this field of study was interested in the role of the body in the process of vision. (Gitelman, Pingree, 2003, 113-116) Crary describes this development of the discipline as vision's shift from presuppositions of timelessness to instability and temporality of the physiology of the human body. (Crary, 1990, 70) For centuries the theory of vision was based on the idea that there was a direct correspondence between objects and their images on the retinae. But evidence brought up by Wheatstone's experiments implied otherwise, in that they demonstrated an interrelation between stimulus and sensation. The resulting model of vision explained sight as an interaction taking place between the body and the world – both being considered as active components in producing the phenomena of vision. (Gitelman, Pingree, 2003, 116-117) Crary also sees a link between developments made in the theory of vision and the contemporary progress that took place within a broad philosophical discourse concerning epistemological issues. (Crary, 1990, 98) In this regard it can be argued that – in addition to the study of vision – Wheatstone's work contributed to considerable philosophical orientations originating in the nineteenth century.

2.2 Stereoscopy in the 20th Century

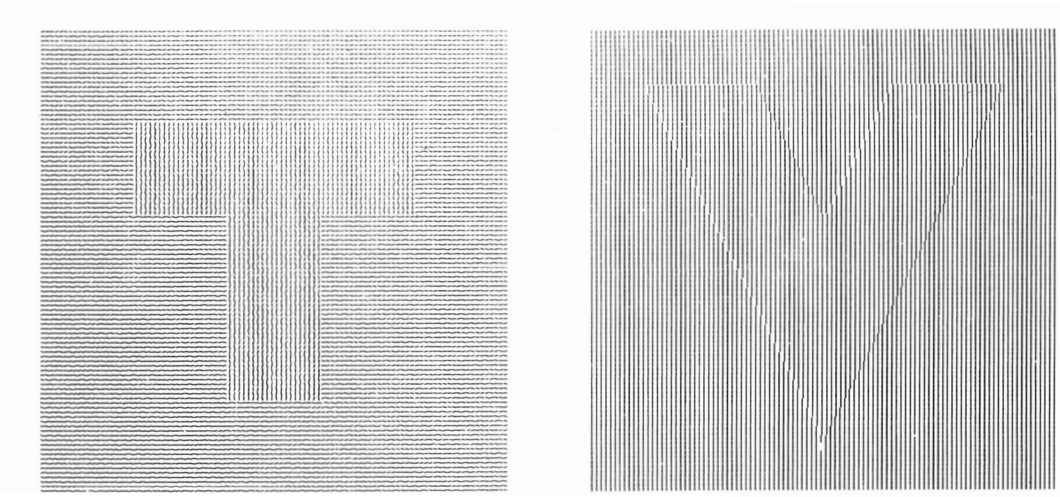
The greater part of the 20th century was a subdued time for the field of stereoscopic culture – at least in the mainstream frameworks of technological development, entertainment, science, and the arts. Regardless of the fact that in the 20th century the rise of cinema and television generally resulted in an ever diminishing interest towards stereoscopic applications and their usefulness, the improvement of stereoscopic techniques continued uninterrupted. Also, attempts to reignite the broader stereoscopic culture (mainly within cinema) were constantly being made throughout the century. According to Ray Zone, the novelty period for stereoscopic cinema lasted until the year 1952, up to which a bewildering variety of technological strategies for creating stereoscopic motion pictures were attempted. Only a few stereoscopic feature films were made in the first part of the century, as most stereoscopic productions of the time were short films with emphasis on the gimmick of the off-the-screen imagery. (Zone, 2007, 1-2) From a 21st century

standpoint it is important to note that the question of the role of the stereoscopic effect in visual productions and products was already being discussed in the early decades of the 20th century. ”During this period of technological progress for the stereoscopic motion picture, there was an aesthetic tug-of-war between the technical and the narrative demands of the medium.” (Zone, 2007, 2) The latter part of the 20th century began with a brief phase of stereoscopic uptrend backed by major operators in the industry of motion pictures. Ray Zone provides a short description of the scale and the duration of this era of acceptance and also his opinion on the main reason behind the quick demise of the widespread implementation of the stereoscopic effect into the art form of cinema: ”With more than fifty stereoscopic films released between 1952 and 1955, William K. L. Dickson’s vision of a crowning realism became a motion picture reality. Cinematic storytellers employed with varying results the expanded narrative palette that the stereographic motion picture presented. The stereoscopic films of the 1950s, using the Academy aperture and converging binocular axes, created awareness of the stereo window bounded by edges, a floating window on another apparent reality. When the exhibitors and studios elected to pursue Cinemascope with its (2:55 to 1) wider screen, the classical Hollywood frame was broken, along with the 3-D film.” (Zone, 2007, 2) New producers and improved technological formats would spur other periods of enthusiasm towards stereoscopic movies in the 1970s and the 1980s. Unfortunately, these periods lacked major mainstream success or long term popularity. (Mendiburu, 2009, 7)

Although it is undeniable that cinema and other formats of moving pictures were the platform for the majority of the development of the stereoscopic applications during the 20th century, there were other fields of study where the stereoscopic principles were of considerable interest. An example of an important study of stereo-optics and the use of stereoscopy outside the entertainment industry is the work of experimental psychologist Bela Julesz. He focused on the physiological psychology of human visual perception – in a pronounced continuation to the works of Wheatstone and the likes over a hundred years earlier. Starting in late 1950s Julesz constructed a specified psychological methodology called ’Cyclopean Perception’. In distinction from other uses of the term ’cyclopean’, which might refer to anything from mythical creatures to identical binocular directions, Julesz takes the liberty of using the term to denote a central processing stage inside the brain, which has a concrete neuroanatomical existence. (Julesz, 2006, xv)



Examples of stimulus portraying information by brightness gradient and texture-density gradient. (Julesz, 2006, 17)



Examples of weak cyclopean stimulus portraying information by line segment orientation and by brakes in lines drawn in the vernier acuity range. (Julesz, 2006, 18)

An example of strong Cyclopean stimulus. Monocularly observed the images appear random, but when stereoscopically fused information appears. (Julesz, 2006, 21)

Julesz was interested in tracing the flow of information in the human visual system – and particularly in the separation of peripheral processes taking place on the physical retinae from the central (cerebral) ones. (Julesz, 2006, 6) To accomplish these goals Julesz had to develop new stereoscopic tools called random-dot stereograms. (Julesz, 2006, xiii) The studies conducted by Julesz in Bell Laboratories from the late 1950s to early 1970s present a notable case, where the interconnected relationship between theoretical thought and technological development have fuelled scientific advancements and provided new possibilities to several areas of visual culture. Julesz was among one of the first scientists to take advantage of computers and their potential in generating a completely new visual imagery. Julesz acknowledges the attempts to develop similar techniques without the use of computers, which took place prior to his work and employed hand painting, and in another case paper disks. However, techniques dependent on human hand coordination can never reach the detailed accuracy of computer generated imagery and always contain imperfections in a scale observable to the human visual system. These flaws within the stereo pair of non-computer generated random-dot stereograms give rise to the monocular cues, which are precisely the kind of visual phenomena Julesz tried to avoid. (Julesz, 2006, 2) The complete elimination of peripheral processes of monocular cues was possible only with the aid of computers and essential to the practice of cyclopean stimulation. This practice is the forming of a percept at some central location within the visual system. Importantly, it is set forth by stimuli incapable of producing the percept at any earlier location. Using computer generated random-dot stereograms Julesz was able to portray information directly to a place in the visual cortex, where the right and the left visual pathways combine. Julesz describes this method similar to operationally skipping the interfering peripheral processes and providing stimuli only to the desired phase of the visual perception system. Julesz also emphasizes the fact that the use of terms like 'earlier' do not refer to any physical location. He is only publishing an information flow chart stating that if a certain process, B, uses the output of another process, A, it is logical to contend that A is before B. (Julesz, 2006, 3) Contrasting the traditional ways of mediating information in images by colour changes and variations in brightness, the binocularly portrayed patterns of random-dot stereograms constructed by Julesz have identical random texture to that of their surroundings. Thus the information is mediated only by depth changes. (Julesz, 2006, 2) In addition to physiological psychology, Julesz sees specialists from many different fields of interest, for example mathematicians and clinicians

focused on the defects of vision, benefitting from his methods and imagery. Importantly, Juelsz notes that his techniques can also serve designers operating with visualizations of complex surfaces and individuals working in the visual arts.

2.3 Development of Stereoscopy in the 21st Century

From a cultural and social standpoint it is too early to tell what will be the result of the latest uptrend in the use and acceptance of stereoscopic applications in the new millennium. It is clear, however, that only after the year 2005, which Ray Zone considers as the beginning of the fourth general era of stereoscopic cinema, did the digital technologies make it possible to cost efficiently resolve many of the technological challenges. These challenges were arguably a great cause restricting the wider acceptance of stereoscopic applications and techniques in the film industry and elsewhere during the last century. (Zone, 2007, 4) However, even if capturing, generating, editing, and projecting stereoscopic material has become a plausible option to almost any type of visual production, one considerable and arguably undesirable technological hurdle still remains even today – namely the specified glasses that are mandatory in the majority of current stereoscopic presentations. The attempts of companies producing stereoscopic equipment to design fashionable shapes for the glasses, or to have the glasses perceived as items of additional value, have not manifested in a mainstream admiration for the technique. In this respect, the glasses can be viewed as the last string combining the current systems to the cultural shortcomings of their historical counterparts, such as the Holmes stereoscope. The considerable efforts by the industry of manufacturers of stereoscopic displays to develop a high quality and adaptable auto-stereoscopic system, which would make the specified glasses unneeded, can be viewed as evidence for a broad based desire to achieve similar independence to that of photography. That is, a supposedly transparent and incorporeal intermediary forming a relationship between observer and the world in a manner described by Jonathan Crary. (Crary, 1990, 136) The applications having advanced the furthest in this quest for auto-stereoscopy are small handheld video gaming consoles produced by companies like Nintendo. While achieving the stereoscopic effect without the aid of the glasses for a single viewer has been proven functional based on current technologies, the situation is different amongst bigger screens and displays catering to a large number of spectators simultaneously. Patents for different types of solutions

claiming to achieve the stereoscopic effect for a number of viewers without any external equipment are pending, and some have also been issued already. Whether these proposed new solutions to a problem of engagement first encountered over a century ago will prove economical, functional, and in demand from audiences, remains to be seen.

Even in the absence of an effortless auto-stereoscopic experience and in contrast to the unfavourable reputation of a quickly passing fad, the mainstream audiences of popular culture have, to a certain degree, accepted stereoscopic representations as a serious format in the first decades of the 21st century. Although it should be noted that the reception has arguably been mixed within different medias and cultural areas. For example, whereas 3-D movies have become a standard for cinemas and production studios alike, the adoption of stereoscopy in TV broadcasting has so far been a failure. In comparison to the dominant forms of visual entertainment, other areas of society, such as medicine, industrial production and art, where the benefits of the stereoscopic effect more decidedly outweigh the discomfort of wearing special equipment, have open-mindedly embraced the novel possibilities the digitalization of our culture can offer. It remains to be seen whether this latest stage of technological development, social acceptance, and professional demand will result in an age where special mentions of stereoscopic content, such as 3-D, will disappear from advertisements and labels the way special notifications of colour and sound disappeared when they became technological and cultural standards in audio visual products during the 20th century. Regardless of the future development of stereoscopic applications within the broad social context, the current stereoscopic tools available for general public offer adequate ways to conduct a wide range of operations in many different areas of interest – especially in the visual arts.

3. Framework of the Study and the Artistic Production

As the historical evidence suggests, the development of stereoscopic principles are amalgamated with the advances made in the philosophical naturalism in the nineteenth century. It is important to note that one of these theories, emerging over a hundred years ago, namely pragmatism, is an initial inspiration for the whole of this study. Some of the core ideas of pragmatism also function as a guiding framework for the artistic production constructed in this study. Therefore, an overview of the main themes of philosophical naturalism and pragmatism, as well as internal demarcations of these particular orientations of thought, is necessary in providing elucidation to the defining solutions that are made during the assembling of the artwork. Also, the theories of pragmatism contribute considerably to the final reflection of the entire process and its outcomes. After an overview of philosophically relevant distinctions of concepts follows an examination of artistic frameworks within which the artwork produced in this study can be situated. Despite being absolutely essential to this study, neither philosophical naturalism nor stereoscopic principles can function as a suitable concept for locating the artistic production in the field of visual arts. For this purpose a relationship between the artistic process of this study and a particular area of artistic interest should be established. An example of a movement that possesses similar aspects to those embedded in the artwork of this study is optical art (or 'op art'), which configures its own criteria for an artistic style. Another way to approach the artistic context is to examine how the use of digital technologies relates this study with the field of new media art. The ambiguous nature of the term 'new media' demands a detailed examination of the features that can be viewed binding this study to the world of new media art. The last analysis in the process of outlining an artistic framework for this study is also the most narrow – in a sense that it highlights an individual artist as a representative of a movement instead of focusing on broader artistic concepts. In conclusion of the chapter, a short synthesis of the philosophical premises and the artistic framework is devised.

3.1 Philosophical Framework of the Study

Broadly defined, the philosophical framework for this study is naturalism. **Jack Ritchie** reflects on the term 'naturalism' and states that despite the diversity of views and theories the term encompasses, there are some common factors that all naturalists share. For example, science and its achievements are admired to a point where they are generally considered as the only acceptable starting point for philosophical theories. (Ritchie, 2008, 195 -196) Ritchie also presents justification for his statements by claiming that especially in epistemology, and in comparison to past philosophers, science has been proven preeminent in describing the world and providing methods for ontological inquiries. (Ritchie, 2008, 200) Describing more distinct features of naturalism, **Pentti Määttänen** points out that critique against Cartesian dualism, which declares mind's independence from the natural world, is a common factor amongst all orientations of naturalism. (Määttänen, 2009, 12) According to Määttänen, the premise of naturalism is that the object of knowledge is the world in which we live in and that this world is causally closed, meaning that causal relations outside nature cannot affect the way events in nature take place. More specifically, within one subsection of naturalism, namely pragmatism, the object of knowledge is defined as a relation between two situations mediated by action and the acting agent is considered as a part of the object of knowledge. This view of the concept of knowledge is prospective instead of retrospective and radically different from the epistemologies proposed by the classical orientations of philosophy. "From these premises follows that all parts of reality are in principle, but not necessarily in practice, available for experience through sensory stimulus or other material instruments. There is no reason to presume objects of knowledge that are only thought to exist because there is no evidence of existence of such objects." (Määttänen, 2012, 2009, 13, 16) Within the framework of naturalism, preconditions for acquiring knowledge are not a priori concepts and -categories, but the biological features of life forms and the cultural qualities of the use of instruments and symbols. (Määttänen, 2009, 15) Importantly, Määttänen also notes that the withdrawal from methods relying on the concept of a priori does not necessarily mean a commitment to the methods of natural sciences. (Määttänen, 2009, 19) In this regard it should be noted that the term 'naturalism' is merely a hypernym for several different philosophical approaches which, despite the fact that they share some common premises, can be contradictory to one another.

As such, the vague concept of naturalism alone is not a sufficient characterization for the philosophical background of this study and a more detailed description of the specific type of naturalism is required. Therefore, it is more accurate to say that this study is based on theories of pragmatism and especially those envisioned by **John Dewey**. It is also necessary to define the type of pragmatism because, like naturalism, the term 'pragmatism' is ambiguous. In the dichotomy of pragmatism, Dewey's thinking represents the soft approach, in which culture is seen as a product of nature and as a process taking place within nature. Dewey's approach denies any transcendent origins of culture and suggests that bodily and symbolic functions are entangled in a manner that makes separation of culture and nature from each other untenable. In addition, Dewey argues that the complex mechanisms of intertwined relations between human thinking and the order of nature are within the grasp of empirical observations made by scientists – even if they can not be distinctively separated as autonomous categories. (Määttänen, 2009, 25) From these aforementioned premises follows pragmatistic theory of art, in which art is considered as a specific type of *an* experience. According to Dewey, these experiences reach fulfilment after the experienced material has run its course. Thus, it ends in a consummation instead of a cessation. In contrast to the less developed and continuous experience of a live creature interacting with the surrounding environment, essentially living, an artistic experience is a particular form of an experience that is in itself complete. It is clearly and consciously distinguished from what took place before and what happened after. (Dewey, 2005, 36-37) The most essential part of this pragmatistic theory of art is the differentiation of art objects from works of art – the former having physical existence and functioning as an initiator for the latter, which is an experience and not a physical object of any kind. The previous statement is a definitive argument about the type of existence of works of art, according to which it is impossible to hang works of art on the wall – this is possible only for art objects. (Määttänen, 2012, 103, 156-157) However, works of art and art objects are not completely separate entities, because true works of art constitute from developing of an experience based on the interaction between organic and environmental circumstances and energies. (Dewey, 2005, 67)

The concept of work of art in pragmatism results in important notions about the possibilities and restrictions of art in general. First, and the most profound, is the epistemological duality of viewpoints, in which the physical is separated from the conceptual.

The ontological difference between the two is that the conceptual viewpoint is subject to change and possible to overcome by altering the ways of thinking, but the physical comprises of biological structures that human beings cannot reform by thought. The latter bounds the produced viewpoint to the physiology of the body and the mechanical instruments built by humans. In essence, this theoretical approach admits the difficulty of comparing viewpoints and gaining objective knowledge. However, even if the conceptual viewpoint is apparently subject to relativism, the physical viewpoint provides an objective basis for evaluating the conceptual components. Arguably the human body, along with other appliances that expand the ways of experiencing the world, are objective facts in the very same physical world which they observe. In short, the pragmatistic theory states that things can be thought in a great diversity of different ways, but in order to gain a status of relevance these lines of thought must have an established connection to the physical world in the form of empirical evidence. (Määttänen, 2012, 124-125) The second significant observation, which builds upon the former, regards communication. This world, in which we operate, and the signs within it are the same for everybody as physical objects. As signs have principally the same physical foundations to one another, whether they are letters in a book or art objects in a museum, they possess the potential to produce alike experiences in human beings. The similarity of aspects such as biological structure, environment, and social conduct, contribute to the assumed correspondence of experiences in different individuals. These connections between the objective entities of physical world and the operations of an individual mind make it possible to use signs to direct the experience of audiences in a desired direction. (Määttänen, 2012, 123, 126) The third crucial point is that despite the evident similarities in the components contributing to the formation of a conscious experience, the theory of pragmatism does not suggest that any isolated case of a perceived experience is identical to any other, even within the same person. Dewey concludes that even though the origins of all experiences can be traced back to the interaction of live creatures and their immediate surroundings, no experience becomes conscious if meanings arising from prior experiences are not involved in the process. (Dewey, 2005, 283) Thus, previous interactions and their observed outcomes result in meanings that provide tools for creating the outset for current interactions and influence interpretations forming the present experience. Referring to these notions, Määttänen clarifies that there are no two identical instances of interaction, since all occurrences cultivate the habits of engagement. Therefore, even the most infinitesimal

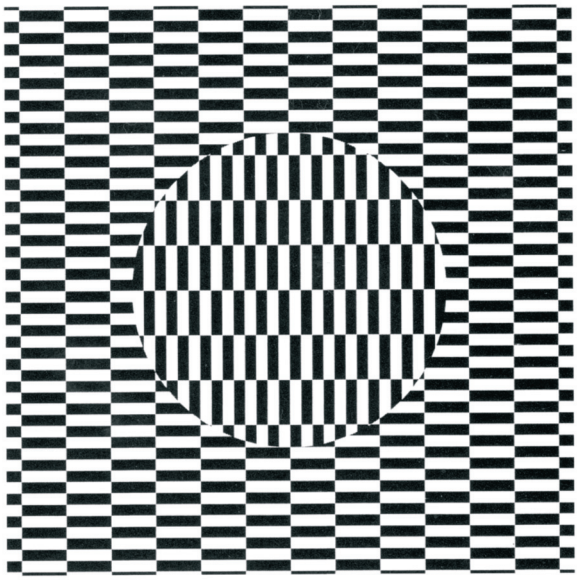
differences in the gestalt of the situation can produce variations in interpretation and so also in meaning. (Määttänen, 2012, 114) Thus, the experience that constructs the work of art in pragmatism is therefore always in flux of the evolving world and its constitutes. Despite being devoid of a status of eternal perpetuity and universal uniformity, the artwork is not a completely arbitrary experience, but one that is founded on the confinements and the possibilities of the physical world and the social conventions of human beings.

There is one more aspect of pragmatism that needs to be analysed due to its importance to this study: namely the concept of experience in a more broader sense than that of a work of art. Instead of a narrow definition of experience as merely sensory stimulus, pragmatism suggests an expansion of the term to cover action and its preconditions as well as resulting outcomes. This approach re-evaluates the relationship between the subject and the object of knowledge that the theories of traditional philosophy have held on to for centuries. In pragmatism it is argued that as an active participant in the processes of the world, the subject of knowledge is an equal object of knowledge to other components of the actual world. Bodily functions are an inseparable factor in the network of interactions which constitutes the world. The former statements describe the premise for the concept of experience in pragmatism and emphasizes the fact that even if conceptual components, such as linguistic signs, do play their part in the processes of interaction, the physical structures of the world, like sensory organs and external equipment, precede any conceptual elements in constituting the human experience of reality. Action serves as an intermediary for discovering and affirming the objective conditions that are considered as the focus of experience. The constancy in the relations between situations and the relational permanency of conditions function as a basis for establishing stable operating procedures in the world. The repetition of nearly similar occurrences of events control the structure of actions and experience. (Määttänen, 2009, 44, 49, 53) Regardless of the fact that Dewey accentuated the unique nature of an individual event of an experience, he distinguishes a case of experience which time after time recurs identically to an observer, and is fundamentally different from perception. This is the instance of mechanical repetition, or routines, not present in the consciousness and thus excluded from the scope of Dewey's inquiry into the concept of art as a special type of an experience. (Dewey, 2005, 284) The former is an important distinction about the operating human being, who mostly consciously reflects the kind of experiences that contain observably relevant quali-

ties – whether the relevance arises from the physical structures of the world or the immaterial constitutes, for example, introspection of relations.

3.2 Artistic Framework of the Study

Regarding the artistic context, the artwork of this study contains several features that come close to the characteristics of the optical art movement. This approach to art had adopted findings of perceptual psychology as an initial basis for creating works of art and aspired to uncover non-obvious abstract circumstances. Even though optical art (more commonly known as op art) saw its most prominent development in the late 1950s and was established as a true form of art with an accompanying exhibition in the Museum of Modern Art in New York in the mid-1960s, the field of so-called optical tricks is a vast one and cannot be confined to a single movement or to a span of two decades. (Nyström, 2006, 7-9) In addition to the recognition of art institutions and audiences, the fact that op art had clear objectives, and also explicitly articulated programs for achieving those objectives, provides a compelling reason to consider op art as an independent movement within the historical traditions of visual arts and optical experiments. An examination of the procedures of op art clearly show that there is an apparent similarity between the fundamental aims of op art and the purpose of the artwork constructed in this study. According to **Stig Nyström**, the op artists strived to ”provide novel visual insight” and this was mostly done with strong static shapes like squares and circles. (Nyström, 2006, 10) Both of these notions, the requirement for new visual combinations and the use of specific symmetries, apply as such to the art object of this study. Within the non-figurative and abstract world of op art there is a sub-genre called kinetic illusions, or virtual kinetics, which has even more fine-tuned connections to the artwork of this study than those of the broad basic principles of op art. Since the term ’illusion’ is in many ways problematic, especially with regards to the philosophical framework of pragmatism applied in this study, it is preferable to use the expression ’virtual kinetics’ in this context. Virtual kinetics is an area of visual culture where the science of vision and art blend in a manner that a specific work can function in both fields of interest without any alterations or cultural interference. Consequently, the works considered as virtual kinetics can be products of an artistic process or a neuroscientific inquiry. Regardless of their origins, the key point is to construct immobile patterns or shapes that give an impression of movement



An example of the art of virtual kinetics, where human sensory system detects movement in a static image. (Ōuchi, 1977)

when observed by a human being. In a similar fashion to the stereoscopic effect of depth perception, the perceptual movement of virtual kinetics arises from the reactions of the human visual system to certain types of stimuli. The brain constructs an impression of movement in a static image and the aesthetics of this formation of an experienced effect can be viewed as an artistic style. Though even if appreciating operations of stimulating the brain in order to construct a certain type of percept as an aesthetic form brings this study, not just technically but also artistically, close to virtual kinetics, there are apparent differences that prevent the artwork of this study to be labelled as such. Namely the fact that, according to Nyström, art objects of virtual kinetics can not include any parts that actually move. (Nyström, 2006, 10) In essence the principles of virtual kinetics precludes all forms of animation.

Whether op art is viewed as another short lived movement of the mid-20th century or a broader concept still evolving today, the uniformity of the basic principles of op art and the artwork of this study cannot be overlooked when an artistic framework is being identified. Also, the links to psychology and theory of vision that bind op art to the broader culture of vision are generally of the same type as those found in stereoscopy. This means that the connections are intertwined in an especially complex manner and that strict borderlines between artistic, philosophical and scientific qualities are difficult to distinguish. Therefore, even if the concept of op art does not comprehensively place the stereoscopic

animation developed in this study to a clearly defined position in the field of art, the awareness of the similarity of the goals and methods used in both does denote a specific point of view.

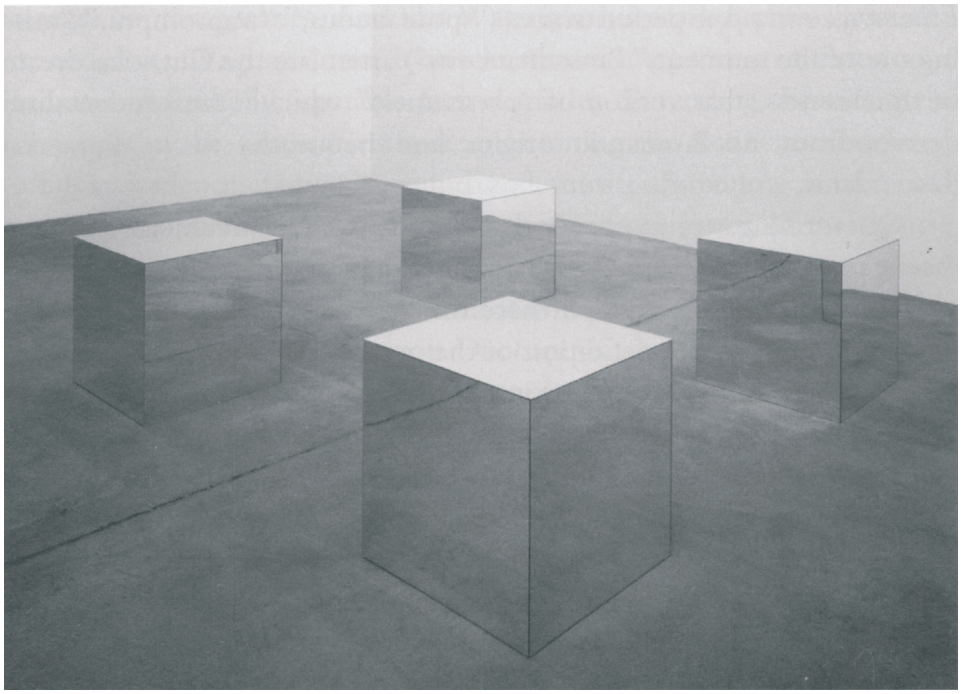
The previous description of the identification of the type of experience and aesthetics arising from specific operations of the brain in relation to certain stimulus is one way to discern an artistic framework for this study. Especially since a central philosophical premise of this study is the acceptance of the notion that a work of art is not a mere physical entity but an experience based on the relationship between an art object and the observing individual – both contributing to the process according to their qualities. Another approach could be to take a look at the technological requirements for accomplishing the formation of the desired experience. Shifting the focus from the operations of the brain to the structures of the art object locates this study within the scope of new media art. With this approach, one of the challenges is to explain what is actually meant with the term 'new media'. Examining this problem **Lev Manovich** has come up with eight different answers ranging from a method for solving algorithms to aesthetics of modern media. To complicate matters further, Manovich notes that, if desired, even more categories can be devised. (Wardrip-Fruin, Montfort, 2003, 16) Based on these kinds of broad definitions of new media, the artwork of this study could be viewed as new media art simply due to the fact that a computer was involved in the process of constructing the art object. Despite the vague nature of the term, distinct connections to specific forms and conventions of new media can be established from the procedures taking place within the artwork of this study. **Roy Ascott** has exhibited interesting ideas regarding the role of scientific thought as a method for initiating artistic creation. According to Ascott, it is possible for an artist to make inquiries about the ways an organism, for example a human being, interacts with its surroundings, and also to contemplate issues like the relation of knowledge to a perception. (Wardrip-Fruin, Montfort, 2003, 129) However, even if both of these advices apply to this study, neither provides a consistent artistic platform, nor a clearly articulated technological context. For a comprehensive framework capable of encompassing artistic qualities as well as technological orientation Ascott suggests turning to cybernetics. From a 21st century viewpoint the term cybernetics may feel outdated and inarticulate, but generally the concept has been understood as a transdisciplinary way of analysing regulated systems as well as their limits and possibilities. Ascott's explicit

encouragement relies on his argument on the absolute necessity for an artist to embrace science as a tool as well as a reference in order to ”fully orientate himself in the modern world”. He also views cybernetics as an integrative program and describes its role as a co-ordinator of science being analogous to the way art is a co-ordinator to experience. (Wardrip-Fruin, Montfort, 2003, 129) It is debatable whether cybernetics is an actual science or not, but arguably Ascott’s description of the program contains several key interests that can be linked to this study. The first important question is ’what systems do?’ – or in other words ’what is the change in the world that takes place due to operating of a system?’ (Wardrip-Fruin, Montfort, 2003, 129) In case of the artistic process of this study, the objective is to alter existing ways of observing spatial dimensions, which in turn can function as a catalyst for an artistic experience. This answer to the first question is also especially well aligned with another feature of Ascott’s declaration, namely the cybernetic aspiration for radically transforming our conception of the world through new modes of perception and qualities of experience that the use of man-made mechanical systems generates. (Wardrip-Fruin, Montfort, 2003, 130) A third point is related to the characterization of the cybernetic method, according to which concepts are generally exteriorized in a concrete form. This means that, like in this study, models utilize hardware as their basis. (Wardrip-Fruin, Montfort, 2003, 129)

The particular connections of this study to new media art and cybernetics have to be identified individually, because both concepts also comprise of several features not applicable to the artwork of this study. An overview of qualities commonly regarded as defining new media, but having to be considered as incompatible with this study, are important in elaborating the artistic framework. The first example of such a concept is network. This study is developed around a system that does not have a mechanism connecting it to other devices or systems. The apparatus constructed in this study is isolated from any other machine or network. Thus, all operating procedures are limited to the qualities of the art object and the observing individual. Hypertext-like qualities referring, or connecting, to matters outside of the art object itself are not a matter of interest in this study. The second feature setting the artwork of this study apart from the conventions of new media is the absence of the possibility for an interaction between the mechanical apparatus and the observing individual. The audience does not have any means to adjust or control the actual processes taking place within the animation constructed in this study. The opera-

tional relationship between the audience and the art object has a fundamental relevance to the type of experience. For example, **Myron Krueger** has outlined an interactive art form based on response. According to Krueger, visual qualities of feedback should not be considered as art, since ”the only aesthetic concern is the quality of the interaction.” (Wardrip-Fruin, Montfort, 2003, 380) It is apparent that the structure of the art object of this study does not allow formation of an experience based on interaction, since the video installation can neither receive nor react to any stimulus coming from the engaging audiences. Yet another contradiction between this study and new media arises from the concept of new media as new avant-garde by Lev Manovich. He outlines essential differences between the modernist avant-garde of the 1920s and the new avant-garde of post media. According to Manovich, the former movement was concerned with creating new representations of the world and novel ways of seeing the world, whereas the new avant-garde of new media is focused on manipulating existing information. (Wardrip-Fruin, Montfort, 2003, 22) Some key features of new avant-garde, like simulation, visualization, and image processing, can be applied to this study, but a plenitude can not, such as for example data mining, search engines, and hypermedia. Therefore even if there are qualities in the art object of this study that combine it to the new avant-garde of post media, the fundamental principles of this study have more in common with the modernist avant-garde. The latter pursued new insight through creation of original material rather than establishing new connections between pieces of existing content in the manner common to new media. (Wardrip-Fruin, Montfort, 2003, 23)

The connections of this study to the artistic orientations described above form a framework within which the experience initiated by the operating structure of the art object precedes instances of visual aesthetics or styles. Though even if the visual appearance of the artwork of this study is mainly the result of the decisions made in order to control the experience brought up by a system utilizing stereoscopic principles, the art object does possess a gestalt or an overall appearance. As a video installation, the art object of this study consists of a defined physical space, where the projection of the animation takes place, and the space of the virtual world within the animation itself. Together these two parts form a setup visually reminiscent of minimalist art created by the likes of **Robert Morris**. Despite the fact that Morris constructed tangible physical items, and that the objects of this study are digital representations, there are apparent similarities.



Untitled (Mirrored Cubes) by Robert Morris, 1965. 1971 refabrication. (Bryan-Wilson, 2013, 20)

An examination of Morris' artistic interest provides insight into his minimalistic approach and also makes it possible to compare his motives with the ones expressed in this study. In his early sculptural works Morris was focused on simple but strong shapes occupying space, but also, and perhaps more importantly, on the different modes of occupancy and the ways they can be perceived. (Bryan-Wilson, 2013, 22) In describing art as an activity of change, Morris states his belief in the process of discovering new perceptual modes, in which willingness for confusion can be of service. (Bryan-Wilson, 2013, 153) This interest in novel means, even the obscuring and convoluted ones, for observing and experiencing space can be viewed as comparable to the integral aspiration of this study. In connection to the previous statement, Morris also discusses the sense of sight and its relation to our awareness of being bodies in space. Morris contemplates that sight is more, and different than, seeing, and that understanding follows from the bodily functions in a given environment. (Bryan-Wilson, 2013, 25) With an emphasis on the physical actions of the knowing subject, this epistemological stand is one that bears resemblance to the disposition of the philosophical orientation of pragmatism that provides the premises for this study as well. Taking into account the aforementioned features and outsets of the thinking of Morris, it is easy to understand why his work has been considered as

being cognitive instead of meaningful – and therefore temporal. (Bryan-Wilson, 2013, 17) Based on this short overview of the mind set of Robert Morris and his relation to artistic creation and intent, it can be suggested that perhaps the parallelisms between his theoretical approach of emphasising cognition and the ones applied in this study have resulted in similarities for the outer appearance of art objects. Though differences, such as the avoidance of the use of textured surfaces in the early works of Morris, can also be found.

However, correspondence to a portion of a single artist's body of work does not designate a specific artistic framework for this study. The vagueness of the framework and the apparent lack of a distinct historically recognized label pronounced by the totality of the examination of the different artistic orientations, from op art onwards, can be justified and even deemed as an advantage. For example, the criticism towards the notion of minimalistic art belonging to the established tradition of modernism, expressed explicitly by **Michael Fried** in 1967 (Fried, 1967), does not as such cause insurmountable problems for ascertaining loose connections in artistic practices and intents between this study and both of the historical conventions. Incompatible features of minimalism and modernism, exposed by Fried (Fried, 1967), would have had fundamental ramifications for the outlining of an artistic framework, if the artwork of this study would have been regarded as indistinguishable from or comprehensively defined by one or the other. Though as is the case, specific features of avant-garde modernism and ideological minimalism can be seen as complementary to one another in laying out a composite of an artistic framework comprising from thresholds rather than strict boundaries. Stating the previous does not imply that this study in itself should be regarded as a new artistic form or an independent category. Instead it points out the fact that behind a diversity of artistic approaches exists particular similarities in some of the initial conditions. The analysis of artistic orientations in this chapter reveals undertones that can be described as belonging to the philosophical naturalism. In correspondence to this study, op art, new media art, and minimal art are all concerned with the experience generated by the relationship between bodily functions and the surrounding environment – each in their own unique way. This conclusion indicates that, in case of this study, the philosophical framework outlined by John Dewey can be emphasised as a precisely defined starting point for a more adaptable and flexible artistic framework comprising of qualities belonging to a broad diversity of established categories of art.

4. Artwork of the Study

The initial idea for the artwork of this study arose from the propositions made in the theories of philosophical pragmatism. If the world consists of a network of relations between entities, and human experience is a based on the configuration of that network, then alterations in the relations of the constitutes of a human being should lead to changes in the perception of the surrounding environment. It should be noted that there is a substantial amount of varying opinions within the different philosophical schools of thought on the issues like the definition of an entity. For this study, the most advanced and specialized philosophical debates do not have to be resolved. The model for the world described above is a sufficient starting point for an artwork to be based upon, even if some factors of the model can be interpreted in a multitude of ways. With the art object of this study, the main idea is to construct a virtual environment simulating the process of eyes moving freely from the constraints of a human body. Since the human brain is not used to this kind of visual information, where in addition to the changes in the lines of sight, also the position of the eyes in relation to one another changes, the resulting visual experience can be challenging. On the basis of Dewey's theory of art as experience, the experience of the brain's struggle to make sense of unusual visual conditions brought upon them by the art object constitutes the work of art in this study.

4.1 Structures of the Artwork of the Study

Despite the fact that in this study the structure of the work of art subjects the audiences to visual conditions they are not used to, the aim is not to produce discomfort or any other negative sentiments. For even though the experience can be challenging, the composition of the animation is designed to bring up settings familiar to human beings. The form of the art object is animated video and it goes through different parts. Phases of confusing visual cues build up to periods of relative harmony of stereopsis – only to fall

back into a phase of extreme stereoscopic distortion where the brain is unable to form a sensation of depth. For this disintegration and emergence of stereopsis to take place in a way that it demonstrates the limits as well as the capabilities of our visual system, and in doing so produces desired artistic experience, it should be constructed on clear examples. Clarity is best achieved with simple shapes familiar to all human beings with functioning cognitive abilities. In this case the shapes are spheres, cones, and a cube. In contrast to the simplicity of the three dimensional objects, there is complexity in the textures used in the animation. The fractal and fractal-like textures are used because of their ability to generate necessary sophistication needed for a strong stereoscopic effect. Without the rich details there would be less information for the brain to form a sensation of depth, and therefore the stereoscopic effect could collapse too easily. If this were to happen, the balance between comfortable stereo-optic conditions and the confusing stimulus would be skewed too much in favour of the latter and the dynamics of suspension and release might suffer considerably. The fractal used in the artwork is also a type of a texture that does not contain shapes or forms resembling any pictorial elements that might distract the focus of audiences away from the overall appearance of the stereoscopic effect constituting the experience.

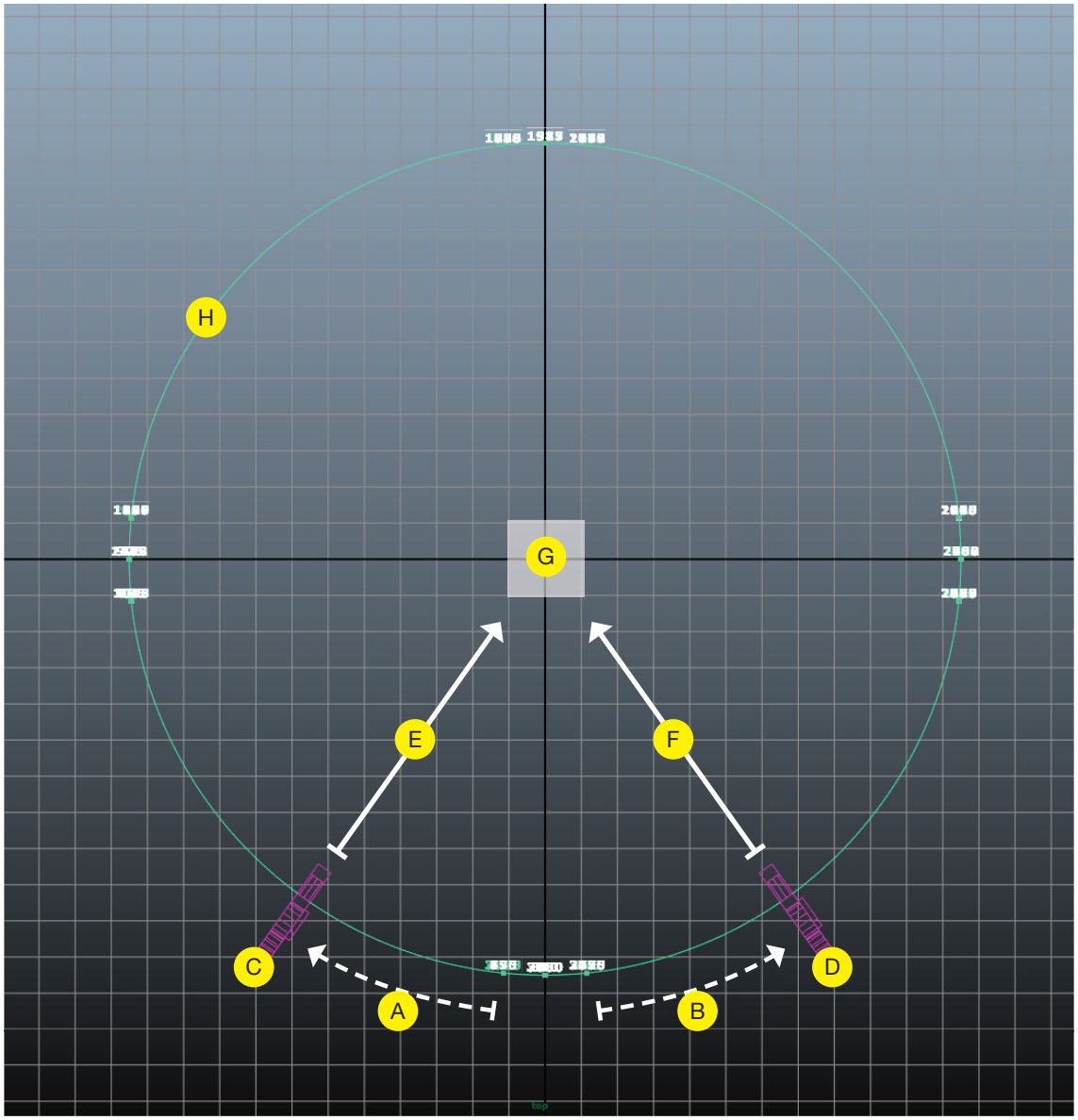
The fundamental simplicity of the inner structures is a theme that continues within the interface of the art object. The borderline, where human beings interact with computer-generated content, is a vertex that pinpoints the physiological and operational differences of the two systems. The constraints of human cognition and biological structure creates a bottleneck for the type of stimuli that can serve as a basis for our perception, and hence knowledge. Most of the interfaces between humans and machines aim to convert the wide diversity of signals, shapes, and dimensions processed by machines and computers to forms familiar to human beings. The conversion process described above serves the purpose of convenience, but does not necessarily entail a desirable outset for the artistic goals of this study. Purposefully challenging our conventions of perception and abandoning the desire for comfort defines the starting point for the structure of the art object created in this study. The previous statement does not necessarily result in complex forms of overall interaction, where the whole situation of engagement with the art object is confusing. In this study the challenge, as well as the possible disorder, is limited to the phase where the observing individual of the audience is already actively involved with

the system, which in itself can be described as straightforward. Prior to the part of the process where the observing member of the audience starts to encounter challenges of perception, she or he has already entered the physical space of the system, put the anaglyph glasses on fittingly and positioned him- or herself according to instructions. All of these operations are designed to be as simple as possible and devoid of any distractions or obstacles requiring special attention. There are different stages with varying degrees of challenge in the process of operating with the system of the art object of this study. To describe this in another way might be to state that with the art object of this study, the adaptation to virtual circumstances difficult to adapt to is made as effortless as possible. In essence: a comprehensively simple way to encounter a complex situation.

4.2 Construction of the Art Object of the Study

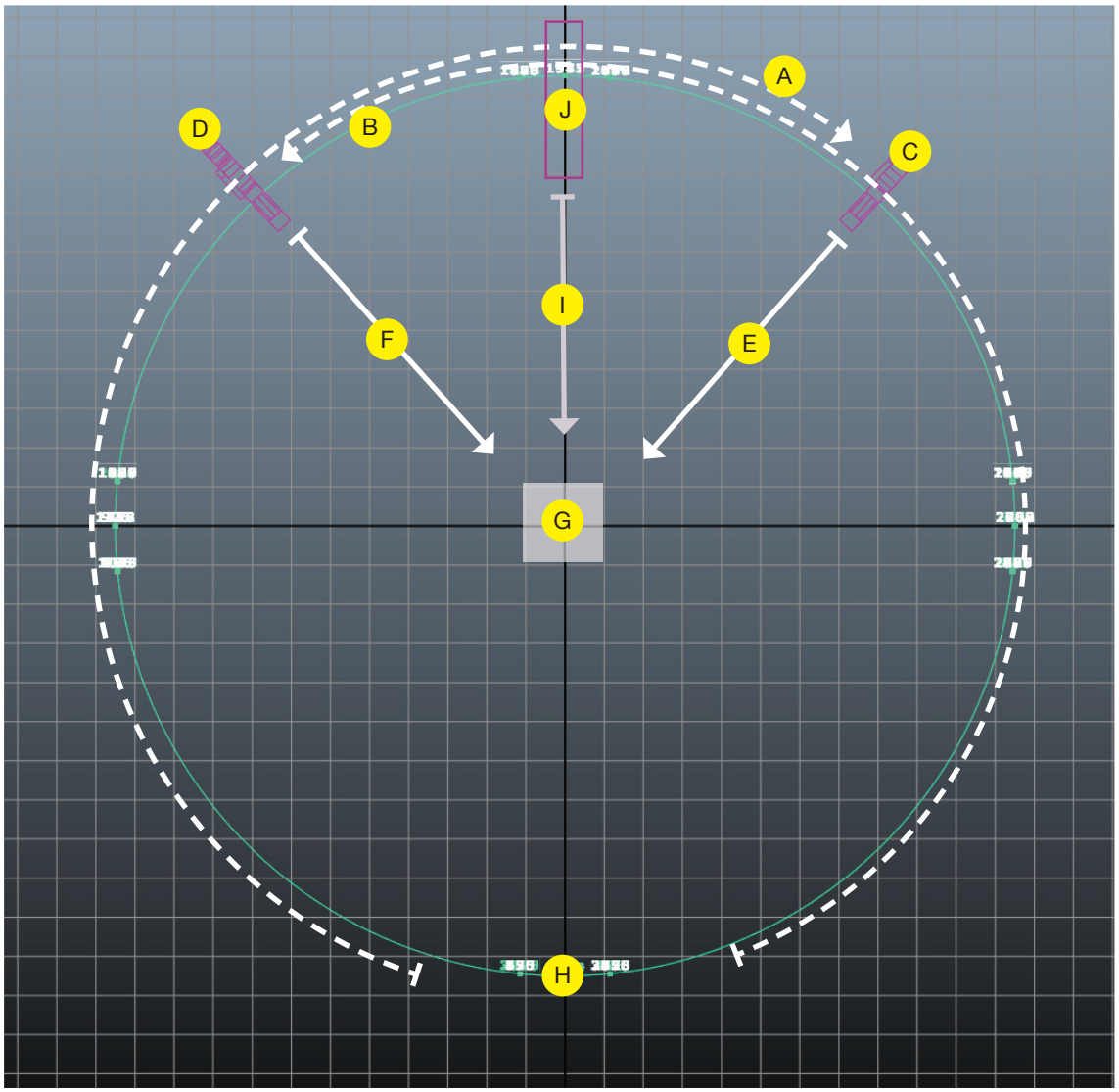
The very first issue in developing the art object of this study is to determine the type of paths the virtual cameras will follow. Since these cameras emulate human eyes, their movement in space is a determinative feature in creating the desired stereoscopic effect. Even though the aim of simulating free movement of an eye is to create distortion, this has to be done in a carefully planned way. Completely random paths for camera movement would result in extreme divergence for the two lines of sight and any occurrences of stereoscopic effect would be very rare – if it would take place at all. Therefore in this study, where the goal is to maintain the stereoscopic effect for considerable amounts of time, the lines of sight have to converge to common points of focus. Yet this principle does not determine the shape of the paths as such – it only necessitates that the cameras have to be directed in a certain way regardless of their position along a motion path. Since changes in the distance between the cameras and the object they are focused on are not required in the process of producing the stereoscopic effect, the spatial relations between the three main components remain symmetrical throughout the entire duration of the animation. In other words, even though the distance of the two cameras in relation to one another changes, they both have the same fixed distance to the object which is being observed. The previous guideline effectively leads to basic forms of minimalism that provide the needed clarity for the unusual visual stimulus. Therefore, the simplicity of the paths, as well as the orientations of the virtual cameras, is not utilized for the aim of creating a minimalist outer appearance, but to emphasise the unusual stereoscopic

PICTURE 1 – View of the scene set up from the top at around frame 600 of 3100



A. Direction of movement of the left eye camera along the motion path
B. Direction of movement of the right eye camera along the motion path
C. The left eye camera
D. The right eye camera
E. The line of sight from the left eye camera
F. The line of sight from the right eye camera
G. The observed object
H. The two identical motionpaths with the same cordinates

PICTURE 2 – View of the scene set up from the top at around frame 1750 of 3100

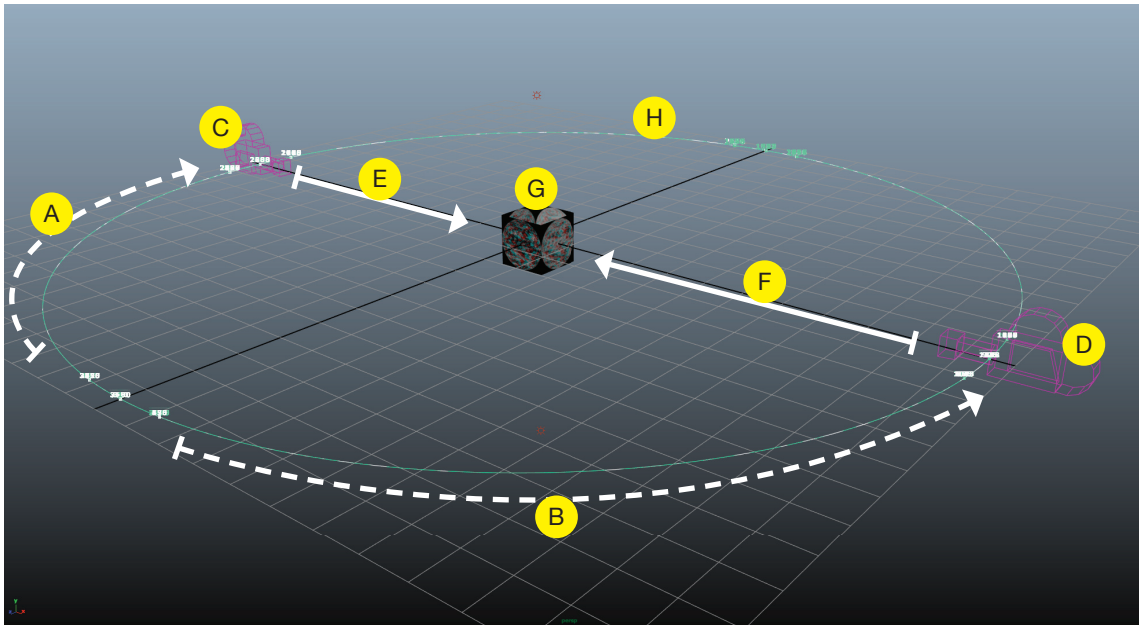


A. Direction of movement of the left eye camera along the motion path
B. Direction of movement of the right eye camera along the motion path
C. The left eye camera
D. The right eye camera
E. The line of sight from the left eye camera
F. The line of sight from the right eye camera
G. The observed object
H. The two identical motionpaths with the same cordinates
I. The common line of sight for both cameras at frame 1550/3100
J. The common position of the cameras along the motionpaths at frame 1550/3100

experience brought forth by the ongoing changes in the interaxial distance between the two points originating lines of sight. In order to explicitly demonstrate the effects of this process of virtually transforming the structures of the human visual system, all other instances of movement have to be kept to a minimum. If this was not the case, and additional movement or changes of shape in any of the components of the animation were to happen, it might be impossible to distinguish the movement generated solely by alterations in the interaxial distance of the two cameras from all other factors causing alterations in the image. This strive for producing a specific type of an experience through the use of a specific type of stimulus, and isolating interfering impulses, is the main reason for the minimalistic approach in the animated movement used in the art object of this study. Based on the previous statement, the two motion paths for camera movements are circular and occupy the same space. The only difference is that the cameras travel along the path in the opposite direction from one another, effectively mirroring each other's movements (Picture 1). This symmetry creates interesting situations impossible to achieve with real human organs, or any tangible components of the macroscopic world. Namely, there are phases in the animation, during which the two virtual cameras pass through each other along their 'orbits' around the observed object. Therefore there are moments in the animation, when both cameras offer identical images to the brain, which is obviously not achievable for any pair of cameras or eyes consisting of physical matter (Picture 2, J). The possibility to gradually fuse and detach the lines of sight is essential for the circular symmetry devised to avoid changes in the observable size of the object.

In this study, the three dimensional properties of the virtual object, observed with the pair of virtual cameras, are inseparably linked with the textures covering the object. In order to understand this relationship, both of these components have to be analysed separately. For the shape of the object, a cube is an ideal choice. First of all because it provides the needed variation for revealing and concealing features, and most importantly a cube allows this to take place symmetrically. In the art object of this study, the balance of emerging and disappearing stereoscopic effect and the resulting distortion is in great part based on the edges and corners of a cube. Another benefit of a cube with mathematically accurate contour is the large flat surfaces for clearly displaying images. This is necessary for extracting the desired distortions of a stereoscopic effect while avoiding others. In this study, four sides of a cube are covered with images. Since the virtual cameras

PICTURE 3 – View of the scene set up at around frame 1020 of 3100



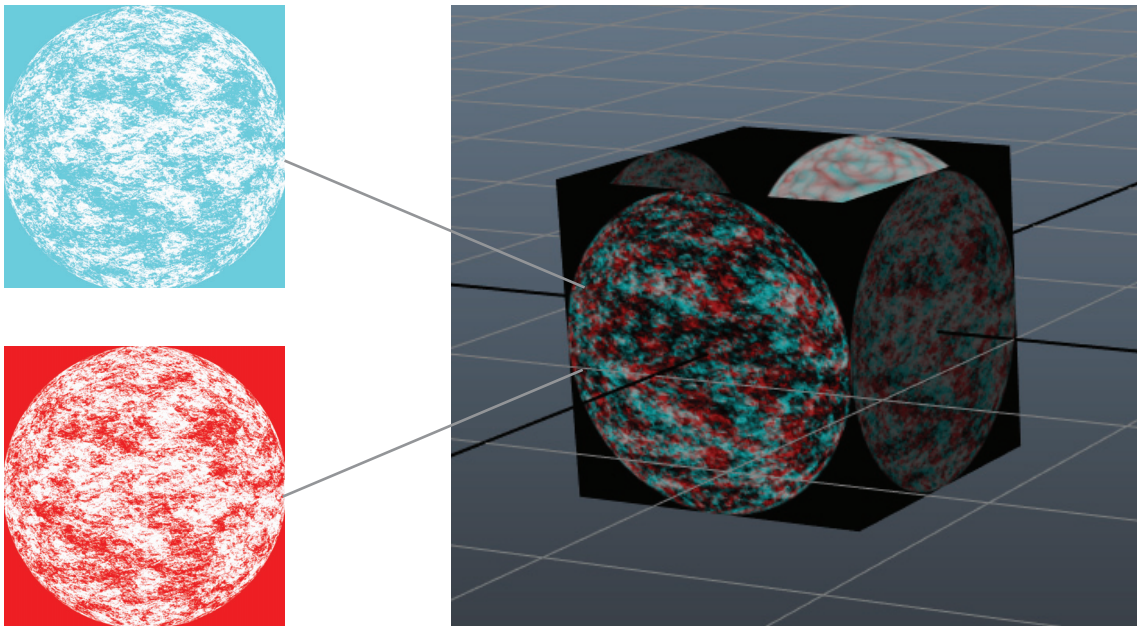
A. Direction of movement of the left eye camera along the motion path
B. Direction of movement of the right eye camera along the motion path
C. The left eye camera
D. The right eye camera
E. The line of sight from the left eye camera
F. The line of sight from the right eye camera
G. The observed object
H. The two identical motionpaths with the same cordinates

only move on a level horizontal plane in relation to the observed object, the top and the bottom surfaces of the cube remain out of view for the entire duration of the animation. This composition makes it possible to completely leave out the two. Even though there are four sides of the cube visible to the cameras, only three different images are used in covering these planes. The front and the back planes have their own unique images, while the left and the right planes display the same image on their surface. The latter is crucial for enabling the formation of the stereoscopic effect in a situation where the two cameras are located on the exact opposite sides of the observed cube. (Picture 3) If the images of the left and the right side planes were completely different, this phase of the animation, in which the lines of sight originating from the cameras are pointing straight towards one another, would result in an undesirable type of confusion. It would essentially be the same as showing a picture to one eye and a completely different picture to another eye,

and even if this does pose a challenge to the brain, in regards to this study, the challenge is of the wrong type. In the installation of this study there remains some common visual ground for both of the cameras throughout the animation.

The images covering the sides of the cube have a special function. They need to provide visual stimulus for the formation of the stereoscopic effect even in a situation where the movement of the cameras around the observed object distorts the proportions of the cube excessively. This is important for maintaining the proper balance of varying stereo-optical conditions. The still images themselves are not only textured ovals on top of a black background, but stereoscopic pictures of round spheres or cones in space (Picture 4). The figures on the front plane and on both of the side planes are essentially the same, only the areas of black and white are inverted. The texture is a fractal that mimics the richness of detail found in chaotic patterns and self-similar structures of nature. It also enables forms of stereo effect that hold up the sensation of depth even in the kind of extreme visual circumstances constructed in this study. Both the texture and the concavity of the third image located on the back plane of the observed cube differ from the ones described above. Whereas the front and the sides depict a cone-like shape with the middle of the oval reaching outward towards the observer, the rear of the cube displays an image of

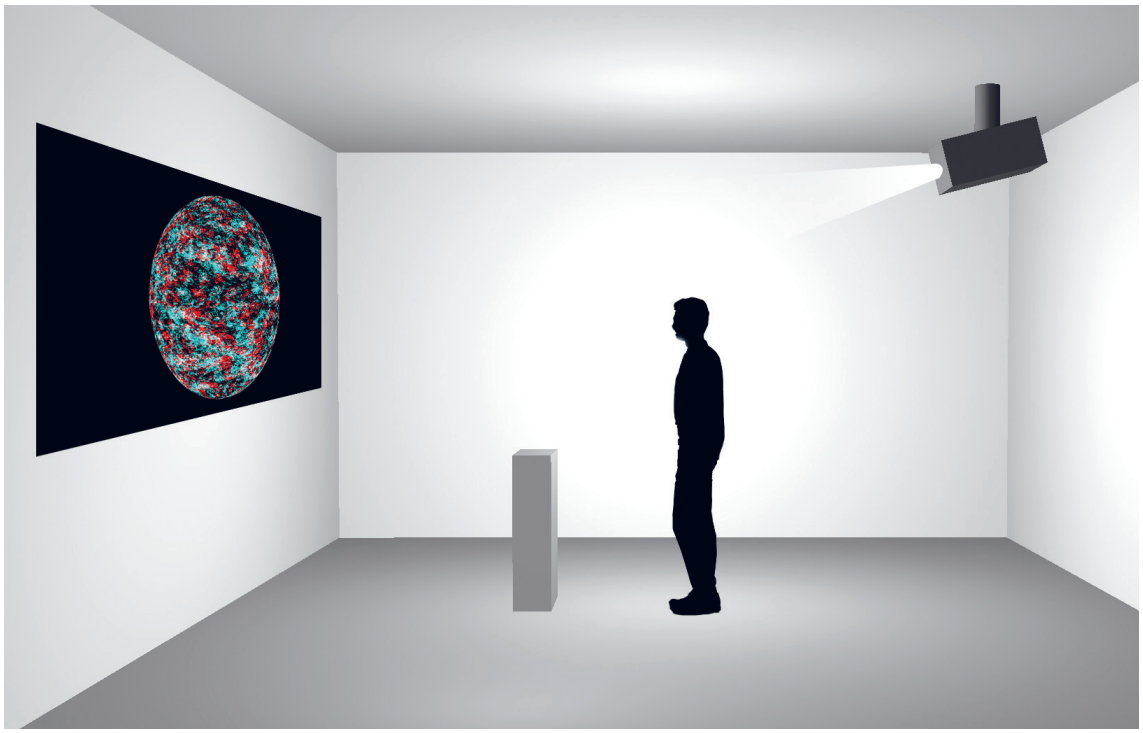
PICTURE 4 – Anaglyphic image of a sphere located on the surface of the observed cube



a dished shape – an exact opposite of an out bulging shape. However, this image is also devised in the same manner and uses the same proportions as the rest. It too fits to the form of the animation. The use of the anaglyphic technique allows this kind of layered structure of stereo imagery, where stereo images as individual objects are placed within a stereoscopic video.

The video installation of this study can be set up in different locations, and thus the exact details for the physical space may vary. Technically, it is also possible to view the animation on a computer screen, although this is not recommended. Even if a small screen can present the challenging visual environment and generate the desired experience to a certain extent, the aspect of immersion will only be partial. Thus, computer screens or television sets can be used to privately demonstrate the features of this study to interested individuals, but they may not be used as a platform for publicly presenting the artwork in exhibitions or elsewhere. For the latter case there are some basic principles that have to be followed in the process of building an ideal setting for the installation. First, the exhibition space, where the animation is presented, should be a plain room with as little distractions as possible, preferably a white cube (Picture 5). Second, there should be some way to control the lighting conditions of the room. Since the animation is projected on a white wall or a screen, preventing daylight or any other sources of undesired light from penetrating the space is important. Isolating the exhibition space from the luminosity of the surrounding environment can be done in a multitude of ways, but all of them have to follow the first principle of minimal distraction. For example, curtains covering possible windows should not have any prints or strong textures on them. The third rule considers the colouring of the space of the installation. It restricts the palette to black and white. Only the floor and the ceiling are exceptions. In a case where they cannot be covered, some toned down tint is acceptable. However, all bright hues are excluded from the ideal forms of elements constituting the physical boundaries for the art object of this study. In addition to these three principles, the space of the installation should be empty, not withstanding a box or a table on top of which two pairs of anaglyph glasses for viewing stereoscopic content are placed upon. This structure, which also has to follow the rules expressed above, serves an additional purpose of denoting a proper location within the installation for a correct viewing experience.

PICTURE 5 – Interior setup of the installation space



In conclusion, it can be stated that the inner structure of the animation is not only a stereoscopic presentation of an object, but an ever-changing stereo view around a cube made of still stereo images displaying round tipped cones floating in space. This challenging virtual environment is confronted in a physical space where the stereoscopic animation is the center of attention and possible elements of distraction are kept to a minimum.

5. Conclusions

This study is an effort to utilize the possibilities of the digital technologies of the 21st century in producing novel experiences. However, without theories discussing the principles of vision and structures of perception, which started to emerge in the 19th century, this study would not have taken place in its current form. Acknowledgement of the ideas and notions expressed by philosophers and scientists have guided the process of developing the installation alongside personal decisions. Though the animation is distinctively a product of the digital age, and would most likely have been impossible to accurately produce without the aid of a computer and accompanying software, the emphasis of the whole study is clearly on the processes taking place within the human body. There are no instances of accessorius use of digital effects or supplementary equipment. Complying with the principles for evoking unforeseen affects, and abandoning any other objectives, visual or otherwise, leads this study to minimalism in the outer appearance of the installation as well as in the interface for engaging with the presented video content. Eliminating features that might interfere with the derivation of isolated stimulation of the part of the brain where the stereopsis occurs is needed in order to generate the desired type of experience.

Dewey demarcates different types of specific experiences, for example aesthetic experiences and artistic experiences, from one another. All of these significant experiences in these divisions possess an individual emphatic unity that enables humans to point to a particular occurrence, for example in the manner of ’that storm’ (Dewey, 2005, 38) Taking into consideration Dewey’s notions on the unique nature of all instances of an artistic experience, providing an unambiguous answer to the question of ’what is the ensuing experience from observing these unnatural stereo-optical conditions like’ seems impracticable. Since an experience is not an physical object, side-to-side comparisons cannot be conducted in an unbiased manner. Even if the experiences cannot be accurately measured

or comprehensively verbalized, the installation as a physical object is the same for everyone. This does not mean that the physical properties of the art object should be subjected to an independent artistic evaluation, but that the installation space in connection to a visual capacity of a human being forms a part of the network constituting the world. Based on the empirical evidence resting on natural evolution, the observable similarity of the neural structures between different individuals can be viewed as a foundation for an estimated similarity in the ensuing experience, even if completely identical instances of an experience cannot take place. Verifiable facts of the world, the coexistence of the video installation and the operating principles of a functional visual system of a human being, provide a starting point for analysing and evaluating the common features of the responses generated from engaging with the art object.

As the aim of the installation is to expose the audience to the strange and unfamiliar, the process of evaluating the outcome cannot be based on valuations of whether the artistic experience is in the end regarded as a pleasant or a repulsive one. Since people tend to react very differently to having to undergo challenging circumstances, attempts to control the type of the sentiment following an exposure to such conditions seem futile. Regardless of the final impression, the way in which the strange manifests itself, and the aesthetics of that manifestation, can be controlled and therefore assessed. The manner in which the stereoscopic effect forms and dissolves is the process that leads to the experience constituting the work of art in this study. The first thing in constructing this fluctuating condition is to make sure there are phases in the video loop where the collapse of the stereopsis actually takes place. Of course stereoscopic conditions easy to form a sensation of depth upon must also be present in other phases. However, the main interest of this study is in the parts between these two opposites. The phases of transition, during which a metamorphosis of visual states takes place, the observed object displays parts that allow the formation of stereoscopic effect while simultaneously revealing information of other parts too disparate for a stereopsis to occur. As the cameras keep moving ever further along their paths around the stationary object, these two parts began to change roles. The viewing angle to the image initially providing the most convenient option for constructing the stereoscopic effect upon begins to skew to the extent that the distortion of visual information makes it increasingly more difficult for the brain to form a sensation of depth. Though at the same time the disassembled parts start to converge and their

synthesis begins to create a new stereo image. During these periods of transformation it is possible to direct ones point of focus to a different part of the visual field in order to have a varying percept. It is an option for an observer to try to hold on to a certain stereoscopic effect, especially in the middle of the screen, for as long as possible. If the observer allows his or her point of focus to drift away from the middle image, the stereo effect collapses and cannot be regained, even if at the same time another observer keeping his or her focus on the center of the screen is still capable of forming the stereo effect. The audience can also focus on the emerging new image and observe the point where parallelism between parts grows to a point that allows the stereoscopic effect to take hold. In addition to the operations described above, bouncing the point of focus between images evolving essentially in opposite directions until another one is gone and the overall composition changes is possible at certain times during the animation. All of these examples of the possible ways of approaching the challenges the unusual stereo-optical conditions pose to the cerebral processes of a human being are evidential in making the claim that an active role is required from audiences engaging with the art object of this study. Therefore, even if there are no means for an individual participant to control the animation itself, one can control the resulting percept by changing point of focus and by adapting differently to the stimulus. This struggle for visual comfort in a challenging optical environment is the main experience of the artwork. Importantly, it takes place within the body of an observing individual.

Personal experiences and ongoing discussions amongst the producers of stereoscopic content point to a flexibility within the human faculty of stereopsis. A person with a healthy visual system possesses the ability to cultivate his or her skills of forming the sensation of depth from two constructed two-dimensional images. In regard to this study, the threshold of keeping up with or generating new stereoscopic effects varies from one individual to another. Someone with no prior involvement with any stereoscopic systems might find the visual challenges posed by the installation more difficult than a person with a considerable background in engaging with stereoscopic content. This notion of a possibility to gain a more developed capacity for adapting to different types of visual phenomena has consequences for experiencing the effects of the video installation of this study. If in the future, stereoscopic techniques penetrate the society and the conventions of consuming visual imagery more profoundly than what is currently the situation, the

audiences of upcoming decades might deem the struggle the artwork consists of more effortless than a person engaging with the art object today in the early 21st century. This is of course unavoidable. But to assume that the imitation of free movement of eyes, which is the technical principle of the art object of this study, would completely displace the fixed stereorigs or other common forms of producing visual culture in use today seems unlikely in the foreseeable future. The previous statement is restricted to human beings only. It does not take into account the future possibilities of robots, cyborgs and independent machine vision, or the ways these totally or partly non-human systems might develop their knowledge and understanding of objects and surrounding environment. However, augmenting the conscious recognition of the role one's own body and its fixed parameters have in the way he or she comprehends the world is a desired outcome from engaging with the installation. Detecting these relations can make the observer increasingly aware of the existence of the strange and unaware – namely an entire universe of different possibilities for seeing and perceiving the world and its dimensions.

If the human culture becomes increasingly more reliant on stereoscopic applications, the ideas of the artwork of this study could be developed further alongside the ongoing technological evolution. However, simply heightening the level of required stereo-optical practice as the stereoscopic culture proliferates would not be actual development. Rather it would be an effort to keep the experience intact with updates. Another way to expand the operating systems as well as the theoretical principles of the art object, in the manner of actually developing the artwork, would for example, be to grant the audiences the possibility to influence the processes of the animation itself. This kind of push in the direction of the central themes of new media art would not necessarily have to be all inclusive, since even a small gradual step of adding a mechanism to speed, slow, or stop the animated process according to ones will would have considerable ramifications to the ensuing experience. Adding an interactive property to the art object would allow an observer to pinpoint the exact level of distortion of stereo imagery his or her neurological systems can endure before the stereoscopic effect collapses completely. This would essentially shift the role of the audience from a position reminiscent of a passenger trying to hold on to the ride to a status of a driver in control of the pace and therefore comfort. From the standpoint of neurological operations, the possibility to alter the level of challenge by one video frame at a time, if desired, is a fundamentally different process than that

of attempting to cope with whatever may come. The partial isolation of the type of an experience this study is interested in would come to an end as new areas of cognitive action would demand attention. Also, making new connections between different operating procedures would expand the diversity of the experience and allow an artistic advancement based novel affiliations. Of course the artwork of this study still leaves a lot to be explored within its own separate model of practice, such as experimenting with complex shapes and symmetries. It is admittable and likely that establishing connections to other artistic methods and principles could contribute to the development of artistic practices applying the specific distortions of the stereoscopic effect, which, as demonstrated in this study, have the potential for generating and directing a specific type of experience.

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7. Attachments

1. DVD disc containing the animation in a MPEG-4 video format

2. A pair of anaglyph glasses