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CONTEMPORARY REINVENTIONS OF EARLY DEVICES THAT FLICKER AND ROTATE: A PARTICULAR TYPE OF ANIMATED INSTALLATION IN THE QUEST FOR AN EXPANDED ANIMATION EXPERIENCE

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SCHOOL OF ART, DESIGN AND MEDIA

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The only true voyage of discovery, the only fountain of Eternal Youth,
would be not to visit strange lands but to possess other eyes,
to behold the universe through the eyes of another,
of a hundred others, to behold the hundred universes
that each of them beholds, that each of them is.…

– Marcel Proust
Remembrance of Things Past/À la Recherche du temps perdu

To Dácio, with love

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Summary

This thesis focuses on a particular type of animated installation, specifically one that employs reinventions of proto-cinematic devices that flicker and rotate—the thaumatrope, the phenakistoscope, the zoetrope, the praxinoscope, and the flipbook in its mutoscope form—and thereby provide a contemporary creative alternative to the traditional experience of animation on screen. In fact, this particular type of animated installation not only explores and expands upon characteristics introduced in the early optical toys but transforms the old devices into an expanded animation experience empowered by the astonishment and wonder they elicit in their public.

In rethinking theories about and/or related to the proto-cinema era and analysis of contemporary artworks, the author provides evidence in this thesis of the important role that these early animation devices played in engendering their contemporary counterpart—as a particular type of animated installation—investigating their connections, similarities, and differences in the quest for an experience that expands and pushes the boundaries of animation. The works of Gregory Barsamian, Peter Hudson, Eric Dyer, Robert Breer, George Griffin, Kumi Yamashita, Toshio Iwai, Ryusuke Ito, Mat Collishaw, David “Meggs” Hooke, the art collective composed of David Lawrey and Jaki Middleton, Paul Cox, William Kentridge, Roberto Freitas, and Milton Marques constitute the case studies of this particular type of animated installation.

The research contained in the thesis exposes and explores the renovation and reconfiguration of animation in its proto-cinematic form as the animated installation in a post-cinematic form, enabling, even in its own way facilitating, the reconnection of past and present to help construct new possibilities for the future of the field of animation. Further, the research reflects upon the consequences of the past and considers an alternative path that cinema could have followed in exploring the potential of the optical toys as devices that produce animation independent of a screen. These optical toys based on flicker and rotation not only contributed incrementally to the technological knowledge that led to cinema but today are reanimated as a specific kind of animated installation.

The theoretical reflections of the thesis are complemented by practical investigation, specifically the author’s invention of a new optical device, the *Silhouette Zoetrope*, and exploration of it as a toy, art object, research tool, and potential animated installation. Indeed, the development of and subsequent improvements to this practical investigation propelled forward the theoretical research, and vice versa. The trinity of history, science, and art are at the foundation of this thesis and its fundamental search for a new perspective on the expanding role of animation in the 21st century.

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NOTE: Additional images and visuals are available as web links in respective footnotes throughout the text, enabling the reader to access the images and devices referred to in this research.

Introduction

1. Inspiration and Context

In the fall of 2009, the author saw for the first time Gregory Barsamian's animated installation *Feral Fount* (1996) at the Museum of the Moving Image in New York City (Figures 48 and 49). It is hard at first to explain the sense of arresting awareness and surprise felt when the spinning structure, animated with strobe lights, brings the sculptures to life—*astonishment*, *wonder*, *awe*, and *magic* are words that come to mind in an attempt to describe a feeling beyond words.

Inspired by the classic zoetrope—an optical device from the 19th century—Barsamian's work challenges the traditional animation experience by allowing the viewer to see animation without the constraints of a screen. As a *non-cinematic*[1] kind of animation, the work arrests the viewers' attention and enhances their sensorial perception during interaction with the optical illusion. Experiencing Barsamian's work was a turning point for the author, an epiphany that ignited the development of this research. It acted as a catalyst to identify more artists whose works use similar structures to evoke related feelings. It also led to an exploration into how she, too, could and would create her practical work under the same principles.

In the quest to find what the author refers to as an "expanded animation experience,"[2] she identified a number of key contemporary artists who are

[1] As one of the most basic elements of cinema is the screen where the movie is projected, the use of the term *non-cinematic* here refers specifically to that lack of a formal projection screen where the animated sculptures, as in the case of Barsamian's work, are perceived as moving.

[2] *Expanded animation experience* is now an established term grounded in Gene Youngblood's canonical book *Expanded Cinema* (published in 1970) and buttressed by *Expanded Cinema: Art, Performance, Film,* an updated (2011) review by editors A. L. Rees, David Curtis, Duncan White, and Steven Ball. A definition of the term and its use in this thesis are included in the Glossary and addressed later in this Introduction, as well as in Chapter 1.

adapting historical optical devices to animated installations. To date, the relationship between specific early devices that flicker and rotate and their contemporary counterparts has not yet received substantial academic attention, particularly in regard to their connections, differences, and contributions in advancing the field of animation.

2. Research Scope and Focus

Within the wide range of works included under the term *animated installations,*[3] this research covers specifically artistic works constructed using mixed media, placed in a physical space, achieving their animated effect through flicker[4] and rotation of their structures. These installations are direct adaptations and reinventions of early apparatuses, such as the thaumatrope, the phenakistoscope, the zoetrope, the praxinoscope, and the flipbook in its mutoscope-like structure.[5]

Among these early devices, the author's research made evident that the zoetrope is the most used and well-adapted device to contemporary animated installation.[6] For this reason this study—after introducing and investigating the abovementioned early devices and identifying their contemporary reinventions—narrows its focus to the zoetrope and its potentialities as the main point of convergence between past and present.

Thus, if an in-depth study of the contemporary reinventions of early optical devices was overdue, focus on the zoetrope and its up-to-date adaptations

[3] A more general definition of the term is available in the Glossary, outlining its meaning as used in this thesis.
[4] By *flicker* the author is referring to the characteristic of some of these early devices in creating a rapid variation in brightness that, when combined with the fast movement of sequential still images (or sculptures), is perceived by the human brain as moving. The effect is fully explained and contextualized in Chapter 1.
[5] Since those were the original devices adapted to create animation during the Victorian era, their variations may be mentioned but not fully analyzed here except when alterations had a significant impact on the history and development of the device or serve the thesis framework, such as the study of flipbooks in their mutoscope-like circular form. (Figures 35 and 36 consist of images of the Mutoscope in Chapter 2.)
[6] See Appendix B, where contemporary artists and artworks are listed and classified according to the early device to which their work is connected.

is even more pertinent. This necessity becomes increasingly relevant when considering that the most complete study on this specific device dates back to the second half of the 19th century, with the publication of the article "On the Zoetrope and Its Antecedents,"[7] by Dr. William Benjamin Carpenter (1813-1885), then Vice President of the Royal Society.[8]

The aged and scarce academic literature on the zoetrope reinforces the significance of the unique connection proposed in the selection of past devices and present artworks here investigated.

3. Outlining the Gap

Even though literature devoted to the topic addressed in this research is scarce, several past events, such as an exhibition, a conference, and publications, have touched on aspects related to the topic here proposed and helped shape the current research. A brief overview of these works, their contributions and particularities in support of and/or opposition to the direction chosen by the author in this research is offered to help outline the gap that this study aims to fill.

In 2001, the Getty Museum presented the landmark exhibition *Devices of Wonder* in Los Angeles. The show sought to shed contemporary light on the history and wonder of a broad range of early optical devices, a goal that falls within the broader aims of this thesis. Yet, of the numerous apparatuses highlighted by the Getty exhibition, the specific ones upon which this research rests—optical devices that flicker and rotate—did not receive the attention that the author believes they deserved as devices that already

[7] William B. Carpenter. "On the Zoetrope and Its Antecedents." In *Student and Intellectual Observer of Science, Literature and Art*, vols. 1 and 2. London: Groombridge & Sons, 1868-69, 427–444; 24-31 and 110-128. Available online at: https://books.google.com.sg/books?id=dcEWAQAAIAAJ&pg=PA29&source=gbs_toc_r&cad=4#v=onepage&q&f=false

[8] The Royal Society is now known as the United Kingdom's National Science Academy, the oldest scientific academy in activity. More information about it can be accessed at: https://royalsociety.org/about-us/history/

encapsulated the idea of *cinema before cinema*.[9] Despite that gap, this important show—organized by Barbara Maria Stafford and Frances Terpak—also established creative connections between past devices and contemporary artists in its catalog essays, although none of these connections were suggested specifically in regard to the early animation devices.

In 2007, more specific cases, such as the Pervasive Animation Conference[10]—organized by scholar Susanne Buchan and film curator Stuart Comer at Tate Modern in London—and the subsequent book published about it, contributed to opening up the dialogue about the changing face of animation and its ubiquitous influence in different fields and practices today. In the *Pervasive Animation* book, three specific chapters share connections with topics related to this thesis: Siegfried Zielinski's chapter on expanded animation,[11] Edwin Carels chapter on animation and museology,[12] and George Griffin's chapter on the reconstruction of proto-cinematic apparatuses as examples of concrete animation.[13]

In Zielinski's case, his approach to animation is too broad for the purposes of the research at hand. His use of the term *expanded* comes as a literal expansion of the understanding of what animates. From references to automata, harpsichords, and robots to Luigi Galvani's experiments on actual corpses in the 18th century, all for Zielinski are examples of animation. However, in this thesis the concept of animation is more specific[14] and consequently cannot include such a vast range of examples for expanded animation. The term and its specificities as used in this thesis are explored further in this Introduction and in Chapter 1.

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[9] The use of this expression is inspired by Virgilio Tosi's book title.
[10] More information about the Pervasive Animation Conference can be accessed at: http://www.tate.org.uk/context-comment/audio/pervasive-animation-audio-recordings#open243081
[11] Siegfried Zielinski. "Expanded Animation: A Short Genealogy in Words and Images." In *Pervasive Animation,* edited by Suzanne Buchan, 25-51. New York: Routledge, 2013.
[12] Edwin Carels. "Spaces of Wonder: Animation and Museology." In *Pervasive Animation,* edited by Suzanne Buchan (New York: Routledge, 2013), pp. 292-274.
[13] George Griffin. "Take the B Train: Reconstructing the Proto-Cinematic Apparatus." In *Pervasive Animation,* edited by Suzanne Buchan, 275-291. New York: Routledge, 2013.
[14] See Glossary.

Edwin Carels, in his chapter, also cites what he calls an "expanded notion of animation" relating to works that make general use of animated content when exhibited in museums, which he conceives as "spaces of wonder." Despite similarities to his use of the terms *expanded animation* and *wonder,* in this thesis the works investigated have specific characteristics that help identify them as a particular type of animated installation: They share a physical component, happen in a multiplicity of spaces, do not need a screen, and have as their essence clear references to early historical devices that flicker and rotate. Zielinski's and Carels' texts are nonetheless inventive, valid sources that helped the author distinguish and set the boundaries of her research.

It was also at the Pervasive Animation Conference that the animator George Griffin presented his concept of *concrete animation,*[15] later developed into a chapter for the *Pervasive Animation* book. Griffin made the pioneering effort to gather and analyze contemporary artists whose practices are related to animation through works that have a "concrete" physical appeal, thereby making his work the one that shares more connections with this study, serving as a key reference. The idea behind Griffin's definition makes it possible to state that—in the range used by the author in this thesis—animated installations are a form of concrete animation, as they use non-theatrical venues that allow the viewers to interact with the pieces in a three-dimensional space and can manifest as physical moving objects animated by strobe light, which features in this category the works of Gregory Barsamian and Eric Dyer, among others.

The main difference between the author's approach in this thesis and Griffin's is that for the latter any work that evokes physical presence can be defined as *concrete animation*, whereas for the author the physical appeal of

[15] George Griffin uses the term *concrete animation* to identify tangible physical experiences that can be caused by the manipulation of early optical devices and elicited by physical artwork that makes use of animation and even films that evoke a more tactile feeling in the viewer. "Concrete Animation," *Animation: An Interdisciplinary Journal* 2, no. 3 (November 2007): 259-274; "Take the B Train: Reconstructing the Proto-Cinematic Apparatus," op. cit.

these works is arguably related to their connection to past mechanical devices—and a connection that not only is at the tangible level but is also connected to science, optical illusions, entertainment, and design. [16] Nonetheless, the examples given by Griffin introduced the author to the work of Eric Dyer and have fundamentally contributed to the search for artists who, like Barsamian, are reanimating[17] the history of early optical devices.

A corresponding effort—this time in classifying the contemporary and unconventional uses of animation—took place in the field of animation studies when the scholar Paul Wells and the filmmaker Johnny Hardstaff published their book *Re-Imagining Animation: The Changing Face of the Moving Image,* [18] in 2008. Although also identifying, among others, the works of Gregory Barsamian and Eric Dyer as new possibilities for animation, the authors aimed to present the diversity of current animation expressions, which challenges what the same authors call "a sense of homogeneity,"[19] particularly as related to the use of computer graphic animation in cinema more broadly. The works selected in the publication point out that difference, reinforcing animation as "an art and craft across multiple platforms and disciplines, and the tool by which art, science, culture and the human condition have been imagined and re-imagined."[20]

However, by focusing on the diversity of works that use animation in unusual ways, Wells and Hardstaff do not fully explore the potential of Barsamian's and Dyer's work. In their classification, Barsamian's work is established as "artist animation"[21] that proposes "alternative worlds," while Dyer's work is categorized under the title of "reclaiming animation history." Therefore, Wells

[16] The relationship between mechanical devices, science, optical illusions, entertainment, and design is explored in Chapters 1 and 2.
[17] The term *reanimate* is used here following Cholodenko's definition of *animation* in his Introduction to the anthology *The Illusion of Life: Essays on Animation* (1991). For him, to *animate* is to endow with life and movement, thus to *reanimate* is to "endow with new life and movement," as clarified by Cholodenko in a conversation with the author. The term is defined in the Glossary.
[18] Paul Wells and Johnny Hardstaff. *Re-Imagining Animation: The Changing Face of the Moving Image*. Lausanne, Switzerland, and Worthing, U.K.: AVA Academia, 2008.
[19] Ibid., p.7.
[20] Ibid., p.184
[21] Specified by Wells and Hardstaff as "a term that seeks to differentiate between fine artists working in animation, and traditional animators." Ibid., p.84.

and Hardstaff overlook the pioneering aspect of Barsamian's historical connections and the authorship side of Dyer's work. Thus, despite being a valid and important attempt to portray the potentialities of animation in the face of ever-changing digital technology, it is clear that their goal was not to study in depth the works of Barsamian and Dyer. Elucidation of the connection with past devices and investigation of the original contributions of each artist to the fields of art and animation are goals of this thesis.

A more specific approach is offered by the scholar Meredith Bak in her 2013 article "Grand Illusions: Large-Scale Optical Toys and Contemporary Scientific Spectacle."[22] There she identifies scale as a common denominator in works from three contemporary artists working with animated installations. Works of Gregory Barsamian, Peter Hudson, and Mat Collishaw are considered as giant versions of early optical toys that re-create a scientific spectacle. Focusing on the transition of toys like the zoetrope, extended from parlor entertainment to large-scale spectacles, Bak—limited by the article's length and the framework built around the scale—scratches the surface of what this thesis proposes to analyze in-depth.

Bak's work thus becomes a foundational reference, as her article demonstrates that the study of the relationship between these past and present devices is a significant line of research. For the author of this thesis, the potential of this line of research helps advance the field of animation in ways that have not yet been fully explored. As Bak points out, the resurrection of these early devices as contemporary animated installations "cannot simply be understood as a resurgence of a long-dormant media."[23] There is so much more to be taken into consideration when studying the current reinventions of the early devices. For instance, while Bak identifies scale as a major contributor to the renewal of the experience, as this research aims to identify, other factors related to the structure of these installations equally contribute to this renewal, such as adaptations of the

[22] Meredith Bak. "Grand Illusions: Large-Scale Optical Toys and Contemporary Scientific Spectacle," *Teorie Vedy/Theory of Science* 35, no. 2 (2013): 249-267.
[23] Ibid., p. 267.

wheel to different rotational structures, use of contemporary themes, adoption of atypical materials, and choice of alternative ways to re-create the flickering. Although these characteristics are mainly related to the design and content of the works, together with the scale factor they change and contribute to the way contemporary viewers experience these pieces in ways fundamentally different from the experience proposed by the early devices.

Historically, a number of scholars and collectors have contributed to the advancement of theory in relation to the early optical toys, as is the case of Laurent Mannoni, Tom Gunning, Giannalberto Bendazzi, Richard Leskosky, and Alan Cholodenko. Their recognition of the importance and influence of these early devices in cinema and animation histories is undeniable.[24] Each scholar has contributed to elucidating aspects related to historical devices. Mannoni rescued the history[25] of a large number of devices and their variations to help trace back the history of cinema. Gunning, among many contributions by him to history and theory of cinema, offered a new view in his investigation of the thaumatrope.[26] Bendazzi contributed a global perspective on animation[27] to a history not only often seen through the lens of cinema, but also often predicated on Western Anglocentric mindsets. Leskosky shed light on the variations and potentialities of the thaumatrope[28] and the phenakistoscope.[29] Cholodenko offered an innovative perspective that puts animation at the center of the history of the moving image through his review of the work of Émile Reynaud,[30] the inventor of the praxinoscope and the Théâtre Optique. The German collector Werner Nekes and his

[24] The author is aware of dissenting scholarly views that consider the beginning of animation only in the context following the invention of cinema. For the author, such views are limited in their understanding of animation, as is argued in Chapter 1.
[25] Laurent Mannoni. *The Great Art of Light and Shadow: Archaeology of the Cinema,* translated by Richard Crangle. Exeter and Devon, U.K.: University of Exeter Press, 2000.
[26] Tom Gunning. "Hand and Eye: Excavating a New Technology of the Image in the Victorian Era," *Victorian Studies* 54, no. 3 (2012): 495-516.
[27] Giannalberto Bendazzi. *Animation: A World History,* vols. 1-3. Boca Raton, Fla.: CRC Press, 2016.
[28] Richard J. Leskosky. "Two-State Animation: The Thaumatrope and Its Spin-Offs," *Animation Journal* 2, no. 1 (1993): 20-35.
[29] Richard Leskosky. "Phenakis[tos]cope: 19th Century Science Turned to Animation," *Film History* 2 (1993): 176-189. Available online at: http://www.jstor.org/stable/i27670714
[30] Alan Cholodenko. "The Animation of Cinema," *Semiotic Review of Books* 18, no. 2 (2008): 1-12.

documentary series[31] in which he plays and demonstrates a broad range of historical optical toys represents a pioneering effort to revive these toys, making them accessible to future generations. The Nekes collection was made available to the public through the book *Eye, Lies and Illusions.*[32] Part of his collection was acquired by the Getty Research Institute in 1993[33] and later exhibited as part of the *Devices of Wonder* show in 2001. Other collectors such as Stephen Herbert and David Robinson from Great Britain and Richard Balzer from the United States have also contributed new perspectives on those devices, Herbert[34] and Balzer[35] in making their collections available online and Robinson[36] organizing special exhibitions of them. Through their work, the growing role of animation as an interdisciplinary and ubiquitous field today becomes undeniable.

However, different frameworks may generalize or limit the specific influences of each of those devices on the understanding of their contemporary counterparts. Thus, although such historical and theoretical approaches have discussed the early optical toys, little is yet devoted to the specific animation devices as studied in the setting here proposed. Therefore, this research's significance builds upon not only the referenced contributions but also omissions and alternative approaches unexplored by those scholars and practitioners.

4. Research Purpose and Goals

Animated installation is a term widely used today to refer to a broad range of works that combine different techniques of animation—commonly using

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[31] *Media Magica* documentary series; listed under Filmography in the Bibliography.
[32] Laurent Mannoni, Werner Nekes, and Marina Warner. *Eyes, Lies and Illusions: The Art of Deception.* London and Aldershot, U.K.: Hayward Gallery/Lund Humphries, 2004.
[33] Getty Research Institute database, available at: http://archives2.getty.edu:8082/xtf/view?docId=ead/93.R.118/93.R.118.xml;chunk.id=aspace_b203dce0607effe9a53453d22fcb48ae;brand=default
[34] Stephen Herbert's website can be accessed at: http://www.stephenherbert.co.uk/wheelHOME.htm
[35] Richard Balzer's website can be accessed at: http://www.dickbalzer.com/
[36] David Robinson. *Masterpieces of Animation, 1833-1908,* Griffithiana 43. Pordenone, Italy: La Cineteca del Friuli, 1991. (Catalog of the exhibition of the same name.)

computer-generated imagery—with art installations. The term *installation,* in art, relates to a spatial and experiential type of artwork that relies on the presence of the viewer; the addition of animation and the *illusion of life* it elicits enhance the overall experience of such artworks. Like installation art, these works can be site-specific and usually rely on the viewer's live experience of the artwork. Thus, traditionally the artworks that can be defined as animated installations in general include, but are not limited to, projection mapping and other mixed animation techniques presented in a variety of platforms, surfaces, and spaces. In this research, the term *animated installation* is used to refer to a specific kind of contemporary artworks that rely on reinventions of early devices that flicker and rotate. To summarize, this thesis approaches animated installations as a particular type of contemporary reanimations of early optical devices that flicker and rotate.

This view therefore challenges the labeling of the early devices as “just toys,” despite general recognition of their role as precursors to the development of cinema. Unfortunately, the attention they deserve is still masked by the label they carry as obsolete, charming antiquated technologies without much further potential. The author hopes that this theoretical and historical study aligned with its practical component can contribute to changing this limited perspective, stimulating additional research and opening up new avenues of inquiry for creative interdisciplinary and artistic work.

In combining historical early devices and the case studies of contemporary artworks, this research does not belong to a specific disciplinary niche but relies on interdisciplinary connections that bring together art, science, technology, and animation. Through art we are invited to “think outside the box,” to use a popular metaphor. This alternative way of thinking can be suitable for different areas in different phases of a person’s life. For example, in questioning and revising the role of old technologies, one can discover new uses and potentialities to reapply those early technologies in the creation of new products—entertainment, pedagogical, and scientific ones, for instance—associated with experiences adapted to our time. These new

applications may lead to new connections of science and technology working together to create a unique experience for the viewer, an experience that can help the viewer to see, feel, and think differently.

The author claims that the potential path once suggested by optical toys is being recovered and explored through a particular type of contemporary animated installations, with the possibility of being enhanced by digital technology. Moreover, a probe into the characteristics shared by the early devices that created animation and these specific contemporary animated installations can help point to directions for untapped expansions of animation beyond the traditional screen. Additionally, the author proposes that rather than merely historical objects belonging to the period before cinema, as the term *pre-cinema* implies, these specific devices may be considered embryonic proto-cinematic forms of cinema, or cinema before cinema, as the term *proto-cinema*[37] suggests. The terms *proto-cinema* and *proto-cinematic* are used herein when referencing this historical period.

In deepening the knowledge of the early historical devices that flicker and rotate, the research goal is to propose new ways of understanding their influences and reinventions as contemporary animated installations. As the thesis reflects on the consequences of the past, it also considers and proposes an alternative path that cinema could follow in exploring further the potential of optical toys as devices that produce animation independent of a screen. In sum, this research's purpose is to investigate the encounter of animation in its proto-cinematic form and animated installations as one of its most unexplored post-cinematic forms, allowing this thesis to participate in, even in its own way to facilitate, the reconnection of past and present and help construct new possibilities for the future.

5. Research Questions

As this research aims to identify and recognize unexplored alternatives and neglected approaches to the relation between contemporary animated

[37] A definition of the term *proto-cinema* is available in the Glossary.

installations and early optical devices that flicker and rotate, three specific research questions guided the study:

1. What are the connections, challenges, and differences in the adaptation of those specific early optical illusion devices to contemporary animated installations?
2. Which are the strategies used by contemporary artists to elicit an expanded animation experience that evokes the feelings of astonishment and wonder?
3. How are those contemporary artworks contributing to advancement of the field of animation?

The organization of the arguments and the methodology used in this research aim to answer these questions, as addressed in the following sections, leading up to the creative process of the author in the invention of her practical work.

6. Methodology

6.1 Research with a Practical Component: Limits and Potentialities

Doctorates of Philosophy in art and design have been the subject of much discussion and debate lately, particularly because of the different approaches embraced by different institutions, normally in regard to diverging views of how artistic investigation should be conducted when the traditional framework of research is established by scientific investigation. A proof of the relevancy of this debate is the current survey of articles related to case studies and other experiences with PhDs in art and design underway by *Leonardo,* a journal of the International Society for the Arts, Science and Technology (published by MIT Press).[38] As one of the oldest publications to address the intersection between the fields of art, science, and technology, *Leonardo* is celebrating its 50th year by shedding light on this debate. A

[38] *Leonardo*'s open call can be accessed at: https://www.leonardo.info/opportunity/call-for-papers-phd-in-art-and-design

similar concern and discussion was raised previously in the magazine's open call for contributions by scholars and institutions to the emergent use and acceptance of the terms *STEAM* (science, technology, engineering, art, and mathematics) and *STEAD* (science, technology, engineering, art, and design) as alternatives to the traditional *STEM* (science, technology, engineering, and mathematics), when these terms are used to refer to cutting-edge research. The importance of the subject can also be observed in the growing numbers of guides, books, and collections about methodology and procedures for research in arts.

Despite divergent points of view that the discussion has raised, many scholars strive to establish clear parameters for and describe the advantages of research in art by comparing it with practice and other exploratory techniques commonly used in science. As the philosophy scholar Mark Johnson states:

> … the value of an artwork lies in the ways it shows the meaning of experience and imaginatively explores how the world is and might be—primarily in qualitative fashion. Therefore, art can be just as much a form of inquiry as is mathematics or the empirical sciences.[39]

In directing attention to artwork, Johnson's comment leads to the role and relevancy of the artwork in a PhD, which in the case of the research in art is also called "artifact."[40] Although the role of the practical work is not broadly agreed upon nor well defined by most universities, institutions that give much weight to the practical work refer to this type of PhD as practice-based. Such is the case of the Glasgow School of Art in the UK and the Center for Digital Arts and Experimental Media in the US, to name but two and as exemplified in an article by Linda Candy and Ernest Edmonds.[41]

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[39] Mark Johnson, "Embodied Knowing Through Art," in *The Routledge Companion to Research in the Arts,* edited by Michael Biggs and Henrik Karlsson (New York: Routledge, 2011), p. 149.
[40] Linda Candy and Ernest Edmonds. "The Role of the Artifact and Frameworks for Practice-Based Research." In *The Routledge Companion to Research in the Arts,* edited by Michael Biggs and Henrik Karlsson. New York: Routledge, 2011.
[41] Ibid., pp.134-135.

Even though these discussions are extremely important and will help shape the future of research in art and design in general, their analyses are beyond the scope of the research of this thesis. Instead, they are mentioned here in relation to the practical work presented in this thesis in order to distinguish this author as a practitioner-researcher. However, this thesis differs from practice-based theses insofar as it is composed of substantial historical and theoretical research in the traditional sense, complemented by a practical component, as established by the institution where the author's research takes place. Nonetheless, the author's background as a practitioner in fine arts and animation is an integral part of the research. It is her way of investigating the world through the lens of her own art practice that animates and informs her approach to research, particularly in her analysis of the history and theory of the field of animation.

This perspective may be argued as having limits, but it also has potentialities. The author is aware of the importance of balancing the interpretation of an aesthetic response with historical and theoretical reasoning and knowledge to substantiate her interpretations. However, it is important to state that, as a practitioner-researcher with a background in fine arts and animation, theoretical frameworks based on semiotics, phenomenology, neuroscience and psychology are beyond the scope of this research. As a practitioner, the author adds to her analyses of the animated installations depth and insights not only on the creative process and related methods but also on the challenges overcome and original outcomes achieved by the artists studied, who created a specific effect or accomplished a certain result of their artwork. This view offers a fresh and alternative way to look at the historical devices as well as the contemporary artworks.

Thus, using mixed approaches to establish the methodology of this study, the author combines the theoretical thesis, as defined by Umberto Eco,[42] with the creation of a practical component that reflects upon this theory from

[42] For Eco, "in a theoretical thesis a student confronts an abstract problem upon which other works may or may not have already reflected." *How to Write a Thesis* (Cambridge, Mass.: MIT Press, 2015), p. 14.

a practitioner's point of view, doing so in order to investigate through experiment and assess the arguments raised in the course of conducting this research. Therefore, in the study of past optical devices that flicker in comparison with the artworks that reanimate these devices today, the author's creative process in the ideation, invention, and production of her own animated installation is an integral element, as well as complement to and extension and consequence, of the historical and theoretical investigation proposed and undertaken.

Thus, while this research has a practical component, it cannot be considered fully practice-based[43] or referred to as entirely practice-led,[44] in the common sense of the terms. The research here undertaken follows the guidelines and requirements established by the institution at which the study was developed, the School of Art, Design and Media, Nanyang Technological University, Singapore. Specifically this category of study is designated a PhD "by Research with Practical Component,"[45] further explained as "multimod[al]

[43] "Practice-based Research is an original investigation undertaken in order to gain new knowledge partly by means of practice and the outcomes of that practice. Claims of originality and contribution to knowledge may be demonstrated through creative outcomes which may include artefacts such as images, music, designs, models, digital media or other outcomes such as performances and exhibitions whilst the significance and context of the claims are described in words, a full understanding can only be obtained with direct reference to those outcomes. A practice-based PhD is distinguishable from a conventional PhD because creative outcomes from the research process may be included in the submission for examination and the claim for an original contribution to the field are held to be demonstrated through the original creative work." Linda Candy. "Practice Based Research: A Guide." *CCS Report* 1 (2006): 1-19. Available online at: https://www.mangold-international.com/ Resources/Persistent/764d26fd86a709d05e8d0a0d2695bd65fd85de4f/Practice Based Research A Guide.pdf

[44] "Practice-led research is a distinctive feature of the research activity in the creative and performing arts. As with other research conducted by arts and humanities researchers, it involves the identification of research questions and problems, but the research methods, contexts and outputs then involve a significant focus on creative practice, to illuminate or bring about new knowledge and understanding, and it results in outputs that may not be text-based, but rather a performance (music, dance, drama), design, film or exhibition." Arts & Humanities Research Council, "The Arts and Humanities: Understanding the Research Landscape" (2003), in *Practice-Led Research, Research-Led Practice in the Creative Arts,* edited by Hazel Smith and R. T. Dean (Edinburgh: Edinburgh University Press, 2009), p.47.

[45] As stated on the School of Art, Design and Media's (ADM/NTU) website: http://www.adm.ntu.edu.sg/Programmes/PhD%20Programme/Pages/Programme-Structure.aspx

form […] with a practical component to substantiate or complement the thesis."[46]

In regard to the practical component, the author's intention was to create an original animated installation relating to—that is, at once acknowledging and extending—the works created by the contemporary artists investigated as case studies in Chapter 3. The author's practical experiments led her to invent a new optical device called the Silhouette Zoetrope that expands the nature of the traditional zoetrope and the understanding of its possibilities, as explained in depth in Chapter 5. The device was granted a U.S. patent whose issuance validates the originality of the new invention and proves that the past devices are still a valid source of inspiration today, contributing to advancements in science as well as in animation. This original practical component results from the historical and theoretical foundations established in the theoretical part of the thesis, which guided the author in putting together pieces of a singular line of research and identifying a specific niche of contemporary art practice catalyzed by the aforementioned historical precedents.

6.2 Primary and Secondary Sources

With the theoretical scholarship as the main research upon which the practical project was conceived, the strategies and techniques used as procedures and methods of research include primary and secondary sources. As primary sources, the author interviewed contemporary artists, consulted their artist's statements, and experienced their artworks, some in person and others through films made by the artists. As secondary sources, books, articles, exhibition catalogs, interviews, videos made by viewers, and websites provided additional, different interpretations and diversified analyses of those artists' practices and works.

[46] As defined in the School of Art, Design and Media's "Handbook for Graduate Students" PDF document, provided by the institution.

Parallel visits to historical and contemporary museum collections have contributed to this research. These field trips (a list of them is available in Appendix C) provided a broad perspective and were fundamental in helping the author identify specifics and further refine the focus of the research. Also, significant contributions were the comments and testimonies of artists, scientists, animators, optical toy collectors, and traditional optical toys sellers around the world who shared with the author (through email exchanges or articles) their impressions of her device, the Silhouette Zoetrope (comments available in Appendix F). Those exchanges demonstrated the impact and wondrous results experienced by a select public when experiencing the author's practical work.

6.3Artist Selection Criteria: Methods and Investigation Background

As previously mentioned, Gregory Barsamian's work provided a remarkable experience that led the author to query, among other things, if there were other artists exploring the boundaries between art and animation in a similar fashion. If there were, how were they doing so, which devices were they referencing, and what made their work relevant to their viewers? Her queries led to the discovery of many artists and their inventive artworks. In fact, the results of her search were so plentiful that research criteria and a methodology had to be established to categorize them and help sharpen focus on artists working with re-appropriations of optical devices that flicker and rotate as contemporary types of animated installations. Thus, the main methodology and related criteria established for this selection and analysis of the research process were the following:

1) Conduct a search for artists worldwide whose artworks relate to optical devices[47] from the proto-cinematic era that elicit astonishment and wonder[48] in their viewers;

[47] The term *optical devices* is applied here to a broader range of media devices and traditions that include the magic lantern, shadow theater, Reynaud's Théâtre Optique, the kaleidoscope, lenticular animation, and catopric anamorphosis using cylindrical and conical mirrors.

2) Define, from the artists pre-selected in the step above, which ones have created works specifically using, adapting, or reinventing optical devices that flicker[49] and rotate;
3) Identify among this group of artists which ones have created an actual artistic installation with a physical piece central to the work exhibited in public spaces, fully independent of a screen;
4) Select, from the latter set of artists, the ones who have been consistently creating these types of animated installations throughout their career.

This set of criteria was grounded in specific reasoning. First, the spectrum had to be worldwide[50] in order to verify that the growing trend in the creation of the particular type of animated installation is not a development peculiar to a given culture but rather a comprehensive global tendency. Second, as a major goal of this research is to understand better the reanimation of optical devices that flicker and rotate as contemporary animated installations, the target had to be fixed on today's artists working with these specific devices. Third, the identification of contemporary works that explore and adapt the

[48] Astonishment and wonder as referred to here are not quantifiable and were identified not only by the author's own reaction to these artworks but also through the observation of different viewers interacting with the artworks live or through the videos that document the works. In addition, descriptions of the works and articles about them that describe the work as "wondrous" were also taken into consideration to select the pieces.

[49] Recapitulating, the optical devices that flicker are devices of animation. As referred to throughout this study, they are the thaumatrope, phenakistoscope, zoetrope, flipbook, and praxinoscope. The term is further explored and explained in Chapter 2. A definition of this term is also available in the Glossary.

[50] The table in Appendix B lists the data references described and analyzed here. Thus, within the first grouping of identified artists, there is at least one representative for every continent in the world, among whom approximately 31 percent are women. Although the majority of artists come from the United States and Europe, the wide spectrum of artists working with animated installations and artistic performances related to animation is a relevant indicator of the pervasiveness of cultural diversity within animation. Unfortunately, the representation of women remains relatively low. However, considering that the inclusion of women and awareness of gender equality are a 20th-century achievement that is ongoing and growing, the number of women working with animated installations has grown in the past decades. The ubiquity of digital technology has a role in that it allows and facilitates processes, enabling wide access to information to minorities and people from emerging countries as well. Thus, women are now less excluded because of the democratization of media technology, the availability of which, generally, provides access across society, transcending prior limits on women's representation in fields like science, engineering, design, and others. Another positive aspect of this increasing accessibility to digital technology lies in the growing number of global art collectives and international artistic collaborations.

use of these early devices without a screen was essential to be able to focus on the live experience, the interaction and the physical and intellectual involvement of the viewer with the artwork. Finally, to ensure that the conclusive selection of artists represented the most significant group working with these specific contemporary animated installations today, it was fundamental that they exhibit: consistency in their approaches, including across their careers; the influence through their work on other artists and the field; and relevancy in their work in providing an expanded animation experience to a wider audience of viewers. Also applied as a subcriterion to all the artists—classified by optical devices that they reinvented in Appendix B—was the determination that their work was based on rotation and structured as a loop[51] and that it proposed a significant innovation in the use of the early devices in their contemporary animated installation forms.

Each of the artists investigated as case studies have helped further the relationship between art, technology, and animation, a relationship not always evident in the arts, and, in their cases, completely distinct from the traditional theatrical and television uses of animation normally associated with and limited by cartoon and animation films. The animated installations created by these artists can be found in venues such as museums, galleries, public spaces, and other locations that allow the audience to experience an alternative relationship with the artwork, causing the viewer to reflect on his or her own perception and sense of delight when taken by surprise by the unusual relocation of animation, which sometimes helps these artworks play a greater interactive role.

Therefore, the goal in establishing the criteria for the selection of the artists is to find those whose work reinvents, renovates, and/or reanimates in original ways—considering not only their animation themes but also their chosen device's structure, design, and possible creative solutions—dependent on the specificities of any of the optical devices that flicker and rotate. Thus, works inspired by the thaumatrope, phenakistoscope, zoetrope,

[51] As the loop is an important characteristic of the historical devices, this subcriterion aimed to investigate how contemporary artists deal with this feature and its limitations.

praxinoscope, and flipbook in its mutoscope format, as devices that flicker and rotate, contributed to narrowing the selection of artists, demonstrating the existence of a particular type of animated installation inspired by them.

The selected artists whose works are consistent with the criteria established in this thesis are the following: Gregory Barsamian, Peter Hudson, Eric Dyer, Robert Breer, and George Griffin from the United States; Kumi Yamashita, Toshio Iwai, and Ryusuke Ito from Japan; Mat Collishaw from Great Britain; from Australia, David “Meggs” Hooke and the art collective composed of David Lawrey and Jaki Middleton; Paul Cox from France and his collaboration with students from Canada; William Kentridge from South Africa; and Roberto Freitas and Milton Marques from Brazil.

From the 15 artists (counting Lawrey and Middleton as one art collective), eight created animated installations using adaptations and reinventions of the zoetrope. The other seven artists’ works utilize other devices that flicker and rotate, including the thaumatrope, the phenakistoscope, the praxinoscope, and the flipbook as mutoscope. The author’s discovery within this niche that the majority of works consistently created as animated installations are reinventions of the zoetrope indicates a trend that requires deeper investigation. Thus, Chapter 3 is dedicated to animated installations that are reinventions of the zoetrope. The remaining artists are mentioned and reviewed in Chapter 2 after the specific historical sections dedicated to each device, connecting them with the contemporary installations to which they are related.

This selection process also revealed other works that initially would have been excluded because they presented animated installations as a film and not as a physical installation exhibited live. However, after further investigation, the author observed that such pieces are the result of a collective effort in the production of advertising, video clips, or even artist’s films as documentations, while being evidence of a growing online phenomenon that the author could not ignore. Thus, a special chapter was

added to address this growing phenomenon, which includes works by David Wilson (UK) and Alexandre Dubosc (France), as well as advertising pieces made for Sony Bravia, Temperley stores, MTV, Allianz, Stella Artois, and Airbnb companies. All these works are inspired by the zoetrope. A parallel trend is found in online stores selling devices that can be personalized and sometimes even assembled by the user as they allow the creation of printed versions of animated GIFs,[52] revisiting the charm and tradition of old technologies with a contemporary twist. For some, including younger generations, these *device films*[53] introduce them to the early optical toys for the first time.

Parallel to her analysis of the selected artists' artworks, the author makes comparisons and associations with the historical devices they used, identifying their connections, similarities, and differences. Prior to this research, this selection of works and artists had never been categorized and investigated within a unifying context such as animated installations. In this regard, the thesis extends the knowledge base of animation studies in identifying and studying a particular type of animated installation. This approach and methodology were also applied to the author's practical work, allowing her to reflect, understand, and improve upon earlier practical explorations of the zoetrope as evidenced by her own device, the Silhouette Zoetrope.

7. Research Structure

In addition to the methodology, to help answer the established research questions, the author designed the research structure by building on the historical and theoretical frameworks that support the criteria for analyzing the contemporary animated installations selected as case studies and the author's practical research. Therefore, **Chapter 1** covers a literature review that analyzes the theoretical framework of the thesis and discusses the

[52] Definition available in the Glossary.
[53] Term coined by the author to categorize specific devices that flicker and rotate built to be demonstrated as films, reaching a larger audience but not necessarily being exhibited live.

author's interpretation and definition of such concepts[54] as attraction, astonishment, wonder, illusion, magic, as well as how they synthesize into a deeper understanding of the development of the expanded animation experience. Based on Gunning's concept of the *cinema of attractions,*[55] this chapter aims to contextualize and extend the concept in relation to the field of animation. The works of scholars Mary Ann Doane, Nicholas Dulac, André Gaudreault, Germain Lacasse, and Alan Cholodenko are reviewed as supplements to and expansions of Gunning's cinema of attractions. Also, the canonical concept of expanded cinema as proposed by Gene Youngblood in 1970 and revised by A. L. Rees, David Curtis, Duncan White, and Steven Ball in 2011[56] is explored with the objective of identifying specificities of the expanded animation experience.

In Doane,[57] the differentiation of the kind of spectacle experienced in manipulating the early optical devices and cinema provides theoretical evidence for the author's distinction between these two forms of entertainment in this thesis. Gunning's use of Doane's analysis of the thaumatrope helps reinforce a specific characteristic of the animation experience in relation to these early devices: their physical manipulation.[58] Doane includes these early devices as attractions, displacing the specific time frame originally defined by Gunning and Gaudreault for the cinema of attractions—which originally covered the period from the first films of 1895 to 1906—before the development of narrative cinema. Dulac and Gaudreault do the same in their study of the phenakistoscope, extending the period of the

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[54] The Glossary also contains definitions to facilitate the understanding of these and other key concepts.

[55] The *cinema of attraction* is a term created by Tom Gunning and André Gaudreault. However, since it was Gunning who explored further the concept in numerous articles the references to Gunning point out to his articles. As defined by Gunning, the cinema of attraction is a cinema that relies on the fascination of the illusion, where the action does not necessarily follow a narrative and the spectator's attention is constantly and directly solicited.

[56] A. L Rees, David Curtis, Duncan White, and Steven Ball, eds. *Expanded Cinema: Art, Performance, Film.* London: Tate Gallery Pub., 2011.

[57] Doane's article was published only in German, therefore the author is using as a reference Gunning's citations of her work mentioned in his "The Play Between Still and Moving Images."

[58] Tom Gunning references Doane in his article "Hand and Eye: Excavating a New Technology of the Image in the Victorian Era."

attraction to investigate the role of repetition and circularity found in optical toys before the advent of cinema. Here, however, Dulac and Gaudreault's framework and approach to attraction are studied in relation to the historical events represented by the world expositions that grew exponentially during the 19th century. In this sense, Lacasse's text provides evidence of the important role played by the lecturer,[59] who served to direct the attention of the public to the attractions during these expositions and fairs. Lacasse's work then helps shed light on the responses of the Victorian-era public and the strategies built to attract them to wondrous experiences.

What Gunning calls "attraction" [60] and "spectatorial involvement" [61] are directly related to what the author interprets as an expanded animation experience driven by astonishment and wonder. In this sense, the author proposes a review of the history and different theoretical interpretations of wonder as a non-quantitative experience. Clues for such remarkable events can be spotted in articles, texts, and advertising from the 19th century as a method evidenced by Gunning to contextualize and identify the cinema of attractions, noted as well by Alan Cholodenko in his article "The Animation of Cinema." [62] In the latter article, Cholodenko turns Gunning's cinema of attractions into *animation of attractions*, which is a concept extremely valid for the topic of this research. This and other key contributions made by Cholodenko, including his pioneering acknowledgment of optical toys as forms of animation,[63] are addressed in Chapter 1. An extension of George Griffin's concept of *concrete animation*[64] is also proposed here in reference to the corresponding contemporary reinventions of early devices.

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[59] For Lacasse, the lecturer is a mediator between the public and the attractions at the fairground before cinema was invented. The lecturer helped create a narrative directing the attention of the audience to the spectacle they were about to see. Germain Lacasse. "The Lecturer and the Attraction." In *The Cinema of Attractions Reloaded,* edited by Wanda Strauven, 181-191. Amsterdam: Amsterdam University Press, 2006.
[60] Tom Gunning, "How Attractions Came into the World," in *Cinema of Attractions Reloaded,* edited by Wanda Strauven, (Amsterdam: Amsterdam University Press, 2006), p. 34.
[61] Ibid.
[62] Cholodenko, "The Animation of Cinema."
[63] In his introduction to the anthology *The Illusion of Life: Essays on Animation* (Sydney, Australia: Power Publications, 1991), pp. 9-10.
[64] Griffin, "Concrete Animation."

To support this non-quantitative approach, the most recent text by author and curator Nicholas R. Bell is examined in his review of the history of wonder in relation to contemporary artworks shown at the *Wonder* [65] exhibition in Washington, DC, in 2016. Bell's historical contextualization of wonder as a desired experiential state supports its appealing renewal for today's public. To complement the use of Bell's approach, Stephen Greenblatt's chapter on "Resonance and Wonder"[66] helps contextualize the attempt of galleries and museum spaces to consciously "heighten the experience of wonder"[67] for their public. In search of identifying different experiences that share similar characteristics related to awe and wondrous feelings, David Rockwell and Bruce Mau's book, *Spectacle,* [68] provides a review of spectacular events that allow people to feel something greater than themselves. Also in relation to the sense of wonder through scale, Norman Klein traces back the history of special effects to historical architectural constructions in his book *The Vatican to Vegas: A History of Special Effects*[69] and it is also a reference for the non-quantitative experience those constructions inspire. Even though there are recent studies[70] that attempt to measure astonishment and wonder, this quantitative approach goes beyond the scope of this research, as the goal here is not to measure a feeling but to recognize works that stimulate such feelings, elucidating their strategies to inspire them.

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[65] The exhibition *Wonder* was curated by Nicholas R. Bell for the reopening of the Renwick Gallery of the Smithsonian American Art Museum in 2016.

[66] Stephen Greenblatt. "Resonance and Wonder." In *Exhibiting Cultures: the Poetics and Politics of Museum Display*, edited by Ivan Karp and Steven D. Lavine, 42-56. Washington, DC: Smithsonian Institution Press, 1991.

[67] Ibid., p. 49.

[68] David Rockwell and Bruce Mau. *Spectacle.* London: Phaidon, 2006.

[69] Norman Klein. *The Vatican to Vegas: A History of Special Effects*. New York: New Press, 2004.

[70]One of the most relevant cases is published in the book *A Neurophenomenology of Awe and Wonder: Towards a Non-Reductionist Cognitive Science* by Shaun Gallagher and others, released in 2015 (Palgrave Macmillan). Employing methods from different disciplines such as neuroscience, psychology, philosophy, phenomenology and others, the authors attempt to reproduce, with the use of technology simulation, the experience of wonder that astronauts feel when seeing the Earth from the space shuttle or even when they gaze into space. The book registers the authors' documentation of this attempt to re-create and measure such wondrous feeling by artificially reproducing the astronaut's experience using digital technology.

For the author, in this thesis the meanings of astonishment and wonder complement each other. Astonishment[71] is, for the author, the feeling related to the first impact, the surprise moment that creates a sense of arresting awareness that is shortly followed by wonder. At this level, there is no intellectual rationalization; it is only an emotional response that lasts very shortly and is soon replaced by wonder.[72] In its turn, wonder is the simultaneous emotional, perceptual, and intellectual response to a feeling elicited when one experiences something never imagined or never thought would be possible. Things unaccountable and greater than oneself are also part of this type of experience.[73] It ignites curiosity and leads to exploration, thinking, and learning. The feelings of astonishment and wonder elicited when seeing the sea for the first time, experiencing the vastness of the Grand Canyon, or a sky full of stars can also be lived in the fruition of an artwork, and more specifically in the animated installation, as, for instance, when seeing sculpted characters coming to life without a screen—as in Barsamian's work, but also Toshio Iwai's Totoro zoetrope made for Studio Ghibli in Japan—or even when making a collective physical effort to put a large-scale device to work for the mere joy of creating an optical illusion—as happened during the Burning Man[74] event with Peter Hudson's giant zoetropes. The collective effort and the surprising results are relatable feelings that are explored here as astonishment and wonder.

Adding to this framework, Gene Youngblood's concept of expanded cinema is here reinterpreted as an expanded animation experience. Youngblood's canonical book documents and analyzes the works of the 1960s avant-garde in North America when artists challenged the mainstream film exhibition formats, moving away from traditional theaters to explore alternative possibilities for the public to engage with a projected artwork. To help reconceptualize the role of cinema, these experimental artists proposed to

[71] A specific definition of the term as used here is available in the Glossary.
[72] A specific definition of the term as used here is available in the Glossary.
[73] The sublime is a topic of such richness and complexity, including in terms of its history and treatment in philosophy, that it would require extensive consideration and elaboration in its own right, especially if and how it might apply to mechanical devices of illusion.
[74] Burning Man is a one-week anti-consumerism communal-experiment event held once a year in the Nevada desert in the United States.

make even more dynamic the dynamic art of film, doing so by transforming, among other elements, the screen itself, through multiplication of screens and reinventing the theater through the use of nontraditional venues and unusual exhibition spaces. Since the publication of Youngblood's book, many new works have been produced building upon his visionary observations and ideas, including an updated review of the topic supplied by editors A. L. Rees, David Curtis, Duncan White, and Steven Ball in *Expanded Cinema: Art, Performance, Film.*

In parallel, today's artists working with animated installations recover this spirit of experimentation—particularly the ones studied in this research—and instead of investigating the boundaries of cinema as their predecessors, these artists are exploring and advancing the original essence of the moving image, the frame-by-frame foundation, which, for the author, is itself a form of animation. Theories and concepts traditionally applied exclusively to cinema are thus extended and investigated to include early optical illusion devices, which are then reanimated as contemporary art installations.

Chapter 2 covers the literature review that centers on the historical framework of optical illusion devices based on flicker and rotation of their structure by: 1) reviewing their scientific origins, 2) demonstrating their fundamental characteristics, and 3) identifying their corresponding contemporary reinventions. More than pointing out who was who in the early proto-cinematic period and describing intricate scientific devices, this chapter studies these devices in terms of the innovative designs they embody and the correlative advances in the understanding of animation that they represent, while offering a review of their specific histories and their role in the overall history of animation.

The works of Laurent Mannoni, Nicholas J. Wade, Virgilio Tosi, Giannalberto Bendazzi, and Richard Leskosky are the principal historical guides of this chapter. A review of Mannoni's work[75] offers historical references framed in

[75] Mannoni. *The Great Art of Light and Shadow.*

the perspective of the history of film. Wade's works[76] help investigate the scientific side of the history of such devices, while in Tosi,[77] a review of the relationship between science and entertainment recovers the scientific roots behind the devices that led to the creation of cinema. To counterbalance these historical views centered on cinema, works from Bendazzi and Leskosky supplement the animation side of that history. The multivolume study of Bendazzi [78] adds the historical framework of such devices, highlighting their impact in the field of animation. At the same time, Leskosky's texts[79] contribute in terms of the analysis of patent processes behind these historical animation devices, proposing new ways to interpret and review them.

Based on the historical overview, the author's goal in Chapter 2 is to elaborate on improvements that were passed from one device to another, identifying elements that can shine a light on potential contemporary uses of these devices, revealing those that were and still are the most successful, as well as characteristics of structural and other changes that took place over time. In addition, theories that are important for the understanding of such devices and their illusionistic effects are also reviewed in this chapter, including the discussion of the phenomena of persistence of vision and flicker fusion.[80]

To help establish the framework within which the contemporary works are analyzed, the author argues that the early devices continue to represent valuable sources of discovery, serving even as an agent for renewal of current media and technology strategies. Therefore, the historical optical

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[76] Particularly the following references: Nicholas J. Wade. *A Natural History of Vision.* Cambridge, Mass.: MIT Press, 1998; *Perception and Illusion: Historical Perspectives.* New York: Springer Science, 2005; "Philosophical Instruments and Toys: Optical Devices Extending the Art of Seeing," *Journal of the History of the Neurosciences* 13, no. 1, (2004): 102–224.

[77] Virgilio Tosi. *Cinema before Cinema: The Origins of Scientific Cinematography.* London: British Universities Film & Video Council, 2005.

[78] Bendazzi. *Animation: A World History.*

[79] Richard J. Leskosky. "Two-State Animation: The Thaumatrope and Its Spin-Offs," *Animation Journal* 2, no. 1 (1993); "Phenakis[tos]cope: 19th Century Science Turned to Animation."

[80] Both phenomena are defined and investigated in Chapter 2.

devices—defined here as proto-cinema devices, as embryonic forms of cinema before cinema—present fresh uses for animation beyond the screen, and evidence is provided in the case studies of contemporary animated installations related to each of those devices.

Chapter 3 focuses on eight artists and their works as case studies of a particular type of contemporary animated installations that renew the zoetrope, reanimating it for today's public. The works are divided into two categories: large-scale[81] animated installations and those that reinvent the wheel[82] structure—as an analogy for the zoetrope as the "wheel of life"—both proposing innovative ways to create an impactful animated installation. In the first category, works by Gregory Barsamian, Peter Hudson, and Mat Collishaw are at the center of the discussion. These three artists are relatively well known, and each uses different strategies to create large-scale artworks. Barsamian is a pioneer in the field and responsible for some of the earliest animated installations created using strobe light. For that reason, Barsamian is also the most cited artist in the genre, mentioned in articles and books on cinema and animation studies. A few contemporary authors recognize that artworks such as the ones made by Barsamian are emergent alternatives of animation, including here the previously mentioned works of Paul Wells and Johnny Hardstaff, Suzanne Buchan, and Meredith Bak.

In Hudson's case, as his work was launched in the context of the Burning Man festival, references to his work remain cloistered in books and articles about this specific event, with in-depth analysis of his work still being occasional and rare in the field of animation studies. Many of the details and specificities in regard to his work are not available in printed or online

[81] A reference inspired but not limited by the work of Meredith Bak in her article "Grand Illusions: Large-Scale Optical Toys and Contemporary Scientific Spectacle." Bak uses as examples the same artists as the author, the large-scale element being a common characteristic of their works to help distinguish them from other animated installations.
[82] The reference to the term here is not in the usual negative cliché meaning of "reinventing the wheel." Rather, the author is referring to a new twist on an old tradition, which in this case means that these artists have found new ways to represent the rotating cylinder of original zoetropes.

sources. The dearth of information made an interview[83] with the artist necessary as a primary source of information about his work, and it now serves as fundamental knowledge about the artist's work and his process.

Collishaw, on the other hand, is a well-established fine artist belonging to the Young British Artists (YBA) generation—the polemical and famous artist Damien Hirst was part of the same group. Collishaw works in a wide variety of media and has a propensity for zoetropes and past technologies, putting them at the service of his rather dark and violent imagination. His works are well known by art critics and are well documented. Recently, the artist gained much media attention for his innovative use of 3D printing technology to re-create as animated installation the actions suggested in the Mannerist painting *The Massacre of the Innocents* by Ippolito Scarsella, known as Scarsellino (1550/51-1620).

The second category brings together a unique set of artists, never before clustered as a group per se in film and animation studies. Their works reinvent the zoetrope and a few other early devices that flicker and rotate in a variety of ways. These artists are Toshio Iwai, Ryusuke Ito, Kumi Yamashita, Eric Dyer, and the collective David Lawrey and Jaki Middleton. For the author, their work presents ingenious alternatives to the traditional zoetrope with the goal of instigating astonishment and wonder in their public. Therefore, the strategies used by these artists to achieve such wondrous results in their public are investigated in this chapter.

Chapter 4 studies additional *troping*[84] cases as a growing phenomenon of constructing crafted animated installations that are only experienced through video on the Internet. This section aims to cover the *device films,* an

[83] Among the artists selected in this chapter, the author interviewed Barsamian and two other artists whose works are not easily accessible: Peter Hudson and Toshio Iwai. The author also had a few email exchanges with Eric Dyer, whose works are well documented online, which is not the case of Hudson and Iwai. Attempts to contact other artists were made without much success.

[84] The term *troping* is used throughout the thesis both to pay homage to the early optical devices that spin and to refer to the spinning movement related to a contemporary piece that somehow simulates the movement of these classic animation devices. A definition for it is also available in the Glossary.

identified growing phenomenon related to the production and display of contemporary animated installations, and other cases where early flickering devices have been explored as what the author terms *troping art.*

In device films, the sense of astonishment and wonder becomes diluted as the artwork is not experienced live. However, the exhibition of these artworks as films plays the important role of registering, displaying, and popularizing this particular type of animated installations. Device films range from the documentation of the concrete pieces previously discussed to advertising pieces and low-budget CGI (Computer Graphics Imagery) zoetropes. As films, these works can reach faraway viewers who probably would never otherwise experience the real pieces. With its innate pros and cons, this category bases its astonishment and wonder on the materiality and unconventional solutions found to market a product or present an artwork, making the work accessible worldwide.

Everything about the device films elicits tactility, even in their virtual computer-graphics versions. They are a particular example of what George Griffin has labeled *concrete animation* but were also selected here because of their direct relation with early optical devices. They can be further amplified by such developments as physical computing using Arduino, robotics, and other physical-digital hybrid media technologies as an extension of and improvement on their forebears, the 19th-century optical devices.

Chapter 5 introduces and articulates the author's practical work in relation to the theoretical and historical research. Thus, this chapter registers the creative process, structure, and production procedures of the author's own invention, the Silhouette Zoetrope, which as an innovative variation of the zoetrope combines optical illusion device, interactive art object, and toy with the potential to be developed into animated installations. To complement the animated installation side of the work, the author's experience at the

Boundary Crossings workshop,[85] in 2015, is also described and analyzed. In this workshop—run by the scholar and animator Rose Bond—participants had two weeks to create their animated installations for public exhibition. The actual experience of observing viewers become users engaging with an artwork was central and remarkable, and enabled the author to experience the astonishment and wonder from the perspective of the creator of an original interactive, hybrid physical-digital artwork.

Although the author created many projects combining different early optical devices with technology since the start of her PhD candidature in January 2013, these two specific projects are the ones most directly focused on the criteria established for this study. As pieces that propose reinventions or reinterpretations of devices that flicker and rotate, the author's animated installations created during the Boundary Crossings workshop and her Silhouette Zoetrope (2016) are the works detailed in this chapter.

These projects followed the same criteria established by the author to select the works investigated as case studies in Chapters 2, 3 and 4. The creative processes of their ideation and production, leading to their final public exhibition, are part of the author's quest, as practitioner, for an *expanded animation experience.* More than ever, works that require physical effort in their production and the active involvement of the public in their delivery or execution emphasize the integral role of concrete experimentation and its transformation into theoretical reflections.

The practical works presented in this chapter embody the results built upon tests and prototypes developed from the connections between the early optical devices and the animated installations uncovered in the author's study. The historic artistic review provided insights into the origins, mechanisms, and meanings essential to achieving a heightened experience for the public. The creative quest of this chapter reflects the fundamental

[85] Boundary Crossings is a biennial workshop that takes place at the Pacific Northwest College of Arts (PNCA) in Portland, Oregon, in the United States.

steps taken in the development of a new troping device that produces a unique animated optical illusion.

These early optical devices have scientific roots from times when magic, entertainment, science (under the name of natural philosophy), and technology were inextricably entangled. Also referred to as philosophical toys in the literature of film and animation studies, these historical devices were adapted and transformed into objects of amusement. From this perspective, one can say that the author's Silhouette Zoetrope is now following an inverse path by transitioning from amusement object to scientific apparatus, allowing the reference to past devices to come full circle, or rather spiral to new possibilities while recovering and revisiting the prior historical record. The scientific, and in particular the neuroscientific, potential of the Silhouette Zoetrope, although beyond the scope proposed in this research, was explored in the author's 2017 article "The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth, and Size Illusions,"[86] coauthored with Quang-Cuong Pham and Gerrit W. Maus. A brief overview of the collaboration and scientific processes that led to this publication is also included in Chapter 5 in order to strengthen the connection and potential of the device analyzed in dialogue with science.

In the **Conclusion,** the author returns to the research questions established and rigorously analyzes the theoretical and practical works, pointing out future possibilities and directions for the further unfolding of the research.

The author's view is that animated installations are part of a vibrant new world of artworks that are incorporating animation, discovering and exploring its fusion with other arts and scientific explorations. Although in this thesis the author has delved specifically into the case of art installations reanimated by devices that flicker and rotate, it is clear that these represent a very particular niche in the midst of other trends of animation, such as projection

[86] Christine Veras, Quang-Cuong Pham, and Gerrit W. Maus. "The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth, and Size Illusions." *I-Perception* 8, no. 2 (2017). Available online at: http://doi.org/10.1177/2041669517700912

mapping, virtual reality, augmented reality, immersive spaces, and others. However, for the focus of this study, the particular type of animated installations here investigated typify well those current art forms and visual media expressions that are exploring the extension and adaptation of early optical devices in the contemporary digital era. Without losing their physicality and haptic appeal, these works propose new possibilities that combine past and present to revive and renew the astonishment and wonder of its viewers through animation. To a greater extent, the kind of experience that animated installations facilitate is freed from the flat screen and can be considered an alternative to the traditional cinema theater setting. In this sense, they follow in the steps of the 1960s avant-garde investigations but now place animation at the core of the experience, eliciting the physicality of the optical illusion. In consequence, their viewers can experience original and refreshing uses of animation inspired by the historical approaches of devices that flicker adapted to contemporary times in the timeless quest for wondrous experiences.[87]

[87] The wondrous experience is not exclusive to this particular type of animated installation and can be experienced in a plurality of ways, although the specific focus of this research rests on this niche of artworks and its particular use of animation.

Chapter 1: The Quest for an Expanded Animated Experience

Say it, reader. Say the word 'quest' out loud. It is an extraordinary word, isn't it? So small and yet so full of wonder, so full of hope.
—Kate DiCamillo

1.1 Introduction

In the quest for an expanded animated experience, many are the possibilities and reasons that can explain and facilitate examination and investigation of this quest, which here will be focused on contemporary animated installations as reinventions of devices that flicker and rotate. The main theoretical approaches used in this chapter relate to Tom Gunning's concept of the *cinema of attractions*[88] and Alan Cholodenko's reconfiguring of it into the *animation of attractions,* [89] as well as the adaptation and reconceptualization of Gene Youngblood's concept of *expanded cinema*[90] as *expanded animation* and current interpretations of it that gain extended meaning in present-day animation practice and teaching. Also, George Griffin's concept of *concrete animation*[91] is revised and extended in light of the specific animated installations that reinvent today the early devices that flicker and rotate. The attraction and appeal of those physical early devices have led the author to propose a distinction between the kind of entertainment the optical toys offered and the one offered by cinema, the former being more related to live magic shows. This latter connection allows the author to relate the optical toys directly with contemporary animated installations and the conjurer aspects they both evoke.

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[88] Tom Gunning. "The Cinema of Attractions: Early Film, Its Spectator and the Avant-Garde." *Wide Angle* 8, nos. 3 & 4 (Fall 1986): 63-70.
[89] Alan Cholodenko. "(The) Death (of) the Animator, or: the Felicity of Felix. Part I: Kingdom of Shadows." In *Animation Studies* 2 (2007). Available online: https://journal.animationstudies.org/wp-content/uploads/2007/12/ASVol2Art2ACholodenko.pdf
[90] Gene Youngblood. *Expanded Cinema.* New York: Dutton, 1970.
[91] George Griffin. "Concrete Animation." *Animation: An Interdisciplinary Journal* 2, no. 3 (November 2007): 259-274. Available online: http://anm.sagepub.com/cgi/content/abstract/2/3/259

The exercise of putting animation at the center of the discussion is fundamental here since cinema has dominated the scholarly audiovisual discussion for more than a century now. In bringing animation to the foreground of the moving image experience, the author seeks to identify what is approached as animation in this thesis, pinpointing the flicker as its main element—a characteristic shared by both early optical devices and its contemporary reinventions.

The contemporary animated installations investigated in this thesis are inspired by the design and tactile and aesthetic qualities of their historical antecedents, the Victorian-era optical toys. Seen as contemporary reinventions of those early devices, these current artistic expressions are here characterized by artworks that are: physically constructed, ranging from large-scale pieces to art objects; display their content by using mixed media; have their design structure and aesthetics inspired by or related to those historical devices that flicker and rotate; and are normally exhibited for a short period of time.

As reinventions of historical devices, the animated installations belong to a broad spectrum of contemporary works based on, inspired by, and influenced by those historical technologies and devices, which led to their classification as "media archaeological." As the term implies and according to the media archaeologist Erkki Huhtamo, "to be worth being identified as media-archaeological, an artwork must evoke earlier media in one way or another."[92] Such categorization can include, for instance, works like Cindy Sherman's contemporary portraits in association with the early 19th-century "metamorphosis game with paper overlay,"[93] as proposed by Stafford and Terpak in their catalog *Devices of Wonder.* Both works, past and present, impersonate and rely on the puzzling transformation of the characters. Other examples of media archaeological work includes the polemical investigations

[92] Erkki Huhtamo, "Art in the Rear-View Mirror: The Media-Archeological Tradition in Art" in *A Companion to Digital Art*, edited by Christiane Paul (Hoboken, N.J.: Wiley-Blackwell, 2016) p. 72.
[93] Barbara Maria Stafford and Frances Terpak, *Devices of Wonder: From the World in a Box to Images on a Screen* (Los Angeles: Getty Research Institute, 2001), p. 229.

started by the artist David Hockney with the art historian Martin Kemp and optical scientist Charles Falco[94] on Vermeer's and other Masters' painting techniques using lenses and the camera obscura.[95] Such investigations shed new light on historical devices, procedures, and techniques interpreted through the perspective of contemporary artists and historians. Therefore, as a practitioner herself, the author of this thesis proposes to examine specific types of contemporary animated installations through the perspective of an artist searching for connections between present and past.

The approach used here embraces "historical study" as defined by historian G. R. Elton and cited by animation historian Giannalberto Bendazzi: "Historical study … is not the study of the past, but the study of present traces of the past."[96] Thus, it is through these *present traces of the past* that the author proposes an interpretation of how characteristics of the past optical toys influence the specific contemporary art niche of animated installations as their reinventions.

Therefore, before entering into a historical review of the early devices that flicker and rotate (Chapter 2) and case studies of contemporary animated installations (Chapters 3 and 4), the concepts and definitions used and established by the author are clarified in this first chapter, in addition to a literature review and presentation of the author's own interpretation of this past and present connection. It is the author's assertion that the selected contemporary artworks explored in this thesis are bringing animation back to nontheatrical venues, as it used to be in proto-cinematic times of the fairground attraction. The contemporary manifestation provides more interactive engagement with the public and resonates through entertainment while providing innovative ways to communicate, motivate, and educate.

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[94] For more information on the polemic created by Hockney, see Andrew Marr, "What the Eye Didn't See…," *Guardian*, October 7, 2001. Available online: https://www.theguardian.com/theobserver/2001/oct/07/featuresreview.review1

[95] A camera obscura was a dark room, or a dark box, in which a small hole (later improved by adding a lens to it) would let the light through "projecting" the external landscape, upside-down, on the opposite wall of the room or box.

[96] Giannalberto Bendazzi, *Animation: A World History,* vol. 1 (Boca Raton, Fla.: CRC Press, 2016), pp. 2-3.

1.2 Understanding the Attraction

The effervescent period of discoveries in the late 18th century and throughout the 19th century interlaced science and entertainment in the search for registering and understanding movement and the creation of the illusion of life. This genesis of the moving image is historically recognized as a period of key technological inventions that led to what is traditionally taken as the birth of cinema in 1895 with the first screenings of the Lumière brothers' cinematograph.

Furthermore, these devices and their inventors advanced the quest to understand and expand human perception. As well, the materiality of these devices and how these little mechanical apparatuses attracted viewers eager to follow the latest trends and be part of the new technological society helped shape 19th-century Western ideas of modernity. The industrial revolution in France, England, and, later, in the United States helped carry the idea of progress to the growing working class. Traditional European fairs of the 18th and 19th centuries were the perfect environment to display the latest entertainment "discoveries." They were also a form of popular entertainment, a place to be enchanted by attractions and all kinds of ingenuity related to the amusement business. Worship of machinery grew, and technological achievements emerged from an ever-longer lineage, reaching a high point with the invention of photography. Many of the pioneers who helped build this newly industrialized society would not foresee that their inventions would lead to cinema as the powerful entertainment industry that we know today. But this specific period changed forever the way we consume and produce entertainment. For Gunning, it was the "beginning of the modern age,"[97] where a new type of image and a new way to register, show, and see the world through optical devices was conceived, consequently expanding the public's perceptions.

[97] Mentioned by Tom Gunning in his lecture "The Hand and the Eye: The Thaumatrope and a New Era of Images," available online at: http://www.indiana.edu/~video/stream/launchflash.html?folder=vic&filename=chaouli_gunning_201202.mp4.

In that context, it is easy to assume that the competition for innovation was high, fueling the search for new attractions and technologies. Establishment of the Universal Exhibition, or so-called World Fair—a kind of large-scale attraction fair that featured, among other activities, the best inventions of every participant country—not only intensified a healthy rivalry among nations but also helped create the idea of a "unifying pride,"[98] raising nationalism in their respective societies.

A few examples of innovations that were introduced at world fairs are the telephone[99] by Alexander Graham Bell (in 1876 at the *Centennial Exhibition* in Philadelphia), the praxinoscope[100] by Émile Reynaud (in 1878 at the *Exposition Universelle* in Paris), the Eiffel Tower[101] by Gustave Eiffel (in 1889 at the *Exposition Universelle* in Paris), and electricity[102] (in 1893 at the *World's Columbian Exposition* in Chicago). The fairs served as a showcase for the latest scientific advances in entertainment and technology and as a medium through which audiences were brought up to date and given a glimpse of what the future would be, reinforcing the relationship between science and entertainment through history.

Specifically, the inventions-cum-attractions that were already producing animation (the proto-cinematic devices) are, for this author, the essence of what Tom Gunning and André Gaudreault would term the *cinema of attractions.* They were specifically targeting films produced during the advent of cinema, 1895 to 1906, creating a division in the period historically standardized as *early cinema*, traditionally set as 1895 to 1914-15. For the focus of this thesis, it is necessary to stretch their concept to include the proto-cinema era. Although this stretch has been done before, the approach

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[98] Michael A. Vanns, Witness to Change, a Record of the Industrial Revolution: The Elton Collection at the Ironbridge Gorge Museum (Hersham, U.K.: Ian Allan, 2003), p. 139.
[99] American National Archives: http://www.archives.gov/education/lessons/telephone-light-patents/
[100] Émile Reynaud Association: http://www.emilereynaud.fr/en/index.php/post/The-Praxinoscope
[101] Eiffel Tower website: http://www.eiffel-tower.com/en/everything-about-the-tower/the-eiffel-tower-at-a-glance.html
[102] History Department, University of California-Los Angeles, research on the 1893 *World's Columbian Exposition*, available online at: http://uclawce.ats.ucla.edu/tech-main

used here aims to review the concept of the cinema of attraction in relation to the attraction already proposed by the optical toys.

Gaudreault, in an article with Nicolas Dulac,[103] has already embraced this approach, as has Germain Lacasse.[104] In fact, the latter proposed pushing the concept even farther back to include magic lantern shows, reinforcing that 19th-century audiences were already quite familiar with the projected visual spectacle. For Dulac and Gaudreault, the *cultural series,* represented by what they call "animated pictures," which includes those featured in optical toys, constitutes a period in which the *attraction* concept "takes shape."[105]

Without disagreeing with Lacasse on the importance of the magic lantern show as a precursor of a visual ritual with projection and paying spectators, this author focuses her research on optical devices that flicker and rotate while embracing the importance Lacasse gives to the role of the lecturer as a fundamental mediator of attractions at the fairground before cinema was invented. A common figure at the fairground and also in the magic lantern shows, the lecturer helped create a narrative by making sense of the images, preparing and directing the attention of the audience to what is yet to come. In the case of proto-cinematic optical devices, the player-viewer becomes that lecturer-performer, absorbing the role of this figure that has fundamentally disappeared in cinema and spectacles over the years.

Thus, it is also a claim of this research that the role of the fairground lecturer will be passed on to the viewer of the optical toys. At the moment that these toys become a home entertainment device, the viewer becomes the user and can also assume the role of the lecturer or the barker in introducing the

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[103] Nicolas Dulac and André Gaudreault. "Circularity and Repetition at the Heart of the Attraction: Optical Toys and the Emergence of a New Cultural Series." In *The Cinema of Attractions Reloaded,* edited by Wanda Strauven, 227-243. Amsterdam: Amsterdam University Press, 2006.

[104] Germain Lacasse. "The Lecturer and the Attraction." In *The Cinema of Attractions Reloaded,* edited by Wanda Strauven, 181-191. Amsterdam: Amsterdam University Press, 2006.

[105] Dulac and Gaudreault, "Circularity and Repetition at the Heart of the Attraction," p. 228.

illusion to others while playing, preparing them for what they are about to see, possibly even creating small narratives to contextualize the optical animated illusions seen. His or her role is also similar to the magician as a performer of a show when postulating that an improbable action is about to happen, inviting the audience to doubt his or her abilities. The more the audience doubts, the more astonished they will be. Thus, the optical devices, offering a spectacle clearly influenced by the fairground attraction and the magic show environment, require a different perspective than the one proposed in the original concept of the *cinema of attractions*.

For Alan Cholodenko, "in elaborating the nature of his cinema of attractions, Gunning unwittingly makes animation the first attraction of cinema, the last attraction of cinema and the enduring attraction of cinema, thereby likewise unwittingly makes his cinema of attractions animation of attractions."[106] As Cholodenko's concept revolves around a broad understanding of animation, it becomes clear that what Gunning proposes for cinema can easily be transposed to animation, as cinema is for Cholodenko and for this author a form of animation.

1.3 A Concise History of Astonishment and Wonder

Astonishment and *wonder* have gained different meanings through time. According to the Wolfram Alpha software, among the narrower terms that can define *astonishment* is "wonder," hence by extension, astonishment can cause a person to wonder. Meanwhile in its online dictionary, Merriam-Webster offers the following as its second definition of the verb *wonder:* "to have interest in knowing or learning something: to think about something with curiosity," which relates to the approach proposed in this thesis of having astonishment as the first elicited feeling, followed by wonder.

[106] "(The) Death (of) the Animator, or the Felicity of Felix. Part I: The Kingdom of Shadows," *Animation Studies* 2 (2007): 16. Available online: https://journal.animationstudies.org/wp-content/uploads/2009/07/ASADArt4ACholodenko.pdf

Colin Williamson in tracing back the "archaeology of magic and the cinema"[107] refers to wonder as a multivalent term.[108] For him, "the attraction is precisely the trick's explainability, its promise of the possibility of knowledge about the obscure and the unknown, its open incitement to wonder."[109] This seed of knowledge and curiosity connects the attraction to wonder. The viewer's need to explain the animated illusion seen in both early optical devices as well as in contemporary installations transforms the awe into a search for understanding.

In his book *From Vatican to Vegas,* Norman Klein proposes an investigation of the historical roots of wonder by tracing the history of special effects. Klein defends the argument that special effects' history began long before cinema, with paintings and church ceilings from the 15th century functioning as early expressions of special effects. Klein's broader meaning for *special effects* takes into consideration the attempt to astonish and evoke "moments of wonder," [110] merely confirming a need for artistic representations that transform special effects into part of the human experience. Places that throughout history were set up to release a "marvel"[111]—such as churches, fairgrounds, amusement parks, and casinos—evoke astonishment through the grandiosity of their physical structure and rely on the experience as being lived in real time and space, the same way traditional live spectacles across the world have been doing so for centuries. The scale, the awareness of the audience, and the live experience are shared characteristics with the early optical toys as well as contemporary animated installations.

An "excess of novelty" was also a result of what is historically defined as the Age of Discovery*,* during which the great navigations of European explorers

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[107] As displayed in the title of his book: Colin Williamson, *Hidden in Plain Sight: An Archaeology of Magic and the Cinema* (New Brunswick, N.J.: Rutgers University Press, 2015).
[108] Ibid., p. 38.
[109] Ibid.
[110] Norman Klein, *The Vatican to Vegas: A History of Special Effects* (New York: New Press, 2004), p. 12.
[111] Ibid., p. 2.

"discovered" new continents and cultures yet unknown, as the art historian John Onians explains:

> The great period of wonder of the sixteenth and seventeenth centuries AD came into being as a result of an excess of novelty, and was brought to an end, as nature prescribes and Bacon and Descartes had foreseen, by a wave of explanation and classification.[112]

This resulted in the fashion of collecting bizarre objects from those "newly discovered" lands to cause wonder and incite curiosity. They were gathered by rich and empowered people into what become known as Wunderkammers. [113] Gradually, with the development of science, explanations and classifications tried to make sense of these collections of bizarre items in times when wonder and astonishment were seen as minor feelings, the result of ignorance and deceiving interpretations. To understand this context helps to deduce the need for explanations and warnings advertised with the philosophical toys for a 19th-century society that was characteristically inquisitive. To better understand the framework of those "devices of wonder" and their contemporary connections, Barbara Maria Stafford points out:

> Understanding that instruments belong to a broader technological system and are integral to connective theories and practices of visual communication allows us to situate them within a more inclusive endeavor, where art and science do not so much rival each other as intermingle and branch.[114]

The connections between art and science in the past created devices and technologies not only to entertain but to understand and explain visual phenomena related to human nature in the realms of sight, perception, emotion, and thought. This collaborative way of connecting art and science in the past can help spur more collaborative ways to approach art and science in contemporary times.

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[112] John Onians,"I Wonder … a Short Story of Amazement," in *Sight and Insight: Essays on Art and Culture in Honour of E. H. Gombrich at 85,* edited by John Onians (London: Phaidon Press, 1994), p. 26

[113] Art historians consider the Wunderkammer to be the earliest form of a museum.

[114] Barbara Maria Stafford, "Revealing Technologies/Magical Domains," in *Devices of Wonder: From the World in a Box to Images on a Screen,* edited by Barbara Maria Stafford and Frances Terpak (Los Angeles: Getty Research Institute, 2001), p. 1.

Today, astonishment and wonder as key human experiences not limited to the visual media share characteristics with current pedagogical research, providing a way to understand how the human experience leads to these ecstatic feelings. *Threshold knowledge,* a term derived from the pedagogical research of Jan Meyer and Ray Land,[115] falls within the theory of threshold concepts to reach a better understanding of the human learning process. Some of these key concepts[116] lie on the edge of the unknown and known, transforming our perception so as to provide an epiphany or eureka moment when passing from one to the other.

The same idea related to the shift between the unknown and the known had already been expressed in an artistic context, as Nicolas R. Bell pointed out in the catalog of the 2016 exhibition *Wonder*, at the Smithsonian's Renwick Gallery: "The history of wonder is peppered with descriptions of what it feels like to stand before an object, blissfully unknowing, in the moments before context, history, intellect, and taste drown out the senses."[117] For this author, that "spark" moment of discovery in the threshold process of experimentation, transposed here to the case of the fruition of an artwork, will be addressed in this research as "astonishment." Thus, astonishment is related to the first impact, the surprise moment that is shortly followed by wonder. Wonder, as interpreted by this author, will in turn ignite a curiosity and lead to exploration, learning, and awareness, inviting the public to reflect on their experiences and the emotions that arise from it. It is in the wonder aspect of these toys that the author grounds her approach toward the experience elicited by optical toys.

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[115] Jan Meyer and Ray Land, eds. Overcoming Barriers to Student Understanding: Threshold Concepts and Troublesome Knowledge. London and New York: Routledge, 2006.
[116] According to Meyer and Land, *threshold concepts* can be categorized as transformative, integrative, irreversible, and troublesome. More information is available at: https://www.sensepublishers.com/media/1177-threshold-concepts-and-transformational-learning.pdf
[117] Nicholas R. Bell, *Wonder*, catalog, (Washington, D.C., and London: Smithsonian American Art Museum/D. Giles Ltd., 2015), p.23.

1.4 From Attraction to the Astonishment and Wonder of an Expanded Animation Experience

For Gunning, the astonishment of the cinema of attractions, as expounded in "An Aesthetic of Astonishment: Early Film and the (In)Credulous Spectator,"[118] is related directly to the surprise and shock of the viewers, but not because they were ignorant of the novelty it represented but exactly because of their awareness of what it represented. When describing the first Lumière film projection for a paid audience at the Boulevard des Capucines in 1895, Gunning explains that the projection carefully transformed photographs into moving scenes.[119] By making an obvious transition between the familiar photographs to the unfamiliar and strange moving images, almost as magicians, the Lumière brothers played with the perception of the audience and added an unexpected element: motion.

However, Gunning does not offer further musings on the prolongation of interests that the astonishment turned into wonder may trigger in the viewer—possibly even leading to new discoveries. For this author, the continuation of effects subsequent to astonishment and wonder is a key aspect. For instance, it caused George Méliès, after seeing the Lumière brothers' early film projections, to acquire a camera of his own, explore the then new media, and create wonderful *trick films* as a natural evolution from his magic shows. In fact, one could go even further in saying that the astonishing and wondrous effects elicited by the Lumière brothers'[120] early public demonstrations of their cinematograph had such a huge impact on global culture that today we still talk about it, study it, and explore it as an example of this extended wonder triggered by an astonishing experience.

As Gunning mentions in his seminal article "The Cinema of Attractions," shock is a key aspect of the cinema of attractions in the context of a recently industrialized 19th-century society seeking thrills that particularly the new

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[118] Tom Gunning. "An Aesthetic of Astonishment: Early Film and the [In]Credulous Spectator." *Art and Text* (Fall 1989).
[119] Ibid., p. 119.
[120] Other pioneering devices related to the moving image were proposed by Étienne-Jules Marey, Eadweard Muybridge, and Thomas Edison.

working class could not experience in daily life. Shock was already a premise explored and extended in the growing phenomenon of places created for the amusement of the masses and their investment in delivering an experience alien from everyday life. However, the combination of the attraction that provided this shock and what this author defines as “astonishment” and “wonder” become the essential elements in drawing the viewer to the center of the experience and giving him or her what this author argues to be a much more involved role than that of the cinema spectator, an interactive role already offered by the optical toys.

Thus, there is a fundamental intellectual stimulation that the wonder can help trigger that can have a remarkable impact, and that, the author claims, is the substance of every new invention, just as the wondrous curiosity of Émile Reynaud led him to create a new device as a spin-off of the zoetrope, the so-called praxinoscope. It would be through its constant improvements that Reynaud’s artful creation, the Théâtre Optique, would pave the way for cinema. His one-of-a-kind invention advanced by many years what cinema and film animation would only be technologically able to achieve much later.[121]

The astonishment and wonder represent here the catalyzer of the experience, not necessarily related to the shock as attraction, as Gunning’s term relates to it. In the specific case of optical devices, the viewer is free to walk around, comment, touch, and play with the device since manipulation is required for the illusion to happen. As stated by Gunning, in endorsing the film theorist and scholar Mary Ann Doane’s view, “part of the attraction lies in the manipulation of the apparatus itself, which one holds in one’s hand, as much

[121] Reynaud’s Théâtre Optique proposed a linear narrative structure, separated character from the background, and displayed colored hand-drawn animations for a paying audience with live sound starting in 1892. His invention was extremely complex and thus performed and repaired by Reynaud himself, who also crafted every animation strip. These artistic features would also be the limitations of his invention, which, in conjunction with its lack of portability, would drive it to obsolescence in comparison to the cinematograph, which would soon be spread and duplicated all over the world.

as in the evanescent image it produces."[122] The live experience of these early devices, therefore, aligns the physicality of the body's gesture with the astonishment and wonder of the senses triggered by manipulation and perception of the device's animated illusion.

Gunning also notes, when defining the cinema of attractions in his seminal article, that "this is a cinema that displays its visibility, willing to rupture a self-enclosed fictional world for a chance to solicit the attention of the spectator."[123] The optical toys not only solicit the attention of the viewers but invite them to perform and produce an illusion by manipulating the device. As claimed by Doane,[124] the viewer/user of these devices "seemed to hold movement in his or her hands."[125] Doane's beautiful construction reinforces the dazzling effect the device caused while empowering its viewer/user, showing that the illusion of movement the viewer performed required a fundamentally different involvement than the cinema spectator would later supply. As attractions themselves, these early devices generated an animated image that did not exist when the device was still, which reinforced their role as illusions ready to trigger awe in their viewers. Hence, with the optical device, what you see is *not* what you get, and what you get is much more exciting and surprising than what you have initially seen.

Furthermore, beyond simply soliciting the viewer's attention, these early devices elicited the conscious participation of the viewer, a fundamental aspect that emphasizes the progression of the process itself: from the apparatus to the illusion and from the perception of the illusion to the effects it instigates in the brain of the beholder. The alternate term of *philosophical toys*[126] for these optical devices is related to that train of thought and thus is

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[122] Tom Gunning, "The Play Between Still and Moving Images: Nineteenth-Century 'Philosophical Toys' and Their Discourse," in *Between Stillness and Motion: Film, Photography, Algorithms,* edited by Eivind Røssaak (Amsterdam: Amsterdam University Press, 2011), p. 41.
[123] Gunning, "The Cinema of Attractions," p. 382.
[124] As referred before, Doane's article was published only in German, therefore the author is using as a reference Gunning's citations of her work mentioned in his "The Play Between Still and Moving Images."
[125] Ibid., p.41
[126] The term also refers to science that was known around the time as *natural philosophy*.

still used by scholars today to refer to these toys. Although the actual origin of the term is obscure, Nicolas J. Wade points out:

> In the nineteenth century, some instruments were called philosophical toys because they provided popular amusement as well as experimental assistance. … Later philosophical toys were used to address visual perception of motion and depth. Development was initially driven by the need for stimulus control so that the methods of physics could be applied to the study of perceptual phenomena. The principal instruments were invented in the first half of the nineteenth century, and they consisted of simple contrivances that manipulated time and space in ways that had not previously been appreciated. They included thaumatropes, phenakistoscopes, stroboscopes, anorthoscopes, stereoscopes, tachistoscopes, and chronoscopes. Several of these philosophical toys proved to be phenomenally popular, particularly when combined with photography.[127]

When the thaumatrope (a term from ancient Greek, crucially proposing that wonder is at stake in it and these toys, for it means *wonder turner*) was invented, the term *philosophical toys* was used as an effective marketing strategy to publicize the scientific and philosophical potential of these toys, making people question what their eyes see and what they know,[128] as Dr. John Ayrton Paris put it. This contradiction between vision and senses was also at the foundation of the cognitive dissonance process researched much later by the Gestalt psychologists.[129] The dichotomy between stillness (what you know) and movement (what you see), together with the conscious participation of the viewer, are, this author claims, what guarantees the renewal of the astonishment and wonder of these early devices through generations. This is also the basic premise of optical (visual) illusions and the reason why we are prone to them. According to the neuroscientist Susana Martinez-Conde, "an illusion is a phenomenon in which our subjective

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[127] Nicolas J. Wade, "Philosophical Instruments and Toys: Optical Devices Extending the Art of Seeing," *Journal of the History of the Neurosciences* 13, no. 1 (2004), p. 102.

[128] In his book *Philosophy in Sport Made Science in Earnest* (1828), Dr. Paris promoted the thaumatrope as a toy that would help develop Cartesian minds, in reference to Cartesian dualism, a derivation from René Descartes' (1596-1650) philosophy in which mind and body are separate entities and mind rationally questions the senses triggered by the body. The thaumatrope was advertised as an aid in developing critical faculty, especially in young minds.

[129] Thomas Elsaesser, "Stop/Motion," in *Between Stillness and Motion: Film, Photography, Algorithms,* edited by Eivind Røssaak (Amsterdam: Amsterdam University Press, 2011), p. 115.

perception doesn't match the physical reality of the world."[130] Overall, these entertaining illusions advance the scientific understanding of how our brain works.

The fundamental differentiator behind Gunning's concept of early films that he considers "attractions" lies in the narrative aspect they lack, which would be developed later in films after 1906 based on literature and theater traditions. However, narrative films will also make use of the attraction element to renew the audience's interest, and the increasing use of stunning special effects is a good example of that today. Much broader and inclusive, the astonishment and wonder proposed and embraced in this research are feelings linked to human nature, while the attraction factor relates to the strategies created to trigger those feelings, instigating intellectual curiosity and aiming to bait and captivate the public. Once the public is hooked, their curiosity may be rewarded by the experience or not. Thus, astonishment and wonder become fundamental reactions when experiencing something that will make the viewer question his or her judgment of reality and significantly change his or her way of seeing the world, to the point that the viewer would recommend the experience and even pass its learning forward.

The review and re-appropriation of older practices can lead to solutions that contemporary means have not yet considered. Hence, animated installations can be seen as possibilities to converge animation with different artistic modes of expression, such as drawing, sculpture, performance, lighting design, literature, and digital media art, among others, thus becoming forms of "transmedia," breaking down the boundaries between those art forms and also between art object, artist, and audience, providing vast new possibilities for producing and disseminating the artwork in non-traditional spaces and to a more diverse public. These types of experimental art practices refer back to the Futurist, Dadaist and Surrealist avant-garde movements of the 1920s that were further developed in following decades, particularly the 1960s, and

[130] Cited in Carrie Nierenberg, "Optical Illusions: When Your Brain Can't Believe Your Eyes," ABC News, October 13, 2009. Available online: http://abcnews.go.com/Health/EyeHealth/optical-illusions-eye-brain-agree/story?id=8455573

which have informed digital media since then due to the pervasiveness and convergent qualities of technology. In each of these historical moments artists reflected on art itself, its processes, and its strategies, producing artworks that mirror their concern and criticism of the social, cultural, and scientific contexts and their personal transformation of and as part of these contexts.

An important documentation of the 1960s avant-garde works that challenged mainstream cinema was compiled and studied by Gene Youngblood and categorized under the concept of *expanded cinema*. This term, coined by him in the late 1960s, refers to an expansion of the public consciousness through works that question the industrial entertainment cinema and lead the audience to experience the artwork in different and sometimes even interactive ways. Youngblood summed up the concept as follows:

> When we say expanded cinema we actually mean expanded consciousness. Expanded cinema does not mean computer films, video phosphors, atomic light, or spherical projections. Expanded cinema isn't a movie at all: like life it's a process of becoming, man's ongoing historical drive to manifest his consciousness outside of his mind, in front of his eyes.[131]

Despite dating from the 1970s and couched specifically for the investigation of alternatives proposed by the avant-garde artists, Youngblood's concept remains current, albeit transformed and adapted to include artworks from the digital era. These works can shed light on alternative options to the ever-growing dominance of mass-media entertainment. It was and still is necessary to reclaim the public's ability to enjoy, interact with, and reflect on an artwork. Even further, the kind of experience elicited by contemporary animated installations enhances the conscious awareness through animation happening in front of the viewer's eyes, not only expanding the idea of cinema, but transforming it into an expanded animation experience beyond the normal limitations of our senses and cognitive abilities linked to them. Recently, the term was reviewed in 2011 to include new thinking on the expansion of *expanded cinema* concepts as well as "forms of contemporary

[131] Youngblood, *Expanded Cinema*, p. 41.

expanded cinema" [132] that benefit from new media technologies, as exemplified in the anthology *Expanded Cinema: Art, Performance, Film.*

The expanded animation experience is for this author also reinforced by the tactile qualities the animated installations elicit. In this sense, one of the first articles to address the phenomenon of animated installations was written by the animator and scholar George Griffin.[133] In his article, Griffin conceived a new term, *concrete animation*, to help identify such haptic works. He established there four basic categories for an animation to be so classified:

> 1) Self-referential animation, films whose subject is dominated by material and process. …
> 2) Animation installed in a non-theatrical venue: in a gallery or other public, non-sedentary or unexpected space; projected onto or within sculptural objects, during live performance, onto irregular, exterior facades, from moving vehicles, into a single-viewer peepshow, etc.
> 3) Object animation which displays physical moving objects arrested in synthetic time by strobe light or shuttering devices (both low and high tech). …
> 4) Flipbooks and other handheld devices for rapid image display.[134]

Diverging from previous artistic movements defined as "concrete" or examples of "concretism," Griffin tried to reconnect the term to physical, tangible images and objects and the animation processes that bring them to life. He used as examples the works of artists such as Robert Breer, Gregory Barsamian, and Eric Dyer. For Griffin, concrete animation is experiential and pervasive. Although discovery of his article facilitated the shaping of the author's own domain embraced by animated installations, at the same time it was clear his concept needed to be extended and updated.

Analyzing his four categories from bottom to top, the author, like Griffin, highlights flipbooks as handheld concrete-animation devices. But the author goes a step further, focusing on the inclusion of other devices from the

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[132] A. L. Rees, David Curtis, Duncan White, and Steven Ball, eds., *Expanded Cinema: Art, Performance, Film* (London: Tate Gallery Pub., 2011), p. 226.

[133] Griffin's "Concrete Animation" was published in 2007. Around the same period, the Platform Festival (http://platformfestival.com) in Portland, Oregon, included animated installations as a distinct category of its program, and a growing number of works appeared exploring the potential of a broad range of animated installations as alternatives to traditional animated films.

[134] Griffin, "Concrete Animation," pp. 261-262.

proto-cinematic era that require manipulation, specifically the thaumatrope, phenakistoscope, zoetrope, praxinoscope, and their variations classified here as devices that flicker and rotate.

In his third category, Griffin specifically includes in the concrete animation category the work of artists such as Gregory Barsamian, who uses strobe light, thus a flickering apparatus, to bring his three-dimensional sculptures to life. This inclusion embraces contemporaneous works and the diversity of the flicker they may create using “low and high-tech,” as Griffin puts it.

In his second category, he reinforces concrete animation’s need for its own space, far from the traditional theaters, which allows for the inclusion of projection mapping and other contemporary trends. For the author of this thesis, such inclusions may work for a broad interpretation of animated installations but mixes different devices and technologies that can be more clearly classified, undermining understanding of their distinctive features. Furthermore, this general inclusion overlooks the subtleties and specificities of works such as the particular type of animated installation as reinvention of early devices that flicker and rotate, the focus of this study.

In his first category lies the main difference his and this author’s approach Griffin includes any animated film that displays or evokes material processes. For the author of this thesis, the filmic recording of concrete works reduces their impact, particularly in the case of the animated installations here studied. Even if the filmed documentation and diffusion of such works have become today ubiquitous via the Internet, the specific tactile feeling inspired by the actual construction of a physical piece is still needed for it to attract and enchant the viewer. Hence, the combination of optical illusion and animated film significantly loses its impact when compared with the live and expanded animation experience physical artworks can offer.

1.5 The Need for Disbelief: The Trick Behind Magic Shows and Animated Installations

As Gunning mentions in his article “An Aesthetic of Astonishment: Early Film and the (In)Credulous Spectator,” the magic shows of the end of the 19th century “used the latest technology … to produce apparent miracles,”[135] and the astonishment these shows achieved is directly linked to the disbelief of the audience. The more they doubt what they see, the greater their surprise. This behavior, as previously mentioned, reinforces the principles established by philosophical toys and shared by optical illusions but will slowly fade with the advent of cinema and the establishment of the *willing suspension of disbelief,* only to be recovered today by the contemporary animated installations, as claimed by this author.

Popular convention maintains that cinema relies on the willing suspension of disbelief, referring to one’s disposition to escape and even transcend reality for as long as the movie lasts. Although the phrase was coined by the poet Samuel Taylor Coleridge at the beginning of the 19th century in reference to the characteristics of fantastic narratives in theater and literature, it later became a term applied widely in the late 20th and early 21st centuries, especially to film. It establishes that to be entertained the audience must suspend their disbelief and enter the story, accepting the nonreality of the words or images as credible, thereby living the story momentarily as if it were true. In other words, the viewers experience as “live” something that is not happening live.[136] Their reward is to have a few hours of entertainment and perhaps a deeper involvement in the experience, forgetting the problems and sorrows of their own reality to “experiment” with other adventures on the page or screen.

In the case of cinema, the artificiality of the environment, a dark theater full of chairs with people seated looking at a screen for a couple of hours, combined with the power of the images and their narrative constructions—catered to involve the spectator—are constantly balanced by an intermittent suspension of disbelief and today constantly put to the test by a cell phone

[135] Gunning, “An Aesthetic of Astonishment,” pp. 116-117.

[136] Many are the interpretations that can be made in relation to cinema not being live, or even as being “dead.” However, the comparison with cinema is called upon here simply to reinforce its difference from the kind of spectacle offered by optical toys.

ringing, a squeeky chair, a noisy neighbor eating popcorn, and so on. However, what is important to emphasize here is the willingness of the spectator to spend a few hours seated, still, focused, watching a story unfold before his or her eyes and looking forward to being moved by it, reacting to it (in good or bad ways). This is also something that the theatrical play can evoke, but with the peculiar characteristic of its being live.[137]

Since movies have become one of the largest and most important industries in the world, we can observe how the concept of willing suspension of disbelief has grown and how spectators are willing to be amused and engaged to escape from reality. However, it is the contention of the author that the kind of reaction and interaction that optical devices stimulated in their audiences is related not to cinema's suspension of disbelief but to the maintenance of disbelief of magic shows instead.

In a magic show, disbelief is an essential element and must last so that the perception of magic can be perceived as "astonishing." As Peter Lamont states:

> Magic is neither theater nor fiction, in that whatever theatrical or fictional elements might be involved, the essence of magic is that something impossible appears to happen in real time and space. To truly experience an impossible event, you must observe an event that you truly believe to be impossible. A willing suspension of disbelief can only diminish that experience. ... In short, if you suspend disbelief, the magic disappears.[138]

In the case of a magic show, and especially in a live magic show like the ones performed by Georges Méliès in the late 19th century at the Théâtre Robert Houdin, if the viewers suspend their disbelief, it is as if they believe that the trick truly happened as some mysterious or supernatural act. However, according to the scholar Colin Williamson, the opposite occurs: "Our almost automatic inclination to say that there must be an ordinary explanation for a phenomenon that we experience as wonderful defines our

[137] Further elaborations on the particular subject are beyond the scope and goals of this research.
[138] Peter Lamont, "Magic and the Willing Suspension of Disbelief," in *Magic Show,* edited by Jonathan Alley and Sally O'Reilly (London: Hayward Pub., 2009), p. 30.

sense of being *tricked* and not credulous."[139] The viewer's conscious doubt in the dexterity of the conjurer to fool him or her reinforces the disbelief and was considered the power of logic against the uncanny. Disbelief thus was a fundamental element in achieving astonishment and wonder in the magic show spectator. Transposing this logic to philosophical toys, the fact that the public must manipulate optical devices that flicker to see the moving image enabled its "magic"[140] to happen in real time and space. The awareness of the basic functioning of the device allows the viewer to participate in the appearance of the image, so the viewer is consciously and actively engaged in "making" the animation happen.

Here, once again a cognitive dissonance occurs, as previously referenced in the cognitive psychology research of Meyer and Land on threshold experiences. Thomas Elsaesser also sought to identify this incongruity in the astonishment that the Gestalt psychologists explained as "the eye sees as real what the mind knows to be impossible."[141] That dissonance is indeed what astonishes the audience of a magic show and also the users/viewers of proto-cinematic optical devices. As in a magic show, even if the observer cannot fully explain why and how the magic happens, he or she nevertheless enjoys the result, and it is this enjoyment that makes the "playfulness [triumph] over its philosophy"[142] in the recurrent use of these early devices. Thus, disbelief reinforces the astonishment and wonder, distinguishing these devices as a different kind of entertainment from cinema, with plenty of potential for exploration.

1.6 Animation at the Foreground of the Moving Image Experience

With the digital technology revolution, the growing role of animation as a ubiquitous art form of the 21st century has become increasingly evident. Indeed, upon reviewing animation's historical role, a handful of authors have

[139] Williamson, *Hidden in Plain Sight*, p. 3.
[140] The term is used here as a synonym for optical illusion.
[141] Elsaesser, "Stop/Motion," p. 116.
[142] Gunning, "The Play Between Still and Moving Images," p. 31.

defended the theory that cinema was always a form of animation: "a particular case of animation,"[143] as Alan Cholodenko put it, and, as Lev Manovich added years later, "Manual construction and animation of images gave birth to cinema and slipped into the margins … only to reappear as the foundation of digital cinema. The history of moving image thus makes a full circle."[144] While Manovich's statement notes circularity, the author finds the spiral to be a more appropriate symbol. As cinema originated from animation and now, with digital technology, is coming back to animation, its starting point and its "end" cannot be the same as a circle implies, but rather as a spiral. And, cinema—as part of the larger structure that is animation—"is never not animation."[145] Digital technology, in fact, has helped reveal this spiral structure to which cinema belongs and is inscribed, letting animation now reclaim its ostracized kingdom, more powerful and pervasive than ever.

Cholodenko's theory, built upon references made by the Russian animator Alexander Alexeieff and the Soviet filmmaker and film theorist Sergei Eisenstein,[146] is re-evoked 10 years later by Manovich, questioned by some traditional scholars, and simultaneously considered as a point of departure by younger ones such as Annemarie Jonson and Colin Williamson, to name a few. For the purposes of this study, however, Cholodenko's essays have helped reinforce the fundamental role of animation before the advent of cinema. In theorizing about cinema as a form of animation, Cholodenko sheds light on what he calls a "blind spot" too long ignored by film and animation studies, thereby enlarging animation beyond the traditional limits defined by cinema. Indeed, his work has called for an expanded and expanding understanding of what animation is. In this sense, although the author does not embrace in this thesis the magnitude of the expansion that Cholodenko envisions (considering all visual media as a form of animation), she does share with Cholodenko his concern for bringing animation once again to the foreground of the moving image experience, and, as this thesis

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[143] Alan Cholodenko, "The Animation of Cinema," *Semiotic Review of Books* 18, no. 2 (2008), p. 3.
[144] Lev Manovich, *The Language of New Media* (Cambridge, Mass.: MIT Press, 2002), p. 302.
[145] Cholodenko, op. cit., p. 1.
[146] Ibid.

will show, not only on the traditional screen but before its existence, that is, to the optical toy, and beyond, to animated installations. In other words, this thesis itself partakes in that expanded and expanding understanding of what animation is.

This train of thought leads to the arduous and almost impossible exercise of defining animation. Yet, even if the goal of this research is not to provide a new theory of animation, the exercise of defining it can shed light on the way animation is seen and approached by film and animation scholars today.

The word *animation* has its origins in the Latin *anima*, meaning "breath, vital force, soul, spirit."[147] Hence, referring to Cholodenko's claim that the term *animation* expresses two important characteristics—movement and life[148] (as endowing with both movement and life)—a definition of animation must include the uncanny impression of seeing sequential still drawings, sculptures, or objects as moving and gaining life, be it through proto-cinematic spinning optical devices or the tropes of contemporary animated installations. The latter are treated in the thesis as reanimations, following Cholodenko's theory, which in this case embraces contemporary animated installations as reanimations of early optical devices that flicker and rotate, as they endow a new life and movement inspired by these early devices.

It should be noted that the commonly used term *frame by frame*[149] is avoided in this thesis not only because the preposition *by* represents more in the case of animation than its basic meaning implies, but also because when installations animate three-dimensional objects independent of a screen, the idea of the frame is lost. The preposition *by* refers to what is not a frame, that

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[147] The most complete definition of the Latin *anima* was found at: http://www.dictionary.com/browse/anima?s=t (The *Oxford English Dictionary* only considers mind and soul as meanings of the Latin root of *animation*, and Merriam-Webster dictionaries only account for soul.)

[148] A claim emphatically made by Cholodenko in his article "The Animator as Artist, the Artist as Animator," published in *Animation Studies* 10 (2015), available online at: https://journal.animationstudies.org/alan-cholodenko-animator-as-artist-artist-as-animator/

[149] Referring to the definition of animation as "Frame by Frame" proposed by Cholodenko in footnote 34 of his introduction to *The Illusion of Life: Essays on Animation* and then expanded upon in footnote 13 of his essay "*Who Framed Roger Rabbit*, or the Reframing of Animation," which appeared in the same book.

which cannot be framed, the in-between space, the gap, the interstice, the pause. For the author, and this is a crucial point for this thesis, these are all related to the *flickering* nature of the early optical toys, so it is rather the flickering of the interstice in the process of creating an animated image that will enable its movement and consequently its soul*,* its *anima,* to be seen. Indeed, as Cholodenko proposes, "animation might be thought as the flicker that is framing…"[150] To which, in conversation with the author, he added "as well, animation might be thought as the framing that is flicker."

Even the scholar Tom Gunning, in reinforcing the connections between animation and photography in his article "Animating the Instant: The Secret Symmetry Between Animation and Photography,"[151] distinguishes between two kinds of animation: "animation[1]", [152] including for him the phenakistoscope and zoetrope, in other words, early optical toys; and "animation[2]",[153] privileged for him as *photographic animation*, which, unlike "animation[1]", produces wonder in the spectator by its play, its metamorphosing of the still into the mobile image and that draws attention to its own process. This is a distinction and exclusion, for this author, unsustainable in regard to the early optical toys insofar as they too had to be given such motion and life by the spectator, who could watch, even make, these still images transform, while also drawing attention to their own process through such play, especially as the viewer's hand animated the process.

Moreover, as Gunning keeps not just the frame but the shutter as core element of his connecting animation and photography in "animation[2]", he opens the door, without going through it, to a more inclusive concept of animation, one that includes "animation[1]" within it, indeed one that incorporates not only optical toys but animated installations, as well as

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[150] Cholodenko, "*Who Framed Roger Rabbit*," p. 237, footnote13.
[151] Tom Gunning. "Animating the Instant: The Secret Symmetry Between Animation and Photography." In *Animating Film Theory,* edited by Karen Beckman, (Durham, N.C.: Duke University Press, 2014).
[152] Ibid., p. 39.
[153] Ibid.

everything that lies historically in between them. The key element that helps us to produce and define this concept of animation as a whole is the flicker. As the shutter produce flicker, it is flicker rather than the shutter that is at stake in the early optical toys and photographic animation, as well as in the animated installations.

1.7 The Flickering Nature of Animation

By *flicker* the author is specifically referring to the effect created by the latitudinal perforations, or slots, made on a cylinder's or a disk's surface that generate a rapid variation in brightness, achieved by the intermittent frequency of these rotating slots, as is the case of the zoetrope and the phenakistoscope. When these devices rotate at a certain speed, the human brain perceives the fragmented, sequential, sliced images as a flowing continuum.

Devices like the thaumatrope and the flipbook, although not having slots, also create this flickering effect mechanically from the variation of frequency created by their rapid turn or manipulation of its pages, respectively. In the case of the praxinoscope, a faceted mirror generates that intermittent vibration. Although the convention is to consider only the phenakistoscope and the zoetrope as flickering devices because of their evident rotating shutter structure created by their slotted perforations, it was during an interview with the artist Toshio Iwai that it occurred to the author that all these devices mentioned above are in fact devices that flicker,[154] thus devices of animation.

Contemporary animated installations also need some kind of flickering to be perceived as moving. The most common way to create that flicker today is to use strobe light (electronic flicker). The use of strobe light in phenakistoscopes and zoetropes to produce the flickering effect is a modern

[154] The ruminations that follow are based on a discussion the author had with co-supervisor Alan Cholodenko, somehow expanding on an idea he let surface in a phrase in footnote 34 of his introduction to *The Illusion of Life.*

manifestation. The electronic strobe light replaces the mechanical flickering created by the intermittent slots used in the early versions of the optical toys. Interestingly, the strobe light's name derives from the stroboscope, Austrian mathematician Simon von Stampfer's 1832 version of the phenakistoscope, simultaneously invented the same year by Belgian scientist Joseph Antoine Ferdinand Plateau. Almost a century later, Harold Eugene Edgerton[155] in his research at the Massachusetts Institute of Technology (MIT) developed an electronic version of the stroboscope, using it to study objects in movement, sometimes with results aesthetically quite similar to Étienne-Jules Marey's chronophotographs of 1890 to 1900.[156]

Toshio Iwai, one of the pioneering contemporary artists to create animated installations using strobe light (another being Gregory Barsamian), has made a unique version of the phenakistoscope that creates the illusion of movement, apparently without any shutter to create the flicker, [157] the animation seems to occur magically before the viewer's eyes. The piece is small and simple, and, though it does in fact use flicker, its animated effect happens without any flicker being visible. Fields related to the psychophysics of vision denominate this effect as *flicker fusion*. It consists of the point in which a flickering frequency becomes imperceptible to human vision, and when that happens the motion effect is perceived as seamless without interferences.[158] The resulting effect of Iwai's piece is so natural that people may not realize how brilliant his invention is. It surprises the most attentive viewers because of its intriguing nature. The seamless flicker fusion rate[159] is

[155] Some of the images created by "Doc" Edgerton are available at: http://lumieregallery.net/wp/246/harold-edgerton/
[156] Per the Victorian Cinema website: http://www.victorian-cinema.net/marey
[157] During the author's interview of Iwai for this thesis, he explained how that effect of motion without flickering was created. Originally inspired by his observations on the flipbook, which for him created its effect through the fast movement–brief pause–fast movement of the flipping of its pages, he took a small stepper motor, a high-precision motor in which the user can define how much the motor will spin and for how long, and after many calculations found the exact relationship between the rotational speed, the quick pauses, and the number of drawings displayed to simulate a flicker imperceptible to the human eye and brain but still enough to create a seamless movement.
[158] Definition expanded from the definition provided by the Encyclopedia of Medical Concepts website, accessed at: http://www.reference.md/files/D005/mD005425.html
[159] Slight variations in the flicker fusion rate may occur from one person to another, but the effect varies drastically among other species.

much more imperceptible in contemporary devices that use strobe light than in the early devices that use mechanical slits. The manual rotation of these early optical devices is unable to achieve and maintain a precise rotational speed that would allow flicker fusion to occur without interferences. However, the resulting animated effect is still evident and surprising in the past devices, and even more so in the contemporary animated installations that rely on strobe lights.

Iwai's work is but another example of the flicker as a fundamental element in the production of animation and, in fact, in the creation of every animation within the scope of the term embraced in this study. Consequently, all known animation techniques make use of the flicker to create the illusion of movement, including here video and digital technology. These technologies developed their own flickering processes, varying from rolling to global shutters, which are basic elements present in both phases of production of an animated piece: the recording (in the cameras) and exhibition (in the monitor displays, TVs, projectors). Therefore, the flicker—produced mechanically or digitally—is the essential element that enables animation to happen, being created by the intermittent pauses (in electronic cases combined with a refresh rate) between the exhibition of each image.

The recording process pertains fundamentally to the celluloid mode of production more recently transitioned to the electronic and digital modes of production of an animation film.[160] When talking about both early optical devices and contemporary animated installations, recording is not part of the process since the images and objects are perceived as animated without the use of any camera or screen as a display. Therefore, animation in this thesis must instead be defined within the boundaries of the flickering mechanism and its effect created by different devices that vary from the early optical toys to the most sophisticated cameras and computers of today and include the perspective of an animator for whom, this author states, the process of

[160] In this case, even cameraless techniques such as drawing directly on film will depend on a projector, TV monitor, or other type of display to reach its audience, although its production does not need the flicker.

generating animation involves the manipulation of space in time to create the illusion of life.

1.8 Conclusion

Those early devices combined amusement and experimentation, provoking astonishment and wonder through their apparent simplicity of operation. Thus, art and entertainment, together with science and technology, are connected by the same obsession for registering movement, which continues to spur development of devices that delight the public. The very progression of optical animation devices and systems foments a continuous, growing need for advances in animation, with concomitant opportunities to further understand the human visual and mental perception systems, while, to equal advantage, eliciting opportunities to delight and entertain.

As Gunning states, "While the trick of motion undoubtedly partakes of the uncanny effect of the animating of the inanimate, the stuff of childhood fables and myth for millennia, it takes on new meanings in the modern era."[161] The feeling of awe that these early devices provoke is still experienced by viewers in contemporary times, renewing their interest in those apparatuses and welcoming the alleged "misleading" of their perceptions.

To reinforce the growing pervasive role of animation, it is observed that in the modern era, the investigation of how museums, theme parks, and other public art spaces are dealing with animation-focused experimentation helps elucidate contemporary strategies for reaching out to viewers. Such characteristics are being explored in multidisciplinary contexts as well, as demonstrated by NODEM[162] (Nordic Digital Excellence in Museums), which in 2014 focused conference efforts on ways to stimulate connections between research and practice in multidisciplinary areas that reflect on the perspectives and issues of digital cultural heritage—where the use of animation is key to connect the different disciplines. These interconnected

[161] Gunning, "The Play Between Still and Moving Images," p. 41.
[162] More information about the NODEM conference is available at: http://nodem.org/nodem-2014/

areas include, but are not limited to, science, education, interaction design, communication, marketing, and media, which promote a differentiated experience for the public not only by archiving the world’s heritage traditions but also by providing a dynamic way for people to recognize, embrace, and share their own cultural heritage through museums and other artistic public spaces. These experiences, when mediated by animation, intensify and become more accessible and memorable to the visitor; and the use of digital technology and its continuing connection with the past can enrich and renew the understanding of human experience, including world traditions by envisioning its transformation in time, the past, the present, and the future, while using and experiencing animation outside the traditional cinema industry framework.

Thus, through physical interaction with animated installations, a sensorial and intellectual experience can be enhanced, recovering the public's ability to enjoy and be astonished by a work of art and relying on art’s ability to transform each individual, who in turn will transform his or her environment, from the local to a global perspective. In this sense, the research presented in this thesis can easily expand into different correlative areas connected to experiences of astonishment and wonder, which today are increasingly linked to animation.

Chapter 2: Ingenious Devices, Misleading Perceptions

Any sufficiently advanced technology is indistinguishable from magic.
—Arthur C. Clarke

2.1 Introduction

The optical devices referred to as “philosophical toys” in the literature of film and animation studies—and specifically the devices that flicker and rotate, such as the thaumatrope, phenakistoscope, zoetrope, praxinoscope, and flipbook in its mutoscope form in this study—come from a long history of devices that elicit wonder, back to times when magic, entertainment, science, and technology were inextricably entangled. These ingenious devices associated science and entertainment through the misleading perceptions they instigated in their viewers—misleading because as optical illusions they created motion from still images in such a manner that what is known as real is not what is seen, a characteristic typical of the philosophical toys and also a defining characteristic of optical illusions.

In this thesis, the author argues that the reanimation of these early devices in contemporary animated installations renews in the public of today the astonishment and wonder felt in the past. In this chapter, the author investigates the theories that attempt to explain the phenomena involved in the creation of the animated optical illusion of early devices that flicker and rotate, explaining why the flicker is the most appropriate term for the study of those specific early devices. Then, a historical outline of each device is established, aiming to create a contextual overview of their time and use. In the overview, the goal is not to exhaust the historical investigation but to offer a context of those devices in a new light, presenting them as the necessary precondition of the animated installations here studied in order to address and understand their modern-day reanimation in them. Hence, the summary of each device is followed by a selection of relevant contemporary artworks (some as as animated objects, some as animated installations) that renovate the device, validating the connection between past and present. In

the case of the zoetrope, it receives in-depth treatment as the device that inspired the largest number of reinventions to animated installations in Chapters 3, 4 and 5.

2.2 The Perception of Motion through Flickering Images

The best-known phenomenon used to explain why we perceive still images as moving is the *persistence of vision,*[163] which in many senses has become dogma. It is the most simple and acceptable explanation used by film and animation scholars to describe why we perceive cinema and animation as moving images. It is still taught in schools and universities as the main reason why we can see live-action and animation films. Long criticized as a myth by cognitive psychologists,[164] it is nevertheless a persistent one. The reason probably lies in the fact that although the theory behind the phenomenon of persistence of vision has been persuasively shown to be imperfect, we still experience the effects encapsulated in the phenomenon—still images in motion—in both the proto-cinematic devices and cinema. In other words, the understanding of the theory has no relation to the ability to see the animated result and ultimately does not compromise its enjoyment. Or even, as James E. Cutting puts it, "the purpose of the representation of motion is more important than motion itself,"[165] which ends up dissociating the scientific explanation from the content portrayed. For instance, nobody needs (or wants) to understand the persistence of vision theory before watching a movie. The same goes for the early optical devices. But, interestingly enough, the theory—or at least the need for an explanation—

[163] The persistence of vision phenomenon is a scientific discovery named and further studied during the Victorian-era and a term widely used to explain the optical illusion effect perceived when sequential still images appear to be combined into a moving flow. It was believed that the impression of an image in the eye of the viewer remained there a bit longer, after the image disappeared, and when a new one, slightly different, replaced the preceding image, these images then overlapped, hence being perceived as moving. The phenomenon was questioned by scientists and scholars as it does not offer an adequate explanation of why and how we perceive still images as moving in animation and cinema.

[164] Back in 1912, Max Wertheimer pointed out the flaws of the theory and proposed a new explanation based on the phi effect.

[165] James E. Cutting. "Representing Motion in a Static Image: Constraints and Parallels in Art, Science, and Popular Culture," *Perception* 31, no. 10: 1,165–1,193.

always surfaces when optical toys are exhibited, and that is why the phenomenon of persistence of vision must be addressed here.

Proto-cinematic apparatuses not only created optical illusions but also demonstrated a scientific principle,[166] establishing their double nature as toys and scientific devices. Maybe the fact that the viewer sees and participates in the entire process, where nothing is hidden, is a key source of the astonishment these devices provoke, next leading the viewer to curiosity and wonder through the desire for an explanation of what the "eye sees but the mind knows to be impossible."[167]

As Nicolas J. Wade explores in "Philosophical Instruments and Toys: Optical Devices Extending the Art of Seeing," *natural philosophy*[168] had previously relied on visual observations of natural phenomena, and it would only be through the use of instruments that human vision will come to be potentialized. Consequently, science emerged, and scientific procedures were established over subsequent centuries. Visual motion would be one of the greatest scientific explorations of the 19th century, the same period in which an explanation for it was convincingly proposed as the persistence of vision phenomenon. At the pinnacle of formation of a mechanistic society, the philosophical contradiction between what is known—the images are not moving—and what the eye (and brain) perceives—moving images—was commonly interpreted as the result of a flaw, a problem, in the human visual system. This view prevailed for too long and reflects Victorian-era reasoning that regarded humans as machines[169] susceptible to flaws.

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[166] Gunning, "The Play Between Still and Moving Images."
[167] Dr. John Ayrton Paris' phrase was intended to promote the thaumatrope as a toy that would help develop Cartesian minds, in reference to *Cartesian dualism,* in which mind and body are separate entities and mind rationally questions the senses triggered by the body. As a derivation from René Descartes' (1596-1650) philosophy, it was advertised that it would help develop critical faculty, especially in young minds. In John Ayrton Paris, *Philosophy in Sport Made Science in Earnest* (Philadelphia: Carey, Lea & Carey, 1828).
[168] An 18th-century term for studies of physics and chemistry. Later they would be renamed the *natural sciences,* a more empirical science, and today are known simply as *science*.
[169] Gunning, "The Play Between Still and Moving Images," p. 30

In trying to understand the apparent motion created by these early optical devices, scientists in the 19th century explained its cause as being the persistence of vision phenomenon. From Peter Mark Roget (1779-1869) and Michael Faraday (1791-1867) to Joseph Plateau (1801-1883), many helped evolve the theory around this phenomenon during the Victorian era, not to mention earlier attempts and understandings of similar related effects already observed by the likes of Aristotle and Leonardo da Vinci.[170] The persistence of vision phenomenon as understood by Victorian-era scientists established that when still images, slightly different from one another, were displayed in a sequential order and shown at a certain flickering speed, the human "eye" was no longer able to perceive them as individual images and consequently superimposed one image upon another, thus giving the impression of movement.

It was not until around 1912 that another explanation, conceived by psychologist Max Wertheimer, founder of Gestalt psychology, was brought forth: the *phi effect*. Wertheimer's hypothesis attempted to explain why we "perceive movement where no real movement exists,"[171] which became known as *apparent movement*. Apparent movement is believed to be one of the key factors that allows us to perceive films in a continuous flow of images. It was initially believed to be a characteristic of the human retina and later attributed to a much more complex system, a combination of the workings between eyes and brain that can no longer be explained only through persistence of vision or the phi effect alone.

Assorted authors and scholars have shared their views and concerns about the persistence of vision phenomenon. Jacques Aumont recognizes that there are now many theories to try to explain the impression of motion.[172] Michael Chanan affirms that "persistence of vision as the nineteenth century

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[170] Wade provides a very detailed review of historical perspectives in his book *A Natural History of Vision,* p. 114, while Gunning also refers to earlier explorations on the persistence of vision in his article "The Play Between Still and Moving Images," p. 28.
[171] Jacques Aumont, *The Image* (London: British Film Institute, 1997), p. 30.
[172] Ibid., p. 29.

understood it is an archaic notion."[173] Joseph and Barbara Anderson[174] support the argument that the term *persistence of vision* is inadequate and should not be used beyond being referenced as a historical legacy.

A review of the statements and complex explanations that support or deny the validity of the phenomenon originally called persistence of vision makes evident that although many agree that the persistence of vision theory is incomplete, the search continues for an explanation of why we perceive static images as moving in films and optical devices. Tom Gunning addresses the issue as follows:

> While contemporary theories of perception do not deny the phenomenon of an afterimage and the apparent motion that the older theory sought to explain, they agree that simply retaining a series of afterimages in different positions cannot automatically yield a moving image (the effect would more likely be that of multiple superimpositions). Contemporary theories have broken the motion into multiple interrelating factors, whose complexities still allow some degree of controversy and uncertainty, even if the inadequacy of the old theory cannot be disputed. [175]

The most important aspect of these theories is that they represent an attempt to understand better human physiology, and as a consequence, different optical apparatuses were developed in trying to demonstrate and explain it. This understanding of human physiology has evolved over time, resulting in significant technological advances that have added complexity to the explanation, as Gunning has mentioned. How well the illusion could be perceived influenced technical aspects of how these optical devices were constructed and their improvements furthered. Many of them have slits[176] in their structure to create a mechanical flicker when rotated, which is, of course, as the author posited in Chapter 1, what allows the perception of still images to be seen as moving. Improvements were achieved through an empirical process of trial and error.

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[173] Michael Chanan, The Dream That Kicks: The Prehistory and Early Years of Cinema in Britain (London: Routledge, 1996), p. 50.
[174] In their 1993 article, "The Myth of Persistence of Vision Revisited," *Journal of Film and Video* 45, no. 1 (1993), p. 3.
[175] Gunning, "The Play Between Still and Moving Images," p. 30.
[176] The term *slits* and *slots* are used interchangeably throughout the thesis.

If our perception of reality can be challenged by the illusions[177] created by early devices, it is recognized by scientists and neuroscientists that research into how these effects are perceived by the human brain can help reveal new perspectives on how our senses and mind work. On the basis of experience to date, it is the author's contention and hope that the 19th-century exploration of motion will continue to inspire scientists to create devices that demonstrate continuous movement from still images. Their search will lead to scientific demonstrations that, in turn, could be artistically explored, maximizing the potential of these devices in ways never imagined by their pioneers. Or, the inverse can also be a possible path, as the author's practical work exemplifies an artistic exploration that generated contributions to scientific and animation fields, a process further explained in Chapter 5.

2.3 Rotation, Cycle, Loop, and Repetition

Cycle, loop, and repetition are the tools of any animator, in the past and also today. To make a character walk, traditional animators draw key steps of the walk, and instead of continually drawing every separate pose—for the duration of the character movement—they create what in animation is termed a *cycle*, which facilitates the process. In it, the position of the last drawing in the sequence is a return to the position of the first drawing in the sequence, thereby making the action look continuous, and fewer drawings, required. For the animator Francis Glebas, "cycles are a great way to save time when you are animating."[178]

In animation, these cycles are also repeated to test if the movement of a character is fluid enough. It is very common for traditional animators to watch their rough pencil tests[179] over and over again in a *loop*. Thus, the cycle in animation is related to the cyclical movement of a character and its

[177] Richard L. Gregory, *Eye and Brain: The Psychology of Seeing* (Princeton, N.J.: Princeton University Press, 1997), p.1
[178] Francis Glebas, The Animator's Eye : Adding Life to Animation with Timing, Layout, Design, Color and Sound (Waltham, Mass.: Focal Press, 2013), p. 70
[179] A pencil test is a rough animation drawing filmed frame by frame and displayed on a loop for the animator to test the movement he or she has drawn.

continuous repetition from beginning to end in a loop. Animation software and video display programs today have the loop as a tool, enabling a sequence to be easily repeated from start to end. These identical repetitions are typical characteristics of machines,[180] but in animation, when correctly used, they help give life to a wide range of characters and actions, where little details can be added here and there to make the animation look less mechanical. The rotation, the loop and the cyclical action of a character are important characteristics already seen in the early optical devices and are further explored in the zoetrope section of this chapter.

2.4 Historical Devices That Flicker and Rotate

In the history of animation, there are many possible beginnings. Scholars who assert that animation only began to exist after the birth of cinema in 1895, as a genre of the latter—notably the pioneering animation historian Donald Crafton, in his book *Before Mickey: The Animated Film 1898-1928*—may date its inception to 1900, with James Stuart Blackton's *Enchanted Drawings,* or to 1908, with Émile Cohl's *Fantasmagorie*, since Cohl's creation adds a more consistent narrative based on the metamorphosis of its main character. Others—including Bernard Lonjon in his book *Le Véritable inventeur du cinema* and Alan Cholodenko in his essay "The Animation of Cinema"—question the aforementioned dates, arguing that Reynaud was doing animation years before the advent of cinema, with his *Pantomimes Lumineuses.* Still others—as Virgilio Tosi in his book *Cinema before Cinema: The Origins of Scientific Cinematography*—assert that the scientific advances in optics and visual perception of the Victorian era and their devices that flicker prove that cinema's roots lie in science turned entertainment through animation. Some may even push the date farther back—as does Marc Azéma in his *La Préhistoire du cinéma: Origines paléolithiques de la narration graphique et du cinématographe*—depending on how they define animation. Each of these scholars' views present arguments to validate their claims, but the point here is to show how there are multiple ways to address history. The

[180] According to Glebas, p .70.

author here uses the early optical devices to conduct a review, focusing on the contemporary reinventions of the zoetrope in Chapters 3, 4 and 5.

To recapitulate, devices that flicker and rotate are specifically proto-cinematic apparatuses such as the thaumatrope, phenakistoscope, zoetrope, praxinoscope, and flipbook in its mutoscope form. All these complicated names were in fashion in the 19th century and somehow attempted to endow these devices with a flair and reputability borrowed from the classical Greek and Latin traditions, oftentimes also referring to the kind of effect they created. The same devices have been reinvented in contemporary times as artistic works that explore and extend those original historical devices.

2.4.1 The Thaumatrope (1824-1825)

The thaumatrope, according to Jonathan Crary, creates a rupture between object and perception[181] and thus is probably the first of the devices that flicker to do so. The images that we see on the device are printed/drawn separately, one on each side of a disk.[182] It is only when the disk turns that we can see the images complementing each other as if they were together on the same side of the disk. Therefore, when not rotating, the disk shows something different from what is perceived when it is rotating (Figure 1). It not only creates the rupture that Crary refers to, but as Gunning puts it, the thaumatrope "solved the paradox of space"[183] with images that the viewer knows are drawn on two different spaces (when not moving) yet are perceived as occupying the same space at the same time (when in motion). It is an illusion that appears to challenge the laws of physics.

[181] Jonathan Crary, Techniques of the Observer: On Vision and Modernity in the Nineteenth Century (Cambridge, Mass.: MIT Press, 1990), p. 106.
[182] The traditional and most common format of the thaumatrope has the shape of a disk, but other shapes are possible as well, including rectangles and squares.
[183] Gunning, "Hand and Eye," p. 499.

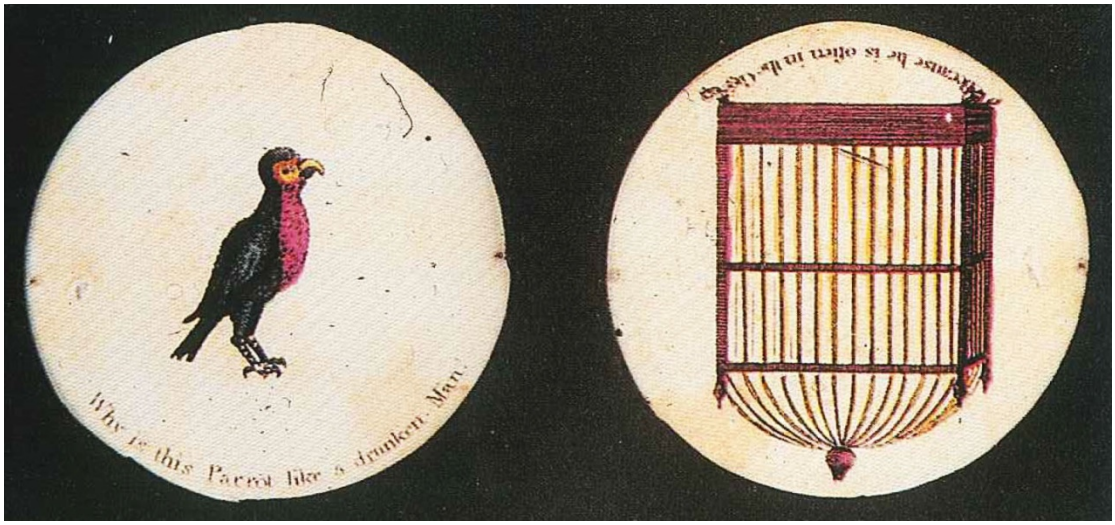

Figure 1. ***Bird and the Cage,*** **thaumatrope, front and back views, 1826** ***(Courtesy of David Robinson Collection)***[184]

This resulting composite image only exists in the brain of the viewer as a perceptual fabrication, since it does not exist on the disk itself. In this case, the flickering is created by the rapid turn of the disk, from one image to the other on the opposite side, with a state in between where no image is actually shown, creating the flickering that will enable the composite image to be perceived.

The thaumatrope was invented around 1824-1825.[185] Scholar Richard Leskosky offers these details:

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[184] All images from the David Robinson Collection appear in his *Masterpieces of Animation 1833-1908,* Griffithiana 43 (Pordenone, Italy: La Cineteca del Friuli, 1991).

[185] The French researcher and filmmaker Marc Azéma released a Pre-history of cinema *(La Préhistoire du Cinéma: Origines Paléolithiques de la Narration Graphique et du Cinématographe,* 2011) in which he introduces a "prehistorical thaumatrope," an artifact found in Laugerie-Basse in 1868, dating from the middle Magdalenian period (15000-13500 BP – archaelogical designation for Before Present). The artifact has a circular shape, is made from bone, and represents on both sides an animal resembling a deer, on one side standing normally on its four legs and on the other side with its legs contracted. The object, just like a thaumatrope, has the images positioned one on each side in opposition to each other. Thus, when spun, the overlapping images give the impression of movement. Azéma, in the DVD accompanying the book, not only reproduces digitally the resulting effect of the object when turned but also invites an artist to reconstruct the fabrication of that object using only materials available in the period of its creation. Since it is not possible to confirm the assumption that human prehistoric ancestors used this object exactly as a thaumatrope as we conceive it in modern terms, it is likewise impossible to confirm from it that a need for registering and reproducing movement was already present in primitive times. But, it is suggestive of the drawings on cave walls representing animals with multiple legs whose split-action forms also suggest movement through a sequence of still images. If the artifact is as Azéma claims, it would take thousands of years for humanity to be capable of reproducing life-like movement, and the Victorian-era optical devices are a landmark in this process of animation.

> The Thaumatrope was invented by a leading geologist (Dr. William Henry Fitton), inspired by a noted mathematician (Charles Babbage) and a renowned astronomer and chemist (Sir John Herschel). It was marketed through the Royal Institution[186] by Dr John Ayrton Paris, a prominent physician and scientific writer, at a relatively high price for the period.[187]

It was Paris who named the device the *thaumatrope* (Figures 1 and 2), which can be translated from the Greek as "wonder*"* (*thauma*) "turner*"* (*trope*), as an originator of wondrous effect. It was the first of the devices that flicker, as well as one of the earliest philosophical toys. Contrary to what many film and animation scholars believe, including Gunning, the thaumatrope enabled the occurrence of a *two-state animation,*[188] as Leskosky elucidates in his article. Even if these moving examples were not as common as the versions in which images are only complementing one another, their animation essence was already there but in only two phases.

The most traditional version of the device was composed of a disk with illustrations on both sides, such as the classic examples of the flower and vase, bird and cage, bald man and wig.[189] When rotating the disk on its horizontal axis by using the threads attached on each side of the disk, the viewer—using both hands to twirl the thread and consequently spin the disk—would see the images combined into one in these traditional examples.

Leskosky, in his research on the original patents of past devices, clarifies that attempts to incorporate movement in the thaumatrope existed early on,

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[186] The Royal Institution (RI) of Great Britain was created in 1799, "founded to introduce new technologies and teach science to the general public through lectures and demonstrations. Humphry Davy, one of the first professors, established scientific research as a crucial part of the RI's identity, something never envisaged by the founders of the institution. Over the last two centuries the building and labs have been home to famous scientists, such as Michael Faraday, who made discoveries which have helped shape the modern world" (http://www.rigb.org/our-history/history-of-research).

[187] Leskosky, "Phenakis[tos]cope," p. 179.

[188] The term is used here as Leskosky does so in his article: "'two-state animation' is the term I use to designate the sort of minimal or threshold animation generated by the rapid alternation of only two different images, such as created by more elaborated Thaumatropes and various nineteenth century devices which do not depend on spinning discs for the switching of the images." In Leskosky, "Two-State Animation," p. 21, note 29. Courtesy of the Author.

[189] These were a few of the recurrent themes in the series of thaumatropes released by Dr. Paris in 1826, which were accompanied by riddles.

including by Paris, who "'shortly after the invention of the basic Thaumatrope"[190] suggested refinements to the device relating to movement. Others followed, and developments were proposed by Thomas E. Bickled in 1892, Richard Pilkington in 1901, and Harry W. Akroyd in 1922.[191] However, from these patented improvements, it is unclear if any have survived or ever reached the market. The best-known type of thaumatrope today is still its classic circular version, sometimes shifting the rotation from its horizontal axis to a vertical axis.[192] Thus, the most challenging examples of two-state animation are still the ones in which creative designs and content are combined to optimize the use of the traditional device.

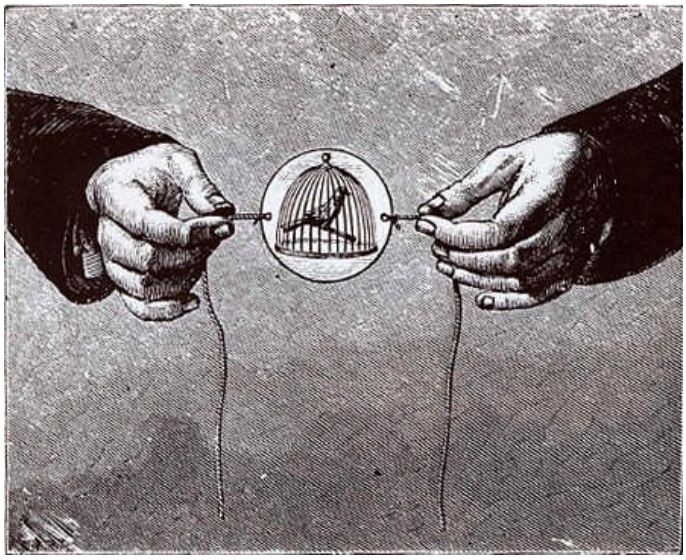

Figure 2. Engraving of the animated image seen on the classic *Bird and the Cage* thaumatrope *(Courtesy of Stephen Herbert Collection)*[193]

Examples of thaumatropes that "produce a crude sense of movement"[194] were available in the series published by Watilliaux in 1860. Particularly inventive are the ones entitled *The Duel* and *Gendarme and thieves*, as

[190] Ibid., p. 26.
[191] For more details on the patents of these different inventors, see Leskosky, "Two-State Animation."
[192] This shift, as Leskosky points out, facilitates the assembly of the thaumatrope by the user, since its opposite image does not have to be placed upside-down as in the traditional horizontal axis. Ibid., p. 27.
[193] All images from the Stephen Herbert Collection were accessed at specific pages on his website; therefore, links will be specified case by case. Figure 2 was available at: http://www.stephenherbert.co.uk/thaumatropeTEXT1.htm
[194] As mentioned by David Robinson in the catalog *Masterpieces of Animation 1833-1908,* p. 20, regarding a series entitled *Trompe l'Oeil*.

shown in Figures 3 and 4.[195] In these versions, the horizontal turning axis was kept, but the shape of the device is a rectangle rather than a circle. As can be seen in Figure 3, *The Duel,* both characters alternate between the state of standing and *en guard*, creating, when the device is spun, the impression of movement, a concise two-state animation loop.

Figure 3. ***The Duel,*** **thaumatrope, front and back views, c. 1860** ***(Courtesy of David Robinson Collection)***

In the case of Figure 4, *Gendarme and thieves,* the two-state animation is composed, on one side, of the running thieves and, on the other side, of the running policeman (*gendarme*, in French). When looking at the images separately, one can immediately perceive the fragmented action, as in a comic book, the thieves portrayed as running away, followed by the running policeman on the opposite side. When the disk is spun, both sides are combined, and the policeman catches the thieves. In this case, two

[195] David Robinson, "Animation: The First Chapter, 1833-1893," *Sight and Sound* 59 (1990), 251-254. Reproduction courtesy of the author.

separated “key” frames generate a third independent action. The illusion persists as long as the device is spun.

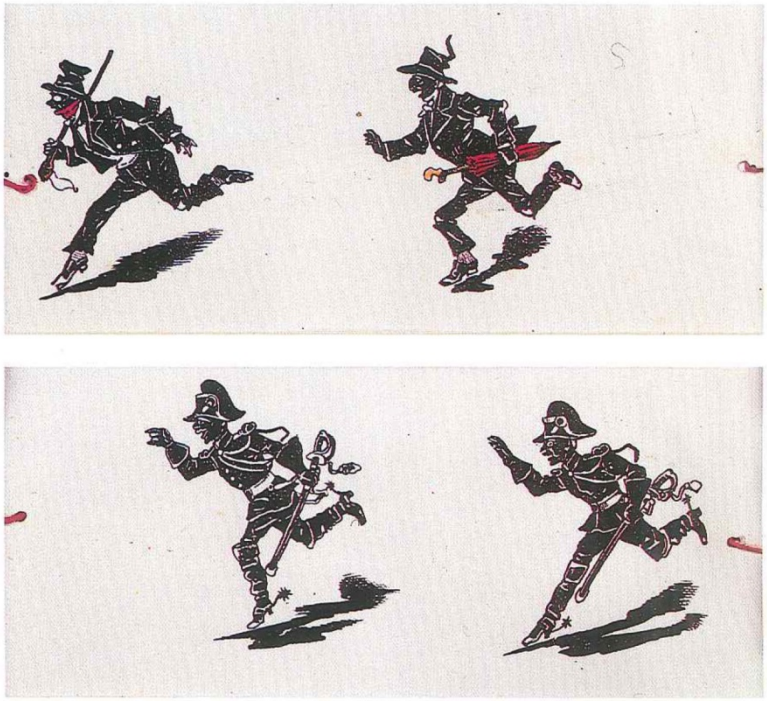

Figure 4. ***Gendarme and thieves,*** **thaumatrope, front and back views, c. 1860** ***(Courtesy of David Robinson Collection)***

The thaumatrope is a device to be seen and manipulated by only one person at a time. Improvements and adaptations in its structure were made over the years. Versions in which the disk is held by a wooden or metal handle were developed to facilitate its rotation. Other simple solutions included having the disk sides glued together on a stick with its movement provided by the friction of the player’s hands.

2.4.1.1 Examples of a Particular Type of Animated Installations: Reinventions of the Thaumatrope

Today the thaumatrope is probably the optical device most used for promotional marketing campaigns of products/brands as well as for educational activities in museums and science centers. By reason of its simplicity of construction and the effectiveness of the illusion it creates, this device has found a niche where it is constantly renewed and reintroduced to

younger generations. Other contemporary versions explore themes related to the Internet culture such as the Twitter logo (the blue bird) as a stand-in for the bird in the classic bird-and-cage version. Traditional thaumatrope themes have been adapted as jewelry and even miniaturized rotating keychains, built in metal and sold on the Internet. Well-known cartoon characters such as Walt Disney's Mickey Mouse and even Tim Burton's character Jack Skellington, among many others, have also been portrayed in thaumatropes.

In contrast, very few contemporary artists have explored this device as an art object or even animated installation in a gallery space. The American artist Robert Breer created works using the thaumatrope, although these were not properly documented and are consequently inaccessible to viewers. Highlighted here are the works of the art collective consisting of David Lawrey and Jaki Middleton (from Australia), the results of a workshop using the device taught by Paul Cox (from France), and the work of David "Meggs" Hooke (from Australia), all exploring the thaumatrope as contemporary animated installatios in an art gallery setting.

The supernatural and ghostly effects created by some of these reanimated proto-cinematic devices are enhanced in Lawrey and Middleton's choice of using iconic pop-culture movies to trigger our memories and impressions of them. Their thaumatrope-based piece *Forever and Ever* (2007)[196] (Figure 5) is an example of the atmosphere they aim to create. In this piece, one side of the device's disk shows a portrait called *Identical Twins* (1967), taken by the photographer Diane Arbus, who was known for her images of marginalized people. The other side of the thaumatrope shows the famous empty corridor in the movie *The Shining* (1965), directed by Stanley Kubrick. A sample of original audio from the movie is in a constant loop while the piece rotates. The curious thing is that the thaumatrope starts to rotate very slowly, displayed on the twins' side; but at full speed, the image of the twins merges with the corridor, and when the thaumatrope stops spinning, it will stop on the image of the empty corridor, in a clear reference to the disturbing scene

[196] This work can be seen at: http://www.wayback.net.au/forever_and_ever.php

in Kubrick's movie where the twin sisters suddenly appear and disappear. Thus, mechanically and with the help of sound the artists re-create the mysterious effect of Kubrick's classic cinematic scene.

Figure 5. David Lawrey and Jaki Middleton, ***Forever and Ever,*** **2007** ***(From the artists' website)***[197]

Other explorations combine interactive art with the thaumatrope, as is the case of a workshop on the device organized by the International School of Design in Montreal (UQAM) and given by Paul Cox, later exhibited as part of Design Week in 2011. In the project, Cox led a group of students to combine typography and interactive media. They created motorized versions of the thaumatrope,[198] aligned side by side (Figures 6 and 7). Each disk, when spun, completed the shape of a word, and the entire line of devices formed the phrase "*Le jeu de l'art est son axe"* (The playfulness of art lies in its axis).[199] This example shows how the creative potential of the thaumatrope can be associated with current technology to create provocative new versions.

[197] Image accessed at: http://www.wayback.net.au/forever_and_ever.php
[198] More information about this project can be found at: https://www.behance.net/gallery/1676206/The-Thaumatrope-workshop-with-Paul-Cox.
[199] English translation done by the author.

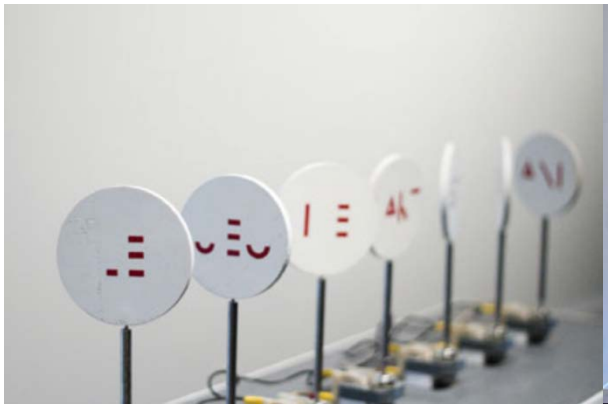

Figure 6. Installation *Le jeu de l'art est son axe* with motorized thaumatropes, still view, 2011 *(Sophie PA online portfolio)*[200]

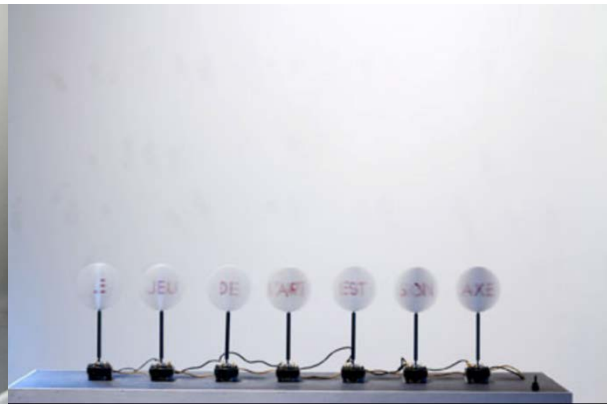

Figure 7. Installation *Le jeu de l'art est son axe* with motorized thaumatropes, rotating view, 2011 *(Sophie PA online portfolio)*[201]

David "Meggs" Hooke in his 2013 exhibit *Heavenly Creatures*[202] at the Thinkspace Gallery in Los Angeles included, among other artwork, four large thaumatropes displaying, in his characteristic graffiti style, a half-skull that forms a complete skull when rotated (Figures 8 and 9). Meggs innovated the traditional setting of the device by adding different images on both sides of the disk, filling the space that normally would be left blank with another image on the back that will alternate with the front image when the device rotates. He added half of a colorful explosion so that when the thaumatrope spins, both the explosion and the skull will be completed, thereby multiplying the combination of images seen simultaneously. This unusual combination creates a hallucinatory effect that matches the artist's style, provoking a dynamic association with death.

[200] Image source from Sophie PA's portfolio as a participant of the workshop conducted by David Cox, accessed at: https://www.behance.net/gallery/1676206/The-Thaumatrope-workshop-with-Paul-Cox.
[201] Image source from Sophie PA's portfolio as a participant of the workshop conducted by David Cox, accessed at: https://www.behance.net/gallery/1676206/The-Thaumatrope-workshop-with-Paul-Cox.
[202] More information about the exhibition can be accessed at: http://www.houseofmeggs.com/portfolio/heavenly-creatures-solo-exhibition-thinkspace-gallery-la-april/

Figure 8. One of the thaumatropes created by David "Meggs" Hooke for the *Heavenly Creatures* exhibition, still view, 2013 *(Thinkspace Gallery website)*[203]

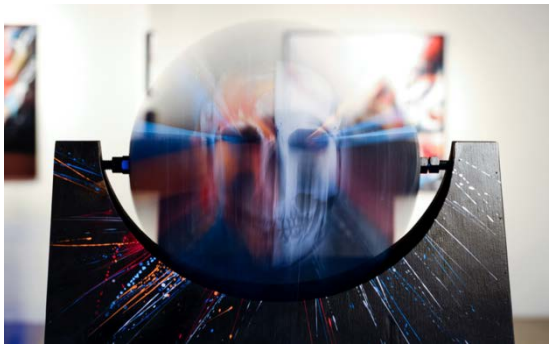

Figure 9. One of the thaumatropes created by David "Meggs" Hooke for the *Heavenly Creatures* exhibition, rotating view, 2013 *(Thinkspace Gallery website)*[204]

Except for these contemporary versions, the majority of works today reproduce only the still effects of the thaumatrope without further investigation into its concise two-state motion. Current versions are also more attached to the circular shape of the device.[205] Victorian-era examples, therefore, still represent some of the most intriguing designs created for the thaumatrope since its invention. In his 1993 article "Two-State Animation: The Thaumatrope and Its Spin-Offs," Leskosky gives some examples of how the two-state animation suggested by the thaumatrope spurred a lineage of related devices and toys using limited animation: lenticular animation and toys like the *Movie-Jektor* in the early 1930s or the *Magic Motion* marketed by Tyco in 1990.

The lineage of devices that flicker shows the potential of creating appealing motion effects and their exciting explorations that started with the two-state animation proposed by the thaumatrope. It was a toy commercialized successfully in its time, and modern improvements and variations renew the device for younger generations. The device is alive, animated, and ready for further exploration into its reanimation.

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[203] Image accessed at: http://www.houseofmeggs.com/portfolio/heavenly-creatures-solo-exhibition-thinkspace-gallery-la-april/
[204] Ibid.
[205] As Leskosky points out in his article "Phenakis[tos]cope," p. 178.

2.4.2 The Phenakistoscope (1832)

Even greater than the popular success of the thaumatrope was that of the phenakistoscope. The thaumatrope had effectively teased the interest of Victorian-era viewers for more philosophical toys, and six years after its invention, a new toy was created. Its name can be loosely translated as the "deceptive viewer"—from the Greek *phenax* (misleading) and *skopein* (to look at).

The device is famously credited as having been invented simultaneously, around 1832, by the Belgian physicist Joseph Plateau (1801-1883) and the Austrian mathematician Simon von Stampfer (1790s-1864). Plateau, in Brussels, created the device (Figure 10) that would become known as the phenakistoscope*, or* phenakistiscope, as an extension of his studies on vision. Meanwhile, in Vienna, Stampfer created his device, baptizing it the "stroboscope" (from the Greek *strobos*, for "rotation," and *skopein,* for "to look at"), later also known as the "Stampfer disk."

Figure 10. Assembled phenakistoscope with viewing mirror, 1833 ***(Collection La Cinémathèque Française)***[206]

[206] Laurent Mannoni, *De Méliès à la 3D, La Machine Cinéma* (La Cinémathèque Française, Paris, 2017), p 25.

According to Laurent Mannoni,[207] Stampfer managed to earn great profits from his device, which almost a century later would lend its name to further developments in the study of the electronic flicker and stroboscopic light (later, strobe light). Plateau, on the other hand, despite having potentially helped design a half dozen of the earliest phenakistoscopes sold by publisher Rudolph Ackermann, did not profit from his invention. Plateau became a scientific reference in the field of visual perception of motion and color, and some devices were marketed with his name to lend scientific weight. Plateau's continuous scientific investigations, including in the field of mathematics, ensured him a place in history despite suffering early blindness owing to his enthusiasm for experimentation.[208]

As originally described by Plateau in 1833, the phenakistoscope works in the following way:

> The apparatus consists in essence of a cardboard disc with a number of thin radial fissures with figures painted on one of its faces. We rotate the disc in front of a mirror and with one eye look through the fissures: the figures we see reflected in the mirror do not become blurred as they do if we look from another angle, do not seem to follow the rotation of the disc anymore, and instead appear animated and to be following their own set of movements.[209]

Plateau was describing what became the most simple and traditional version of the phenakistoscope, a device that, he explicitly and notably states, makes figures "appear animated" and moving autonomously. Many different names were later given to similar devices, and variations were commercialized, featuring potential improvements.[210] For the purposes of this research, the reasons behind why the phenakistoscope became one of the most popular devices and how its principles have become the basis for every subsequent device that flickers are key aspects of this brief historical review.

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[207] Mannoni, The Great Art of Light and Shadow p. 219.

[208] As an experiment, in 1829 Plateau stared at the Sun for about 25 seconds, the effect of which accelerated a disease that left him completely blind by 1843. See: http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Plateau.html and https://www-ncbi-nlm-nih-gov.ezlibproxy1.ntu.edu.sg/pubmed/2209370

[209] Cited in Tosi, *Cinema before Cinema*, p. 21.

[210] Leskosky's article "Phenakis[tos]cope: 19th Century Science Turned to Animation" details going through the patent files of the phenakistoscope and its variations and provides a wealth of research and innovative thinking on the history of the device.

As noted by Nicolas J. Wade, "The development of moving pictures has its origins in the phenakistoscope and stroboscopic disc,"[211] because these were the first optical devices to portray successfully a complete series of animated images, becoming a huge popular success, with disks sold everywhere.[212] The foundation of a new visual culture based on and produced by the machine and its mechanical power in these early devices was the epitome of scientific reasoning of the time. Unfortunately, as Leskosky laments, most film scholars still "ignore most aspects of the phenakistoscope's development and its place in the history of animation and the cinema."[213] This author not only concurs but would extend that line of thought to include most aspects of practically every one of the devices that flicker and rotate, which remain neglected by most scholars of animation and cinema. Only in the last few decades have more scholars, such as Gunning, Doane, Gaudreault, and some of their collaborators, begun to turn to these devices to question and suggest new interpretations of their history, following the lead of scientific cinema historian Tosi and cinema and animation scholars Leskosky and Cholodenko, who had been proposing this since the early 1990s.

In Plateau's case, as the inventor, his research evolved from principles established by Peter Mark Roget (1779-1869) and Michael Faraday (1791-1867), the former a scientist of "Thesaurus fame,"[214] as put by Charles Solomon. The innovation Plateau proposed in his phenakistoscope is rooted particularly in Faraday's wheel,[215] although Plateau decided to substitute the

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[211] Nicholas J. Wade, *A Natural History of Vision* (Massachusetts: MIT Press, 1998), p. 202.
[212] As the title of one of Mannoni's sections establishes in *The Great Art of Light and Shadow*, p. 219.
[213] Leskosky, op. cit., p. 176.
[214] Charles Solomon, *Enchanted Drawings: The History of Animation* (New York: Wings Books, 1994), p. 7.
[215] Michael Faraday, inspired by Roget's work on persistence of vision, developed from 1830 to 1831 what became known as the Faraday wheel. Making further advances and simplifications to the device, he created a disk with slits as apertures and geometrical shapes drawn on it. Its movement soon becomes boring for not having much appeal. It is significant, however, that in one of his experiments, he drew different numbers of concentric divisions in different layers of the disk, which enabled the layers to move independently and at different speeds when the disk was rotated in front of a mirror. The moving result was seen through the slits. Dr. William Benjamin Carpenter, when later explaining the characteristics of the zoetrope in his article, also documented the effect of patterns moving at different speeds in the same disk and thus confirmed that different speeds of motion

geometrical shapes of the toothed wheel for something more entertaining, as noted by Mannoni.[216] He then created on a disk a sequence of images of a pirouetting dancer (Figure 11), in a fashion similar to the artistic part of his exploration of the Anorthoscope.[217] These examples highlight Plateau's creative vein, inherited from his artistic father, and these skills helped him make the leap from scientific experiment to artistic creation, shaping his perception of animated images.

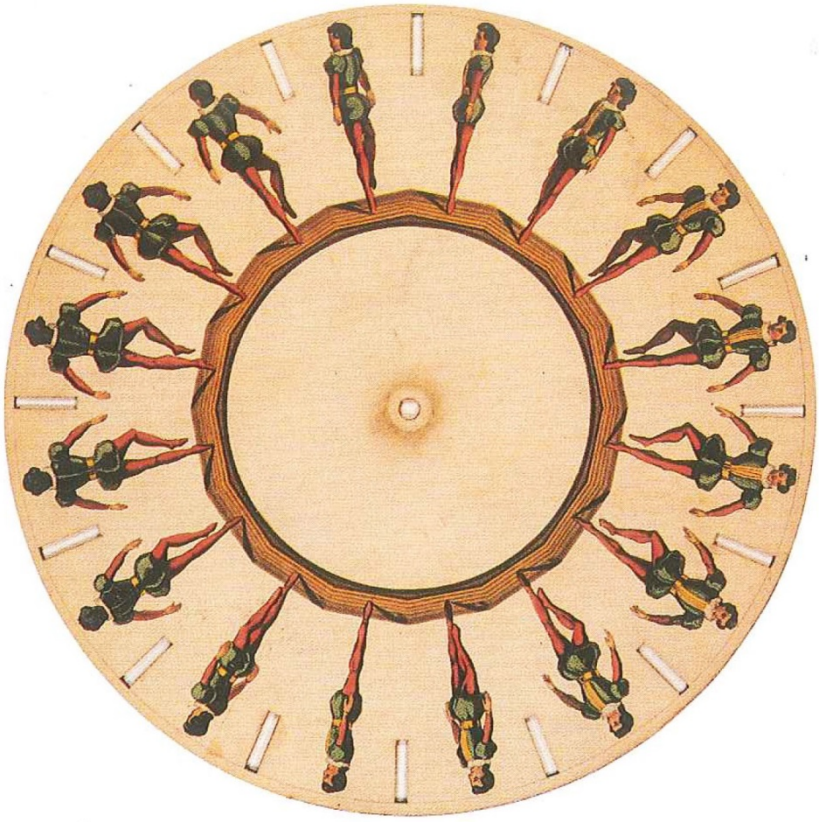

Figure 11. Joseph Plateau's original Phenakistoscope, *Dancer*, 1833 ***(Courtesy of David Robinson Collection)***

displayed on the same disk generate a variation in the movement of different elements drawn on it, always in relation to the number of slits (apertures).

[216] Mannoni, op. cit., p. 215.

[217] While observing Roget's spoked wheel phenomenon, Plateau started to investigate its effects. He added an artistic touch to it to better demonstrate the phenomenon. The Anorthoscope enabled distorted anamorphic images to be seen in their correct static shape when watched through a rotating disk with slits placed in front of the anamorphic image disk, which rotated faster and in the opposite direction of the slotted disk, in accordance with Roget's observations on the spokes of a wheel seen through the vertical apertures of a fence.

As mentioned, Plateau's invention was mass-produced and commercially sold in London by the famous publisher Rudolph Ackerman under the names of the Phantasmascope and the Fantascope, around 1833. In collaboration with the artist Jean-Baptiste Madou (1796-1877), Plateau helped create beautiful illustrations for the first printed series of his devices. Subsequent series printed by the same publisher also featured renowned artists Thomas Talbot Bury (1809-1877) and Thomas Mann Baynes (1794-1876). Together, these first three series of phenakistoscopes set the tone for ones that would follow, either as copies of these original works or explorations of new actions based on similar principles. Some of these early designs, as Stephen Herbert [218] has extensively researched, already proposed in-depth movements that would enhance their visual impact. For the author of this thesis, these artists were pioneer animators.

The Plateau-Madou disks revealed rich designs associated with a very precise understanding of sequential movement. The series of six disk displays is composed of *Dancer* (Figure 11), *Death's Heads* (Figure 12), *Snakes* (Figure 14)*, Circles* (Figure 15)*, Frogs* (Figure 16), and *Prancing Monkeys* (Figure 17)*.* [219] In the *Dancer*, the first of Plateau's phenakistoscopes, the little dancer defies the flat surface of the disk by making a complete pirouette in 16 frames (on a disk with 16 slits), suggesting a three dimensionality to his body in space that does not really exist on the actual object. An important observation is that in the phenakistoscope, the moving action is perceived simultaneously in every position in which the character was drawn. Thus, the 16 phases of the dancer's pirouette are perceived as 16 dancers rotating at the same time in every position drawn around the disk. The idea of individual characters would appear much later. Hence, while the dancer rotates around himself, backward or forward around the disk, his motion is perceived as if he were turning in place, instead of moving, so all the 16 dancers move in perfect synchronicity, each in his own place on the disk. This effect relies heavily on the relationship between the

[218] Stephen Herbert on the phenakistoscope, available online at: http://www.stephenherbert.co.uk/phenakPartOne.htm

[219] The disk names are reproduced here according to Robinson in the catalog *Masterpieces of Animation 1833-1908,* pp. 21-22.

number of slots and the number of drawings and will be explained in more detail further in the text.

The *Death's Heads* and *Snakes* disks also have 16 slots each but are built around a spiral structure, rather than the circular structure of the *Dancer.* The use of the spiral creates the impression of depth on the disk, with objects coming out of it or withdrawing back, depending on which direction the disk is spun. In the case of *Death's Heads* and *Snakes,* each uses different strategies to enhance this effect. In *Death's Heads* (Figure 12), the monstrous faces occupy, side by side, the entire disk creating a crescendo, with parts of the faces being cut on the disk's edge to give an impression of the faces being spread beyond the limits of the circumferential space. The disk's background is entirely black, and the multiplied monster's faces emerge from the darkness in a fade-in effect, probably with the intention of enhancing the feeling of fright. The faces' movement is very subtle, and despite the sequential head enlargement, the eyes of the monsters that are on the edge of the disk slowly look down toward the center of the spiral, where new monsters are coming out, enhancing the impression of depth.

Figure 12. ***Death's Heads*****, from the Plateau-Madou phenakistoscope series, 1833** ***(Courtesy of David Robinson Collection)***

Figure 13. ***Lady and Ogre*****, author unknown, c. 1860** ***(Courtesy of Andy Voda Collection)***[220]

[220] The collector e-mailed this image directly to the author.

The *Death's Heads* disk, in fact, was the inspiration for one of the most impressive phenakistoscopes ever made, portraying the transformation of a beautiful young lady into a horrendous ogre, or vice versa (Figure 13). The beautiful lady disk probably marks the first time that the metamorphosis effect was used in a phenakistoscope, an element extremely important for the development of animation film and that was embraced much later by the French animator Émile Cohl (1857-1938).[221] On this disk, the spiral effect of *Death's Heads* is reproduced but with the transformation of the lady into a monster, or vice versa. The shapes also occupy the entire disk and expand upon it, even repeating the look-down effect with the ogre's eye. This is one of the most beautiful phenakistoscopes, and its effect is hypnotizing. The similarities with the Plateau-Madou design for *Death's Head* are probably the main reason for the disk's unconfirmed attribution to the duo. The artist, nonetheless, remains unknown, and it is uncertain to which publisher collection it belongs. French film historian Dominique Willoughby[222] dates the disk to circa 1860 and states that it belongs to the collection of the Museum of the History of Sciences at Ghent University, but further details are obscure.

On the *Snakes* disk (Figure 14), the subjects emerge from a hole drawn in the middle of the disk and sinuously wind their way out.[223] The unexpected characteristic of this phenakistoscope is that when a snake reaches the edge of the disk, there are small parts of the animal literally coming out of the edge, as little cutouts that alter the overall shape of the disk while also reinforcing its circular shape by suggesting that the snake has curved over the disk and is now somewhere behind it.

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[221] Both Cholodenko and Gunning claim metamorphosis as a privileged figure in animation.
[222] Dominique Willoughby, Le Cinéma graphique, une histoire des dessins animés: Des Jouets optiques au cinéma numérique (Paris: Textuel, 2009), p. 55
[223] This is an assumption of the intended direction of the movement as the snake's head is pointing outward. However, if the disk is rotated the opposite way, the snake continuously goes back inside, the whole moving backward with the snake backing up and down.

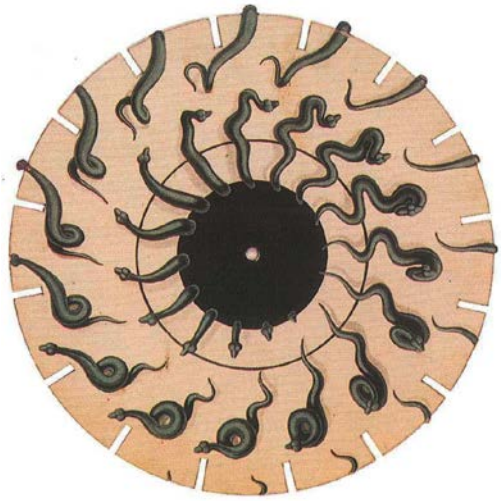

Figure 14. ***Snakes*****, from the Plateau-Madou phenakistoscope series, 1833** ***(Courtesy of David Robinson Collection)***

The other three disks of the series all have 20 slots each. In the case of *Circles* (Figure 15), David Robinson refers to it as "the first known abstract animation."[224] Following the same spiral structure of the previous disks, small circles radiate from the center of the disk, becoming ever larger as they approach its edge, and achieve the opposite effect if the disk is rotated in the opposite direction. The circles also change color in tandem with their growth in size. The different sizes create a visual effect as if these circles are placed in space at varying distances, in a three-dimensional spiral inward or outward depending on how the disk is rotated. The colors are vivid, and the disk could easily be believed to be the work of a modern artist.

Figure 15. ***Circles*****, from the Plateau-Madou phenakistoscope series, 1833** ***(Courtesy of David Robinson Collection)***

[224] Robinson in the catalog Masterpieces of Animation 1833-1908, p. 21.

The last two disks boast an interesting peculiarity. Despite having 20 slots each, they both only have 19 main characters distributed in a circular structure. The *Frogs* disk (Figure 16) has a beautiful plant drawing in its center with a small frog leaping around it, viewed from the top, enhanced by detailed shadows on each. The plant does not move, but its shadow and background color gently do. The drawing of the frog repeated only 19 times on a disk with 20 slits creates the illusion that it is leaping forward a bit faster than the speed of the disk. Faraday had already observed this effect on the geometrical shapes he created[225] for his device, as also acknowledged by Plateau in an article in 1833.[226]

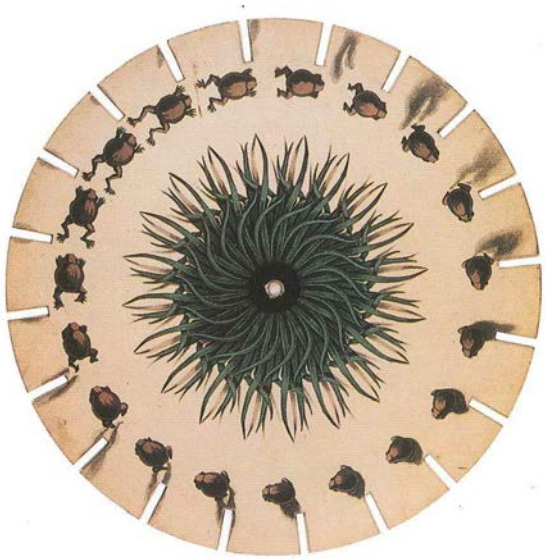

Figure 16. ***Frogs,*** **from the Plateau-Madou phenakistoscope series, 1833** ***(Courtesy of David Robinson Collection)***

In the case of the *Prancing Monkeys* disk (Figure 17), the monkeys in question, hand in hand, move forward in an amusing way. Again, they are in total 19, while the disk has 20 slits. At the center of the disk is a sun-like figure whose edges do not move; movement will be created by the subtle changes in its background color. Another peculiarity of this disk is that while the monkeys move, they appear to be aware of the disk's structure, bending down as they pass the physical slots of the disk. The monkeys not only reveal dexterity in their movement but also acknowledge the characteristics

[225] Mannoni, The Great Art of Light and Shadow, p. 215.
[226] Leskosky, "Phenakis[tos]cope," p. 180, footnote 14.

of the space, which enhances the feeling that they are not only moving but "alive," reacting to their environment.

Figure 17. ***Prancing Monkeys,*** **from the Plateau-Madou phenakistoscope series, 1833** ***(Courtesy of David Robinson Collection)***

All the disks play with optical illusions, intensifying the experience of the viewer by enhancing the depth cues, such as adding shadows to the graphics or little cutout elements to the overall shape of the disk. The subtleties hidden in each movement; the use of cutouts, shadows, spiraling actions, and color transitions; and character reactions to their environment demonstrate a sophisticated understanding of movement by the artists who created these disks. The timing strategies they developed later become "tricks of the trade" in animation, and some of the best designs will reveal the same attention to detail, along with pushing boundaries, all aiming to astonish the viewer while expanding his or her wondrous experience of the device. These aspects led to a "phenakistoscope craze"[227] among a public anxious to play with the optical toy and discover the illusion of movement and life it created, as well as see the "little animated dramas"[228] Mannoni found in them. Or, as stated by Leskosky, "a minimal embryonic form of narrative could also be seen in the repeated actions portrayed,"[229] in other words, a form of proto-narrative was already present and spotted by them.

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[227] As the title of one of Mannoni's sections establishes in *The Great Art of Light and Shadow*, p. 219.
[228] Mannoni, The Great Art of Light and Shadow, p. 222.
[229] Leskosky, "Phenakis[tos]cope," p. 177.

The phenakistoscope reigned supreme over public imagination for at least 30 years, until a new toy, the zoetrope, appeared on the market. This dominance explains the numerous phenakistoscope designs available and its favored status in film and animation literature. Dominique Willoughby asserts that the invention of the phenakistoscope marks the first forms of *cinéma graphique,*[230] a term that he uses to define the graphic investigations of a genre that for him started with these early forms of animation. Regarding the aesthetics and designs of the disks, the ones attributed to Plateau have become very popular, and many of the most beautiful disks we have access to today owe this quality to effects already detailed in the Plateau-Madou series.

Meanwhile, the disks produced in parallel by Stampfer[231] sold well, but their themes and designs never became well-known references as Plateau's ones did. In one of them, however, found in the collection of the Cinémathèque Française, Stampfer explores three-dimensional space, creating an unusual perspective for a phenakistoscope (Figure 18). The majority of Stampfer's disks portray very mechanical themes, such as rotating gears, colored spirals, and geometrical shapes, sometimes through characters. He was aware of the relationship between the number of slots and characters to create accelerated or decelerated movement within the action, exploiting it on a few disks. However, it is clear that his understanding of movement was not as complex or intriguing as the disks designed by Plateau-Madou, as featured above. Usually Stampfer's disks were printed as colored lithographs, while Plateau's original ones created with Madou were hand-colored etchings, as described in the Cinémathèque Française collection, which explains the significantly higher price tag of the Plateau-Madou disks.

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[230] Willoughby, *Le Cinéma graphique,* p. 18.

[231] Stampfer's disks originally had slits positioned differently from Plateau's, which was soon corrected, thus making his disks identical to Plateau's phenakistoscopes although still being called stroboscopes. Samples of Stampfer disks are housed in the archive collection of the Cinémathèque Française and may also be found in the online collection of Dick Balzer. Many other publications include variations of the disks. Cinémathèque Française Collection accessed at:
http://www.cinematheque.fr/fr/catalogues/appareils/#

Figure 18. Example of a Stampfer disk (untitled) from 1833[232] ***(Collection of the Cinémathèque Française)***[233]

Another phenakistoscope pioneer worthy of mention is Jan Evangelist Purkinje (1787-1869). As a Czech physiologist, he was familiar with the device as an educational instrument to teach science. Virgilio Tosi details that Purkinje had even proposed an improvement to the stroboscope[234] by separating the device into two disks, one to show the animated images and the other to create the flickering effect. That is why his illustrated disks do not have the slots cut on their surface. Some of Purkinje disks demonstrated the functioning of the human heart, and another showed structures like spermatozoids swimming around an egg.[235] He was probably the first to combine text and drawings on a disk in which a hand is constantly writing the letter *a* (Figure 19). He designed and published many disks that displayed scientific content, contributing to facilitate its understanding. He even

[232] Dominique Willoughby dubbed this disk *Manège* in *Le Cinéma Graphique*, p. 59.
[233] All images from the Collection of the Cinémathèque Française are available through its online archive, accessed at: http://www.cinematheque.fr/fr/catalogues/appareils/#.
[234] Tosi, Cinema before Cinema, p. 27.
[235] Purkinje designs are available through the collection of the Cinémathèque Française and were accessed at:
http://www.cinematheque.fr/fr/catalogues/appareils/collection.html?sort=date_ajout&sortway=desc&personne=1032

created his own variation of the device, originally called the Phorolyt and later named the Kinesiskop.

Figure 19. Example of a Purkinje Phorolyt disk from 1860 ***(Collection of the Cinémathèque Française)***

As with the case of the thaumatrope, the phenakistoscope allows only one person to view its animation at a time,[236] and that person, in the case of the phenakistoscope, needed to stand very near the disk to be able to see its animation reflected in a mirror. Despite the phenakistoscope mania, the device presented two major design problems that inspired improvements leading to the creation of the next device that flickers, the zoetrope.[237] According to Leskosky, the problems of the phenakistoscope were the limited number of viewers and the necessity that the viewer be positioned very close to the device to be able to perceive the animation.[238] The invention of the zoetrope, however, did not halt production of new phenakistoscopes

[236] Leskosky mentions a version designed by Dr. Paris proposing a two-view phenakistoscope. However, as the scholar recognizes, there is no indication that any such version was ever commercialized. Even if it was, it still provides limited viewing for only two persons at time. Leskosky, "Phenakis[tos]cope," p. 182.
[237] Leskosky, "Phenakis[tos]cope," p. 180.
[238] Ibid.

or even of new devices directly derived[239] from it, nor exploration of its features.

2.4.2.1 Examples of a Particular Type of Animated Installations: Reinventions of the Phenakistoscope

Contemporary use of the phenakistoscope highlights its modern-day exploration by artists like the Japanese Toshio Iwai, the South African William Kentridge, and the Americans Kelly Coats and even Eric Dyer, whose work merges the device with the zoetrope (the latter is studied in depth in Chapter 3, which focuses on reinventions of the zoetrope).

Iwai's *Phenakisti-scope* series (1982) is a result of earlier explorations with optical devices and using elements characteristic of the Japanese culture. In this revisiting of an early animation technique, the artist used a copy machine to "produce" his sequential images, adopting a technological twist to speed up the process. Thus, strings start to move, peanuts to dance, paper origami cranes to fly, and grains of rice to gallop around a negative space in the shape of a seemingly Muybridge-inspired horse (Figure 20). The copy machine captured the sequential imagery displayed as in a traditional phenakistoscope but with images created with concrete material, such as origami paper, strings, and rice, instead of drawings. Particularly in the case of the horse, Iwai pays homage to Eadweard Muybridge's historical experiments to capture the gallop of a horse in a photograph. Iwai's unusual choice of materials, using rice in the case of the portrayal of the horse to surround its shape in negative space, is a creative reinterpretation of the phenakistoscope and Muybridge's experiment that blends in elements from his own culture.

[239] Over the years a smaller portable version called the Ludoscope (1904) was created, as well as a horizontal version, to be placed on top of a gramophone, called the Kinephone (1920), which unfortunately does not explore the combination with music as the use of the gramophone might suggest but takes advantage of the turntable position to increase brightness, consequently improving the perception of the animation.

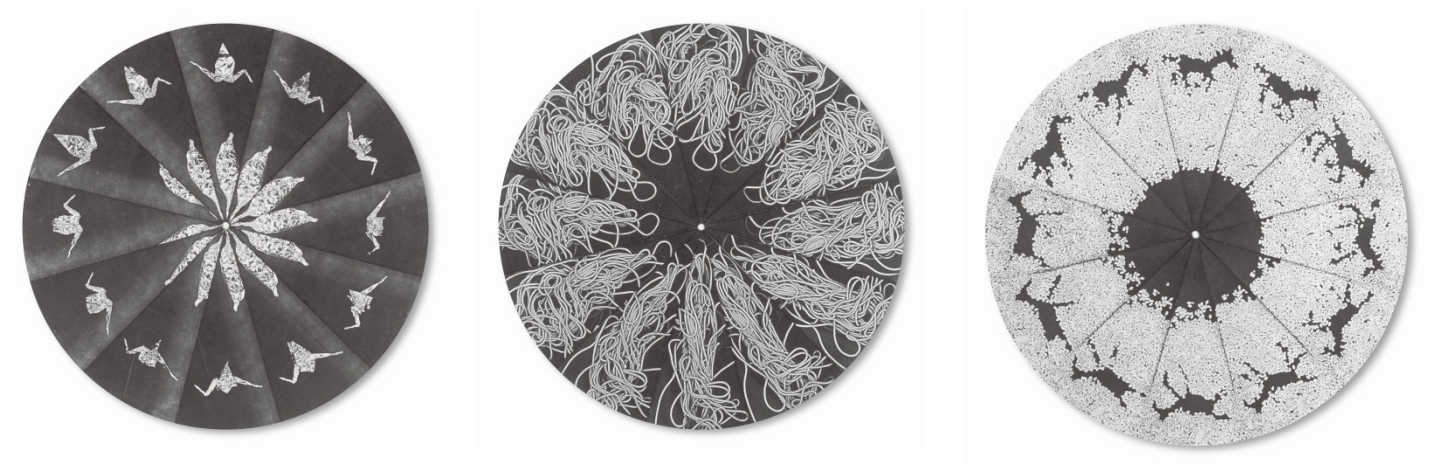

Figure 20. Toshio Iwai's 1982 *Phenakisti-scope* series *(from left to right):* origami cranes, strings, horses and rice *(Courtesy of the artist)*

Following these works, Iwai invested his inventiveness in the creation of zoetropes (further investigated in Chapter 3), then returned to phenakistoscope-like devices in his *Step-Motion* series (1990) (Figure 21). Using a stepper motor, creating animated disks without slits, and avoiding use of strobe lights, Iwai challenges perception as well as his own abilities, the goal being to create animation without these evident flickering elements.

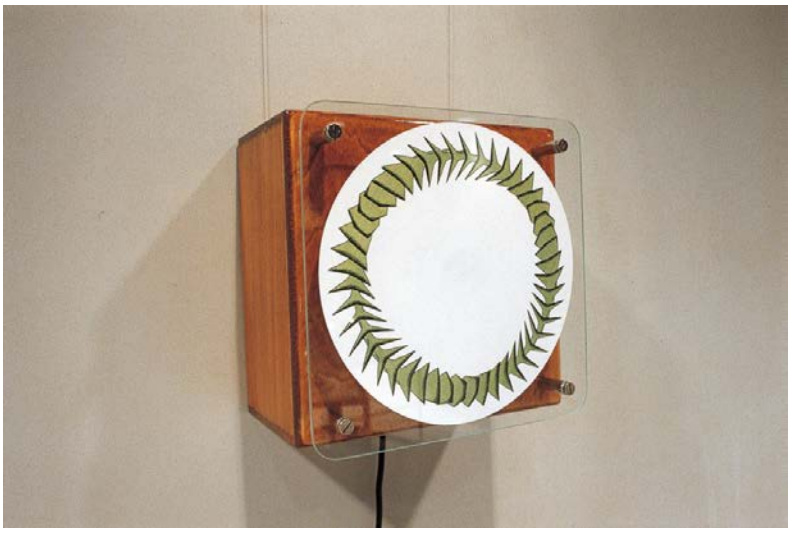

Figure 21. Toshio Iwai, *Step-Motion,* 1990: gallery setting showing a version with moving abstract shapes *(Courtesy of the artist)*

The resulting artwork has numerous small images smoothly moving around the edge of a disk, working as modern mini-versions of a phenakistoscope. The apparent simplicity of the device may take some viewers by surprise when they realize that the images are being animated in front of their eyes. With the clever use of stepper motors, he creates an imperceptible flicker by

making the motor briefly pause after a certain number of turns. The result is astonishing. When compared to classic phenakistoscopes, whose images range between 16 and 20 drawings, the number of sequential phases of images in Iwai's artwork ranges between 40 and 60 figures, probably as a consequence of his calculations of the precise movement made by the stepper motor to create the animation.

According to the artist, the main inspiration for his creative solution came from the flipbook, where he noticed that its simplicity lies in the combination of a very fast movement and short pauses, which we control by hand. In using a stepper motor, he was able to control the movement and the pause, tricking our perception in the same way the old devices did. In his clever and simple device, the artist no longer needs an apparent flicker strategy, although the flicker is certainly there but imperceptible to the human eyes. Indeed, the flicker makes his invention an original contemporary version of the classic phenakistoscope.

Kentridge is an established artist with an extensive and diverse body of work that includes films and operas. References to optical toys and early cinema productions can be clearly identified in his works, which have been transformed and adapted into his oeuvre and style. He has worked with phenakistoscopes and flipbooks and has even played with anamorphosis effects that use catoptric (cylindrical) mirrors. As the focus of this study is the devices that flicker and rotate, only his work on the phenakistoscope is investigated within contemporary trends of the device's renewal.

Kentridge's *Phenakistoscope* (2000) reveals the interest of the artist in using physical materials as a way to convey his creative process of thinking with the body[240] while playing with the viewer's perception as the piece invites direct manipulation by the viewer. His phenakistoscopes were created in a special edition of 40 units published by the New Museum of Contemporary Art in New York. The work portrays a procession of characters waiting to be

[240] Ibid.

set into motion by the viewer. Each consists of two vinyl disks, one with slits and the other with sequentially moving characters hand-printed on top of lithographs from *Bacon's Popular Atlas of the World* (1893) and *The Oxford Atlas* (1951)[241] (Figure 22). Except for the unusual use of material, Kentridge's phenakistoscope does not add much to the exploration of further potentialities of the device.

Figure 22. William Kentridge, *Phenakistoscope,* 2000 *(Double Vision Gallery)*[242]

A curious case, however, is revealed in the work of Kelly Coats titled *Epic Thriller* (2005) (Figure 23). In a clear reference to the metamorphosis disks created by Plateau and Madou (see Figures 12, 13), the contemporary artist plays with the physical transformation of the face that the pop music icon Michael Jackson (1958-2009) changed over his career. The work is embedded with contemporary iconography and popular references easily

[241] As described on the Double Vision website, available at: http://doublevision-berlin.de/werke/william-kentridge-phenakistoscope-2000/

[242] Image accessed at: http://doublevision-berlin.de/werke/william-kentridge-phenakistoscope-2000/

recognizable by a Western viewer, and to many, amusing. By having as theme Michael Jackson's facial transformation through time, the work animates him as the reanimator of his appearance.

Figure 23. Kelly Coats, *Epic Thriller,* 2005 *(Kelly Coats website)*[243]

The growing contemporary trend of animated GIFs[244] can also be interpreted as a popular form of reanimation of the phenakistoscope and other early optical devices on the Internet. Indeed, by using computers to animate the phenakistoscope[245] and stroboscope disks, a mirror is no longer required to see the animation. And, by simply rotating the device digitally, with the help of any animation software, it is easily possible to watch the animation effect that a GIF displays, its full beauty animated clearly without the need for slits

[243] Image accessed at: http://kellycoats.com/art/epic.html

[244] GIF (graphics interchange format) is a digital file format that allows short sequences of images to be condensed into a single file that is lightweight and repeats as a never-ending loop.

[245] Since 1985, the Joseph Plateau Honorary Award, which is a phenakistoscope, is presented yearly to special guests of the Film Fest Ghent in recognition of Plateau as a pioneer of cinema. More information available at: http://www.filmfestival.be/en/about-film-fest-gent/awards/joseph-plateau-honorary-award/27.

since the flickering of the screen compensates for their absence. In fact, the viewing quality of these "disks" is better today than in their own times given that the correct adjustment of the viewer, apparatus, lighting, and mirror was required for their illusion to be fully enjoyed.

The phenakistoscope was once the most innovative of the optical devices; but in contemporary times, despite humorous content and crafted designs, it lacks more insightful designs, with the exception of Iwai's work that is now almost 30 years old. Nonetheless, his investigations pushed the boundaries of the device and proved that new technology when combined with the early devices that flicker can bring about a renewed fascination among today's public.

2.4.3 The Zoetrope (1834)

The zoetrope was not successfully commercialized until 1867—more than 30 years after its invention—when it was given its name and patented by numerous people.[246] As a variation on and following the same principles as the phenakistoscope, its name was taken from the Greek, meaning "wheel of life."

The *wheel of life,* as an expression, has a long tradition dating back far beyond its relatively recent nomenclature in Greek of *zoetrope*. From the mandala, [247] symbolizing the Universe in Hindu cultural traditions and Buddhist religion, variations of the wheel of life are also found in other civilizations, including the ancient Greek and Roman. As a representation of the universe's constant movement or even as contemplative shapes with religious symbologies, the mandala concept was transformed and adapted over the centuries. In the Middle Ages, in the Western world, the allegory of the wheel of fortune became a strong symbol in Christian beliefs associated

[246] Mannoni, The Great Art of Light and Shadow, p. 218.
[247] A mandala is a geometrical diagram with repeated patterns traditionally related to spiritual beliefs in the Hindu culture. In a direct translation from Sanskrit the word *mandala* means "circle."

with fortune and chance in one's life. Joseph Campbell explained the Christian interpretation as follows: "If you are attached to the rim of the wheel of fortune, you will be either above going down or at the bottom coming up. But if you are at the hub, you are in the same place all the time."[248]

These multicultural, religious, and mythological symbols of the wheel of life may differ in meaning yet end up suggesting the learning process humans go through in life, while also relating to the mythological cycles of suffering and reward. In the Greek myths, these loop cycles are represented as actions, eternal punishments dealt by the gods to those who dare challenge them or commit terrible acts against humankind. The idea of Hell carries with it the burden of hellish tasks, which are never-ending, as often addressed in Western literature and a wide range of artistic and cultural expressions. The plights of Prometheus,[249] the Daughters of Danaus,[250] Tantalus,[251] and Sisyphus[252] illustrate these never-ending punishments, to mention only a few famous Greek myths. Sisyphus, especially, represents a well-known metaphor for the condition of human suffering, while the other myths also portray repetitive tasks as loop cycles.

Back in 1834, however, William G. Horner referred to his invention as the Daedaleum in an article he wrote entitled "On the Properties of the Daedaleum, a New Instrument of Optical Illusion." His original description of the zoetrope reads as follows:

> The apparatus is merely a hollow cylinder, or a moderately high margin, with apertures at equal distances, and placed cylindrically round the edge of a

[248] Joseph Campbell, Betty S. Flowers, and Bill D. Moyers, *The Power of Myth* (New York: Anchor Books, 1998), p. 118.
[249] Prometheus stole the fire from the gods and gave it to humans. The gods sentenced him to be chained on a mountain and have an eagle eat his liver during the day. The liver would grow back during the night so that the eagle could continue to eat it the following day.
[250] Danaus' daughters were condemned to carry water in a sieve through eternity in an attempt to wash away their sins. The 50 daughters were punished for having killed their husbands (some versions say all but one) on their wedding night.
[251] Tantalus, after committing cannibalistic acts on his own son, was punished by the gods to spend eternity deprived of nourishment. Surrounded by the fruits of a tree and water nearby, he tries to reach out for them, but every time they recede.
[252] Probably the best-known of all Greek myths is that of Sisyphus. For being an evil king and having tricked the gods many times, Sisyphus is sentenced for all eternity to push a rock up the hill only to have it roll back down before reaching the top.

> revolving disk. Any drawings which are made on the interior surface in the intervals of the aperture will be visible through the opposite apertures, and if executed on the same principle of graduated action, will produce the same surprising play of relative motions as the common magic disk [phenakistoscope] does when spun before a mirror. But as no necessity exists in this case for bringing the eye near the apparatus, but rather the contrary, and the machine when revolving has all the effect of transparency, the phænomenon may be displayed with full effect to a numerous audience. I have given this instrument the name of Daedaleum, as imitating the practice which the celebrated artist of antiquity was fabled to have invented, of creating figures of men and animals endued with motion.[253]

Hence, Horner's name for the device made reference to Daedalus. According to the Greek myth, Daedalus was an inventor who created the Minotaur's labyrinth and had among his skills the power to endow things with life, like the wings used by his son Icarus, among other inventions. By so naming his device, Horner recognized the invention's characteristic for attributing movement to things (sequential still drawings "endued with motion"[254] as Horner mentions above). The Daedaleum, Horner noted, could be enjoyed by a large number of simultaneous viewers who did not need to be placed close to the device to enjoy its animated illusion, as was the case with the phenakistoscope and its variations. Furthermore, the zoetrope freed the hands of the viewer, requiring only occasional engagement in the rotation of the device to help keep its pace, whereas the phenakistoscope required the user to employ both hands,[255] one to hold its handle against a mirror, while the other rotated the device as the viewer peeped through the slits (Figure 24).[256]

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[253] William George Horner, "On the Properties of the Daedaleum, a New Instrument of Optical Illusion." *London and Edinburgh Philosophical Magazine and Journal of Science* 4, no. 19 (January 1834), p. 37. Accessed at: http://babel.hathitrust.org/cgi/pt?id=coo.31924015289568;view=1up;seq=471

[254] *Endue* means to provide or endow.

[255] This observation was made by the writer of an 1869 newspaper article covering a legal case involving the zoetrope, as recounted by Stephen Herbert on his website. Accessed at: http://www.stephenherbert.co.uk/MayBordes.htm

[256] Please note that this illustration featuring two people handling the device is represented in this way merely for aesthetic purposes, and the image was used for marketing purposes. Normally the mirror was hung on a wall or placed on a table so that the same person manipulating the device did not have to also hold the mirror. The viewer still needed to use of both hands, however, to make the sequential drawings move. And, in fact, only the person directly in front of the device, looking through the slits, could see the animation.

Figure 24. French lithograph demonstrating use of Plateau's Phenakistoscope, c. 1833 ***(Courtesy of David Robinson Collection)***

With the phenakistoscope, the animated illusion could be perceived almost like a magic trick seen in a mirror, evoking the idea of magic mirror illusions more than a magical device per se. With the zoetrope, the device was brought to the center of the magic trick as a magical object that could transform different still actions (strips with sequential drawings) into motion, empowering its viewers and changing them from viewers to users and from users to possible performers, even magicians. By increasing the number of viewers significantly (Figure 25), the zoetrope also created a playful atmosphere for collective enjoyment. As Horner acknowledged, the effect produced was the same "surprising play of relative motion" of the phenakistoscope, although the design of the device was essentially different. Thus, it is possible to state that the zoetrope simplified the process of perceiving the animation while also creating delightful animated illusions to captivate its users.

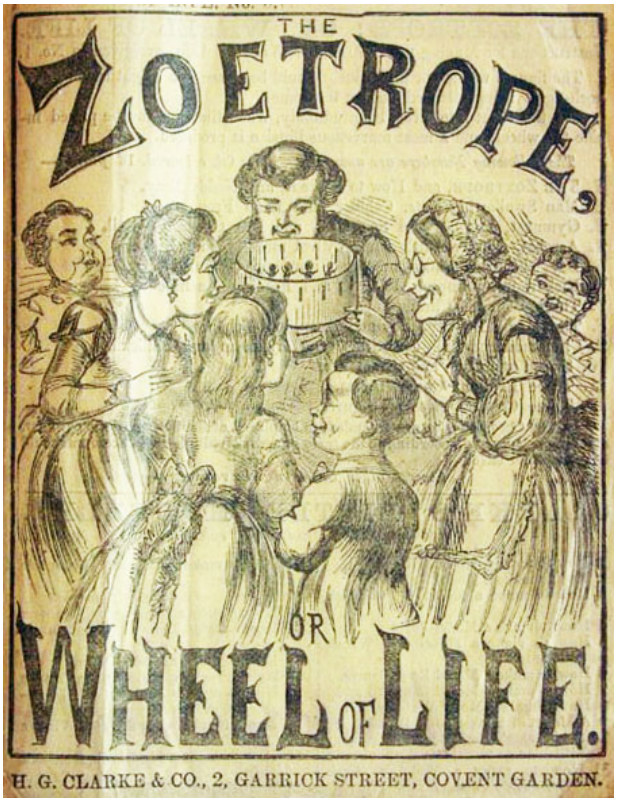

Figure 25. Label of H. G. Clarke's "Zoetrope, or Wheel of Life" toy, c. 1867 ***(Courtesy of Stephen Herbert Collection)***[257]

The legacy of the mythological loop cycles became a recurrent structure and context for many proto-cinematic devices, enhanced by their circular design. A significant difference in the content of the animation exhibited in these early flickering devices is that their animations leaned more toward comedy and sarcasm than the essentially suffering cycles of Greek mythology and medieval symbols. Historical collections of paper strips for optical devices had the last drawing of a sequence continue the action of the first drawing of the same sequence, thereby creating a complete cycle. The number of drawings was limited by the size of the zoetrope's drum and the effect the artists wanted to achieve. During the Victorian era, in the prime of the zoetrope, those strips were specially made—sometimes even commissioned to artists[258]—for the device by companies such as London Photographic and Stereoscopy Company, Milton Bradley, Alphonse Giroux, and Delacour and Bakes,[259] and explored the potential of the cyclical repetition. The cycle

[257] Accessed at: http://www.stephenherbert.co.uk/zoetropestripsClarke.htm
[258] As exemplified by David Robinson in his *Masterpieces of Animation 1833-1908* p.14.
[259] As exemplified in the online collections of Stephen Herbert and Richard Balzer, respectively accessed at:

represented by those sequential drawings has symbolic and mythological precedents in history that reinforce their role as philosophical toys, often influencing the viewer to be aware of the connection between the action portrayed in the animation and the cyclical or repetitive patterns in nature and life, as reflected in stories and myths and their never-ending cycles.

Figure 26. Replica of a zoetrope with 13 slits
(Collection of the author)

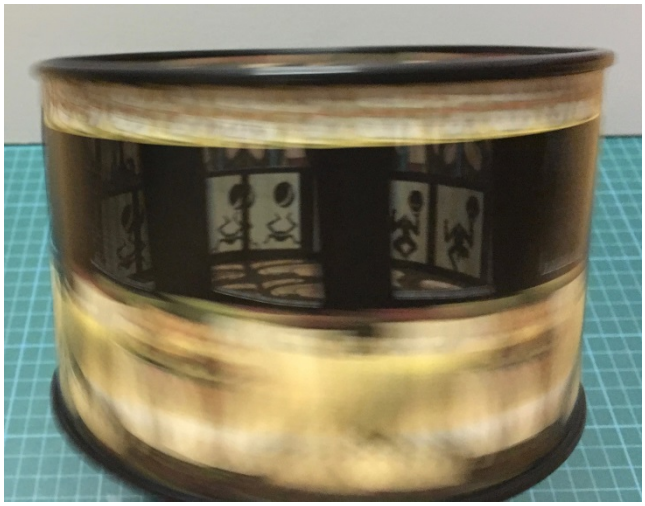

Figure 27. Replica of a zoetrope with 13 slits, rotating
(Collection of the author)

The characters in a zoetrope are perceived as multiplied, that is, the same character is performing the same "in-place" action on the sequential paper strip [260] when seen through the slits. But, instead of seeing the entire circumference of the disk animated, as previously exemplified in the phenakistoscope, only half of the cylinder is visible to any given viewer when the cylinder is still. However, when the zoetrope rotates, a curious optical effect occurs, and instead of seeing only half of the animated characters, the viewer perceives two-thirds of the animated images. This happens because when the slotted cylinder rotates, the images appear to shrink a little bit, creating an effect similar to Plateau's Anorthoscope. This effect characteristic of the zoetrope is rarely discussed in the literature of animation and cinema, even though it can also be observed in the phenakistoscope.

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http://www.stephenherbert.co.uk/wheelZOETROPEpart2.htm
http://www.dickbalzer.com/Optical_Toys.203.0.html

[260] These strips had many subjects and their arrangement remind the author of comic strips.

The linearity of the axis of the device, combined with the impossibility of seeing the entire circle, perhaps become deciding factors in the zoetrope strip's requiring more "character driven" actions.[261] Instead of having layers of actions happening simultaneously, as is the case in the vast majority of phenakistoscopes, in the zoetrope there is generally a main character performing repetitious actions.

By shifting the verticality of viewing the phenakistoscope to a horizontal orientation, the characters seem more prone to be trapped in their ordinary tasks, rooted and condemned to repeat them perpetually in the zoetrope. Although in Stampfer's stroboscope and Plateau's phenakistoscope disks we also have a clear idea of repetition, there is an evolution of shapes that can interact with one another, always running away or toward the center, which also reinforces the idea of alternating, never-ending images passing through the disk. They seem to appear and disappear from the edge to the center, or vice versa. The action portrayed in the phenakistoscope as well as in the zoetrope shows multiple characters performing a single action in different sections of the disk or the strip, sometimes even interacting with one another. The phenakistoscope can give the impression that a multiplicity of characters come and go, as exemplified in Figure 12, while in the zoetrope the character is multiplied, repeating its action with no clear beginning or end. The repetitive action contains a cycle within the loop, as one character is moving in the midst of a group of identical characters portraying the same action simultaneously.

For the scholar Dominique Willoughby, the action displayed on the zoetrope strips represents a regression in terms of artistic content and designs achieved in the phenakistoscope.[262] However, for the first time in an optical toy, the ability to combine strips centering around the character's action is possible with the zoetrope. Furthermore, some artists whom the author considers early animators played with the innate repetition of the zoetrope

[261] Obviously the term is not referred to here in terms of what is known today as character-driven narrative but recognizes a subtle change in the action performed in the zoetrope versus actions performed in other devices.
[262] Dominique Willoughby, *Le Cinéma graphique*, p. 63.

strips and achieved interesting effects drawn from experience of the phenakistoscope, particularly relating to the number of slots of the device and the variation in the number of characters.

As mentioned earlier, fewer characters than slits will create the effect of movement being pushed forward, and more characters than slits will slow down movement, creating the effect of receding backward. Only with the exact same number of slots and characters is the animated scene seen as moving in place. These characteristics were referenced by Plateau—besides being portrayed in the first set of disks that carried his name—and further explored by William Benjamin Carpenter (1813-1885) in his article "On the Zoetrope and Its Antecedents"[263] in 1868. Strangely enough, especially considering that zoetropes are still made today, normally as an introduction to the animation practice, these key Victorian-era characteristics are today virtually forgotten, rarely taught or even explored by students and practitioners when designing strips for the device.

Seldom performed, the task of resurrecting and popularizing the basic elements to create a zoetrope strip, as established by Carpenter, rests in the hands of scholars, practitioners, and specialists. Stephen Herbert is one of the few specialists in the field who has not only republished the Victorian-era articles related to optical devices but, as a collector, has also made available on his website an abundance of material about the zoetrope and other devices, indicating its historical sources. Richard Balzer is another. Throughout the 1990s and early 2000s, a boom in the media archaeology field contributed to the rediscovery of these devices, however not with the intensity, depth, experimentation, and reflection they deserve, particularly regarding devices that flicker and rotate. Thus, up to the present, Carpenter's analysis of the zoetrope remains one of the most complete studies of the design and scientific characteristics of this device. Through trial and error,

[263] William B. Carpenter. "On the Zoetrope and Its Antecedents." In *Student and Intellectual Observer of Science, Literature and Art*, (London: Groombridge &Sons, 1868-1869); vol. 1: pp. 427–444; vol. 2: 24-31 and 110-128. Available online at: https://books.google.com.sg/books?id=dcEWAQAAIAAJ&pg=PA29&source=gbs_toc_r&cad=4#v=onepage&q&f=false

many animators and zoetrope enthusiasts today apply empirically the characteristics presented in Carpenter's article. Probably, if they had access to the knowledge contained in the article, better explorations of the animation potential of contemporary zoetrope strips would result.

For instance, to create more challenging animated effects with the zoetrope, the number of characters can be manipulated according to the number of slots on the device and depending on the effect the artist wishes to create. Carpenter called this relationship "movement of translation." As an example, Carpenter describes the mixed effect of all three phases of this movement in the zoetrope strip *The Red-Legged Ogre and His Poodle* (Figure 28), in which a poodle jumps through a hula-hoop placed above an ogre:

> …for the number of hoops being thirteen is equal to that of slots, so as to produce a stationary spectrum, the number of poodles being fourteen, their spectrum has a movement of onward translation, and the number of ogres being twelve, their spectrum has a movement of backward translation.[264]

The effect of the strip mentioned by Carpenter mimics the results obtained by Faraday in 1831 using geometrical shapes, also explored by Plateau in early versions of the phenakistoscope. Many artists used these strategies to create more compelling and challenging movements for the zoetrope and phenakistoscope, but rarely are they all found combined in the same animated strip or disk. The impressive animation of some of these strips was registered in books and mentioned in articles mainly from the 19th century, and their review here aims to fill a century-old gap.

[264] Ibid.

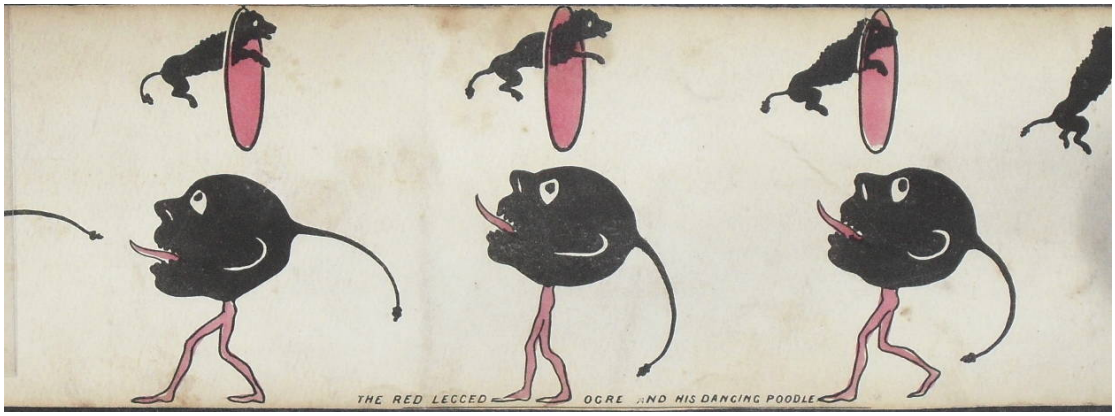

Figure 28. Partial image of the zoetrope strip *The Red-Legged Ogre and His Poodle,* from the catalog of the London Stereoscopic & Photographic Company *(Courtesy of Stephen Herbert Collection)*[265]

According to the scholars Dulac and Gaudreault, these early animated actions do not represent a narrative and are therefore classified as "attractions." The author, however, argues that early animations are "proto-narratives,"[266] as well as attractions, specifically because they suggested embryonic forms of narrative, of a story.[267] Just the titles of some of the classic zoetrope strips suggested this, as, for instance, "*Fly! Leave My Nose Alone," "Irish Tail," "Precocious Chickens," "More Free Than Welcome," "You're Getting Very Bald, Sir," "A Well-Known Domestic Tragedy,"* among others listed in Appendix A (respectively numbers 67, 59, 55, 44, 31, and 34 in that catalog). These titles suggest messages (often humorous) embedded to tease minds when combined with the animation. They include clever puns, jokes, and references to events, historical or anecdotal. Unfortunately, many of those references were lost with the passage of time and led to a view and interpretation of these proto-narratives as mere attractions, losing their connection to events of the time and surroundings.

A compelling example for the author's claim is a strip that portrays the body of a man, drawn 13 times, passing his head forward from one body to the next (Figure 29). As the number of heads is only 12, in other words, fewer

[265] Image accessed at: http://www.stephenherbert.co.uk/zoetropestrips3.htm
[266] A term coined by Alan Cholodenko in discussions with the author about this research, specifically referencing for him the sequential changes in the movement of figures within the spiral, looping form of movement of strips. They are not exactly narratives in the sense that cinema will establish with D. W. Griffith but can be considered embryonic forms of narratives containing the germ, the origin, of the narrative form in visual media.
[267] Is it not in that way that every narrative originates?

than the number of bodies and number of slots, a movement of his head passing forward is created. Illustrative of Victorian-era humor, some versions of this strip were entitled *French Revolution,* as mentioned by Herbert.[268] Thus, at each revolution of the zoetrope, heads are lost and heads are gained in a clear reference to the guillotine but also related to political power games. When a new head is passed forward, a new person is in power, a new authority rises; but that does not last long, and the repetitive movement makes the viewer philosophize on how the game of power may seem to change, while things remain fundamentally the same. Consequently, the stability lies in the change since that is the only thing one can be sure will continue to happen. Thus, the use of the zoetrope as a trope (its "troping," turning) helps spin heads (inside and outside the slotted cylinder) and invites the audience to think creatively about the animated actions, establishing their own connections and stories. These proto-narratives may be subtle and sometimes only suggested by a funny combination between title and image; but when explored, they have the potential to be expanded into stories.

Figure 29. Partial image of the zoetrope strip A Headwork but also jokingly known as *French Revolution,* from the catalog of the London Stereoscopic & Photographic Company *(Courtesy of Stephen Herbert Collection)*[269]

The zoetrope included a fundamental change in the axis of the device: From the phenakistoscope's disk, positioned parallel to the viewer, like the thaumatrope as well, this vertical axis was shifted to a horizontal axis, with animations seen inside the slotted cylinder (Figures 26 and 27). Inspired by the alteration, some publishers released series of zoetrope strips together with circular bottom sheets designed to be placed inside the cylinder. These circular bottom sheets were in fact like phenakistoscopes, but displaying

[268] Information available in Herbert's website, accessed at: http://www.stephenherbert.co.uk/wheelZOETROPEpart2.htm
[269] Image accessed at: http://www.stephenherbert.co.uk/zoetropestrips3.htm

mainly geometrical animated motifs that could be seen adjacent to the main animated strips. This change anticipates the future merger of the zoetrope and the phenakistoscope in contemporary times, a claim further discussed in Chapter 3.

With the zoetrope, the abstractions that were more common in the phenakistoscope gave way to more representational, everyday scenes, such as a girl feeding a chicken, people and animals walking, swimmers, or jugglers, among other motifs, all drawn on a horizontal strip of paper varying in scenes of 12 to 18 frames, according to the size of the zoetrope drum. For the author, the shift in the axis position of the phenakistoscope to the zoetrope plays an intuitive role in that content shift. In the shift from the circular display of the phenakistoscope to the zoetrope's paper strip, the point of view of the action portrayed is fundamentally changed. Instead of having the characters portraying actions in a circular fashion, they are grounded, which means that the movement happens by following the horizon line instead of the circle, which has impact on the content of the animation. This change of content is mainly observed in terms of the lack of abstractions.

Aside from the novel advantage of the zoetrope permitting multiple simultaneous viewers, other main characteristics relate to the simplification of the device's use in comparison to the phenakistoscope. Another is related to something that Carpenter pointed out in his 1868 article and has since been addressed by Tosi,[270] Dulac and Gaudreault,[271] and Wanda Strauven:[272] the separation of the apparatus from its content.[273] With the zoetrope, the

[270] Tosi, Cinema before Cinema.
[271] Nicolas Dulac and André Gaudreault. "Circularity and Repetition at the Heart of the Attraction: Optical Toys and the Emergence of a New Cultural Series." In *The Cinema of Attractions Reloaded,* edited by Wanda Strauven, 227-243 (Amsterdam: Amsterdam University Press, 2006).
[272] Wanda Strauven. "The Observer's Dilemma: To Touch or Not to Touch." In *Media Archaeology: Approaches, Applications, and Implications*, edited by Erkki Huhtamo and Jussi Parikka, 148-162 (Berkeley: University of California Press, 2011).
[273] When considering a broader span of optical devices, the magic lantern in the 17th century provided such separation, followed much later by the cinematograph of the Lumière brothers, among others. (This reinforces the fact that these devices are improved and tested

actual slits and the sequential drawings were separated, which made it much easier to change strips.

So, whereas antecedents of the zoetrope such as the thaumatrope and the phenakistoscope combined content and device into one (as the flipbook would also), the zoetrope embodied innovation in separating content from device, making it possible not only for the same device to be used with different strips but also for the strips to be combined and their content merged, multiplying the playability of the device. This innovation was already hinted at in the catalog of the London Stereoscopic Company, but it will be given a name by Dulac and Gaudreault: "zoetropic editing." The playful and most pleasurable consequence of zoetropic editing resides in the fact that the user gains a certain level of control over the animation. By being allowed to freely choose the combination of different strips, the user can select those that have a more similar aesthetic movement, even though their action is completely different. As a specific characteristic of the zoetrope not embraced by the animated installations this element is not explored further in this thesis, but is a key reference for future studies and investigations about the zoetrope.

Of all the 19th-century optical devices that flicker, the zoetrope is the most popular and reclaimed one for animated installations. Given that among the contemporary artists featured in this thesis, more than half have produced works that are clear variations and reinterpretations of the zoetrope, those current reinventions to animated installations are investigated as case studies in Chapters 3 and 4, including the author's practical work in Chapter 5.

2.4.4 The Praxinoscope (1877)

Created as an improvement of the zoetrope, the praxinoscope (Figure 30)—meaning "action [*praxis*] that we look at [*skopein*]" in Greek—also allowed for

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based on their antecedents.) Finally, this characteristic also applied to Émile Reynaud's Théâtre Optique in 1892. See Cholodenko, "'The Animation of Cinema."

multiple simultaneous viewers but with the added benefit that its animated images were seen reflected on a faceted mirror positioned in the center of the cylinder. This innovation resulted in clearer and brighter images than in any of the earlier optical devices. Forgoing the use of slots, the device's faceted mirrors acted as a prism, and the interruption created by these facets generated the necessary flickering for the images to be seen animated.

Figure 30. Émile Reynaud's Praxinoscope, 1879 ***(Collection of the Cinémathèque Française)***

The praxinoscope was created by Émile Reynaud (1844-1918) in 1877, winning an Honorable Mention at the Paris Exposition of 1878. A Renaissance man of sorts, Reynaud's skills ranged from mechanical engineering to manipulation of optical instruments to photography, drawing, and industrial design. He was extremely creative and ingenious. From the creation of the praxinoscope, he kept working to improve his invention[274] and in doing so, in many ways helped advance the history of animation and consequently cinema.

The strips that Reynaud created for his Praxinoscope were carefully hand-painted, arranged sequentially, and possessed an aesthetic quality so

[274] A less-known portable version of Reynaud's praxinoscope is the Toupie Fantoche (1879), commercialized in 1881 (Richard John Neupert, *French Animation History* [Oxford and Malden, U.K.: Wiley-Blackwell, 2011], p. 6), which has been adapted into a digital technology version, in combination with the Pepper's Ghost effect, as an animated display used today for marketing purposes. Reynaud's Praxinoscope Théâtre (1879), Projection Praxinoscope (1880), and Théâtre Optique (1888) followed the original Praxinoscope. Later in life, Reynaud even created the Stereoscopic Praxinoscope, in 1908. Reynaud also developed smaller praxinoscopes, with only eight mirrored facets (instead of the traditional 12 to 13 facets), for smaller children. The luxury versions, many of which were also adapted to be powered by steam and even electricity by other inventors, permitted the animation to be seen for longer periods of time since the user no longer had to rotate the device manually.

appealing that copycats abounded. Even today, when acquiring historical reconstructions of optical toys, it is easy to identify which of the strips are based on Reynaud's originals, many times sold together with zoetropes as well as praxinoscopes, since both devices placed their animated strips inside the device in the same way.

His search to create longer actions and enable only one animated image to be perceived led Reynaud to improve his device from the original Praxinoscope to the Praxinoscope Théâtre and its subsequent versions, culminating in the Théâtre Optique. His investigations clearly show his interest in pushing the limitations and proposing new possibilities for optical toys, which drove him to develop a kind of spectacle quite similar to what would later become the standard in cinema. Indeed, the Praxinoscope Théâtre (Figure 31) reveals Reynaud's interest in isolating the animated image instead of having the action happen simultaneously in multiplied characters, as occurs in the phenakistoscope, zoetrope, and the early version of the praxinoscope.

Figure 31. Émile Reynaud's Praxinoscope Théâtre, c. 1879 ***(Courtesy of David Robinson Collection)***

Employing a viewer and a clever system of mirrored reflections, a praxinoscope, Reynaud was able to isolate the individual character to be animated, now composited and viewable in front of different backgrounds. The user of the device peeped through an outer wooden box structure to observe the animation. The use of strips with characters drawn against a black background was key to creating this innovative effect. With the

changes in the background, the character could be placed in different settings—a living room, outdoors, a theater, etc.—which would consequently lead to a wider range of stories that could be told or spun with the same character, even though its movement was in a loop. The separation of background and character in an animated film would be achieved only after the invention of the transparent cel in 1910. That separation between what moves and what is stable was fundamental to advancing the animation system and speeding up the production system of the future entertainment industry. Yet, much earlier, this same interest in character isolation, as well as the desire to tell longer stories, motivated Reynaud's development of the Projection Praxinoscope and later on the Théâtre Optique. All of Reynaud's devices were created for home use and sold in Paris in every department store,[275] with the exception of the Théâtre Optique, his masterwork.[276]

Probably one of the most underestimated and unrecognized pioneers in the history of cinema and animation, Reynaud was already projecting his films to a large paying audience at the Musée Grévin in Paris in 1892 with his Théâtre Optique. His *Pantomimes Lumineuses* were animated films drawn and painted by hand by Reynaud himself on transparent strips. After being seeing by more than a half-million viewers, in 1900 Reynaud gave his last show in the Musée Grévin.

His projections were in color and had live sound accompaniment. Frustrated and unable to keep up with the pace of updating and performing his crafted films, Reynaud struggled to survive in the face of competition from the Lumière brothers' newly released cinematograph. Their device was portable and could record and project images, rendering Reynaud's system obsolete. Reynaud would later destroy the Théâtre Optique and its film strips. Only two strips have survived: *Pauvre Pierrot* (1892) and *Autour d'une cabine* (1894).

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[275] Mannoni, The Great Art of Light and Shadow, p. 372.
[276] See Alan Cholodenko's "The Animation of Cinema," where he resurrects the name, work, and achievements of this most singular and forgotten figure in the history of film animation.

2.4.4.1 Examples of a Particular Type of Animated Installations: Reinventions of the Praxinoscope

Considering the praxinoscope's start specifically as home-use entertainment, Reynaud's animated optical device added greatly to the philosophical toy concept, later expanding it further in the Théâtre Optique to the level of the social ritual for which cinema would soon come to be known. In today's time, one of the most impressive uses of the praxinoscope lies in the video clip *We Got Time,*[277] from the singer Morey McLaren and created by the artist David Wilson. Categorized as a *device film* in this thesis, the work presents the optical device as a film, using modern version of Reynaud's praxinoscope on top of turntables. Wilson innovates when creating a longer narrative by piling up the devices and moving the camera from one praxinoscope to another to illustrate and tell the story that accompanies the music. Each disk was drawn by hand by Wilson, and through editing, he connects the images from one disk to another in a smooth transition, creating a seamless continuation of their animated images that exists only in the video. The video has a physical and concrete appeal, too. The animation portrays real objects, but its end result reaches the public as a video clip to be shown on a screen. In this case, the user is a spectator to whom direct interaction through manipulation is denied. However, this observation does not diminish the work of the animator/filmmaker but helps identify the fundamental difference between the animated installations experienced live and the device films. Evidently, the advantage of the device films is that its outreach is significantly larger than any of the animated installations could ever strive for.

In terms of physical animated installation as reinventions of the praxinoscope to date, very few have been identified, among which the author highlights the work of the art collective David Lawrey and Jaki Middleton, as well as the Brazilian artist Roberto Freitas.

[277] Available at: https://www.youtube.com/watch?v=j9e38cuhnaU.

Lawrey and Middleton's piece *You're My Only Hope* (2008)[278] (Figure 32) uses the structure of the Praxinoscope Théâtre to create a reconstruction of a scene from *Star Wars: Episode IV—A New Hope* (1977) in which Princess Leia loads the stolen Death Star plans in the droid R2D2 to be sent to master Obi Wan-Kenobi as her "only hope." In the contemporary artwork, different women reenact the scene while placed in assorted ordinary environments. The characteristic of the Praxinoscope Théâtre of isolating the multiple animated images adds to the imagery a holographic-like, ethereal quality, with the advantage that the animated action can be placed in different settings.

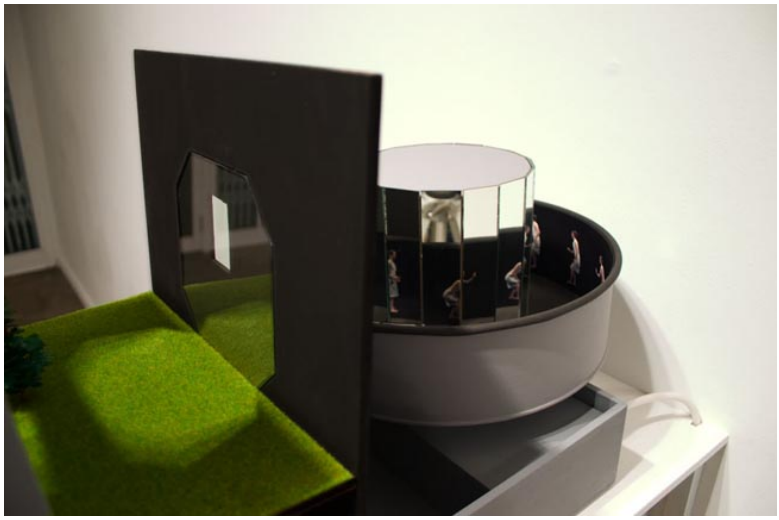

Figure 32. David Lawrey and Jaki Middleton, *You're My Only Hope,* 2008: gallery setting *(From the artists' website)*[279]

This reinterpretation of a pop culture classic like *Star Wars* using a reanimated proto-cinematic device connects history and the evolution of image technology, reviving what was once new to younger generations. What makes this animated installation astonishing is the association between past and present where the ghostly effect created by Reynaud's praxinoscope is adapted to portray such a famous modern scene. Once more, the play between familiarity elicited by a pop culture icon and its reframing as a contemporary animated installation proposes that these early historical

[278] The work can be seen at: http://www.wayback.net.au/you-re_my_only_hope.php
[279] Image accessed at: http://www.wayback.net.au/you-re_my_only_hope.php

devices be seen in a new perspective, one that restores their cutting-edge technology past.

Três (2012-2015),[280] created by Freitas, pays homage to and extends Reynaud's ingenuity by adding a digital technology twist to it, as a perfect example of the type of ingenuity these contemporary reinventions have the potential to display. In his installation (Figures 33 and 34), he creates a dance performed through the intricate connections of moving objects. His fragile and elegant machines, in a Rube Goldberg-like structure, synchronize movement, sound, and visuals while enabling ghostly dancers to appear to perform. Their dance uses sensor and algorithmic calculations that interpolate the data to create unique live performances that the artist himself no longer controls.

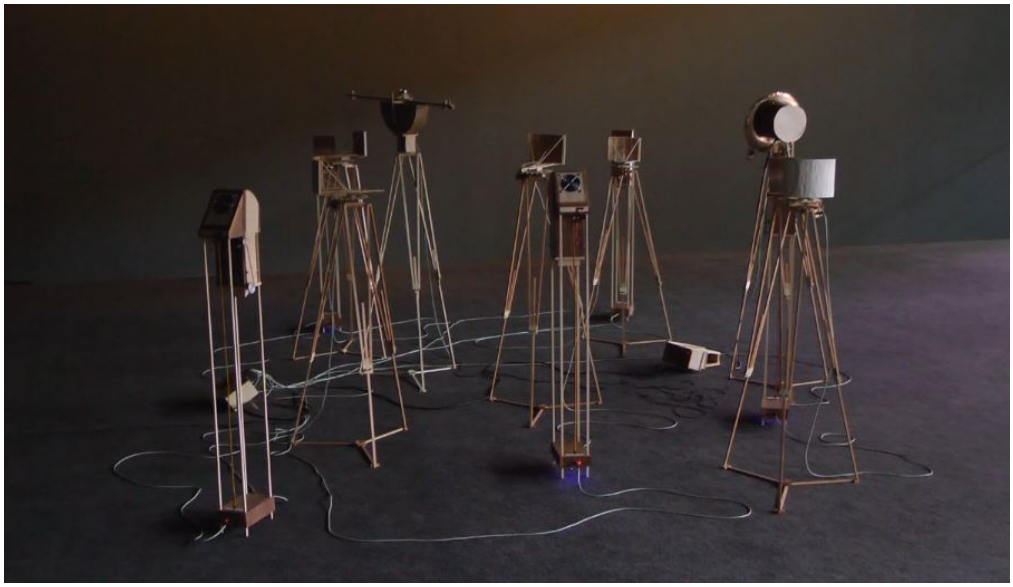

Figure 33. Roberto Freitas, *Três,* 2012-2015: in gallery setting *(From video on Roberto Freitas' Vimeo channel)*[281]

[280] Roberto Freitas' installation *Três* can be accessed at: https://vimeo.com/60268149
[281] Video accessed at: https://vimeo.com/60268149

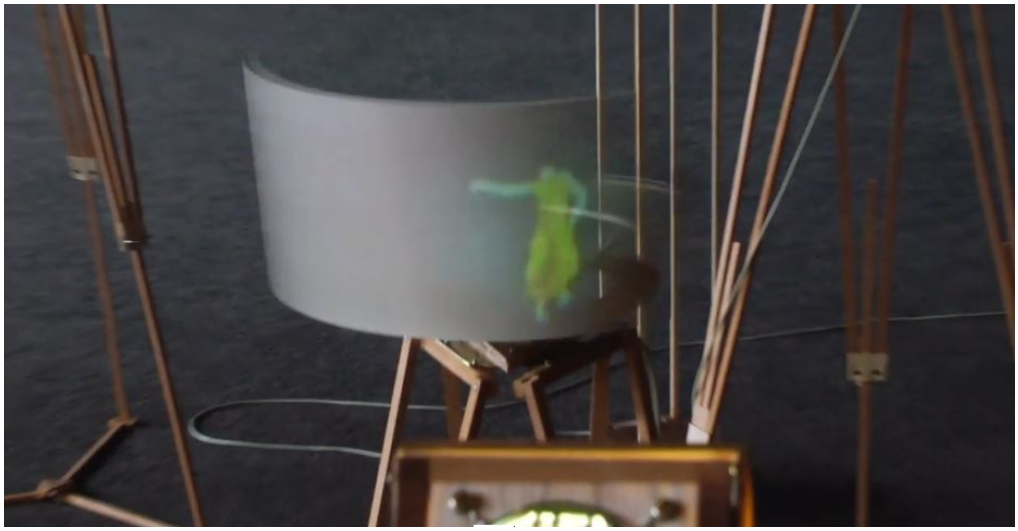

Figure 34. Roberto Freitas, *Três,* 2012-2015: detail *(From video on Roberto Freitas' Vimeo channel)*[282]

The machine system activates and interacts in different ways at every presentation. This element of chance encounters is an embraced part of the work that slowly gains form as a consistently animated installation piece. Sounds created by the physical movements of the devices also contribute to the perceptual movement of his animation devices. Inspired by Reynaud's proto-cinematic projections of ghostly, almost holographic-like moving figures in his Praxinoscope Theater and later Théâtre Optique, the Brazilian artist constructs his own mechanical ballet as a beautiful homage to early optical devices and films alike.

2.4.5 The Flipbook in Its Mutoscope Form (1894)

The flipbook, like many of the optical devices, has a history of two inventors. Although its conceptualization can be linked to the Frenchman Pierre-Hubert Desvignes (1804-1883) and his folioscope, or *feuilletoscope*, of 1860, it would not be until 1868 that an official patent for a similar device named the kineograph would be filed by John Barnes Linnett from Great Britain. Patent registers prove to be the most reliable way to trace back the history of these devices, because although they may not always document the original

[282] Video accessed at: https://vimeo.com/60268149

inventor, they are accurate certifications of the development of apparatuses through time.

The flipbook differs from all the previously mentioned devices that flicker in that it does not necessarily rely on the loop and can tell longer stories,[283] depending on the size of the book. However, in selecting early devices that are reinvented today, not only the flicker but also their rotation is an important element that establishes the domain addressed in this thesis. As the principle of the flipbook was adapted in other commercial devices,[284] the focus of this section is on the flipbook in its best-known variation, the mutoscope (Figures 35 and 36).

The mutoscope was invented and patented by Herman Casler (1867-1939) in 1894, who, as a former employee of Thomas Edison, simplified the device to disguise its inspiration in Edison's kinetograph,[285] as explained by Mannoni. Much cheaper and simpler than Edison's apparatus, the mutoscope was a success, especially because the audience could control the speed of the animated photographs by moving a crank faster or slower, which consequently changed the flicker rate of the device. The mutoscope came to be known in Britain as "what the butler saw" machines, referring to the often erotic scenes it portrayed.

[283] Some versions of the flipbook allow the telling of multiple stories hidden in the same book by using different shaped cuts intercalated among the pages. Thus, by changing the way the book is flipped, one changes the story. A current example of this is *Kali, the Little Vampire/Kali, o Pequeno Vampiro* (2012) by Regina Pessoa, which portrays six different animations in a single flipbook by using the cut-edges technique. More information about this flipbook is available at: http://curtas.pt/agencia/filmes/288/

[284] Other handheld adaptations of the flipbook were the Folisocope by Georges Demenÿ (1850-1917), the Filoscope by Henry William (Harry) Short, the Petit Biograph Parisien, smaller versions of the Kinora, as well as publishers' special versions, such as the Kinophot by Grass & Worff.

[285] Mannoni, The Great Art of Light and Shadow, p. 433.

Figure 35. Wooden Mutoscope from Biograph, c. 1901 ***(Collection of the Cinémathèque Française)***[286]

Figure 36. Mutoscope, 1898 ***(Collection of the Cinémathèque Française)***[287]

[286] Mannoni, De Méliès à la 3D, p 53.
[287] Cinémathèque Française Collection, accessed at:
http://www.cinematheque.fr/fr/catalogues/appareils/collection/folioscopeap-95-1821.html

The mutoscope had sequential images, mostly photographs, assembled vertically as in a Rolodex, the desktop index-card browser device. The viewer deposited money to activate the machine, a simpler version of the peepshows that were in fashion before cinema—a trend set by Edison's kinetoscope. Aside from the fact that the Mutoscope could display longer stories and actions, the flipbook is still the most accessible form of entertainment, one that many schoolchildren rely upon as a pastime by drawing in the corners of their notebooks. This is probably the reason that has guaranteed its enduring appeal. The same is not necessarily true for the mutoscope, which soon after the invention of cinema started to lose its customers.

2.4.5.1 Examples of a Particular Type of Animated Installations: Reinventions of the Mutoscope

Variations of the flipbook are numerous, even today, with subject matter ranging from adult-only material to children's pastimes. In 2005, a landmark exhibition and the first of its kind to be exclusively dedicated to the flipbook took place in Dusseldorf, Germany. It was titled *Daumenkino, the Flip Book Show* and was curated by Christoph Schulz and Daniel Gethmann. Featured in this exhibition were numerous artists who had created contemporary flipbooks, including Andy Warhol, Stan Van der Beek, Gilbert and George, Keith Haring, George Griffin, Ruth Hayes, Gregory Barsamian, William Kentridge, and many more. In many cases their works displayed at the *Daumenkino* exhibition still can only be seen through the catalog. However, with a specific focus on the flipbook in its mutoscope form, the number of contemporary artists proposing significant explorations of the device drops significantly. Among them, the author highlights Americans Robert Breer (1926-2011) and George Griffin (1943-), and the Brazilian Milton Marques (1971-).

Among these artists, Breer stands out. As confirmed by George Griffin, Breer created the "first fine arts edition flipbook" in 1955, *Image par image*, to

accompany the program of the historical exhibition *Le Mouvement* (April 6-30) held at the Galerie Denise René in Paris. Much of Breer's later filmic explorations were built upon or evolved from his understanding and use of optical devices. Investigating ideas related to the loop, film editing, metamorphosis, space, and interactivity, he conceived pieces related to the flipbook and its variations.[288] By building his own mutoscope-like machines to be hand-cranked by the viewer in 1964 (Figure 37), he expanded his films beyond the screen, allowing the viewer to experience those films in a more haptic way. He even created stereoscopic versions of his mutoscopes from 1978 to 1980 (Figure 38) to be physically manipulated by viewers in the gallery. Breer's animated installations combined the sense of vision, touch, and hearing (through the cranking noise they performed).

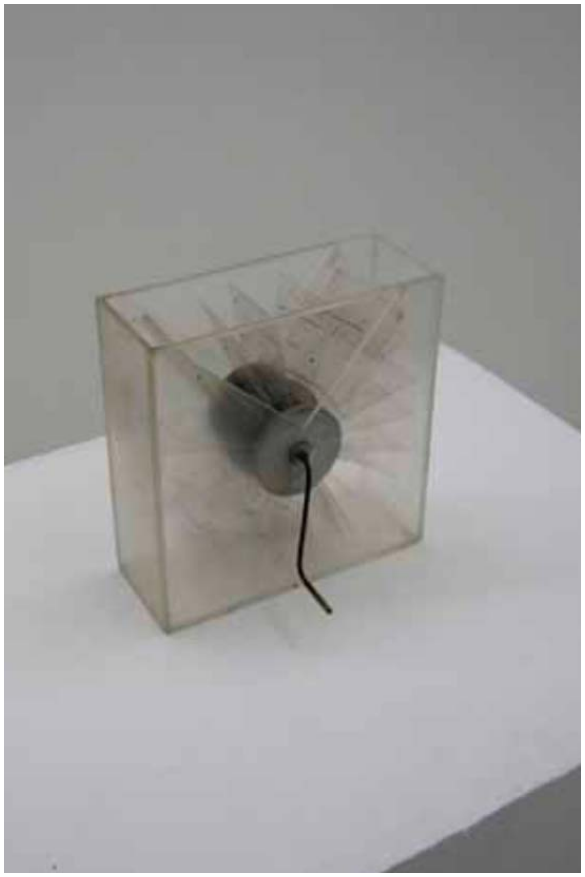

Figure 37. Robert Breer's mutoscope-like machines of 1964 had to be hand-cranked by the viewer (Daumenkino *exhibition catalog)*

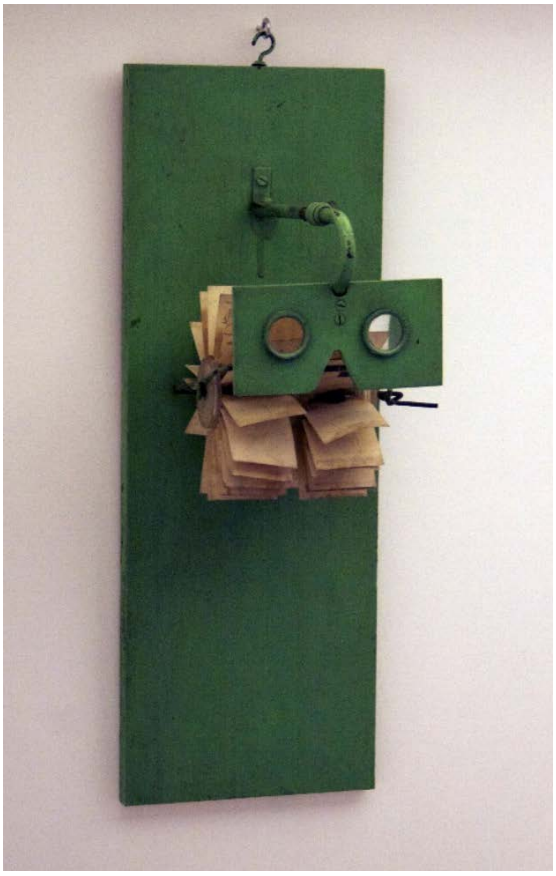

Figure 38. A stereoscopic version of Robert Breer's flipbook/mutoscope devices, 1978-1980 (Daumenkino *exhibition catalog)*

[288] There is a record of a thaumatrope-like device built by Breer and exhibited at the Museum of the Moving Image. No pictures or other documentation of the device were found. Information is available in an article written by Jackie Leger for the Animation World Network website, available at: http://www.awn.com/mag/issue1.4/articles/breer1.4.html

Playfulness is an essential part of Breer's work, and the devices and other objects he crafted allowed him to extend his artistic practice beyond the "black box" structure imposed by traditional film. Also, to be able to see his animation in the bright space of the gallery, he had to propose a different type of animated experience and interaction. Unfortunately, the documentation of Breer's animations displayed on some of these devices was not properly recorded, so it was his actual animated films that became the best known of his explorations, independent of the machines he built and reinvented inspired by the early optical devices.

As a great admirer of Breer, Griffin was influenced by his elder colleague. Griffin's works, as tangible examples of the *concrete animation* concept, are not only self-referential but also connect traditional practices with technology. Although the majority of Griffin's production is made as animated film format, produced in 16mm, including a series that he calls *trickfilms*, he has also created many flipbooks. Probably the most significant piece that combines optical devices and technology is reflected in his *Viewmaster*[289] (1976), which was restored from its 16mm format to be digitally displayed in a mutoscope-like structure (Figure 39), hand-cranked by the viewer.

[289] The complete animation can be accessed at: https://vimeo.com/120504373

Figure 39. George Griffin's *Viewmaster,* 1976, adapted as a digital mutoscope (George Griffin)[290]

Figure 40. George Griffin's *Viewmaster,* 1976 (George Griffin)[291]

The animation is structured as in a phenakistoscope disk, and each character was drawn in different styles performing his or her own walk cycle. The artist named his hybrid creation a *Geogriff*, a contraction of his name and surname (Figure 40), and titled the animation in reference to the View-Master toys that displayed stereoscopic photographic slides on a cardboard disk. Even though the animation follows the shape of a phenakistoscope and is seen in a kind of modern mutoscope, its resulting moving image is more related to animated film.

Milton Marques' artistic practice, meanwhile, pushes the boundaries of the early devices. Since the late 1990s, Marques,[292] who lives and works in the capital city of Brasilia, has built versions of optical devices and other machinery using abandoned old media and obsolete technology objects found as trash. Marques creates devices that resemble gadgets as if belonging to a post-futuristic world. Some of his works, a combination of

[290] Image accessed at the animator's website: http://www.geogrif.com/Mutoscopes.html
[291] Image accessed at the animator's website: http://www.geogrif.com/Mutoscopes.html
[292] Milton Marques' works are available at: http://galerialeme.com/artist/milton-marques/?section=photos

digital technology and physical machinery, are reconstructions of early optical devices built with found objects in an attempt to reanimate something that was lost. The assembly of these rescued objects and technological parts creates a visual quality that can be interpreted as useless working machines repurposed. However, his reinvented hybrid machines propose a new look and different possibilities for re-assembly of these devices, introducing magic lantern and flipbook-like gadgets that create experimental and suggestive poetic imagery associated with their technological patchwork-like structure.

The piece *Untitled* (2002) (Figure 41) displays a self-portrait of the artist in motion. Following the mutoscope structure, Marques created a hybrid machine to flip through the sequential pictures assembled in horizontal fashion, not vertically as in the traditional displays of the mutoscope.

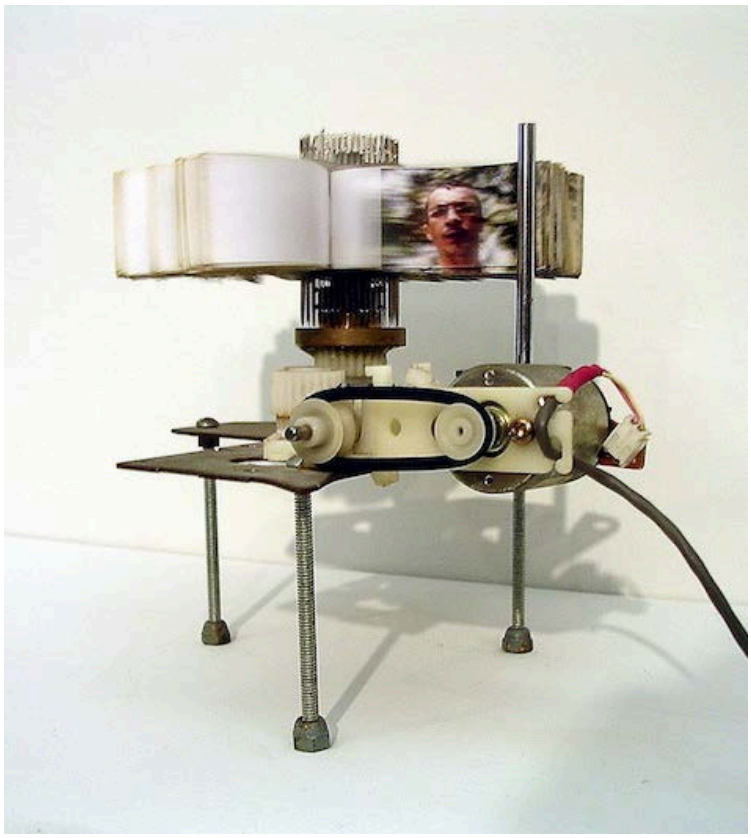

Figure 41. Milton Marques, *Sem Título,* 2002 *(Galeria Leme)*[293]

[293] Accessed at: http://galerialeme.com/artist/milton-marques/?section=photos

Even more recently, constructions of the largest flipbook devices ever,[294] based on the mutoscope structure, were undertaken as a recreational activity at Beam Camp (Figures 42 and 43). At this summer camp for Makers[295] nestled in the New Hampshire woods, these giant mutoscopes required hand-cranking to enable their animation to be seen. Those who are handling the crank cannot see the animation, because of its size, which calls for a collaborative environment in which people take turns generating the animation, apprehending and enjoying it. Collaboration and creativity are part of the summer camp's mission, helping young people develop hands-on skills and innovative thinking by working together. It defines itself as a place where "kids [are] making things happen."[296]

Figure 42. Giant flipbooks as play machines, created at the Beam Camp: general view *(Wired)*[297]

[294] According to the *Wired* article featuring these devices, accessed at: https://www.wired.com/2016/10/giant-flip-books-hiding-woods-new-hampshire/#slide-6

[295] The Maker movement philosophy believes that making enhances learning and that every person has the potential to be creative, inventive, and productive. Born from *Make: magazine* and *Maker Faire*, both initiatives created by Dale Dougherty, the global Maker movement has stimulated people to return to craft skills, consequently regaining the pleasure of creating something with their own hands. This also can be a way to restore feelings of capableness and belonging to a community that shares knowledge and inspires curiosity by producing things. Through its DIY (Do It Yourself) kits, the FlipBookit group contributes to spreading the Maker philosophy.

[296] As stated in the logo and mission statement of the camp, accessed at: https://beamcamp.org/beamcamphistory/

[297] Accessed at: https://www.wired.com/2016/10/giant-flip-books-hiding-woods-new-hampshire/#slide-2

Figure 43. Giant flipbooks as play machines, created at the Beam Camp: device in use *(Wired)*[298]

The world beyond the realm of the fine arts is also increasingly embracing a mixture of works with animation, particularly in the mutoscope form. Two examples of current trends is a proposed flipbook DIY kit, where the user can not only create his or her own animation but also build his or her own mechanical device manually. This specific example has gained popularity in two major initiatives, one in the United States and another in Italy, respectively called FlipBookit[299] and Giphoscope.[300]

FlipBookit (Figure 44) was inspired by Muybridge's work and the desire to create a simple, engaging experience for the viewer. By enabling people to assemble and create their own flipbooks, makers Mark Rosen and Wendy Marvel are transforming the current market for optical toys and devices. Their kits can come pre-assembled or ready for assembly by the user, with different levels of detail and complexity to choose from. For instance, a person can choose to use a hand crank or have an automated electronic/digital system to rotate the pieces independently. Once more, the evolution of technology and its accessibility are empowering people to imaginatively create while exploring the potentialities and limitations of

[298] Accessed at: https://www.wired.com/2016/10/giant-flip-books-hiding-woods-new-hampshire/#slide-2
[299] Official website: https://flipbookit.com
[300] Official website: http://www.giphoscope.com

technology and animation. Rosen and Marvel have wisely given users the option to create the content for their flipbooks both online or manually, while also offering a few versions portraying Muybridge's photographs. For the online version, they have developed a software application that helps divide videos into frames and prepare the file to be printed on flipbook cards, which is in fact a mini-mutoscope. They have also created educational videos about how to create a loop in animation and how to optimize the repetition effect in a flipbook. Cleverly exploiting associations with the Maker philosophy and heightened interest in arts, design and handcraft, the creators empower the user, creating a bond with their product through the artwork and its technical prowess.

Figure 44. Image of Original FlipBookit *(FlipBookit)*[301]

Independently, in Europe, a company called Officina K created the Giphoscope (Figure 45). The device is handmade by Alessandro Scali and Marco Calabrese using the finest of materials. Although achieving similar results as the FlipBookit, the Giphoscope is marketed, as the name suggests, for use of modern GIFs in the framework of a 19th-century device, offering a "unique and artistic way to bring a short digital video to analog life and create

[301] Accessed at: https://flipbookit.com/product/original-flipbookit/

a magical, perpetual emotion."[302] The transformation of an essentially digital work, the animated GIFs, into a real, manual object connects the short modern loops with the short animations of early devices, following the reverse path of the concrete animation concept but still keeping its haptic quality. The Italian duo offers custom-made Giphoscopes, collections containing public-domain works by Edison, Muybridge, and other loops, as well as contemporary artistic versions.

Figure 45. Giphoscope's Muybridge collection *(Giphoscope)*[303]

Both the FlipBookit and the Giphoscope are inspired by the mutoscope, as a type of cyclical flipbook. This divergence from traditional flipbooks and their linear structure ensures that the pieces presented in these new devices are much more intriguing, as their animated content never really end but rather loop. The rotating cycle is a characteristic of all these works, ranging from the art realm to DIY commercial initiatives that renew the early devices in contemporary times.

2.5 Conclusion

[302] As described on the Giphoscope website: http://www.giphoscope.com/giphoscope
[303] Accessed at: http://www.giphoscope.com/collections

These ingenious early devices that portray moving images have the power to entertain, leaving behind their essentially scientific origins as the century advances. Somehow, their accessibility to growing audiences and the fact that they were developed into toys for home use reinforced their potential for long term survival and renewed the interest of the public in their playful qualities. In the past, they helped bring movement into the limelight of the Victorian era yet in one way or another, never lost their ability to enchant audiences through time and are now being renewed and rediscovered in the contemporary era.

Other associations between past and present are present in the analogy of the content and structure of these early devices and the animated GIF files found on the Internet in abundance. Modern-day GIFs encompass the potential of the loop once used in optical devices. Furthermore, these simplified cyclical forms of contemporary animation reinforce the fact that there is a short narrative suggested in their content, often based on social, comic or satirical views that specifically exploit repetition as part of their popular success. GIFs use snippets of images from popular movie scenes, actors, politicians, artists, artworks, personal home videos, anecdotal or even embarrassing situations to express, in short repetitive actions, ideologies and themes of our time. Thus, in the case of animated GIFs, the present echoes the past, resuscitating core premises with the help of digital technology.

The most successful GIFs are still those that rely on the seamless cycle of the action, although absurdity of content reigns free. In some cases, the action may not end in the same place it started, but the discontinuity, reinforced by its endless repetition, can also create ironic, humorous, or dramatic effect in the Internet context. Influenced by the digital culture trend, software applications (apps) are created to enable users to create their own loop videos or remixes, such as the case of Vine, Giphy, and other software programs and apps. Phenakistoscope disks and zoetrope strips are also a form of reanimation when transformed into animated GIFs. In those cases, as a simple Google search helps to identify, the animation happens without the

mechanical flicker and probably leads to a more consistent and hence better perceptual experience, as the illusion of movement is enhanced by improved spatial registration and temporal consistency on a digital display than in their original form.

The artists, Makers, and creators featured in this chapter are representative of the people worldwide helping reanimate Victorian-era optical devices in contemporary times. In reconnecting past and present, each of these devices, as well as their corresponding reinventions, could have been the focus of an in-depth exploration. However, the intention of this chapter is instead to show the wide range of interpretations and explorations of human creativity in the past and today. The historical review in juxtaposition to contemporary artworks facilitates the basic understanding and functioning of those devices, preparing the reader for the following focus on the reinventions of the zoetrope and its theoretical background.

Chapter 3: A Particular Type of Animated Installation: Reinventions of the Zoetrope

Toys are not really as innocent as they look.
Toys and games are the prelude to serious ideas.
—Charles and Ray Eames

3.1 Introduction

This chapter presents two sections specifically related to contemporary as reinventions, reanimations of the zoetrope. The first concerns artists who work with large-scale installations. The second highlights artists whose creations have challenged and innovated the flicker and rotation from the classic zoetrope.

The selected artists whose works are investigated as case studies in this chapter are: Gregory Barsamian, Peter Hudson, and Eric Dyer from the United States; Kumi Yamashita, Toshio Iwai, and Ryusuke Ito from Japan; Mat Collishaw from Great Britain; and David Lawrey and Jaki Middleton from Australia. Parallel to the analysis of their artwork, comparisons and connections with the classic zoetrope and its historical characteristics are made.

The dichotomy between fine art and animation was a point of consideration in the author's discussions and interviews with some of the artists featured in this chapter. The majority of the artists exploring animated installations do not see themselves as or call themselves "animators," though for the author they are. Except for Eric Dyer and probably Alexandre Dubosc (discussed in Chapter 4), all the other artists have problems with the designation, primarily because of the historic connection of the term *animation* with cartoons, children's films, and commercial products. While its exploration is beyond the scope of this present research, the topic of the boundaries and role of animators can be an interesting source of future investigation.

The relevancy of this study is fortified by a growing exploration by artists of new artistic expressions relating to technology, digital or analog, in the search for viewer engagement in an expanded animation experience—recapitulating, as an experience that transcends space and time; an immersive experience that makes the viewer forget his or her surroundings and focus on the illusion of still objects endowed with life and movement, creating the "illusion of life," at least for a moment. The works analyzed here were selected based on their potential of having a tactile and aesthetic quality relating to animation, even when making use of digital technology. The technology employed by the selected artists should be regarded as a means and not as an end in itself. Some may ask why the need to expand the animation experience? For the author it is not a need but a phenomenon that is occurring and therefore requires study to help, in the words of Buckminster Fuller, "'humanity to synchronize its senses and its knowledge,"[304] making this experience an opportunity that can lead to new discoveries. Thus, for this author it is the combination of the astonishment triggered in the viewer's senses and the curiosity and wonder turned into knowledge that, in return, creates a cycle of discoveries when those senses and knowledge are synchronized—something that in the experience of the author is in place in the particular type of animated installation here investigated.

Another essential characteristic to be taken into consideration is that the selected animated installations can be considered as physical structures and objects that instigate creativity, the questioning of perception, thereby enhancing and transforming the space and the relationship with their audience in ways different from art installations that use moving image[305] and also from traditional animated films.

The early optical devices based on flicker and rotation from the proto-cinematic era are treated in this thesis as potent sources for new forms of animation and for new creations, aside from having already influenced on a

[304] Quoted in Youngblood, *Expanded Cinema*, p. 35.
[305] Such art installations are commonly screen based or rely or some kind of projection.

continuous basis animated films, animation performances, animated installations, optical illusions, magic shows, painting, advertising, education, and many other related fields. The historical context of these early devices is broad, and instead of categorizing them as museological curiosities, this study aims to portray them as a constantly renewed source of astonishment and wonder for generations since their invention. However, although sharing characteristics with cinema genealogy and even video game history, these early devices have their own peculiar lineage, and the particular type of animated installation investigated in this thesis can be seen and is treated here as their direct descendant.

3.2 Large-Scale Animated Installations

The works of the three contemporary artists analyzed in this section are connected through dreams, cycles, and their large proportions. Gregory Barsamian (1953-), Peter Hudson (1964-), and Mat Collishaw (1966-) make large-scale zoetropes with themes that relate to their personal views of human nature, using strobe lights to create the flickering effect that enables their creations to “come to life.”

The use of strobing lights to produce the flickering effect in adapted forms of zoetropes, thereby replacing their mechanical flickering slits, is a contemporary increment. A particular strategy shared by practically all the contemporary artists studied in this section is to adjust the strobe light flickering frequency in front of the public’s eyes until it reaches the point of flicker fusion. This process of adjusting the flickering rate is, for the author, an essential factor in eliciting wonder in the viewer. When the piece is spinning with regular room lighting switched on, the figures are blurred and indistinguishable. But when the strobe light is switched on, its frequency begins to adjust. This adjustment phase is key, despite being very fast, because it prepares the public for what is coming. Once the objects/characters start to be visible again and the viewer may think that the movement is already surprising enough, the flickering frequency of the light

reaches the flicker fusion point in association with the speed of revolution of the structure. Then, a small glitch happens, and the structure that was rotating in one direction magically “freezes” its rotation, causing only the objects/characters to be seen as moving. Before having time to reflect upon that glitch—or even consciously perceive it as it happens in a fraction of a second—viewers are surprised by the smooth movement as the objects/characters incredibly gain life before their eyes, at which point surprise and astonishment takes place. All of this happens in a matter of seconds, followed by the curiosity and wonder, the quest to understand how the effect is created. In some cases, the understanding of how the effect was created can lead to a second astonishment, and the brilliance and the simplicity of these artists’ solutions can be appreciated. In these cases, even when the viewer intellectually understands the phenomena in place, the impact of the piece does not necessarily diminish. The viewer enjoys watching it over and over, sometimes even willing to learn how this perception works, as a renewal of the philosophical toys.

Each of these artists has his own way of creating the flickering effect that will bring characters to life. In Barsamian’s case, the structure is always rotating; and when the room lighting is switched off, the strobe light is switched on, in continuous alternation. In Hudson’s case, he uses different techniques according to the requirements of the work. However, he is the only one of the three whose pieces are placed in the open air with the work remaining still until it is activated by human power, with the flickering subsequently activated once the structure reaches a certain rotational speed. In Collishaw’s case, the structure is also still and slowly starts to move with room lighting turned on, soon to be switched to the strobe light. This allows the piece to be appreciated in its still state and lets the viewer look at its details and imagine how it will soon move. The technique creates anticipation and expectation shortly to be surpassed by the piece’s surprising transformative motion.

In these installations, the short preparation before experiencing the actual illusion is essential in the creation of an impactful effect in the viewer, much like the early movie screenings presented by the Lumière brothers with their cinematograph. Gunning describes that in the latter case, the images were shown at the beginning of the screening as photographic stills that suddenly gained movement when the rotation of the crank in the cinematograph reached an imperceptible frame rate, which would lead to the sudden perception of the animation of the photographs, thus captivating the viewers as in this case, in Gunning's words, "the astonishment derives from a magical metamorphosis rather than a seamless reproduction of reality."[306] Thus, the viewers by their witness, even experience, shockingly so, the sudden endowing with motion and life by this new machine.[307] This trick is similar to the *techniques of disorientation* used by magicians in their shows to distract the public's attention from where the "magic" is happening. These contemporary artists deliberately explore these techniques to engage their viewers.

The public never seems to tire of strobe light zoetropes, resulting in an increased viewer attention span for these types of pieces, no matter where they are exhibited, in art galleries, museums, science centers, theme parks, or other public spaces. The relevancy of this lies in the fact that attention is becoming an increasingly important commodity. The longer a viewer stays to enjoy an artwork, the longer the memories will last, and the chances for the experience being shared and recommended increase as well. Therefore, an animated installation using a large zoetrope structure is practically a guaranteed source of public success, which can easily be transformed into high rates of attention and attendance along with greater revenue for the places in which they are presented. Thus, the practical implications of astonishment and wonder not only relate to the promotion of a unique experience for viewers but can also be good for business. An example is Barsamian's *Feral Fount,* installed at the Museum of the Moving Image in

[306] Gunning, "An Aesthetic of Astonishment," p. 118.
[307] Ibid.

New York, that keeps bringing viewers back, as recurrent references on the Internet and social media confirm.

Factors involved in the creation of astonishment and wonder through these works are related, but not limited, to: the live experience; the three-dimensional quality of the sculpted figures; the absence of slits that normally create a separate space between the animated images and the viewer; the animated movement of solid objects that seems to combine dream and reality; and their repeating action. Today, the relatively new trend of "selfie," fueled by the urge to capture every moment one experiences on camera, the ubiquity of cell phones and the easy manipulation of their cameras have facilitated this need to register every new experience, which is also revealed when encountering live animated installations. However, these particular animated installations defy easy recording. Recording cameras have their own frame rate and shutter speed—imperceptible to human eyes—that make it hard to film the installations as they flicker. This limitation inadvertently invites the viewer to instead live the moment, the live experience, as its recorded version will not be the same. In professional cameras, an adjustment is possible to film them, but as film recordings can be manipulated through editing and special effects, these professional films, despite being impressive, also partially lose their intensity and consequently lessen the wow effects experienced live. Living in the moment and seeing with one's own eyes are still primary experiences of the individual that contribute to the wondrous impact of the animated installation.

Furthermore, the sequentially sculpted figures in their concrete physical presence as three-dimensional objects, when combined with the strobe light flickering effect, evoke the common childhood dream of one's puppets and dolls coming to life to play. In fact, this shared dream was the premise of many live-action and animated films, including the blockbuster movie *Toy Story* and its sequels. In the case of this Pixar studio production, the theme of the movie and its success justified interest in creating the studio's own three-dimensional zoetrope portraying the movie characters as coming

“alive” in a real space. The zoetrope was created specifically for the Pixar exhibition that toured the world. It is now displayed at Disneyland (Anaheim and Hong Kong) and was clearly inspired by the pioneering works of Barsamian and Iwai,[308] although these artists were not officially credited.

Three-dimensional figures are more easily sculpted today with the help of 3D-printing technology. However, of the three artists whose works are analyzed in this section, only Collishaw has used this new technology. Barsamian and Hudson still use traditional craft techniques for molding and casting their sequential characters. Whichever process was used to create the sculptures in their animated installations, the fact that they are concrete and tangible forms adds materiality to the work of all three, as examples of concrete animation. Beyond that, this materiality, when associated with the live experience of the characters’ movement, underlines characteristics that cinema generally lacks, namely, the physical presence of the object and its animated existence at the moment that the viewer witnesses its action takes place. The repetition of the action is also important since it gives time for the viewer to understand the movement and appreciate its nuances. The effect is so wondrous that the viewer may be afraid of not being able to absorb it, and this can also be related to the potentiality of being a live experience.

In their works, a contradiction is established by using an early device usually considered a children’s toy as an artistic tool to express bizarre and sometimes violent actions. The loop can reinforce the brutal and ignoble trap in which the characters are arrested, reflecting the worst of human nature. The conflict between the disgust and the fascination of seeing objects come to life*,* only later to perceive that they portray violent actions, may shock the

[308] An important note is due here: Barsamian and Iwai are pioneers in the use of strobe light zoetropes with three-dimensional figures. Barsamian, since the 1980s, works with this type of animated installation, including his large piece *Feral Fount* (1996), part of the permanent collection of the Museum of the Moving Image in New York, as well as many other works in museums and private collections around the world. In 2000, Iwai created a piece for the Miyazaki Studio portraying its Totoro character that was installed in the Studio Ghibli Museum in Japan. The Pixar Studio piece was undoubtedly inspired by both these artworks, although they were not publicly credited—apparently this is a Disney company policy. Iwai mentioned to the author in an interview that he was only credited when the piece was shown in Japan.

viewer. Although each of these artists has different motivations, they all share their reinvention of the zoetrope as a large-scale artistic installation and in highly intellectual and conceptually complex ways, generally for an adult audience.

According to David Rockwell and Bruce Mau in their book *Spectacle,*[309] there are a few types of events that can change human perspective because of their larger-than-life characteristics, scale being one of the principal characteristics. In the case of the zoetropes analyzed here, their size will play a major role in the elicitation of astonishment in their viewers. Some of these animated installations, due to their scale, also lose the manipulation aspect typical of early optical toys, transforming the user into solely viewer. In the early optical devices, the viewer is also user, playing and even assuming the role of the fairground lecturer, as these toys were made for home entertainment. Yet, in these specific large-scale animated installations, their immense size provides an alternative to the lack of direct interactivity, promoting a shift between "the modes of looking and models of spectatorship," [310] as Meredith Bak explains in her article "Grand-Illusions: Large-Scale Optical Toys and Scientific Spectacle." The viewer of these contemporary pieces is free to walk around and consciously enjoy them while in a state of wonder, not lost in any suspension of disbelief.

Nonetheless, this apparent loss of direct, intimate, personal interaction is not the case of all the large-scale animated installations. Peter Hudson's work challenges this characteristic and tries to keep the user role alive in the manual operation of his larger-than-life zoetropes.

For artists such as Barsamian and Collishaw, technology plays a major role in facilitating the relationship with the viewer. In environments like museums, sometimes even galleries, and places where outreach to a larger number of people is common, there is a need for planning the encounter of the public with the artwork and how they will experience it. Proximity sensors can

[309] David Rockwell and Bruce Mau. *Spectacle.* London: Phaidon, 2006.
[310] Bak, "Grand Illusions," p. 253.

activate setups when the public approaches a piece, or the installation can be running nonstop with a timer that alternates between the strobe light and the room lighting. Hudson's case will be different because his pieces are presented almost as performances, in open-air spaces, during a specific and limited period of time.

This technological preparation phase is necessary to plan the interaction with a large number of people, discarding the need of narrator at hand beside the piece, as once happened at the fairground or even in home use of the early optical toys. Another characteristic of the contemporary counterpart to the early optical devices is that today's viewer plays a more active role in the interpretation of what he or she is seeing. Set free from the lecturer or minstrel figure, the public can engage and interpret their own astonishment turned wonder spectrum, and even share comments and impressions among friends and strangers.

Bak recognizes that optical toys are living a "robust resurgence of interest"[311] in recent decades. Focusing specifically on large-scale contemporary zoetropes, she argues that the scale factor is essential in justifying the success of their current renewal, which resonates with the uniqueness of the larger-than-life spectacle, as proposed by Rockwell and Mau. Barsamian, Hudson, and Collishaw challenge themselves when creating large pieces to be experienced live by viewers. The colossal quality of these reanimations of the zoetrope in contemporary times goes against the trend of miniaturization found in digital technology, as Bak points out.[312]

For George Griffin, the complexity and cumbersomeness of works like Barsamian's reveal these artists as "architects of animation."[313] In times when experiences are becoming increasingly virtual and manual skills and craft are increasingly rare, these works are going in the opposite direction of the tendencies of a digital technological dematerialization, and this is

[311] Ibid., p. 252.
[312] Ibid., p. 253.
[313] Griffin, "Concrete Animation," p. 269. Accessed at: http://anm.sagepub.com/cgi/content/abstract/2/3/259

therefore one more reason behind their astonishing and wondrous effects. As the author defined them in the Introduction and Chapter 1, the “solicitation of the viewer’s curiosity”[314] is the appeal to astonish, and the “brief moment of revelation”[315] of the attraction is its transposition to wonder. Aiding in this process, the short actions represented in the animated installations are constantly repeated in a loop to fulfill the viewer’s need to study it, and upon gradually understanding their own perceptions, enjoy it again and again.

The repetition of the cyclical movement has a different resonance with the viewer after the first time he or she encounters the toy or the installation, although enjoyment continues in observing the repetition of the loop action. Although the characters’ action is repeated, we as the spectators have changed between that first encounter and subsequent repetitions. We have crossed the point of no return, and regarding our individual experience, the cycle conceptually and experientially becomes a spiral. Our emotion may seem to move in circles, but the point of origin and its apparent end point are far apart, creating a spiral of time changes in our temporal experience. We may be seeing the “same” objects, but we are not the same anymore. This transformation happens in many spheres of human experience, including here in the case of the large-scale animated installation.

3.2.1 Wondrous Dreams: The Pioneering Work of Gregory Barsamian

Books flip themselves to reveal lizards or even a truck comes out of its pages. Hands browse, shake, wash, or try to grab things that will soon disappear or melt. Paper becomes human hearts, soon to transform into birds. Cherubim mutate into helicopters, while phalli become airplanes. Objects are thrown out of photographs and become real matter in a three-dimensional space. On the Brooklyn side of the East River, an artist working with heavy machinery is creating a dreamlike atmosphere with his wondrous animated installations.

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[314] Tom Gunning, "An Aesthetic of Astonishment,” p. 123.
[315] Ibid.

The play between objects apparently unrelated composes fragments of the juxtapositions created by Gregory Barsamian as he tries to make connections with his subconscious mind through his dreams.[316] The creative techniques of the Surrealists are another source of inspiration for the artist, as they claimed that the association of dissociated imagery could lead to inventive and original connections, stimulating new ideas and potentially setting creativity free. For Barsamian, as for the Surrealists, the isolated objects that make up his installations are not supposed to be analyzed separately. Their coherence, or incoherence, lies in the whole, and this whole is subject to the experiences and interpretations of the viewers. For him, art is a dialogue.[317] What the artwork suggests is transformed by the viewer, who in turn may be transformed by the artwork. The uncanny impression that the animation is happening before the viewer's eyes makes the boundaries between dream and reality even narrower.

For this author, the Armenian-American artist Gregory Barsamian[318] could be referred to as the *sculptor of time*,[319] as his creations transform the time perceived into time performed, expanding the viewer's idea of time itself. Based on the principles of the zoetrope, his creations are powered by an engine, presenting a transformation cycle of physical, sequential sculpted objects rather than of drawings. The entire structure is synchronized with a strobe light that produces a flickering effect. The strobe light seems to "freeze" the rotation of the structure when achieving the flicker fusion point, enabling only the sculpted objects to be perceived as animated. In other words, the perceived motion is an illusion, while the real rotational movement of the piece becomes invisible. In terms of the subjective experience elicited, the illusionistic movement of concrete sculpted objects in space gives the impression to the viewer that time stops, as an intuitive feeling, reinforcing to Barsamian's title, given by this author, of sculptor of time. The emotional

[316] For more than 20 years Barsamian has been recording his dreams, and they have become his main creative source.
[317] The author interviewed Gregory Barsamian in his studio in Brooklyn on June 25, 2014.
[318] Barsamian was born in Chicago, Illinois, in 1953. He is currently based in Brooklyn, New York.
[319] A title in film given to the Soviet filmmaker Andrei Tarkovsky.

perception of the experience defies logic, stimulating the senses at different levels. Psychological scientists Melanie Rudd, Jennifer Asker, and Kathleen Vohs have discovered that being in a state of awe modifies the subjective experience of time.[320] It is exactly that subjective experience of time that occurs when experiencing Barsamian's pieces, as many other animated installations that inspire similar effects.

With a wide range of works that are categorized in this thesis as animated installations, Barsamian's artistic practice[321] can be divided into two major categories: peep devices and dark room sculptures. This division can also be interpreted as the artist transitioning between the art object and the art installation. As peep devices, his works can vary from gigantic, such as the large head from *Artifact* (2010), commissioned by the Museum of Old and New Art (MONA) [322] in Tasmania, to small, such as the *Fan* (1990), *Narsisyphus* (1990), *Phone Pit* (1990), *Night of the Audile* (1993-1994), *The Runner* (2008), *Drum 52* (2013), and *Dryer* (2013). Many of these works are conceived from scrap machinery, like a dryer, a used oil drum, and other objects that become repurposed.

The dark room sculptures, as the name suggests, depend on a dark environment for their illusion to be better perceived, which contributes to enhancing their dreamlike atmosphere. They also vary in size, although they are still significantly larger than the small[323] peeping objects. The dark room sculptures represent two-thirds of Barsamian's artistic production. The works discussed here were selected based on his large-scale pieces and their availability to the public.[324]

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[320] Melanie Rudd, Jennifer Asker, and Kathleen Vohs. "Awe Expands People's Perception of Time, Alters Decision Making, and Enhances Well-Being." *Psychological Science* 23, no. 10 (2012). Available online: http://www.bauer.uh.edu/mrrudd/download/AweExpandsTimeAvailability.pdf

[321] The majority of Barsamian's works can be accessed via his website: http://gregorybarsamian.com/archive/index.html

[322] MONA website: https://mona.net.au/museum

[323] The author, when calling an object "small," is referring to an object at the household-level scale, such as a fan, a turntable, a lamp, and so on, and not on a minuscule scale.

[324] In other words, works from the artist's collection are not being considered except when justified.

Psychological studies indicate that the act of recounting dreams helps humans make sense of them.[325] Although Barsamian claims he does not like artworks that are overtly personal, by using his dreams he is—consciously or unconsciously—attempting to create coherence for himself, and by sharing them with the public, he seems to hope to touch universal truths and questions common to every human being. These questions gravitate to the realm of life and death, routine repetition, and the search for purpose in life, which make his work accessible to different cultures and explain his appeal among viewers from all over the world.

Death is a presence and constant reminder in Barsamian's work. His 2013 exhibition *Memento Mori,*[326] which in Latin means "remember you must die," captured the fleeting nature of time, while the repetitive action underscored the pace of time and our being trapped in a loop, just as his characters are. If the skull was the memento mori of a well-educated man during the 17th century, in Barsamian's work the repetition of the cycles is our current reminder of time's dissipation.

Varying from the circular cage to the cylindrical structure, his installations make use of the spiral in an attempt to enlarge time and be able to portray a longer "story." Barsamian, in fact, stated in an interview: "I'm restricted by the fact that my timeline has to occur within one revolution of a cylinder. If I could make one a city block long, I'd have a 10-second film, maybe even a minute."[327] The connections between time and space become evident in his work, where the expansion of space literally means an expansion of time, which in turn explains the choice of large-scale representations in the majority of his pieces. The supporting vertical structure of the cylinder is embraced by a spiral that connects the cycles to one another. Through this structure the artist can trick the viewer's perception and create cycles that

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[325] Roger C. Schank, *Tell Me a Story: Narrative and Intelligence* (Evanston, Ill.: Northwestern University Press, 2000), p. 135.
[326] More information about the exhibit is available online: http://woodstreetgalleries.org/portfolio-view/gregory-barsamians-installation/
[327] Quoted in Kurt Shaw, "Kinetic Sculptures Whirl into Three-Dimensional Animations," *Pittsburgh Tribune-Review*, June 22, 2003, pp. C1, C4. Available online: http://woodstreetgalleries.org/wp-content/themes/neon/press/press_img/about_time/trib.pdf

are seen as consecutive actions in both the horizontal and vertical axes. Barsamian uses metamorphosis of one object into another to associate the spiral and his objects.

Transfigurations (1992) (Figure 46) is the first of Barsamian's animated installations to portray a complete spiral structure where objects seem to interact with one another. From this creation onward, he will call the metamorphosis of his objects "transfigurations," and that structure will become his trademark. In this 1992 work, a book falls and while descending is transformed into a dead bird, but before reaching a basket on the floor, the bird is turned into a paper ball. As in the classic zoetrope, the action is multiplied and seems to be happening simultaneously at each vertical section of its wire-frame armature. In Barsamian's case, his work adds a new illusion: Because at every revolution the cycle of movement is complete, it gives the impression that a new book is thrown away, which will become a new bird, which will become another paper ball that will eventually fill the basket, as the action is repeated over and over. And, if repetition for us can be associated with quantity, Barsamian's basket is never full, once more forcing us to confront what we know and what we see.

Figure 46. Gregory Barsamian, ***Transfigurations,*** **1992** ***(Courtesy of the artist)***

In *Leçon sur l'herbe* (1994) (Figure 47), Barsamian uses in a new way an element that was present in his early works, the animated photograph. As in a flipbook, the flat animated images play a supporting role in relation to the main action of the sequential animated sculptures, except that in this case, the images are not flipped but animated by the strobe light, while the actual volume of the objects is what elicits their physicality, their tactility. In this work, an action in the photograph triggers the three-dimensional movement, a displacement that connects different spaces and suggests the influence of outer space on an inner space: A framed photograph shows a man in a park with a group of children. He takes a white dove out of a basket and throws the bird out of the photo frame, like a magician. The dove then becomes one of Barsamian's sculptures, and it metamorphoses itself into a pair of flying hands. The hands close, and when they open again, out of them appear a kind of fruit that floats upward. The cycle continues.

Figure 47. Gregory Barsamian, ***Leçon sur l'herbe,*** **1994** ***(Courtesy of the artist)***

This is the first of Barsamian's pieces to portray the bird as alive;[328] earlier works such as *Narsisyphus* (1990) and *Transfigurations* (1992) having featured a dead bird. The bird was also part of Étienne-Jules Marey's investigations in the late 19th and early 20th centuries, when he used his

[328] Maybe because the work is part of the Creative Museum's Discovery collection in Chattanooga, Tennessee, a family museum with many activities aimed at children.

photographic gun to capture the movement of birds in flight, trying to fragment the action to understand better the phases that compose the whole. In Barsamian's case, he is using sculptures of these fragmented phases of a bird's flight to create the illusion of a whole movement, his own imaginary bird flying. Thus, what science requires to be investigated in detail (the fragmentation of the movement), art transforms and integrates to create a rich emotional and intellectual experience (a seamless movement of a flying bird).

The white dove is conventionally interpreted as a symbol of peace, as well as being associated with magic and freedom. The connection between the bird's wings and hands reinforces the idea of the sculptor's hands as magical instruments of his freedom through art. The hands in Barsamian's work will also have an important role, as they are not only molded by the artist's hands but are also replicas of his own hands, constant reminders of the craft process they create and represent.

Feral Fount (1996)[329] (Figures 48 and 49) was commissioned by the American Museum of the Moving Image in New York for its collection. Aside from the mesmerizing movement and metamorphosis peculiar to Barsamian's pieces, the particularly remarkable characteristic of *Feral Fount* is the use of the *movement of translation,* as described by Dr. Carpenter in the 19th century and referenced in Chapter 2. This movement corresponds to the number of "drawings" in relation to slits: Fewer drawings than slits will propel the movement forward; more drawings than slits will have the contrary effect.

Before exploring the movement of translation that the piece represents, a few relevant details about the piece need to be shared. *Feral Fount* consists of 97 sculptures distributed in a cylindrical steel framework that measures 2.4 meters (nearly 8 feet) high and 1.2 meters (4 feet) wide. A strobe light flashes 13 times per second, while the piece rotates at 50 rpm. The movement of translation in the piece is quite discreet but extremely effective and only occurs at the end of the vertical cycle.

[329] *Feral Fount* is precisely the piece that the author experienced live and consequently inspired this research.

The piece shows a dripping tap whose water drop turns into a bomb that melts while slipping through the fingers of a hand, its resulting mass transformed into paper, which folds itself into a paper plane, flying forward and hitting a plate that breaks inside a dishpan. The paper plane accelerates forward to create momentum before hitting the plate, which clearly indicates that the cycle of the paper plane is shorter than those of the other objects, as predicted by Carpenter in his 19th-century article. Even if the idea of a paper plane being capable of breaking a plate seems preposterous, the movement is convincing, and that is all that matters for the brain to accept it.

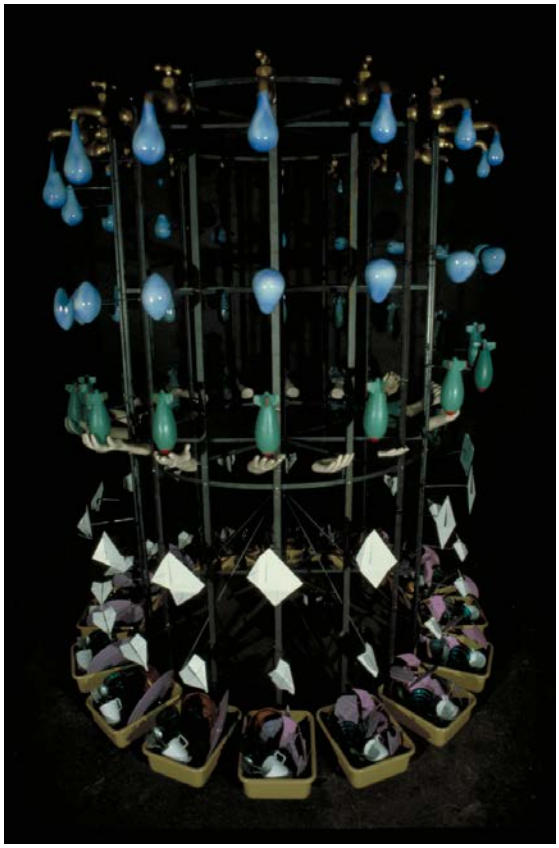

Figure 48. Gregory Barsamian, *Feral Fount,* 1996: overall view *(Courtesy of the artist)*

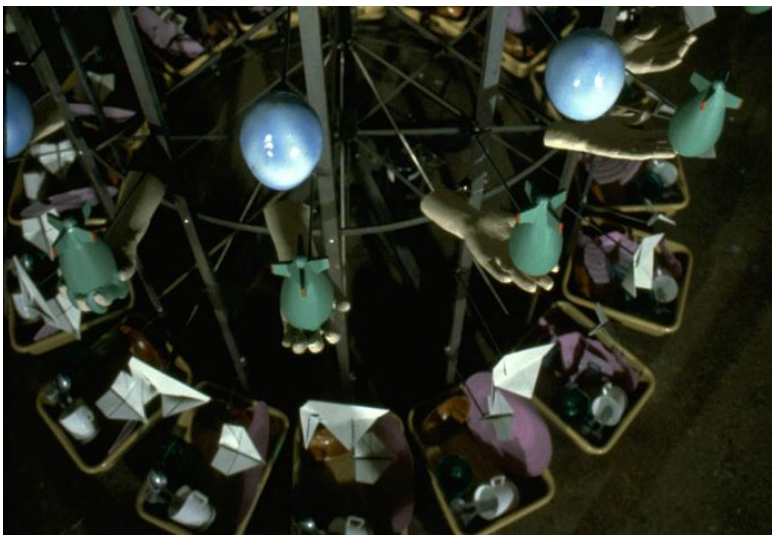

Figure 49. Gregory Barsamian, *Feral Fount,* 1996: detail *(Courtesy of the artist)*

As mentioned, Barsamian uses the spiral structure[330] to create his animated sculptures. However, the workings are more complex, as the spiral implies at

[330] Some of Barsamian's circular cycle installations, including *Putti* (1991), *Shuttlecock* (1991), and *Forty* (1993), are placed high in the gallery ceiling with the viewer free to walk below them and appreciate the incidental moving shadows cast by the moving objects on the walls. Other circular cycle installations are placed on the ground, and their smaller scale allows people to walk around them, depending on the setup of the gallery, as is the case of

least two different actions: one related to the individual cycle of each object, which is essentially circular, and another related to the vertical cycle of the different objects, which constructs short narratives in combination with its different layers. Although in the classic zoetrope—whose structure is essentially horizontal— the first image must be a continuation of the last for the loop to convey smooth continuity, this premise does not necessarily apply to animated installations, particularly when using a spiral structure. The vertical cycle of the combined objects seems to continually generate new elements—like water dripping from a faucet, in the case of *Feral Fount*—following the canon of gravitational force, with its action happening from top to bottom. The apparent end of the vertical cycle happens when the paper plane breaks the dish, immediately after which the dish is reassembled and is ready to be broken again. So, what would be seen as a strange cycle in the zoetrope does not seem to bother the viewer of the animated installation because the combination of objects gains different meanings in the layered spiral structure proposed by Barsamian.

The *Juggler* (1997) (Figure 50) is the largest animated installation created by Barsamian to date, boasting a height of 4 meters (more than 13 feet) and presenting life-size wireframe orange men. It was specially commissioned by the ICC (InterCommunication Center) in Japan. In the *Juggler*s case, the spiral structure becomes even more complex as it includes objects that simultaneously go up and down. The cycle is completed by the figure of the juggler.

The Scream (1998) and *Five Stages of a Grief* (2008). As these works represent smaller scale works they are not studied here.

Figure 50. Gregory Barsamian, *The Juggler,* 1997: partial view *(Courtesy of the artist)*

For safety reasons, Barsamian's large-scale works are confined to a corner with protective bars to avoid people getting too close. Indeed, the effect can be so mesmerizing that such measures are necessary to restrain the urge to touch and to protect the viewer from a violent shock with reality. This raises the issue of how fundamentally different these installations experienced on such large scale are from the optical toys that inspired them. In addition, the animated large scale characters (like automatons) allow the viewer to expand their experience of animation as they now cannot control their movement as happens in an optical toy, but are left to marvel at the movement and replication of life they suggest, which adds a magical and oneiric aspect to the work.

Charlie Chaplin, in the movie *Modern Times* (1936), sets up his iconic character, the Little Tramp, to confront the most dehumanizing situations in capitalist society, where the human becomes a cog in an assembly line system of production, the consequence of a modern society based on productivity. As a combination of *Modern Times* with a Rube Goldberg[331]

[331] Rube (Reuben Garrett Lucius) Goldberg (1883-1970) was a cartoonist and inventor who became famous for creating a cartoon series representing intricate and complicated gadgets to perform the simplest tasks. His name became synonymous with these crazy types of machines, which many people tried to re-create in real life with physical objects. The most contemporary and advanced examples of this would be the video clips of the music band OK Go!

structure, *Phaeno Museum* (2005) (Figures 51 and 52), commissioned by the Phaeno Science Center in Germany, makes reference to those machines that keep repeating simple tasks nonstop.

Figure 51. Gregory Barsamian, *Phaeno Museum,* 2005: overall view *(Courtesy of the artist)*

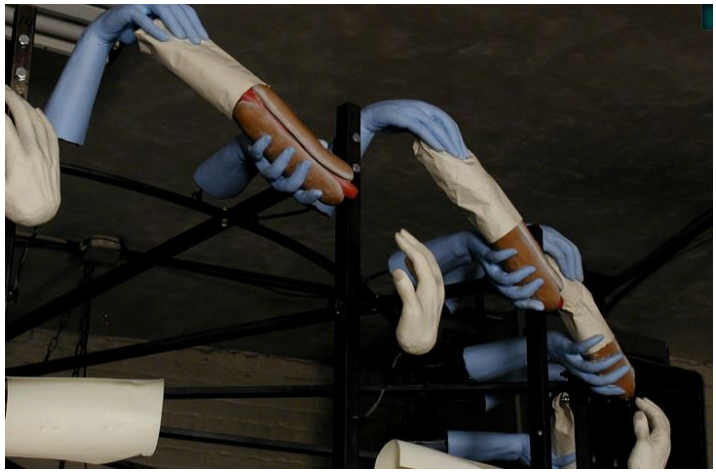

Figure 52. Gregory Barsamian, *Phaeno Museum,* 2005: detail *(Courtesy of the artist)*

The piece shows a pair of hands efficiently working: One hand holds a hot dog that has just been wrapped, while the other hand unwraps it, throwing the paper away. The falling paper crushes itself while plunging toward the floor. Before hitting the floor, it transforms into a rose that starts to decay, while next to the rose there is a torn newspaper portraying a man trying to protect himself from the falling object. On the floor beside the decaying rose there is a canister that spills white ink. The ink blob rises up, transforming itself into an egg. The egg hatches a hand that tries to grab the hot dog and is transformed into its wrapping paper, soon to be thrown away to start the cycle again. In this piece, the end of the cycle that goes down is different from the beginning of the cycle that goes up, with nothing to connect both, as was the case in the *Juggler*.

Artifact (2010) (Figure 53), meanwhile, falls in the category of Barsamian's large-scale peep devices and consists of a gigantic metal head lying down,

ear to the floor, with holes to peer inside on the top of the head and on the forehead. The head of the piece is its own cloister, which helps create the darkened sealed space needed for the strobe lights to create their flicker effect and, at the same time, allows for the piece to be displayed in an illuminated environment without compromising the animation. When the strobe light is lit inside the head, as viewed from outside the work, light rays gently reveal the pieces that form the head like a metal patchwork. The animation exposes some recurrent elements of his works—a book, a head, and birds—jumbled among distorted metal rods. In this supposedly chaotic structure nests an extremely organized sequence and helps hide some of Barsamian's tricks.

Figure 53. Gregory Barsamian, *Artifact,* 2010 *(Courtesy of the artist)*

Barsamian's commissioned pieces, particularly those commissioned by family-oriented museums or science centers, have a tendency to portray lighter subjects suitable to their general public. Other smaller works created by the artist that are still part of his personal collection or were acquired by private collectors often present darker themes, including *Cake Walk* (1997),

Coprophagia (1991), *Shuttlecock* (1991), *No, Never Alone* (1997), and *Untitled* (2000). Among these, *Cake Walk* (Figure 54), despite being a small-scale work, it deserves particular reference as this is the first and only time in Barsamian's work that only part of the structure is animated.

The piece is a birthday cake missing a single slice (Figure 66). In its place, pages are being flipped, and a little human figure comes out from the cake to be hit by the pages, from which a truck cutout can be seen approaching. A new man continues to come out after the first one is hit. The cake hides the multiplicity of actions, and the slice allows only one complete scene to be seen. Just like Reynaud and how his investigations led him to isolate the animated image and develop later his Théâtre Optique, Barsamian is exploring and pushing the boundaries of his own creations.

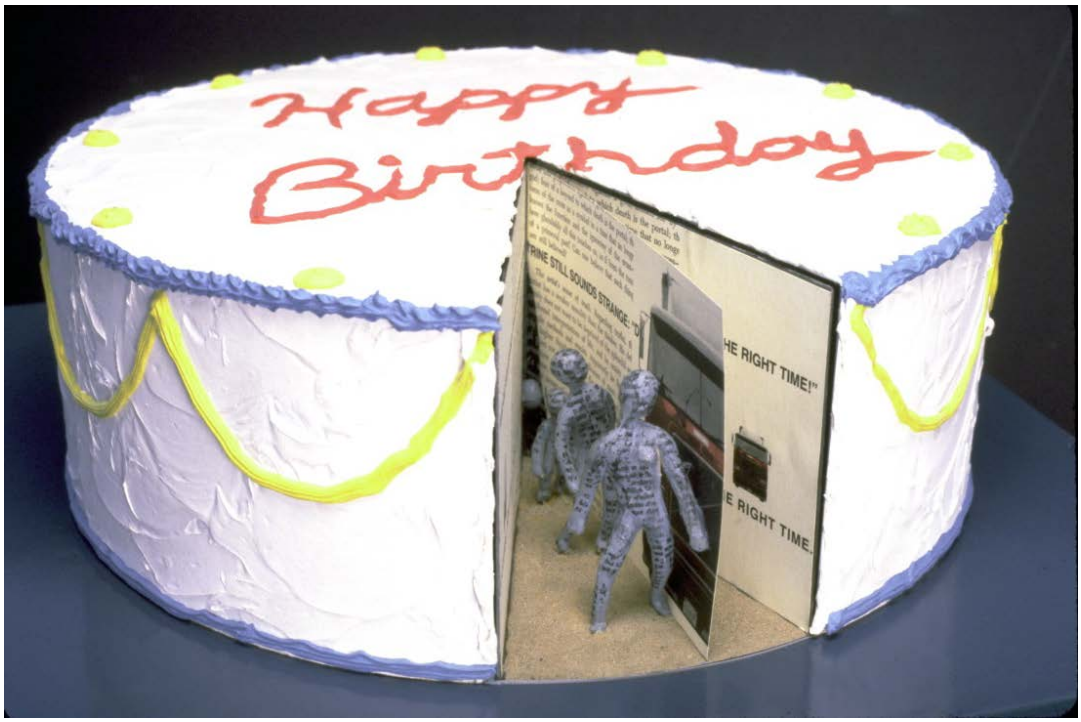

Figure 54. Gregory Barsamian, ***Cake Walk,*** **1997** ***(From Suzanne Buchan, "Extracinematic Animation: Gregory Barsamian in Conversation with Suzanne Buchan")***

The *Cake Walk* title has different meanings that range from a dance style of the 19th century to modern slang for something that is ridiculously easy. Yet, far from easy to make, Barsamian's astonishing pieces are the result of calculated craft, done in old-school style, the product of the artist's hands, essentially without a computer. Barsamian proves that the old can be new again. In renovating his formulas, the artist proposes new solutions to deal

with the repetition and the limitations of the cycle, something not achieved in an early optical toy, except for Reynaud's later explorations that can be more related to animated installations than with the philosophical toys per se.

With the content and inspiration of his animations coming from his dreams the artist invites the viewers to create free associations between the animated objects displayed. As Ellen J. Keiter and Jean-Paul Maitinsky refer in their essay about the artist "viewing Barsamian's animated sculptures is a magical experience, as difficult to put into words as describing a vivid dream. While Barsamian is willing to share his working method with his audience, he won't reveal the meaning behind it."[332] Many times, their illusion of life and movement can be more mesmerizing and intriguing than their actual content.

3.2.2 Going Low-Tech and Collaborative: The Giant Animated Installations of Peter Hudson

On the west coast of the United States, another American-born artist is giving a "new spin to an old art."[333] The year 2000 marks the debut of Peter Hudson's life-size, site-specific art installation at Burning Man,[334] opening the path to the giant animated installations that are now his trademark. To better understand his work, therefore, it is necessary to understand what Burning Man represents and its impact.

Burning Man is a one-week anti-consumerism communal-experiment event held once a year in the Nevada desert. Despite much controversy, the festival has grown from its humble origins as a kind of "beach party" into a temporary community of more than 67,000 "citizens" in 2016[335] known as Black Rock City, a town that rises for the event and vanishes when it is over. The inhospitable landscape, far enough from civilization and lacking

[332] Gregory Barsamian, "Dreamscape: Five Animated Sculptures by Gregory Barsamian" (New York: The Hudson River Museum, 2001), p. 5.
[333] Phrasing used in the title of an NBC Bay Area interview with Peter Hudson. Accessed at: http://www.nbcbayarea.com/news/local/San-Francisco-Artist-Puts-a-New-Spin-on-Old-Art-287297411.html
[334] More information about the Burning Man can be accessed at: http://burningman.org
[335] Numbers for the 2017 festival were not available at the time of this writing.

infrastructure, forces event-goers to prepare in advance for the experience. There, cell phones do not work, and commercial transactions [336] are prohibited since gifting and sharing are the essence of this community experience. People help and look out for one another, but most important of all, they are free to express themselves in any way they want. To ensure this mindset is understood and maintained, the founders [337] of the festival established 10 principles[338] as the philosophical center of the festival: radical inclusion (anyone is welcome), gifting, decommodification (no commercial transactions or sponsorships), radical self-reliance, radical self-expression, communal effort, civic responsibility, leaving no trace (ecological footprint), participation, and immediacy (live the moment).

As Rachel Bowditch mentions in her book about the event, the festival aims to recover instinct as a "reaction against mainstream values and beliefs,"[339] aspiring to celebrate life in a truly collaborative environment where art and self-expression are essential to transformative participation. For these reasons, at the end of the festival, a giant sculpture of a man is burned, followed the next day by the burning of the Temple—a temporary structure representing the spiritual heart of the event, unattached to any particular religion but welcoming all—symbolizing a rite of passage, in this case, the closure of the festival and the start of the exodus.[340]

The event clearly shares ideals with the counterculture movement of the 1960s. The revision of values brought about by the counterculture in the United States helped advance cultural and social transformations through its antiwar protests; calls for civil, racial, and gender equality; sexual revolution;

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[336] With the exception of the price of the ticket, which can only be bought in advance, and the sale of ice.
[337] Founders Larry Harvey, Harley Dubois, Marian Goodell, Michael Mikel, Will Roger Peterson, and Crimson Rose collaboratively ran the festival from 1998 to 2013.
[338] For more information, see: http://burningman.org/culture/philosophical-center/10-principles/
[339] Rachel Bowditch, *On the Edge of Utopia: Performance and Ritual at Burning Man* (London and New York: Seagull Books, 2010), p. 5.
[340] So designated by the organizers and participants of the event, it marks the moment when everybody starts to leave the desert. It is expected that after living in an alternative community for a week, each member will treasure and honor the experience by multiplying its learning in the outside world.

experimentation with psychedelic drugs, music and fashion; environmental awareness; and many other causes and activities that spread all over the world. It was a period that helped catalyze change and shaped a new era in every sector of society.

Around that time, the avant-garde movement in the arts grew stronger, inspired by the European artistic avant-garde of the 1920s. Different artists experimented with new artistic possibilities in search of meaningful ways to express their vision. Collaborative and creative exchanges were frequent among them, while intellectual and artistic freedom was their choice. The U.S. West Coast, particularly San Francisco and the Bay area, welcomed these expressions and provided not only a rich experimental art scene but also an audience avid for these experiences. The artists explored and integrated different fields in search of a way to better express their individual worldview.

It is easy to assume that the post-counterculture artistic environment of the West Coast influenced Peter Hudson, a San Francisco-based artist who was born in Oakland in 1964. Before exploring life-size animated installations, Hudson's experience included the roles of stagehand, set designer, art director, and stage carpenter for the San Francisco Opera. Skilled in lifecasting[341] and particularly moved by his experience at Burning Man in 1999, which he called "life-changing,"[342] he decided to contribute a site-specific installation to the community in 2000.

With a team of eight to nine people, he created *Playa Swimmers* (2000) (Figure 55). Playa is a dried lakebed where the majority of the artworks at Burning Man are displayed. Inspired by the site's remote past, Hudson decided to create his piece using lifecast sculptures buried in the ground of people in swimming poses. His first artistic intervention at the Burning Man Festival, although suggesting movement, was not animated but established a

[341] Lifecasting, according to the *Oxford English Dictionary*, is "the practice of making a mould of a living body in order to create a three-dimensional representation of the subject."

[342] As stated in an interview by Renea Roberts, included in her documentary *Gifting It: A Burning Embrace of Gifting Economy* (2002). Excerpt available at: http://hudzo.com/zoetrope/other-works/

marker from which his subsequent works can be considered an evolution of the same concept. As every year Burning Man has a different theme, Hudson's work was related to the event's theme for that year, "The Body."

Figure 55. Peter Hudson, *Playa Swimmers,* 2000 *(Courtesy of the artist)*

In 2002, Hudson created *Sisyphish* for Burning Man, whose theme that year was "The Floating World." As an extension of his 2000 work, he presented 20 plaster-cast human sculptures of swimmers (half-torso) placed on a rotating circular platform, like a turntable, with a diameter of 4 meters (13 feet) (Figure 56). As the sculptures were sequentially distributed in representation of phases of the front crawl swimming stroke, with the use of a strobe light[343] his swimmers gained life at nightfall. Hudson's first animated installation played with the myth of Sisyphus, with characters swimming concentrically outward from the center of the structure as if trying to find their way out but never succeeding. The entire structure was pedal-powered, and participants had to crank the pedal to make the platform rotate and switch the strobe lights on. A curious fact about this piece is that each body of the sequence of

[343] The author interviewed the artist via Skype on November 4, 2016. At that time, Hudson explained that his choice to start working with three-dimensional strobe light zoetropes was inspired by his experience of a similar type of zoetrope displayed at the Blue Man Group show. A recent version of this zoetrope, portraying dancing men, can be seen at the end of the following video: https://www.youtube.com/watch?hl=en-GB&gl=SG&v=W-yLfm5HsHc

swimmers was cast on the bodies of different actual people of completely different sizes.[344] When the piece starts to rotate, the brain fills the gaps and the different shapes are seen as a continuous, moving ensemble, a collective body.

Figure 56. Peter Hudson, *Sisyphish,* 2002 *(Courtesy of the artist)*

Hudson's work, like Barsamian's, is defined in many ways, including as large-scale kinetic constructions, spin art, and stroboscopic zoetropes, among other names. However, unlike Barsamian, the West Coast artist presents his work in the harshest conditions and on a gigantic scale, the largest of all the artists studied in this thesis. His choice for going low-tech, which means not using a computer to control his pieces, and his engagement with large groups of collaborators to help construct and install the work represent his artistic statement. These choices reflect not only the alternative ways that a combination of craft and ingenuity can be embraced but also echoes the Burning Man experience. Despite the constant repairs and mechanical problems his pieces may present during the Burning Man, he always finds support from strangers who, moved by his artwork, gladly help him patch, fix, and fine-tune his pieces.

[344] As the artist shared with the author during their interview on November 4, 2016.

Bowditch, in her comprehensive book about the Burning Man phenomenon, uses Roger Caillois' categories of play—*agôn, alea*, *mimicry,* and *ilinx*[345]—to classify the festival's experience. Particularly compelling is her classification of Hudson's work as belonging to the *ilinx* type, especially since this clearly resonates with Wanda Strauven's article[346] in which she also uses Caillois' structure to categorize the classic zoetrope as *ilinx*. This comparison reinforces the link between past and present and despite apparent contradictions, also strengthens this author's claim that the classic zoetrope should not be defined exclusively as part of *ilinx* type of play. The main reason why it makes sense to classify Hudson's work as *ilinx* but not the classic zoetrope lies in the scale. *Ilinx* games are based on dizziness and temporary disorientation of the subject, and this significantly occurs when the size of the zoetrope reaches the human-size scale of Hudson's work, in addition to the fact that the strobe light effect can create a sense of vertigo, or even cause seizures, in extremely sensitive viewers, even though it is not the viewer who is physically spinning.

Thus, although Caillois' classification is used by different scholars to categorize optical devices from the past and animated installations of today, the author asserts that this categorization is clearer and more precise in regard to contemporary large-scale works such as Hudson's, but not necessarily so in relation to early devices such as the classic handheld versions of the zoetrope and phenakistoscope. Hudson's case is also special because it is a rare occasion in which the viewer still physically manipulates the pieces, despite the large size and only offering one animation option,

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[345] Simplifying the description of these categories, they can be summarized as follows: *Agôn* refers to games of competition and skill, such as soccer and chess; *alea* is related to games of luck, usually with dice, where the skill can be overcome by chance; *mimicry* is related to imaginary universes found in games of make-believe as, for instance, when one temporarily pretends to be someone else—here, Caillois makes reference to illusions, returning it to its Latin roots, where the words *in lusio* indicate the beginning of the act of playing—and *ilinx*, which in Caillois' words, "includes [games] which are based on the pursuit of vertigo and which consist of an attempt to momentarily destroy the stability of perception and inflict a kind of voluptuous panic upon an otherwise lucid mind." Roger Caillois, *Man, Play, and Games,* translated by Meyer Barash (Urbana: University of Illinois Press, 1958), p. 12.
[346] Strauven, "The Observer's Dilemma."

without the possibility of variety as in the classic interchangeable zoetrope strips.

Hudson's next piece for Burning Man was even more ambitious and larger, 3.6 meters (12 feet) high and 9 meters (29.5 feet) in diameter. It evolved from the same idea of his earlier work of swimmers in the desert's Playa, but this time the character is shown full body, making a straight dive into the ground. *Deeper* (2004) (Figure 57) astonishes the viewer by its size and its continuous loop, with "new" divers falling continuously, one after the other. This piece is also human-powered; the entire structure starts functioning (motor and strobe lights) when the two bikes attached to it are pedaled. The idea of having people take turns to keep the illusion playing is in keeping with the collaborative spirit of Hudson's pieces. This interactivity was extended in his next pieces, as well as his fame among the "burners," which in consequence also significantly increased the number of his collaborators.

Figure 57. Peter Hudson making final adjustments to *Deeper,* 2004 *(Courtesy of the artist)*

In 2007, Hudson returned to Burning Man with the piece *Homouroboros* (Figures 58 and 59). The name combines the words *homo* and *Ouroboros*, the mythical symbol of the snake eating its own tail, which in cultural cosmology is associated with the cyclical nature of the Universe. As the festival theme for that year was "The Green Man," Hudson chose to portray

an ancestor of *Homo sapiens*, a monkey-like figure jumping from branch to branch on a metal tree structure while a snake carrying an apple approaches the monkey and ends up being eaten by the simian. In a preproduction video,[347] Hudson mentions that the piece may represent his take on denial of Original Sin in the face of evolution, justified by the artist's revision of his own Catholic upbringing. Catholics believe in the Original Sin of Adam and Eve to explain the creation of the world according to the Bible, thus the artist in this work is confronting his religious past with the scientific evolutionary theory that man descends from the ape and in this case makes the monkey eat the infamous snake that carries an apple. The viewer may not immediately understand the artist's intention, but his view certainly enriches the interpretation of the piece.

Figure 58. Peter Hudson, *Homouroboros,* 2007: overall view *(Photo Terry Bowker,*[348] *Swayframe on Flickr)*[349]

Figure 59. Peter Hudson, *Homouroboros,* 2007: detail *(Photo Terry Bowker,*[350] *Swayframe on Flickr)*[351]

The most striking part of the piece lies in the way it invites viewers to interact and how it clearly evolves from his previous works yet presents new

[347] A preproduction video for *Homouroboros* is available at: https://www.youtube.com/watch?v=H3KHm2tW8Ls
[348] Image accessed at: http://terrybowker.smugmug.com/keyword/peter%20hudson/
[349] Image accessed at: https://www.flickr.com/photos/swayframe/1347928301/in/gallery-hudzo-72157624706755644/
[350] Image accessed at: http://terrybowker.smugmug.com/keyword/peter%20hudson/
[351] Image accessed at: https://www.flickr.com/photos/swayframe/1347928301/in/gallery-hudzo-72157624706755644/

challenges and twists. The metal tree structure is more than 7 meters (23 feet) tall and has a diameter of 9 meters (29.5 feet). In this installation, only the top of the tree spins, like a giant wireframe Lazy Susan, which allows people to come closer to the structure to appreciate it from different points of view.

Drums of different sizes and shapes are placed around the tree trunk, inviting viewers to play. Each drumbeat activates a flash of the strobe light, while its sound is amplified, helping create a tribal and theatrical mood. The motor that makes the monkeys spin is activated when the cluster of 10 bicycle booths distributed around the piece is pedaled, converting solar energy via the solar panel on top of the booths into electrical power. The drum players and the bikers only need to work for a while to feed the engine, and after some time, the structure reaches its correct flickering frequency and speed, astonishing all.

In transforming viewers into users, Hudson is also welcoming them to be part of the performance as the ones "responsible" for activating the artwork. This participation creates a feeling of belonging shared by all who experience his pieces. The shared live experience mixes action and awareness celebrated by the animated movement of the piece that gains life through this collective effort. To attract involvement with the piece during the daytime, monkey masks were adapted with active shutter lenses inside—flickering glasses—allowing people who look through them to see the monkeys' movement in 3D during the day. *Homouroboros* was exhibited in different places after the festival with the support of the Black Rock Arts Foundation,[352] including at the Exploratorium[353] in San Francisco, a place that combines art and science through interactive exhibits.

Hudson's pieces for Burning Man rely on curiosity and play. As the artworks remain scattered in the desert, people who dare to venture around may come

[352] The foundation is dedicated to extending the Burning Man experience beyond the event.
[353] More information is available at:
https://www.exploratorium.edu/visit/calendar/homouroboros

across them and attempt to discover how they work. Particularly in the case of *Homouroboros,* the experience of Hudson's piece lies in the popular saying "*monkey see, monkey do,"* and the hope that people will end up discovering and learning from others how to interact with it, being rewarded in the end with the surprising animation effect of his moving three-dimensional figures. (Versions of his works exhibited in public spaces after their debut at the festival sometimes are not fully human-powered but still keep some level of interactivity.)

The human element is also at the center of his pieces, not only because of the interactivity he proposes but also through the living human body forms that he normally uses to give shape to the characters of his installations. Hudson interestingly maximized the potential of his particular ability in lifecasting while enhancing the identification of the viewer with a cast of one's own body. In capturing a pose in the human body, he transforms the movement into stillness only to set it into motion again when the overall piece rotates to life with the help of strobe lights.

Tantalus (Figure 59) was Hudson's response to the 2008 Burning Man theme of "The American Dream." Continuing to play with Greek myths and their cyclical structure, here he took up the myth of Tantalus and the eternal, unattainable temptation. In Hudson's reinterpretation of the myth in relation to the American Dream, he portrays the circular structure of his three-dimensional zoetrope as the hat of Uncle Sam and the colors of the American flag. Along the red strips of the hat, a hand holding a golden apple appears, while a man emerging from the hat's brim tries to reach for it. The hand and the apple then rise together farther out of the man's reach until they disappear on top of the hat, only to reappear and tempt the man anew.

Figure 60. Peter Hudson, ***Tantalus,*** **2008** ***(Photo Terry Bowker)***[354]

Tantalus makes specific reference to the difficult times the United States and its citizens were facing in 2008 and its rusty look reflects that. December 2007 to 2010 marked a period that came to be called the Great Recession, probably the worst recession to hit the U.S. economy since the Great Depression that started in 1929. For Hudson, the piece's golden apple represents the fruits of labor, from buying a house to health insurance, anything that after much effort has become far out of reach for the majority of the American people.[355] In this vein, Hudson adds political depth to his artwork, questioning the cycle of difficulties borne by the American population around that time, consequence of the actions of those who are in power—all this suggested in a three-second animation cycle.

Once more, the participation of the viewers is called upon to bring the piece to life. This time the artist uses four railroad pump cars distributed and fixed around the piece; each car requires four people to pump and thus make the artwork rotate and the strobe light sync. The physical effort and the commitment of the public to bring the piece to life are remarkable. Videos available on the Internet capture the engagement of the public as they

[354] Image accessed at: http://terrybowker.smugmug.com/keyword/peter%20hudson/
[355] As explained by the artist in an interview, which can be accessed at: https://www.youtube.com/watch?v=lSW4YBxr3L0

manipulate the pump cars, ensuring that their struggle will help create something compelling. Indeed, at another level, Hudson's call for participation and engagement in his laborious mechanism can be seen as a call for the people to come together, work hard, and share in the exhilaration of the experience.

His next piece *Charon* (Figure 61) was exhibited at the 2011 Burning Man event, whose theme was "Rites of Passage." Charon, according to Greek mythology, is the ferryman from Hades who carries the souls of those who have passed away to the afterlife. He drives a boat over the river Styx that divides the world of the living and the underworld. In his representation of the rite of passage from life to death, Hudson evokes the mythology of the ferryman as the messenger of death, characterized by a skeleton rowing a boat with his oar. The entire cycle consists of 20 such rowing skeletons, and the complex animation of the skeletons marked Hudson's first collaboration with former Pixar animator Warren Trezevant.

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Figure 61. Peter Hudson, *Charon,* 2011 *(Photo Michael Holden)*

This giant piece was built as a Ferris wheel structure with a diameter of almost 10 meters (33 feet). It was Hudson's first work displayed on a vertical axis. Interactivity this time was even more intense and physically demanding not only in terms of participation but also in terms of coordination between

participants to successfully animate the piece. Parallel to the main wheel with the skeletons were two half-arcs placed on either side. Each of the arcs had at each end three sets of ropes to pull and thereby generate the necessary power to spin the giant wheel, so a total of 12 people, distributed into groups of three, on parallel sides of the main wheel were needed.

The physical effort demanded by this piece resulted in participants bending down on their knees, bowing in reverence to bring *Charon* to life. The effort quickly paid off, however, with the rowing ferryboat skeleton swinging the oars around as if he were the one propelling the boat. As in all of Hudson's pieces, the physical labor of viewer-turned-participant is rewarded, as they lend their movement to create the suggested effort of the three-dimensional animated skeleton characters. In turn, the characters swim, dive, reach out, swing, and row as long as some viewers are willing to pass to them the "breath of life," the anima that generates the animation. In this piece, the use of skeletons makes reference to the iconic sequence in the movie *Jason and the Argonauts* (1963), created by the master of special effects Ray Harryhausen. In the famous sequence, skeletons come to life and fight with the living. The fact that Hudson's skeletons are life-size increases the impact of seeing the piece live, as if bringing Harryhausen's scene to a concrete form.

Hudson's most recent piece for Burning Man is *Eternal Return* (2014) (Figure 62), again working in collaboration with Trezevant. The complexity of the piece delayed its exhibition by one year as it was originally to be presented at Burning Man in 2013. Furthermore, it was the first of Hudson's pieces to be partially funded by crowdsourcing. And, significantly, relying on the fame of his previous works for inspiring the public to help and participate, the artist was able to reach his financial goal without providing a single detail about the new piece before its debut. His supporters, eager to live a new larger-than-life experience, donated the funds needed to transform his animated installation into reality. This is a rare case that confirms not only the power of the live experience but also the human interest in being surprised and in awe.

Figure 62. Peter Hudson, *Eternal Return,* 2014 *(Courtesy of the artist)*

In exploring the many understandings of the *eternal return* through history and in different cultures, Hudson explains the concept behind his work:

> The concept of the eternal return is touched upon in virtually all cultural and religious narratives. The concept can be found in Ancient Egyptian, Mayan and Aztec beliefs, in East Indian, and ancient Greek philosophy, as well as the 19th century deliberations of Friedrich Nietzsche. Tibetan Buddhism's Bhavacakra is a symbolic representation of Samsara, or "cyclic existence". The concept of the eternal return speculates that the universe has been recurring, and will continue to recur, in a self-similar form, an infinite number of times across infinite time and/or infinite space. Rather than portray Sisyphean repetitive never-ending punishment, Eternal Return will celebrate the joy and ecstasy of life, not just repeated, but begun anew.[356]

The spiral life and motion of the optical toys and animated installations is given animate form in the cycle of *Eternal Return*. The character chosen to represent Hudson's interpretation of the Eternal Return as the "joy and

[356] As stated on his website: http://hudzo.com/eternalreturn/

ecstasy of life" was a female full-body golden figure doing an acrobatic routine in a spiral structure. This is the first female figure clearly represented in Hudson's work. After exploring the potential of the circular structure in previous works, Hudson pushed the boundaries once again by introducing the spiral movement and suggesting by it the shape of the symbol for infinity. And, whereas his previous works relied on a cycle that could be seen as bitter or ironic, Hudson's piece invites people to reflect on their own life, recognizing their own repetitive but renewing cycles as a step toward transformation, much like the artist, who stated in an interview with the author that his own fear is to be stuck in a cycle like the ones represented in his pieces. The positive view of the cycle represented by the spiral still suggests repetition but never the exact same repetition. Time has changed, we have changed with it, and so does the piece and the experience we take from it.

The piece was 7 meters (23 feet) high and human-powered by 16 rowing machines, doubling the number *8,* which horizontally becomes the infinity symbol as represented by the golden woman's movement (Figure 63). Her animation was much more complex, with its timing and momentum carefully planned as she falls slowly and rapidly swings back up to eagerly start her jump again, an example of Carpenter's movement of translation (discussed in Chapter 2) that in animated films today is related to the number of frames in which an action is portrayed in connection with its "timing,"[357] making the movement more fluid.

[357] Timing in animation is related to the speed of an action that can be faster (fewer frames) or slower (more frames).

Figure 63. Detail of *Eternal Return,* 2014, by Peter Hudson *(Photo Erich Remash)*

Parallel to creating and installing works at Burning Man, Hudson managed also to exhibit his pieces in different locations around the world, finding particular success at music festivals. His larger-than-life animated installations were perfectly suited to the grandiosity demanded by events such as Burning Man and the collaborative spirit it inspires. For Hudson, the dream is to bring his visions to life, find amazing collaborations in the process of making them, in the best example of human fraternization, which in consequence may inspire his viewers.

3.2.3 All Things Fall: The Dark Side of Illusion in the Work of Mat Collishaw

With themes that mix the tastes of the Marquis de Sade with those of François Rabelais, the work of Mat Collishaw lies on the boundary between the grotesque and the sublime.[358] He is a renowned fine artist whose works range from photography and painting to zoetropes and other early optical

[358] As mentioned previously, the sublime is a topic of such richness and complexity, including in terms of its history, that it would need extensive consideration and elaboration in its own right, especially regarding if and how it might apply to mechanical devices of illusion.

device installations. Collishaw uses in his zoetropes the same flickering technique as Barsamian and Hudson, the strobe light, but with a different frame rate.[359] But while Barsamian and Hudson have embraced the zoetrope sculpture as their main mode of expression, Collishaw's works encompass different styles and techniques.

Born in 1966, in Nottingham, Great Britain, Mat Collishaw belongs to the group that graduated from Goldsmiths College in London and later became known as the Young British Artists (YBA). Collishaw's fame was established much later than that of his fellow schoolmates, who include Damien Hirst, Tracey Emin, and Sarah Lucas. Raised as a Christadelphian,[360] Collishaw grew up in an extremely religious environment where he was not allowed to watch TV. This deprivation since childhood only increased his interest in animation and early optical toys. Collishaw's first use of animation as a reinvention of early optical devices occurs in his first solo exhibition, called *Shooting Stars,* at the now-closed Haunch of Venison Gallery in London in 2008. The zoetrope that was part of this exhibition was called *Throbbing Gristle*.

Throbbing Gristle (Figure 64) represents mythical figures in unexpected actions, such as the Minotaur mating with a woman, the Three Graces, a she-wolf, and a drunken cherub. Sue Hubbard remarked in her essay on Collishaw's work, these figures "move magically in their corrupted Eden."[361] Interestingly, although the sequentially sculpted figures cast in resin are rough and their movements are not very elaborate, the effect of seeing them come to life is so visually arresting and their actions so unexpected—especially in comparison to themes traditionally shown in zoetropes—that the public is immediately awestruck.

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[359] At every revolution of the structure, the strobe light blinks around 18 times per second, said Mat Collishaw in an interview available at: http://matcollishaw.com/about/media/

[360] Christadelphians are a particularly conservative Christian group that seeks to live according to early Christians beliefs. More information can be found at: http://www.bbc.co.uk/religion/religions/christianity/subdivisions/christadelphians_1.shtml

[361] Sue Hubbard, "Terrible Beauty," in *Mat Collishaw* (London: Blain/Southern, 2012), p. 13.

Figure 64. Mat Collishaw, *Throbbing Gristle,* 2008 *(From the artist's website)*[362]

According to Verena Butt, in her article[363] about Collishaw, his work is supported by three main pillars: his deep knowledge of art history, his use of past and present technologies of the image, and his desire to disturb the audience's perception. [364] Independent of the technique used in his works, these pillars are a fundamental part of Collishaw's artistic practice.

If Hudson portrays his works at the contemporary "carnival" represented by Burning Man, Collishaw refers back to similar but ancient festivities that also celebrated the end of a cycle with popular rites that included sexually libertine behavior, gluttony, and disguise. Collishaw combines myth and pagan rituals in his work by re-reading traditional artworks and using techniques in the light of cutting-edge digital technology to animate his works to life.

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[362] All images from the website of Mat Collishaw may be accessed at: http://matcollishaw.com/

[363] Verena Butt. "Au-delà de l'évidence, les mécanismes d'une perception troublée." In *Mat Collishaw ou l'horreur délicieuse,* by Barbara Polla et al. Brussels: La Muette, 2011.

[364] Ibid., p. 87.

Following *Throbbing Gristle* came *The Garden of Unearthly Delights*[365] (2009) (Figure 65), which portrays devilish creatures, like little hellions, disturbing nature by throwing stones at butterflies, beating fishes in the river, trying to break eggs in a bird's nest, and torturing snails. The beauty of the flora and fauna contrasts sharply with the harmful tricks played by the mischievous childlike figures. The title of the piece refers to the work of the 15th-century Dutch artist Hieronymus Bosch (1450-1516) and his triptych, and most famous painting, *The Garden of Earthly Delights* (1503-1515). While Bosch portrayed the transition of humankind from paradise to hell, Collishaw focuses on the paradisiac peace interrupted by unearthly delights, taking the point of view of the devilish creatures, but also as a dystopian view of the Earth.

Figure 65. Mat Collishaw, ***The Garden of Unearthly Delights,*** **2009** ***(From the artist's website)***

The viewer, attracted by the reanimation of the zoetrope, is caught in a voyeuristic act that leads to conflicting feelings of disgust and seduction. Typical of his works, Collishaw plays with the attraction factor of animation but displaces its traditional naive content, marking much of the imagery of

[365] The piece forms part of the collection of Damien Hirst, as well as of the Ukrainian art collector Victor Pinchuk.

the 19th century optical toys with nasty acts. In contrast to his first animated installation, however, *The Garden of Unearthly Delights* portrays all its characters in full vibrant colors. The entire structure has a 2-meter (6.5-foot) diameter and also uses a strobe light that slowly adjusts its frequency to create the animated effect.

Collishaw's follow-up animated installation reached a larger scale than his previous one. Commissioned by the Victoria and Albert Museum in London, he decided to transform the museum's architectural crown cupola into a giant animated installation entitled *Magic Lantern* (2010) (Figures 66 and 67). As light attracts moths, the work presents insects flying around a light in the middle of the building's cupola. When introducing the work the artist explained:

> As the Victoria and Albert Museum is the world's greatest art and design museum, I wanted to create a work that reflects the V&A's standing as a monument to cultural achievement. The cupola will be lit to represent the museum itself as a beacon of light to which objects of beauty, activity and life are drawn.[366]

In this homage to the museum's tradition and cultural role, Collishaw's work is more valid as a concept than as an experience per se as the public could not access his 9 meter (29.5-foot) wide by 4 meter (13-foot) high installation at the museum. As it could only be viewed from afar, with the flash of lights and passing shadows suggesting its movement, the artist created a small-scale version of it that could be experienced up-close by viewers. The *Small Magic Lantern* (2010) (Figure 68), approximately 1 meter (3 feet) in diameter, was accessible to all museum visitors.

[366] The article about the work, "Mat Collishaw's Magic Lantern at the V&A," (March 11, 2011) is available on the Other Criteria website at:
https://othercriteria.com/uk/blog/2011/03/11/talk-mat-collishaws-magic-lantern

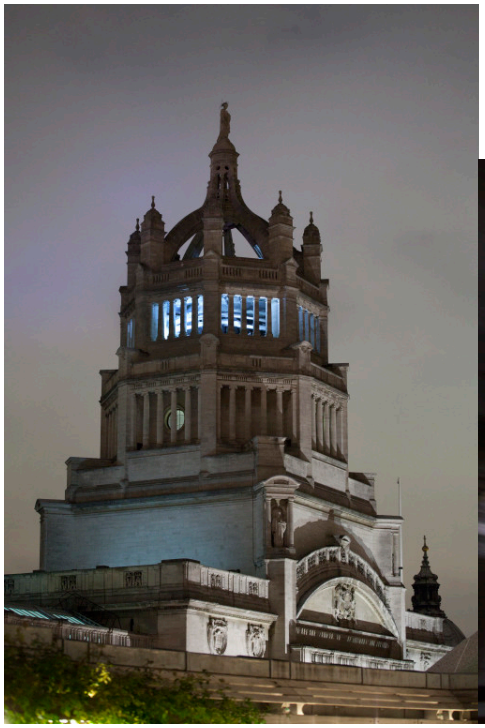

Figure 66. Mat Collishaw, *Magic Lantern,* 2010: external view of the Victoria and Albert Museum dome *(From the artist's website)*

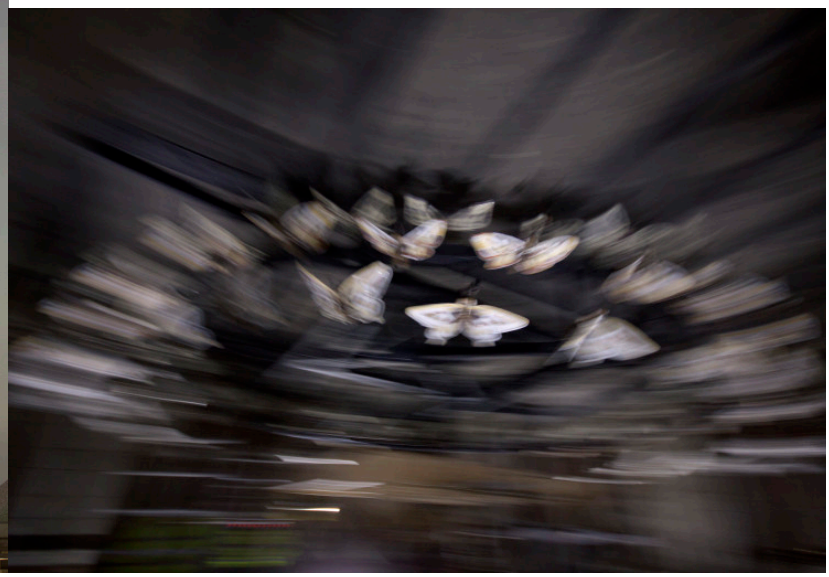

Figure 67. Mat Collishaw, *Magic Lantern,* 2010: detail of the moving effect *(From the artist's website)*

Figure 68. Mat Collishaw, *Small Magic Lantern,* 2010 *(From the artist's website)*

After a four-year gap between the *Magic Lantern* and his next animated installation, the artist attracted substantial popular attention with his artistic collaboration with Sebastian Burdon and the Italian company Factum Arte, the extremely elaborate 3D-printed zoetrope *All Things Fall* (2014) (Figure 69).

The piece is based on the painting *King Herod's Massacre of the Innocents* by Ippolito Scarsella, better known as Scarsellino, a painter from the early 17th century. Scarsellino's work portrays the biblical massacre ordered by Herod of all boys under the age of two in Bethlehem. Herod had come to learn that a new king was born and feared being dethroned by the new King of the Jews.[367] This passage is described in the Bible in Matthew 2:16–18.

Figure 69. Mat Collishaw, *All Things Fall,* 2014 *(From the artist's website)*

There is so much going on in Scarsellino's painting that the viewer's eye cannot settle, which, according to Collishaw,[368] was a technique used by painters of the time to create a restless feeling in the viewer. To provoke the same feeling in today's audience, Collishaw decided to breathe new life into the work of this 17th-century master of the Mannerist period as a large three-dimensional zoetrope. The animated scene can be interpreted as simultaneously fascinating in its reconstruction as a 3D model and loathsome in its violence, a contrast of conflicting feelings that are present in all of Collishaw's work. Its carousel-like structure underscores the ambiguity between childlike entertainment and the violent murderous acts performed

[367] Herod had been appointed by the Romans to rule over the Jews, and the new king of the Jews was Jesus Christ.
[368] As stated in an interview available at: http://www.studiointernational.com/index.php/mat-collishaw-interview-i-think-human-beings-are-always-drawn-to-the-slightly-illicit

by his characters, who are committing infanticide, while the repetition of the massacre stresses a nightmarish atmosphere. The theme is still contemporary as people continue to face similar kinds of violence in events such as the Syrian war and terrorist attacks. In this sense, the artist forces viewers to reflect not only on the violence but also how we are somehow attracted to it. In referencing a classical painting to create this work, Collishaw explained:

> Over time, our perception of paintings changes, not only because they become iconic, but because the media around us has totally changed. We don't generally stand around looking at a picture that's not moving, because it's not that interesting compared to what else is on offer. So I'm trying to reintroduce the concept of time to these works, or at least evoke the idea that these works do work within time. They are not static. They unfold in front of you and require your eye to move around as you engage with them.[369]

Engaging with technological changes while attempting to renew traditional experiences for a media-saturated contemporary audience, Collishaw invites viewers to see traditional works such as Scarsellino's painting through a new lens by enlisting the imagination when bringing it to a three-dimensional animated format as a graphic sophistication that elicits emotions, especially fear and violence.

One of Collishaw's recent animated installations is titled *Seria Ludo* (2016) (Figures 70 and 71). The work was exhibited at the Fountains Abbey and Studley Royal Water Garden and co-commissioned by the foundation of this historical site and the UK National Trust Collections. Collishaw chose the Banqueting House to host his piece, reasoning that a modern zoetrope would be appropriate to relive the historical past of gluttony in the follies organized by its 18th-century owners. The name of the installation translates roughly from the Latin to a serious kind of play, probably referring to the type of party attended only by adults owing to its permissive nature, which may lead to vulgar and obscene behavior.

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[369] Collishaw, in an interview available at: https://www.britishcouncil.org/voices-magazine/its-accomplishment-if-someone-stops-look-art

To match the ornate surroundings of the Banqueting House, Collishaw chose a bohemian chandelier as the main object in which tiny drunken figures will frolic without any sense of decorum. Made of transparent acrylic to mimic a fancy crystal version, the chandelier consists of 18 sections among which the characters interact with one another on different levels. Drunken, naked fleshy women dance around the chandelier's candle, while a man urinates on a bowl of soup that continues to be served to the drunken guests; even children are drinking, and the entire scene has an orgy feeling to it.

Figure 70. Mat Collishaw, *Seria Ludo,* 2016: overall view *(From the artist's website)*

Figure 71. Mat Collishaw, *Seria Ludo,* 2016: detail *(From the artist's website)*

Once more the viewers are trapped as voyeurs at a party. Some laugh, others judge. This excitable contemporary version of the zoetrope confronts

the site's tranquil ambience, while its characters relive a possible Bacchanalian past. Like a time machine built with 3D-printing technology, Collishaw's work revisits the boundaries of past morality and decency (or the lack thereof) with contemporary displacements of morally questionable behavior.

Collishaw's most recent animated installation work is titled *The Centrifugal Soul* (2017). It portrays birds of paradise in their mating rituals surrounded by flowers opening and closing in a frantic rhythm (Figure 72). In this large, full-color, 3D-printed zoetrope, the artist proposes a reflection on nature's exhibitionist instincts in a nonstop search for lust and pleasure. A correlation can be found between these exhibitionist instincts and contemporary society and its use of Internet and social media. An intriguing part of his current work is that at first look, the artistic expression, conveyed through beautifully detailed and colored flowers and birds, may appear to have become less violent. However, it will be their repetitious cycle that transforms the paradise into hell, as their reiterated actions traps the characters in a never ending loop.

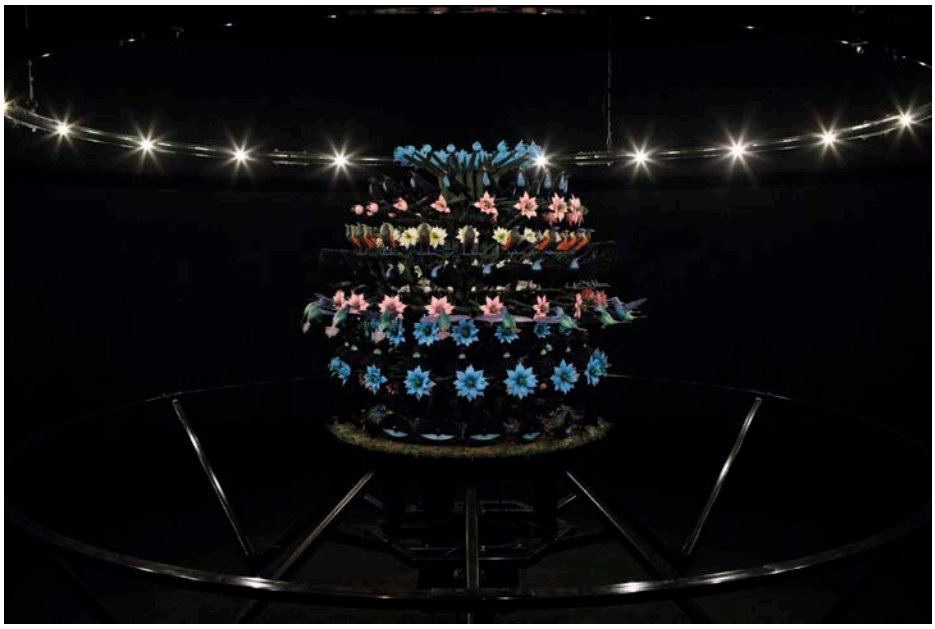

Figure 72. Mat Collishaw, ***The Centrifugal Soul,*** **2017** ***(From the artist's website)***

The innovative aspect of this work lies in how the artist has chosen to disclose the animated action. At first, the viewer arrives and the piece starts to rotate. When its movement reaches a certain speed, all that can be seen is

blurred colored objects (Figure 73). At this moment, the lights dim to complete darkness (the piece is placed in a separate room where the lights can be controlled). After a while, the lights are suddenly turned on again, and the viewer discovers the animation in perfect motion. In this case, the transitioning from the blurred images to the animation is not visible to the viewer but is abruptly discovered, which enhances the "wow effect" of the piece.

Figure 73. Mat Collishaw, *The Centrifugal Soul,* 2017: detail *(From the artist's website)*

Collishaw's animated installations are often part of larger exhibitions in which his painting, photographs, and other types of artistic installations share the space and the viewer's attention. The artist uses computers to design, test and simulate his animated installations. He has established himself as thought provoking and constantly striving to reinvent traditional techniques and devices to play with the perception and senses of his viewers.[370]

[370] It was reported that four years ago he was working on a piece that is an animated interpretation of the nine circles of hell as a giant modern zoetrope for Stanford University, but the current status of this project is unknown.

Giant and large-scale structures, along with the use of devices of wonder, such as parabolic and anamorphic mirrors, complete the wide range of works he creates to elicit surprise and instill curiosity in his viewers. Even if the surprise turns to disgust and the senses are deceived at different levels, his work remains vigorously committed to provoking questions more than providing answers. As mentioned in an article about the artist, for Collishaw, "art is the modern religion."[371] The same way that art was historically exhibited in temples and churches, today, in times of disconnected beliefs, art galleries and museums are assuming the role religious institutions once held, where exhilarating participation is experienced.

3.3 Reinventing the Wheel

Research on animated installations has revealed other contemporary artists who have created works that also reinvent the zoetrope structure, specifically reinterpreting the wheel of life, although not necessarily keeping its wheel structure. These artists are Toshio Iwai, Kumi Yamashita, Ryusuke Ito, Eric Dyer, David Lawrey, and Jaki Middleton. Three of these artists come from Japan (Iwai, Ito, and Yamashita), one from the United States (Dyer), and two from Australia (Lawrey and Middleton as an art collective). All portray different global approaches to the early devices, always striving to impact their viewers.

Specifically, Iwai, Dyer, and Lawrey and Middleton have created animated installations as reinventions of the zoetrope and other early devices, in addition to other types of artwork not always related to animation. In the case of Yamashita and Ito, they each have only one significant work that renovates the zoetrope structure, which makes them exceptions among the other artists mentioned in this chapter. Their explorations nonetheless contribute significant presentations of a range of possibilities enabled by their inventive

[371] Mat Collishaw in an interview, available at: http://www.standard.co.uk/lifestyle/mat-collishaw-is-art-s-mr-nasty-6720511.html

use of the early devices that flicker, making the investigation of their work worth including in this thesis.

3.3.1 Toshio Iwai: The Magician of Light, Sound, and Heat

It is very difficult to find references to Toshio Iwai in English-language publications. Even his own presence in cyberspace is discreet, as the artist does not have a website of his own, making it even more challenging to find primary sources of information about his work. The latest report on him, in fact, dates from 2006-2007, when he released, in partnership with Yamaha, a musical instrument for the digital age, the Tenori-On.[372] In addition, the vast majority of information on the Internet, in English at least, referring back to the launch of the Tenori-On, generally overlooks all the preceding works created by this influential media artist.[373] Iwai is influential because even if a person may not recognize his name, he or she will certainly know one or another of his works, or at the very least, works by other famous artists who were inspired by him (sometimes crediting him, sometimes not).

Iwai's name was first mentioned to the author during her interview with Barsamian. Barsamian commented he had met Iwai in the late 1990s in Tokyo and realized that the two were probably the only people then creating artwork with three-dimensional strobe light zoetropes. Coincidentally, the two had started creating zoetropes in the 1980s, one in the United States and the other in Japan, completely unaware of each other. It was only when they both had pieces commissioned for the InterCommunication Center (ICC) [374] in Tokyo that their paths crossed. In addition, in 2000, both Barsamian and Iwai had their works selected as finalists for the

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[372] A review of the Tenori-On, written by Paul Nagle for the February 2008 edition of *Sound on Sound*, is available at:
http://www.soundonsound.com/reviews/yamaha-tenori

[373] Iwai has received many awards and been exhibited around the world. He has also been invited as artist in residence at ZKM (Germany), the Exploratorium (United States), and IAMAS (Japan), and his works form part of permanent museum collections such as those of the MoMA (United States), Exploratorium, Studio Ghibli (Japan), and National Media Museum (Britain), to mention but a few.

[374] For the permanent exhibition *Art Meets Media: Adventures in Perception*. Information accessed at: http://www.nttticc.or.jp/en/feature/2005/art_meets_media/Works/work09.html

MIT/Leonardo New Horizons Award for Innovation in Media, [375] with Barsamian ultimately receiving the award together with another artist, recognizing the common basis and profound effect of this kind of work on the public, particularly when considering that Barsamian does not utilize digital technology but builds upon 19th century optical toys to create what the award publication calls “magical realism.”[376]

Born in Kira, in Japan’s Aichi Prefecture, in 1962, Toshio Iwai (岩井 俊雄) began making his own toys at a very young age. During a talk he gave at the MIT Media Lab in August 2006,[377] he shared anecdotes from his childhood that establish the groundwork for his future artistic practice. A few of them are referred to here to illuminate and contextualize his work. This talk is the most complete source of information in English about Iwai’s work to date, in which he explains his creations and talks about his influences.

Iwai, even as a child, always liked to draw, and two illustrated children’s books in particular had a great impact on him: One about insects and the other, an educational comic book entitled *Magician of Light, Sound and Heat*—in some ways an anticipation of his future—were very early influences, which he credits with helping him develop his visual expression. Perhaps the most remarkable event of his early years, which he has established as the foundation of his artistic practice, occurred when his mother told him that she would stop buying toys for him. Despite his initial shock, she supplied him with materials and books for him to learn how to build his own toys. From then on he started to invent.

Flipbooks were the earliest forms of animation that triggered Iwai’s love for proto-cinematic apparatuses. As was the case for many artists and animators, his first animations were made on the corners of his schoolbooks. While growing up, technology also became a growing interest. When entering

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[375] Leonardo award information accessed at: http://www.leonardo.info/isast/newhorizons2000/finalists.html

[376] "New Horizons Award for Innovation in New Media." (*Leonardo* 34, no. 3, 2001). Accessed at: http://www.jstor.org.ezlibproxy1.ntu.edu.sg/stable/1576931 , p.179

[377] Video of talk at the MIT Media Lab, “Toshio Iwai: From Flipbooks to Media Art,” August 4, 2006. Available online at: https://www.media.mit.edu/video/view/iwai-2006-08-04

university, he chose to study Fine Arts, more specifically the plastic arts and mixed media[378] at the University of Tsukuba. In 1982, finding inspiration in his interest in animation and apparently the films of the Scottish-Canadian animator Norman McLaren, Iwai began to experiment with different mediums and developed short animations with flipbooks and phenakistoscopes.

The next natural step was to migrate to zoetropes. Iwai has mentioned that for him the "zoetrope is the first moving-image mass media entertainment"[379] because it allowed many viewers to enjoy the illusion at the same time. Although magic lantern shows already existed as a collective event in the early 18th century, if we consider only the universe of optical devices that flicker and rotate, the zoetrope was indeed one of the earliest toys to transform an individual amusement into a collective entertainment, particularly because the structure of the zoetrope facilitated the perception of illusion of motion being seen by many at once.

In Iwai's quest to uncover and extend proto-cinematic technologies, an engraving of Étienne-Jules Marey's zoetrope with three-dimensional sculptures of birds in sequential poses of flight (Figure 74) was a happy discovery for him. Marey's work is probably the earliest and best-known version of a zoetrope using three-dimensional models. This engraving had a profound impact on Iwai, and it was after seeing it that he decided to experiment with sculpted models.

Iwai's first pieces, in 1988, retained the slotted structure of the traditional zoetrope and used clay figures. Already concerned with user interactivity with his pieces, Iwai added a crank to his device to allow the viewer/user to manipulate it.[380]

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[378] According to an online article available at:
http://www.revolvy.com/main/index.php?s=Toshio%20Iwai

[379] Mentioned by Toshio Iwai during an interview with the author, August 14, 2016.

[380] Author's note: My research on the work of Toshio Iwai was conducted after my having invented my own versions of the zoetrope, one of which also had a crank to allow user/viewer interaction. I was quite surprised when I saw how similar his earlier device was to mine. However, similarities end at the crank, since my device provides a structural shift in relation to the traditional zoetrope, as will be explained in Chapter 5.

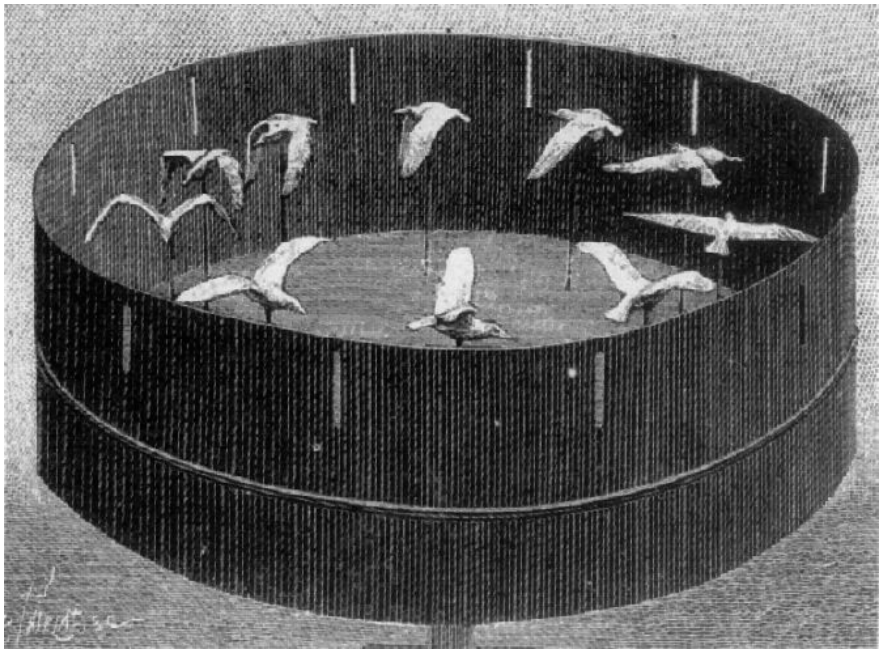

Figure 74. Engraving of the tridimensional zoetrope created by Étienne-Jules Marey in 1887 as a study of the movement of birds in flight *(Courtesy of Stephen Herbert Collection)*[381]

The series of zoetropes that followed are examples of his genius, each work learning from the previous and innovating anew. Iwai constantly strives to improve and push his artwork a step further than its previous version, which makes his investigations consistent and ever fresh. The *Time Stratum II* (1985) (Figures 75 and 76), for instance, incorporated paper models of animals and leaves animated with a strobe light. However, since Iwai was interested in the combination of technologies, he created the strobe effect through the flickering of a computer monitor placed upside-down above the piece. The flickering changed speed to demonstrate different phases of the animation and to give different impressions through the piece. To heighten these aspects, he added color, which changed via the monitor, which in turn flickered in sync with the sound. Although he was still working on a relatively smaller scale than Barsamian, for him the Time Stratum series represents his first accomplishment toward the extension of proto-cinema technologies that he proposed through his work.

[381] Image accessed at: http://www.stephenherbert.co.uk/mareyzoetrope_1.jpg

Figure 75. Toshio Iwai, *Time Stratum II,* 1985: overall view *(Courtesy of the artist)*

Figure 76. Toshio Iwai, *Time Stratum II,* 1985: detail of the animated objects *(Courtesy of the artist)*

More cybernetic versions followed, such as *Time Stratum III* (1989) (Figures 77 and 78), in which three cryogenic-like plastic domes suggest a controlled environment where the animated objects, hundreds of sequential paper cutouts placed inside each dome, are brought to life. This time, four computers controlled the structure, three for the flickering colored lights from the monitors and one specifically for the synchronized sound. These flickering changes created abstract forms within the shapes, and the illusion of seeing the same object under different circumstances created an emotional impact on the viewer, reinforced by the music, also composed by Iwai.

Figure 77. Toshio Iwai, *Time Stratum III,* 1989: overall view *(Courtesy of the artist)*

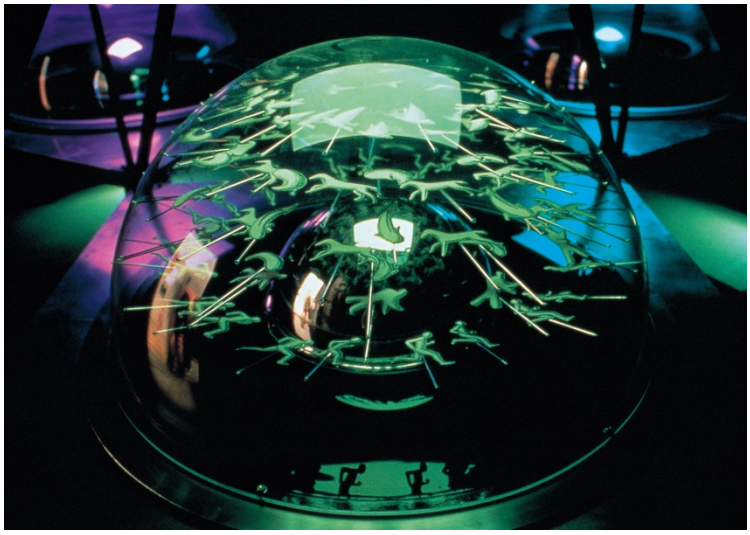

Figure 78. Toshio Iwai, *Time Stratum III,* 1989: detail of animated objects *(Courtesy of the artist)*

The attention to detail and the beauty of Iwai's structures come from a long cultural tradition of respecting and recognizing craft and finishing as important aspects in the completion of an artwork. In an article about the Japanese art collective TeamLab, Barbara London[382] refers to this Japanese characteristic when contrasting it with her Western and more content-driven experiences. In many ways, these characteristics also refer to Iwai's work. His attention and dedication to the machine parts and structure of his pieces may sometimes overshadow the content, the animated action portrayed. The experience of his pieces is much like a magic show, where a magician creates illusions with very simple objects or limited resources. However, in Iwai's case, he is quite articulate about demystifying the "trick" behind his devices, which does not diminish the work but rather increases the admiration for the artist and his inventiveness. In the process, Iwai's work transforms the art of the traditional zoetrope into a performance where light, music, and movement arrest the viewer's attention. His software programming knowledge and skills are placed at the service of this apprehension of a new kind of beauty. The spectacular aspect of his works

[382] Barbara London, "Contemporary Masters: TeamLab," in *Teamlab's First Art Book* (Tokyo: Koumeisha, 2015), p. 9.

captures the audience's attention for its impeccable form, offering the public a unique animated experience, as described further in the following works.

When referring to his Phenakistoscope series in his MIT talk, Iwai posed an interesting question: What would cinema be if the Lumière brothers had not invented it? He proceeded to address the square/rectangular shape of the screen that rigidly frames all post-Lumière Brothers' film productions, indicating its juxtaposition with early animated devices that flicker and rotate, which were mainly based on a circular shape. While the exact answer will never be known, there is much room to speculate. For her part, the author proposes that in the animated installations addressed in this study may lie a potential answer to Iwai's question as these works can be seen as alternative ways to produce and view animation beyond a screen. It is through rich investigations by artists like Iwai that we see the potential of inventive uses of the moving, living image in space.

Undoubtedly, Iwai's most popular piece to date is the *Bouncing Totoro Zoetrope* (2001) (Figure 79), commissioned by the Ghibli Museum in Japan. The Studio Ghibli crew helped create the sequential sculptures and offered Iwai all the necessary support to bring this innovative character-driven zoetrope to life. The famous animation director Hayao Miyazaki in person checked the animation with Iwai, and the entire piece took one and a half years to complete. The strobe light effect was created using programmable LEDs, one of the first times that LED lamps were used to create the strobe effect in an installation.

Figure 79. ***Bouncing Totoro Zoetrope,*** **created in 2001 by Toshio Iwai** ***(Copyright Studio Ghibli)***[383]

In 2003, John Lasseter, the Chief Creative Officer of Pixar Animation Studios in the United States, visited the Ghibli Museum. In an interview there, he was asked to choose his favorite piece in the museum. He chose the Totoro zoetrope for these reasons:

> It [the Totoro zoetrope] communicates what animation does to people, more than anything else. It is so magical to see it. … You walk in, and here it is all these sculptures, and the thing starts to spin, and they almost disappear because they are spinning so fast. Then the strobe light comes on, and it is like magic! They are just alive, right there! And what is interesting is that we are all familiar with Totoro, we have all seen it many times, but that is animation on a screen. To see these figures, three-dimensional figures, right in front of you alive and moving, it was like Totoro was real, right there. And you get so captivated, and I found myself just looking at all the different figures moving and suddenly the strobe light goes off and you are like… Wait! They are not alive? And the thing slows down and the sunrise comes up and it is so beauiful. I probably sat on my knees for half an hour watching that. It is so beautiful and magical and very well done too.[384]

Lasseter's experience summarizes the spirit of the animated installation and how its "magical" aspect animates in the viewer can inspire: Pixar Studios went on to create its own version of a three-dimensional zoetrope using the *Toy Story* characters. Lasseter, after experiencing Iwai's animated installation for Miyazaki, understood the emotional power of associating well-known

[383] Image from the video available on YouTube at: https://www.youtube.com/watch?v=5khDGKGv088

[384] Lasseter, in an interview at the Ghibli Museum, available at: https://www.youtube.com/watch?v=RjlNX9tYC6M

characters to such three-dimensional animated illusions. It extends the experience of the animated film, not only expanding the animation experience beyond a screen but also reinforcing its relation between dream, magic and reality.

Always motivated by curiosity and self-imposed challenges, every new work needs to have a technological twist and improvement in relation to the previous one. He plays with materials and technology. After creating zoetropes, Iwai moved to interactive pieces ranging from visual music to video games. However, while dealing with digital technology, he became frustrated by the rapid evolution that made some of his works quickly out-of-date and consequently unable to permit interaction with the public.[385] Committed to not transforming his art practice into a business, Iwai discovered that creating children's books can also be a way for him to renew an old technology in innovative ways. He has published four picture books, which have been translated into many languages, with the English versions still pending.

During his interview with the author, Iwai explained why he believes experiences that enhance the tactile element will continue to grow, the book being one of these. For him, although technology keeps evolving, the human body remains the same, feeling and sensing in the same way. Iwai regards the Maker movement as very important not only for combining art and invention but for enabling and teaching people how to reconnect with their own creativity through the sense of touch. Iwai's artistic production lies somewhere between art and invention, with his creativity allowing him to actually "reinvent the wheel" in unique ways with each new piece.

[385] It was during this period that he created the Tenori-On, in 2007, in collaboration with Yamaha. For him, the music device was not only a product but an accessible artwork that people could interact with and take home to create music visually. After the instrument was discontinued by Yamaha, he was invited to create a children's book and found in that opportunity a chance to revisit a medium that in his opinion will never be outdated, as the artist believes books can pass on from one child to another, reaching different generations.

3.3.2 The Animated Shadow Play in the Work of Ryusuke Ito, Kumi Yamashita, David Lawrey, and Jaki Middleton

When an opaque body blocks a source of light, a shadow is created. From humans to animals and from trees to stones, where there is light, there are also shadows. The shadow play is often considered an obsolete tradition, but it has never disappeared, and its enchantment and magical appeal manifest themselves in many different artistic expressions from prehistoric times to today.

In this section, the works of the Japanese artists Ryusuke Ito and Kumi Yamashita, as well as of the Australian art collective formed by David Lawrey and Jaki Middleton, will be analyzed. All of them, working independently, have created animated installations in which the use of shadow is combined with a zoetrope-like structure and which have been exhibited in museums and art galleries. Their works have points in common that vary from their use of shadow to the inventiveness and creativity of the materials they use. Ito plays with cinematic perceptions in what he calls "installations with moving images."[386] Yamashita, meanwhile, is the only one of these artists whose specific medium is light and shadow. Using very little material, she can create impressive shadow effects. Lawrey and Middleton explore the possibilities of different early optical devices remixed with content related to pop culture. To date, each of these artists has created only one animated installation that reinvents the use of the zoetrope, and these are the works to be analyzed here: Yamashita's *Conversation* (1999), Ito's *Discovery of Motion Pictures* (2006), and Lawrey and Middleton's *The Sound Before You Make It* (2005).

In the case of Kumi Yamashita, in her 1999 work *Conversation* (Figure 80) the artist uses 60 styrene cutouts of faces, each slightly different from the other, to simulate a speech. These face-shaped profile cards are arranged vertically as an unfolded origami sphere assembled atop a rotating structure. The

[386] On Ito's website his works are divided into "film, videotape," "installations with moving images," and other media: http://www.ne.jp/asahi/r/ito/indexeng.html

rotating three-dimensional ensemble is illuminated by a single light source, and the animation can be seen through its shadow cast on the wall. The shadow flattens the three-dimensionality of the objects; the viewer perceives the heads as talking owing to the flicker created by the space in between each profile card. They are, in fact, saying "My name is Sylvia,"[387] through lip-synched cutouts.

Figure 80. Kumi Yamashita, *Conversation,* 1999 *(From the artist's website)*[388]

Yamashita's work impresses by its ingenuousness. The solution of using the shadow as animated medium is an innovative way to re-create the magical and inspiring qualities of the early optical devices, which form the basis of the feelings of astonishment and wonder, while also making reference to shadow theater traditions and other types of shadow play objects. In *Conversation,* the physicality of the rotating cardboards is better understood when perceived through the ethereal quality of its shadow. Particularly interesting is the similarity of Yamashita's piece with such 19th-century

[387] Some online references assert that the phrase mouthed by the sequential profiles is "My name is Jenny." The author tried to contact the artist to confirm which is the correct information but never received a reply.
[388] Image accessed at: http://www.kumiyamashita.com/portfolio/conversation/

deceptive objects as canes and chess pieces that hid human profiles only clearly perceived through their shadows (Figure 81). The duality of the face's contour is revealed through two profiles of one head back to back. The three dimensionality of the object reveals two human profiles in the flatness of its shadow.

In Yamashita's case, these heads talk in a loop, constantly introducing themselves, possibly to one another, or maybe to the viewer. Perhaps they are each claiming to be the true owner of the name they are speaking. Certainly, through the dual head cutouts Yamashita is continuing her exploration of the potential and relationships of light and shadow in her only work to use animation to date.

Figure 81. A needle case with a shadow image, c. 1840 ***(Richard Balzer Collection)***[389]

Born in Takasaki, a city in Gunma Prefecture, Japan, in 1968, Yamashita is presently based in New York City. In an interview,[390] she credited her having

[389] Image accessed at: http://www.dickbalzer.com/typo3temp/pics/d033be0882.jpg
[390] Interview with Kumi Yamashita by designboom website, 2015. Available online at: http://www.designboom.com/art/kumi-yamashita-interview-03-05-2015/

been born and raised in Japan as one of the main influences on her work, particularly relating to the minimalist aesthetic of reducing things to their most essential elements and the high level of craftsmanship cultivated there. For her, the light, the material, and its shadow are the essential elements she tries to explore in an effective way. The object itself is not complete without its shadow, and it will be this ethereal shape that will define her work. An example can be found when she places sculpted numbers or letters apparently scattered on a wall. Only when the light source is turned on does the randomness of the placement of those numbers and letters gain meaning in the combined shape of their shadow forms.

The interplay between object and its shadow will also create the wow effect of her pieces in general. Yamashita revisits the early devices revealing the animated image, using an almost imperceptible flicker. Her process is careful and well thought out: She plans her pieces as meaningful site-specific experiences. For her, to make art is a way to connect with people.[391]

The author's first encounter with Ryusuke Ito's work was at the Art Stage Fair in Singapore in 2016. Hidden in a corner of the Kodama Gallery, his installation included children's toys and random objects spread around the floor. Some toys were on top of a vinyl disk, rotating on an old turntable. There were lights, torches, a fish bowl full of water, and a fan. The scene immediately triggers memories of childhood, and as the viewer tries to make sense of all the scattered objects and why they are displayed in that particular way, he or she discovers a moving shadow on the wall. It is, in fact, all these objects in unison that create the magnified shadow of a galloping horse on the wall. The perplexity caused by this discovery then moves the viewer to immediately go back to the objects in curiosity trying to understand how everything works.

Ito is a visual artist and filmmaker born in Japan's Hokkaido Prefecture in 1963. He is also a media critic writing under the pen name *Murasame Kenji*.

[391] Ibid.

His recurrent questioning in his work—if what one sees is actually real—can be connected to the philosophical toy concept. The simple act of trying to discover, or uncover, how an Ito image was generated is part of the ingenuity of his artwork. That can also be exemplified in his other works, as when Ito re-creates Eisenstein's famous scene of the Odessa staircase from the film *Battleship Potemkin* (1925) with a rotating scale model or even when he demonstrates how some special effects in films are created, doing so by constructing and deconstructing the image. His installations are normally accompanied by a projection, as well as physical objects and scale models. What you see on the screen are parts of the objects and scale models on display. He reveals the tricks of cinema, investigating the power of the moving image, consequently returning to animation.

In his beautiful reinterpretation of the zoetrope, *Discovery of Motion Picture* (2006) (Figures 82 and 83), Ito develops a way to re-create the magic of optical toys without making use of the strobe light or traditional slotted drums. The simplicity of his installation is mesmerizing and exciting, composed of the ordinary objects previously mentioned.

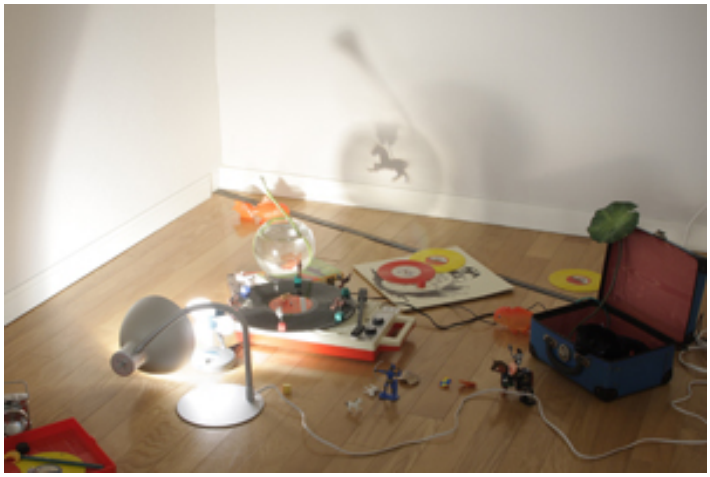

Figure 82. Ryusuke Ito, *Discovery of Motion Picture,* 2006: overall view *(From the artist's website)*[392]

Figure 83. Ryusuke Ito, *Discovery of Motion Picture,* 2006: detail *(From the artist's website)*[393]

[392] Image accessed at: http://www.ne.jp/asahi/r/ito/Installation.discovery.eng.html
[393] Image accessed at: http://www.ne.jp/asahi/r/ito/Installation.discovery.eng.html

The main light source and side flashlight are switched on. Ito glues the toy horses on a disk and turns on the turntable. The fish bowl full of water acts as a lens, magnifying the projection. Yet all these objects are unable to create the animation; a flickering element is needed. The fan placed between the fish bowl and the wall is used especially for that, but with a catch. Normally, in this kind of "projection," the object would be seen as inverted, and in Ito's installation, the horses are seen galloping normally, not upside-down. A closer look at the structure reveals that each horse is positioned upside-down on the turntable, glued on a stick attached to a Lego piece. We can even notice the shadow of the Lego brick on the wall as well. The stick gives a feeling that the horses belong to a carousel, adding a nostalgic charm to the childhood memories the installation evokes. For the effect to be achieved, the artist had to find the correct adjustment to synchronize the speed of the fan and the speed of the rotating vinyl disk. It is this kind of mechanical exploration that helps create such mesmerizing results. In this sense, Ito's work and investigation are reminiscent of Toshio Iwai's work and exploration of the medium to reinvent the early devices.

Similarly, it is no matter if the viewer sees the animated shadow first. The viewers may still become intrigued in discovering how the image is being produced and will then look to the objects that appear to be carelessly scattered on the floor, connect the dots, and try to make sense of what is going on. It is a wondrous curiosity in action, and there is a sense of accomplishment in the discovery.

The environment as a whole exudes improvisation that somehow hides the meticulous and well-thought solutions conceived by the artist to re-create the animation effect. As in a Rube Goldberg structure, each step leads to the next until reaching the grand finale, which in this case is the resulting animated shadow on the wall. The title of the piece is *Discovery of Motion Picture,* referring not only to the childhood discovery of moving images but also to the viewer's discovery and deeper understanding of all the elements needed to create an animated image. The simplicity of Ito's installation

reinforces the origins of moving image technology as being deeply rooted in animation. Each part is essential to create the effect, and the experience of seeing the objects alive makes it much more special.

The horizontal rotating base of the turntable and the shutter created by the fan represent in this piece a disassembled structure of the zoetrope that can also be related to the phenakistoscope and other devices that flicker, even to the Lumière brothers' cinematograph. In separating the phases of the production of an animation, Ito simplifies the process of creating a motion picture as if belonging to a child's play. His work also pays homage to the forefathers of cinema and their inventiveness in creating machines that capture and synthesize the movement of things.

This spirit of inventiveness is exemplified in the artist's choice to use a horse as animated object, which evokes an important reference in the flowering of moving image technology. It was the challenge of discovering whether a horse simultaneously lifts its four legs in the air during a gallop that led Muybridge to develop solutions to prove the fact back in the 1870s. Since then, the horse is a repeated theme and an important reference in the moving image realm. With very few frames a full continuous movement of a galloping horse can be reproduced and repeated in an almost imperceptible loop, as is the case of Ito's work. Much as Toshio Iwai made recent reference to the horse in his phenakistoscope, the theme also appears in Ito's work. With only six toy horses, Ito creates the convincing movement of a gallop, to the delight of the viewer.

On the other hand, Australian artists David Lawrey (1973-) and Jaki Middleton (1979-), working together since 2005, have explored a variety of proto-cinematic devices and Victorian-era trickery—including the zoetrope, thaumatrope, Reynaud's Praxinoscope Théâtre, panoramas, infinite mirrors, and Pepper's Ghost illusion[394]—as means to create their own interpretations

[394] The Pepper's Ghost illusion dates back to the 19th century and plays with mirrors to create a ghostly effect on stage, making a real person appear to be a specter. The effect has been rediscovered and is used in animated product displays.

of some of pop culture's most iconic films and music. Their work combines repetition, the re-use of early image technology, and the remixing of objects. Based in Sydney, Australia, both studied at Sydney College of the Arts, The University of Sydney.

Their specific explorations with optical devices that flicker date to the first half of their collaborative career, today placing greater focus instead on creating installations using the Pepper's Ghost illusion. The most significant exploration of the 19th-century devices made by Lawrey and Middleton was their three-dimensional version of the zoetrope in *The Sound Before You Make It* (2005)[395] (Figure 84). They call their animated installation a "kinetic sculpture," and using a strobe light dome on top of a rotating table, they portray a group of three zombie-like figurines—repeated 32 times around the edge of the circular plate—that dance to "Thriller," Michael Jackson's hit from 1982. The zombies are replicas of Jackson and two other zombie dancers from his famous music video, and their movements, a loop section of the actual dance. The piece has a sensor and is activated when the viewer approaches to take a look.

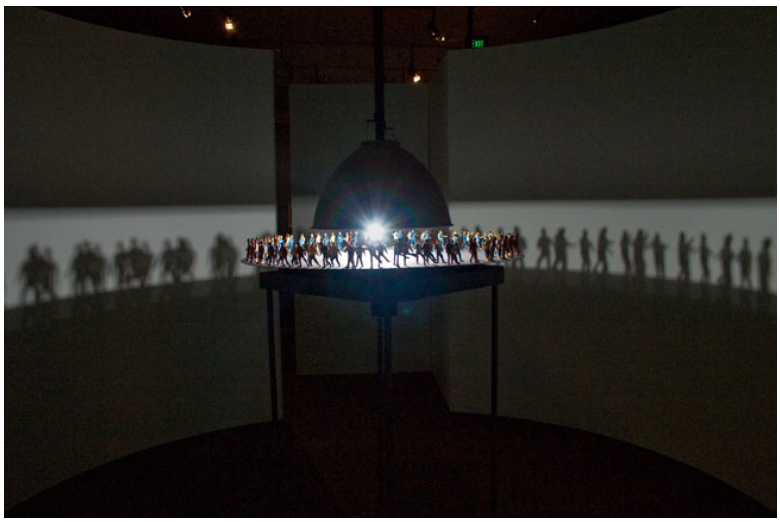

Figure 84. David Lawrey and Jaki Middleton, *The Sound Before You Make It,* 2005 *(From the artists' website)*[396]

[395] This work can be seen at: https://vimeo.com/157976531.
[396] Image accessed at: http://www.wayback.net.au/the_sound_before_you_make_it.php

Even the name of the animated installation comes from the lyrics of the song: “You try to scream, but terror takes the sound before you make it.” In Lawrey and Middleton’s piece, the sound of the pop song reaches the viewer before he or she has time to understand what is happening, but the popularity of the song makes the reference immediately clear. Playing with a symbol of pop culture that is extremely well known, the artists bring the zombies back to life.

In this piece, the surprise of seeing the little zombie figures moving before one’s eye, emphasized by the repetitive excerpt of Michael Jackson’s music, is enhanced by their shadows. The flatness and fuzziness of the dancing zombie shadows seem to multiply and increase their size, as if they were more numerous and closer to the viewer than they actually are, helping create a mysterious atmosphere. The playful association with the pop song may also trigger in the viewer personal memories related to the video clip, its song, and even its dance. *Thriller* has become so popular beyond its generation that every year on Halloween, around the globe, groups gather to reenact the zombie dance.[397] Lawrey and Middleton’s works consistently play with pop culture icons—probably the same icons that influenced their childhood—which may demand that viewers have a similar background to be able to understand the approach of their work rooted in early optical devices of Western culture.

Although each of the artists featured in this section has his or her own style and created a personal interpretation of the zoetrope (and sometimes of other proto-cinematic devices), they all share a common thread: their use of shadow. Both Yamashita and Ito reveal through their work different possibilities for perceiving and portraying an animated image, and their interpretation is rooted in their Asian cultural background. Their work can be further connected not only through the zoetrope but also in its synthesis of the knowledge and technology that belong to all the devices that flicker and rotate, adding to it the ephemeral quality of the shadow play. Lawrey and

[397] A recent example of this was US president Barack Obama’s performance, along with his wife, of the zombie dance at a White House Halloween party in 2016.

Middleton, on the other hand, mix their recollections of Western pop culture, and especially iconic movies, related to their generation with their peculiar interpretation of early optical toys.

Each of these artists renews and refreshes the “wheel of life” that is the zoetrope, which by now has gained different shapes and may even spin in different directions. Notably, all of their works have a physical, concrete nature whose meaning will be given or increased by their ethereal shadow characteristics. And, thanks to their association of movement and shadow, these works are not only reinventing the wheel but also exploring the mixing and remixing of past and present technologies that at different levels create astonishment and wonder while stimulating their viewers to curiously rediscover the way they see and perceive moving images.

3.3.3 Eric Dyer: Spinning Art

Another special case of the reinvention of the wheel is presented in the work of American artist Eric Dyer (1971-). Dyer and Barsamian are the two contemporary artists most often referred to by animation scholars, who recognize their innovative explorations with and as animation. Coming from a commercial background of creating animation for publicity and producing experimental short animated films, Dyer eventually felt the urge to leave the computer screen and do something more hands-on. It was during his Fulbright fellowship in Denmark that the combination of still photographs of his daily experience and zoetrope sculptures merged.

More specifically, his work uses sequential cutouts vertically displayed on top of a turntable. The animated result is shown through the lens of a video camera, with adjusted shutter speed, allowing the animation of the piece to be seen without slits as the camera provides an imperceptible flicker. Originally, Dyer had conceived the work to be seen only as an experimental animation film or even a multiscreen installation. But, as the work triggered the curiosity of people eager to understand his process, he began to display what he calls “cinetropes” together with the films. His debut was at the

Sundance Film Festival[398] in 2007 and since then he has exhibited his work worldwide.

Dyer's work represents the perfect transition from film to animated installation and from these installations back to film. He explores these connections while relying on the intrinsic relationship between craft and film. Thus, he enjoys the best of both worlds: His films are exhibited at traditional film festivals, and his "kinetic sculptures" spin at art galleries. As Dyer has deepened his explorations in animation and optical devices, he has come to place his cinetropes and other works under the more comprehensive term of *spin art*.

From filmmaker and animator to kinetic art sculptor, the different labels and names that define his work may vary, but as he creates contemporary adaptations of early flickering devices, his work clearly falls into the animated installation category as defined in this research. His film/animated installation *Copenhagen Cycles* (2006-2014)[399] (Figures 85, 86, 87, and 88) represents a major turning point in his career. To build his first cinetropes, he printed sequences of footage shot around Copenhagen, selecting loops that range from 18 to 25 frames and assembling them as cutouts in different layers of action running parallel to one another and changing in size, which helped to create a three-dimensional tiered juxtaposition of the cutout images.

[398] The video documentation of the work at the Sundance Festival can be accessed at: https://www.youtube.com/watch?v=uKtnD_xfx3U
[399] Eric Dyer's film can be seen online at: https://vimeo.com/17603523

Figure 85. Eric Dyer's *Copenhagen Cycles,* 2007: setting for his exhibition at Sundance Festival, external room *(Image capture from his video)*[400]

Figure 86. Eric Dyer's *Copenhagen Cycles,* 2007: detail of the internal room setting for his exhibition at Sundance Festival *(Image capture from his video)*[401]

Figure 87. Eric Dyer's *Copenhagen Cycles,* 2014: setting for his solo exhibition at the Ronald Feldman Fine Art Gallery in 2014 *(Artsy Gallery)*[402]

Figure 88. Eric Dyer's *Copenhagen Cycles,* 2014: setting detail for his solo exhibition at the Ronald Feldman Fine Art Gallery in 2014 *(Artsy Gallery)*[403]

The multiplicity of actions occupies the entire screen, and its side-by-side repetition creates moving patterns that may seem hard to recognize at first. The excerpts of the animation are edited and displayed separately on a different screen. In searching for understanding of what the viewer is seeing,

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[400] Image accessed at: https://www.artsy.net/show/ronald-feldman-fine-arts-eric-dyer-copenhagen-cycles

[401] Image accessed at: https://www.artsy.net/show/ronald-feldman-fine-arts-eric-dyer-copenhagen-cycles

[402] Image accessed at: https://www.artsy.net/show/ronald-feldman-fine-arts-eric-dyer-copenhagen-cycles

[403] Image accessed at: https://www.artsy.net/show/ronald-feldman-fine-arts-eric-dyer-copenhagen-cycles

the viewer is invited to explore the cinetropes to make sense of the whole. What intrigues, welcomes, challenges, and ultimately attracts and captivates the viewer is the discovery of the complex structure each of these parts belongs to while witnessing the blurred revolution of the cinetropes turn into animation through the display of the video camera.

Dyer's works, although being defined as modern zoetropes, have a visual quality and certain characteristics more akin to the phenakistoscope. As previously mentioned, this author finds a merging of the phenakistoscope and the zoetrope in contemporary times, particularly in works requiring the use of the strobe light. Both devices have been set free from the slits previously required, and it is now difficult to distinguish them in their contemporary reinventions. Their orientation axis, vertical in the phenakistoscope and horizontal in the zoetrope, is an indicator of their differences, but today's use of three-dimensional objects or even cutouts to perceive the animation from different angles challenges those indicators, merging one into another. To some extent, the classic zoetrope had also incorporated the phenakistoscope when a circular base with patterns was added inside the slotted cylinder.

In *Bellows March* (2009/2015)[404] (Figure 89), Dyer turns to the use of 3D-printing technology to create the march of hundreds of hand-painted concertinas in a cycle of destruction and creation that mimics humankind and its war cycles. As a combination of the phenakistoscope and zoetrope, viewers of this piece can walk around it, looking from the side, the top, or any other angle. In this work, Dyer empowers his viewers to see his 3D-printed cinetropes as alive: His rotating sculptures are, he declares, "a blur to the human eye but come to full animated life when viewed through shutter glasses or the lens of a fast-shutter video camera."[405]

[404] The film by Dyer can be seen at: https://vimeo.com/17314292
[405] As explained by Dyer in the following video featuring his film *Bellows March*: http://vimeo.com/17314292

Figure 89. Still from *Bellows March,* 2009/2015, by Eric Dyer *(From video on Eric Dyer's Vimeo channel)*[406]

When merging digital shutter technology to animate the analog version of his installations, Dyer also enables the viewer to become the editor of his or her own experience, an unusual break from the traditional artist's desire to direct and impose his point of view, as reflected in the animated film version of his work. This idea of a somewhat independent viewer is better exemplified in his project in progress, *Short Ride* (2013-). Here, Dyer proposes the creation of a tunnel where external and internal walls are covered by sequential actions and viewers. Using a strobe flashlight, the viewer will point the light beam to any part of the moving tunnel, thereby enabling animation of that particular section of the work to be seen.

Currently, Dyer is experimenting and playing with scale and macro perspectives in the film format. In shifting the construction of his loop cycles to the vastness of landscape, the work gains life through his videos. Dyer's latest, *Geotrope #1* (2014-2016),[407] presents geometrical patterns cut on grass with a lawn mower. Like giant phenakistoscopes, these large-scale drawings are filmed from above by drone, and spun later using the software After-Effects. With patterns extremely similar to the early Faraday wheel, Dyer's animated results play with the different speeds at which each section of the circle moves, referring to and demonstrating the movement of

[406] Video accessed at: https://vimeo.com/17314292
[407] Video excerpt accessible at: https://vimeo.com/172637061

translation proposed by Carpenter. The end effect is then compiled, cut, and transformed during the digital editing process, and the final film embodies all these experiments with shapes, movement, and sound. In this way Dyer's work has evolved from an exploration of different patterns in a city to the discovery of the "moving" beauty hidden in patterns found in utility holes and umbrellas to the animation of nature.

Returning to historical and aesthetic traditions, however, it is impossible to avoid comparison of Dyer's new explorations with the aerial patterns found in the 1930s Busby Berkeley (1895-1976) film musicals orchestrating the synchronous movements of chorus girls. As a military parachutist, Berkeley had acquired the experience necessary to give him a novel perspective explored in the innovative musical numbers he conceived. Resembling living and moving phenakistoscopes, Berkeley's patterns set the camera free, creating an essentially aesthetic experience where the part disappears in the whole. In a sense, the experiments with patterns and sounds made by Dyer relive in the film format a tradition begun with optical devices and further reinvented by Berkeley, which demonstrate that animation is always reinventing itself through the imagination and creativity of artists.

Of all the artists selected for this study, Dyer is probably the one who best navigates between the intangibility of digital film and the tangibility of sculptures (some kinetic, others not). His projects are inventive and make great use of the devices that flicker, pushing them to a new level of exploration not necessarily detached from film but dialoguing with it in new ways and presenting original convergence points of coexistence. What his viewer cannot experience live will be synthetically created in his experimental animation films. Although Dyer is currently exploring the enlargement in scale of his work, which as a result requires it to be seen on traditional screens, the size does not necessarily interfere with the overall experience of the viewer, as happens in the case of Barsamian, Collishaw, and particularly Hudson. Therefore, Dyer's work falls better in this section about the specific reinventions of the wheel than among large-scale animated installations.

Under the influence of animated film and still fascinated in exploring the different patterns created by found objects or exhibited in unusual formats, Dyer also explored zoetropic creations with printed animated sequences on the external side of balloons and on vinyl disks. His transition from the physical or material to the ethereal or immaterial world naturally closes the section of animated installation reinventions, and his screen-based films fluidly lead into the next chapter focusing on works using the zoetrope and other devices that flicker created especially for the screen rather than dealing with the improvisation and spontaneity brought by the live experience and performance.

3.4 Conclusion

As evidenced by the reactions of people documented on videos and interviews, the astonishment and wonder created by the animation of the works analyzed in this section is so strong that it may compensate for today's inability to replace and exchange the animation loops as was possible with the early zoetropes and their interchangeable strips. The focus on a giant size and/or inventive unconventional animated installation, portraying fixed actions embedded in the three-dimensional quality of its sculptures becomes the main focus of the viewer. As their content may be from dreams, history or everyday life, the fact that its animated actions seems "so real" is what is astonishing about these works. Their techniques enhanced the magical quality by making the magic real. This merger of dream and reality is what is wondrous because there is no screen and the animation is physically happening in front of the viewer. The flicker is the key element in compressing spiral time and looping space as a new kind of zoetrope. Furthermore, the increase of the structure to larger scales often compensates for losses in interactivity and control by the viewer/user, particularly because the skillful craft and hard work involved in bringing these pieces to life are recognized and appreciated. The handmade quality and texture elicits empathy and admiration on the part of the viewer.

According to the scientist and scholar Arthur Shimamura, when referring to Merleau-Ponty's suggestion that paintings can enhance the "bond between creator and beholder,"[408] the traces of the physical manipulation of the creator are strong causes of empathy in the viewer of an artwork. Yamamura even arguably mentions that movies, music, and literature have "never been physically touched by its maker."[409] In the case of most animated installations—3D-printed ones being a notable exception—with its sequential objects sculpted by the artist through a laborious process, as handheld objects, manipulated and carved by this same artist can be considered as traces of its creator increased by the animation they portray, endowing with life and motion those shaped objects.

The artists introduced and investigated in this chapter may believe[410] that animation is merely a vehicle to express their artistic views, but in fact, the animated illusion they create is a major component in making their pieces impactful, potent, and memorable. Even when appealing to violence and a more irrational and bizarre side of human nature, viewers enjoy the illusion of perceiving their characters as living creatures, which is made possible through animation. Beyond cartoonish stereotypes and beyond the screen, these artists are proposing a broader and inclusive use of animation in art galleries, museums, and public spaces. Their renewal of early optical devices with a contemporary interpretation is an innovative source of surprise and magic fundamental to the elicitation of astonishment and wonder, bringing deeper awareness of perception, and questioning of reality, leading to new possibilities for the viewer to consider other visual phenomena through visual thinking, art and animation.

The welcoming of these animated installations in spaces traditionally reserved for the fine arts raises awareness of the historical past of image technology while allowing classical works of art to be seen in a new light and

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[408] Arthur P. Shimamura, *Experiencing Art: In the Brain of the Beholder* (New York: Oxford University Press, 2013), p. 241.
[409] Ibid.
[410] At least the ones interviewed by the author have expressed themselves as seeing animation as a vehicle or a tool to express their artistic views.

through a new lens, as in the case of Collishaw's *All Things Fall*, for example. The encounter of animation and art away from the traditional flatness and framework of a screen renews their illusionistic nature when concrete characters or objects gain movement as if endowed with life. In this sense, it evokes the analogous investigations that occurred during the avant-garde movements of the 1920s and 1960s but this time having animation as the center of the investigation, proposing alternatives to advance the field of animation away from animated films and cartoons.

Ephemerality is a common characteristic of the majority of the works discussed in this chapter—with the exception of the ones that belong to permanent collections of museums and are being exhibited. The brief live experience they offer is outlived in their video documentation, which attempts to transpose the liveliness of a subjective experience to the film format. Evidence of their breathtaking and wondrous effect is recorded and thus becomes the most lasting evidence of their existence.

Chapter 4: Device Films and Other Cases of Troping

Watching, by definition, is different from doing.
—Noah Hawley

4.1 Introduction

This chapter addresses creations—both artistic and relating to publicity—that constitute animated installations inspired by devices that flicker and rotate but engage with their viewers only on a screen, without direct, concrete physical interaction. Here, the works of Alexandre Dubosc and Jim Le Fevre and others developed for advertising purposes, such as the Sony *Braviadrome*, the Airbnb zoetrope and Stella Artois' *Pay a Lady a Drink,* are investigated and categorized by this author as *device films*, for lack of a better term. This overall selection of works and artists has to date gone uncategorized and without examination from a scholarly perspective, a task which this thesis seeks to precipitate.

This section explores the *device film,* a growing phenomenon related to the production and display of contemporary animated installations, and other cases where early flickering devices have been used to create what the author calls *troping*[411] *art.* Although in device films the astonishment and wonder of the live experience become diluted, this visual media expression plays the important role of registering, displaying, and popularizing animated installations through film. Device films range from the documentation of the concrete pieces previously discussed, including advertising pieces, to low-budget CGI (computer graphics imagery) zoetropes. Device films can reach out to faraway viewers who probably would never otherwise experience the real pieces. With its innate pros and cons, this category delights its viewers in the materiality of the installations and unconventional solutions found to market a product or present an artwork. Everything about the device films

[411] *Troping* is used throughout the thesis both to pay homage to the early optical devices that spin and to refer to the spinning movement related to a contemporary piece that in some way simulates the movement of these classic animation devices.

elicits tactility, even in their virtual computer-graphics versions. They are a particular example of what George Griffin has labeled *concrete animation*, and the ones selected for inclusion here have a direct relation with early optical devices.

In this category, advertising pieces are analyzed in terms of innovation and the physical structure that proposes a reinvention of early optical devices that flicker and rotate. In fact, the choice to publicize a brand or a product by building a physical and intricate structure is evidence of the appeal of such awe-inspiring animated installations, a feeling that advertisers want to have associated with their brands. Therefore, cases such as the Sony *Braviadrome* (2008), *Temperley London Spring Zoetrope* (2010), Alexandre Dubosc's caketropes (2011-2015), Airbnb zoetrope *A Different Paris* (2015), and Stella Artois zoetrope *Buy a Lady a Drink* (2016) represent creative contemporary uses of animated installations inspired by the zoetrope and used as advertising tools. However, despite their astonishment factor, their final result usually can only be appreciated in a movie demonstrating them, the *Braviadrome* and the *Temperley* being the exceptions as they were publicly exhibited.

When studying other troping cases later in the chapter, the work of Japanese artist Akinori Goto is investigated as one of the most recent and innovative explorations in reinventing the zoetrope in association with digital technology. Goto's piece was not conceived as a device film or advertising piece as it was publicly exhibited in Japan. However, the work went viral on the Internet precisely because it was shown and shared as a demo video. Other curious cases of contemporary explorations of optical devices using the most varied materials and creative solutions are cited to exemplify the growing trend of using the Internet as gallery to showcase artworks.

Unfortunately, the nature of the physical animated installation condemns these pieces to be forgotten, no longer in use and relived only through their films, as is the case of the majority of the case studies of Chapter 3. In fact,

this ephemerality is characteristic of all animated installations exhibited for a short period of time. As ephemeral pieces, these works post-exhibition can live on only through their device films, which enable access and serve as a collective memory, including for studies such as this research. Therefore, although not having the live experience as a characteristic, the device films are an essential part of sharing and giving access to the experience.

The making of these pieces of ephemeral art represents a tour-de-force, sometimes employing cutting-edge technology. Such was the case for the 2016 Stella Artois zoetrope: A large, robotic motion-controlled camera was used to film the device composed of hundreds of glass cups. However, with the effort is delivered a superior film, making use of editing, camera angles, and cinematic code to reproduce for the public as best as possible an experience they will never have live. For this very reason it may seem useless to put so much effort into the construction of such mechanical and intricate pieces, yet here lies their "x factor." The absurdity of such pieces and their unconventional appeal, particularly considering that their publicity film lasts only a few minutes (if that), defy logic.

4.2 Device Films

A perfect example of the unusual or even unthinkable is the Fallon agency campaign *Color Like No Other* for the release of the Sony Bravia TV in 2005 to 2008: The agency proposed that the company avoid computer graphics to demonstrate the highly sophisticated technology presented by the Sony product and create instead crafted physical experiences. Such daring generated remarkable advertising pieces, including the release of more than a half-million colored bouncing balls on a San Francisco street; the invasion of a square in New York City by hundreds of Play-Doh stop-motion bunnies, animated by a group of 17 animators from the animation studio Nos;[412] the explosion of bags filled with colored paint on a building to be demolished;

[412] More information about Nos animation studio can be accessed at: http://www.studionos.com

and the construction of the world's largest zoetrope,[413] the *Braviadrome,* in a square in Venaria, Italy.

The huge success of the campaign was reflected in the public's reception of the Sony Bravia brand, as noted by David Patton, Sony Europe Vice President Of Marketing Communications: "I learned that creativity really does work. A big idea, executed in a simple, bold and iconic way across a range of different media, directly contributed to the success of the Bravia business in 2005/2006."[414] The Bravia case established a trend in the repurposing of analog technology and became an awarded campaign.

Figure 90. Sony *Braviadrome (From the commercial, uploaded to YouTube)*[415]

The *Braviadrome* (Figure 90) is the only piece in the campaign inspired by a device that flickers and rotates. Having a diameter of 9.9 meters (32.5 feet) and featuring the Brazilian soccer player Kaká endlessly dribbling a ball, the large size of the piece allowed a longer loop to be displayed, consisting of 64 images of the player, backlit, and using a very narrow slit to ensure a sharper image. As the flickering devices are hard to film, probably either the frame

[413] It is listed in the online *Guinness Book of World Records*, available at: http://www.guinnessworldrecords.com/world-records/largest-zoetrope

[414] "Case Study: Sony Balls." D&AD website. Available online at: http://www.dandad.org/en/d-ad-sony-balls-case-study-insights/

[415] Video accessed at: https://www.youtube.com/watch?v=5xPFVuFxObY

rate on the camera was synced or the black frames were cleaned up in postproduction to enable viewing of the final video without interference.

As documented in the Braviadrome video shows, the people who experienced the animated installation live were absolutely caught by surprise.[416] Sony's giant zoetrope had a futuristic look that contrasted with the traditional architecture of the Italian city in which it was placed. The choice of using a large-scale zoetrope was justified in the demonstration of the 200 Hz motion flow feature of the new Sony Bravia television. Motion flow allows the flickering rate to be smoother, which ensures a higher-quality image, almost as if inside each new Bravia TV was a modern and improved zoetrope.

The *Temperley London Spring Zoetrope*[417] (Figure 91) wraps sequential footage of circus performers, acrobats, and models, re-creating a vintage circus around an elongated cylinder, 3.6 meters (nearly 12 feet) tall. Without any slits, the piece comes to life through the manipulation of the shutter speed of the video camera, while an old-style camera (resembling a Lumière cinematograph) placed on a moving platform appears to simultaneously shoot the film. A projection in the background of close shots of each layer of the device amplifies the rich texture and design of the structure, while animating the images of the zoetrope.

[416] The *Braviadrome* ad is available online at: https://www.youtube.com/watch?v=5xPFVuFxObY
[417] The Temperley zoetrope can be seen online at: https://www.youtube.com/watch?v=rjoH36waNHU

Figure 91. *Temperley London Spring Zoetrope (Legs Production Company)*[418]

The piece was used for two film spots in addition to being displayed as a traveling installation throughout the spring fashion season of the Temperley brand collection. In one of the films, the installation and screen projection were combined, while in the other, the detail of the animation displaying the clothing collection is featured in the moving stills of the zoetrope as straightforward advertising. To complete the publicity loop, the Temperley zoetrope was also re-created digitally and portrayed on the company's website where it could be virtually manipulated and studied in detail by online

[418] Image accessed at: http://glossyinc.com/misc/legszoetrope.html

viewers. The ornaments and vintage circus look, in sync with the clothing collection, helped create a unique atmosphere, enhanced by the jazz music that accompanied the campaign. This multiplicity of media in which the zoetrope was displayed denotes an attempt to modernize and expand public outreach, attracting different viewers and striving to amplify their experience by creating an old-time look to sell modern clothes displaying a mix of models and circus performers.

In France, the animator Alexandre Dubosc has created his own peculiar style of device films inspired by zoetropes and praxinoscopes. In combining the French culinary tradition with optical devices, Dubosc's "caketropes" have attracted millions of hits on YouTube. Using a combination of stop motion and flickering control in the camera, he animates multilayered cakes made of clay and cardboard. In his rotating animated cakes chocolate, candies, raspberries, and popcorn come to life.

Within device films, Dubosc has created a niche, a style of his own. In playing with food he aims to trigger memories that not only are visual but also activate the senses of taste and touch in viewers. As his fellow countryman Marcel Proust did when evoking feelings, memory, and perception in his remembrance of tasting madeleines,[419] Dubosc plays with the same spectrum of sensations, but conjuring chocolate that moves. His pieces immediately arouse a craving to eat them, and the most common request the animator receives is people inquiring if they can eat his cakes. However, food behaves differently than from clay, and the pieces required time and partnership with pastry experts to achieve the perfect combination of animated look and taste.

In 2014, Dubosc finally did create animated edible cakes, and the result was presented at the 20th anniversary of the Salon du Chocolat. Titled *StroBeaux Gateaux*,[420] his cakes were animated live using a strobe light and eaten

[419] Marcel Proust, "Combray," in Remembrance of Things Past, part 1: The Walk by Swann's Place (1913).
[420] More information is available at: http://strobeaux.blogspot.sg

afterward. To name his creations, the animator uses many puns in French that refer to food or the pleasure of eating, making the humor another ingredient of his works. For instance, he calls his short films *"court-mandises,"* playing with the French word for the short film (*court-métrage*) and the word *gourmandise,* which is associated with gluttony. In Dubosc's works, form and content are well harmonized beyond the animating technology.

Using a mix of stop-motion animation, optical devices, and technology, Dubosc has created to date a total of 13 short films, among which seven display different animated cakes. To ensure correct placement of the frames, he uses a tabletop stand—where a camera/projector can be placed above the object/cake—projecting the computer-generated layout on top of the cakes to guide his positioning of each piece of clay. Laser-cut patterns and recent advances in food printing are also convenient facilitators. His entire process is documented and explained on his website.[421]

His two most-acclaimed caketropes are *The Caketrope of Burton's Team*[422] (2012) and *Melting Pop*[423] (2015) (Figures 92 and 93, respectively). In the former, Dubosc pays homage to Tim Burton's films, portraying a few characters and symbols from the director's creations, from Jack Skellington to Batman. Burton's humorously creepy style is also represented when the cake reveals itself as a "living" smiley monster at the end of the video.

Figure 92. Alexandre Dubosc, *The Caketrope of Burton's Team*, 2012 *(From the artist's website)*[424]

[421] Alexandre Dubosc website: http://alexandre-dubosc.com
[422] Available at: http://www.alexandre-dubosc.com/web3/the-caketrope/
[423] Available at: http://www.alexandre-dubosc.com/web3/melting-pop/
[424] Image accessed at: http://www.alexandre-dubosc.com/web3/film/

In *Melting Pop*, Dubosc makes humorous reference to popcorn and chocolate, although the *pop* in the name of the film also refers to pop culture, as represented by Pac-man and the device film's speed of action and sound effects. His cakes are attractive pieces that combine multiple references to films and popular culture playing with actions that have a cause and effect. The awe factor is augmented by their being real concrete pieces, crafted and built in a laborious process, that inspire cravings for an experience that goes beyond the senses of vision and touch to include taste as well.

Figure 93. Alexandre Dubosc, *Melting Pop,* 2015 *(From the artist's website)*[425]

The Airbnb zoetrope[426] entitled *A Different Paris* (Figure 94) was aired as a savvy advertising campaign on the Internet in 2015. It was created by TBWA agency in Singapore and built in Sydney by the Yippee Ki-Yay Workshop. The multilayered zoetrope, 3.8 meters (12.5 feet) in diameter and 1.5 meters (5 feet) in height, was used to demonstrate the kind of experience Airbnb users can have while traveling. Airbnb is a relatively new concept of "travel agency" grounded in a trusted community network. Founded in 2008, the company claims to provide "unique travel experiences"[427] to its users, who can visit different places and live as locals, not as tourists, for short periods of time. To give their users a taste of this and to clarify the company's vision, Airbnb chose a large three-dimensional zoetrope to convey its message.

[425] Image accessed at: http://www.alexandre-dubosc.com/web3/film/
[426] The Airbnb zoetrope can be seen at: https://vimeo.com/140178908
[427] Airbnb description as found on its website: https://www.airbnb.com.sg/about/about-us

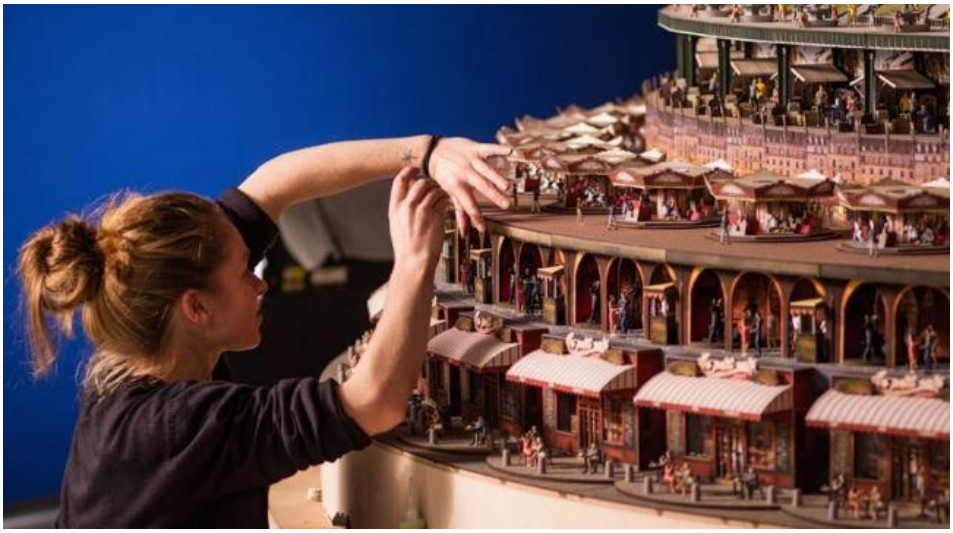


Figure 94. The Airbnb zoetrope, entitled *A Different Paris,* 2015 *(Source:* AdWeek *article)*[428]

The ad starts with real footage of a girl dressed in a pinkish dress looking at a window where a scale model of the Eiffel Tower is seen. The narration of her experiences in Paris guides the visual story, and the camera moves from one layer of the zoetrope to another. The Airbnb zoetrope had in total six animated layers representing different sights of Paris, topped by the iconic Eiffel Tower, the only part of the entire installation that did not rotate. Each layer portrayed the following sites: a park next to the Eiffel Tower, a flea market, a carousel courtyard, a nightclub, a Parisian café, and the original room where the girl, now a puppet, is looking at the window, remembering everything she did in the city. Her flesh-and-blood alter ego is then pictured preparing to leave the city, choosing another place to visit on the Airbnb website. Incorporating 1,680 3D-printed figurines and consisting of 11,256 assembled parts, the hand-painted zoetrope exudes the craftsmanship behind it. The characters were 3D printed, but many of the details had to be assembled, colored, and manipulated by hand.

In the advertising piece, the camera movement never reveals the entire zoetrope, and although the action is happening simultaneously on each layer, the camera focuses on only one action section at a time, isolating it from surrounding repetition. The character of the girl is distinguished by her dress

[428] Image accessed at: http://www.adweek.com/adfreak/airbnb-built-giant-3-d-zoetrope-wild-ad-showing-you-different-side-paris-167087

and can be easily identified at each location. The loops are very smooth, mixing characters that make a very subtle lifelike movement with characters that do not move. Some of the loops are composed of 36 repeated sets in the same level, as is the case of the carousel layer. The figurines are also very small, and the camera amplifies the set details, enhancing the puppet-like and handmade feel. The zoetrope is used as a narrative device in which the camera directs the gaze of the spectator and shows only what is important for the scene.

The mix of memory and toy-like moving sculptures creates an atmosphere of enchantment and nostalgia, precisely the immaterial goals that Airbnb wishes to provide to its customers. The choice of using an animated installation to inspire these feelings transports the Victorian-era optical device into the 21st century while advancing its storytelling potential with the help of technology and traditional film editing, re-exploring innovation achieved with the classic zoetrope through zoetropic editing in the past.

Another advertising campaign to feature a large zoetrope was *Buy a Lady a Drink*[429] for Stella Artois beer (Figures 95 and 96). Conceived by the British agency Mother and built and shot in Mallorca, the ad features the partnership between Stella Artois and the NGO Water.org, aiming to ensure access to clean water to communities in developing countries. According to the campaign, more than 760 million people around the globe lack access to clean and safe water. With each purchase of one of three specially designed chalices that Stella Artois was selling, consumers could ensure five years of clean water to those communities in need. Despite concerns regarding sexism as suggested in the campaign's title, the cause was recognized as benevolent, and the controversy in fact helped draw more attention to the campaign.

[429] This device film may be viewed at: https://www.youtube.com/watch?v=LfsufdBSFN8

Figure 95. Stella Artois advertisement, *Buy a Lady a Drink,* 2016, view of the structure *(Source: AWN article)*[430]

Figure 96. Stella Artois advertisement, *Buy a Lady a Drink,* 2016, detail *(Source: AWN article)*[431]

The cylindrical tower of chalices is composed of 384 glasses, each portraying a still drawing of the animation sequence. The images were laser cut and pasted individually by hand on each chalice. The entire structure had to be sturdy to avoid shaking during the rotation, which could not only break the glasses but also interfere with the perception of the animated illusion. Each glass was assembled on top of a laser-cut Plexiglas structure, ensuring that they were precisely positioned about each other with cuts that fit perfectly each glass. The trickiest part was the lighting of the piece as both glass and Plexiglas are extremely reflective materials. This is probably one of

[430] Image accessed at: http://www.awn.com/news/1stavemachine-reimagines-zoetrope-stella-artois

[431] Image accessed at: http://www.awn.com/news/1stavemachine-reimagines-zoetrope-stella-artois

the reasons why control of the shutter speed via a motion-control camera was preferred to animate the piece rather than strobe lights, which would create numerous sparkling spots when reflected on the chalices.

Using a spiral structure similar to Barsamian's pieces, the Stella Artois animated installation was able to tell a longer sequential story. The correct adjustment of the camera shutter speed and the spinning speed of the structure was synced to the point at which the viewer was able to forget about the moving sculpture and focus on the story it narrates when the camera zooms into the structure. A motion-control camera in a synchronous upward movement was able to ensure that. In this case, the film shows to a larger audience what would be very hard for a person to see when experiencing the same piece live: the actual animation. As the glass tower is high[432] and the images are small stickers placed on the chalice surface, the action taking place at the top of the structure would be very hard to see. Also, strobe light or projection would be needed to exhibit the piece live. No register of the public display of this piece was found by the author.

When controlling the camera's shutter speed, the spinning of the glass tower structure is frozen, and its sculptural shape gives way to the story being told. A woman who used to spend time walking long distances for clean water for her family is now able to use her time to grow and sell vegetables, educate herself, and help in her community. By empowering these women to invest their time in the improvement of their lives, the entire society is benefitted. The physical spiral represented by the tower of glasses portrays the evolution of these women and how their lives improve once they have ready access to clean water and can invest their time instead in education, for example. From the beginning to the end of the film, the empty chalices begin to fill with water. This positive analogy aims to mimic the goal of the campaign and the difference a small gesture can make in the lives of millions.

[432] Exact measurements are not provided.

All the film devices referred to here have in one way or another facilitated the access of a large number of people to the animated installation through the Internet, television, and other screen-based media. The editing and film strategies allied with the material appeal of these physical pieces creates a sense that dreams are extended and externalized in the physical world. The loss of actual interactivity is compensated by different camera angles, the direction of the scene (you see what the director wants you to see), the creation of behind the scenes, and production videos. These sculptural pieces have a popular appeal as they represent crafted, intricate works, and in the case of advertising campaigns, they can employ cutting-edge technology in association with artistry, something that can be out of the reach of many artists.

The amount of money involved in these advertising campaigns is far greater than the budgets of many of the previously mentioned artists in Chapter 3. However, it is art and skilled craftsmanship that inspire these campaigns, and with money and technology at their disposal, these pieces of advertising advance the investigation and adaptation of early devices into contemporary times. The exploration of different aesthetics, materials, objects, and media is in accordance with the concept and story to be told. Some of these device films use these animated installations as machines that usually would be seen as disconnected from the product they are representing. These ads invest in the wondrous effect those machines inspire, attempting to manipulate the viewer's emotions and feelings to create a desire for the product being sold. Strategies used to reinforce the awe effect of those advertising pieces are related, although not limited to, their gigantic scale (*Braviadrome*) or their charming vintage look (Temperley zoetrope) or the mix of senses that they inspire (Dubosc's caketropes). However, pieces such as Airbnb's and Stella Artois' have a story to tell, and they use the zoetrope to enhance the feeling and emotional connection they aim to inspire.

Another increasing tendency related to device films is the creation of virtual zoetropes—as digital reproductions and with structural design similar to

some of the examples previously mentioned—as products of a combination of ever-improving software and the ever-increasing skills of digital technology artists. Virtual zoetropes are intangible versions of pieces that have the potential to be turned into physical installations. The majority of the zoetropes reconstructed today as animated installations are first built and tested on the computer, as virtual zoetropes—as does Mat Collishaw, for instance. This ensures that the animation is precise and all the items are in place, reducing production costs. However, some of these virtual zoetropes are never physically constructed for financial or creative reasons or owing to time constraints. The MTV Zoetrope[433] and the "Art of Prosperity" ad for Chartered Accountants ANZ[434] are cases in point.

The MTV Zoetrope (Figures 97 and 98) was created in 2012 as a spot to open the MTV European Music Awards. The entire piece was constructed virtually to mimic the functioning of a real zoetrope, including the advantage that when spinning at the indicated speed, the animation is perceived due to the embedded flickering speed and frame rate of monitors and televisions. This particular piece was also used for an online game[435] employing WebGL[436] technology to facilitate its rendering and virtual manipulation, expanding the possibilities of user interaction with the virtual piece.

Figure 97. The MTV Zoetrope, 2012: view of structure *(Source: MTV video)*[437]

[433] The virtual MTV Zoetrope can be seen at: https://vimeo.com/53282354
[434] The "Art of Prosperity" ad can be seen at: https://www.youtube.com/watch?v=DIpujwLrWMg
[435] The game can be accessed and played here: http://lab.sehsucht.de
[436] Web Graphics Library, or WebGL, helps speed up the rendering process of 2D and 3D images to be seen online.
[437] Video accessed at: https://vimeo.com/53282354

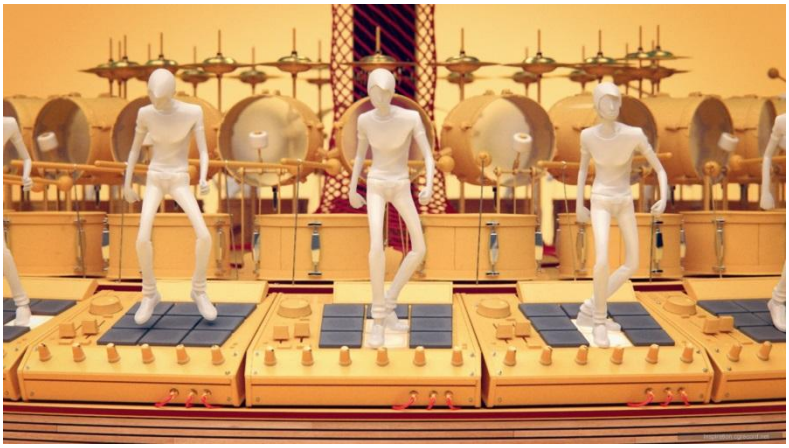


Figure 98. The MTV Zoetrope, 2012: detail *(Source: MTV video)*[438]

In the game, the user puts the virtual zoetrope in to spin by dragging and clicking the mouse on top of it. When the game starts, the user moves the mouse sideways or the mouse wheel up and down, following the beat of the music. While doing that, different views of the zoetrope can be activated by pressing different numbers on the keyboard.[439] The virtual MTV Zoetrope has four main layers that represent young people, from garage bands to the top, where they become rock stars. The different phases of the game are based on these layers of the zoetrope. To pass from one phase to another, the user needs to get the spinning bits right, which is not easy for first timers or people not very well acquainted with game speed-control manipulation. The virtual zoetrope is free from the "normal" laws of physics as its behavior can be programmed. Since its top layer is larger than its base, the piece would be much more complex, time consuming, and expensive to actually build than its 3D CGI modeling shows.

On the other hand, the 2016 "Art of Prosperity" ad for Chartered Accountants ANZ (Figure 99) is inspired by the caketropes of Dubosc. However, rather than investing in the laborious process of producing a Dubosc cake, the organization opted to produce its more affordable virtual version. The CGI model imitates texture and even flaws that would normally be found in

[438] Video accessed at: https://vimeo.com/53282354

[439] By pressing 1, it is possible to pan the camera; by pressing 2, the user can zoom; and by pressing 3, the camera can be rotated. This mobility of the camera creates interactivity just as in a video game.

handmade clay objects, creating textures and a look that try to evoke the same appeal as the work of the French animator, who was not involved in the project.

Figure 99. "Art of Prosperity" advertisement for Chartered Accountants ANZ, 2016 ***(Source: ANZ video)***[440]

However, as Dubosc has become very well known, the imitation of his style by the bank advertisement has raised angry comments by viewers who watched this ad online, as demonstrates the YouTube comments of this video. This probably caused bad publicity for the company. This case shows that sometimes to simplify the process does not guarantee the success of the product. The charm and appeal of such pieces lie in the human effort and craftsmanship they demand, even if the final product is essentially a film.

Development of 3D printing and its accessibility to the general public have helped many of these modern zoetropes come to life. The quantity of these device films appearing on the Internet every year is in direct correlation to the growing ubiquity and pervasiveness of digital technology. The Maker movement and the DIY trend play a leading part in the pervasiveness not only of technology but also of technology associated with craft. With the facility of accessing videos online that teach the viewer how to do almost anything,

[440] Video accessed at: https://www.youtube.com/watch?v=DIpujwLrWMg

common users can create their own zoetropes using any method available to them.

On the Internet, along with videos of artists and miraculous advertising films, it is possible to find homemade videos recording the creations and experiments of people who may not know how to master the editing of their videos but succeed in presenting their prototypes. Thus, together with creative new versions of the early optical devices, is the reconstruction of the same devices in their classic structural glory, sometimes with ingenious twists and solutions to make them spin, sometimes with inventive content.

4.3 Other Cases of Troping

A recent case that went viral on the Internet is a zoetrope-like piece created by the Japanese media artist Akinori Goto. The work was publicly presented during the 2016 Spiral Independent Creators Festival[441] in Tokyo. The two known versions of the device patented by the artist are *Toki: Walk* (2015)[442] and *Toki: Ballet* (2016)[443] (Figures 100 and 101). Both pieces follow the same principle and the artist's attempt at merging space and time. Using an animated cycle of a man walking in one piece and a woman dancing in the other, Goto increases the number of in-between "frames" of the movement to such a degree that when displayed on a circular structure these sequential three-dimensional shapes merge into one another forming a solid circular structure that he later 3D-prints, as can be seen in Figure 102.

When placing the 3D-printed morphed structure on top of a rotating table in a dark environment, he uses a thin beam of light pointing out only one section of the structure, illuminating what would be traditionally called a "frame." The light, in the beginning, remains still, and the animation is perceived because of the rotation of the intermittent blended shapes that still

[441] Spiral Independent Creators Festival website accessed at: http://www.sicf.jp/
[442] Video and explanation of the artist's process are available at: https://www.youtube.com/watch?v=tqEVTfGqo8M
[443] The actual name of this piece is unknown as information about it is not provided on the artist's website or in other media-related articles about his device.

have a small gap between them (Figure 100). By looking at the organic waves of the circular structure, it is hard to identify precisely what will be their movement. Yet, when precise lights are switched on to illuminate specific sections of the device, the movement emerges. The same principle works for the walking man and the dancer pieces. The increase in the number of frames makes the movement extremely smooth. By using multiple lights, it is possible to illuminate almost every frame in the structure, and by moving the light, a movement within the movement is created.

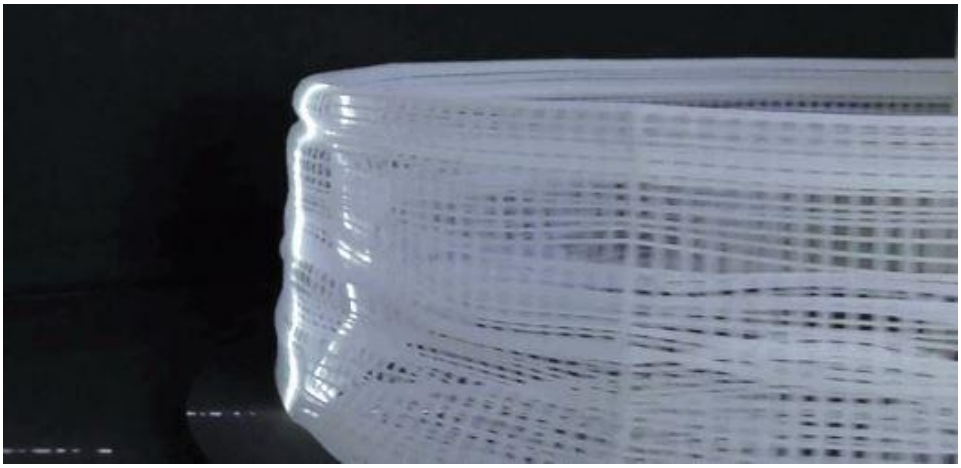


Figure 100. Akinori Goto, ***Toki: Walk,*** **2015** ***(From videos available on the artist's website)***[444]

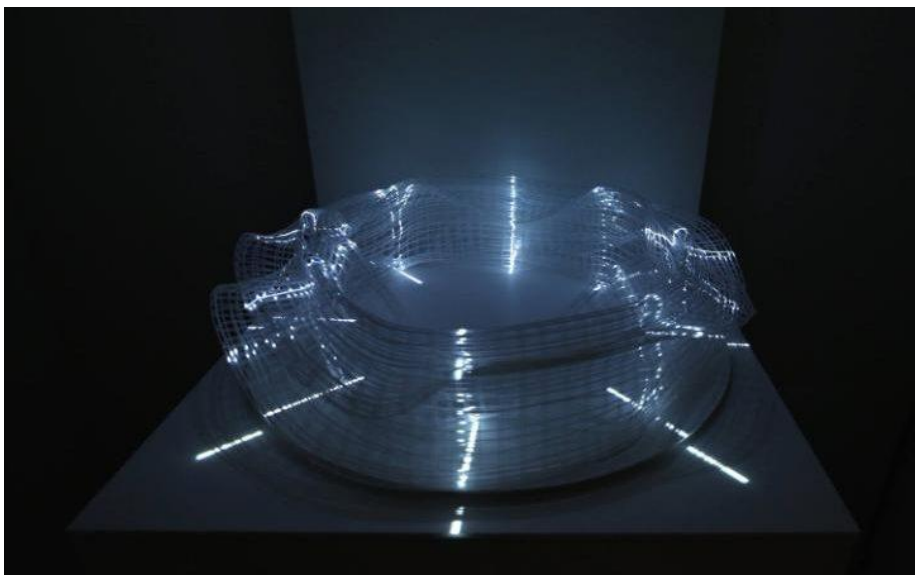


Figure 101. Akinori Goto, ***Toki: Ballet,*** **2016** ***(From videos available on the artist's website)***[445]

[444] Video accessed at: http://akinorigoto.tumblr.com/
[445] Video accessed at: http://akinorigoto.tumblr.com/

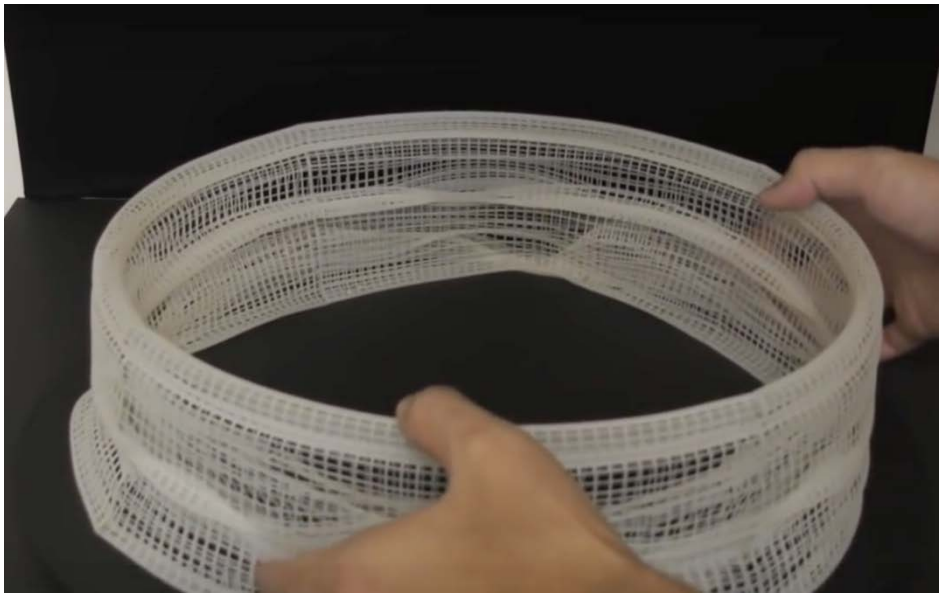


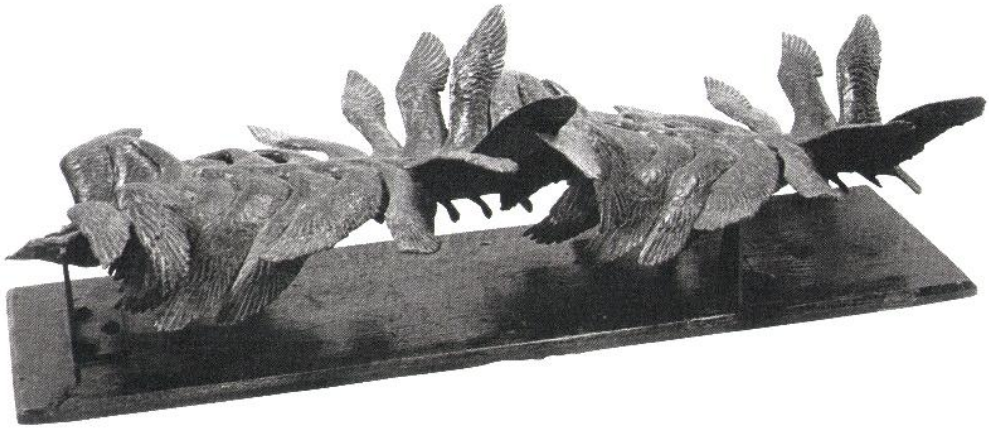
Figure 102. 3D-printed cylinder for *Toki: Walk* (2015), by Akinori Goto *(From video available on the artist's video)*[446]

Once again technology plays a key role in instilling astonishment and wonder in the viewer while also renewing experiments and possibilities already proposed in the 19th century. As the work represents what seems as miniatures "living" people it makes dreams come alive in the physical world again, in a poetical way using light. Marey, in his obsession to understand the flight of birds, created a bird sculpture in which their movements merge into each other (Figure 103), while his chronophotographs merged time and space into photographic stills. Norman McLaren, almost a century later, transposed Marey's aesthetic into the film *Pas de Deux* (1968). Now both heritages merge into Goto's work, combining animation, actual objects, 3D printing, and lighting to "blow the viewer's mind."[447]

Now, more than ever, devices from the past can be reanimated and reinterpreted with the help of cutting-edge technology, which makes them contemporary representations of current worldwide cultural trends, even though in the majority of the cases they are created as a one-time-only exploration. At the same time, they experiment with different materials,

[446] Video accessed at: https://www.youtube.com/watch?v=mJtgSNI2me8
[447] Many articles featuring Goto's work described it as "mind-blowing," one example can be accessed at the *Telegraph News* online, accessed at: http://www.telegraph.co.uk/news/2016/07/10/spinning-3d-printed-zoetrope-creates-dancing-ballerina-illusion/

merge different devices, and create reinventions of those devices made with a wide variety of materials and techniques, including devices that are embroidered; [448] are made of chocolate; [449] demonstrate mathematical principles;[450] constitute theme park attractions;[451] are created on top of vinyl disks, [452] pottery, [453] furniture, [454] jewelry, [455] umbrellas, [456] carved pumpkins, [457] lamps, [458] crystal, [459] and anything else that the human imagination can invent. The whole world comes alive in new ways, and even our imaginations have new life in experiencing these inventive creations.



[448] A sample of *Embroidered Zoetrope* (2013), created by Elliot Schultz, can be seen at: https://vimeo.com/133396066
[449] The *Chocolate Factory Zoetrope* (2011), created by John Aitchison, can be seen at: https://vimeo.com/80992769
[450] The *Blooming Zoetrope* (2015), created by John Edmark and inspired by Fibonacci's principle, can be seen at: https://vimeo.com/116582567
[451] The *Life-Size Zoetrope* (2007), created by Mark Simon Hewis, can be seen at: http://animateprojectsarchive.org/films/by_date/2007/life_size_z
[452] A selection of bands and music groups whose disks portray a contemporary version of a zoetrope-phenakistoscope can be seen at: https://thevinylfactory.com/features/the-10-most-mind-bending-vinyl-zoetropes/
[453] A sample of a pottery zoetrope (2013) was commissioned by the Crafts Council and created by Jim Le Fevre, Mike Paterson and Roops and Al Johnstone, can be seen at: https://www.youtube.com/watch?v=SoGeydTSKas
[454] The *Zoetrope Bench* (2013), created by Kuniko Maeda and Mario Minale, commissioned by the Textile Museum in Tilburg, Netherlands, can be seen at: http://www.minale-maeda.com/ZOETROPE-BENCH
[455] Karen Smith's Zoetrope Rings (2012-2016) and *Phenakistoscope Brooch* (2012) can be seen at: http://www.ksjewelleryandmetaldesign.com/zoetrope-rings/ and http://www.ksjewelleryandmetaldesign.com/kinestic-narrative/
[456] The *Meta Umbrella* (2016), created by Kota Ezawa, can be seen at: https://vimeo.com/147794097
[457] The *Pumpkintrope* (2015), created by the advertising agency Picturesmith, can be seen at: https://vimeo.com/143408246
[458] The *Zoetrope Lamp* is an ongoing project created by Rob Coen that can be seen at: https://www.indiegogo.com/projects/zoetrope#/
[459] The *Crystal Zoetrope* (2009), created by Woohun Lee and JinHa Seong, can be seen at: https://www.youtube.com/watch?gl=SG&hl=en-GB&v=eqYUYXY3cbk

Figure 103. Étienne-Jules Marey, *Flight of a Gull,* 1887, bronze *(Collection of the Musée Marey)*[460]

These provocative "dream machines," both classic and modern, represent far more than an enduring fascination for the illusion. They are a celebration of human ingenuity and dexterity in creating something unique. Proof of that lies in the wonder evoked when experiencing these artworks, leading one to exclaim: "Why haven't I thought about this before?" The cleverness of the idea and its brilliant execution reinforce the attraction of contemporary counterparts of the 19th century optical device. Indeed, they share much in common with the cinema of attractions simply because, as the author has proposed, they are based on the same type of spectacles existent prior to the advent of cinema. This commonality highlights, for the author, the different potential paths that animated installations point to beyond the screen, further enhancing their physicality and appearance of being within the grasp of the viewer.

The animated installation experience can be considered more than just an encounter with the past; it is also an encounter with possible futures. Since a clear, scientific understanding of why we perceive still images as moving has yet to be definitively reached, we continue to be amazed by the phenomenon.

4.4 Conclusion

Every work analyzed or mentioned in this chapter has its own peculiarities that bring animation back to the physical and material domain, as it once was when the early optical devices were invented. As human beings, a great deal of everything we do is somehow related to the physical, palpable, and tangible, so even the most cutting-edge technology must still be adapted to the limits of perception and senses of the human body. Toshio Iwai observed in an interview with the author that, for him, although technology keeps

[460] Accessed at: http://www.hoodedutilitarian.com/2012/08/dwyck-tempus-fugit-degas-comics/

evolving, the human body remains the same.[461] On a similar note, in an interview, the artist and scholar Vibeke Sorensen stated:

> There is an enormous transfer of skills between cultures that digital technology facilitates because it is a common medium. This is the potential but also a problem. The use of sense based media in particular is ultimately the same across disciplines because the human body is more or less common to everyone. So solutions in one field or culture are useful to others.[462]

Today, with our hands being occupied much of the time with cell phones, tablets, keyboards, mouses, and joysticks, it has become common sense that an excessive online presence can encourage a disconnection with the real world. Physical experiences have a sense of accomplishment imbued in them, and that sense of accomplishment is something that virtual reality experiences often lack. The modern animated installation, therefore, represents a tangible piece of art that proposes a physical approach to astonishment and wonder, perceived as heightened physical experiences that share solutions and renew, mix, and incorporate early and new technologies in contemporary times.

A return to tactile experiences as provided by animated installations and to some degree also by device films is now more than ever welcome, especially when the laborious crafted process is evident. When the hard work is compiled into a concrete physical product, the cycle is complete, and this is something that optical devices and their contemporary counterparts, animated installations, help us perceive. Thus, a return to craft techniques puts in practice our human abilities, developing different thinking skills. The challenge posed by Peter Hudson's work, for instance, is an example where the viewer is invited to participate in solving the "puzzle" and discover how the piece works. In return for his or her intellectual and physical efforts, the viewer is gratified by seeing the animation happening live, a direct result of

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[461] Mentioned by the artist when the author interviewed Toshio Iwai on Skype, August 14, 2016.

[462] Cliff Eyland. "Interview with Vibeke Sorensen." Gallery One One One, University of Manitoba, Winnipeg, 2005-2006. Available online at: http://www.umanitoba.ca/schools/art/content/galleryoneoneone/vs02.html

his or her collaborative effort, which only enhances the viewer's empathy toward the artwork.

The role of childhood play and the experience of optical devices as toys early in life have proven to have a positive effect, as some of the artists investigated in this thesis have exemplified through their early experiences and later artistic practices. As providers of remarkable encounters in childhood, the toys later lead to more elaborate developments when these devices evolve from their entertainment versions into animated installations, proposing much more complex creations committed to the sense of wonder.

Independent of the strategy employed to make creations come to life, the perception of a blurry image being transformed into actions with characters dancing and jumping in a constant loop, and challenging our perception of reality and merging it with our imaginations, never ceases to amaze. And, for the author, it is this goal that guides the new investigations and readaptations of the early optical devices in animated installations and device films today. Permitting the user to question and explore his or her senses and comprehension by manually operating troping devices is an important characteristic that will be adapted even in computer-graphic versions of these contemporary devices turned games and other forms of interactive media play.

This celebration of tactility may diminish in the device films, but they are still what guarantee the longevity of those pieces, real or virtual, as they ensure more people to experience these time and site specific animated installations.

Chapter 5: Practical Component: Creative Process and Contributions

There is no theory without practice; no practice without theory;
no progress without history…
—Paul Wells[463]

Tell me and I will forget, show me and I might remember,
involve me and I will understand.
—Confucius

5.1 Introduction

As suggested by Paul Wells in the epigraph of this chapter, the unfolding spiral connecting theory and practice expresses and advances what this chapter is about: the creative process of a practical work that embodies history and theory, leading to new discoveries to be investigated that in turn indicate new interdisciplinary perspectives of animation—having practice and theory once more complementing each other. The practical work studied here is inspired by historical and contemporary theories and practices. It is through the practice that the viewer is invited to experiment (be involved) to understand, not only physically and emotionally but also intellectually—as suggested by the Confucius epigraph—which enriches the viewer's experience.

The practical work of the author presented in this chapter is the Silhouette Zoetrope, a 21st-century device inspired by 19th-century scientific toys from the proto-cinematic era. It creates a "virtual" moving image by playing with the viewer's perception. As the theory and history of optical devices have demonstrated, the early devices that flicker and rotate were conceived as scientific experiments to better understand how human vision and perception worked, and later adapted to become entertainment devices. Created from a crafted prototype made of paper, the Silhouette Zoetrope is a new optical illusion device with the potential to be explored as an animated installation. If

[463] In Wells and Hardstaff, *Re-Imagining Animation*, p. 20.

the early devices from the 19th century were created from science and from science conquered other fields, the Silhouette Zoetrope allows a return to its origins. Conceived as an entertainment and artistic piece, it can be connected back to science, thereby continuing to unfold this conceptual spiral.

Even though an in-depth study of the scientific contributions of the device is beyond the scope of this research, science, art, and entertainment are once more entangled in the device. In this chapter not only is the creative process behind the invention analyzed, but also the tests, discoveries, and their potentials are explained. In addition, this chapter includes a review of collaborations and the creative and scientific processes that led the invention to be awarded, by neuroscientists, artists, and the general public, as one of the top three optical illusions of 2016. Accordingly, the research questions raised in this thesis are also applied to this chapter, guiding the author as she reflects upon and identifies its connections with early optical devices, its relation to providing an expanded animation experience, and the contributions of the practical work to the field of animation.

In 2017, the author published a peer-reviewed article in collaboration with Nanyang Technological University (NTU) associate professors that demonstrates mathematically how the optical illusions of the Silhouette Zoetrope work. The full article, "The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth, and Size Illusions,"[464] is available as Appendix H of this thesis and is reviewed later in this chapter, considering its scientific premise and interdisciplinary cooperation as demonstrations of the diversified potential of the device—without entering into scientific details and mathematical explanations that are beyond the focus of this research.

The Silhouette Zoetrope was not the only practical experiment and artistic creation undertaken by the author. Throughout the four years of her PhD

[464] Christine Veras, Quang-Cuong Pham, and Gerrit W. Maus. "The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth, and Size Illusions." *I-Perception* 8, no. 2 (2017). Available online: http://doi.org/10.1177/2041669517700912

candidature, the author conceived various artistic explorations and pieces. In experimenting with different media and technologies, as well as diverse optical devices, the author created in this period a visual music piece titled *AcquaLumen*[465] (2013) and a flipbook version of the *AcquaLumen* visual music piece. The latter led her to experiment with electronics and physical computing to create the *Sound Flipbook Project*[466] (2013); the animated installation called *FAKEstoscope: Animating the Unanimated*[467] (2015), inspired by the phenakistoscope, as well as magic lantern shows; a "hold-to-light postcard"[468] box spin-off using LED lights and Arduino board[469] (2015); as well as different collages and boxes (from 2014 to 2016) inspired by the works of the animator Lawrence Jordan (1934-) and the artist Joseph Cornell (1903-1972).

All of these artistic explorations indicate empirical phases in the quest for astonishment and wonder in the creation of the author's own animated installation. However, as not all of those works fit the criteria established for the selection of artists as defined in this study,[470] among these works—and apart from the Silhouette Zoetrope—only the animated installation *FAKEstoscope: Animating the Unanimated* fits the criteria. This artwork was the result of the Boundary Crossings workshop at Pacific Northwest College of Art (PNCA) in Portland, Oregon. Although this is not the final practical component proposed in this chapter, its study here is relevant because the Boundary Crossings offered the author the opportunity to observe and connect with the public, whose reactions the author recorded as an online

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[465] This visual music piece can be seen at: https://vimeo.com/121893078

[466] More about the *Sound Flipbook Project* can be found at: https://vimeo.com/121893078

[467] A video of the work *FAKEstoscope: Animating the Unanimated* can be seen at: https://vimeo.com/143951573

[468] During the late 18th and 19th centuries, when people did not have electricity, computers, or phones, they kept in touch with friends and loved ones by exchanging letters and postcards. To enrich the experience, some of the postcards available portrayed a day landscape scenery that when held up to the light, such as a candle from behind, turned into a night scene. They were thus referred to as "hold-to-light" postcards, or *megalithoscope* cards. This "magical" optical illusion was possible through the use of cutouts, thin paper prints built in layers and sometimes colored paper.

[469] A demonstration of this project can be seen at: http://www.chrisveras.com/post/128915636286/dandelion-box-project-video-showing-a

[470] Recapitulating, the most basic criterion defined in this thesis focuses on the study of devices that flicker and rotate. The other criteria were defined in the introduction and are also listed in Appendix B.

diary [471] and reflected upon. The overall experience contributed to the improvement of the author's artistic practice and influenced the final outcome of the Silhouette Zoetrope.

The Silhouette Zoetrope was invented in September 2014 and was publicly presented in July 2015, during the Society for Animation Studies Conference in Canterbury, England. Immediately following this event, the author had the opportunity to participate in the Boundary Crossings workshop at PNCA. The workshop offered her the opportunity to experience an interdisciplinary, hands-on intensive practice with the goal of creating and exhibiting a new animated installation in two weeks. This experience broadened her artistic practice and provided the author with the seeds of solutions further developed and implemented later in the version of the Silhouette Zoetrope for exhibition and viewer interaction. For that reason, the creative process of the Boundary Crossings experience appears in this chapter before a detailed description of the invention of the Silhouette Zoetrope.

The Silhouette Zoetrope builds on a history of devices that not only explore optical illusions but also help introduce the viewer/user to the principles of animation. Thus, the practical work advances the field of animation by offering an intriguing alternative to the zoetrope the Victorian-era mechanical apparatus that can be explored as handheld toys, art object, or animated installation, or even as scientific device.

In this chapter, the author has opted to write henceforth in the first person, making the documentation of her practice more dynamic and directly related to her experience in the creation of the artistic work.

5.2 Boundary Crossings: An Animated Installation Experience

Boundary Crossings is a biennial institute in animated arts that offers a two-week workshop for artists and graduate students interested in exploring the

[471] The specific text on the public's reaction is available at: http://www.chrisveras.com/post/126157991034/reactions-and-interactions

boundaries of animation in a multiplicity of ways. The director and founder of the program is animator Rose Bond,[472] whose practice and encouragement of diverse forms of animated installations is well known and mostly related to what today is known as projection mapping. Under Bond's guidance, a group of renowned scholars and artists offered the participants a diverse spectrum of perspectives. The participants set daily goals followed by a tight schedule of lectures, group dynamics, readings, and hands-on activities. In 2015, when I participated, the animator Pedro Serrazina [473] was the international guest, and the visiting artists were Julie Perini[474] and Marina Zurkow.[475]

At each Boundary Crossings workshop, every participant creates an animated piece according to their own practice, but all must address the theme of the workshop, which in 2015 was "Space and Identity." At the end of the two weeks, all of the works are presented in a collective exhibit open to the public.

Originally from Brazil but traveling from Singapore, I was the only foreigner among the 12 participants in the workshop. Thus, the way I experienced the classes and the city was highly inquisitive, as everything was new to me. When placed out of your comfort zone, in an unknown environment, with unfamiliar people and places, your senses become more acute, and details in the everyday journey may catch your attention more than they usually would, as happened to me.

In preparation for the workshop, I planned to develop an animated installation that would create a dialogue between early optical devices and digital technology in association with my Ph.D. research. As the Silhouette Zoetrope was already invented by that time and it is a device completely

[472] More information about Rose Bond and her pioneering work at the Boundary Crossings can be found at: http://rosebond.com/about/biography/
[473] Pedro Serrazina's works can be accessed at: https://vimeo.com/pedroserrazina
[474] Julie Perini's website can be accessed at: http://julieperini.org
[475] Marina Zurkow's website can be accessed at: http://www.o-matic.com/play/index.html

independent of digital technology and electronics, I decided to experiment with computerized possibilities.

The workshop dedicates the first week to helping participants develop their projects, while the second week is fully dedicated to realizing the actual work. The group collaborates and offers feedback on one another's ideas. At the beginning, I had developed a small prototype of a mechanical system with three phenakistoscopes that did not use digital technology. The idea was that one disk would represent Brazilian culture; the other would represent Singapore; and the third would be formed from a combination of elements from these two cultures in an attempt to visually represent how space can affect and transform one's identity. The device would be inserted in a mirrored base that would complement the animation on its reflective surface. All three disks had no slots in them to produce the flicker. The idea was to produce the flicker by having one black slotted disc in front of the entire structure, which means that the viewer would have to direct his or her gaze to each of the disks to see the animation. The entire piece would be hand-cranked and rotate together. However, despite the fact that it did not use digital technology, the device would take more time than available to build. A paper prototype was built to illustrate the idea (Figures 104 and 105).

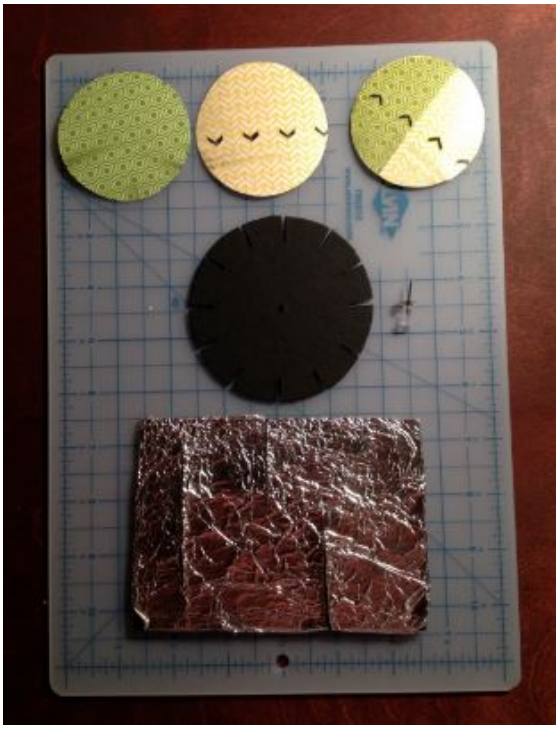

Figure 104. First prototype for the Boundary Crossings triptych phenakistoscope idea, showing separate parts ***(Christine Veras)***

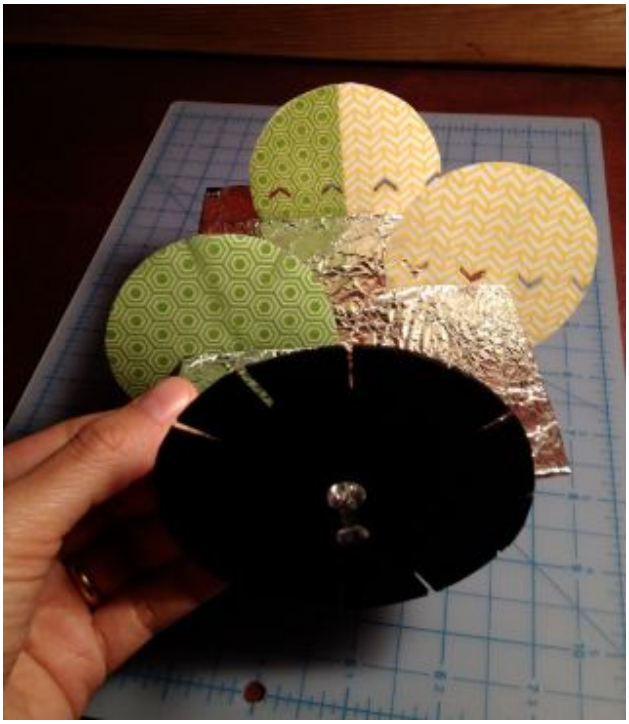

Figure 105. First prototype for the Boundary Crossings triptych phenakistoscope idea: assembled version ***(Christine Veras)***

From this original idea, I wanted to keep the hand-cranked part, as it would allow for the direct interactivity and physical contact that are important elements to me. It was a way to keep a concrete element connecting the user to the piece, in direct association with the manipulation of early optical devices. The enhancement of the senses of touch and physicality elicited by the optical toys when reproduced in an animated installation offers a bond between user and object, connecting past and present. But, as seen in the case study of Peter Hudson's human-powered pieces, which require the engagement of and effort from the user to put the piece to work, direct interaction and contact also create a sense of belonging, making the viewer an essential part of the artwork, without which it would not work. As current art installations tend to be increasingly more visual and less hands-on, I decided that I would like to recover this characteristic and observe how people would interact with it, while still exploring computerized possibilities.

Parallel to the workshop, I was keeping a visual journal, taking pictures every day with my camera phone of curious things found on my way to the PNCA. I captured metal buttons in electric poles, fire hydrant signage, utility holes,

floor tiles at the train stop, bicycle wheels, textures, and even cookies. In particular for this project, everything that was related to my experience of Portland that had a circular shape was captured in photo. I had always been concerned with these kinds of images, and as I had studied photography with design parameters, I used it as a kind of structuring element for composition of my artworks since it allows me to see everyday things that one usually does not heed.

Meanwhile, I found in the teaching room where the Boundary Crossings group gathered an old Moviola film winder (Figure 106). Also available to participants was a Makey Makey,[476] the same electronic kit I had used in my sound flipbook prototype, and a digital pico-projector (Figure 107). The Moviola has a crank handle and a metal spindle, while the Makey Makey needs an element that conducts electric current, which made them a perfect match to my needs and project. I decided to create a piece in which the viewer controls the projection, using the film winder machine as a cyclical, manual "remote control":[477] If the user turns the handle of the winding machine to the right, the images move forward; if the user turns the handle to the left, the projected images move backward; and when the user stops turning the handle, the images stop, so he or she must keep turning the handle to see the entire piece.

[476] Makey Makey is an electronic board that when connected to a computer transforms any conductive object into a keyboard or mouse, allowing its combination with games and sound players via the most unusual objects. More information is available at: http://www.makeymakey.com/

[477] In developing the piece, I benefited from the technical support and assistance of Dácio de Castro and Nagaraju Thummanapalli directly from Singapore.

Figure 106. Moviola film winder from PNCA *(Christine Veras)*

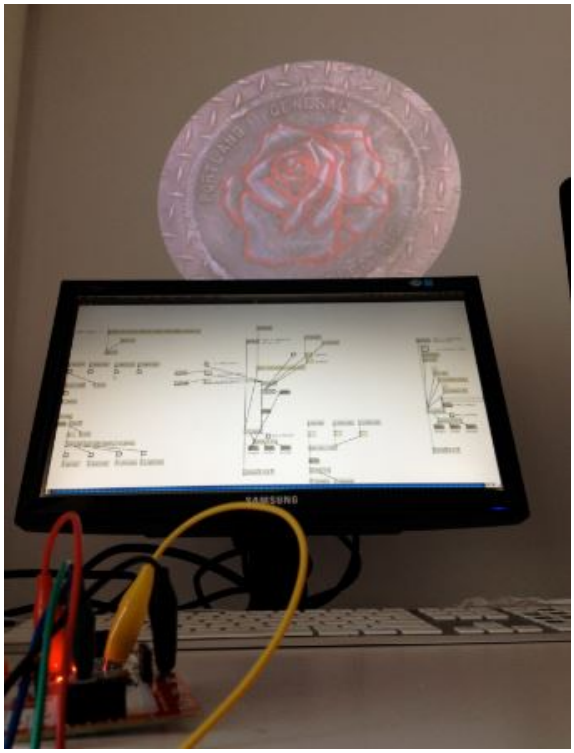

Figure 107. Early projection tests with Makey Makey board *(in the foreground)* **and Pure Data Software** *(Christine Veras)*

At the same time that I developed the physical structure of the piece, I considered options for the specific content, what to portray and animate on it. As I reflected on the photographs I had been taking in my visual journal, it became evident that the images I took around the city would be appropriate. The idea of the city as an experience of time and space was also consistent with the idea of exploration of time and space that the original historical devices opened up. In its final version, the piece used the photographs of the round things that I had been documenting in Portland as spinning images (Figure 108), one image fading into the other until the viewer discovers short animated sequences, drawn on top of some of these images. I was aware that to keep the viewer spinning the handle until the end of the piece could be tiring, so the piece was nonlinear to allow people to see and interact with it at any time and for as long they wanted. Those who were patient enough to keep on turning the crank would have the bonus of discovering the animation bits superimposed upon the images at different times throughout the film.

Figure 108. ***FAKEstoscope: Animating the Unanimated*** **concept design, 2015** ***(Christine Veras)***

The work was titled *FAKEstoscope: Animating the Unanimated* (2015), a combination of the word *phenakistoscope* with the word *fake.* The name *phenakistoscope* means "perception deceiver," and in the FAKEstoscope, things that are normally seen as still (unanimated) appear to be set in motion and gain life (animated). In some of the images, small animated drawings evolve on top of the gyrating photographs as the images are controlled by the turning of the crank. For instance, the Portland utility hole[478] image that has a metal rose cast on it, the symbol of Portland, gains color when red lines start to move around the rose, vibrating and reanimating it.

For me, the piece shares visual similarities to the 19th-century phenakistoscope, particularly in its shape and the vertical way in which the animation is seen. However, its large-scale projection changes the way the

[478] Only when writing the third chapter of this thesis, long after my participation in the Boundary Crossings workshop, did I become aware of the current exploration by Eric Dyer of putting still things into spin, as he did with manholes, umbrellas, and other common objects. Another recent exploration by Dyer, called *Girona Octopi* (2016), includes a handle to spin the top projection of the viewer on a printed pattern of Dyer's cinetropes. The viewer is included in the projection and activates the resulting animation. A video of this new project from Dyer can be accessed at: https://vimeo.com/192471992

piece is experienced. The size of this projection also has visual associations with 17th-century magic lantern spectacles, which used circular large projections of mostly still images. A fundamental difference from the latter is that in my piece the viewer controls the projection, becoming a user and not only a spectator.

Figure 109. Overall view of the Boundary Crossings exhibition *Space and Identity: No Road Map*, PNCA Gallery, Portland, Oregon, 2015. The animated installation *FAKEstoscope: Animating the Unanimated* can be seen projected on the back wall in the image. *(Christine Veras)*

Figure 110. Animated installation *FAKEstoscope: Animating the Unanimated* (projected on the wall with mechanical crank) at the Boundary Crossings *Space and Identity: No Road Map* exhibition, PNCA Gallery, Portland, Oregon, 2015 *(Christine Veras)*

My original intention was to project the images in a smaller size onto a wall, using the pico-projector, creating a more intimate relationship with the viewer. However, after viewing my final presentation and attracted by the quality and texture of the images, the other participants and I discussed the possibility of the piece being displayed on a larger scale. The final piece was indeed projected on the main wall of the gallery in a much bigger size. The decision to shift the scale significantly altered the way I approached the question of interaction with the piece, and seeing these small everyday objects displayed on the wall as a circular projection of 3 meters (nearly 10 feet) in diameter, in larger-than-life scale, would, I hoped, approach the

astonishing effect of the old magic lantern shows (Figures 109 and 110). Public interaction with the piece on opening night would confirm, or refute, this. The piece was projected directly onto the wall, without a traditional screen. The computer and the projector therefore created the flicker digitally. Not only did the projected artwork rotate, but also the gesture of the viewer/user was circular. The physical motion of their hand rotating the handle activated the virtual motion of the images.

When playing with scale, as noted by David Rockwell and Bruce Mau in their book *Spectacle,* "the familiar becomes unexpected; the ordinary, extraordinary,"[479] and that is what happened to the images of small objects photographed around Portland. Their simplicity and beauty, enhanced as well by their circular shape, was put into motion by the viewer who became user. My poetic statement that accompanied the piece is:

> Where are the clues?
> I spin my eyes to find them.
> What elements in this environment will find me?
> I'm looking forward to this encounter.
> Where are the hidden beauties, the textures, and magical elements?
> In the eyes of the beholder and the way we try to make sense of the world around us.
> Morning journey. People. What do all these people have in common?
> We share the same paths every day, we pass through the same streets; the same brick is there.
> Always … even when we are not there.
> It sees us.
> Does it matter?
> For me it does.
> Do we see it?
> I see you.
> You are not alone anymore.
> The marks of time, the traces, the dust, the dirt …the imperfections
> Beauty lies in that.
> Touch and discover these elements.
> Bring them alive with your touch and see them through my eyes.[480]

It was an intensive learning process to see how all the projects progressed. There was a collaborative spirit among participants during preparations for the opening of the exhibition. This was my first interactive exhibition, and

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[479] Rockwell and Mau, p. 22.
[480] Christine Veras, show statement for her piece *FAKEstoscope: Animating the Unanimated* (2015) at the group exhibition *Space and Identity: No Road Map*, at PNCA Gallery, in Portland, Oregon.

although I was on a quest to create astonishment and wonder through my artwork, I must admit that for me the wondrous experience was to witness people interacting with my animated installation. Their expressions of curiosity and delight upon discovering that they were the ones coordinating the projection was my most gratifying moment of the workshop and the one that made the entire process worthwhile (Figures 111, 112, and 113).

Figure 111. Public interacting with the animated installation *FAKEstoscope: Animating the Unanimated,* 2015 *(Christine Veras)*

Figure 112. Public interacting with the animated installation *FAKEstoscope: Animating the Unanimated,* 2015 *(Christine Veras)*

Figure 113. Public interacting with the animated installation *FAKEstoscope: Animating the Unanimated,* 2015 *(Christine Veras)*

The first to approach the piece at the opening were children, and they intuitively started to spin the crank and scream with joy when they

discovered that the images changed while they spun. “Mom, it changes!” exclaimed one of them. Their excitement pushed them on to spin the entire film, saying out loud the names of what they saw projected. While one was spinning, the other children tried to grab the moving image on the wall.[481]

Unlike the spontaneous reaction of the children, many adults were at first afraid to touch the crank, and sometimes, when they did, they cranked so slowly that it did not activate the video. I tried to give the users time to discover how the device works, and only after a few failed attempts did I step in to offer guidance and let them know they were spinning it too gently. At the same time, I also wanted to understand their experiences and hear their feedback. Many spontaneously approached me, curious about how it worked; sometimes even after hearing it explained, they could not really believe it. All they could see was a stand with the film winder on top of it, in front of giant projected images.[482] As the projector used was the main projector of the gallery, suspended from the ceiling with the lighting, they could not see where the image was coming from and started to look for wires or hidden projection devices. Some asked me if I had actual film stock hidden somewhere inside the pedestal, or if the images were slides. As the projection was circular, not the usual rectangular shape, their curiosity was piqued, and they were surprised at how the image was created and began to wonder how it was possible for them to see what they were seeing. The conflict between logic and perception successfully took place, which was one of my goals in the quest to create an experience of astonishment and wonder in the viewers.

Some people asked if the crank was a big pencil sharpener; others knew it was a film winder machine. An old man who used to be a film editor identified the Moviola brand and was very pleased that the installation was giving new life to an old machine. The most gratifying part of it was when people started to recognize the images from Portland. A woman thanked me

[481] The author has recorded the public’s reactions as a written and visual online journal that can be accessed through #boundarycrossings on Tumblr or on the Archive link for the months of July and August 2015, accessed at: http://www.chrisveras.com/archive
[482] The Makey Makey wires and the computer were hidden.

for recording the beautiful utility holes of Portland's streets. Since Portland is known as the City of Roses, their covers display beautiful roses cast in metal. Apparently, they are no longer manufactured and are slowly disappearing.

For me, the piece grew in meaning after the interaction with the viewers. Each viewer/user contributed to my research process by providing comments recorded in my online journal, which added crucial feedback on the success and significance to the artwork. The viewers/users own meanings and identities are changed when they embrace the interpretation I have offered of objects from their daily surroundings. Even if just for a few moments, they were invited to see things from a different perspective, which resulted in expressions of surprise and delight, as exemplified by Rose Bond, who wrote to me about my piece, saying, "I actually heard several people talk about how 'wonderous' *[sic]* your piece was! I'm so glad you made the long trip and hope this experience contributes towards your journey."[483]

I had the chance to talk with many of the viewers, explaining the project to them and recounting how in just two weeks the "unanimated" images of Portland had come to life through the movement created by them in their willingness to interact with the piece. That night, common forgotten objects displayed in the piece had their brush with celebrity on a wall of the PNCA Gallery.

I can say with confidence that the piece successfully provided an expanded animation experience for viewers/users as it challenged their expectations, from the way to interact with it to its theme. As the case studies of this thesis have shown, the expanded animation experience brings people to relate with animation in a different setting, challenging the traditional standard viewing in a theater of on a home screen, both of which are rectangular. The circular format of the projection, its physical manipulation, the scale of the projection, the repurposing of an old film winding machine, and the magnification of

[483] Written by Rose Bond in an email, dated September 9, 2015, to the author after the exhibition in Portland.

small everyday objects were crucial to establishing a physical and emotional connection with the viewer/user.

It was a rich exchange. The experience certainly increased my awareness of and attention to the viewer's synergy with the piece. Over the two-week workshop, the most provocative part of the entire experience was its revelation of the challenges we have to surmount, what we learn and discover in the process, how we handle the stress and find solutions, and last but not least, how one's vision as an artist is shaped as part of a constant development process and transformed by the viewer when interacting with the artwork. For me, all the toil and hardship vanished as soon as the public not only understood the work but interacted with it, interpreting it in personal and often unexpected ways. Of all the pieces displayed at the Boundary Crossings 2015 exhibition, mine was one of the few that people could physically touch and directly engage with. This experience impacted future exhibitions of my work, which includes the Silhouette Zoetrope.

5.3 The Silhouette Zoetrope

5.3.1 Description

The invention of the Silhouette Zoetrope represents an attempt to combine traditional puppet shadow cutouts with the proto-cinematic zoetrope. Its design kept the rotating slotted cylinder of the classic zoetrope. The expansion of the nature of the classic zoetrope rests in the placement of the object to be animated outside the cylinder, instead of inside. The animated result consists of a multiplicity of external cutouts being seen inside the cylinder as a single moving silhouette in the center of the rotating structure, with an overall design that relates to Reynaud's praxinoscope. Although the structure may seem reminiscent of the praxinoscope, its design differentiates it from the latter by having its flicker created by the use of the rotating slotted cylinder as in the classic zoetrope, rather than faceted mirrors. The cylinder

of the Silhouette Zoetrope, however, is smaller and taller than the one used in the classic zoetrope.

My interest in exploring the combinations of cutouts and shadow puppets with the zoetrope was influenced by Lotte Reiniger's[484] films produced with animated cutouts (Figure 114). Traditionally using paper strips with sequential drawings, the classic zoetrope structure does not necessarily allow for cutout images to be placed inside its cylinder independent of a strip. So, after considerable thought and research on the structure of both cutouts and the zoetrope, I attempted to draft a few design variations to combine them, but none seemed to work and were ultimately discarded. I returned to Reiniger's films anew in search of inspiration as well as to Asian puppet shadow representations, trying to understand their dynamics and possible adaptations to the proto-cinematic device. Marey's engraving demonstrating three-dimensional sequential sculptures of a bird inside a zoetrope (Figure 74 in Chapter 3) is also a reference and an inspiration showing that independent objects could be used in association with the classic device, although still in the traditional positioning inside the device. At this point, every innovative idea seemed to have been already done by someone, and I wanted to create something poetic, drawn from my dreams and memory, and yet visually and technically original. I was determined to combine cutouts and zoetrope in a new way, and finally, the inverted structure solution came to me in a dream.

[484] Lotte Reiniger (1899-1981) was a German animator and film director famous for her work with cutouts and silhouettes.

Figure 114. Still from Lotte Reiniger's silhouette animation *Papageno*, 1935 *(Captured directly from the film by Christine Veras)*

Even though I do not recall many details of the dream, I recognize its role in solving difficult problems and providing creative solutions. The imagination is needed for hypotheses in science and art, and this is part of the creative process, as well as the scientific one. While asleep, I remember seeing the mental image of a lacy paper structure, similar to Reiniger's intricate cutouts, placed outside the slotted cylinder. There was no specific animation sequence, but the cutouts suggested a continuous wave surrounding the slotted cylinder. I awoke and drew what I could recall from the image and then went back to sleep. The next morning, I decided to build a paper prototype. As the sequential photographic studies of Marey are a copyright-free reference, I decided to experiment with the movement of flying birds—one of Marey's most beautiful historical researches—but instead of drawing, I would have each phase of the bird flight produced as a cutout, in homage to Reiniger. At first, the prototype built followed the traditional zoetrope cylinder design, with short drum and short slits. This design made it difficult for the animation to be seen, but if put at an angle, the handheld device could be adjusted enabling the user to see the animation, although not very clearly. However, after some additional alterations to the cylinder's design, the animated illusion was easily perceived.

Thus, instead of using sequential drawings on a paper strip placed inside the zoetrope slotted cylinder, the Silhouette Zoetrope uses cutouts, or three-dimensional figures. These cutouts are arranged sequentially, each slightly different from the one that precedes it, outside the slotted cylinder. Specifically, the cutouts are glued onto sticks affixed to the outer edge of a large circular plate; the slotted cylinder is glued in the center of the plate as shown in Figure 115.[485]

[485] The drawings demonstrating the Silhouette Zoetrope displayed in this chapter were made by the author and used originally in the patent process. The reference to this original source duly refers to the patent and the author.

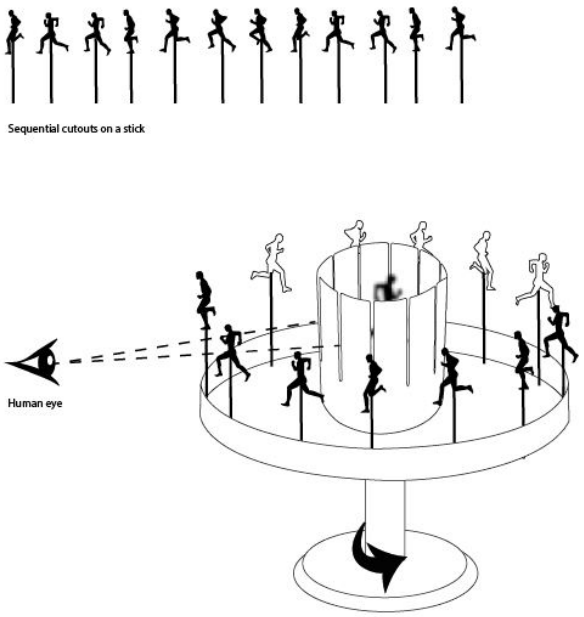

Figure 115. Illustration of a perspective view of the Silhouette Zoetrope with cutouts of a man running ***(U.S. Patent no. 9,488,903; drawing by Christine Veras)***

As stated, the design of the cylinder is smaller and more elongated than in the classical version of the zoetrope. This is an important improvement that allows viewers to easily see the moving silhouette. When the structure rotates in the opposite direction to that which the external cutouts are facing, the viewer sees inside the cylinder[486] a moving silhouette horizontally flipped. As in the traditional zoetrope, the number of slits should match the number of images/cutouts displayed. However, whereas in the classic zoetrope the reduction or increase in the number of drawings in relation to the number of slits creates different moving effects, in the Silhouette Zoetrope this change in the number of cutouts to slits alters the number of animated silhouettes seen inside the cylinder.[487] This occurs particularly because in the Silhouette Zoetrope the positioning of the object in relation to the slit immediately alters by two or three the number of the resulting animated illusions seen inside the slotted cylinder.

[486] The effect is perceived when the viewer is looking inside the cylinder through the slits on the side.

[487] Many prototypes were made, the earlier ones created using acrylic and Styrofoam. The version received by the examiners only has the possibility of changing positions in relation to the axis in front of the slit. Earlier versions allowed the cutouts to be placed anywhere, as the plate base was made of Styrofoam, which is how the change in the number of animated birds seen inside the cylinder was confirmed.

The entire structure rotates together. In the last, improved version of the device, the circular plate has holes, in line with the slots in the cylinder, to insert the sticks holding the sequential cutouts. Other larger plates can be added to this structure to create different layers of animation, all simulating interaction and movement inside the slotted cylinder. Traditional zoetrope paper strips with sequential drawings can be added as well, combining the moving silhouettes with the classic drawings. This combination can be created in ways that they appear to interact inside the cylinder. More about the tests done and possibilities of the device are explained in following sections of the chapter.

5.3.2 Historical Improvements

Since the 19th century, the structure of the zoetrope has remained fundamentally the same. Many contemporary artists have explored the potential of this early device in their artwork, and for many years now, its most significant structural change has involved creation of the flickering effect. In the majority of cases today, instead of the traditional slits of the classic zoetrope, artists use a strobe light to create the animated effect in a spinning structure. As detailed in previous chapters, the works of Gregory Barsamian, Peter Hudson, Mat Collishaw, and a few others incorporate this alteration. The same animated result can also be achieved by adjusting the shutter speed of the recording camera to enable the viewer to see the animation through a screen or displays, as occurs in Eric Dyer's cinetropes and in many of the device films mentioned in Chapter 4. Still other versions are modern reproductions of the Victorian-era zoetrope without any significant structural changes beyond the fact that sometimes the slotted cylinder is created with a wide array of materials, which includes repurposed and recycled objects.

Thus, I argue here that the use of the strobe light is partly responsible for the merger today of classical devices that flicker into one apparatus, particularly the phenakistoscope and the zoetrope. The absence of slits removes the

physical barrier and frees the device to portray cyclical animations in both horizontal (as in a zoetrope) and vertical (as in a phenakistoscope) positions. Thus, without the slits, the rotating device becomes essentially a turning disk surface. This surface allows objects, cutouts, and any other kind of sequential imagery to be displayed vertically, as the strips are placed in a classic zoetrope, or horizontally, as the drawings of a classic phenakistoscope would be seen if looked at from above.

Normally the phenakistoscope is displayed on the vertical axis, but in modern renderings it is often placed parallel to the turning table, as in a zoetrope-bottom pattern. In fact, with the modern removal of the mechanical slits, replaced by strobe light, identification with a particular early device that flickers is not necessarily evident, which is may be a reason why many people still confuse the names of and have problems distinguishing between the phenakistoscope and the zoetrope. For instance, many of Dyer's creations can be more visually associated with the phenakistoscope, even though the artist is known as the master of zoetropes.

There is no doubt that the phenakistoscope was a major invention in the history of optical devices that flicker and rotate. It was originally created for scientific purposes and then adapted into a toy. When the zoetrope was later created, it proposed an easier way to perceive the animated images, while increasing significantly the number of viewers from one to many. Since then, the historically most significant design change made to the structure of the zoetrope created with mechanical flicker dates from the 19th century, which led to the creation of a new device, the praxinoscope.

Reynaud's example is extremely relevant here, as it shifted from an animation device that showed animated images moving in a multiplicity of "frames" to a much more complex device in which he was able to isolate the animated action in a projection system with a single character. In short, Reynaud's improvements took the zoetrope/praxinoscope from an optical toy to a complex, large-scale kind of animated installation, whose final goal was the

animation projected onto a screen. Its relevancy here lies in the shift from a device with multiplicity of frames to one with single frames.

To reiterate, these three early devices—the phenakistoscope, zoetrope, and praxinoscope—display multiple animated images performing the same action simultaneously, while the search for the separation of the action into a single moving character was one of the quests pursued by Reynaud. In different ways, the Silhouette Zoetrope also separates the action, allowing the animation to be perceived as a single character moving inside the slotted cylinder. Multiple characters can also be seen depending on how the cutouts are positioned in relation to the slit.

As Reynaud's Théâtre Optique had to be performed live, by himself, and it was his manipulation of the machinery that created the animated illusions, Reynaud could extend an action or even repeat it according to the reactions of the audience, himself acting and reacting in relation to them, which is anticipatory of the interactive potential of digital multimedia in contemporary times. His huge apparatus was hidden behind the screen, probably so as not to distract the viewer from his *Pantomimes Lumineuses,* keeping his machine as a secret device capable of bringing drawings to life. The ingenuity and craft involved in his apparatus were a clear evolution of the earlier devices, and its complexity permits its interpretation as an early example of an animated installation that combined projection and exhibition already shown in a museum. However, the fact that his device itself was not the main attraction, as it was hidden from viewers, places his Théâtre Optique among the first mechanized entertainment systems, making him a visual media pioneer along with Thomas Edison and the Lumière brothers.

The practical project presented here was invented during the process of trying to create an original animated installation that elicits astonishment and wonder. Turning out to be much more than proposed, the new device is considerably in line with Reynaud's 1877 invention of the Praxinoscope, as it also proposed changes in the structural design of the zoetrope. In fact, the

Silhouette Zoetrope expands the potentialities of these classic optical devices by creating the animated illusion as spectral effect inside an empty slotted cylinder.

5.3.3 Characteristics and Peculiarities

From the zoetrope's early patents dating from the 19th century to the present, there are no records[488] of any proposal to create an animated effect in which sequential cutouts are placed outside but move inside a cylinder as a spectral effect while maintaining the vertical cylinder structure with slits from the classic zoetrope. As this is exactly what the Silhouette Zoetrope does, the granting to it of the U.S. patent no. 9,488,903 (see Appendix E) in November 2016 recognizes the authenticity and uniqueness of the device.

Among the many characteristics of the Silhouette Zoetrope already mentioned, a few can be highlighted besides the evident shift of the traditional structure of the classic zoetrope. The animated image of the sequential cutouts is seen inside the cylinder as a ghostly silhouette, being perceived as something apparently detached from the original cutout. Even though the sequential cutout images are placed on a stick, while the structure rotates, the stick is not perceived as being part of the animated illusion and can be seen only if one consciously searches for it. In the Silhouette Zoetrope, the animation is no longer seen as moving drawings on paper. Instead, it is taken out of the traditional paper zoetrope strips upon which sequential drawings are made and are now, in my device, placed into space. Reynaud, when choosing to put his characters against a black background on the strips of his Praxinoscope Théâtre, was aiming to create a similar effect, which he later made more sophisticated by separating the background from the animated image. This separation is also something achieved by the Silhouette Zoetrope with the possibility of including different backgrounds to complement and extend the animation.

[488] This was corroborated by experts I consulted, among them Stephen Herbert, Rufus B. Seider, Andy Voda, Giannalberto Bendazzi, and David Robinson: All of them confirmed the originality of the Silhouette Zoetrope.

The simple change of placement of the characters, from inside to outside, revealed some intriguing discoveries, such as the fact that the slits in the cylinder are not necessary. Having a white strip alternating with the black color of the cylinder is sufficient to see the animation. In the classic zoetrope, the slits needed to be cut because the strip with sequential images was placed inside, and peeping through the holes was the only way to allow the viewer to see the animation. In the Silhouette Zoetrope, the slits are no longer needed since the object is placed outside the cylinder.

However, the advantages of having slits cut in the Silhouette Zoetrope cylinder are twofold: The depth cues are enhanced, and the feeling that the animated silhouette character is moving in space is stronger in comparison to having only a white strip (not cut) on the cylinder. Other advantages relate to different colored landscapes that can be placed inside the slotted cylinder as a background to the illusion (Figure 116) and the possibility of using the traditional zoetrope strips inside the Silhouette Zoetrope's slotted cylinder, creating a combination of both devices.

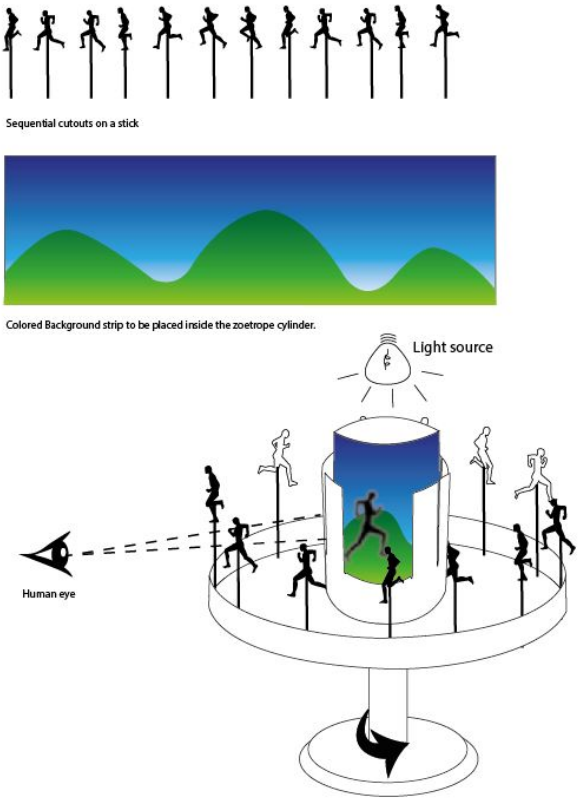

Figure 116. Illustration of a perspective view of the Silhouette Zoetrope with colored background and cutouts of a man running ***(U.S. Patent no. 9,488,903; drawing Christine Veras)***

In addition to the separation of animated image and background, another important characteristic of the Silhouette Zoetrope, as previously mentioned, is the perception of only one individual character animated inside the cylinder rather than a multiplicity of moving characters, as in the traditional phenakistoscope and zoetrope. However, by changing the position of the cutout in relation to the slit or the diameter of the slotted cylinder, it is possible to multiply the characters seen while maintaining the same number of external cutouts. Altering the positions of the cutout in relation to the slits can also create other effects. For instance, the animated image inside the cylinder appears distorted depending on how close the external cutout is from the slit: The closer it comes to the slit, the more horizontally distorted the moving image becomes.

Finally, the animated illusion is vertically flipped in relation to the original cutout. This effect relates to the field of vision and its constriction when perceiving images passing through moving vertical slits. The illusions created by the Silhouette Zoetrope, as well as its characteristics and peculiarities, allow the shift from two to three dimensions and the inversion of positioning relative to the spinning cylinder, while opening up many opportunities for spatial, temporal, perceptual, and creative research and invention. There is also the alternative of integration of the device with interactive physical-digital multimedia, as demonstrated in the explorations proposed in the FAKEstoscope.

Apart from offering contributions to the study of how the human brain perceives synthetic movement, the illusion of movement and life created by the Silhouette Zoetrope can contribute to the understanding of how the impression of a spectral silhouette moving in space is created without the use of stereoscopic glasses. The device is a unique combination of shadow puppets and the zoetrope, enabling the user/viewer to see a moving silhouette, thus an animated illusion. The fields of optics, physics,

neuroscience, cognitive psychology, and stereoscopy are but a few that can benefit from this invention, and more about the scientific potential of the animated object is explained later in the chapter. But, before discussing the version built for scientific tests, the different prototypes created are chronologically reviewed.

5.3.4 Tests, Prototypes, and Variations

Some variations of the Silhouette Zoetrope include, but are not limited to, the use of color in the animated object/cutout (Figure 117) or background (Figure 116); stereoscopic view (Figure 118); a combination of layered levels of animated objects/cutouts (Figure 119) to create different effects, according to the desired result and the subject of the animation; and use of a transparent strip with cutout images glued onto it to create the animated silhouette effect without the sticks (Figure 122).

Tests were conducted as an essential part of the investigation and as fundamental to understanding the characteristics and potentials of the new device. Images accompany the explanations of each test. These tests and experiments conducted on the Silhouette Zoetrope since its invention addressed the following variables, among others:

- Use of cylinders with thinner and wider slits;
- Use of different color schemes to create contrast between the internal and external parts of the slotted cylinder;
- Use of colored cutouts;
- Change in the rotational axis of the device;
- Use of cutouts with translucent colors;
- Use of different sequential cutouts (those created include bird, dolphin, man walking, and geometric shapes);
- Use of source light in different positions;
- Replacement of the cutouts glued on a stick with cutouts glued on transparent plastic strips;

- Building of a motorized version of the device;
- Use of three-dimensional objects instead of cutouts;
- Use of slotted cylinders of different sizes and shapes; and
- Creation of a recycled rotation mechanism.

Figure 117. Photo displaying samples of transparent Silhouette Zoetrope strips with color, different sequential cutouts, and objects *(Christine Veras)*

Each of these experiments brought enlightening observations that were later applied in an improved prototype, such as the use of thinner slits as in the classic zoetrope, which make the image sharper but its background becomes less bright. Wider slits create a blurred image. The use of color is also possible when using translucent colored paper. The left-right inversion of the cutout image took place in every case.

To test if the contrast between black and white is the only possible option, I built prototypes where the internal side of the slotted cylinder was black while its external part and cutout birds were white. The animated effect was more difficult to perceive but was nevertheless apparent. With the rotational movement, the black internal part of the cylinder merges with the external white part and appears grayish. As the bird is actually closer to the viewer's eye, it is perceived as brighter in color than the cylinder. Other options were

constructed in order to maintain the external black color while changing the color of the bird and the internal color of the slotted cylinder. I used contrasting colors to enhance the effect, for instance, yellow birds and a purple internal cylinder, or even blue birds and the inner cylinder orange. The color stimulus in the eyes was too strong and too distracting, due to retinal and related visual effects, such as simultaneous contrast. The black exterior with black birds and white interior proved to be the best contrasting combination to more easily perceive the effect.

The change in the axis of the device, as shown in Figure 118, created what seems to be a stereoscopic effect: The perception of the optical illusion is seen as if animated outside the slotted cylinder. In that assembly, both eyes are looking into the same slit that is parallel to the viewer's eyes. The preliminary observations of that effect show that there is potential for further research and creativity in this aspect of the device, which I will pursue in the future.

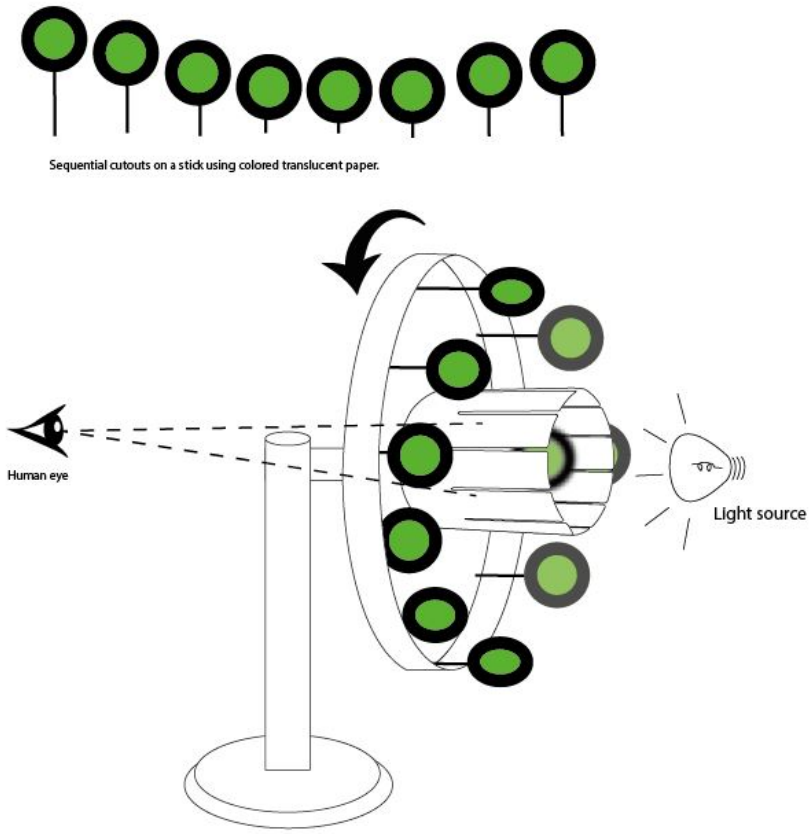

Figure 118. Illustration of the Silhouette Zoetrope suggesting a stereoscopic view ***(U.S. Patent no. 9,488,903; drawing Christine Veras)***

The use of translucent colored cutouts of geometric shapes creates a colorful moving effect; however, the geometric shapes do not have the same appeal as the mimicry of organic movements, such as the flying of a bird, a man running, or even a jumping dolphin. The perception of the animated silhouette simulating the movement of a living being is much more compelling and magical than the motion of geometric shapes. For this reason, I chose to use representational rather than nonobjective (abstract) shapes for this experiment ensuring the viewer's ability to recognize them while allowing for greater perceptual consistency in this phase of the technical and aesthetic development of the device. The structure of the cylinder also creates a cage-like perception, which can be associated with the early thaumatrope in one of its most famous designs, the bird and the cage. The option of combining different animations into one device can be achieved by the enlargement or combination of multiple plates (Figure 131).

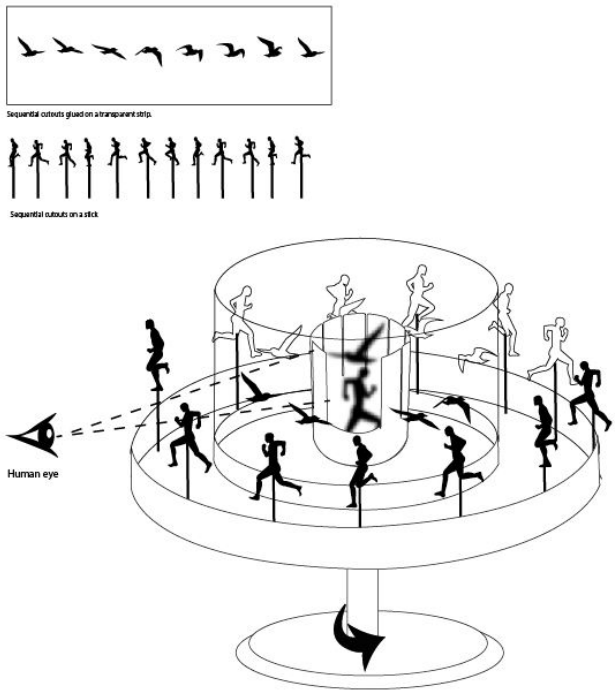

Figure 119. Illustration of the Silhouette Zoetrope with combined layers of different sequential cutouts ***(U.S. Patent no. 9,488,903; drawing Christine Veras)***

In the Silhouette Zoetrope, adding a source of light above the slotted cylinder heightens the contrast and creates a sharper and stronger animated illusion. The placement of the light in different positions external to the cylinder does not change or enhance the effect the same way the top light on the slotted cylinder does. This finding is what confirmed that the perceived animated image was, in fact, a silhouette and not a shadow. To clarify, a shadow is created when a person or object blocks a source of light (Figure 120). A silhouette is created by the contrast between a well-lit background and a person or object on which no light is falling (Figure 121).

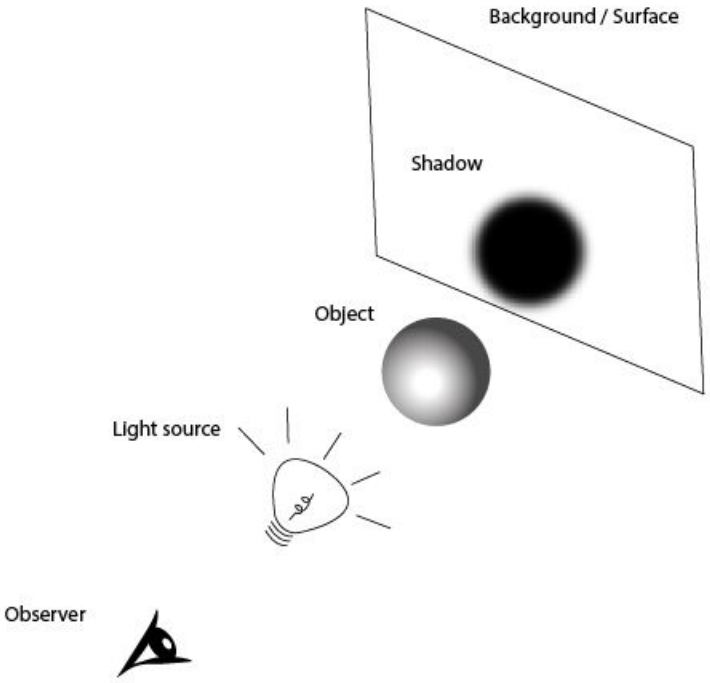

Figure 120. Diagram depicting the creation of a shadow *(U.S. Patent no. 9,488,903; drawing Christine Veras)*

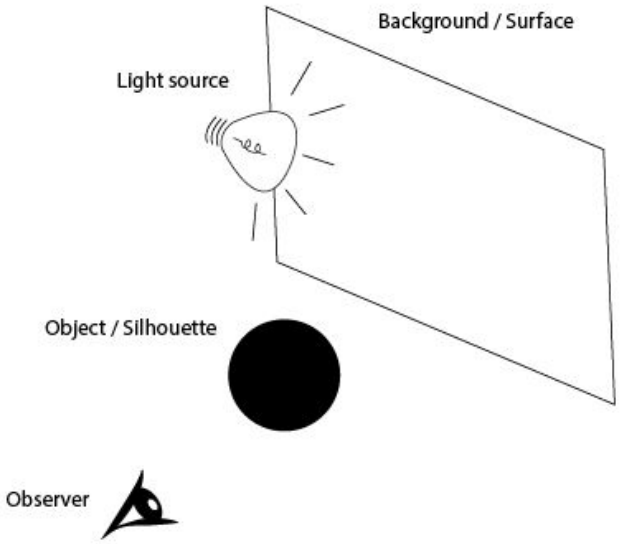

Figure 121. Diagram depicting the creation of a silhouette *(U.S. Patent no. 9,488,903; drawing Christine Veras)*

The use of a transparent plastic strip (Figure 122) freed the cutouts from the sticks but somehow diminished the tangible physical appeal that the cutout as an object has. Since the slits of the Silhouette Zoetrope are higher, the plastic strips also needed to be higher, covering the entire circumference of the plate and the height of the slotted cylinder, which made it difficult to afffix them to the plate and complicated their later storage. If the strips are stored flat, a system to lock/unlock them in the circular format must be created. In my tests, I solved the issue by using Velcro on both ends of the transparent strip, but this created a noticeable mark that interfered with the perception of the animation.

Figure 122. Still image of the Silhouette Zoetrope with a transparent strip portraying growing dots *(Christine Veras)*

The Silhouette Zoetrope is operated, and its speed controlled, by spinning it by hand. I am aware that motorized devices have the advantage of preventing damage, as the viewers do not need to touch the device to make them rotate. However, the tests I conducted using stepper motors and even geared systems of rotating toys generated a loud annoying noise that interfered with the work. More sophisticated motors exist, but the complexities and expenses in building, operating, and maintaining the electronic system also increases. Using a motor requires an adjustment of the speed, which comes more naturally and instinctively when manipulating the device directly by hand or through a mechanical crank system.

The use of three-dimensional objects was also tested. Using Styrofoam cubes, I tested if the image would be perceived as a rotating cube; however, as I empirically discovered, shadows, as well as silhouettes, flatten three-dimensional objects, and unless the shape is easy to identify, its silhouette movement is hard to distinguish. An idea associated with three-dimensional objects—yet to be explored in the Silhouette Zoetrope—is the creation of

sculptural moving shadows, with the flattened moving silhouette created by the combination of different three-dimensional objects and lighting, which may lead to other discoveries and solutions.

The process of testing and experimenting with different possibilities for the device led to the building of many prototypes (Figure 123). Slotted cylinders with different shapes distorted the animated image perceived, and the best design proved to be the tall cylindrical drum. In order to test different formats of cylinders and plates of different sizes a solution to easily exchange them became necessary. Plastic bottlenecks combined with ball bearings from remote-controlled toy cars and wooden rods were used to rotate plates of different sizes and slotted cylinders of different shapes (Figures 124 and 125). Attaching the plastic bottle cap inside the cylinder held everything in place; however, although the system was adequate for testing purposes, it was too unstable and fragile for public display, as the device is rotated by hand.

Figure 123. Photo displaying some of the early prototypes created with cylinders and plates of different sizes *(Christine Veras)*

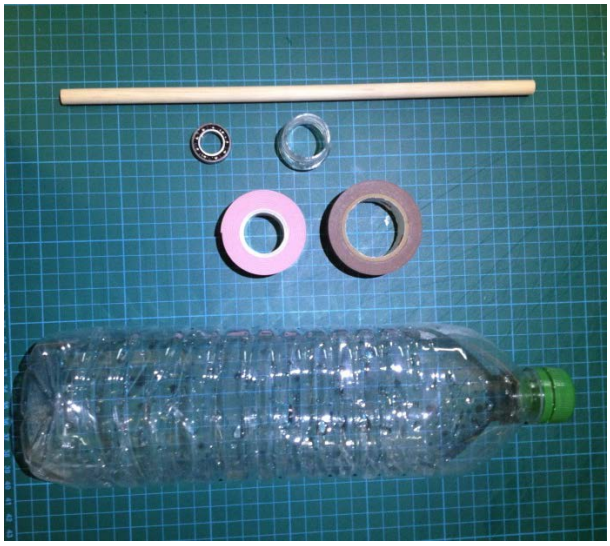

Figure 124. Photo displaying the system adapted to easily swap cylinders, consisting of a wooden rod, plastic bottle neck, toy car ball bearing, and tape (Christine Veras)

Figure 125. Photo displaying the assembled system *(Christine Veras)*

Every prototype took significant time to plan, produce, and build. The devices sent to each of the examiners of this thesis represent the finest crafted version of the Silhouette Zoetrope to date. Just to glue the base takes 24 to 48 hours to allow it to set and dry. The subsequent assembly, finishing, and testing after all parts are laser-cut are relatively fast but take another day. Also, the cutouts must be individually glued onto the sticks, while both are finished in black, all done by hand. The cylinder is made from paper, laser cut for precision and manually assembled with only the exterior painted black. The crafting process behind the production of such pieces also considers the way people will interact with the device. Without the need for batteries or any other electronic or digital device, it can be likened to the *put and play* analog version of the current Plug and Play. The user puts the birds in place, and the device is ready to play.

5.3.5 Exhibition

The first public demonstration of the Silhouette Zoetrope, as mentioned earlier in the chapter, took place on July 15, 2015, at the 27th Annual Conference of the Society for Animation Studies (SAS) in Canterbury, England. The author presented the device during her talk entitled “Silhouette

Zoetrope, Reinventing the Wheel"[489] as part of the day's "Alternative Ways of Seeing" panel discussion. By that time, the provisional patent process was already filed, and the invention could be disclosed.

Presentation of the Silhouette Zoetrope at the SAS Canterbury event was significant in that worldwide specialists from the field of animation were gathered for the occasion. The feedback and reactions from the animators and scholars present were intriguing. Many were surprised and tried to understand what they were seeing (Figures 126, 127, and 128). As the zoetrope is a well-known device, the inversion of its structure created an unusual effect, and the prototype passed through many hands and raised many questions from curious viewers and animation specialists, all fascinated by the Silhouette Zoetrope.

The majority of the questions were related to how the optical illusion was created, and the answer for it was still under investigation at the time. In fact, that was one of the reasons why I wanted to present the device at an animation conference, to exchange ideas with people from the field about the device, toward a better understanding of the multiple phenomena taking place. Many people, mainly intrigued by the fact that the animated image was seen inside the slotted cylinder and flipped horizontally in relation to the actual cutout, tried to offer explanations. The video documentation of the presentation demonstrates these unusual characteristics.[490]

[489] The phrase is used here not in the usual negative cliché meaning. Rather, "reinventing the wheel" refers to providing a new twist to an old tradition, the wheel, in this case, being the cylinder that composes the zoetrope.
[490] Available upon request.

Figure 126. Photos of SAS Canterbury participant reactions: David Mesple and Yuanyuan Chen *(Erika Savernini)*

Figure 127. Photos of SAS Canterbury participant reactions: Harvey Deneroff and Christine Veras *(Ben Shedd)*

Figure 128. Photos of SAS Canterbury participant reactions: Paul Ward and Steve Weymouth *(Christine Veras)*

The following year, the SAS conference was held in Singapore and hosted by NTU School of Art, Design and Media (ADM). The group exhibition *Constellation: A Survey of the ADM Animation*[491] included the Silhouette Zoetrope as part of the conference activities.

A new Silhouette Zoetrope was specially made (Figures 129 and 130) for this exhibition and constitutes the largest version created to date, with the top plate measuring 45 centimeters (nearly 18 inches) in diameter. The device's

[491] Curated by ADM Gallery director Michelle Ho, together with Associate Professors Biju Dhanapalan and Ben Seide, the show was exhibited in ADM Gallery 1, from June 26 to October 30, 2016.

structure of slotted cylinder and plate was assembled on top of a specially-designed wooden box. The slotted cylinder was made of stiff paper with the slits laser-cut, while the plate was made of acrylic and also laser-cut for precision. Everything was assembled by hand. An old meat grinder crank was adapted to the structure that rotated on top of a microwave turntable roller with the help of an assembly gear toy, extended and adapted to the crank by a 3D-printed shaft.

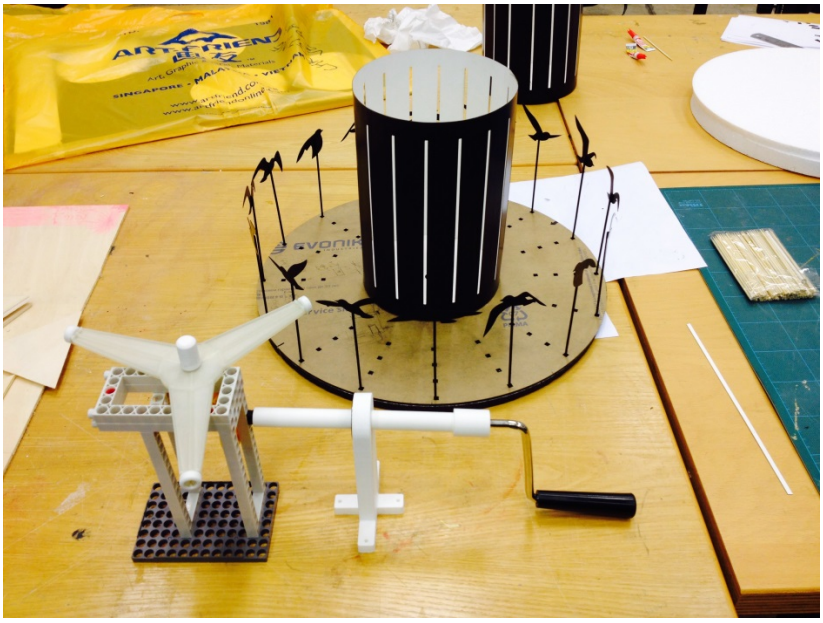

Figure 129. Building the large Silhouette Zoetrope: separate parts *(Christine Veras)*

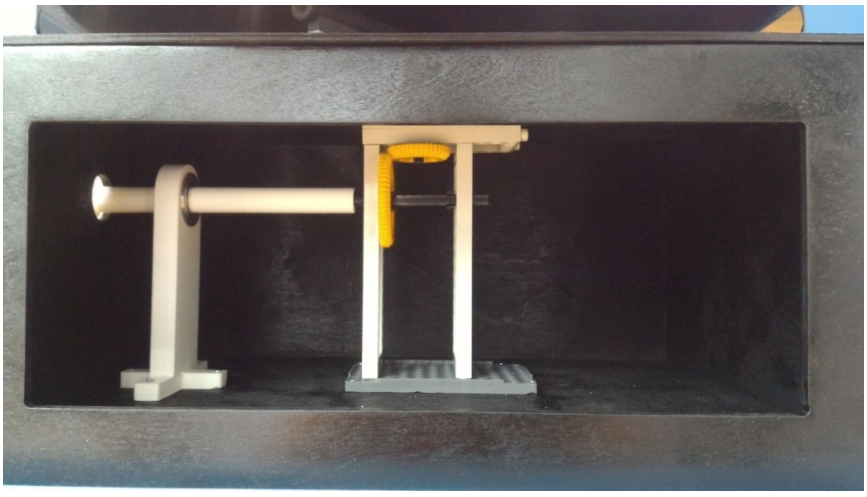

Figure 130. Building the large Silhouette Zoetrope: side view of the box opening *(Christine Veras)*

The rotational structure of the piece proved the most complicated aspect to create. Despite advice given to me to use a motor to rotate the piece

automatically, after my experience with the Boundary Crossings exhibit in Portland, it was important to me to have people manually interacting with the piece and the viewer as the producer of the animated illusion. The vertical rotation of the crank needed to be transformed into horizontal rotation to turn the plate, which is where the toy gears come into place. However, this Silhouette Zoetrope was heavier than previous paper prototypes and needed a base that facilitated easier and more consistent rotation. That is when the idea of using the support roller of an old microwave was conceived and adapted, and the structure was thus completed.

The entire process involved trials, errors, and glitches, and by learning from each one of them, the final work was successfully completed. I received the support of the ADM technical staff and professors, which was crucial to the successful realization of the project. They helped find a better solution to create the crank system and the structural box. The piece was exhibited for four months, during which it endured constant usage, was broken only three times, and each time repaired. I eventually came to the conclusion that the main reason for damage was the lack of instructions to the public on how to physically handle it. Once a poster was put up explaining the need to pause before inverting the rotation of the crank, no more problems were registered. So, as much as I would like to allow people the freedom to experiment and discover how to use the piece intuitively, the prototype structure was fragile, which is a point for future improvement.

The entire process of producing this piece for the exhibition, the need for maintenance, and attempts to predict user behavior taught me how to understand better the intricacies related to such an exhibition and the advantages and disadvantages of an interactive piece. After all, the way I handle the piece is completely different from curious new viewers who may push interactivity to the limit. Many of the considerations for this exhibit were not necessarily related to animation or to my invention and experiments. Rather, planning and solutions peculiar to details of this piece had to be found, such as testing which glue can better fix acrylic in Styrofoam; the

sanding, painting, and assembly of a wooden box; the design and 3D-printing of the crank extension to be connected to the toy gear system; the connection of the microwave support roller to the plastic rod of the toy gear by molding the connecting parts in epoxy; adjusting the lighting; and discovering how to fix the piece in the pedestal, among others (Figures 131 and 132).

Figure 131. Gallery view of the exhibition *Constellation: A Survey of the ADM Animation (Jeremy Chua, Doubleshot Studios)*

Figure 132. Gallery view of the exhibition *Constellation:* public interaction with the Silhouette Zoetrope *(Jeremy Chua, Doubleshot Studios)*

In the case of the Portland exhibit of the FAKEstoscope, fortunately the rotational structure for it was preexistent and robust, which facilitated much of the overall process. For the Singapore exhibition, the rotational system of the Silhouette Zoetrope had to be built from scratch, and the challenges faced were much more intense, although at the same time not necessarily related to my device. As the Silhouette Zoetrope displays the sequential cutouts outside the slotted cylinder, the entire structure is more fragile under manipulation. That is why the crank solution can protect the structure while still encouraging people to interact with the piece. However, there is no doubt that in the future, the rotation system will have to be made sturdier to withstand the interaction.

This time, instead of being a large installation, the piece exhibited was an interactive animated object. In Singapore, many people took selfies with the device, as well as films taken with their phones showing the animated illusion before and after it rotates. As the exhibition was launched during the animation conference, many animators and scholars approached me to ask about the piece. Their feedback and enthusiasm were remarkable. The scholar Robert Musburger, for instance, insisted on photographing the device to be part of his upcoming publication on animation. Peter Moyes, Director of the Animation Program at Griffith Film School in Brisbane, Australia, was excited about the invention and asked me many questions about its creation. It was around the same time that the video I made demonstrating the Silhouette Zoetrope was selected to participate in the Illusion of the Year Contest.

5.3.6 Best Illusion of the Year Contest, 2016

The Best Illusion of the Year Contest[492] is an annual event organized by the Neural Correlate Society, a group that gathers scientists and artists from fields related to vision, optics, and illusions. The nonprofit organization is presided over by the neuroscientist Susana Martinez-Conde from the State University of New York (SUNY) Downstate Medical Center. Experts founded the worldwide contest in 2005 as a strategy to follow the latest innovations in the field of optical illusions that may lead to new discoveries in neuroscience.

To enter the contest, participants must prepare and submit a one-minute video demonstrating their illusion. A panel of international judges[493] — composed of artists, neuroscientists, and specialists in the field of optical illusions—watches the videos and selects the top 10 illusions from around

[492] More information is available at: http://illusionoftheyear.com

[493] The judges of the 2016 contest were Stephen Macknik (moderator) from the SUNY Downstate Medical Center (United States); Allison Sekuler from the Vision and Cognitive Neuroscience Lab at McMaster University (Canada); Rosa Lafer-Sousa from Kanwinsher Lab at MIT (United States); Patrick Terry, host of *Wondershow* (United States); Françoise Pétry, editor of *Cerveau & Psycho* magazine (France); Devin Powell, freelance writer for *Smithsonian, National Geographic, Nature,* the *Washington Post,* and *New Scientist* (United States); and the artist Alexa Meade, known for turning real-life people into seemingly 2D works of art (United States).

the world. The selected videos are uploaded to the contest website and are open for a public vote during 24 hours. The top three with the greatest number of votes are announced shortly after. In 2016, the Silhouette Zoetrope won third place as one of the Best Illusions of the Year (Figure 133).

Figure 133. Screenshot of the announcement of the winners of Best Illusion of the Year Contest, 2016, featuring the Silhouette Zoetrope in third place *(Christine Veras)*

Figure 134. Screenshot of the YouTube page of the winning video *(Christine Veras)*

At first I was very hesitant to prepare a video for the contest, as the effect of the Silhouette Zoetrope is much more impressive when seen live than in video, precisely the reason I did not submit the animated illusion to the 2015 contest. The flickering shutter of the camera, when combined with the flickering of the slits in the device, can create an interference of juxtaposing flickering rates while also distorting the slits of the cylinder if the camera's frame shutter rate and flickering rate of the slits are not synchronized with each other. The result can be distracting and interferes with appreciation of the optical illusion. In trying to avoid these drawbacks, I discovered that it is possible to use a camera with a global shutter, instead of the rolling shutter existent in every regular camera, to record the illusion created by the Silhouette Zoetrope without the flickering interferences. In the exploration of the potentialities of the device, it was exhibited live and also online as a device film. While experimenting with my own work, I was able to demonstrate one of the advantages of the device films (explored in Chapter

4) as the YouTube video of the Silhouette Zoetrope (Figure 134) became accessible to a wide range of people worldwide.

The one-minute demo video[494] was recorded with the Arri Alexa,[495] a professional digital camera that has a global shutter, thereby preventing distortion of the rotating slits. A new prototype of the Silhouette Zoetrope was specially made for the shooting using a small revolving cake plate as rotating base. Film professors Ben Shedd, Biju Dhanapalan, and Lucas Jodogne from the School of Art, Design and Media (Figure 135) were present at the video shoot, providing their feedback and suggestions on how the illusion could be better presented in the film. To show how the device works, the video demonstrated the Silhouette Zoetrope's major features: The sequential cutouts are placed outside the slotted cylinder; the slotted cylinder is shown to be empty; then, when the structure rotates, the animated image is seen inside the cylinder, moving in the opposite direction of the actual cutouts.

Figure 135. Production photo of the video shoot of the Silhouette Zoetrope ***(Photo: Jolly Lee)***

[494] The Silhouette Zoetrope demo video can be seen at: https://www.youtube.com/watch?v=2-A_Pcrz6xU&t=1s.
[495] More information about this camera can be found at: http://www.arri.com/camera/alexa/

After editing and adding my narration along with the music—specially composed[496] for the film—the video was submitted to the Best Illusion of the Year Contest 2016. It was exciting when the Silhouette Zoetrope illusion was selected in the top 10 and even more so later when it was selected by the public via Internet as the third best illusion of 2016. As a result, the contest results generated a great deal of media attention, and the device was featured on more than 80 news websites worldwide. A list of selected links is available in Appendix I and a selection of the best full articles about it is available in Appendix J. The film was also presented on a morning TV show in Japan called *Sukkiri.*[497]

The global exposure of the device that resulted from the contest has allowed me to receive feedback from a great diversity of people. And the most fascinating part of this entire process has been to see how people embrace the invention and speculate about how the animated illusion is created. I have interacted with some of the people who made comments on the video and on subsequent online articles written about it. A few could not tell the difference between the Silhouette Zoetrope and the classic zoetrope, which reveals how the Victorian-era devices are still misinterpreted and misunderstood by the general public. The overall curiosity and feedback of viewers congratulating me and wanting to know more about my invention were gratifying and proved that there is indeed current interest in such animation devices.

Since the invention of the Silhouette Zoetrope in September 2014, I have been gathering reactions and feedback from different experts, scholars, artists, and animators about the device. Appendix F offers a compilation of their principal comments.

5.3.7 Scientific Potential

[496] The music was composed by Dácio de Castro.
[497] *Sukkiri* is apparently the most-watched daily morning infotainment show in Japan. The Silhouette Zoetrope was featured on the Friday, July 8, 2016, show. Unfortunately, no recording of the show is available online.

As a continuation of the explorations and experiments with the Silhouette Zoetrope—and parallel to the exhibition, the patent process, and the Illusion of the Year Contest—I gathered some scholars from NTU interested in investigating further the scientific explanation of how the animated illusion is created in the Silhouette Zoetrope.

I organized meetings to demonstrate the device, presenting the tests and prototypes created so far. The participants were Assistant Professor Gerrit Maus of the Cognitive Psychology area, School of Social Sciences; Assistant Professor Quang-Cuong Pham of the Robotics area, School of Mechanical and Aerospace Engineering; and, in the early stages of the investigation, Associate Professor Biju Dhanapalan, specialist in Visual Effects, of the Film and Animation areas, School of Art, Design and Media.

The resulting article, published in *i-Perception* journal,[498] focused on three particular illusions that the Silhouette Zoetrope comprises: the mirroring of the animated bird, the perception of the moving bird as flying in the middle of the slotted cylinder, and the difference in size of the flying bird depending on the distance from the slit that the cutout image is placed. All these features were tested in experiments with human subjects to gather quantitative data to prove or disprove the hypotheses and explanations we had discussed. The gathering of this quantitative data with human subjects was only possible because Maus' lab has an approved IRB[499] protocol that covered

[498] *i-Perception* journal can be accessed at: http://journals.sagepub.com/home/ipe

[499] IRB stands for Institutional Review Board. According to the NTU website the role of the IRB is as follows: "NTU IRB is established to meet the international standards and expectation in order to protect human subjects involved in research projects as well as to support the researchers and protect the standing of the institution. NTU-IRB will conduct ethical review on all research proposals involving human research participants or human biological materials. The setting up of NTU-IRB is not to hinder research but to promote ethical research. Usually funding agencies will only release funds to Principal Investigators (PIs) for research when the research proposal is given the clearance on ethics issues, by IRB. Also many scientific journals will only publish research manuscripts if the research proposal has been reviewed and approved by IRB." More information about it can be accessed at:
http://research.ntu.edu.sg/GuidelinesnForms/Pages/default.aspx

psychophysics experiments and the tests were performed in conformity with the Declaration of Helsinki (DoH).[500]

Before starting the experiments I had to prepare two new prototypes of the Silhouette Zoetrope in which the rotation was automatic and measurable to ensure the viable reproducibility of the tests by any future researcher. One prototype had the traditional sequential cutouts of a flying bird, and the other had cutouts of the bird repeated in only one position, which appeared fixed to facilitate the perception of the size distortion. We tested the device with 11 participants, six female and five male. (The details of the setting and tests are described in the published article but will not be detailed here.) Based on the answers given by the participants, we compiled the results and gathered enough evidence to evaluate our theories.

Maus and Pham worked to demonstrate mathematically why we perceive the bird in the middle of the cylinder, as well as why the mirroring of the animated illusion occurs. The size of the bird was tested with the creation of a fixed template with five different sizes of birds for the participants to choose from according to what they are seeing in the device. Detailed explanations are offered in the article together with diagrams and calculations, available in Appendix H. The article was peer-reviewed, and the back-and-forth process with the reviewers helped improve the quality of the explanations. However, due to limits in article length, the information had to be shortened and made more accessible to a wider audience.

The purpose of describing here the collaboration and the behind the scenes of the experiments that led to the publication of the scientific article on the Silhouette Zoetrope is mainly to show ongoing scientific interest in the early philosophical toys. The historical optical devices were the subject of interest of different scientists during the 19th century who attempted to understand

[500] DoH is a set of ethical principles for experiments with human subjects. More about it can be accessed at the World Health Organization website: http://www.who.int/bulletin/archives/79(4)373.pdf

and scientifically explain the optical illusions the devices create. Paris,[501] Horner,[502] Carpenter,[503] Hardy,[504] and Bruce[505] are a few of them. Many of those researchers helped inform and advance the knowledge that led to the creation of cinema, whose optical illusion effects in the human brain are still discussed today. In the scope of this thesis, the publication of the article on the Silhouette Zoetrope demonstrates that the device has the potentialities of an animated installation, a toy, an art object, and, significantly, a scientific device, helping develop new research areas in fields related to optical illusion and visual perception, as well as open up new possibilities in animation. As a 21st-century philosophical toy that allows viewers to shift fluidly between perception, conception, and reflection while experiencing it, the Silhouette Zoetrope is a device to be explored in a variety of ways.

5.3.8 Future Possibilities

The possibilities, besides the scientific explorations of the Silhouette Zoetrope, fall into three main areas directly related to this research: as an animated installation, a toy, and an art object. Variations on the form and content of the animation shown and the aesthetic possibilities are vast and can also be explored to create many more animated alternatives.

As an animated installation there remains doubt over whether the illusion would continue to be perceived well at a much larger scale. In that sense, works in the vein of Peter Hudson's, which are human-powered mechanical devices, could be informative and inspirational. For example, as the cyclical

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[501] John Ayrton Paris. *Philosophy in Sport Made Science in Earnest.* Philadelphia: Carey, Lea & Carey, 1828.

[502] William George Horner. "On the Properties of the Daedaleum, a New Instrument of Optical Illusion." *London and Edinburgh Philosophical Magazine and Journal of Science* 4, no. 19 (January 1834). Available online: http://babel.hathitrust.org/cgi/pt?id=coo.31924015289568;view=1up;seq=471

[503] William B Carpenter. "On the Zoetrope and Its Antecedents." In *Student and Intellectual Observer of Science, Literature and Art*, vol. 1: 427–444; vol. 2: 24-31 and 110-128. London: Groombridge & Sons, 1868-1869. Google-digitized.

[504] Arthur C Hardy. "A Study of the Persistence of Vision." *Proceedings of the National Academy of Sciences of the United States of America* 6, no. 4 (1920): 221-224. Available online: http://www.jstor.org/stable/84382

[505] Eric Stuart Bruce. "The Projection of Luminous Objects in Space." *Journal of the Society of Arts* 46, no. 2,357 (1898): 201-212. Available online: http://www.jstor.org/stable/41334337

powering structure could be placed farther away from the rotating device, it might be possible to create enough distance for the person or people who are generating the power to rotate the structure to also be able to see its animated illusion. Also, using Gregory Barsamian's work as inspiration, the use of a loop structure with different layers of cutouts could be explored. The challenge would lie in hiding the supporting rods and cables to allow the silhouettes to be clearly seen. Computerized simulations are also a possibility to be explored to facilitate tests of a 3D-printed model, following the technological explorations of Mat Collishaw.

As an animated installation it would also be possible to adapt a merry-go-round or other rotating playground structure on which a Silhouette Zoetrope could be mounted. The viewer, in rotating the mechanism, would turn together with the structure. However, the Silhouette Zoetrope should turn in the opposite direction from the viewer to allow him or her to perceive the animated illusion. In this case, instead of using the version of the device with sticks to hold the sequential cutouts, the ideal would be to use transparent acrylic strips with the sequential drawings painted on it. The sturdiness of the structure would allow it to be exhibited in public open-air spaces.

In the realm of toys, the device has huge potential to be further developed, particularly as a scientific toy, following the steps of its 19th-century precursors. The toy could be created as an assembly kit with a few sequential cutouts as play options but also designed to allow the user to create his or her own cutout sequence and even mismatch combinations. In the same way that the classic zoetrope allowed for "zoetropic editing," the Silhouette Zoetrope could also suggest metamorphosis with one silhouette transforming into another in a never-ending loop through the mix of different sequential cutouts. The options to make the toy spin are numerous and could vary from hand-cranked mechanical systems to electronic ones, much in accordance with similar zoetrope toys sold today. It could be used for storytelling, with sequential loops; for step-by-step sequences for entertainment or education; or for purely aesthetic creative works, such as

abstract sequences of visual music or an emerging genre that blends sculpture with space-time illusions. The creative works I have made with it so far emphasize the poetic and representational, given my selection of the bird and its counterpoint in motion, as well as abstract forms and sculptures with which I experimented. There are no other works of this kind in existence, and therefore, it was necessary for me to produce these experiments and works in order to study them, realize the invention, and point to its future possibilities.

As an object, opportunities could extend from the art gallery to education, entertainment, and the home design realm. For example, use of the device as a designed piece is a possibility for exploration, or even as an adapted crib mobile or an unusual home light fixture, paying homage to the Chinese lamp tradition as a proto-zoetrope.

A pending test that forms part of future investigations of the device is the use of more elaborate and intricate cutouts, with detailed characters, as in the silhouette cutouts created by Lotte Reiniger. So far, overly detailed images do not work very well in the Silhouette Zoetrope, as the constant rotation of the device contrasts with the simplicity of the resulting silhouetted image. However, there is the possibility that with the help of laser-cut machines, different sequential and more detailed characters can be reproduced. Further experiments with motors and spin rates, scale, and other parameters are needed in order to pursue the style of Reiniger's films or even of Asian shadow puppet theater traditions, which have influenced this work through the context of my living in Singapore during the period of this PhD candidature. Unexpected outcomes and new and surprising possibilities will undoubtedly continue to emerge.

5.4 Conclusion

According to the scholar Paul Carter, "invention begins when what signifies exceeds its signification—when what means one thing, or conventionally

functions in one role, discloses other possibilities."[506] It is in disclosing other possibilities that the invention of the Silhouette Zoetrope helps advance the field of animation. Revision of the classic zoetrope by proposing a fundamental but significant change brings together optical illusion and animation in an original way, informed by my imagination, knowledge, and memory. The exploratory journey that led me to the invention of the Silhouette Zoetrope has been rich, and its future holds room for growth and alternatives that dialogue with emerging technologies, particularly the ones that are merging in the hybrid physical-digital world that is "rematerializing" media.

The return to crafted, elaborate, handmade processes—under which the DIY and Maker cultures are thriving—is reviving and consequently catalyzing the readaptation of old devices and toys to the current world. The timing for the launch of their reinventions is providential as we are living in a moment when the adjustment of the facilities and conveniences of the digital can be combined with the charm, physicality, and materiality of the analog and mechanical. In the same way that animated installations are reanimating optical devices that flicker, other devices that had been considered "dead media"[507] are now returning, transformed and adapted with the help of digital technology, which can be seen as a growing current trend.

For instance, the revival of the Super 8 camera by Kodak[508] in early 2016 created a commotion at the Consumer Electronics Show in Las Vegas. At a time when innovation is an encouraged trend and every media-related company is pursuing the next big hit, Kodak's choice to invest in an "obsolete" format was certainly a daring step. Yet, by adding the convenience of digital technology to the new (and improved) Super 8

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[506] Paul Carter, "Interest: The Ethics of Invention" in *Practice as Research: Approaches to Creative Arts Enquiry,* edited by Estelle Barrett and. Barbara Bolt (London: I. B. Tauris, 2007), p. 15.

[507] An important related reference is the Dead Media Project and Bruce Sterling's manifesto, accessed at: http://www.deadmedia.org/modest-proposal.html

[508] David Sax, "Kodak's Old-School Response to Disruption," *New Yorker* (January 27, 2016), available online at: http://www.newyorker.com/business/currency/kodak-and-the-analog-response-to-disruption

camera, Kodak prompts nostalgia and renews the excitement felt by those who used to work with the analog Super 8. The company is simultaneously attracting young and curious filmmakers who probably never had the chance to use a Super 8 camera but know of it and will now have the opportunity to experiment with it.

The same pattern of predicted obsolescence in the wake of the digital revolution and then later renewal would apply to printed books, the letterpress machine, film stock, LPs, and even cassette tapes.[509] The list goes on and on. Some of them, such as the printed book, never disappeared entirely, but these predigital processes, devices, and technologies are re-gaining space in society—and most important, not in competition with digital technology, but having their digital versions as alternatives and recombinations, and with it the emergence of new hybrid and extended forms. Similarly, the archive of zoetrope loops created in the past are thus available to new users of my device for adaptation. It can give users and artists something to build upon and makes the whole experience of creative exploration much richer.

In consequence, a new generation, attracted by these vintage crafted processes and technologies, is rediscovering the awe and wonder they together can provoke. Sometimes, this discovery may happen within defined niches and as part of specific groups, such as music fans who acquire cassette tapes and vinyl disks from independent labels, or contemporary graphic designers working with typography, or painters working with calligraphy who familiarize themselves with old letterpress machines to create artworks with a haptic feeling and away from the mainstream printing companies. Machines and processes that were once predominant are making a comeback, producing “special editions” of more crafted or even handmade works. These old technologies can offer a energized coexistence with the new—some even becoming hybrids, like the Kodak Super 8—

[509] Michael Hunt, “Why the Cassette Tape Is Still Not Dead,” *Rolling Stone* (April 18, 2016), available online at: http://www.rollingstone.com/culture/news/why-the-cassette-tape-is-still-not-dead-20160418

proposing more crafted alternatives in times where the best of both worlds, digital and analog, can live in creative harmony.

As suggested by the words of Confucius, in the epigraph of this chapter, the experience that involves the viewer can be interpreted as a significant step toward knowledge. If, as neuroscientist Arthur P. Shimamura states, "art has been valued for its capacity to make us see, think and feel in new ways,"[510] then allowing viewers to physically interact with a work facilitates their engagement at different levels that go beyond the purely intellectual and traditional way. In fact, many intellectual explorations are triggered and even enhanced by the engagement of the senses, which transforms the experience into a remarkable one.

Art plays with our brain and may trigger exciting and unconventional connections or even the revision of old concepts through a new light. For Shimamura, "When we resonate with an artist's viewpoint—when we understand the message—feelings generally flow." [511] In this sense, an artwork can stimulate childhood memories, dreams, and emotional and intellectual reactions that can enrich the experience. These feelings may lead to astonishment and wonder, as demonstrated and documented in the examples of contemporary animated installations analyzed in Chapters 3 and 4. However, for the feeling of participatory engagement to be complete, a direct involvement or a live experience is best. I hope that in instigating a physically playful involvement with the object, the Silhouette Zoetrope will renew the astonishment and wonder of past eras. With new digital doors opening our understanding of and interaction with our creative minds and bodies, we can combine aesthetics and technology, life and art, by holding them in our hands and sharing them with other viewers. In this way it can inspire and lead viewers/users to think and speculate about different possibilities and uses for this new device.

Having more people playing, using, and testing the Silhouette Zoetrope can

[510] Shimamura, *Experiencing Art: In the Brain of the Beholder*, p.263.
[511] Ibid., p. 241.

trigger new explorations in the same way the classic zoetrope and other optical devices have been stimulating the popular imagination for more than a century. Following the Silhouette Zoetrope's debut on the Internet in the wake of the Best Illusion of the Year Contest, some viewers contacted me for help in their own assembly of versions of the Silhouette Zoetrope. Thanks to cyberspace, something that I invented in Singapore has reached more than a half-million people [512] from all over the world, and some are already reinterpreting it through versions of their own. The feeling of accomplishment when something is created with your own hands and mind is a motivational trigger that inevitably leads to further investigation and discoveries. And, that is what I have always hoped these experiments with the Silhouette Zoetrope would lead to. This is also the premise and promise behind the Makers movement that continues to grow worldwide. In learning from and exploring old technologies, we open up the possibility for stimulating innovative connections that are at the core of every invention.

As observation of numerous interactions with the Silhouette Zoetrope has shown, the mouths open, eyes sparkling, expressions of surprise are soon followed by questions of how it is possible to see what is seen. Once more the perception of what the eye sees and what the brain knows as logical are challenged, and the astonishment and wonder process is in place and active. The quest is part of a never-ending path led by imagination and discovery.

[512] As shows the YouTube views to date, available at Appendix G.

Conclusion

Indeed, the study of delight and amusement
often turns out to be a way of predicting the future.
—Steven Johnson[513]

This thesis was inspired and driven by the astonishment, curiosity, and wonder experienced by the author when seeing live one of Gregory Barsamian's animated installations. Key among this thesis' advances are the identification, categorization, and exploration of a specific group of contemporary artists working with a particular type of animated installation as reinventions of devices that flicker and rotate, which until now had not been selected and examined within this specific framework. This connection between present and past has shed light on proto-cinematic devices in general and the zoetrope in particular, as devices so far existing as outcasts from the literature of animation and cinema. In the process of understanding the astonishment, curiosity and wonder these devices inspired, this thesis has extended the theorizing of the cinema of attractions and the astonishment it delivers as proposed by Gunning and Gaudreault, and as re-theorized by Cholodenko as the animation of attractions, to such philosophical toys, recasting them as devices of animation. And it has proposed that those toys reanimate, that is, endow with new life and motion, this body of contemporary artworks, works which expand the privileged experiences animation offers of astonishment and wonder, including the passage of animation beyond the screen, as an experience that lies between dream and reality, into physical objects that gain life in front of the viewers' eyes. As concrete forms of animation, the works here studied explored Griffin's concept, updating it and proposing a categorization of concrete works that are directly descendant from the physical experiences already elicited by the philosophical toys. The expanded experience, inspired by

[513] Steven Johnson, "Want to Know What Virtual Reality Might Become? Look to the Past," *New York Times Magazine* (November 3, 2016), available online: http://mobile.nytimes.com/2016/11/06/magazine/want-to-know-what-virtual-reality-might-become-look-to-the-past.html

these animated installations, re-conceptualizes the role of moving images beyond the tradition of cinema, enlarging Youngblood's concept, bringing animation to the centre of the discussion. It is a reanimation enabled and still growing larger by means of the increasingly ubiquitous and pervasive role animation as an art form has been taking and which the research and study of this particular type of animated installation has aided in unveiling.

But, rather than try to measure and quantify the feelings provoked by that experience of the Barsamian installation, the author has undertaken a quest to try to understand the common characteristics found in the artworks that elicit those feelings and how these devices animate them. The historical, theoretical, and practical research presented here was grounded in evidence of the human ability to mesmerize others and to be mesmerized by things that cannot at first be explained—as occurs in magic shows, optical illusions, and, as exemplified in this thesis, animated installations. In fact, even when a reasonable explanation for the "trick" or "illusion" is available, curiosity still motivates to strive to comprehend further the phenomenon. For the author, the discovery and understanding of how an illusion is created does not diminish its wondrous effect. On the contrary, for her, it makes one appreciate all the more how it is created and arguably even enhances our propensity to enjoy being tricked in these circumstances. It is a position supported by Williamson in his book *Hidden in Plain Sight: An Archeology of Magic and the Cinema* about the relationship between magic tricks and cinema.[514] In the awareness of being tricked there is recognition of human inventiveness, artistry, and geniality, in this case presented in the work of the illusion makers, magicians, artists, and creators.

If the early devices already proposed to mislead the viewer's perceptions through mechanical toys that displayed animation, the renewed experimentation with the senses typified in the contemporary animated installations featured in this thesis is currently on the rise and should

[514] Colin Williamson. *Hidden in Plain Sight: An Archaeology of Magic and the Cinema.* New Brunswick, N.J.: Rutgers University Press, 2015.

continue to increase, not only in the area of animated installations but more generally in science, entertainment, art, and other related fields. This growing tendency restores the combination of the physical object with a visual stimulus, but now with the alternative of being empowered by digital technology. Following the continuum of the proto-cinematic devices, this union of science, entertainment, and art not only is being repeated today but is being enhanced by the merging of experiences that aim to teach, inform, and amuse.

To better summarize the relationship between past and present investigated in this thesis, this Conclusion is divided into three different sections, each aiming to answer the questions that guided the study, which were presented in the Introduction as follows:

4. What are the connections, challenges, and differences in the adaptation of those specific early optical illusion devices to contemporary animated installations?
5. Which are the strategies used by contemporary artists to elicit an expanded animation experience that evokes the feelings of astonishment and wonder?
6. How are those contemporary artworks contributing to advancement of the field of animation?

1. Connections, Challenges, and Differences

Many were the connections, challenges, and differences presented in relation to the early optical devices and the contemporary animated installations throughout this thesis. The most important elements concerned: (1) the design, in the relationship between form and content; (2) the space; and (3) the time of the featured animated installations in comparison to the original historical devices. Regarding their overall design, the main aspects investigated included size; strategies to create the flicker, rotation, and light control to introduce the animation; variation of the animation; and the

possibility of easily changing the action portrayed. The space element focused specifically on the venue and places where the public engages with the past and present works, varying from real to virtual. The time factor studied the timeframe that the public had or has to interact with the works, which in contemporary cases is significantly ephemeral when experienced live but extended and outlived in the video documentation propagated mainly through the Internet as device films, as explored in Chapter 4.

Scale is a key difference between the design of the early optical devices, particularly in the case of the zoetrope, and present-day animated installations, as explored in Chapters 2, 3, and 4. In some cases enlarged to gigantic proportions in contemporary times—as demonstrated in the works of Gregory Barsamian, Peter Hudson, and Mat Collishaw—the rotating structure of the original zoetrope not only grew in size but was also redesigned, transformed, and reinvented—as demonstrated in the works of Toshio Iwai, Eric Dyer, Ryusuke Ito, Kumi Yamashita, and David Lawrey and Jaki Middleton. These design reinventions consequently affected the way these works re-create the flicker, which vary from the use of strobe lights to camera shutter adjustments to shadow intermittency. The scale of these works has also fundamentally changed the way people interact with them, which is no longer independent and exploratory as it used to be with the early optical devices. The life-size element and the innovative reinventions presented in the current artworks are crucial in compensating for the lack of physical interaction. The exception to this is the work of Peter Hudson, which despite its large size, physically engages the viewer in the creation of the animated illusion.

Alternatively, in the case of the device films, specifically investigated in Chapter 4, their proposed reinventions changed and challenged the experience of the animated installation by being no longer experienced in real time but playable and reproducible over and over again. This change in medium, from a kind of kinetic sculpture to a video, also implies a change in space: from the physical to the virtual.

From the time perspective, with the exception of artworks that belong to the permanent collection of a museum, the ephemeral quality of the live experience of contemporary animated installations is only outlived by its video documentation. This is the case of device films, as the actual works are created with the goal of being displayed as a film and not as a concrete, tangible piece of art, thereby trumping the ephemeral characteristic of animated installations. However, the physical appeal of the actual constructed pieces is still essential in order to create empathy in the audience, allowing the public to be amazed by the intricacies of the actual construction of the piece and the effect it causes.

All three elements (design, space, and time) were also explored in relation to the classic zoetrope and the author's practical work. In disclosing new possibilities of the optical device, the Silhouette Zoetrope has served to reinforce the assertion that the early devices are still a valid and fruitful source that can inspire and be extended to artworks and scientific research in current times. In conjunction, these modern-day applications strengthen the goal of this thesis to propose new ways of understanding the influences and reinventions of the classic devices in contemporary times. Not only have the case studies of this thesis exemplified how contemporary artists are helping to advance the field of animation, the author, too, in proposing a new and original device inspired by historical antecedents, has proposed and demonstrated theoretically and practically how the connections between past and present can suggest new alternatives to the fields of animation and science. By bringing together animation and optical illusion in an innovative way, the Silhouette Zoetrope combined astonishment and wonder to present a new expanded animation experience.

Historically, an in-depth study of the philosophical toys in general and the zoetrope in particular has no contemporary correspondence and has thus led the author to shed light on particularities of the early devices that can help improve the quality of the contemporary production of animation. The further

understanding of what Dr. Carpenter called “movement of translation” and the actual experimentation of what Dulac and Gaudreault named “zoetropic editing” can help improve the learning of animation in its early stages, when students tend to experiment with optical toys but are normally unaware of those characteristics.

2. An Expanded Animation Experience Evoking the Feelings of Astonishment and Wonder

The contemporary artists selected as case studies use different strategies to elicit astonishment and wonder in their audience, consequently creating an expanded animation experience for their viewers.

As detailed in Chapter 3, some of these artists choose to rely on the gigantic, larger-than-life scale of their installations to create a “wow” moment. However, in such cases, it is not only the scale that contributes to the impact but also how, when the piece starts to rotate, the illusion of life is created. The result reinforces the feeling of living a dream while still awake. The manner in which these artworks enable their viewers to experience the installations “coming to life” may vary, but the result is similarly astonishing. Hudson makes the audience work hard to see the illusion, while Barsamian and Collishaw rely on timing of the strobe lights’ activation to produce the animated experience. As the magic unfolds, the brief contrast between before—when the structure is spinning, but there is no animation—and after—when the structure continues to spin but now with the generated flicker—is key to the success of these pieces.

The audience’s playful discovery of how these animated installations reveal their illusions makes the entire process gratifying to the public. Indeed, the intrigue, surprise, and curiosity about how the illusion works is a result of the astonishing impact of these works. For instance, the surprising, moving shadow created in Ito’s work, and also in Yamashita’s, is enhanced by the understanding of how the trick is achieved. These are examples in which the

understanding of how the illusion is created only reinforces its wondrous effect. Without a doubt, the timing of the animation, the creativity and ingenuity of its content, and the manner in which the animation is introduced to the public are also determining factors in the successful evocation of feelings beyond words, delighting the public and leaving them with a childish desire to see it again.

Repetition in the loop structure common to this type of animated installation is also reflected in the public's willingness to experience the effect over and over again. This feeling is explicitly expressed by John Lasseter in Chapter 3, in his testimony on the first time he saw the *Totoro Zoetrope* in Japan. Video records of Hudson's pieces during Burning Man also demonstrate the thrill of the audience when the animated result that they have helped achieve is reached. The eye-popping and jaw-dropping reactions are the same signs of surprise and wonder seen throughout history, from representations of Leonardo da Vinci's explorations and inventions to even the exaggerated depictions of character reactions in animated cartoons, such as the ones created by Tex Avery.

Although animated installations should ideally be experienced live, the device films of today are helping re-create such moments, making them available to a wide audience that otherwise would most likely never be able to participate in a site-specific, unique performance. Therefore, the expansion of the animated experience relies also on the broadening of the public and its access to such moments. Even though the uniqueness of the live moment is significantly amplified, it can now at least be shared through video documentation.

The particular type of animated installation here studied reveals the same playful nature as the philosophical toys that inspired those contemporary artworks. In endowing still objects with movement, re-creating the illusion of

life, these animated installations exemplify modern-day "experiences designed to delight and amaze,"[515] as Steven Johnson succinctly puts it.

The spiral loop of connections between past and present allows us to see the early optical toys beyond the label of charming old technologies. They did indeed entertain and enchant people for generations, but currently they are being adapted and reconfigured as animated installations. These reinventions of 19th-century devices continue to trigger emotional and intellectual engagement and to elicit astonishment and wonder, but with contemporary twists—sometimes even challenging the boundaries between art and science, as exemplified and explored in the case studies in Chapters 3, 4, and 5.

The author's Silhouette Zoetrope further supports the co-implication of science and entertainment. Hence, study of optical toys and their entertainment and artistic potentials in contemporary times promises to offer new perspectives and expanded alternatives to the study of animation beyond the frame and the screen, beyond cartoons and traditional animated films.

3. Advancing the Field of Animation

Animated installations are one part of a vibrant new world of artworks that are incorporating animation and discovering and exploring its fusion with other arts and scientific principles. The Maker movement simultaneously is rediscovering animation devices as mechanical objects to be built and re-created. In this thesis the author has delved specifically into art installations as reanimations of devices that flicker as a very particular and clearly overshadowed niche in the midst of other more prominent and large-scale current trends within the animated installation, such as projection mapping, virtual reality, augmented reality, immersive spaces, and others. For the focus of this study, the particular type of animated installation here investigated

[515] Johnson, *Wonderland*, p. 12.

represents well those current art forms that are better exploring the extension and adaptation of early optical devices that flicker and rotate in the contemporary digital era without losing their physicality and haptic appeal in the name of the "virtuality" of digital technology. Additionally, the kind of experience that animated installations facilitate is freed from a screen and presents alternative possibilities to the traditional movie-theater setting or even the art installation that utilizes moving images. They enable their viewers to experience original and refreshing uses of animation inspired by the historical approaches of the devices that flicker and rotate yet adapted to contemporary times to create astonishment and wonder. The magical experience of seeing objects moving, as living, in those specific animated installations plays with the viewer's senses and memories, triggering narrative connections that the viewer is free to combine, as happens in a dream.

4. Further Considerations

The current expanding uses of animation, in all its forms, in museums, theme parks, and other similar open and/or public spaces, allow a wide range of deployments that could not be covered in this study but may present opportunities for future studies. In the 21st century, museums [516] are becoming facilitators of experiences that encourage the physical engagement of the visitor in public spaces through hands-on activities, often related to some kind of proto-cinematic device. Adults and children still react in wonder when they discover the illusion of life as a "reality" created by these devices, and enjoy exploring and creating their own animations. The growing tendency of museums worldwide to develop workshops for schools, groups, and families related to their collections confirms this tendency. This phenomenon is apparent when visiting museums not only in situ but also via

[516] Science centers and other similar venues are also committed to engaging the public in these explorations concerning scientific knowledge. The connection with museums is emphasized here for their combination of art and animation in a space not traditionally known for exhibiting animation but is now increasingly making room for the use of animation and its inclusion not only in their collections but also as a way to approach their public, offering them a unique experience.

their websites, where they usually have an information section about their educational activities, specifically developed by a pedagogical team to optimize the museum experience for the visitor.

For instance, in 2014, the educational team of MoMA Art Lab in New York explored the qualities of touch and movement found in artworks of the museum's collection. In an effort to awaken and deepen the public's sensitivity to art via multi-sensory engagement in the art-making process, the program, titled Movement, included activities such as stop-motion animation and the creation of a thaumatrope, which were made open to the public.[517]

As another example, in addition to the many initiation ateliers offered at the Cinémathèque Française, the pedagogical team there also provides educational workshops for the exploration of magic lanterns along with the creation of other optical toys. In them, the workshops concepts related to animation, cycles, metamorphosis, composition, spatial organization, and use of color are introduced and developed; but they also explore participants' ability to present their work through narrative and engagement of the audiences (fellow participants), connecting the art they create to the overall process of telling a story. In this case, the traditions of the magic lantern and the fairground lecturer serve as a conduit not only to understanding the past but also to reflect on the future, empowering viewers by transforming them into users and creators. In this sense, even now ubiquitous PowerPoint-type presentations can be seen as modern heirs of the magic lantern show and the fairground lecturer.

Another tendency that may provide opportunities for investigation relates to the similarities between museums and theme parks, which share the same goal of providing an illuminating experience for their visitors, one aiming to facilitate a memorable encounter with knowledge and history and the other aiming to create a memorable thrill. Both need to guarantee the right mix of

[517] Information about the MoMA Art Lab: *Movement* is available at: https://www.moma.org/learn/moma_learning/blog/moma-art-lab-movement-why-play-with-spinning-tops-and-tinker-toys

experience, knowledge, interactivity, and emotion. Surprise, delight, astonishment and wonder will ensure their visitors come back and share their positive experiences.

Current computational developments, for example, have spurred exploration of virtual reality (VR) and augmented reality (AR). It is the author's belief, that in the near future it will be systems that integrate physical and digital processes that will prove more effective in creating experiences that combine visual and haptic senses. For this reason, now is the moment to not only re-examine the potential of tangible animation devices but also study their presence in contemporary animated installations to help, in the near future, combine solutions that can also aid in eliciting a more active participation by the viewer as user and creator, expanding the explorations related to digital technology.

The investigations made in this thesis have offered new perspectives in the study of early optical devices that flicker and rotate, showing that they are still valid sources of research that can lead to innovative discoveries and the new kinds of creative artworks, such as the author's practical work. In addition, exploration of the specific field of animated installations that display reinventions of those early devices has reinforced their creative potential and original use, placing those animation devices firmly in our contemporary society. Although the majority of the case studies presented in this thesis do not rely on digital technology, the possibilities that the latter enables can be significantly extended. It will be through the ubiquity of the Internet that those artworks will reach viewers worldwide, inspiring and spurring new research, as well as artistic and scientific works. In this sense, the larger spiral loop of related research keeps rotating, and as suggests Johnson's phrase reproduced in the epigraph of this chapter, the study of contemporary animated installations has not only been informed by the early devices but has also improved the understanding of present and future alternatives for animation—starting in the 19th century and now being reanimated in the 21st

century, which reinforces the study of the past "as a way of predicting the future."[518]

[518] Johnson, "Want to Know What Virtual Reality Might Become? Look to the Past," op. cit.

Appendices

Appendix A: London Stereoscopic Company Catalog, reproduced here as a Courtesy of David Robinson Collection

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Appendix C: Museums, Archives, and Collections Visited and Consulted for Research Purposes

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Appendix H: Reproduction of the article “The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth, and Size Illusions” published in the iPerception Journal

Appendix I: Selection of Links of Online Articles Featuring the Silhouette Zoetrope

Appendix J: Printed Selected Articles About the Silhouette Zoetrope Participation at the “Illusion of the Year Contest 2016”

Appendix A: London Stereoscopic Company Catalog

LIST OF DESIGNS FOR THE
WHEEL OF LIFE, OR ZOETROPE,

With Suggestions for the best Method of Viewing them.

LONDON STEREOSCOPIC & PHOTOGRAPHIC COMPANY,

54, *CHEAPSIDE*, & 110, *REGENT STREET*.

Sole Licencees under the Royal Letters Patent.

SERIES No. 1.

1. The Black Turn Over.
2. The Gymnast
3. The Wild Irishman.
4. A Large Feeder.
5. "I Chews."
6. Base Ball.
7. The Little Umbrella Man.
8. A Jolly Dog.
9. Foot Ball.
10. Paddy at Donnybrook Fair.
11. Fish and Fowl.
12. No-body's Little Game.

SERIES No. 2.

13. The Cure.
14. Leap Frog.
15. Steeple Chase.
16. "Such a Getting Up Stairs" (moderate motion).
*17. "Who's that Knocking at the Door?" (ditto).
18. Headwork.
19. "There's Life in the old Donk yet!"
*20. Warm Work for Blackey
*21. Jack-in-a-Box.
22. Red and Black Waltz.
23. The Coffee Grinder.
24. The Red-Legged Ogre and his Dancing Poodle

SERIES No. 3.

25. "Tuck in your Tuppenny."
*26. "Footsteps beneath Him."
27. "Catchee, Catchee, Catchee."
28. The Indian Juggler (moderate motion).
29. "More Stings than Honey."
30. Engine and Feline
31. "You're getting very Bald, Sir."
*32. Sairy defends her Pattens.
*33. The Wheel of Life
34. A well-known Domestic Tragedy (moderate motion).
35. The Modern Man in the Moon.
*36. "Don't you wish you may get it?"

SERIES No. 4.

37. Light Headed.
38. The Hurdle Race.
39. Pair of Donkeys.
40. Celarius Waltz.

SERIES No. 4.

37. Light Headed.
38. The Hurdle Race.
39. Pair of Donkeys.
40. Celarius Waltz.
41. The Ig-noble Art.
42. High Life Below *Stairs* (moderate motion).
43. "The Rising Moon."
44. More Free than Welcome.
45. Bottle Imp (moderate motion).
46. Bob Sawyer.
47. A Horse Laugh (moderate motion).
48. The Indian Leotard (moderate motion).

SERIES No. 5.

49. A Caution to Bad Boys (moderate motion).
50. Music with Dancing (slow motion).
51. A Lively Tubster (ditto).
52. The Skipping Girl (moderate motion).
53. A Skating Circle (slow motion).
54. An Engine Cutting.
*55. Precocious Chickens (slow motion).
56. The Sportsman (ditto).
57. Mr. Simpson, of Vauxhall (ditto).
58. Steam Scissors.
59. Irish Tail (moderate motion).
60. Badgered Cat (ditto).

SERIES No. 6.

61. A Cold Bath.
62. Perpetual Motion.
63. The Light Fantastic Toe.
64. The Donato Dance.
65. A Black Joke.
66. A Hop and a Blow.
67. Fly! Leave my Nose alone.
68. The Black Ethardos.
69. Such a Gettin' Down Stairs.
70. Keep it up, Boys.
71. Old Dobbin.
72. Fountain of Bon-Bons.

*The subjects marked thus * show better when the Cylinder is turned from left to right, otherwise the usual motion is from right to left.*

COMBINATIONS.

Very effective and humorous Combinations can frequently be made by overlapping one strip of Figures with the half of another strip Amongst some of the most effective of these combinations, the following numbers will give very amusing results:—

4 & 5.	7 & 10.	3 & 13.	12 & 18.	14 & 25.	1 & 25.	26 & 27.	23 & 30.
15 & 19.	20 & 12.	5 & 18.	6 & 12.	20 & 24.	1 & 40.	38 & 48.	
38 & 39.	43 & 45.	18 & 37.	19 & 38.	24 & 48.	3 & 41.	37 & 47.	
2 & 39.	27 & 49.	20 & 59.	2 & 50.	3 & 52.	20 & 60.	11 & 60.	
26 & 66.	9 & 71.	*8 & 63.	12 & 62.	20 & 68.	64 & 65.	39 & 70.	

* *This is a singular metamorphosis.*

LIGHT.

The Light should be immediately over the Cylinder; but, if this cannot be arranged, a Lamp placed at the side and higher than the

Appendix B: Table of Artists Selection Criteria

TABLE CLASSIFIED IN ALPHABETICAL ORDER PER DEVICE/TECHNIQUE

Nº	Pre-Selected Contemporary Artist	Country	Gender Female/Male	Work/Year/Link	Proto-Cinema Optical Device/Technique related to work	Criteria for selection							
						Artist has other works related to proto-cinema devices/techniques?	Does the work inspire astonishment and wonder?	Is it an Artistic installation?	It uses optical devices that flicker?	It has a physical component?	It uses a loop structure	Is there any innovation in the use of the past device as a contemporary art installation?	Does the artist have a career as animator?
1	William Kentridge	South-Africa	M	*What will Come (Has Already Come)* , 2007 *Phenakistoscope,* 2000	Anamorphosis/Phenakistoscope	Y	Y	Y	Y	Y	Y	Y (animated anamorphosis)	Y
2	Kathy Rose	United States of America	F	The Cathedral of Emptiness, 2008 [11]	Animated Performance	Y	Y	N (performance)	N	Y	Y	Y.Combines digital and live performance	Y
3	Tu Wei-Cheng	Taiwan	M	The Emperor's Treasure Chest[9], 2012	Diverse: Praxinoscope, Shadow puppet, Stereoscopy, etc	N	Y	Y	Y	Y	Y	N (he just uncovers old devices and adds a more cultural theme, no changes on the original devices)	N
4	Robert Breer	United States of America	M	Flipbook Mural 1964[2]	Flipbook	Y	Y	Y	N	Y	N	Y (Vertical structure on the wall)	N
5	Milton Marques	Brazil	M	Sem título[4], 2002	Flipbook	Y	Y	Y	Y	Y	Y	Y (re-uses tech-junk to create a self-rotating mutoscope)	N
6	Juan Fontanive	United States of America	M	Many flipbooks to choose [31]	Flipbook	N	Y	N	Y	Y	Y	N. Uses the Flipbookit to create and exhibit his own animations	Y
7	George Griffin	United States of America	M	Diverse flipbooks and *Viewmaster,* 1976	Flipbook/Mutoscope	Y	Y	Y/N	Y	Y	N	Y (On his viewmaster he combines digital technology to control the animation manually through a device that looks like a	Y
8	Rob Wilson	United States of America	M	Union Square in Motion, 2014 [27]	Horizontal Zoetrope/Lenticular	Y	Y	Y	Y	Y (make people move to see the animation)	N	N. Play with Lenticular animation in public space	Y
9	Olafur Eliasson	Denmark	M	Viewing Machine, 2001-2003	Kaleidoscope	Y	Y	Y	Y	Y	Y	Y (takes the kaleidoscope to a new level playing with light and reflections)	N
10	Laura Heit	United States of America	F	Two Ways Down, 2014 [30]	Kinetic Shadows	N	Y	Y	N	Y	Y	Y. Combination of projection and moving shadows	Y
11	Bruce McClure	United States of America	M	Various	Magic Lantern performance	Y	Y	N (performance)	Y	Y	N	Y. Renew the Magic Lantern spectacles to contemporary audiences in different formats	N
12	Ken Jacobs	United States of America	M	Nervous Magic Lantern, 2014	Magic Lantern performance	Y	Y	N (performance)	Y	Y	N	Y. Renew the Magic Lantern spectacles to contemporary audiences in different formats	N
13	Les Rémouleurs collective	France	F/M	TBC[6]	Magic Lantern/Shadow play	Y	Y	N (performance)	Y	N (performance)	N	Y (Adapts the magic lantern to contemporary times)	N
14	Marcel Duchamp	France	M	Rotay Glass Plates, 1920 [Yale University Art Gallery] [25] Rotary Demisphere, 1925	Phenakistoscope	N	Y	Y	Y	Y	Y	Y. Early experiments in rotational discs also called Rotoreliefs (Optical Disks)	N
15	David Wilson	United States of America	M	*We got time (Videoclip)* , 2008	Praxinoscope	N	Y	N	Y	Y (through video, not accessible to public)	Y	Y (continuation of story through multiple praxinoscope)	N
16	Roberto Freitas	Brazil	M	Três, 2012-15 [26]	Praxinoscope/Théâtre Optique	Y	Y	Y	Y	Y	Y	Y. Combines old and digital technologies in an installation that uses images and sound.	N
17	Dpt and Laurent Craste	France	M	Parade, 2014 [23]	Shadow play	N	Y	Y	N	Y	Y	Y. Physical objects gain life when visitor moves the light in front of them	Y
18	Miwa Matreyek	United States of America	F	*Dreaming of Lucid Living* , 2002	Shadow Theatre	Y	Y	N (performance)	Y	N (performance)	Y	Y (Combination of shadow theatre and digital animation interacting)	N
19	Rubén Ramos Balsa	Spain	M	Zapateado de Luz[5], 2007	Shadow Theatre	N	Y	Y	N	Y	Y	N	N
20	Birgitta Hosea	United Kingdon	F	Trotting Shadows I (Ram Ladies), 2015	Shadow Theatre/Chinese Lamp	Y	Y	Y	N	Y	Y	N. Hommage to the old Chinese Lantern, moving shadows	Y
21	David Meggs Hooke	Australia	M	Heavenly Creatures[10], 2013	Thaumatrope	N	Y	Y	Y	Y	Y	N (interesting use of the Thaumatrope but no changes made in the original device)	N
22	Runa Islam	Bangladesh	F	The Restless Subject, 2008 [29]	Thaumatrope/Film	N	N	Y	Y	Y (through the sound of the projector)	Y	N. More artistic and conceptual work in which the Thaumatrope is used to refer to the still nature of film	N
23	Jim Le Fevre	United Kingdon	M	Flying Circus title sequence [28]	Vertical Zoetrope	Y	Y	Y	Y	Y (through video, not accessible to public)	Y	Y. Adjusted the frame rate on the camera	Y
24	Gregory Barsamian	United States of America	M	Feral Fount, 1999 + other works	Zoetrope	Y	Y	Y	Y	Y	Y	Y (strobe light + animated sculptures)	N
25	Bill Brand	United States of America	M	Masstransiscope, 1980	Zoetrope (linear)	N	Y	Y	Y	Y	Y	Y (inversion of the movement)	N

26	Mat Collishaw	United Kingdon	M	All things Fall, 2014[1]	Zoetrope	Y	Y	Y	Y	Y	Y	Y (strobe light and 3D printing)	N
27	Kaisa Penttilä	Finland	F	Garbage Whirl, 2015 [12]	Zoetrope	N	Y	Y	Y	Y	Y	Y. The viewer rotates instead of the structure	Y
28	Stephen Meierding	United States of America	M	United - Appomattox videoclip, 2014 [13]	Zoetrope	N	Y	N	Y	Y (through video, not accessible to public)	Y	Y. Innovative videoclip editing combining different parts of the animation in one screen	N
29	Mark Simon Hewis	United Kingdon	M	The Life Size Zoetrope, 2007 [15] The Slow Zoetrope, 2015	Zoetrope	Y						Y. Slows down the animation creating a more impactful effect	Y
30	Breadart Collective - David Boultbee	United Kingdon	M	Zoetropes, 2013 [18]	Zoetrope	Y	Y	Y (public art)	Y	Y	Y	Y. Shifts the structure of the zoetrope to project silhouettes outside the drum	N
31	Peter Hudson	United States of America	M	Various at the Burning man Festival [19]	Zoetrope	Y	Y	Y	Y	Y	Y	Y. Giant scale zoetropes with clever, humorous and witty ways for people to interact with it (day and night, despite the	N
32	Jamie Burmeister	United States of America	M	Diverse Zoetropes [20]	Zoetrope	Y	N	Y	Y	Y	Y	N. Uses sculpture models. His main focus is on the content more than on the form of the of the zoetrope	N
33	Rebecca Cummins and Rusty Oliver	United States of America	F/M	Velotrope, 2010 [21]	Zoetrope	N	Y	Y	Y	Y	Y	Y. It uses bicycles to speed up the animation	N
34	Trope Collective - Carol MacGillivray and Bruno Mathez	United Kingdon / France	F/M	Diverse [22]	Zoetrope (no rotation)	Y	Y	Y	N	Y	Y	Y. They use a system called D-Scope to give movement to static objects suggetsing the use of strobe	Y
35	Jacqueline Passmore and Electric Pedals	United Kingdon	F	Bicycle Zoetrope, 2012 [24]	Zoetrope	N	Y	Y	Y	Y	Y	Y. People moving zoetropes through bicycles, which activate large projections of the zoetrope animations. @Tate Modern	Y
36	Hugo Glover	United Kingdon	M	Banyan Deer Flame Powered Zoetrope, 2015	Zoetrope	Y	Y	Y	Y	Y	Y	Y. Zoetrope that moves using the hot air from a bonfire	Y
37	Kim Thomé	Norway	M	Zotem, 2015[7]	Zoetrope/ Kaleidoscope	N	Y	Y	Y	Y	Y	Y (crystal cut creates different effects and shapes in the moving fabric)	N
38	Jo Fairfax	United Kingdon	M	Calke Abbey Zoetrope, 2011 [17]	Zoetrope/Lenticular	N	Y	Y	Y	Y	Y	Y. Rotating structures that mix zoetrope idea and lenticular animation rotating really slowly. It gives a beautiful timing to	N
39	Eric Dyer	United States of America	M	*Cinetropes* , 2006	Zoetrope/Phenakistoscope	Y	Y	Y	Y	Y	Y	Y (Phenakitoscopes as sculpture + film)	N
40	Kumi Yamashita	Japan	F	*Dialogues* , 1999	Zoetrope/Shadow play	N	Y	Y	Y	Y	Y	Y (animated shadow)	N
41	Ryusuke Ito	Japan	M	*Discovery of Motion Picture* , 2006	Zoetrope/Shadow play	Y	Y	Y	Y	Y	Y	Y (recreation of cinematic effect with toys)	N
42	Heidi Kumao	United States of America	F	Cinema Machines, 1991-99 [16]	Zoetrope/Shadows	Y	Y	Y	Y	Y	Y	Y. She uses the zoetrope as rear projection of the animation giving 'life' to old objects and memorabilia	N
43	David Lawrey & Jaki Middleton	Australia	M/F	The sound before you make it, 2005 [14] Forever and ever and ever, 2007 You are my only hope, 2008	Zoetrope/Thaumatrope/Praxinoscope	Y	Y	Y	Y	Y	Y	Y. Animated images are seen as shadows projected outside and little sculptures animated inside the cylinder using strobe light.	N

*Table made to help organise and select the artists to be analyzed in the thesis. There are other artists that are creating new and exciting works related to animation devices that flicker that may be missing as the list requires constant updates.

Appendix C: Museums, Archives, and Collections Visited and Consulted for Research Purposes

Appendix C: Museums, Archives, and Collections Visited and Consulted for Research Purposes

- Cinémathèque Française, Paris, France
  Contact: Sébastien Ronceray, Pedagogy Department

- Centre National du Cinéma et de l'Image Animée (CNC), in Bois d'Arcy, France
  Contact: Béatrice de Pastre, Director of Collections

- Museum of Arts et Métiers, Paris, France
  Automaton collection demonstration

- La Cité des Sciences et de l'Industrie, Paris, France
  Exhibitions*: Light Games* and *Brain* (permanent) and *Shadow and Light* (temporary)

- Museum of Jurassic Technology, Los Angeles, United States

- LACMA (Los Angeles County Museum of Art), Los Angeles, United States
  Temporary exhibition: *Hans Richter: Encounters*

- La Gaïté Lyrique, Paris, France

- BFI (British Film Institute), London, United Kingdom
  The Reuben Library

- Museum of the Moving Image, New York City, United States
  Permanent collection and the temporary exhibition *Future of Storytelling*

- Getty Museum, Los Angeles, United States

- Museum of Modern Art (MoMA), New York City, United States

- Singapore Science Center, Singapore
  Optical Illusions exhibition *The Mind's Eye* (permanent)

- National Museum of Singapore
  Permanent collection: Strobe light zoetrope displayed at the Growing Up Gallery celebrating the legacy of Ms Tang Pui Wah, Singapore's first female Olympian.

- Museum of Precinema, Padova, Italy
  Laura Minici Zotti's permanent collection of magic lantern and early devices.

Appendix D: Published Articles, Papers and Exhibited Works by Christine Veras

Appendix D: Published Articles, Papers and Exhibited Works by Christine Veras

1. Published Works

A. Articles

Veras, Christine, Quang-Cuong Pham, and Gerrit W. Maus. "The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth and Size Illusions.". *i-Perception* (2017). Available online: http://journals.sagepub.com/doi/full/10.1177/2041669517700912

Veras, Christine. "Lawrence Jordan: Giving Birth to a Dream." Animation Studies Blog, Animation Auteurs Series, 2016. Available online: https://blog.animatiostudies.org/?p=1361

Veras de Souza, Christine. "Instalações Animadas: busca pela potencialização da animação como meio artístico" (Animated installations: the search for empowering animation as an artistic medium." In *International Conference of Cinema, Art, Technology, and Communication at Avanca/Portugal*, 1,156-1,165. Avanca: Edições Cine-Clube de Avanca, 2011. Available online: https://goo.gl/Blk0vZ
(1 citation, Google Scholar, written in Portuguese)

Veras, Christine. "O Gênero Musical Reinventado"(The musical genre reinvented). In *Intercom, 30th Brazilian Congress of Communication Science, Santos, Espírito Santo, Brazil*, September 2007. Available online: https://goo.gl/X6hOKZ
(Written in Portuguese)

B. Online Reviews

Art reviews: Artitute: Art News Website
January 2016-March 2017
http://www.artitute.com

"Steve McCurry's Iconic Photographs: Exhibition Review"
https://goo.gl/IDFYgj

"Jan Kroeze through a Lighting Perspective"
https://goo.gl/141vru

"Discovering Betwixt, a Digital Art Festival Beyond the Gaps"
https://goo.gl/Q4IHnP

"Exhibition Review: Donna Ong's Five Trees Make a Forest"
https://goo.gl/VMY3Pg

"Review: Zheng Lu's Reflections on Still Water"
https://goo.gl/I1CTEC

"Interview with Paul Sermon, Pioneer of the Interactive Media Art" https://goo.gl/h7XUhh

"Exhibition Review: Salvador Dalí and Pierre Argillet, Thirty Years of Collaboration"
https://goo.gl/3g6t1u

C. Other

Visual abstract (credit cited in acknowledgments): Amaniampong, Prince N., et al. "Biomass Oxidation: Formyl C¢HBond Activation by the Surface Lattice Oxygen of Regenerative CuO Nanoleaves." *Angewandte Chemie* international edition (July 2015). Available online:
http://onlinelibrary.wiley.com/doi/10.1002/anie.201583161/epdf

2. Unpublished Works

A. Conference Papers

"Rediscovering the Zoetropic Editing," 29th Annual Conference Society for Animation Studies: And Yet It Moves…, July 3-7, 2017, Padova, Italy

"Animation in the Gallery: Conquering the White Cube," 28th Annual Conference Society for Animation Studies: The Cosmos of Animation, June 26-30, 2016, Singapore

"Silhouette Zoetrope, Reinventing the Wheel,"27th Annual Conference Society for Animation Studies: Beyond the Frame, July 13-16, 2015, Canterbury, United Kingdom

"Norman McLaren Pas de Deux: How Ordinary Becomes Extra-Ordinary," 26th Annual Conference Society for Animation Studies: The Animator, June 16-19, 2014, Toronto, Canada

"Sewing Fragments of Time," Wearable Technology Symposium, Part II: TEXT-iles and Intertextuality, November 2013, Singapore

B. Master's Thesis

Veras, Christine. "O Show Deve Continuar: O Gênero Musical no Cinema" (The show must go on: the musical genre in cinema). Master's thesis. Escola de Belas Artes at Federal University of Minas Gerais (UFMG), Belo Horizonte, October 2005.
https://goo.gl/Ege7cw
(11 citations, Google Scholar, written in Portuguese)

3. Recent Exhibitions

AcquaLumen Stills (2013-2017), *50 Years of Diplomatic Relations between Brazil and Singapore* group exhibition,June 20-July 5, 2017,Brazilian Embassy Gallery, Singapore
(The piece now belongs to the Permanent Collection of the Brazilian Embassy in Singapore)

Silhouette Zoetrope: Birds (2016), *Constellation: A Survey of the ADM Animation* group exhibition, June 26-October 30, 2016, ADM Gallery 1. Available online:
http://www.adm.ntu.edu.sg/NewsnEvents/ADM-Gallery/Pages/CONSTELLATION-A-Survey-of-ADM-Animation.aspx

FAKEstoscope: Animating the Unanimated (2015), *Space and Identity: No Road Map* group exhibition, August 7, 2015, Pacific Northwest College of Arts Gallery. Available online: https://vimeo.com/143951573

Appendix E: Cover page of the U.S Patent 9,488,903 granted to the Silhouette Zoetrope

The United States of America

The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, or importing into the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Michelle K. Lee

Director of the United States Patent and Trademark Office

US009488903B1

(12) **United States Patent**
Veras de Souza

(10) **Patent No.: US 9,488,903 B1**
(45) **Date of Patent: Nov. 8, 2016**

(54) **SILHOUETTE ZOETROPE**

(71) Applicant: **Christine Veras de Souza**, Belo Horizonte (BR)

(72) Inventor: **Christine Veras de Souza**, Belo Horizonte (BR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/195,270**

(22) Filed: **Jun. 28, 2016**

Related U.S. Application Data

(60) Provisional application No. 62/191,754, filed on Jul. 13, 2015.

(51) **Int. Cl.**
G03B 21/14 (2006.01)
G03B 25/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G03B 25/00*** (2013.01)

(58) **Field of Classification Search**
CPC G03B 25/00
USPC 352/50, 54, 87, 101, 102
See application file for complete search history.

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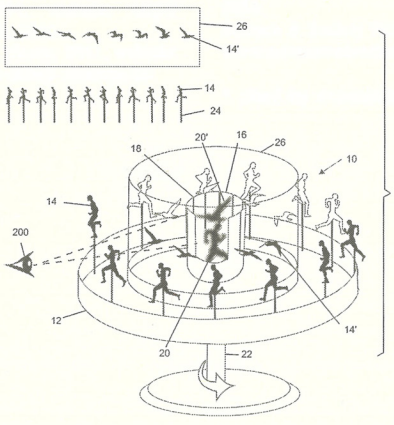
Primary Examiner — William C Dowling
(74) *Attorney, Agent, or Firm* — Thomas P. O'Connell; O'Connell Law Firm

(57) **ABSTRACT**

An animation device for producing the perception of animation within a slotted cylinder. The animation device has a rotatable platform, and a slotted cylinder with wall segments at least partially separated by longitudinal slots retained to rotate concentrically with the platform. Images, such as two-dimensional or three-dimensional figures, are retained to rotate with the platform along a circumference substantially concentric with but greater than the circumference of the slotted cylinder whereby the slotted cylinder is disposed radially inward of the images. The images, which can be sequential, could be retained by elongate support members, by an image cylinder, or by any other support. When the platform is rotated, an observer looking through the slots in the slotted cylinder can perceive an animation of the plurality of images within the slotted cylinder. Multiple, separate pluralities of images can be retained, potentially along different circumferences, to produce distinct animations.

20 Claims, 10 Drawing Sheets



Appendix F: Table of Experts Comments and Reactions to the Silhouette Zoetrope

Experts and artists comments about their first impression seeing the Silhouette Zoetrope (the majority of comments were expressed on personal email exchange with the author):

NAME	EXPERTISE	COMMENT
Alan Gilchrist	Professor of Psychology, Newark College of Art and Science, Rutgers University, United States of America	"The Silhouette Zoetrope created by Christine Veras represents an impressive achievement. The device consists of a black vertical cylinder, the base of which is a disk of larger diameter. The cylinder wall contains a series of vertical slits. A dozen or so paper birds, frozen in flight, are mounted on posts outside the cylinder, along the periphery of the disk. When the device is spun, the viewer perceives a single bird flapping its wings inside the cylinder. The effect is enchanting. Beneath the esthetic success lies a dual technical achievement as well. The device functions as a stereoscope to that the bird appears three-dimensional in a different location within the cylinder. In addition, a series of flashed silhouettes creates the illusion of motion. The slits and the bird figures must be placed in just the right spatial arrangement so that the images received by the two eyes differ just as they would if there were actually a real bird in the cylinder. And the timing of the successively flashed silhouettes must create the impression of smooth movement. The delightful result is a testament to both Ms. Veras' grasp of visual perception and to her talent as an artist." (Email on 28/09/2017)
Andy Voda	Founder of Optical Toys Store, United States of America	"Wow!" (Email on 30/06/2016)
Carola Rupprecht	Head of the Education Program, Deutsches Hygiene Museum, Dresden, Germany	"Your 'Silhouette Zoetrope' would fit perfectly into our exhibition chapter "vision" as it is a lot more beautiful and surprising than the classical zoetrope." (Email on 10/10/2017)
David Robinson	Optical Toys Collector, United Kingdom	"Your zoetrope is WONDERFUL." (Email 24/07/2016)

Ernst Pöppel	Psychologist and Neuroscientist, Munich Center for NeuroSciences, Germany	“Please give me some time to think about the ‘Veras Phenomenon.’” (Email on 26/09/2016)
George Griffin	Experimental Animator, United States of America	“Looks Fab!” (Email on 30/06/2016)
Gerhard Frei	Scientific Advisor and Project Manager Swiss Science Center Technorama, Switzerland	“For the first sight, it may look kind of an antique zoetrope – but when you look closer, it is an amazing and subtle item (with a bird flying in the opposite direction, flying in the centre of the cylinder, being of different shape than the real cutouts) – all this is so surprising and the birds are so poetic. Maybe, it is more surprising for people who know, how the antique zoetropes work, and who take their time to find out what is special in your zoetrope.” (Email on 21 September 2017)
Gideon P. Caplowitz	Cognitive Neuroscientist, University of Nevada, Reno, United States of America	“I would also like to mention there is a very long history of studying illusions. And probably the most profound illusion that we experience is at the movies. Motion pictures are a continuous sequence of still images that, when played at the correct speed, give rise to continuous motion. The movie experience that we have today is the culmination of almost 200 years of technological development investigating how to create moving images out of still frames. There’s a beautiful entry in the illusion contest this year called the “Silhouette Zoetrope.” It's a modification of one of the earliest picture devices, the zoetrope, which dates to pre-cinematic optical devices in the Victorian era. And I was very, very happy to see this new version of the zoetrope in the contest this year. It’s another new trick for an old dog.”[1] (Washington Post interview published on 7/July/2016)

[1] https://www.washingtonpost.com/news/wonk/wp/2016/07/07/five-of-the-best-optical-illusions-reveal-hidden-secrets-about-the-brain/

Gregory Barsamian	Artist, United States of America	“Brilliant!” (Email on 29/07/2016)
James Dalgety	Collector and creator of the Puzzle Museum, United Kingdom	“Your Silhouette Zoetrope looks wonderful and certainly deserves to be made commercially if possible.” (Email on 13/09/2017)
Nicholas J. Wade	Psychologist, Emeritus Professor at University of Dundee, Scotland	“That is truly remarkable!” (Video recorded during the Illusion Night at ECVP 2017, Berlin, on 29/08/2017)
Peter Hudson	Artist, United States of America	“I love your zoetrope. Are you using the central slits as shutters to strobe the interior light? Genius!” (Email on 4/11/2016)
Pierre-François Maquaire	Founder of Heeza, Optical Toy Store, France	“Wow! Il est vraiment très joli votre Zootrope! Bravo!” (Email on 04/07/2016)
Priscilla Heard	Experimental Cognitive Psychologist, UWE Bristol, United Kingdom	“I love your Silhouette Zoetrope.” (Email on 13/09/2017)
Ron Labbe	Stereoscopy specialist, United States of America	“Interesting- first time I've seen this.” (Email on 17/11/2015)
Rufus Seder	Founder of the toy company Eye Think Inc., United States of America	“I think it's remarkable!” (Email on 14/10/2016)

Stephen Herbert	Collector and Specialist on Early Cinema and Victorian optical entertainments, United Kingdom	“That’s truly amazing. And counter-intuitive. (…) Wonderful, and mysterious.” (Email on 17/11/2015)
Susana Martinez-Conde	Neuroscientist and Science writer, SUNY New York, United States of America	“Gorgeous!” (Email on 13/04/2016)
Thomas P. O’Connel	Patent Lawyer, United States of America	“As it turns out, the Patent Office just issued the attached Issue Notification indicating that your patent is going to issue as U.S. Patent No. 9,488,903 on November 8, 2016. This too has happened incredibly quickly. I am not clear why, but your case is moving at the fastest speed I believe I have ever seen in 22 years of practice.” (email on 21/10/2016)
Toshio Iwai	Artist, Japan	“I watched your youtube video and I was very interested in. It's simple but nice idea, and congratulation to the 3rd prize of the Best illusion of The Year Contest!” (Email on 10/08/2016)

Appendix G: Screenshot of YouTube views of the Silhouette Zoetrope video

YouTube SG

silhouette zoetrope

Silhouette Zoetrope

The Illusion contest

Subscribed 9.3K

603,277 views

Add to Share More

592 18

Appendix H: Reproduction of the article “The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth, and Size Illusions” published in the iPerception Journal

Short Report

i-PERCEPTION

i-Perception
March-April 2017, 1–8
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DOI: 10.1177/2041669517700912
journals.sagepub.com/home/ipe
SAGE

The Silhouette Zoetrope: A New Blend of Motion, Mirroring, Depth, and Size Illusions

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School of Mechanical & Aerospace Engineering, Nanyang Technological University, Singapore

Gerrit W. Maus
Division of Psychology, School of Humanities & Social Sciences, Nanyang Technological University, Singapore

Abstract
Here, we report a novel combination of visual illusions in one stimulus device, a contemporary innovation of the traditional zoetrope, called Silhouette Zoetrope. In this new device, an animation of moving silhouettes is created by sequential cutouts placed outside a rotating empty cylinder, with slits illuminating the cutouts successively from the back. This "inside-out" zoetrope incurs the following visual effects: the resulting animated figures are perceived (a) horizontally flipped, (b) inside the cylinder, and (c) appear to be of different size than the actual cutout object. Here, we explore the unique combination of illusions in this new device. We demonstrate how the geometry of the device leads to a retinal image consistent with a mirrored and distorted image and binocular disparities consistent with the perception of an object inside the cylinder.

Keywords
zoetrope, optical illusions, anorthoscopic perception, motion, animation

Introduction
In 1834, William G. Horner first published an article about a new invention, the *Daedaleum*, a new type of optical device that would become popular much later under the name *Zoetrope*. The new apparatus was informed by previous optical illusion devices such as

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the Thaumatrope (1825), the Anorthoscope (invented in 1828, but only commercialized in 1836), and the Phenakistoscope (1832). Coming from a long history of inventors simultaneously working on similar ideas from different perspectives, these devices were created as both entertainment and as tools to study human vision. From Michael Faraday's mathematical studies to Joseph Plateau's scientific and artistic investigations, many have contributed to evolve this long lineage of optical illusions. Among them, Étienne-Jules Marey created one of the first Zoetropes to use three-dimensional figures representing the sequential phases of a bird's flight, and Antoine Claudet pioneered devices stimulating the eyes successively to create moving stereoscopic images (Carpenter, 1868; Mannoni, 2000; Wade, 2012, 2016).

Inspired by this history of proto-cinema optical devices in association with the Asian shadow puppet theater tradition, we present a new addition to this line of optical illusions: the "Silhouette Zoetrope." The Silhouette Zoetrope produces the perception of animation within an empty, slotted cylinder that rotates concentrically with sequentially cutout objects placed in front of each slit (see Figure 1 and video 1, link present in the appendix). The interior of the slotted cylinder is white, while its external side and the cutout figures are black. Illuminating the inside of the cylinder enhances the effect. When the structure is rotated, an observer looking through the slits can perceive an animated silhouette moving inside the cylinder. Despite its apparent simplicity of function, the Silhouette Zoetrope compiles a remarkable set of illusions.

First, and most strikingly, the cutouts are perceived to be horizontally mirrored, that is, although the birds in Figure 1 are facing to the right, observers see the animated bird facing left when the Silhouette Zoetrope is rotated. Second, particularly with binocular viewing, the animated figure appears to be floating in the center of the cylinder. Third, the resulting animated figures may vary in size, that is, the silhouette of the bird can look smaller or larger than the physical size of the cutout depending on its placement in relation to the slit. We confirmed these observations in a set of brief experiments.

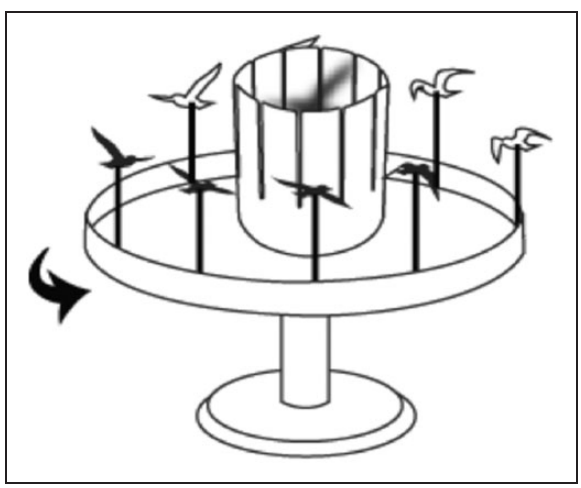

Figure 1. Schematic drawing of the Silhouette Zoetrope. The outside of the cylinder is painted black, whereas the inside is white (not pictured here to facilitate visualization). Cutout birds are also black and are seen as a silhouette illuminated from the back. Also see video 1, link present in the appendix.

Methods

Participants

Eleven observers (six female, five male) volunteered to take part in this study. All had normal or corrected-to-normal visual acuity. The study was approved by Nanyang Technological University's Institutional Review Board and was performed in compliance with the Declaration of Helsinki.

Materials

We used an electrically driven version of the zoetrope that rotated the cylinder clockwise at a constant speed of 150 rpm. The cylinder had a radius of 4.25 cm with eight regularly placed slits, each measuring 4 mm horizontally. The figures (bird cutouts facing to the right) could be mounted in three possible positions, at 1.1 cm, 2.2 cm, or 3.3 cm distance from the cylinder in front of each slit. Observers' viewing distance (from the center of the spinning cylinder) was about 80 cm.

Procedure

First, the participants wore an eye patch over their nondominant eye to view the zoetrope monocularly. A movable screen covered the device and was removed only when the zoetrope was in motion. The zoetrope was setup with the cutout birds at the furthest distance, at 3.3 cm. The following questions were asked:

(a) "Which direction is the bird facing? Left or right?"
(b) "Where do you see the bird? In front of, inside, or behind the cylinder?"

Observers then removed the eye patch and answered Question (b) again for binocular viewing.

Next, we tested the perceived size of the bird in the zoetrope display. Since the animated cutouts vary in horizontal extent as the bird flaps its wings, we changed the cutouts to a static version, that is, we mounted eight identical cutouts of the bird (horizontal length 4.6 cm) outside the rotating cylinder. Observers viewed the rotating Silhouette Zoetrope with the birds mounted at one of the three distances, once each in a random order. A cardboard with five versions of the bird with different horizontal lengths (3.4, 4.0, 4.6, 5.2, and 5.8 cm) was placed in front of observers, and they were asked to indicate which of the five options most resembled their percept of the animated figure.

Results

All observers (100%) reported that the bird was facing to the left, that is, in the opposite direction of the actual cutout figures placed outside the cylinder. Under monocular viewing, 45.5% of observers reported seeing the bird in front of the cylinder, whereas 45.5% saw the bird inside the cylinder. Under binocular viewing, the proportion of observers experiencing the illusion of seeing the bird inside the cylinder increased to 72.7% (Figure 2(a)).

Discussion

In the following, we discuss the unique combination of illusions occurring in the Silhouette Zoetrope. We developed simple geometrical models to explain the

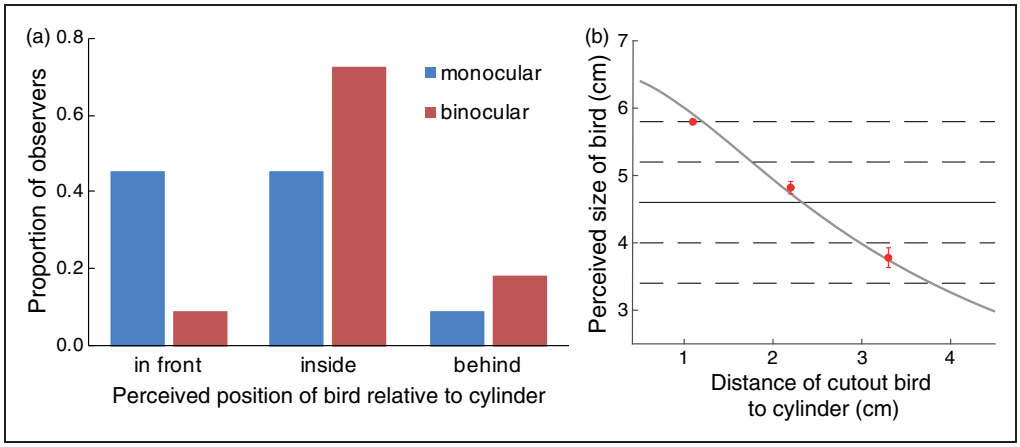

Figure 2. (a) Perceived position of the cutout bird relative to the cylinder. Under monocular viewing, observers were equally likely to perceive the bird in front of or inside the cylinder. Binocular viewing led to most observers seeing the bird inside the cylinder. (b) Perceived size of the bird for different mounting positions outside the cylinder (red dots, error bars denote SEM). The actual size of the bird was 4.6 cm (horizontal solid black line); observers judged size by choosing one of five size options on a cardboard in front of them (horizontal lines). The solid gray function shows predictions from a geometric model of the inside-out zoetrope (see text). Figure 2(b) shows the mean responses of 11 observers in the size estimation task (and standard errors of the mean). Perceived size varied with the cutout's distance from the cylinder, with larger size estimates resulting when the bird was mounted closer to the cylinder. At the closest distance of cutouts to the cylinder, observers always picked the largest option (5.8 cm); at the middle distance, observers picked on average a larger option than veridical (mean = 4.82 cm, SEM = 0.09 cm); and at the furthest distance, observers picked a smaller than veridical option (mean = 3.78 cm, SEM = 0.15).

perceived horizontal reversal, the perceived depth of the figure, and the distortion of perceived size.

The apparent horizontal reversal is so counter-intuitive, that naïve observers anecdotally tried to explain the percept by hypothesizing that they were seeing the bird from *behind* the cylinder through aligned slits in the front and back. However, this was not the case. The percept of the animated figure does not change, when the slits are covered and made opaque by white paper inside the cylinder, making it impossible to view the figures on the opposite side of the cylinder through aligned slits. The reversal of the figure can be understood when considering the consecutive images presented to the retina as the cylinder rotates. With counterclockwise rotation, the rightmost part of the figure will be illuminated from the back by the slit in the cylinder first, but in the most leftmost position. Then the center of the figure is visible, and then the leftmost part of the figure in the rightmost position (see Figure 3(a)). Temporally summing over these three time points results in a horizontal reversal of the figure.

About half of observers readily perceived the image inside the cylinder, even under monocular viewing. Since there are not many other depth cues available in the display, the visual system might assume that partial visibility of the figure at any one time is caused by occlusion of the figure by the cylinder, rather than illumination of the figure from the back. Thus, the partially occluded object (the bird) would be perceived to be further away than the front of the cylinder. However, our experiment showed that binocular viewing led to a stronger illusion of the figure being perceived inside the cylinder. The perception of the

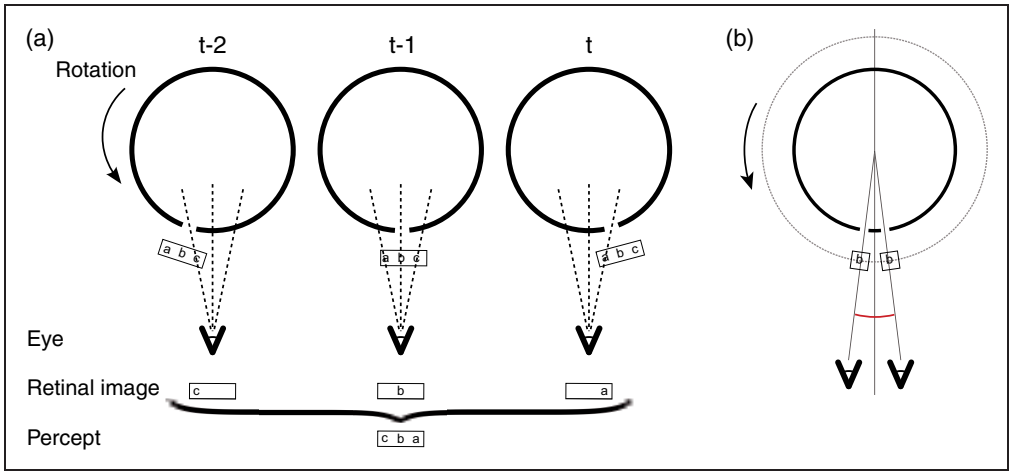

Figure 3. (a) The horizontal reversal of the figure can be understood by looking at three separate time points, at which the front (c), middle (b), and back (a) parts of the figure are lined up with the slit, respectively. When these three views are integrated into one percept, the figure is perceived as horizontally reversed. (b) Under binocular viewing, the resulting binocular disparities of corresponding points of the figure as the zoetrope rotates are consistent with the figure being located in the center. Just the center point of the figure is shown here for simplicity.

bird inside the cylinder thus seems to be related to binocular disparities. In fact, matches of corresponding parts of the figure visible in both eyes are consistent with the image originating in the center of the cylinder (see Figure 3(b)).

Interestingly, the corresponding points of the figure are not available on the retina simultaneously, but sequentially, as each eye's view of the figure is anorthoscopically "painted" onto the retina (Rock, 1981), with the images being successively perceptually constructed when the figure passes in front of the slit. Simultaneous retinal images are very dissimilar from each other; only after monocular images are temporally integrated and perceived as a whole figure can corresponding points be identified and matched stereoscopically. This is consistent with studies on the temporal properties of processing of binocular disparities (e.g., Gheorghiu & Erkelens, 2005; Kane, Guan, & Banks, 2014; Nienborg, Bridge, Parker, & Cumming, 2005; Richards, 1951).

The perceptual expansion or compression of the figure along its horizontal axis depends on the silhouette's distance from the cylinder and can be explained by an analysis of the visual angle subtended by the figure.[1] Figure 4 shows the relevant angles and distances between the viewer's eye and the components of the zoetrope. The triangle ACE can be used to calculate α, the angular distance of Point A, when it is lined up with the eye and the slit, from the center of rotation C. Due to symmetry, α is also the angular distance of Point B when the rotation has lined it up with the slit. Thus, α also represents half the visual angle subtended by the figure as seen from the observer when the zoetrope is rotating. Employing the law of sines, α can be determined as a function of the sizes and distances in the zoetrope setup (see equations in Figure 4). Assuming that—due to the binocular constraints mentioned earlier—the observer perceives the figure in the center of the cylinder, Emmert's law can be used to calculate the perceived size $S_{perceived}$ as a function of α and L:

$$S_{perceived} = kL2\tan\alpha$$

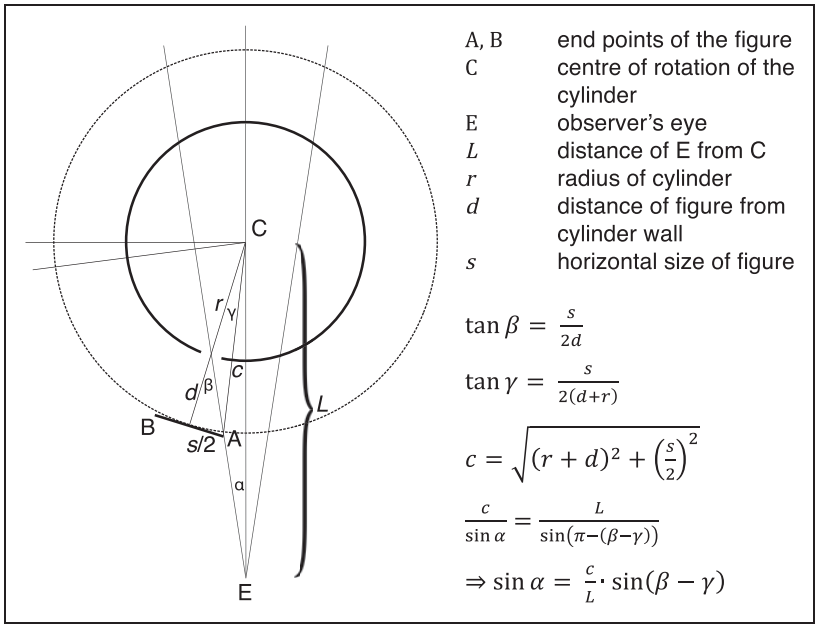

Figure 4. Illustration of the relevant angles and distances for working out the retinal size of the figure when the zoetrope is rotating. β is the angle subtended by half the figure's length as seen from the slit, γ is the angle subtended by half the figure's length as seen from C, and *c* is the distance of Point A from C and is given through the Pythagorean theorem. With β, γ, and *c*, the visual angle subtended by the figure can be calculated (see text).

where k is a scale factor to account for any over- or underestimation of distance, as is commonly reported in distance judgments (Holway & Boring, 1941).

Using the above equation, we fitted predictions for perceived size to the empirical size judgments from our experiment (gray line in Figure 2(b)). The model predicts that perceived size of the figure decreases with increased distance between the silhouette and the cylinder, and fits the empirical data from our experiment well. Note that our model has only one free parameter, k. The fit in Figure 2(b) uses a value of $k = 0.77$. A value of $k < 1$ indicates an underestimation of distance. Although observers overestimated distance of the figure to be inside the cylinder rather than in front, they also underestimated the total distance. This underestimation, however, might be due to a perceptual compromise between the horizontal and vertical extent of the figure when judging size.[1]

Conclusion

We present a simple but counterintuitive innovation on the traditional zoetrope. Mounting the animated figures *outside* of the slotted cylinder still results in perception of an animated figure. On top of the illusion of motion, observers experience a unique combination of visual effects—a horizontal reversal of the figure, a mislocalization of the figure into the empty cylinder, and a misperception of the figure's size. This simple device presents a wealth of optical and visual effects for the curious observer.

Acknowledgements

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Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The first author C. V. has been awarded a U.S. Patent (N°. 9,488,903) for the device described in this article.

Funding

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Note

1. We only consider perceived horizontal extent of the figure here. Vertically, the figure's angular size will be larger as the distance from the cylinder increases, that is, the distance to the observer decreases. This also means that observers perceive a distortion of the figure's aspect ratio. However, vertical size estimates are predicted to be off by only up to 0.2 cm, whereas the horizontal size is off by up to 1.5 cm in our display (see Figure 2(b)).

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Author Biographies

Christine Veras has a BFA in Animation and an MFA in Visual Arts, both from the School of Fine Arts at the Federal University of Minas Gerais (UFMG), Brazil. Currently, she is a PhD candidate at the Nanyang Technological University, School of Art, Design and Media in Singapore. In her PhD research, titled ''Animated Art Installations: Astonishment and the Quest for an Expanded Animation Experience,'' she investigates physical and digital multimedia strategies that connect animation, contemporary art installations and optical illusions to provide a unique experience for the public. Her invention, the Silhouette Zoetrope (US Patent N¤ 9,488,903) won the third prize in the international contest ''Best Illusion of the Year 2016'' organized by the Neural Correlate Society.

Quang-Cuong Pham was born in Hanoi, Vietnam. He graduated from the Departments of Computer Science and Cognitive Sciences of École Normale Supérieure rue d'Ulm, Paris, France, in 2007. He obtained a PhD in Neuroscience from Université Paris VI and Collège de France in 2009. In 2010, he was a visiting researcher at the University of São Paulo, Brazil. From 2011 to 2013, he was a researcher at the University of Tokyo, supported by a fellowship from the Japan Society for the Promotion of Science (JSPS). He joined the School of Mechanical and Aerospace Engineering, NTU, Singapore, as an Assistant Professor in 2013.

Gerrit W. Maus studied Cognitive Science in Germany, got a PhD in Psychology in England, and moved on to California, where he worked as a Cognitive Neuroscience researcher at the University of California in Davis and Berkeley. He has also visited the Max Planck Institute for Brain Research in Frankfurt, the University of Glasgow, the Smith-Kettlewell Eye Research Institute in San Francisco, and the Laboratoire Psychologie de la Perception in Paris. Since 2015, he is a Nanyang Assistant Professor at NTU. His lab focuses on studies of visual perception and its underlying neural mechanisms, investigating how the brain is able to predict and fill in missing information.

Appendix

A video of the Silhouette Zoetrope in action can be found at https://www.youtube.com/watch?v=2-A_Pcrz6xU. Please note that, obviously, the stereoscopic depth effect is not present in the video. The video corresponds roughly to the monocular condition in our experiment. Also, in the video, special lighting was used to enhance the illusion effect for the camera mainly for aesthetic reasons. However, the illusion can be perceived in practically any light conditions, as long as the contrast between the white inside of the cylinder and its darker exterior is kept.

Appendix I: Selection of Links of Online Articles Featuring the Silhouette Zoetrope

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Gizmodo (United States)
Ria Misra. “This Mind-Bending Trick Is Actually Two Illusions in One.” July 1, 2016.
http://gizmodo.com/this-mind-bending-trick-is-actually-two-illusions-in-on-1782953231

Numerama (France)
Julien Cadot. “La Meillure Illusion d’Optique de l’Année 2016 transforme des carrés en cercles.” July 1, 2016
http://www.numerama.com/sciences/179439-lillusion-de-lannee-2016-transforme-carres-cercles.html

Meduza (Russia)
Meduza. “Лучшие иллюзии 2016 года: Превращение круга в квадрат и эксперимент с локтем”. July 2, 2016.
https://meduza.io/shapito/2016/07/02/luchshie-illyuzii-2016-goda-prevraschenie-kruga-v-kvadrat-i-eksperiment-s-loktem

***Daily Mail* Online (United Kingdom)**
DailyMail.com. “Engineer manages to solve mind-bending optical illusion that flummoxed the internet—and it isn't as complex as you think...” July 3, 2016
http://www.dailymail.co.uk/news/article-3672044/Mind-bending-optical-illusion-internet-flummoxed-SOLVED.html

Underholdning (Denmark)
Rikke Museth Janniche. “Årets bedste illusioner: Her bliver din hjerne fuldstændigt snydt.” July 4, 2016
http://underholdning.tv2.dk/viralt/2016-07-04-aarets-bedste-illusioner-her-bliver-din-hjerne-fuldstaendigt-snydt

Sciences et Avenir (France)
Lise Loumé. “Les meilleurs illusions d’optique de l’année 2016.” July 4, 2016.
https://www.sciencesetavenir.fr/sante/cerveau-et-psy/les-meilleures-illusions-d-optique-de-l-annee-2016_104437

CNN Español (United States)
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http://cnnespanol.cnn.com/2016/07/04/estas-son-las-tres-mejores-ilusiones-opticas-del-ano/

Standnews (China)
Standnews. July 4, 2016.
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Appledaily (Taiwan)

最新. July 4, 2016.
http://www.appledaily.com.tw/realtimenews/article/new/20160704/900565/

Siete24 (Mexico)
Siete24.mx. “La illusion óptica del año. ¿Qué ves?” July 4, 2016.
http://siete24.mx/la-ilusion-optica-del-ano-que-ves

RT News (Russia)
RT en español. “‘La illusion óptica del año’: ¿Las figures se mueven o permanecen estáticas? No te dejes engañar.” July 4, 2016.
https://actualidad.rt.com/videoclub/212172-ilusion-optica-figuras-enganar

Minute News (France)
Nickraven. “Décrouvez les 3 plus belles illusions d’optique de l’année 2016.” July 4, 2016.
https://www.minutenews.fr/divertissement/trendy/decouvrez-3-plus-belles-illusions-doptiques-de-lannee-178395.html

Smithsonian.com (United States)
Erin Blakemore. “Check Out the Best Illusions of 2016. Baffle your brain with these contest-winning mind-benders.” July 6, 2016.
http://www.smithsonianmag.com/smart-news/check-out-best-illusions-2016-180959703/?no-ist

Scientific American: Illusion Chasers blog (United States)
Stephen L. Macknik. “A Review of 2016's Best Illusion of the Year Contest.” July 6, 2016.
http://blogs.scientificamerican.com/illusion-chasers/a-review-of-2016-s-best-illusion-of-the-year-contest-video/

Focus (Italy)
Elisabetta Intini. “I cilindri allo specchio e alter illusioni ottiche da perdere la testa.” July 6, 2016.
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AV Club (United States)
Alex McCown. “Now you see the 2016 Best Illusion Of The Year Contest winners”. July 6, 2016.
http://www.avclub.com/article/now-you-see-2016-best-illusion-year-contest-winner-239148

Washington Post: Wonkblog (United States)
Ana Swanson. “This square isn’t actually rotating. Here’s why.” July 7, 2016.
https://www.washingtonpost.com/news/wonk/wp/2016/07/07/five-of-the-best-optical-illusions-reveal-hidden-secrets-about-the-brain/#comments

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Kraftfuttermischwerk (Germany)
Ronny. “Illusions of the Year 2016.” July 7, 2016.
http://www.kraftfuttermischwerk.de/blogg/illusions-of-the-year-2016/

HowStuffWorks Science (United States)
Kathryn Whitbourne. “Watch: Amazing Video of This Year’s Top Three Optical Illusions.” July 7, 2016.
http://science.howstuffworks.com/life/inside-the-mind/human-brain/watch-amazing-video-this-years-top-three-optical-illusions.htm

Chip (Germany)
Nadine Englhart. “Wie funktioniert das nur? Diese Illusionen auf YouTube sind unglaublich.” July 8, 2016.
http://www.chip.de/news/Vorsicht-Hirnkrampf-Diese-Illusionen-auf-Youtube-sind-irre_96463314.html

GenK (Vietnam)
Tham Khảo. “Hãy xem 3 màn ảo thuật vừa đoạt giải Ảo ảnh xuất sắc nhất năm 2016.” July 12, 2016.
http://genk.vn/hay-xem-3-man-ao-thuat-vua-doat-giai-ao-anh-xuat-sac-nhat-nam-2016-20160706164107029.chn

LiveScience (United States)
Greg Uyeno. “How’d They Do That? The Best Illusions of 2016 Named.” July 12, 2016.
https://www.livescience.com/55359-best-illusions-of-the-year-2016.html

Hvg.hu (Hungary)
Hvg.hu. “Mi alig hiszünk a szemünknek: mutatunk 3 nagyon nehezen hihető optikai csalódást”. July 14, 2016.
http://hvg.hu/tudomany/20160714_optikai_csalodas_illuzio_video

Naver (Japan)
u1bell. July 16, 2016.
https://matome.naver.jp/odai/2146863690121481201/214686649304608590 3

SouBH Notícias (Brazil)
Sou BH. “Mineira é premiada em concurso internacional de ilusão de ótica.” August 19, 2016.
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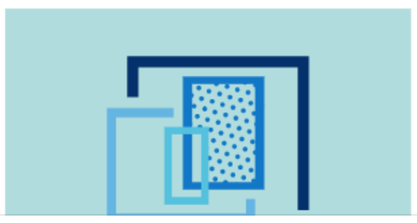
Appendix J: Printed Selected Articles About the Silhouette Zoetrope Participation at the “Illusion of the Year Contest 2016”

You may also like

Gizmodo

Did Prehistoric People Watch the Stars Through This 6,000 Year Old 'Telescope'?

6/29/16 7:01pm



Recent from Ria Misra

Gizmodo · Ria Misra

Dinosaurs More Likely Cooed Than Roared

Today 5:30pm

Gizmodo · Ria Misra

This Bizarre Galaxy Is Younger on the Inside Than the Outside

Today 12:00pm

Gizmodo · Ria Misra

Nobody Wants to Eat Margarine Anymore

Friday 5:50pm

This Mind-Bending Trick Is Actually Two Illusions in One

Ria Misra
7/01/16 11:08am · Filed to: IT'S AN ILLUSION

27.2K 27 6

What sorcery is at work here? Careful, this trick—er, *illusion* has a second, surprising twist in it.

Share Tweet

Technological University in Singapore. It was one of the top three illusions in this year's Best Illusion of the Year contest, in which scientists compete with each other to create the most confounding illusions.

At first, Veras' illusion appears to be a relatively simple one. You see one bird flying inside the cage, but the bird is actually several still birds outside of the cage. It's the rotation of the wheel combined with strategically placed slats of light that make it appear to be inside instead of out and moving instead of still. Easy enough, but watch all the way to the end, and you'll see a second illusion embedded in the first.

The bird you see flying is facing to the right, but when Veras stops the zoetrope and you see the birds, in various stages of flight, are all facing to the left. It's only when you see them in rotation through the slats, that they appear to be flipped.

This illusion is the third place winner of the Best Illusion of the Year contest, the results of which were just announced. You can see all 10 right here, including this marvelous little bit of trickery from Kokichi Sugihara from Meiji University (whose work we've covered before.)

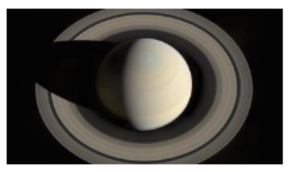
Crazy Illusion Somehow Transforms Rectangles Into Circles in the Mirror

What in the sorcerous hells is this? Kokichi Sugihara's 'Rectangles and Circles' illusion is a...

Read more sploid.gizmodo.com

MAGIC MAGIC MAGIC

No, This Hill In Canada Isn't Using Magnetic Force To Pull Cars Uphill



An Optical Illusion Has Been Tricking Everyone About the Size of Saturn's Rings for Centuries

How Does This Mind-Bending Illusion Work?

Ria Misra ria.misra@gizmodo.com @misra

Reply | 27 replies

Like 323

Ria Misra's Discussions All replies

Warning: Replies that are pending approval may contain graphic material. Please

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Discover The Fastest Way To Make Money On Qoo10

Deals · Shep McAllister

This Samsung 4K Prime Day Discount Might Be the Best TV Deal We've Ever Seen

Today 6:12pm

proceed with caution.

theimmc > Ria Misra
7/01/16 11:31am

We're seeing the birds at the back, not the front. Neat illusion. But not as mind bending as the shapes by Sugihara.

Reply

2

Asbuuu > theimmc
7/01/16 11:48am

That's not quite right. We are seeing the birds in the front, but the scanning light effectively inverts the image. More impressive than it seems at first!

Reply

2

ToastLover > theimmc
7/01/16 11:48am

Nope. We're seeing the birds in the front. But the slits show us the bird beginning with the beak and ending with the tail feathers while they're moving to the left thus inverting the image.

Reply

5

eMouse > ToastLover
7/01/16 12:13pm

What ToastLover says is correct. Consider this: the outside of the center is black, but when it's spun it turns white? Why? Because the 'white' we're looking at is actually the slits showing the white interior. It's moving fast enough that our brain (and the camera) blurs it into one continuous solid space.

During the time a single slit passes across the front, it highlights a sliver of the bird as well. Due to the birds being further out on the wheel, they have to pass the eye faster than the slit, so a west-facing bird is shown to us beak-first, tail last. And because at any given moment the slit is only showing us a small increment of the bird, then our brians/cameras blur the movement of the slit together, it does the same for the bird, only in reverse, flipping the apparent direction of the bird.

Reply

3

chveras > theimmc
7/02/16 9:26am

Congratulations Asbuu, ToastLover and eMouse! You are correct. When I created the device, I have done a very simple test to prove that the bird we are seeing is, in fact, the front bird and not the bird on the back. I have removed all the birds and left only one to be seen when the device rotates. The result is that, as you have mentioned, we can only perceive the illusion when the birds pass in front of us, not behind the cylinder. The effect is better perceived live, although the film can give an idea of how it works.

Reply

6

theimmc > chveras
7/02/16 9:33am

Thank you. It is more mind bending than I mistakenly assumed.

Reply

1

VolunteersForAwesome > chveras
7/02/16 10:57am

What led to this idea being made a reality? Even setting out to create a mind bending illusion I'm curious about whether there was a process working through ideas trying to get the most bad-ass illusion possible or if you knew this was exactly what you wanted from the very beginning.

Reply

1

chveras > VolunteersForAwesome
7/02/16 10:57pm

The invention is the result of my PhD research on Astonishment and Wonder triggered by animated artistic installations. I was always fascinated by the Zoetrope, and I was trying to combine it with Puppet Shadow Theatre traditions when I had the inspiration for this illusion, which offers a paradigm shift from the traditional Zoetrope. The results are even more astonishing when seeing live since the camera makes us loose the depth perception cues created by both our eyes.

Reply

VolunteersForAwesome > chveras
7/03/16 9:28am

PENDING APPROVAL

That actually makes a lot of sense, I'm curious to see what else could come out of the combination.

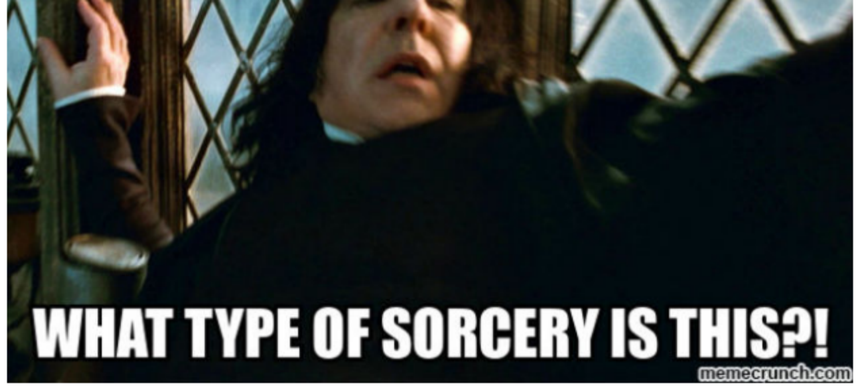
As a sidenote: once you complete your dissertation it is my opinion you should be 100% certain to bill yourself as a leading expert in the field of Astonishment and Wonder.

Reply

Collapse replies

JoshB2084 > Ria Misra
7/01/16 11:22am

22



Reply

El Gigante > JoshB2084
7/01/16 2:58pm
PENDING APPROVAL

Reply

PopeBenedict > JoshB2084
7/01/16 5:08pm
PENDING APPROVAL
1

.

Reply

Eustache Dauger > Ria Misra
7/01/16 11:26am
1

> The bird you see flying is facing to the right, but when Veras stops the zoetrope and you see the birds, in various stages of flight, are all facing to the left.

Well, the one in the front is facing left. The one in the back is facing right. One is towards us, one away, the rest are somewhere in between. They are all facing clockwise, though.

Reply

eMouse > Eustache Dauger
7/01/16 12:19pm
1

But the illusion isn't caused by the one in the back. Consider that everything you see as white when it spins has to be the inside of the cylinder. The only times you see through to the other side is when the slits line up perfectly, creating a dark vertical line. The silhouette of the bird, which is black on a white background, has to be the bird in front of the cylinder, which is facing left.

Reply

Executor Elassus > Ria Misra
7/01/16 12:33pm
4

Uh, you didn't actually include a link to the 10 winners, just the link to the ambiguous cylinders illusion twice.

Reply

FadekynOfArrakis > Ria Misra
7/02/16 7:34pm
PENDING APPROVAL

This isn't an illusion. It's inverted animation.

https://www.google.com/search?q=early...

Reply

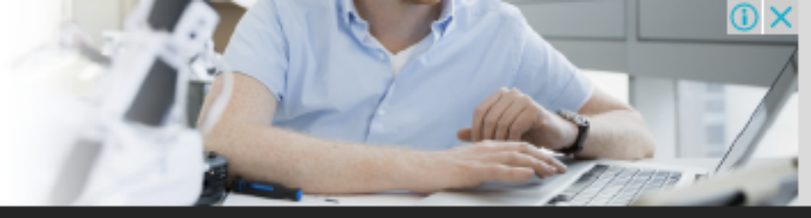
FadekynOfArrakis > FadekynOfArrakis
7/02/16 7:35pm
PENDING APPROVAL

She took a well known old system and flipped it inside out.

Reply

Load more

Reuse data to fuel innovatio
Be Fearless. DO IT NOW
AUTODESK



ШАПИТО

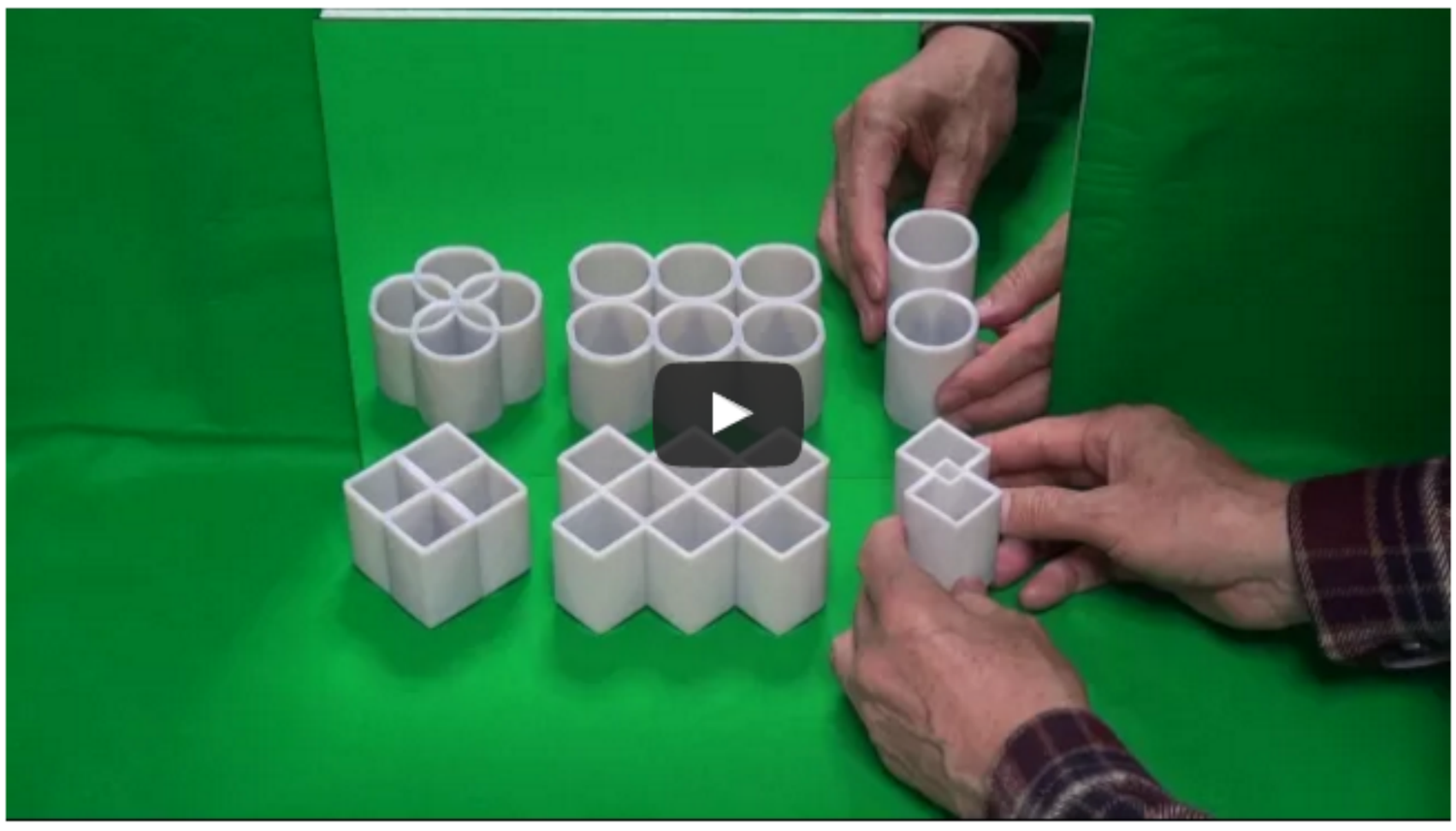
Лучшие иллюзии 2016 года: Превращение круга в квадрат и эксперимент с локтем

Meduza 05:47, 2 июля 2016

В США прошел конкурс «Лучшая иллюзия года». Одна из целей проекта — помощь в обнаружении основ иллюзорного восприятия, которое интересует офтальмологов, неврологов и художников, работающих с иллюзиями.

Судьями выступают врачи и преподаватели университетов. Мероприятие проводится некоммерческой организацией Neural Correlate Society ежегодно уже 12 раз.

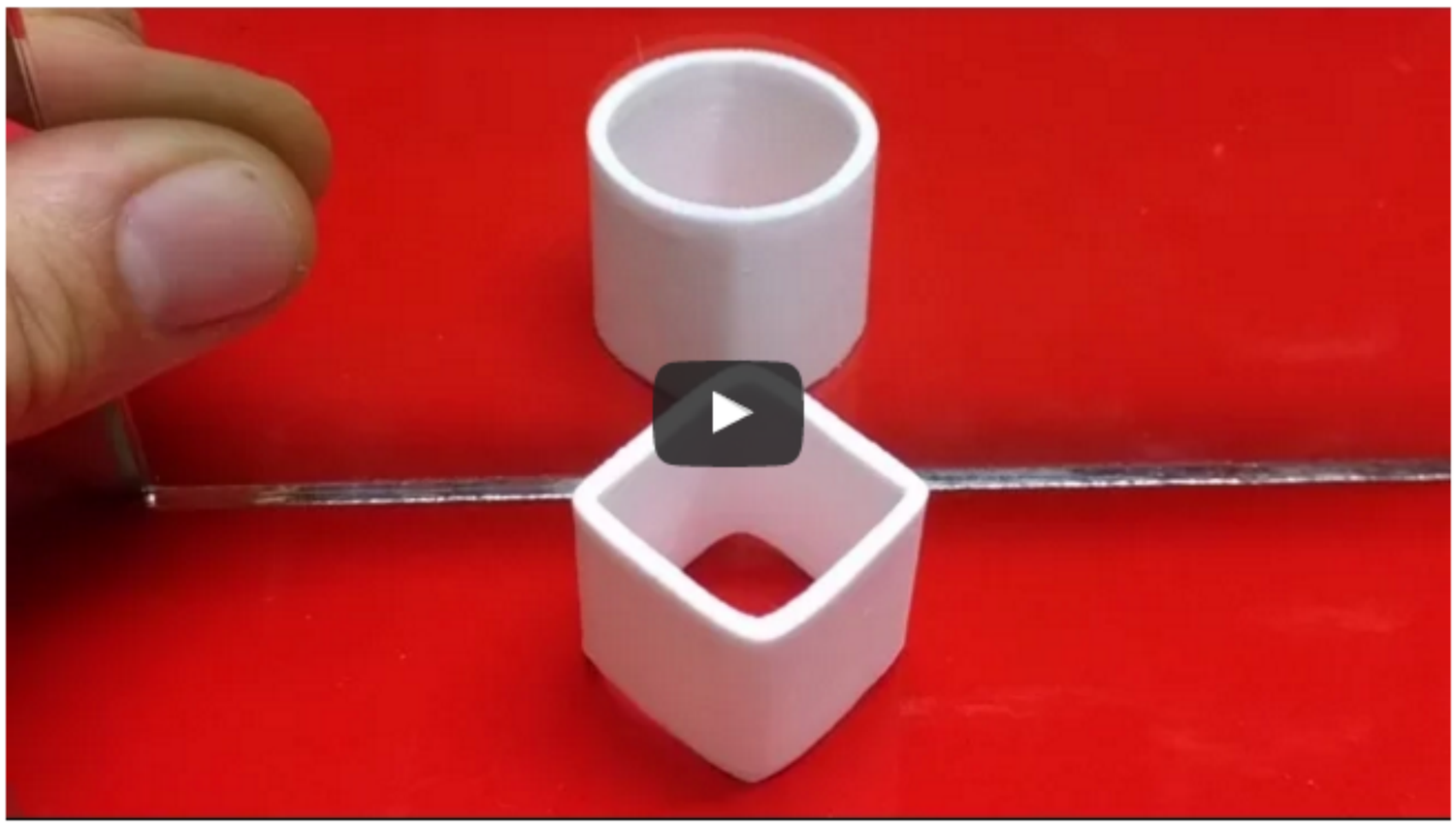
В этом году одним из финалистов стал японский математик Кокичи Сугихара из университета Мэйдзи, показавший фокус с геометрическими фигурами. Сугихара в своей иллюзии превратил круг в квадрат (но не только). Автор работы занял второе место.



Ambiguous Cylinder Illusion / TheIllusioncontest

На иллюзию обратили внимание читатели Reddit. Один из пользователей попросил, чтобы кто-нибудь показал 3D-модель цилиндров и медленно их повращал перед камерой. Другой комментатор выполнил просьбу.

Тут вы можете поближе разглядеть формы, которые преобразуются из круга в квадрат и не только.



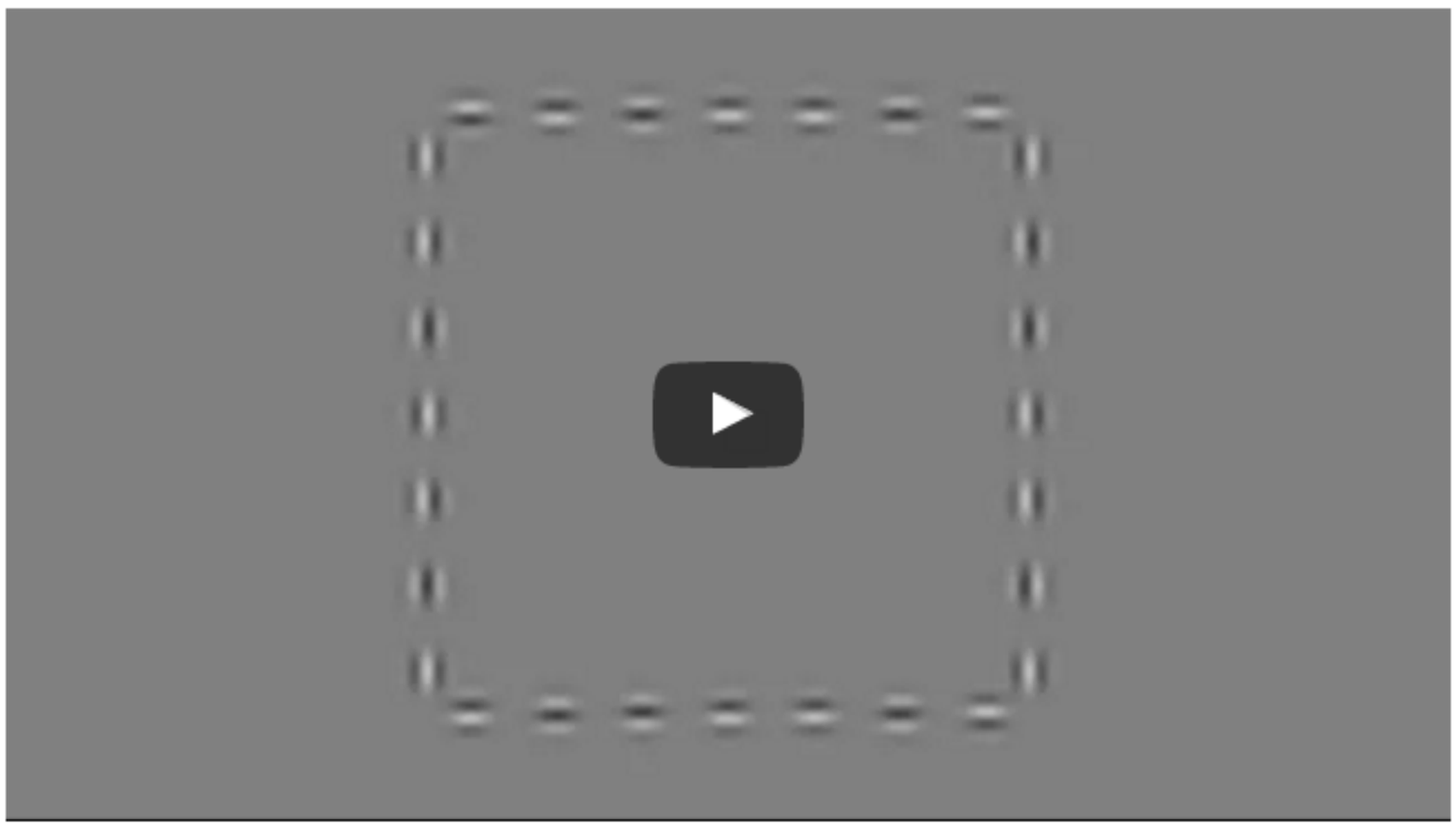
Ambiguous Cylinder Illusion // How it Works / Make Anything // 3D Printing Channel

Еще большое внимание привлекла к себе работа с силуэтами зоотропа Кристины

Верас из Наньянского технологического университета (Сингапур). Девушка поместила на внешнюю сторону зоотропа игрушечных птиц. Верас за работу присудили третье место.

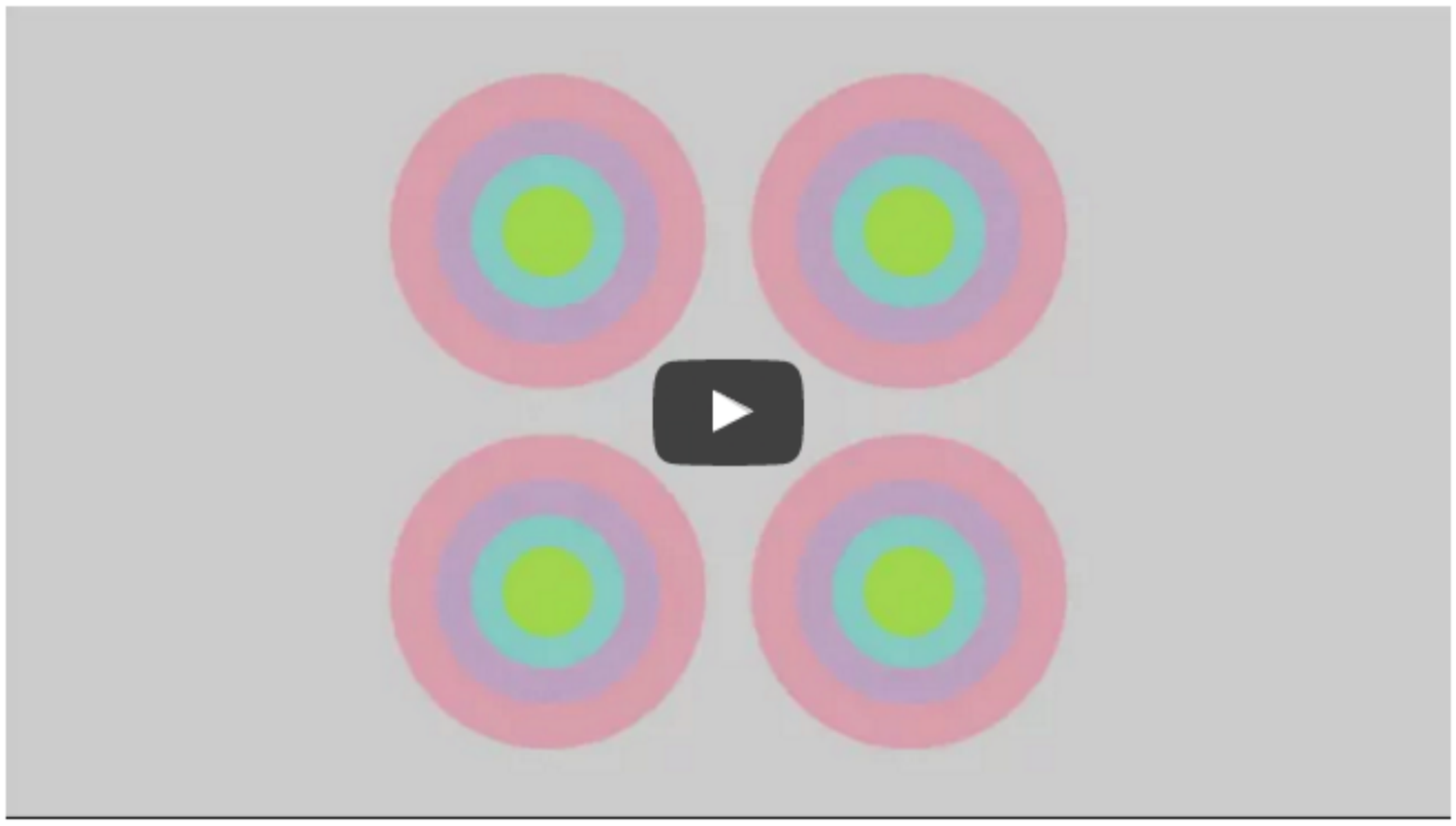
Silhouette Zoetrope / TheIllusioncontest

Мэтью Т. Харрисон и Гидеон П. Капловиц из Университета Невады в Рино оказались победителями конкурса. Ученые на сером фоне разместили черно-белые круги, в которых шевелятся черно-белые полоски, из-за чего кажется, что фигуры и полоски с такими кругами двигаются.



Motion Integration Unleashed New Tricks for an Old Dog / TheIllusioncontest

Трое ученых из университетов Бельгии, Нидерландов и США, сделали иллюзию с бесцветными пузырями, которые все же кажутся цветными. Причем пузыри в видео разных размеров и каждый имеет свой цвет.



Caught inside a bubble / TheIllusioncontest

Ученые Питер Брюггер и Ребека Мейер из Швейцарии показали иллюзию, знакомую многим с детства. Если попросить человека закрыть глаза и медленно водить пальцем по внутренней стороне его руки, то он не сможет угадать, когда палец окажется у локтя.

палец оказется у локтя

A New Illusion at Your Ellbow / TheIllusioncontest

Остальные иллюзии, которые вошли в десятку лучших, можно продолжить смотреть здесь.

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Юлия Ефимова завоевала первую российскую медаль Игр-2016 в плавании

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Мужская сборная России по спортивной гимнастике завоевала первую олимпийскую медаль за 16 лет

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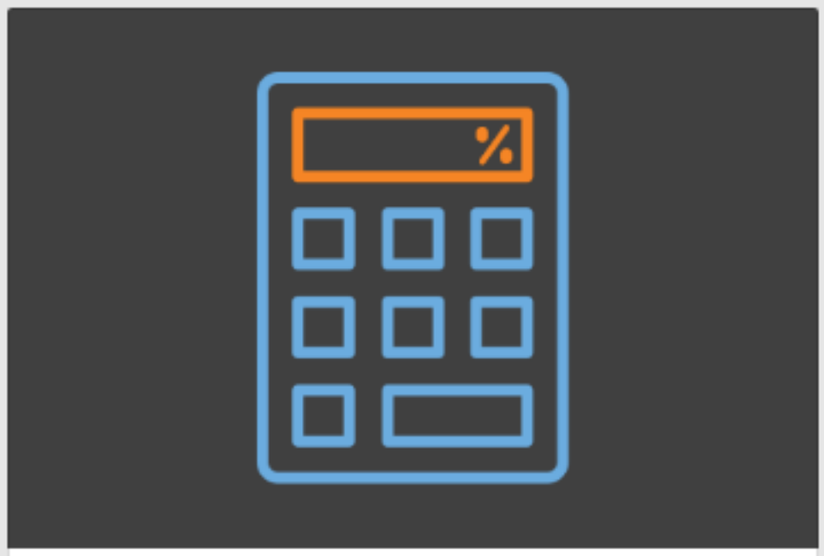

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Личный «Убер» Шувалова Почему вице-премьер не должен декларировать свой самолет. Объясняет Алексей Венедиктов

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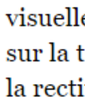
Les meilleures illusions d'optique de l'année 2016

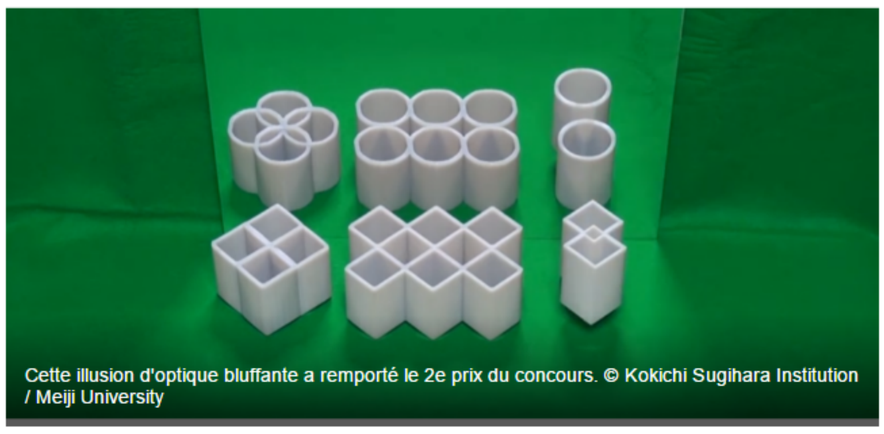


Par Lise Loumé
Voir tous ses articles

Publié le 04-07-2016 à 15h43

A+ A- 🖶

Chaque année, deux laboratoires américains récompensent les meilleures illusions d'optiques réalisées par des scientifiques. Découvrez les vainqueurs de l'édition 2016 du concours.



Cette illusion d'optique bluffante a remporté le 2e prix du concours. © Kokichi Sugihara Institution / Meiji University

G+1 6

L'arrangement particulier de certaines scènes visuelles amène notre cerveau à faire des erreurs sur la taille d'un objet, la couleur d'une surface ou la rectitude d'une ligne : c'est ce que l'on appelle des illusions d'optique. Celles-ci ne sont pas seulement d'étonnants tours de magie : elles permettent aux neurobiologistes de mieux comprendre comment nous percevons notre environnement et révèlent des mécanismes spécifiques de notre cerveau. C'est pourquoi, dans le cadre de travaux de recherche, de nombreux chercheurs sont amenés à produire leurs propres illusions d'optique. Et chaque année, un concours nommé "The best illusion of the year" et organisé par la *Neural Correlate Society* (qui regroupe un laboratoire de neurosciences intégrées et un laboratoire de neurophysiologie comportementale) récompense les trois meilleures. Découvrez-les dans les vidéos ci-dessous.

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À LIRE AUSSI
Et si les illusions d'optique n'étaient pas des illusions ?
EN IMAGES. 7 illusions d'optiques qui piègeront votre cerveau
VIDEO. Les meilleures illusions d'optique de l'année 2015

Troisième prix : un zootrope pas comme les autres

Inventé à l'époque victorienne, le zootrope est une sorte de jouet optique qui donne l'illusion de mouvement : concrètement, c'est un cylindre percé d'une dizaine de fentes abritant à l'intérieur une bande de dessins, qui se mettent en mouvement dès que l'on fait tourner le cylindre. Christine Veras, de l'Université de technologie de Nanyang (Singapour), s'est amusée à inverser la structure traditionnelle du zootrope : les silhouettes, qui représentent des oiseaux, ne sont plus à l'intérieur du cylindre - une cage -, mais à l'extérieur. En faisant tourner le cylindre, l'on découvre un oiseau qui vole dans sa cage. Poétique.

Deuxième prix : un cylindre qui se transforme en carré

L'illusion de Kokichi Sugihara, chercheur de l'Université Meiji de Tokyo (Japon), est très déstabilisante : un objet composé de carrés en 3D se transforme en un autre fait de cercles quand on le regarde dans un miroir. Et si l'on tourne l'objet, c'est l'inverse ! Difficile au final de déterminer la vraie forme de l'objet en question. L'illusion ne disparaît jamais, même si nous essayons de corriger notre interprétation.

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LES PLUS LUS

La grenade révèle une puissante molécule anti-vieillissement

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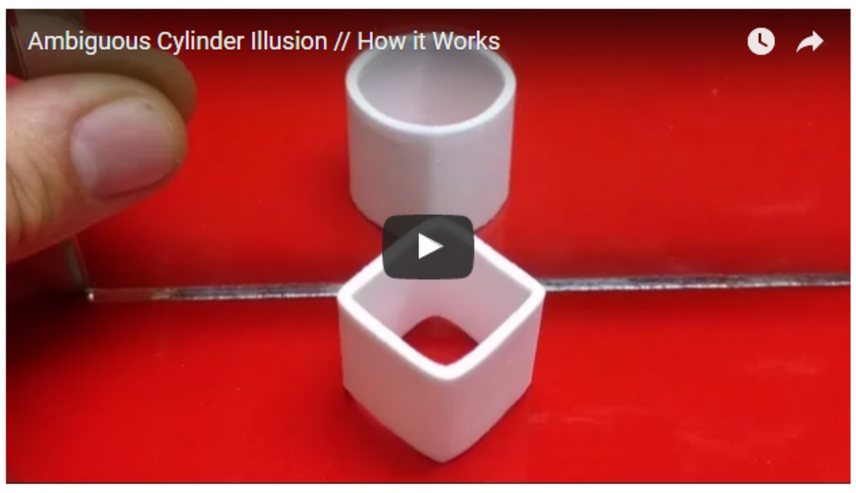
DIAPORAMA

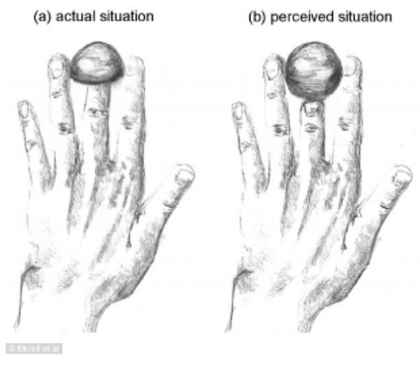
Cet effet d'optique très réussi tient à l'angle d'inclinaison du miroir, à celui de l'observateur et surtout aux bords biseautés de l'objet, comme l'explique la chaîne "Make Anything" dans la vidéo ci-dessous.



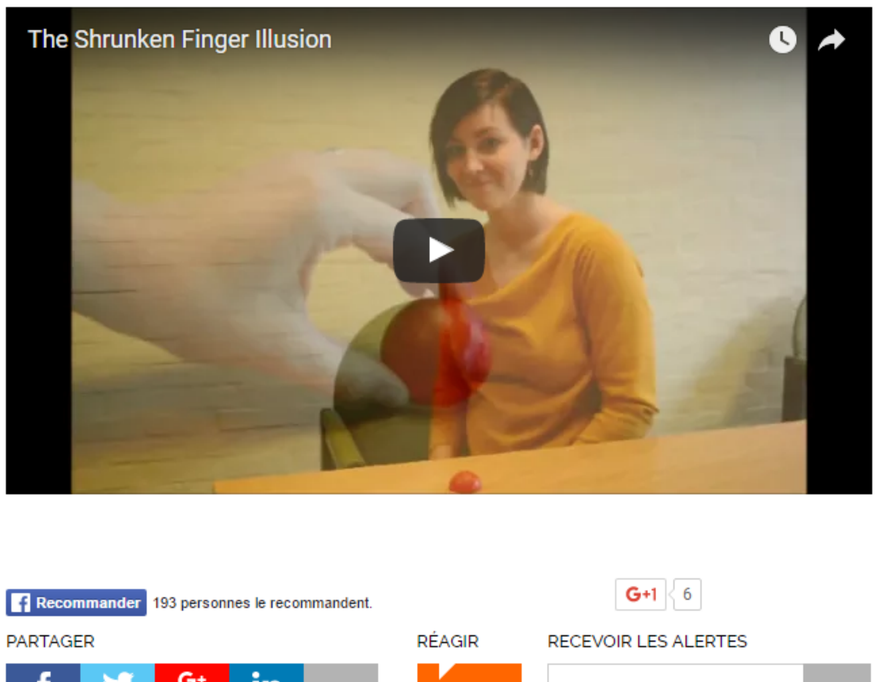
Premier prix : des cercles immobiles... qui bougent

Le premier prix du concours revient à Mathew T. Harrison et Gideon P. Caplovitz, de l'Université du Nevada à Reno (États-Unis), qui ont proposé une illusion plutôt classique mais impressionnante : difficile de vous en persuader, mais dans la vidéo ci-dessous, aucun cercle ne bouge, simplement les lignes noires et blanches à l'intérieur. Et pourtant, tous les cercles semblent se déplacer, parfois de manière synchronisée. Si vous ne nous croyez pas, placez une règle sur votre écran et vous constaterez par vous-mêmes qu'ils restent bien à leur place.

Coup de cœur : l'impression du doigt coupé



Non récompensée, l'illusion de Vebjørn Ekroll, Bilge Sayim, Ruth Van der Hallen et Johan Wagemans, chercheurs de l'Université catholique de Louvain (Belgique), vaut le coup d'œil. Présentée dans un précédent article de *Sciences et Avenir*, elle consiste à demander à un volontaire de placer une demie balle de ping-pong sur le majeur et de regarder d'au-dessus. Cela lui donne l'impression que son doigt est coupé ou raccourci (cf. schéma ci-dessus) ! Une erreur d'interprétation du système visuel ? Pas vraiment, c'est plutôt le cerveau qui va inférer l'existence de la seconde moitié de la sphère, ont montré ces chercheurs dans un article paru dans le *Journal of Vision*.



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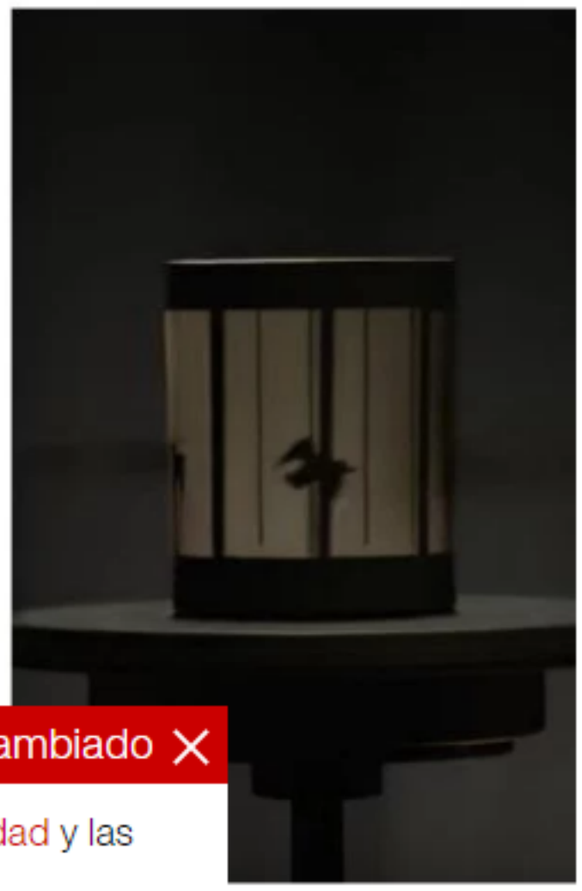
VIDÉOS

NOTICIAS

Estas son las tres mejores ilusiones ópticas del año

1K+ 3



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Por **CNN Español**
21:51 ET (01:51 GMT) 4 julio, 2016

(CNN Español) - Hace poco se dieron a conocer los ganadores de un extraño pero absolutamente genial concurso en internet: las mejores ilusiones del año. Y el resultado no es decepcionante, pues las ilusiones ganadoras no solo han dejado perplejas a miles de personas, sino que muestran los límites y engaños fascinantes de la percepción humana.

En el concurso, realizado por la Neural Correlate Society, miles de votantes el línea alrededor del mundo escogieron las ilusiones más desconcertantes y maravillosas. Las tres primeras de seguro te dejarán pensando dos veces.

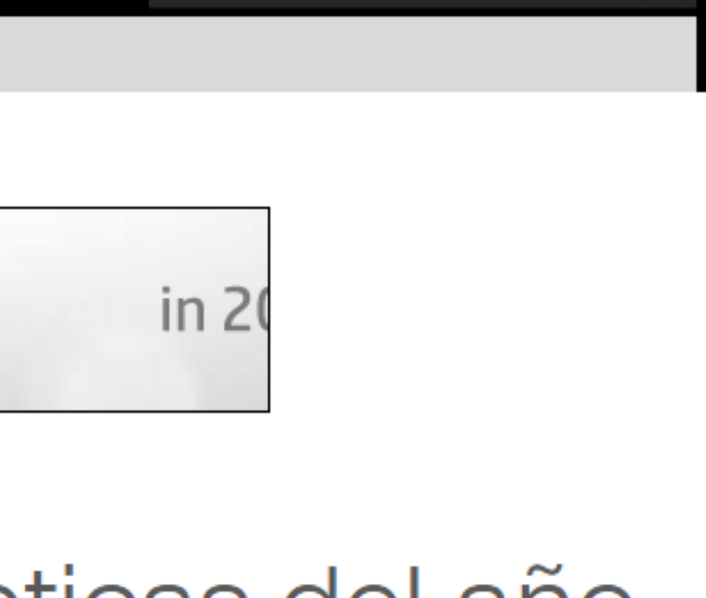
La primera —y ganadora de 3.000 dólares— es la ilusión de Mathew T. Harrison y Gideon P. Caplovitz de la Universidad de Reno, en Nevada. Se llama "Motion integration unleashed" y muestra que el cerebro cree lo que no es: en este caso, que unos círculos se mueven, cuando en realidad permanecen quietos en la pantalla.

¿Se mueven estos círculos?

Motion Integration Unleashed New Tricks for an Old D...

Lo más importante

Las ilusiones ganadoras no solo han dejado perplejas a miles de personas, sino que muestran los límites y engaños fascinantes de la percepción humana



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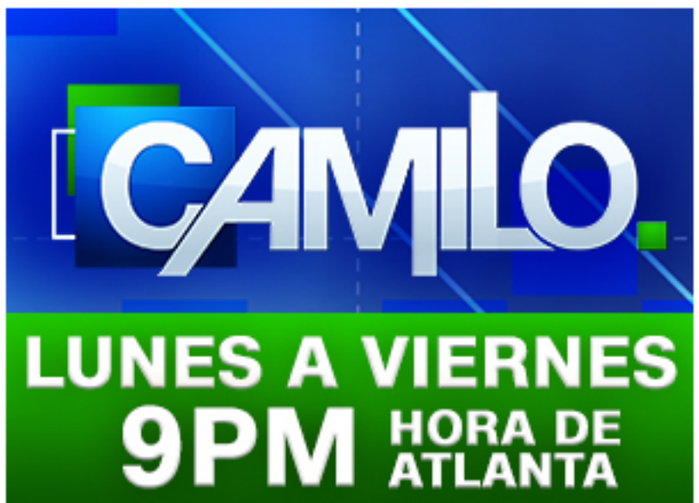

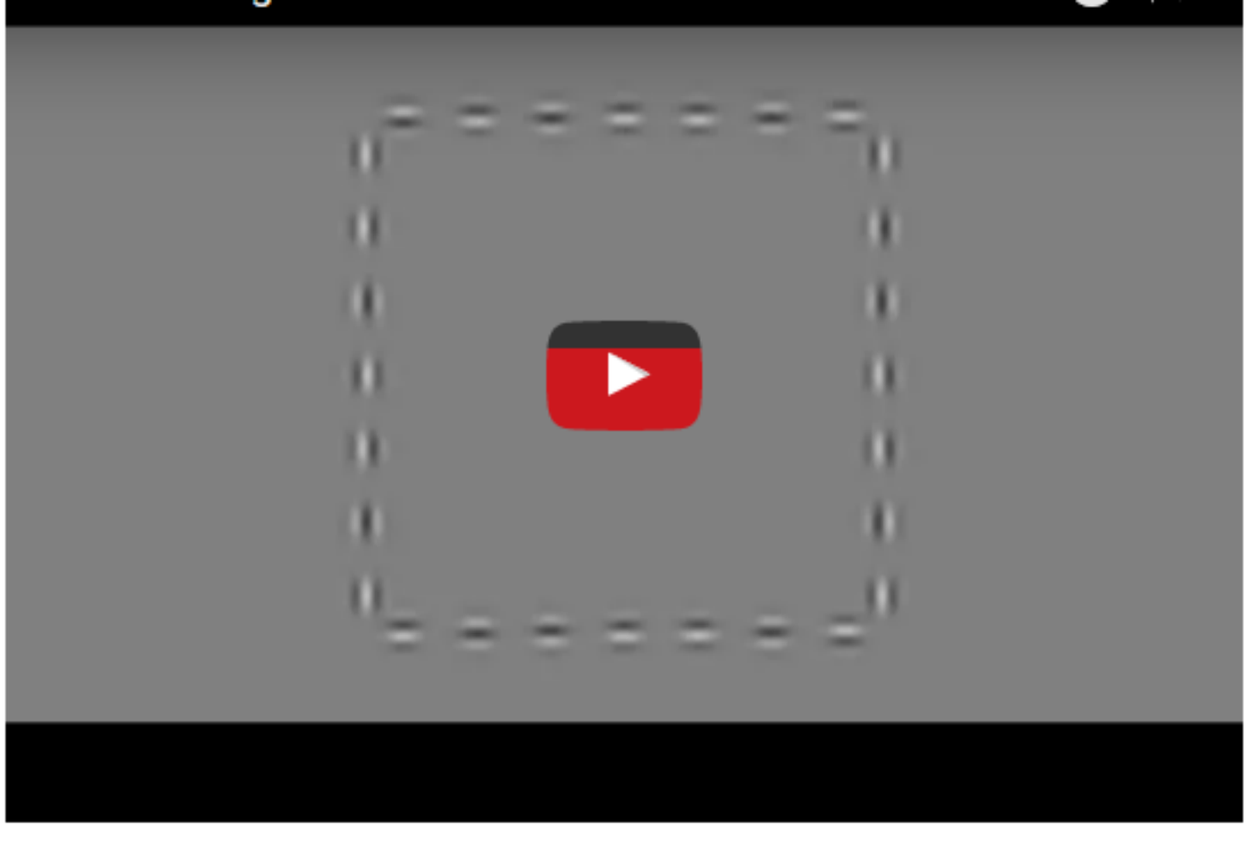

Los pequeños círculos crean formas, como un cuadrado que, debido al movimiento interno de los puntos, parece moverse.

El video suma más de 300.000 reproducciones en YouTube.

¿Cilindros o rectángulos?

El segundo lugar fue para "Ambiguous Cylinder Illusion" de Kokichi Sugihara de la Universidad Meiji en Japón, una ilusión verdaderamente inquietante que desafía la percepción.

Sugihara, profesor de matemáticas, pone lo que parece ser una serie de cilindros frente a un espejo, que refleja objetos con formas completamente distintas. Al rotarlos, cambian de de nuevo de forma, sin aparente explicación.

¿Photoshop? ¿Magia? SPOILER ALERT: Un usuario que comentó el video en YouTube proporcionó la respuesta: los objetos no son tubos completamente cilíndricos ni rectangulares, sino que son cilindros moldeados con cortes en relieve en las puntas que juega con las sombras.

El canal en YouTube Make Anything también descifró la ilusión: la clave es que dos lados del tubo terminan arcos cóncavos y los otros en arcos convexos. Depende de donde se mire: la forma parecerá un circular o rectangular.

El video original de Sugihara se hizo viral en Reddit y en YouTube suma más de 2,8 millones de reproducciones.

Un zoótropo diferente

El tercer lugar fue para “Silhouette Zoetrope”, una ilusión de Christine Veras de la Universidad Tecnológica Nanyang en Singapur. Se trata de la reinvención del zoótropo, el clásico juguete de animación. En este objeto, el dibujo no está adentro sino afuera del estroboscopio.

Las aves parecen volar dentro de la caja, pero. Además, sin movimiento van hacia un lado, pero cuando se mueve el mecanismo vuelan hacia el otro.

Las aves parecen volar dentro de la caja, pero. Además, sin movimiento van hacia un lado, pero cuando se mueve el mecanismo vuelan hacia el otro.

La siguiente edición del concurso —la edición número trece, en 2017 — ya están abiertas.

#Ilusión óptica

Notas relacionadas

La ilusión óptica que tiene loca a la gente en redes: estas dos piezas son del mismo tamaño

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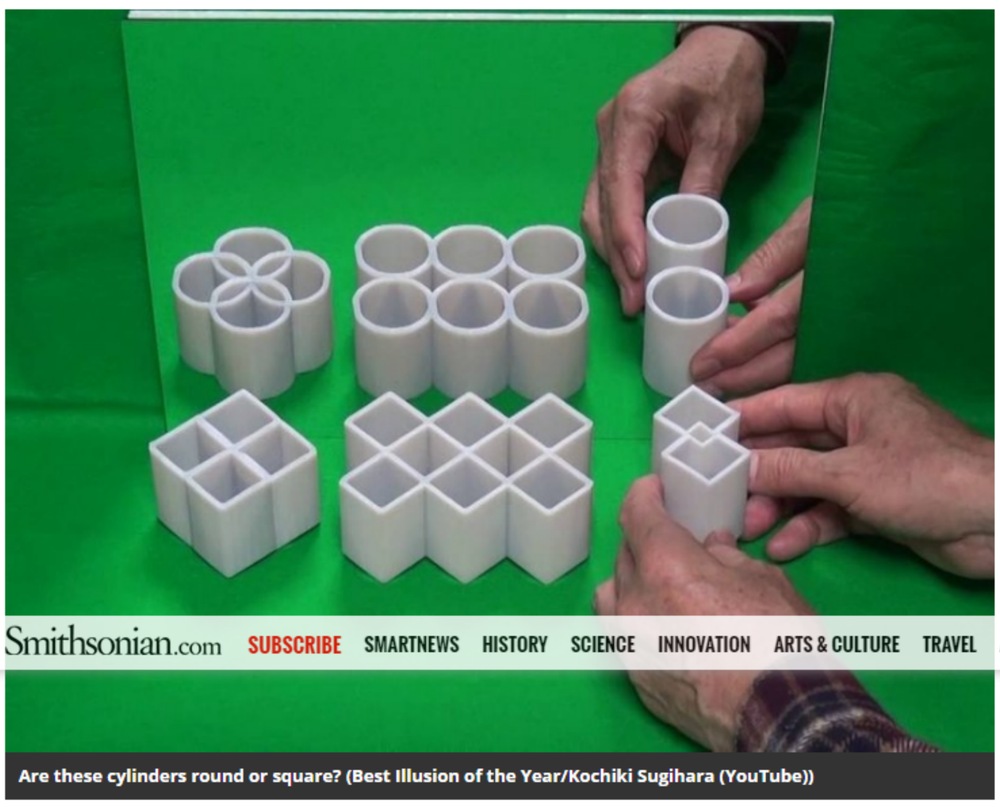
Check Out the Best Illusions of 2016

Baffle your brain with these contest-winning mind-benders



Are these cylinders round or square? (Best Illusion of the Year/Kochiki Sugihara (YouTube))

Smithsonian.com SUBSCRIBE SMARTNEWS HISTORY SCIENCE INNOVATION ARTS & CULTURE TRAVEL AT THE SMITHSONIAN + SHOP

By Erin Blakemore
SMITHSONIAN.COM
JULY 6, 2016

413 28 9 6 4 44 568

The 2016 winners of the Neural Correlate Society's Best Illusion of the Year Contest may not only challenge your sense of reality, they could turn what you think you know about the world on its head.

Every year, the contest challenges everyone from artists to ophthalmologists to come up with illusions so mind-bending, you may never understand how they work. The contest solicits public submissions, creates a top ten list using a panel of judges, and then lets the public vote on their top three.

This year's winners, Mathew T. Harrison and Gideon P. Caplovitz of the University of Nevada Reno, created something truly mind-boggling—a set of seemingly moving black-and-white shapes that aren't really moving at all. When you take a look at the dots, you'll realize that they are not in motion, even though the configurations of black-and-white specks seem like they're morphing into all kinds of designs.

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The illusion isn't just a trippy trick—it's an example of drifting Gabors. Gabor patches are also known as "Gaussian-windowed, drifting sinusoidal luminance patterns." The concept is more simple than it sounds. A sine wave can be seen through a grate-like phenomenon that makes it appear like a moving object. Gabors are sometimes used to test or train vision. In this case, the context of many Gabors whose filters drift makes it look as if all of the spots are moving around. This isn't the first time Caplovitz has confused onlookers: He's a neuroscientist who's been in the contest's top ten before.

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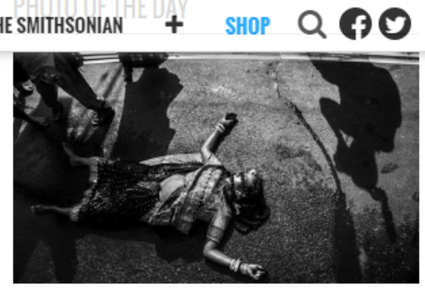

Lost in Faith

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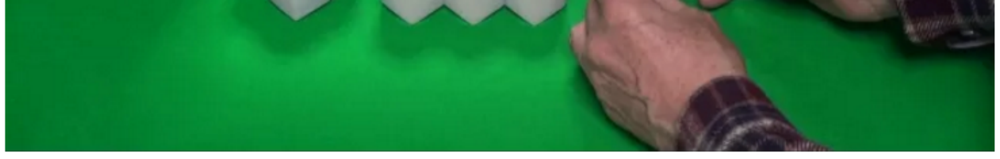

In second place is Kokichi Sugihara, an engineer who has created something truly bizarre. This seemingly impossible illusion, which Sugihara calls the "ambiguous cylinder illusion," tricks the brain with objects that look square, but seem to become circular when placed in front of a mirror.

"We cannot correct our interpretations although we logically know that they come from the same objects," writes Sugihara. "Even if the object is rotated in front of a viewer, it is difficult to understand the true shape of the object, and thus the illusion does not disappear."

That statement characterizes the weirdness of watching an object morph from squares into circles and back again, but it doesn't explain the illusion. It took 3D printing specialist "Devon" from the Make Anything channel on YouTube reverse engineering the illusion to reveal what is going on. The trick relies on a cylinder that looks square from the bottom, but has curved sides that, when placed next to a mirror at the right angle, look circular instead. The trick relies on a lazy brain that tries to fill in all four sides with the shape it perceives. Not bad for a simple cylinder.

The contest's third place winner, "Silhouette Zoetrope" by Christine Veras, is an empty, zoetrope-like object that seems to leap to life when spun. But unlike a regular zoetrope, it doesn't contain animated illustrations. Rather, the light of the cylinder makes it look like birds on the outside of the zooetrope are inside in silhouette. And even more weirdly, the birds seem to fly in the opposite direction that they point when stable.

Veras, a Ph.D student in art, design and media, created the illusion by combining multiple visual effects. In a release about the prize, Nanyang Technological University explains that multiple visual phenomena are at play. The flashing glimpses of birds in different positions tricks the brain into thinking that they are moving with a phenomenon called stroboscopic apparent motion, while an accommodation conflict between the eye's desire to focus on multiple images at different depths makes it look like the birds are inside the spinning zoetrope. And then there's Emmert's law, which makes objects of the same size appear to be different in physical size when their perceived distance increases.

Essentially, all three illusions rely on the brain to interpret information from the eyes, but the brains fill in information that isn't necessarily correct depending on what they expect to see. If it sounds confusing, it is; the release notes that the relationship between sight and perception is still being studied.

Ultimately, what we see and what we perceive are not always the same thing. That makes for some stunning stumpers and provides plenty of fodder for scientists looking to unravel the mysteries of human cognition. Until they figure it out, the rest of us will just look on...and scratch our heads.

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Erin Blakemore is a Boulder, Colorado-based journalist. Her work has appeared in publications like *The Washington Post*, *TIME*, *mental_floss*, *Popular Science* and *JSTOR Daily*. Learn more at erinblakemore.com.

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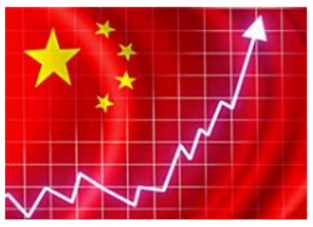
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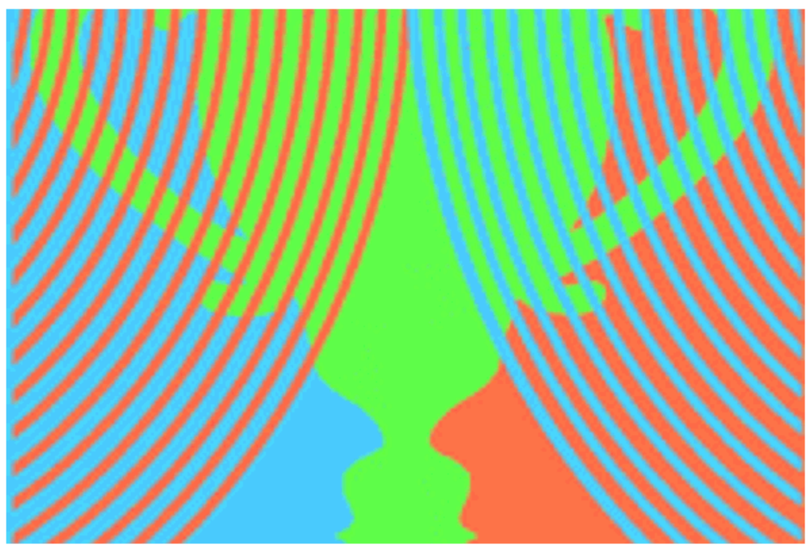
Illusion Chasers

A Review of 2016's Best Illusion of the Year Contest [Video]

Last week you chose the winners of the 12th annual Best Illusion of the Year Contest. Many of you have wondered how the illusions work, and what they tell us about our brains. I discuss each of the TOP 10 illusions here, and explain what we know

By Stephen L. Macknik on July 6, 2016



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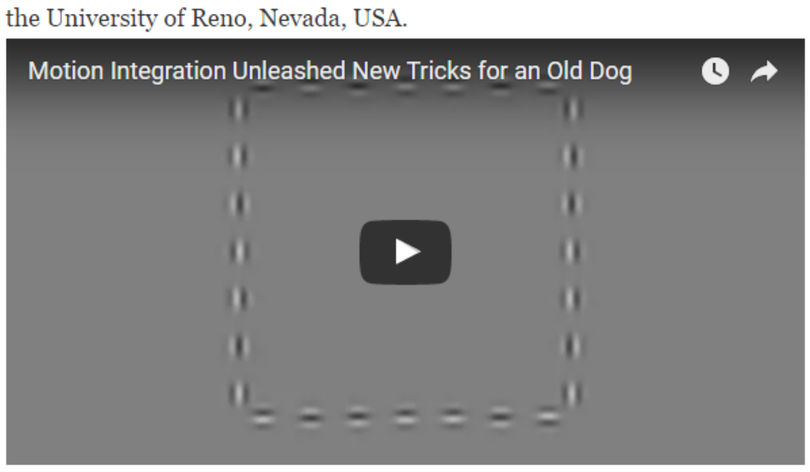
Many readers have inquired as to how the illusions from this year's contest work in the brain. Here is a brief explanation of each.

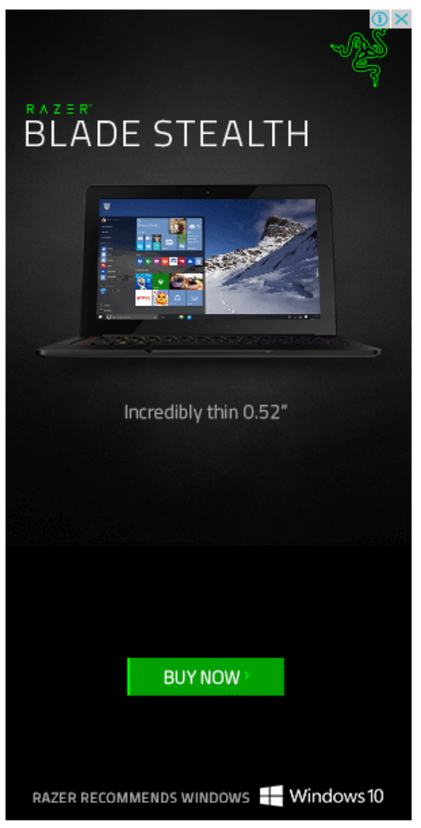
First Place went to "**Motion integration unleashed**:" a motion perception illusion by Mathew T. Harrison and Gideon P. Caplovitz from the University of Reno, Nevada, USA.



Sine-wave grating blobs called "Gabors"—a favorite stimulus that visual scientists use in the lab--can be arranged in various configurations that give rise to dramatic motion effects. Gabors can drift while not actually moving from one position to another. A static square seems to rotate, chopsticks appear to gnash, and waves appear to roll: all without physical displacement. Usually, all the parts of a given moving surface have a single coherent global motion. Our visual system determines this motion by integrating the local motion signals from the points around the surface's edges. Harrison and Caplovitz's illusion showcases this principle by employing strong local motion signals (the drift inside each stationary Gabor) that fool the brain into thinking that the whole object is moving. In the real world, barber poles are subject to the same illusory mechanisms: The poles rotate horizontally around their axes, yet the stripes appear—falsely—to move vertically. The barber poles' apparent vertical motion arises from the same neural wiring that is responsible for Harrison and Caplovitz's discovery.

See also: Past illusion contest contributions from this and other labs, such as the Infinite Regress Illusion (2005), the Curveball Illusion (2009), and the Steerable Spiral (2010), all of which used drifting gratings to demonstrate the interaction between global and local motion signals.

Second Place went to "**Ambiguous Cylinder Illusion**:" a perspective illusion by Kokichi Sugihara from Meiji University, Japan.



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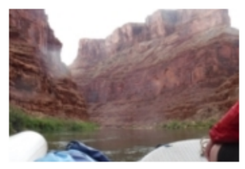

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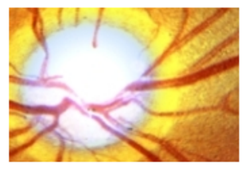

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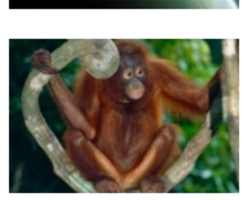

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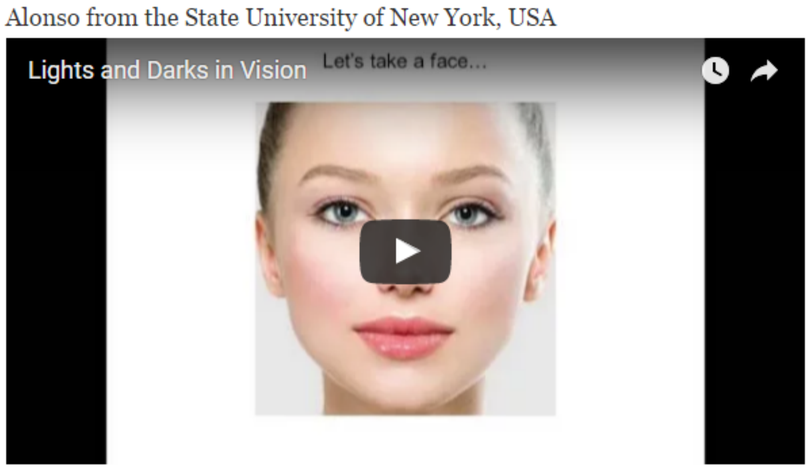
Sugihara has built outstanding sculptures of impossible objects, that appear as very different shapes depending on their vantage point. At any other angle, the illusion fails. Scientists refer to this as the accidental view, but there is nothing accidental about it. To perceive the illusion, the view must be carefully staged and choreographed, or else the audience will fail to see the "impossible" sculpture.
See also: **Ambiguous Cylinders: A New Class of Impossible Objects.** K Sugihara. Computer Aided Drafting, Design, and Manufacturing. *3 September 2015 25(3):1.*

Third Place went to "**Silhouette Zoetrope**:" a motion illusion by **Christine Veras** from Nanyang Technological University, Singapore.

This illusion is an homage to early tropes that have tricked our senses since the Victorian Era. Unlike in traditional zoetropes in which the rotating objects within a cylinder are viewed through moving slits in the cylinder, Veras inverted the structure, so that the slots strobe behind the cutout images, thereby animating them. Interestingly, the animation nevertheless appears to take place inside the empty slotted cylinder, to create the illusion of moving silhouettes. Each cutout image was attached to a stick and placed outside the slotted cylinder. The interior of the slotted cylinder was white. The resulting animated image only exists in our brain. The illusion not only helps us better understand how our brain perceives movement but illustrates that the impression of an image can be created at an arbitrary depth without the use of projection or digital technology. It is a unique combination of what can be characterized as shadow puppets and an inside-out zoetrope, enabling the viewer to see moving silhouettes. The fields of optics, physics, neuroscience, and stereoscopy come together in this invention. Veras says that she has always been fascinated by the zoetrope, and was working to try to design a new way to combine shadow puppets with the zoetrope when she had a dream about a different way to structure the device. The result was exciting and astonishing.
See also: **Victorian Theatrics**. S Martinez-Conde, S Macknik. Scientific American Mind. *2015*.

I have described the remaining Top 10 Finalists below, in no particular order:

Lights and Darks in Vision" is a brightness illusion by Jose-Manuel Alonso from the State University of New York, USA



This is a study in how the visual system differentially processes information about light (against a dark background) versus darkness (against a light background) and uses the two types of information for different perceptual purposes. If we split a picture of a face into just the dark pixels versus just the light pixels, we see that the 'whites' of the eyes in the dark-half picture have the same luminance as the 'dark' lips in the light-half image, though the lips appear as much darker than the eyes. This strong contrast illusion occurs with any face or visual scene photographed with a standard digital camera and processed in this manner. Notice that the crisp dark image seemingly contains most of the detail of the face, whereas the light image appears to have relatively high contrast: as if the two different polarities of visual contrast have different roles in vision. Alonso came up with this demonstration while writing a grant application for the National Institutes of Health and thinking about ways to illustrate the function of ON and OFF visual pathways (which are specialized to see lights versus darks) in the brain. When he created the two versions of the face, he noticed that the light-half image paradoxically appeared darker than the dark-half image, and vice-versa. Puzzled, he

measured the physical luminances of both images to ensure he hadn't made a mistake. Ultimately, he realized that he had discovered a powerful brightness illusion that helps us now to understand how the visual system processes darks vs lights.

See also:

Principles underlying sensory map topography in primary visual cortex. *J Kremkow, J Jin, Y Wang, JM Alonso.* ***Nature*** *533, 52-57, doi:10.1038/nature17936.*

Neuronal nonlinearity explains greater visual spatial resolution for darks than lights. *J Kremkow, J Jing, SJ Komban, Y Wang, R Lashgari, X Li, M Jansen, Q Zaidi, JM Alonso.* ***Proceedings of the National Academy of Sciences (USA).*** *2014.*

"**A New Illusion At Your Elbow**" is a tactile illusion by Peter Brugger and Rebekka Meier from University Hospital Zurich, Switzerland

Move your finger slowly along the inside of a friend's forearm from the wrist towards the elbow with their eyes closed, and he or she will erroneously report that you have reached the elbow well before you actually do reach the crook. This illusory anticipation may rest on our experience of tactile velocities that are usually much faster, and make us believe that we feel touch at a body location not yet reached. Neural characteristics of skin receptors specialized for slow motion may also contribute to the anticipation error. Like previously described illusions, the elbow crook illusion is larger on the non-dominant arm. Women showed a smaller illusion than men, confirming their reportedly superior cutaneous sensitivity. The illusion may rely on the interplay between two factors, one psychological and influencing tactile perception in a "top-down" way, the other a "bottom-up" neurophysiological mechanism. The psychological factor is based on our everyday experiences of motion on the skin, which is mostly faster than that experienced in the elbow game. This makes us anticipate touch at a body location in the direction of motion. The neurophysiological factor comprises especially long after-discharges of cutaneous mechanoreceptors, which can lead to a subjective enlargement of slow-motion tracks on the skin. The authors learned about this illusion from Brugger's daughter, who played this game on the playground with other children.

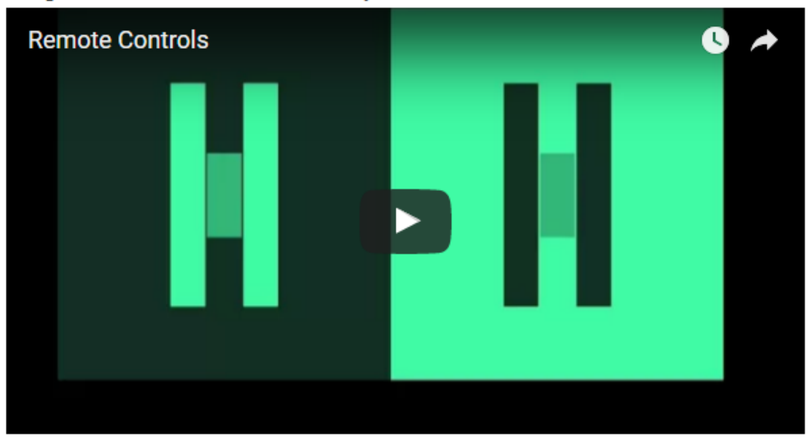
See also: ***A new illusion at your elbow.*** *P Brugger, R Meier. Perception, 2015, 44:219–221. doi:10.1068/p7910*

"**The Shrunken Finger Illusion**" is a visual-tactile illusion by Vebjørn Ekroll, Bilge Sayim, Ruth Van der Hallen and Johan Wagemans: University of Leuven, Belgium

You can make your finger feel shorter than it is by putting it into a halved ping-pong ball. Look at your finger directly from above, with the fingertip extended upwards towards your eyes. Then, place the halved ping-pong ball on top of your finger, such that your fingertip is hidden inside the half-ball. Now, when you look at the halved ping-pong ball from above, it will look like a complete ball. But what about your finger? It feels shorter as if to make space for the unseen half of the illusory ball! The shrunken finger illusion shows that our experience of the hidden backsides of objects are "real" to us in the sense that they can affect the experience of our own body in a dramatic and almost bizarre way – even against better knowledge. From this, we can conclude that our experience of the hidden backsides of things is not only a product of our conscious thinking but also automatically constructed by perceptual mechanisms that are impervious to conscious knowledge. When you look at the world around you, it rarely appears as an empty façade, though there is no way you could know that it was not, and the brain evidently disambiguates these possibilities by concluding that objects are 3D solids. The Shrunken Finger Illusion shows that this perceptual shortcut extends to sensory modalities other than vision. The creators discovered the illusion during a research study of magicians. They were specifically studying a trick known as "multiplying balls", in which the magician fools the audience by using a halved ball such as the one used in this illusion.

"**Remote Controls**" is a perceptual alternation illusion by Arthur G.

Shapiro from American University, USA



Two physically identical rectangular bars alternate their lightness and darkness in synchrony but appear as if they wink in alternation in certain conditions. The appearance of winking (alternating) or blinking (bars in sync) can be controlled by rectangles placed in the vicinity of the modulating bars: the bars blink when the rectangles are far away or adjacent to the bars, but wink when there is a gap between the bars and the rectangles. The effect is remarkable because of the sudden change from wink to blink or vice versa, and because the change can occur across large distances. Remote Controls may look like a standard brightness illusion, but it is not! In a standard brightness illusion, two identical test patches appear differently from one another, whereas in Remote Controls, the two identical patches appear in illusory modulation with respect to one another. The key to the Remote Controls illusion is contrast. When the bars are both bright, one bar has a high contrast relative to its background, and the other bar has a low contrast relative to its background. When the bars are dark, the contrast relationships are reversed.

The main point is that the visual system represents the contrast apart from the appearance of color. That is, the difference between the bars and the background is just as salient to our perception as is the color of the bars. Shapiro predicted this illusion was predicted from his theoretical work about brightness perception in the brain.

"**The Dalesmen Singers Illusion**" is a motion illusion by Mike Pickard and Gurpreet Singh, from Sunderland University, UK

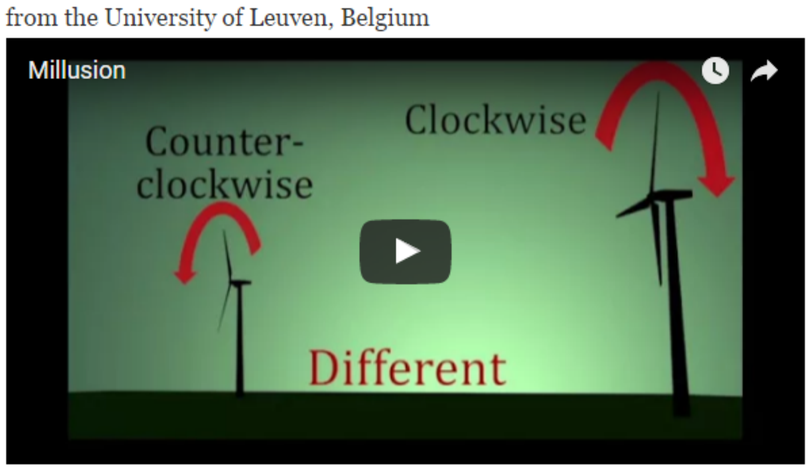
The moving letters in the illusion are actually rock steady on screen! All that changes is the filled middle of each letter. This alternating contrast change at the edges nevertheless creates an impression of movement. As the luminance alternation cycles, it sometimes matches the background and becomes momentarily indistinct, whereas at other points in the cycle the apparent contrast reverses, as if the letters' shadows were moving. Pickard and Singh's illusion shows that there are situations in which we cannot be sure of where things are, or if they are moving or not. Both illusion creators are academics whose interest lies is in linking visual science knowledge to design practice, in a process known as Visually Directed Design. They use multimedia software to examine and test illusory phenomena and then use them in creative concepts applied to design practice. The Dalesmen Singers Illusion incorporates multiple visual factors that work together to create a maximum illusory effect.

"**Caught Inside a Bubble**" is a color adaptation filling-in illusion by Mark Vergeer, Stuart Anstis, and Rob van Lier, from the University of Leuven, Belgium, the Radboud University Nijmegen, The Netherlands, and the University of California, San Diego, USA

In this illusion, you see colors that are not actually present on the screen. An image of colored bullseyes alternates with an image containing different sized greyscale bullseye circles (bubbles). Although the bubbles are colorless, they appear to be colored. These illusory colors are the afterimages of the previous bullseye's colors. The intriguing thing is that the colors that fill each bubble change, depending on the size of the bubble. One colored image causes multiple, completely different afterimages, and each bubble 'captures' the afterimage of the bull's eye color that matches the bubble's size. When your brain is confronted with

the same color at the same location for a prolonged period of time, it will become less sensitive to this color: this is called color adaptation. As a consequence, if you stare at a colorful image, and then look directly at a white screen (or wall), you will perceive the colors opposite to the colors in the initial (adapted) image: a color afterimage. One property of afterimages is that they become stronger, and more salient when the contours of the adapted color match the contours of the colorless image presented after the colored image. In the illusion created by Vergeer, Anstis and van Lier, you see the afterimage of the bull's eye color that matches the contour of each bubble, which varies depending on the bubble's size. Your brain uses contours to reinforce your color experience. The authors have worked together on the visual science underlying the interaction between colors and contours for several years now. "Caught Inside a Bubble" is the product of some of the perceptual principles unveiled by their collaboration.

"**Millusion**" is an ambiguous perspective illusion by Sylvia Wenmackers, from the University of Leuven, Belgium



Because this illusion involves windmills, the author calls it a Mill-illusion, or "Millusion". The "Millusion" occurs when we view windmills, under conditions in which we can only see their silhouettes (for instance, due to fog). During the day and without fog, shadows and light help us to determine whether each windmill's blades are turning in front of the turbine or behind it, so the illusion does not occur. When we see only silhouettes, however, we lack strong depth information and may interpret the mills as pointed in the wrong direction. The author experienced this illusion while driving past a windmill farm in the evening. One turbine seemed to be turning "the wrong way" compared to the others. By the time she got home that night, she had puzzled out what must have happened: her perception was wrong, not the direction of the windmill. She later asked a scientific illustrator, Pieter Torrez (Scigrades), to help her animate the illusion.

See also:

A column about the illusion (with a still of the animation) in the Dutch language, in a popular science magazine (Eos) and in March 2016 on their online portal (link).

A machine-translation is available, which may give you a rough indication of the contents (link).

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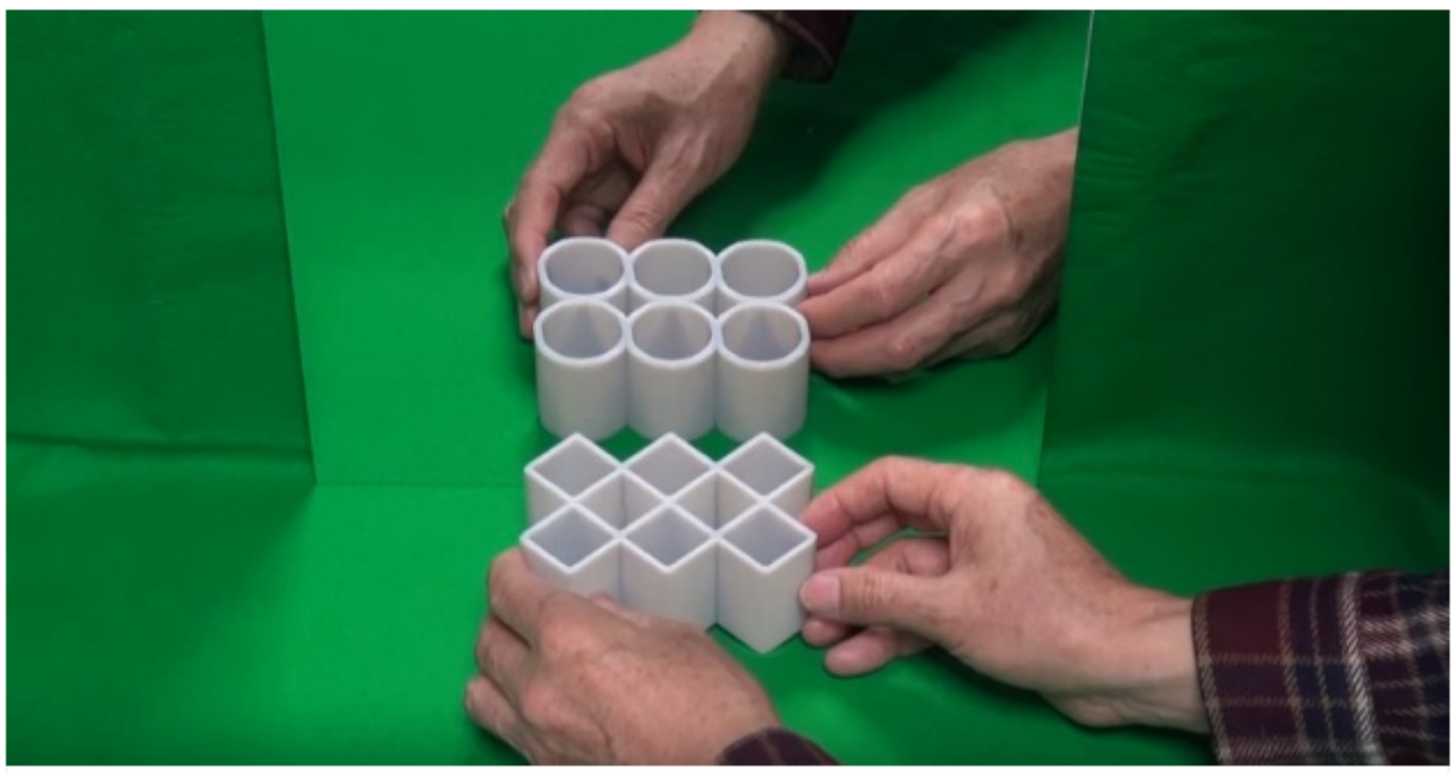
I cilindri allo specchio e altre illusioni ottiche da perdere la testa

Gli scherzi del cervello vincitori del concorso Best Illusion of the Year 2016, e le spiegazioni.



Di quale versione fidarsi? | KOKICHI SUGIHARA

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Ai confini della realtà: illusioni ottiche artistiche
Queste foto inganneranno i vostri occhi

Benvenuti nel magico mondo dei "Cilindri ambigui", l'illusione ottica creata da Kokichi Sugihara, dell'Università di Meiji, in Giappone, che si è classificata al secondo posto nel concorso più disorientante dell'anno, il Best Illusion of the Year 2016, dedicato alle migliori illusioni ottiche inedite prodotte dai ricercatori di tutto il mondo.

Come in ogni illusione ottica che si rispetti, vediamo qualcosa che il cervello fa fatica a interpretare. E anche se il dimostratore ruota le forme davanti al nostro naso, la confusione tra immagini dirette e riflesse non svanisce.

Colpa della sagoma dei solidi, dai lati ricurvi, a metà tra parallelepipedi e cilindri cavi. Complice la prospettiva, il cervello tende a "regolarizzarne" la forma, e ricondurli all'una o all'altra categoria. Ma il fatto che l'immagine nello specchio non combaci con quella verso lo

spettatore, crea un maggiore effetto di straniamento.

EPPUR (NON) SI MUOVE. L'illusione che ha vinto la competizione del 2016, però, è un'altra. È una cosiddetta illusione di movimento, creata da Mathew T. Harrison e Gideon P. Caplovitz, dell'Università di Reno, in Nevada. Si tratta di una reinterpretazione dell'illusione "classica" dei Gabor che si muovono (un Gabor è un'immagine visiva a strisce bianche nere caratterizzata da una certa frequenza).

È noto che un Gabor che trasla attraverso un campo visivo può sembrare muoversi nella direzione opposta a quella reale. In questo caso, i ricercatori hanno dato vita, con Gabor stazionari, a figure che sembrano spostarsi nello schermo (esatto: l'immagine sta scorrendo, ma il puntino non si sta spostando nello spazio).

LO ZOOTROPIO AL CONTRARIO. Al terzo posto, infine, una rivisitazione di uno zootropio, quel dispositivo ottico che genera l'illusione di movimento grazie a una serie di disegni riprodotti su una striscia di carta all'interno di un cilindro munito di feritoie (che viene fatto roteare su se stesso).

In questo caso, la struttura è invertita. Nello Silhouette Zoetrope, le immagini della colomba si trovano all'esterno del cilindro, e vengono proiettate su di esso grazie a un gioco di ombre. Quando il cilindro rotea, sembra che l'animale sia all'interno, ma il cilindro, come si vede, è completamente pulito e vuoto. Le sagome dell'uccello puntano tutte ad ovest, e naturalmente, si ha l'illusione che il pennuto voli verso est.

Queste foto inganneranno i vostri occhi

VAI ALLA GALLERY **(22 FOTO)**

Le 10 illusioni ottiche più strane del 2014

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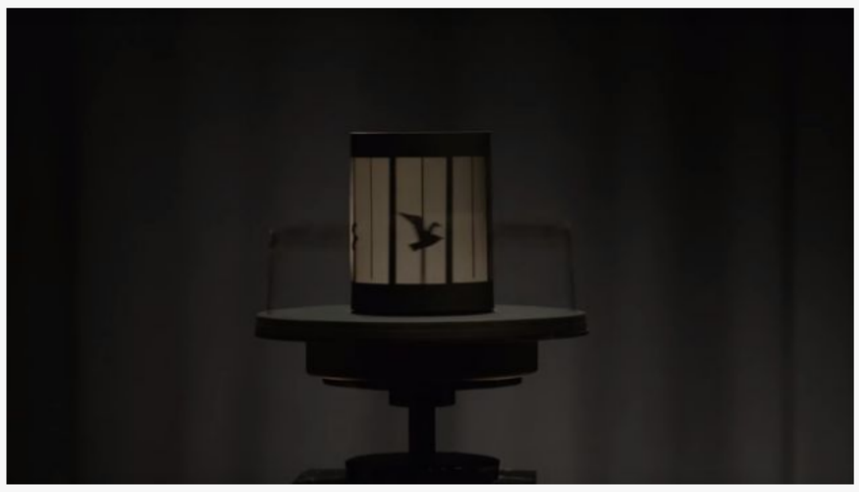
Now you see the 2016 Best Illusion Of The Year Contest winners

By Alex McCown @alexm247 Jul 6, 2016 • 11:00 AM



"Silhouette Zoetrope" by Christine Veras (Screenshot: YouTube)

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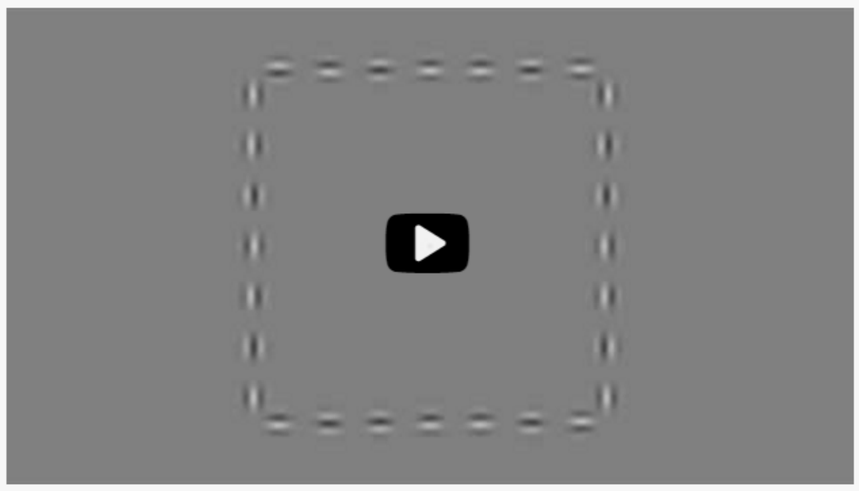
If your response to the question "Do you like magic?" is a halfhearted, "Um, I guess," perhaps you deserve to have your mind blown just a little bit today. And the winners of the 2016 Best Illusion Of The Year Contest are here to remind you that seeing something amazing doesn't have to involve fancy pyrotechnics or dressing like a douchebag. No, it can be as simple as an optical illusion, and the ones on display here are all the more impressive for how simple they are. Some are innovative variations on familiar tricks, such as the illusion of movement in first-place winners Mathew I. Harrison and Gideon P. Caplovitz's "Motion Integration Unleashed: New Tricks For An Old Dog":



Others are so unusual they seem like they must involve some sort of sleight of hand. For example, second-place winner Kokichi Sugihara's "Ambiguous Cylinder Illusion," which makes some jaw-dropping shape changes based on oddly constructed cylinders:

And then some are just oddly beautiful. There's nothing terribly revolutionary about it, but the "Silhouette Zoetrope" by Christine Veras, which took third place, is an elegant and minimalist illusion that we wouldn't mind having in our living room:

You can see the other top-10 finalists at the Illusion Of The Year website. Contestants from around the world submit original illusions, and a panel of judges evaluates and winnows them down to these few outstanding examples. Presumably next year at this time, we'll be seeing an award for Best Illusory Romance going to Tom Hiddleston and Taylor Swift.

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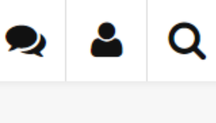
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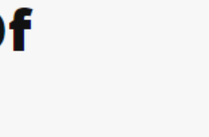

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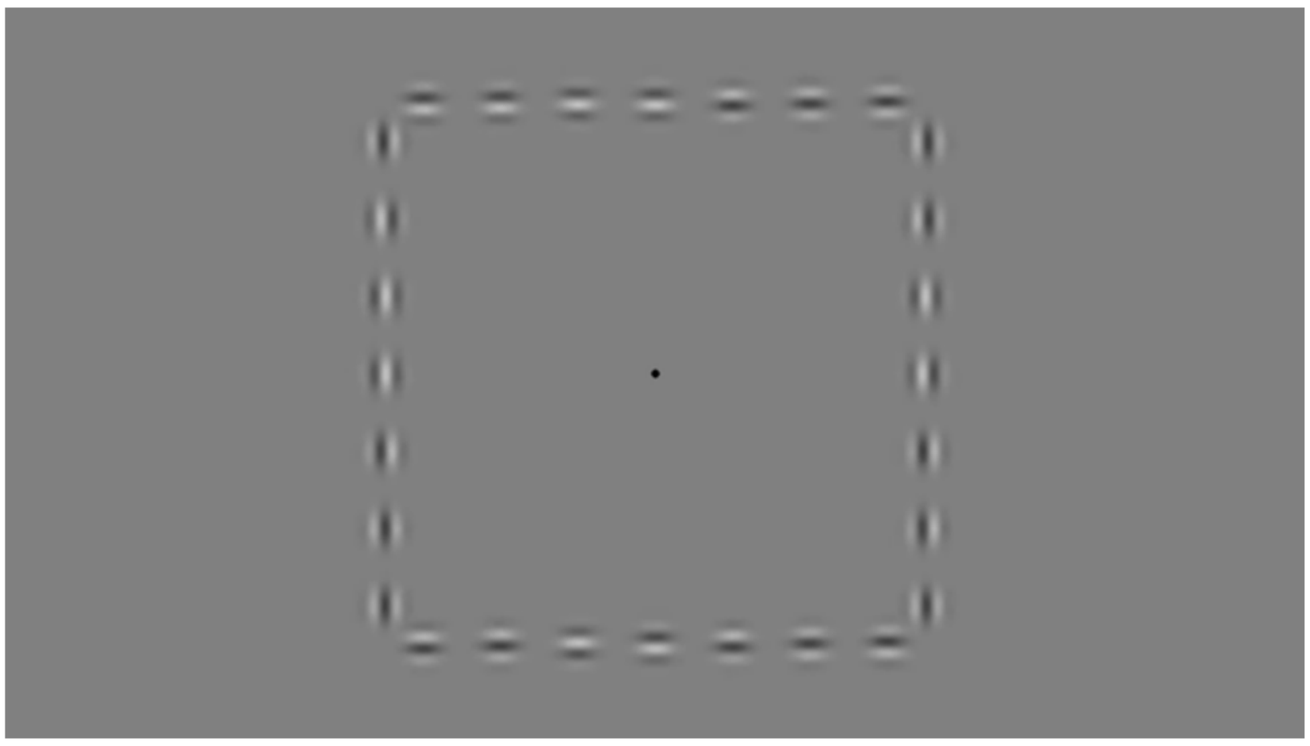
By Ana Swanson July 7



Read on to understand why this square isn't actually rotating

Many people think of their eyes as operating like a movie camera – capturing everything that happens in front of them and then projecting those images back into the dark room that is the brain.

But scientists say that metaphor isn't accurate. Our brains don't just watch a rolling film of everything in front of our eyes – that much information would quickly overwhelm us. Instead, neurons in the brain pick out specific signals that might be important, while other neurons take those signals and fill in the gaps.

That process mostly functions beautifully, but sometimes it can malfunction in interesting ways — as it does when we view optical illusions. Patterns of color and light that trick our eyes and brains into seeing things that aren't there, optical illusions have been valued as entertaining puzzles since at least the Victorian era. But today, scientists are also studying them for insight into how our brains work.

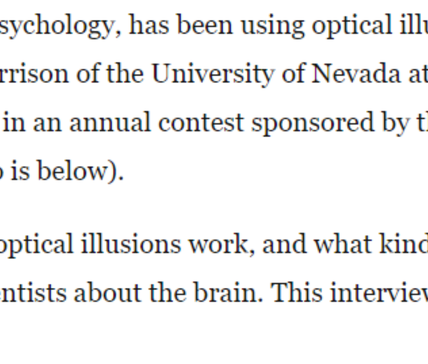
Gideon P. Caplovitz, a professor of psychology, has been using optical illusions in his research for more than a decade. Along with Matthew T. Harrison of the University of Nevada at Reno, Caplovitz created the optical illusion that won first prize this year in an annual contest sponsored by the Neural Correlate society (above is a gif from their illusion -- a full video is below).

Caplovitz spoke with me about how optical illusions work, and what kinds of fascinating clues they are offering new generation of neuroscientists about the brain. This interview has been edited for length and clarity.

So broadly, what do optical illusions tell us about the brain?

Illusions represent the mistakes the brain makes in interpreting what we're looking at, which arise because of the way our visual systems have evolved. And so by understanding these illusions, we can gain insight into how our visual system works.

We don't experience the world the way a movie camera operates. We experience the output of neurons in our brains that respond to light hitting our retinas. These neurons capture different types of visual information – like color, motion, the position of an object, or elements of its shape or size. And the visual system ultimately has to combine all of this information together in a best guess as to what we're looking at.



There's all sorts of stuff out there in the world that we don't see, like infrared radiation or radio waves. For example, bees have visual systems that are very different from ours, and they experience colors and shapes that we don't see.

We experience the world that we do because of the visual information our brains are able to represent. In general, what we experience is accurate enough to allow us to not fall into holes, or get run over by cars. But visual illusions highlight that sometimes what we see is incorrect.

Your illusion won first prize in the 2016 contest for Best Illusion of the Year. Explain to us exactly what is going on in the video below.

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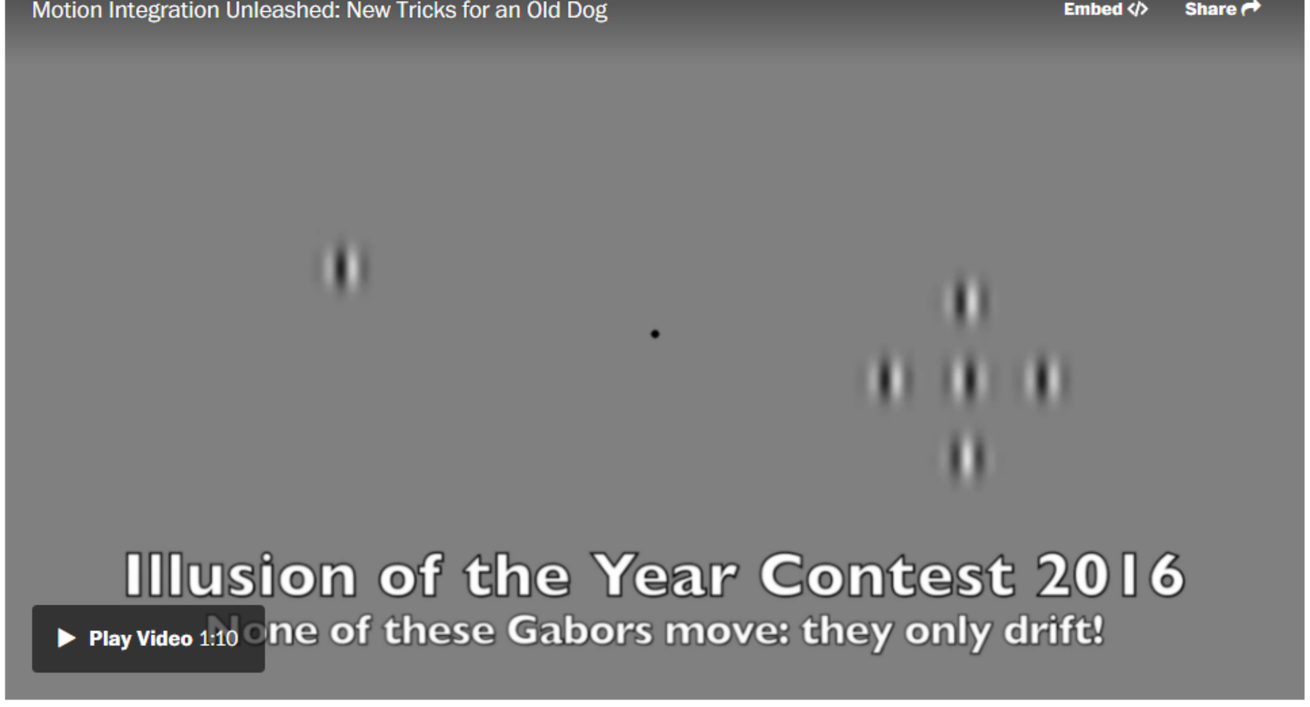


This video show that configurations of drifting Gabors that are stationary can give rise to dramatic global motion percepts: a rotating square, oscillating chopsticks and rolling waves. Video via The Best Illusion of the Year Contest, hosted by the Neural Correlate Society, see more at illusionoftheyear.com (Mathew T. Harrison and Gideon P. Caplovitz / Neural Correlate Society)

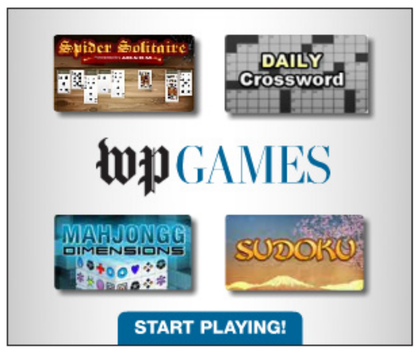
If you watch our illusion, you will see a rotating square or lines rocking back and forth, when in fact there is no rotating square or moving lines. What's happening is that these little gratings — we call them sine wave gratings or Gabor elements — they are rotating on themselves and creating what are called local motion signals that are detected by our visual system. Our neurons then integrate these local motion signals, and that integration can lead to the experience of a rotating square, or these waves, which actually aren't there.

I don't have a rotating square detector in my brain; what I have are neurons that detect local motion, and then other neurons that integrate them. And the output of that is what we experience. So the existence of the illusion is telling us something about the way the brain works.

Now, this all may seem silly, talking about rotating squares or rocking lines. But pretty much from the moment you open your eyes in the morning to the moment you close your eyes at night, unless you're visually impaired, you're visually experiencing the world around you, and it's moving, and you're moving. So this helps answer the question, why do things look the way they do?

Is there a real-world situation in which your brain would be detecting and integrating this kind of information?

The mechanisms that underlie this illusion pretty much underlie our experience of anything that's moving. Where it's particularly tangible would be the experience of seeing a car driving down the road, but from where you're standing, that car is either driving behind bushes or through trees, and you only get bits and pieces of it at any moment in time. But your brain is able to integrate these bits and pieces into a car as a visual whole, and figure out where it's moving and how fast.



There's another illusion that's not exactly the same, but similar, that we've all experienced, which are the red, white and blue stripes of a barbershop pole. Barbers have been exploiting this illusion for its advertising purposes forever. As the cylinder rotates, we have the experience of those stripes moving up, even though they're not.

I was going to ask you about that — are there other famous illusions that rely on similar principles?

There's a long history of them. Karen DeValois, a researcher at Berkeley, first reported this effect in the 1980s. Peter Tse, who was my graduate adviser, won the second-place prize in the illusion contest in 2006 for what he called the infinite regress illusion. Then in 2009, Arthur Shapiro won the first-place prize with his colleagues for an illusion demonstrating virtually the same effect, what he called "The Break of the Curve Ball." He published a paper suggesting that these neural mechanisms underlie the perceived "break of the curve ball" in baseball — the notion that a curve ball to a batter or a spectator appears to be traveling on a straight trajectory, and then at the last moment curves. In fact, it is a continuous curve from the moment it's released from the pitcher's hand.

And motion illusions are just one category of optical illusions, right?

Yes. In 2014, we won the illusion contest with a dynamic size illusion. It's related to a classic size illusion called the Ebbinghaus illusion. Hermann Ebbinghaus was a psychologist who found that if you take a small circle and surround it with big circles, it will look smaller than the same size circle surrounded by small circles. You may have seen this — it's one of those, if your uncle is going to send you some spam email with illusions in it, it often includes an Ebbinghaus illusion.

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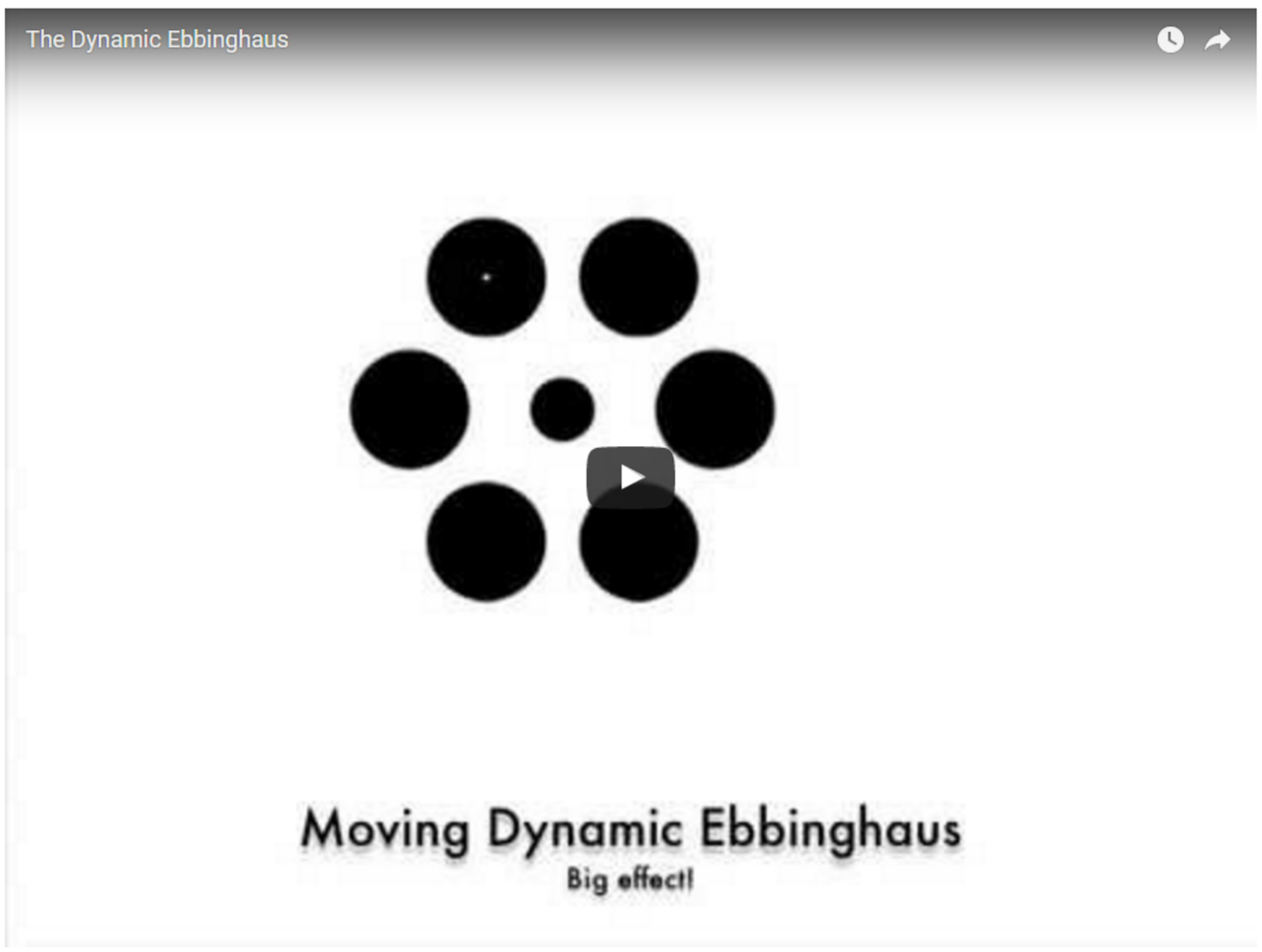
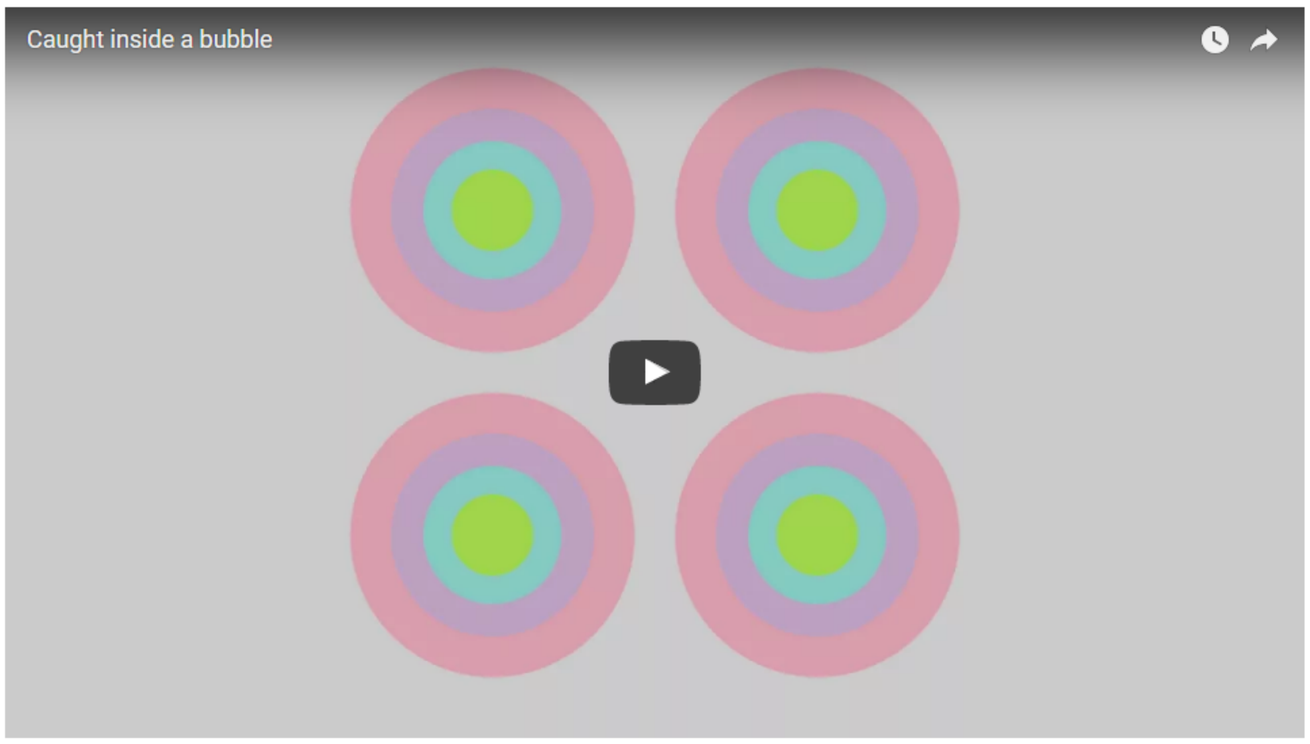
Basic Ebbinghaus illusion; Wikimedia commons

What my colleague and I discovered is that if you put this into motion, so that the surrounding circles are growing and sinking, the illusion gets really strong. So we call this the dynamic Ebbinghaus illusion, because everything is moving.



And there are some other illusions involving color afterimages?

Yes, there are a whole class of color illusions. There was a spectacular one that won first prize in the illusion contest in 2008, and a variant of it was presented in this year's contest. It was my favorite this year.



You're seeing colors that aren't there, and the way these colors manifest themselves is telling us something about the way the brain processes visual information.

What does it say about the way the brain processes information?

You'd have to ask the creators for the full explanation, but fundamentally, it's saying that the brain isn't processing visual information on a point-by-point basis. Even though the bubble does not have any color, it is dictating what color you see.

I would also like to mention there is a very long history of studying illusions. And probably the most profound illusion that we experience is at the movies. Motion pictures are a continuous sequence of still images that, when played at the correct speed, give rise to continuous motion. The movie experience that we have today is the culmination of almost 200 years of technological development investigating how to create moving images out of still frames.

There's a beautiful entry in the illusion contest this year called the "Silhouette Zoetrope." It's a a modification of one of the earliest picture devices, the zoetrope, which dates to pre-cinematic optical devices in the Victorian era. And I was very, very happy to see this new version of the zoetrope in the contest this year. It's another new trick for an old dog.

In a typical zoetrope, the inside of the cylinder contains a series of images, and as the cylinder revolves you see a short scene play out. But here, the birds are on the outside of the cylinder, and you're just catching a small glimpse of the bird through the cylinder, which creates the illusion of motion?

Right, you get a small slice of it at a time. You had people in the first half of the 19th century making devices like this, some of which were sold as toys to children. It's pretty neat to see them bring that back and add something new to it.

A classic zoetrope. © Andrew Dunn, 5 November 2004, Creative Commons Attribution-Share Alike 2.0 Generic license

Is that what you what mean by "another new trick for an old dog"? These illusions have been around for a long time, but now they're revealing something very new about how our brains work?

Going up to the Gestalt psychologists in Germany in the 1920s and 1930s, you have scientists describing illusions for their phenomenological aspects, to explain the principles of how we see the world.

But then in the advent of the age of neuroscience, which starts post-1950s, the question arises of what illusions are telling us about the way the brain works. Now we can use illusions as one of the tools in neuroscience's toolbox — in fact, these are sometimes called "the psychologist's electrode," a non-invasive neuroimaging technique. That's in part the source of the resurgence of optical illusions, and one of the reasons why the illusion contest has been as successful as it has been. I think it speaks to the degree to which these illusions are valuable as a tool for neuroscience.

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Ana Swanson is a reporter for Wonkblog specializing in business, economics, data visualization and China.
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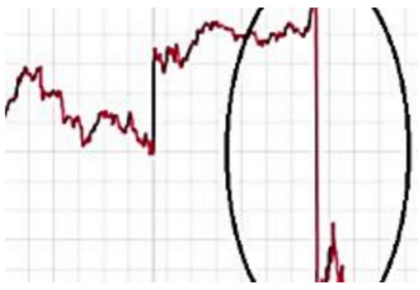

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Texan15
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So interesting. If I carefully look at one row or column of the Gabor elements it is clear that they are moving within but not from their location. Shifting vision to the entire group it is difficult to accept that they are not moving around.

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By Greg Uyeno, Staff Writer | July 12, 2016 07:22am ET

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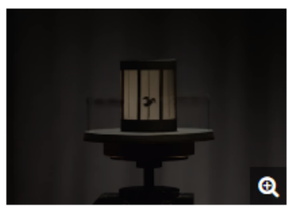

Flight in silhouette

Credit: Christine Veras, YouTube

One principle at play in all zoetropes is apparent motion, in which a series of similar images presented in quick succession appear to be one object in motion, "which is exactly what happens in animation," Sekuler said.

As the viewer consolidates the many spinning birds into a single image, they have to go somewhere. "The place that makes sense in the case of the zoetrope is right in the middle of where all those objects are," Sekuler said.

And the bird in flight appears to reverse directions, which may have something to do with the ambiguity of animations in silhouette. "When it's just a silhouette, you can misinterpret the direction of motion," Sekuler said.

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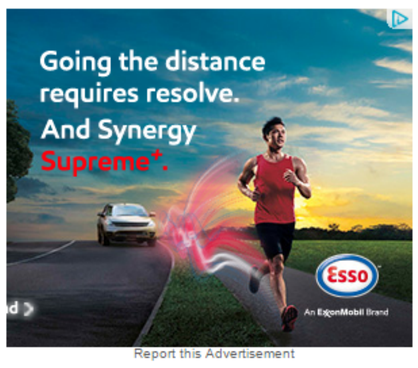
Author Bio

Greg Uyeno, Staff Writer

Greg Uyeno is a science journalist. He has studied cognitive science at the University of California, Berkeley and journalism at New York University. He's always interested in the language of science and the science of language.



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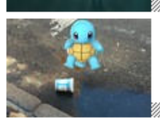
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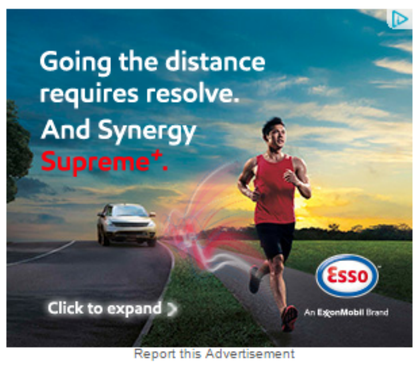

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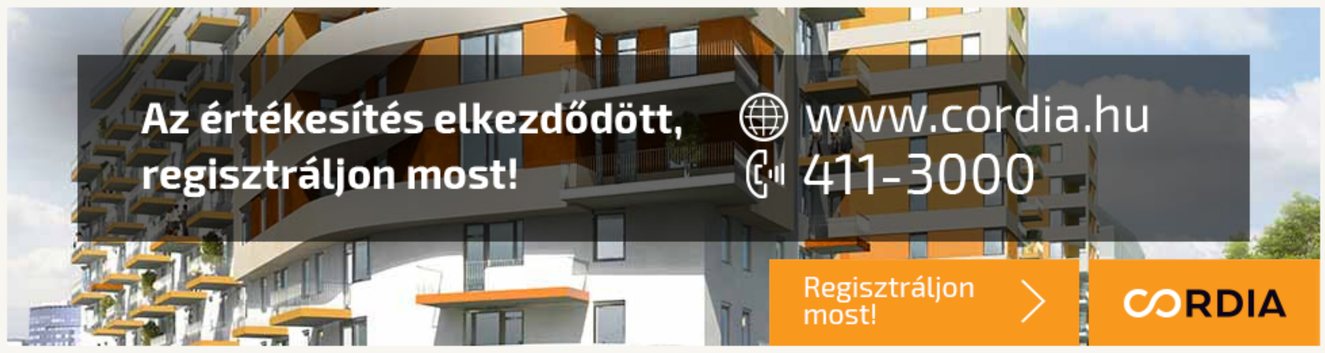

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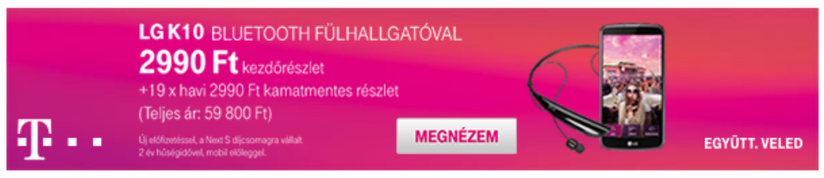
1 ezer
Ajánlom

Bő egy évtizede rendszeresen megszervezik az év legjobb illúzióit kereső versenyt, ahová különböző optikai csalódásokkal lehet nevezni. Megmutatjuk az idei három legjobbnak választott trükköt – mindegyikre van tudományos magyarázat, de még azzal együtt is nehéz belátni őket.



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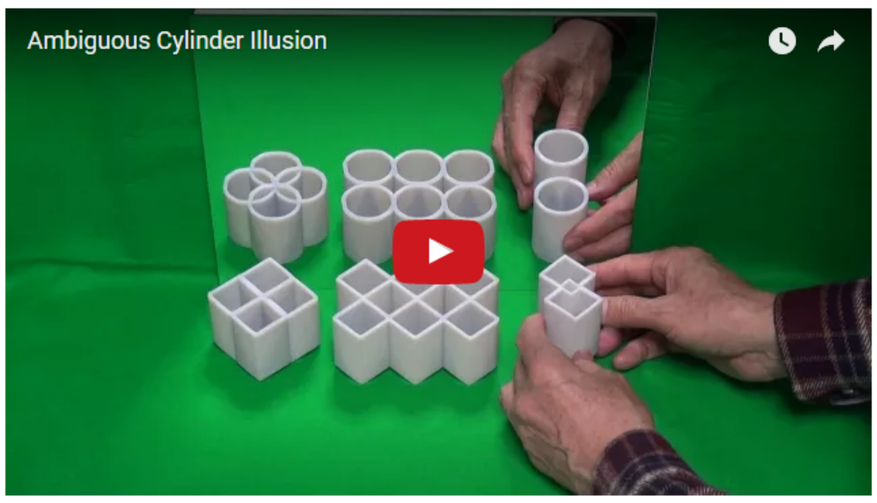
A neurológusokból álló Neural Correlate Society által meghirdetett Best Illusion of The Year versenyen idén a harmadik helyezést a szingapúri Nanyang Műszaki Egyetem hallgatója, Christine Veras érte el. Veras a mozgó alakokat mutató optikai játékszert, a zoetrópot fejlesztette tovább. A zoetróp valójában egy henger, aminek az oldalán apró rések találhatók. A belsejére egy alakot festenek fel a mozdulat több különböző fázisában, így ha a hengert megtekerjük, úgy tűnhet, mintha egy mozgóképet látnánk. A szingapúri egyetemista ezzel szemben az alakot (egy madarat) nem az eszköz belsejében, hanem azon kívül helyezte el. A fénynek és az árnyékoknak köszönhetően az egészet megpörgetve olyan, mintha a madár a hengeren belül repülne.

A dobogó második fokára Kokichi Sugihara került fel, aki a japán Meiji-i Egyetemen készített el egy különleges tárgyat. Az első ránézésre négyszögletűnek tűnő tárgyak a tükörben kör alakúnak látszanak.



Az apró csövek alakja valójában átmenetet képez a négyszög és a kör között. Mivel a tükörképet más szögben látjuk, mint az előtte lévő tárgyat, az agyunk nem képes korrigálni a különbséget, még akkor sem, ha tudjuk, hogy ugyanazt az alakot kellene látnunk. Sugihara szerint a nézőnek még akkor is nehéz megérteni a 3D-nyomtattással készült eszköz alakját, ha azt megmutatják neki.

A versenyt a Nevadai Egyetemről Mathew T. Harrison és Gideon P. Caplovitz nyerte meg, méghozzá egy szó szerint szemkápráztató trükkel. A videóban látható négyzetet a néző úgy látja, mintha körbe-körbe forogna, holott valójában meg sem mozdul. Ennek oka, hogy az azt alkotó apró részek (Gábor

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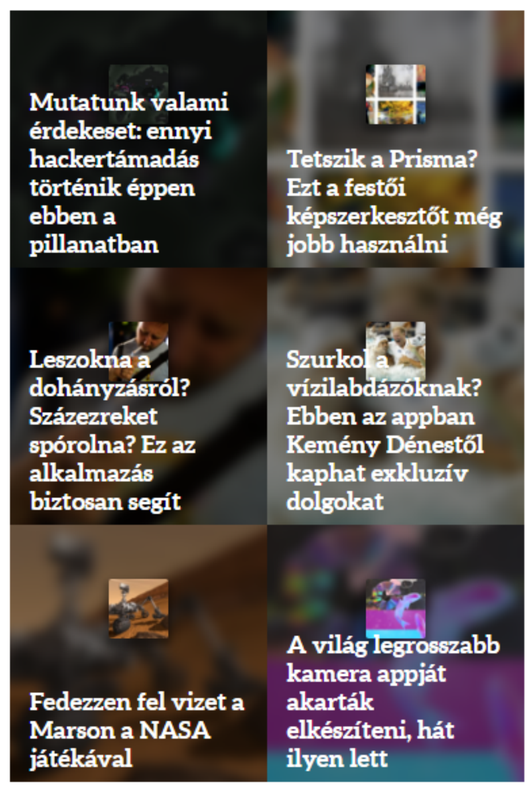

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Hol táborozzon egy allergiás gyerek? Két minisztérium is csak vakarja a fejét

Vérszemet kaptunk: ma újra aranyat (aranyakat) várunk - itt a program

Tusup: "Teljes sokkban vagyok"

Nem látta éjszaka Hosszú Katinka második aranyát? Itt a videó

Hosszú: "Álmodtam róla, de nehéz felfogni"

Hosszú, Kenderesi, Cseh – micsoda nap volt megint!

Glossary

This glossary aims to facilitate the understanding of terms used in the thesis from the perspective of the author. The theoretical construction and justification for their use and their respective definitions are explored further in the text.

animated GIF: a digital file format; *GIF* stands for graphics interchange format. It allows short sequences of images to be condensed into a single file that is lightweight and can repeat the sequence as a never-ending loop.

animated installation: in spite of broad usage of the term[519] and by reason of the shortcomings of other terms[520] that may at first appear to be more specific, in this thesis the term *animated installation* relies on flickering (mechanical or electronic) to create its animated illusion free from a screen, and includes a rotation-based structure, which combined are here named as a particular type of animated installation. As physical moving structures (ranging from giant to human scale), this particular type of animated installation offers an enhanced sensorial experience, particularly when experienced live by its viewer.

animation: the word *animation* has its roots in the Latin *anima*, meaning "breath, vital force, soul, spirit."[521] Alan Cholodenko claims that the term

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[519] *Animated installation* is a term widely used today to refer to a broad range of works that combine different animation techniques—commonly employing computer-generated imagery—with art installations. In the context of art, the term *installation* is applied to a spatial and experiential type of artwork that relies on the presence of a viewer; the addition of animation and the illusion of life it elicits enhance the overall experience of art installations. Animated installations can be site-specific and typically rely on the viewer's live experience of the artwork. Thus, those artworks defined as animated installations in general include, but are not limited to, projection mapping and other mixed animation techniques presented in a variety of platforms, surfaces, and spaces.

[520] Other incomplete or imprecise terms include *kinetic sculptures* (limiting the artwork to movement, without any reference to flicker), *zoetropic installations* (limiting the artwork to a specific kind of early device rather than a range of devices that share similar characteristics later adapted to contemporary animated installations), and *contemporary optical devices* (eliminating the idea of the spatial experience and suggesting that the installation is a device to be manipulated, which is a key difference between past devices and present animated installations).

[521] The author found the most complete definition of the Latin meaning of *anima* at: http://www.dictionary.com/browse/anima?s=t
The *Oxford English Dictionary* only considers "mind" and "soul" as meanings of the Latin root, while the Merriam-Webster dictionaries only account for "soul."

expresses two important characteristics: movement and life[522] (as in endowing with both movement and life). Therefore, the uncanny impression of seeing sequential still drawings, sculptures, or objects as moving and gaining life, be it through proto-cinematic spinning optical devices or the tropes of contemporary animated art installations, is considered animation.

animation of attractions: a term derived from Alan Cholodenko's revision of the "cinema of attractions" concept, as defined by Tom Gunning. If cinema, for Cholodenko, is a special case of animation and the first years of cinema are designated by Gunning as "attractions" (spectacles aimed to surprise and shock its spectators), then the cinema of attractions can be considered more broadly as the animation of attractions. Thus, *animation of attractions* refers to early strategies to use animation to astonish and surprise the public, including through optical devices, and in contemporary times also applies to visual effects and animated installations.

astonishment: according to the *Oxford English Dictionary* (*OED*), the word *astonishment* means "expectation, looking forward; feeling of wonder, *astonishment*; quality of inspiring wonder." Based on that, the term *astonishment* is addressed in this thesis as a feeling related to the first impact upon the subject, that of the surprise moment that creates a sense of arresting awareness, which is shortly followed by wonder.

device film: term created by the author to help identify an animated installation inspired by early devices that flicker and rotate but that engages with viewers only on a screen, without direct interaction.

expanded animation experience: in this thesis, an immersive experience that transcends space and time, one that makes the viewer forget his or her surroundings and focus on the illusion of still objects endowed with life and movement, creating the "illusion of life." The use of the concept in the thesis is based upon on Gene Youngblood's canonical book *Expanded Cinema*, where the concept was first used, particularly in reference to American avant-garde artworks and experimental and artistic moving images and films, including experimental animation.

[522] A claim made emphatically by Alan Cholodenko in his 2015 article "The Animator as Artist, the Artist as Animator," published in the journal *Animation Studies;* available at: https://journal.animationstudies.org/alan-cholodenko-animator-as-artist-artist-as-animator/

flicker: a rapid variation in brightness that, when combined with the rapid movement of sequential still images, is perceived by the human brain as moving. The flicker can be created by mechanical or electronic means.

illusory motion device: a term that refers to both early scientific optical devices and contemporary animated installations when they make use of motion to create their optical illusions.

magic: a term used in this thesis to identify conjurer tricks that play with the audience's perception to entertain them. It can be applied to both optical illusions and animated installations in cases where these use the same stratagem to mislead their viewer's perception.

optical device that flickers and rotates: designation that characterizes an early optical toy whose structure creates mechanical flicker and is based on the rotation of the device. The main examples in this thesis are the thaumatrope, phenakistoscope, zoetrope, praxinoscope, flipbook in its mutoscope form, and their variations that follow the same parameters.

optical illusion: a visual phenomenon in which what is seen does not correspond to physical reality, hence its being an illusion.

philosophical toy: an optical device from the Victorian era that helped the user to question what he or she sees as real and what the mind knows as true. This designation refers to a Cartesian approach to optical illusions.

proto-cinematic device: a device representing an embryonic form of cinema—or cinema before cinema, as the term *proto-cinema* suggests—as opposed to referring to it merely as a historical object belonging to the period before cinema, as the term *pre-cinema* implies.

proto-narrative: an embryonic form of narrative consisting of images of actions that have the potential to be further developed into stories.

trope/troping: used in this thesis as a verb to indicate the circular movement of a device, a concept, or even an idea. A trope (as a noun) is a recurrent theme or phrase, a motif of sorts. The name of the *zoetrope* incorporates the word via its Greek roots, in the latter case referring to the rotational movement of a wheel.

wonder: according to the *OED*, the word *wonder* means "to feel or be affected with wonder; to be struck with surprise or astonishment, to marvel." Based on that, and complemented by the interpretation of

definitions offered by different scholars and authors, the term *wonder* is addressed in this thesis as the emotional, perceptual, and intellectual response to a feeling elicited when a person experiences something he or she has never imagined or never thought possible. Things unaccountable and greater than oneself are also part of this type of experience. Wonder ignites curiosity and leads to exploration, thinking, and learning.

zoetropic editing: the combination of two or more zoetrope strips, depending on the size of the zoetrope, to create a merged content, multiplying the playability possibilities of the device. Nicolas Dulac and André Gaudreault coined the term to identify a characteristic of the device already suggested in the Victorian-era catalog of the London Stereoscopic and Photographic Company.

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