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Animated Sequences: Chronophotography in Contemporary Animation Practice

by

Bronwyn Gillian Horne

(327289)

A thesis submitted in partial fulfilment of the requirements for the degree of *Doctor of Philosophy* in Digital Art at the University of the Witwatersrand, Johannesburg, South Africa.

Supervisor: Professor Christo Doherty

March 2022

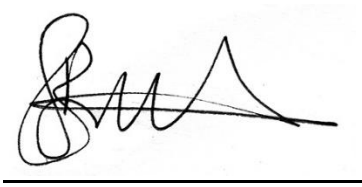
Abstract

This creative research project addresses the question of how to reveal the construction of character animation in order to influence viewer engagement. Nineteenth-century chronophotography captured what the eye cannot see due to the physical limitations of human perception. These images encouraged the viewer to expand their sight into a new mode of *seeing*. Chronophotography has inspired artists interested in the representation of movement throughout history. By considering these artistic engagements with chronophotography, I focus on animation techniques from the Golden Age of American animation. I am interested in the representation of movement in these cartoons – the squashes and stretches, the 'smears' and 'multiples' – and how these techniques go *unseen* by the viewer in standard viewing practice. I argue that they are the fleeting 'moments' that give meaning to animated movement, enhancing the visual style of the animation – but due to the technical nature of cinema, are never actually *seen* by the viewer. I therefore ask, how can the animator exploit these 'moments' that are barely visible to the audience? Also, if exposing these 'unseen' frames proves effective, what would it reveal about the movement itself? Using techniques of chronophotography to inform my creative practice, I expand on the strata-stencil animation technique to create an experimental short film and art exhibition that reveal movement for the viewer in a deliberately playful manner. Together these works provoke the viewer to question their understanding of animated movement and the aesthetics involved in seeing more than one frame at a time. I propose that we look at the individual frames not in isolation but simultaneously as sequences, so that the notion of seriality informs the viewer's understanding of animated movement as a distinct aesthetic experience. In doing this, I challenge the viewer to look at cartoons in a different way. This study is about making the imperceptible, perceptible and raises questions about how sequential images speak to us.

Keywords: Chronophotography, Golden Age of animation, animation techniques, imperceptible, experimental, strata-stencil, sequences, aesthetics.

Declaration

I declare that this thesis is my own unaided work. It is being submitted for the degree of Doctor of Philosophy in the field of Digital Arts by creative project and thesis at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.



7th day of March 2022 at the University of the Witwatersrand, Johannesburg.

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

Registration number: REC-101114-044

15 December 2021

Re: Mrs. Bronwyn Horne (327289)

Waiver letter number: HRECNMW22/01/07

To whom it may concern,

Mrs. Horne is currently a registered PhD student at the School of Arts at the University of the Witwatersrand, Johannesburg. This letter is to confirm that, at the time of writing, Mrs. Horne does not need ethical clearance for his PhD study entitled *'Animated Sequences: Chronophotography in Contemporary Animation Practice'*. This decision has been reached based upon a description of the project supplied by Mrs. Horne to the University Human Research Ethics Committee (Non-Medical), which has been evaluated by the Chairs and Deputy Chairs. If, however, if Mrs. Horne changes the methods of data collection and analysis for this study, this decision may no longer be valid. If such changes take place, this should be communicated to the University Human Research Ethics Committee (Non-Medical) as soon as possible. This waiver letter is valid until 14 December 2024.

Please feel free to contact me should you require any further information.

Thank you.

Yours sincerely,
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Dedication

To Craig and Jessica.

I couldn't have done this without your continuous love and support.

I am the luckiest mom in the world!

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Chapter 1

Introduction

This practice-driven research project addresses the question of how to reveal the construction of character animation using techniques of chronophotography through experimental creative practice in order to influence viewer engagement. The creative work that results from this project encourages the viewer to focus on and appreciate the representation of animated movement as a distinct aesthetic experience.

As an artist, I have engaged with different kinds of creative practices that have informed my approach to this study. After studying Fine Arts, I trained and worked professionally as a hand-papermaker in the archival and conservation industry in South Africa. As part of a community engagement and education initiative at the University of Johannesburg, I researched and managed the production of archival handmade papers using locally available cotton and sisal fibres. During this time, I also explored artistic practices that employed creative hand-papermaking processes and the book as an art object. I have since trained as a digital three-dimensional (3D) animator, working professionally on projects for the local media industry. However, my passion for education led me to return to the teaching of digital animation techniques, and I have since remained in the field of animation education. This project aims to bring the medium of paper, my expertise in digital animation and my enthusiasm for artistic practice and education into a single creative and academic project. Focusing on methods of transforming digital animation into tangible works of art, I explore the aesthetics of the animated frame as a material art object.

In contemporary society, animation is a popular form of cinematic entertainment. It is a diverse medium with a long history that has resulted in varying approaches, techniques and styles. In this research I focus on classic cartoon animation from the Golden Age of American animation which began with the emergence of cartoons with sound in 1928 and ended in the 1960s when theatrical animated shorts began to lose their popularity to television

media. This period of animation is renowned for its innovations in movement design, integration of character personality and the development of engaging stories. Many of the popular seven-minute shorts were celebrated for their absurdity, excessive styles and abstract approaches to movement design. This was an era where many of the animation techniques which are now fundamental to animation education were first established. From the twelve principles of animation to innovations like the 'smear', 'multiples', and dynamic use of timing, animation emanating from this period is significant for analysis. My interest in animation from this era is in the visual representation of movement in these cartoons – how the animators of the Golden Age employed the process of observation and creatively applied it to the movement of cartoon characters.

I am also intrigued by how many of these fundamental techniques and innovations in movement design go unnoticed by the viewer in standard viewing practice. When screened for an audience, animation is made up of thousands of individual frames projected at a constant frame rate. Many animation techniques only occupy one or two frames out of the twenty-four frames required for one second of animation – yet these are the fleeting moments that give meaning to animated movement and enhance the visual style of the animation. Because of the technical nature of cinema, these frames are never actually consciously *seen* by the viewer. I therefore ask, how can the animator exploit these 'moments' that are barely visible to an audience? Also, if exposing these '*unseen*' frames proves effective, what would it reveal about the movement itself? In this research I present a different way of viewing animation that will allow the viewer more time to examine the unfolding of the animated movement. I propose that we look at the individual frames, not in isolation but simultaneously as sequences, so that the notion of seriality informs the viewer's understanding of the animated movement itself. Although my research is focussed on the movement design in theatrical cartoons, my creative practice is experimental in nature and falls within the genre of expanded animation. As a result, the creative work that emerges from this research challenges the boundaries of contemporary digital animation and offers the viewer new ways of experiencing and understanding animated movement.

1.1 Movement Analysis

Historically, movement analysis has been a concern for many disciplines. The nineteenth-century American industrialist and politician Leland Stanford had a keen interest in equine motion because of his interest in racing, breeding and training horses on his farm in Palo Alto, California. Stanford endeavoured to resolve the argument of "unsupported transit" in the horse's gallop[1] (Braun *Picturing Time* 45). Eadweard Muybridge was the photographer who was contracted by Stanford in 1872 to prove this claim, for which he developed a pioneering technique of high-speed photography using a multiple camera system. Muybridge's innovations resulted in the production of a set of sequential images that gave rise to the nineteenth-century photographic technique known as chronophotography. Operating in a time when technical methods for recording the instant[2] were extremely primitive, the first chronophotographers dedicated their practice to developing their equipment to investigate the successive phases of movement. These chronophotographic studies covered a range of subjects,[3] resulting in various arrangements of static sequential images. Among the pioneers of chronophotography was French physiologist Etienne-Jules Marey. In this study I concentrate on Marey's most significant innovation and contribution to chronophotography: his multi-exposed images of movement, a pictorial format distinct from Muybridge's sequential images.

In developing these techniques, the chronophotographers challenged the accepted notions (in art as well as science) of *how to read an image*. They were able to use the camera to arrest the ephemeral moments of an object in motion, capturing what the eye could not see due to the physical limitations of human perception. Chronophotography enabled the viewer to shift their modes of viewing a single image to focus on the mechanics of a movement, by means of an arrangement of sequential images. Because of the visual nature of chronophotography and the profound questions these images raised about the human perception of movement, it subsequently inspired many artists interested in exploring the visual representation of movement. This project continues that aesthetic exploration of movement, but in the field of animation.

1.2 Animated Movement

Using techniques of chronophotography to inform my creative practice, I have developed a hybrid animation technique to create an experimental animated short film that reveals the construction of animation for the viewer in a deliberately playful manner. Each frame of the film is created in paper and then filmed in stop motion to capture the animated movement in a digital format. This experimental short film was embedded in a larger visual research project which investigated ways of presenting the tangible sequential frames resulting from the filmmaking process. The exhibition of the frames that resulted from this research offered a number of different presentation formats for sequential images. Drawing on various arrangements of chronophotographic images, these sequences provoke the viewer to question their understanding of animated movement and the aesthetics involved in seeing more than one frame at a time. Operating outside of cinematic conventions, the tactile paper frames disrupt the normal (cinematic) flow of animation and are presented in a manner that incites a forensic gaze. In this process, the viewer has control over 'animated time', allowing them to consider how these sequences of movement can convey meaning about the animation design.

1.3 Framing the Study

In her book *Frame by Frame: A Materialist Aesthetics of Animated Cartoons*, animation scholar Hannah Frank examines the individual frame, searching for evidence of the artist within the assembly-line of the studio era. In her study of 1625 animated cartoons released between 1915 and 1965, Frank focuses on the individual animation cel, searching for deviations in the animation process and how the contents of these cels can influence what we see on the screen (Gunning Foreword *Frame-by-Frame* xvi). By concentrating on the assembly-line where repetition, exploitation, fatigue and a loss of individuality play a role, she encourages viewers to see things that they never did before. Through rediscovering the still-frame and reverse-engineering the animation process, she invites us to look at animation differently, transforming it from a "process of illusion into a method of investigation" (Gunning Foreword *Frame-by-Frame* xvi). Frank's focus on animation from the Golden Age does not follow a traditional historical analysis. Instead, she raises questions

about the “epistemological and the aesthetic”, asking whether these traces (of the artists she identifies in the study) change our perception of these films (Gunning Foreword *Frame-by-Frame* xxv). Franks’ interest in this era of animation, as well as her method of scrutiny and frame-by-frame analysis, has been a valuable stimulus for my research. However, I extend my study beyond the single frame to focus on a series of frames through the development of a creative project. In my artworks I illustrate a character in an action, concentrating on the representation of movement in these frames.

In this thesis I consider the factors that differentiate animation from live action film. I argue that one of the key factors lies in the crafting of movement itself. How do animated characters move? What makes their movement different from that of live-action actors? In a review of the 1942 animation *Bambi* produced at the Disney Studios, the author T. S. asks the question that if cartoons are simply going to resemble life, then “why have cartoons at all?” (*The New York Times*). This research aims to unpack the representation of animated movement in order identify what makes it distinct from the real-life representations of live-action film.

These questions led me to investigate how animation emerged technically as an industrialised practice during the Golden Age of American animation. I start by focusing on the development of the twelve principles of animation, a set of rules that helped animators create a sense of believable movement, that were formalised by the Disney Studios. I then examine how these principles were challenged by more abstract approaches of motion representation, most vividly exemplified by animation directors at the Warner Bros. Studio. In doing this I begin to unpack the visual language of cartoon movement. I concentrate on this era of animation, the so-called ‘Golden Era of American animation’, because of its significance as the time during which animation developed into a fully resolved practice and became a viable business model for some studios. By focusing on the work emanating from the Disney and Warner Studios, I concentrate on the individual technical ‘moments’ in an animation. In the close examination of these sequences I endeavour to expose how construction of these frames provides meaning to the series of frames that makes up that

movement. I present several cases in which representation has been challenged – where famous cartoon characters become distorted beyond recognition, or are revealed in poses that contradict their actions. In so doing, I uncover and highlight the 'unseen' frames that contribute to the narratives that made these cartoons so memorable.

By uncovering and re-presenting these 'unseen' frames, I am in some way revealing aspects of my own creative process for the viewer. In researching ways in which other animators revealed their process, I have found that there are varied approaches, and that scholars refer to these techniques using different terminology. In this study I refer to this as 'process representation', and it is central to my own practice. In his influential study of early animation titled *Before Mickey: The Animated Film 1898-1928,* published in 1982, animation historian Donald Crafton calls it "self-figuration". This, he explains, is the "tendency of the filmmaker to interject himself into the film" which can "take several forms; it can be direct or indirect, and more or less camouflaged" (*Mickey* 25). He focuses his discussion on the early animators as performers who used the technique in their films in a flattering manner, where it was implied that the animator was "a demigod, a purveyor of life itself" (Crafton *Mickey* 26). It is a characteristic that was prevalent in early animation and exemplified in the work of Emile Cohl, Stuart Blackton and Winsor McCay. It is also a characteristic of many experimental animated films which have informed the way I have approached my practice.

In Frank's 2019 publication, discussed above, she too addresses this notion of 'self-figuration' in animation, calling these cartoons "self-reflective, quasi-Brechtian" (5). Frank's interest in this technique is through questioning the relationship between art and labour, and how this affects the viewing of the cartoons themselves (Frank 4). She asserts that animation is a record of the labour process, and analyses each frame as a document that contains primary evidence of those that worked on it (Frank 4).

In Tom Gunning's chapter "Animating the Instant: The Secret Symmetry Between Animation and Photography", he discusses how some "animated films frequently display their own

processes by the baring of their devices" (location 1048). Gunning states that it brings attention to the "invisible discontinuous frames" and reveals how the animation is created. It is evident that Frank's approach is strongly related to Gunning's theories where the individual frame is the focus. In this study 'process representation' becomes both a conceptual and an aesthetic goal for the creative work. Drawing on Gunning's theories that probe the technical processes of animation, I manipulate modes of presentation in both the still and the moving image. In doing this, I aim to reveal the construction of the animated movement and to focus the viewers' attention on how it is made.

In his Foreword to Frank's book, Gunning (xiv) also addresses how early animation evolved from

> the confluence of the nineteenth century's scientific research into perception, the industrialization of precision machines, and a broad cultural fascination with visual illusions. But drawings had already been animated for decades for a variety of devices, known as "philosophical toys".

The attraction of these devices[4], which were operated by hand, allowed the viewer to witness and influence the transformation of still images into motion and vice versa (Gunning Foreword *Frame-by-Frame* xiv). However, the development of these images into the cinematic medium took this interactive spectatorship away from the viewer, transforming it into an illusionary experience with a "complacent spectator"[5] (Gunning Foreword *Frame-by-Frame* xiv). Like some contemporary experimental animators[6], this research aims to return some of this interactivity to the viewer, creating an innovative viewing experience.

The problem of the 'complacent spectator' echoes the purpose of Frank's enquiry into the individual animation cel. In her study, Frank aims to direct the reader to the materiality of the medium. She forces us to rediscover that these cels were made by human hands, testifying to the existence of a specific time and place, questioning how images speak to us and asking if "knowing about a particular technical process shape what we are able to see" or "*how* we see it?" (Frank 4). However, she states that "this is not how cartoons have ever

been watched. They are meant to be seen in motion, as objects of pleasure", where all these nuances are lost (6), and continues:

> My desire to arrest movement, to view animated cartoons not in motion but as a series of stills, tacitly acknowledges the primal power of movement to occlude the labor behind it. To view an animated cartoon in pieces, one motionless image after another, affords a precision of vision that allows us to see the strokes that constitute cartoon characters, which stand as physical traces of the lowest craft worker. (Frank 9)

This sentiment resonates with my interest in materiality and my desire to create a tangible sequence of animated frames and to exhibit them for aesthetic pleasure. In the digital age, rarely does the avid viewer get to experience the mechanics and materiality of this craft. Digital images[7] do not exist in a tangible form (like animation cels did), and therefore cannot be enjoyed outside of the digital realm. Frank attests to this dilemma through the need to direct her research to the digital animation frames filmed by the camera, instead of the original material 'documents' (i.e. cels). This is because the original cels that were created have either been destroyed or "were frequently washed off once they had been photographed, so that the cels could be reused in subsequent productions" (Frank 37).

The animator and filmmaker Norman McLaren also addresses issues of materiality in animation through his pioneering work created at the National Film Board of Canada. McLaren extended the boundaries of animation by developing several experimental animation techniques. Specific to the issue of materiality are his drawn-on-film animated films, where he drew directly onto the film stock, thus eliminating the need for the camera[8]. McLaren experimented with different approaches for mark making, using drawing materials such as ink or paint, or even the technique of etching lines into the film stock with a knife. He did this in a frame-by-frame manner, sometimes even ignoring the frame divisions completely and drawing across the length of the film strip itself. In addition to this, McLaren's drawn-on-film animations are full of evidence of self-figurative aspects, like environmental dirt, dust and even his own fingerprints. He embraces the notion of 'making' and materiality in a medium that is projected cinematically.

McLaren's experimental films also address questions concerning the mechanics of animation as a cinematic medium. By eliminating the need for the camera and ignoring the frame-by-frame nature of the film strip, McLaren raises questions about how animation is created. He asks: Can the combinations of line, rhythm, colour and music present enough information for a viewer to experience aesthetic pleasure? His approach is reminiscent of Gunning's article mentioned above, which addresses the technical nature of cinema and how it can be used as a mechanism for interrogating questions around stillness and movement. In this study these questions are addressed in terms of how standard viewing practices can be challenged in order to promote a more engaged animation viewer.

In the book *Norman McLaren on the Creative Process,* McLaren emphasises the importance of process in his work. He states that at first it seems obvious that the finished product (the film) is the most important factor – but then, through working on the film, he realises that the process (the creating, the making) is what means the most to him (26). His approach to animation practice has inspired my work, and even more so, his experimentation with chronophotography in his film *Pas de Deux* (1968). This film speaks to the very nature of my interest in revealing movement for the viewer in a cinematic medium. For me, McLaren's approaches to filmmaking are significant because through focusing on process and materiality he invites the viewer to *see* animation differently.

South African artist William Kentridge also brings attention to his process through his experimental animations which he calls "drawings for projection" (Kentridge qtd. in Krauss 25). Similarly to McLaren (and as a result of this process), Kentridge's films evoke Marey's multi-exposed aesthetic in the animated medium, making it valuable for analysis in this research. In addition to this aspect of his work (which I am unable to cover in my research due to scope), Kentridge's exhibitions frequently display his fascination with optical instruments, revisiting the nineteenth century technologies that encourage interactive spectatorship. Kentridge's installations engage the viewer in a collaborative manner which appeals to my desire of challenging standard viewing practices for animation and seeking new modes of presenting the individual frames.

In this research, the result of a tangible product – an object that exists in our world – is important in my work. For this reason, I extended the strata-stencil animation technique developed by artist and animator Javan Ivey in 2007, which uses paper cut-out frames to reveal the consecutive frames of a movement. In my practice, by reconstructing each frame in paper and exhibiting them in ways that question their modes of construction, I allow the viewer to engage with the animation differently. In doing this, the viewer of my work becomes an analytical viewer, one that is able to question the relationship between the frames, and by doing this even being able to learn the principles of our craft while savouring the distinctive aesthetic qualities of my animated film and exhibition installations.

The experimental short film is created through an appropriation of animated characters from the Golden Age of American animation. I do this in response to how Marey approached the subjects in his images: he photographed professional athletes in the act of performing their abilities, so that this could be adapted to the training of other athletes. This research unpacks movement design from those that understood it best: from animators that established the animation principles and techniques that are continually practised and remain fundamental in contemporary animation education. Through my creative practice, I aim to critically evaluate, honour and make these animation techniques visible for the viewer in a manner that is unique.

Of interest in this research is the contemporary visual art exhibition titled *Sequences* that was curated by artist Paul St George and toured England in 2004-2005. St George states that the aim of the exhibition was to present work that "in some way continued one or more of the enquiries of the nineteenth-century chronophotographers" (1). The works that he selected explore various approaches to the representation of time and space inspired by current digital technologies, while continuing to capture the investigative essence of chronophotography as a means of understanding the world, as opposed to its mere representation (Mazière ix). In the introduction to his book *Sequences: Contemporary Chronophotography and Experimental Digital Art*[9], St George interrogates how animation and cinema produce the illusion of continuous motion using the "neglected corners of

chronophotography" (5). In the research I interpret St George's insights regarding the still and the moving image, and consider how altering static and cinematic modes of presentation could influence viewer engagement.

Through applying chronophotographic practices, as well as notions of materiality and process in my creative work, the research reveals the mechanics of animated movement for the viewer. Through expanding on the strata-stencil technique I have been able to bridge the gap between the still and the moving image, and to create a novel viewing experience – one that focuses on movement but empowers the viewer to question how it was made. By juxtaposing chronophotographic techniques with animated sequences in the exhibition, the viewers were able to make their own connections and commentaries about animated motion and the aesthetic opportunities that the work presented.

Thesis structure

In this introductory chapter I presented the focus of the study and the major influences that directed its development. Chapter 2 focuses on the practices of nineteenth-century chronophotography. I examine the work of two of the pioneers of chronophotography: Eadweard Muybridge and Etienne-Jules Marey. Drawing from the comprehensive research of these chronophotographers by academic scholars Martha Braun, Rebecca Solnit, Sarah Gordon and Phillip Prodger, I evaluate Muybridge and Marey's opposing approaches to movement analysis and present an argument as to how their distinct representational formats influence viewer engagement and consequent 'readings' of their work. I also address the influence that their work has had on modern artists, to assess what aspects of this scientific practice appealed to artists and consequently influenced my creative practice.

In Chapter 3 I begin to evaluate motion representation and unpack the visual language of animated movement. I do this by focusing on two of the key role players in early animation practice: the Disney and Warner Bros. studios in the Golden Age of American animation. I evaluate their varying approaches by applying the chronophotographic practices of

Muybridge and Marey. I present the Disney Studios innovations in the representation of movement and argue how this approach can be aligned to Muybridge's syntax of cinematic realism, or in Disney's case, 'verisimilitude' and classic Hollywood cinema. I also examine the Warner Bros. Studio's deviations from Disney's 'code' with their dynamic advances in motion representation, and argue for a relationship between 'Mareyism' and the Warner style, both approaches resulting in recognisably distinct forms of graphic abstraction. By applying a chronophotographic understanding to these innovative modes of movement representation in early animation, I use these observations and evaluations to inform my creative practice and consider how exposing these techniques could influence viewer engagement in animation.

In Chapter 4 I begin to unite the concepts and practices of chronophotography with animation through an evaluation of how the viewer experiences movement in the still versus the cinematic format, and start to look at the creative potential of their synthesis. I argue that through altering modes of viewing practice one can influence the viewer's experience. By using St George's theory of how animation and cinema produce the illusion of continuous motion, I unpack the different visual formats of chronophotography and animation and argue how this understanding can be used to exploit the way we see things – and in this research, particularly how we view animation. St George proposes that we can use the 'gaps' as an opportunity to change the 'picture' to gain a slightly different 'picture', which is a key insight that I develop through my creative practice. In this chapter I also identify and evaluate the potential of the strata-stencil animation technique as a tool for exposing the construction of animation for the viewer.

Chapter 5 serves to present the creative practice by outlining the design process. I discuss the creative impetus behind my practice and critically assess the outcomes according to the objectives outlined and questions raised in the study. Through this presentation I critically assess *a[CHRONO]mation,* the larger visual research project that encompasses the experimental short film and exhibition. Together they explore methods of exposing animation's construction using chronophotographic practices in order to influence viewer

engagement. The film develops and expands on the strata-stencil technique, offering a new mode of viewing animation in a cinematic format. The exhibition expands on the representational formats used by Muybridge and Marey, and presents different ways of experiencing the static frame-by-frame presentation of the work, focusing on the analysis, experience and understanding of animated movement.

By offering these innovative and playful modes of viewing the animated frames, I introduce an educational aspect for the viewer that reveals how animation is made. By allowing the viewer to experience animation in unique ways, they ultimately question the construction and representation of animated movement, while enjoying the aesthetics of the sequential arrangements.

Chapter 2

Nineteenth-century Chronophotography: Aesthetic and Conceptual Inspiration

Character animation requires close observation of the movements of living beings – how a person/animal walks, runs, or acts out an action. This information is then creatively adapted and applied to characters[10]. The observation of movement is a critical part of our practice. A useful tool for this purpose can be found in nineteenth-century chronophotography, a set of photographic techniques intended to reveal the mechanics of a movement, capturing what the eye could not see due to the limitations of human perception. A vast amount of movement studies were generated during this period, as chronophotographers developed photographic technology to suit their subjects and interests, with varying results. These studies are an indispensable resource for character animators, providing accurate images of how the body moves in an action, as well as information on the timing and duration of an action. Chronophotography has also inspired many artists interested in exploring approaches to representing movement. It is a visual medium that forces the viewer to shift their modes of viewing to examine the mechanics of a movement. My interest is in chronophotography as a representational practice and in the creative opportunities it affords artists.

This chapter presents the work of two prominent[11] chronophotographers, Eadweard Muybridge and Etienne-Jules Marey. I evaluate their opposing approaches to movement analysis and present an argument for how their distinct representational formats influence viewer engagement and consequent 'readings' of their work. I also address the influence that their work had on early modern artists, to assess what aspects of chronophotographic practice appealed to artists and that have consequently influenced my creative practice.

2.1 Early nineteenth-century innovations

Chronophotography developed in a time of radical change. In the nineteenth-century there were several technological innovations and industrial developments that launched the

modern world. These changes had a considerable impact on one's understanding and experience of time and space. Important milestones, like the development of railroads and the standardisation of time in Europe and America, enabled ordinary people to travel beyond their immediate surroundings, ultimately changing the pace at which they lived. In *River of Shadows, Eadweard Muybridge and the Technological Wild West*, Rebecca Solnit describes how this acceleration was achieved through new technologies that aspired to "annihilate time and space", how machines made life "easier, faster and more predictable", how consumption increased and a new world emerged (11, 21). These developments had a significant impact on how one interpreted the world, where the notion of time became a pressing universal concern.

An object that directly addressed the notion of time and memory was the photograph. Early photography was celebrated for its ability to freeze its subject and depict a reality that accurately portrayed a particular place or individual at a specific moment (Prodger vii). The camera was able to capture memories faster and more accurately than painting, but exposures could take up to several minutes, limiting it to portraying only the "slow or the still world" (Solnit 16-17). Photographic portraits required the subject to sit completely still for long periods so that their images would not be blurred. Landscapes could only be captured on a windless day, when trees and rivers stood still for the camera (Solnit 16). However, these limitations were overcome through the advancement of photographic materials and techniques. A significant contribution to this development was made possible by those concerned with capturing the ephemeral – the fleeting movements that were imperceptible to normal vision. This emerging photographic technique became known as chronophotography, an investigative practice centred on understanding how time and space operated in the act of a movement. These chronophotographic images were said to "freeze rapid action for analysis and study" (Hannavy 297) "by means of a series of instantaneous photographs taken at very short and equal intervals of time" (Marey qtd. in Rabinbach 107). Chronophotography covered a wide range of subjects, including the movement of planets, fluids, airflow and, most prevalent, the locomotion of humans and animals.

Central to the development of chronophotography were Eadweard Muybridge and Etienne-Jules Marey. Most accounts of Muybridge have interpreted him as an artist, a visionary and an entrepreneur, driven by fame and always seeking to represent the world from a unique perspective through his passion for photography (Solnit; Prodger; Braun; Clegg; Leslie). Beginning his career as a successful landscape photographer, Muybridge used his foundational artistic knowledge and 'pictorial traditions' to condition the way he used the camera, seeking innovative methods for representing his photographic subjects (Braun *Picturing Time* xvi). In contrast, Marey was a medical physician, inventor and scientist whose work in the scientific community was pivotal (Braun *Picturing Time* xvii). His work traversed the disciplines of cardiology, physiological instrumentation, and aviation, the science of labour, and photography. Marey had a long and distinguished scientific career spanning more than fifty years. His systematic approach, research contributions and longstanding reputation in the medical field verify his value as a notable scientist and significant innovator of chronophotography.

Muybridge and Marey both contributed significantly to chronophotography and have been recognised as pioneers of the technique. Central to my interest in their work are the differences between the formal presentations of their movement studies. In the discussion I contrast Muybridge's sequential arrangement of images with Marey's use of the single multi-exposed chronophotograph. By focusing on their individual approaches to the representation of movement, I argue that these two formats inspire varying aesthetic responses and demand distinct engagements with the viewer, where the 'singular' and the 'multiple' compete for prominence and provide meaning in the work.

2.2 Eadweard Muybridge

It is undeniable that Muybridge's key accomplishment was his 1878 sequence of images entitled *The Horse in Motion*. Solnit's historical account of the images resulting from the study outlines Leland Stanford's request[12] for Muybridge to produce a single image proving 'unsupported transit' in the horse's gait, a single moment of its trot (79). However, Muybridge addressed the problem in a unique way. Using a battery of adjacent cameras

placed along the side of the racetrack, and a set of corresponding tripwires stretched across the track, Muybridge was able to capture a series of images taken at rapid intervals, triggered by the horse's movement down the track. Muybridge understood that in order to analyse motion, he needed to capture a sequence of images that were fractions of a second apart (Brookman in Nicholls 00:51:14-00:51:26). Although the authorship of this approach to instantaneous photography was contested by Stanford,[13] and had previously been suggested in 1860 by Sir John F. W. Herschel[14] and somewhat accomplished by Jules Jansen[15] in 1874, I add to the discourse of how the innovation and ingenuity of Muybridge's images lies in how he chose to present these images to an audience, i.e. their presentation format. The originality of *The Horse in Motion* was that the authenticity of the 'suspended horse' image was achieved by reassembling and arranging the photographs into a sequence of images that displayed each incremental moment in the horse's gait, thereby validating its position in the series. We can assume that this was done through a process of rationalisation (possibly anticipating some hostility from his audience, its validity having been questioned after his first attempt in 1872). Or perhaps Muybridge was aware that a single image can be ambiguous and does not easily and explicitly reveal its intended meaning, especially a single image of a horse whose legs were "crumbled under the horse's belly like the dangling legs of a crushed spider" (Gunning in Frank 94). In his chapter "Animating the Instant: The Secret Symmetry between Animation and Photography", Tom Gunning has argued that "the positions of the horses' legs in Muybridge's images were considered absurd, ungainly, and impossible" (location 1190). However, Muybridge had realised that by exposing the 'controversial image' through a sequence of images – by providing context and further visual evidence – his findings would be irrefutable. Both his approach and the resulting images provided fundamental opportunities for instantaneous photography and the motion studies that followed.

Before embarking on a close analysis of Muybridge's chronophotographs, I address a single work that Solnit highlights, which marked a notable shift in his modes of representation: the *Panorama of San Francisco* (1878). Taken from the highest point at California Street/Nob Hill (the tower of the Mark Hopkins mansion), the 360-degree panoramic images offered an immersive, uninterrupted view of the entire city and its harbour, that Muybridge assembled

into a single panel. The work was meant to be read as a single image, but because of the way the images were captured (at intervals of 15-20 minutes, using multiple cameras spaced approximately 30 centimeters apart), Solnit proposes that we see the images as akin to his motion studies – each representing an individual moment of the movement of the sun across the landscape (175). This suggests that we see them as a sequence of images, each representing a different time and portion of the landscape. Solnit describes how the work – or perhaps the thinking that resulted in the images – marked a substantial shift in Muybridge's methods of representation, and revealed the potential for his upcoming studies in movement. It is evident that the process he devised for capturing the landscape of San Francisco informed the way in which he approached the images of the trotting horse produced in the same year. This was the format that he continued to practice throughout the remainder of his career as a photographer. From this point, Muybridge immersed himself in exploring methods for capturing and representing movement using sequential images, a format that has had a profound effect on artists throughout history.

2.3 An assessment of Muybridge's sequential image format

In the following section I evaluate Muybridge's representational format from his ground-breaking eleven volume collection *Animal Locomotion: An Electro-Photographic Investigation of Connective Phases of Animal Movements 1872-1885,* published in 1887. Marta Braun labels this collection the "hallmark" of his creativity with organising sequences ("Authorship" 45). By taking a close look at the arrangement and contents of his motion studies in this series, I develop a vocabulary and understanding essential for the development of my own sequential practice, and consider how these elements impact viewer interaction and the reading of sequential images. I do this by concentrating on three main aspects of his formal arrangements: the layout of the sequences on the pages; the temporal ordering of the images in the sequence; and how the content of the images was influenced by his method of capturing the images. I complete the analysis with an aesthetic reading of the work, which has informed my creative practice and the manner in which I view chronophotography.

Commencing after the *Horse in Motion*, the publication *Animal Locomotion* was a massive project that resulted in the production of 781 photographic plates[16] illustrating various movements of men, women, children and animals. The project was overseen by a committee labelled the 'Muybridge Commission' and funded by the University of Pennsylvania, made up of professors from the disciplines of Anatomy, Physics, Veterinary Anatomy, Engineering and Fine Arts, with a focus on "muscle movement in humans and animals" (Gordon "Sequence" 11). The project was expected to meet the intellectual interests of the members of the Commission (Gordon "Sequence" 11, 14, 20). Together the images in the collection offer the viewer (who Muybridge identifies as artistic or scientific) a "comprehensive and systematic" resource of movement analysis (Muybridge *Animal Locomotion* 4). The collection originated in the sciences and arts for the purpose of academic study, and was not a product of creative intention. However, I examine the work from an artistic perspective in an attempt to unpack how images can speak to creative practitioners. I will demonstrate that through subtle creative choices and formal manipulations Muybridge's sequence of images has the power to communicate to a viewer beyond the 'subject' being depicted. Through this different mode of viewing we can gain insights and develop our own understanding of how image sequences can operate in the creative space.

In his article "Categories and Comparisons: How We Find Meaning in Photographs", sociologist Howard S. Becker questions how photographers communicate and create meaning for the viewer, by comparing sequences of documentary photographs to statistical tables. He investigates the analytic role of both the creator and reader of such representations, focusing on the approach of a "sophisticated viewer" – one that "consciously and carefully" analyses images by examining the small details in order to seek meaning in the work (Becker 6). My discussion employs the perspective of this 'sophisticated viewer' and considers Becker's theories on the sequential reading of images through the creator's intention and creative manipulation.

Becker's article examines how a photographer arranges large amounts of material so that the images can clearly communicate their intention for the viewer. In this study, he considers how ordering, arrangement, presentation, and content of the images affects the viewers' reading of the work. Becker asserts that through the process of comparison and analysing the relationship of each photograph to the others, "the meaning of any one picture arises in its connection with the others" in the series (5). It is a systematic, analytical role that the viewer adopts to understand the work – one that is akin to how we read statistical tables and graphs.

In the opening pages of the *Animal Locomotion* series, labelled "Studio, Apparatus and Method of Working" and "Analysis of the Plates", Muybridge explains his methodology and his presentation of the photographs. He claims that they all adhere to a rigorous systematic approach, which he explains in detail (7-11). He explained that the standard layout that he used for the images displaying "progressive motion" was the following: twelve lateral views in the top row of images; twelve rear foreshortening views (taken at a 90-degree angle from the laterals) in the middle row; and then twelve front foreshortening views (taken from a 60-degree angle from the laterals) in the bottom row. When this layout is employed, each row of images correlates to the image above or below it (i.e. each correlating image is captured at the same time). When captured from only one or two angles, a system of arrangement "which is considered the most convenient for their especial comparative examination" was adopted (Muybridge *Animal Locomotion* 11). Muybridge's arrangement of camera angles in the sequence requires a visual 'reading' of the sequences that interchanges from left to right, to right to left, driven by the direction of movement of the subject and the position of the cameras as the movement was captured. In fig. 1 below Muybridge visually explains the layout and ordering for the reader; in fig. 2 we can see how some images deviate from this.

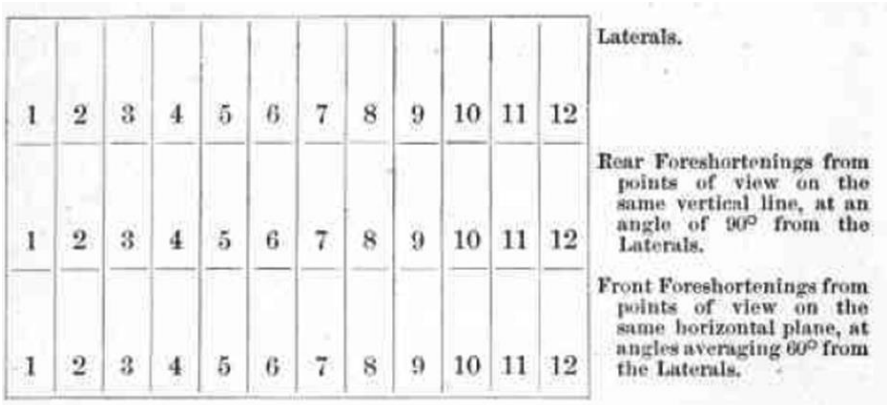


Fig. 1. Image showing the arrangements of Muybridge's plates in *Animal Locomotion* (10).

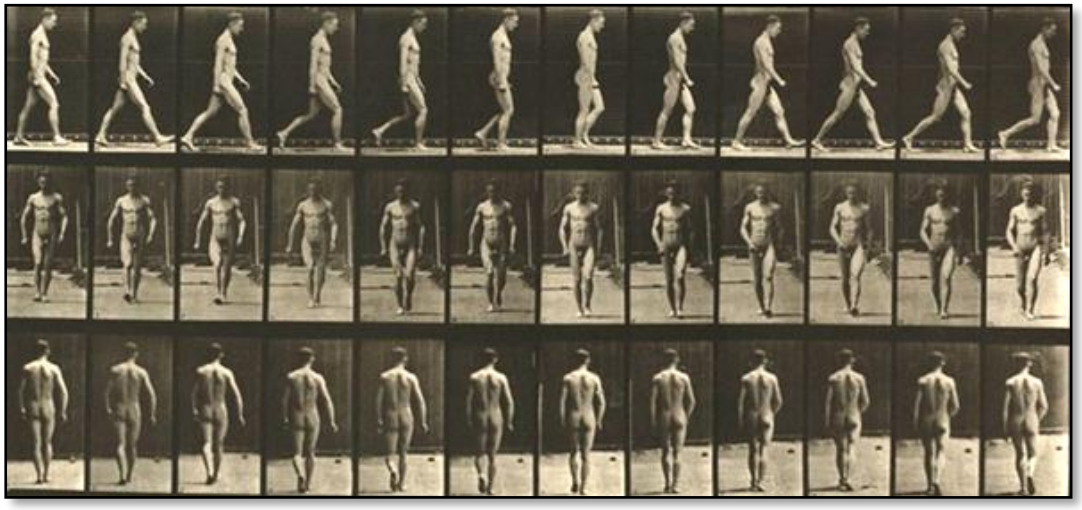


Fig. 2. Plate 1, showing how ordering was often swapped in the series in Muybridge's *Animal Locomotion.*

As formulaic as this explanation seems, Muybridge states that this "perfect uniformity of time, speed and distance, was not always obtained" (*Animal Locomotion* 9) and that in some instances "the number of phases of motion from each of the respective points of view do not correspond, some being omitted" (*Animal Locomotion* 11). Braun states that this layout (of the thirty-six intact images) only accounts for almost half of the published prints (*Picturing Time* 237). She elaborates on this by analysing how Muybridge sacrifices "scientific accuracy" for a "pictorially acceptable" final print, rearranging the layout as cameras failed or as negatives were lost (Braun *Picturing Time* 237-238). This is an example of Becker's theory of how photographers communicate and create meaning for the viewer by way of their consideration of the ordering, arrangement, presentation, and content of the images. In an attempt to remain scientifically accurate, Muybridge has made creative choices on how to account for the failed cameras.

An example of Muybridge's approach to this deviation from his prescribed layout can be seen in fig. 3 below, where he has either included a blank background image as a substitution for the missing rear foreshortened view, or has not cropped certain images to compensate for the missing frame, both examples highlighted in red. These irregularities[17] or the practice of excluding images is frequent in the series; however, Muybridge deems the 'interest or importance' of the plate such that it is essential to include it in the collection (despite the irregularity), as the action, he claims, would have been impossible to replicate (Muybridge *Animal Locomotion* 11). Although this may not have been satisfactory for accurate scientific analysis, he felt that these inclusions would still offer valuable artistic reference.

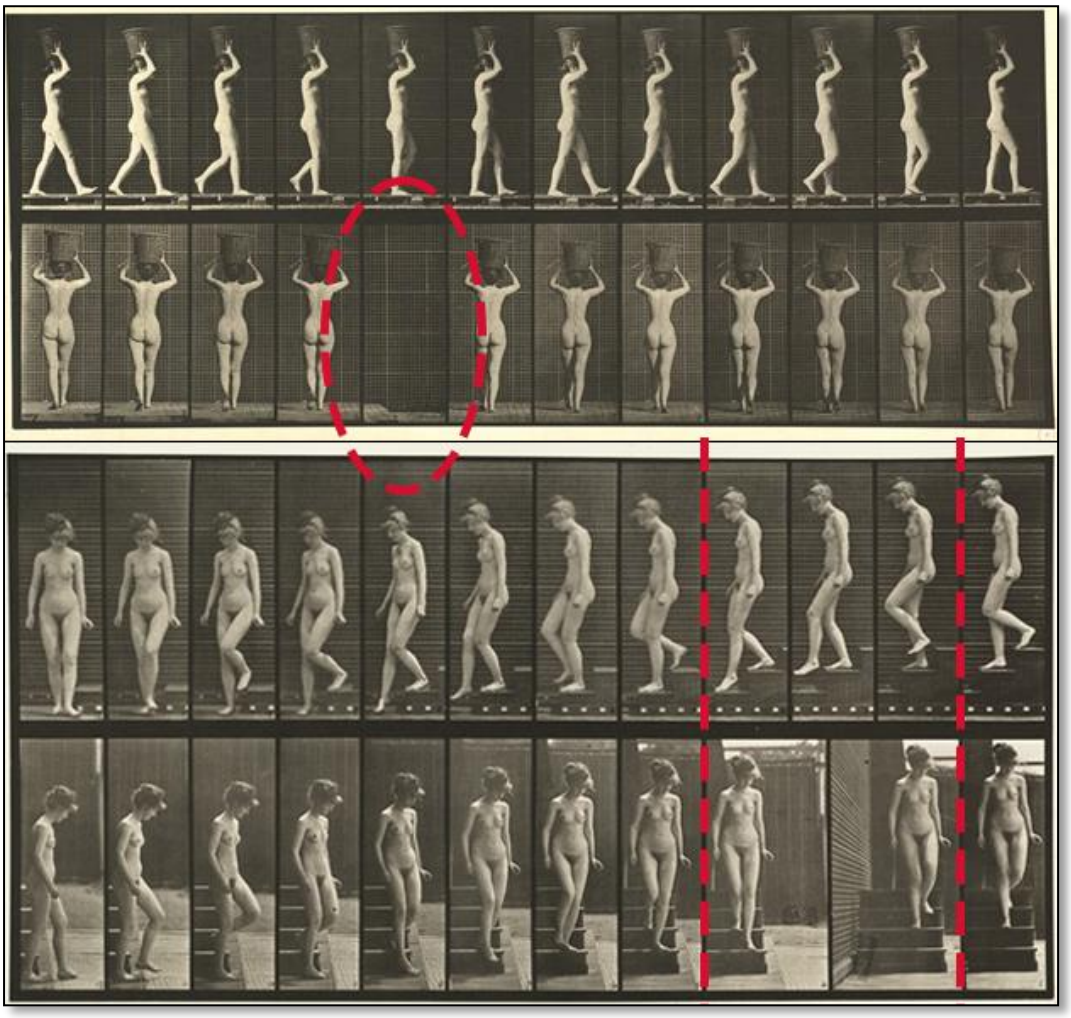


Fig. 3. Top: Plate 34 – *Walking and Carrying a Fifteen Pound Basket on Head, Hands Raised*. Bottom: Plate 137 – *Descending Stairs and Turning Around.*
A blank background image has been inserted as a substitution for the missing rear foreshortened view in frame 5 (top image, 2nd row, frame 5 from the left, circled). Frames 2 and 3 in the bottom row (bottom image, from the right) have not been cropped, in order to compensate for the missing frame (Muybridge *Animal Locomotion*).

In Sarah Gordon's article "Out of Sequence: Suspended and Spectacular Bodies in Eadweard Muybridge's Animal Locomotion Series", she examines certain aspects of reception of the images, focusing on how modes of viewing encourage fleeting glances at the bodies but offer endless opportunities for experiencing sustained pleasure. Her first observation makes reference to the spaces between the images that are evident in both Muybridge's cinematic-style lecture format and the printed serial photographs (the latter being the focus of this discussion). Gordon notes how when Muybridge lectured he presented his images using the zoopraxiscope, the precursor to the film projector ("Sequence" 13). Muybridge would not use his original images for this device, instead redrawing them from the original photographs (Prodger 73). Gordon observes how, in the cinematic format, the spaces are so quick that they seem to disappear and the subjects in the images appear to move ("Sequence" 13). However, in the printed version these spaces are "filled by the viewers' imagination", deeming them active participants in the re-animation of the movement (Gordon "Sequence" 13). She argues that the lateral viewing procedure encourages the viewer's active engagement as opposed to the contemplation of each individual frame (Gordon "Sequence" 13). Gordon does not examine these spaces between the images in detail; however, they are an important consideration in sequential image practice.

Comics theorist Scott McCloud refers to a similar phenomenon in the medium of comics in his book *Understanding Comics: The Invisible Art*. He refers to the comic viewer as the "conscious collaborator" of the comic, where the gutter[18] inspires the human imagination to take two separate images and transform them into a single idea (65-66). Comic panels (similar to Muybridge's discrete sequential images) "fracture both time and space, offering a jagged, staccato rhythm of unconnected moments" that we mentally connect into a "unified reality" (McCloud 67). Muybridge's sequences contain minimal black spaces between the uniformly sized[19] images, each gap representing a moment of time that has passed (between each image). The viewer uses these gaps to reconstruct the motion in a participatory manner: We actively engage with the sequence to mentally reconstruct the motion – a part of the process which provides meaning for the viewer. Without this engagement, movement in each image does not exist.

The ordering of the images also plays a pivotal role in this process. Muybridge's ordering was predefined by the movement contained in the action of the figures; they needed to be presented in sequential order so that movement could be reconstructed, analysed and understood. However, Braun states that "the sequential ordering of the images on the plate dictates our perception of the relation among the individual images even when there is no relationship" (*Picturing Time* 237). In her assessment of Muybridge's "sequential arrangements", Braun explains how the format promotes notions of order, logic and progression in the viewer: it cues us to believe that these images were taken in the order in which they have been presented to us, inviting us to see a continuity of movement (*Picturing Time* 237-238). However, this is not the truth for many studies concerned with the movement of objects. In St George's book *Sequences: Contemporary Chronophotography and Experimental Digital Art*, he uses the example of Arthur Mason Worthington's *The Splash of a Drop* (1865) (fig. 4) to address the importance of ordering and the presentation of sequential images. St George's interest in this particular work was in Worthington's method for capturing the images. Worthington's sequential images were constructed from various studies of a ball falling into a mixture of milk and water. Because of the limitations of photography at the time, Worthington had to take several individual images of the event, by varying the height of the ball in each 'take', so that he could record different moments of "a ball's descent" that were then arranged into a sequence of images to give the "illusion of a continuous series, one ball in descent" (St George 9).

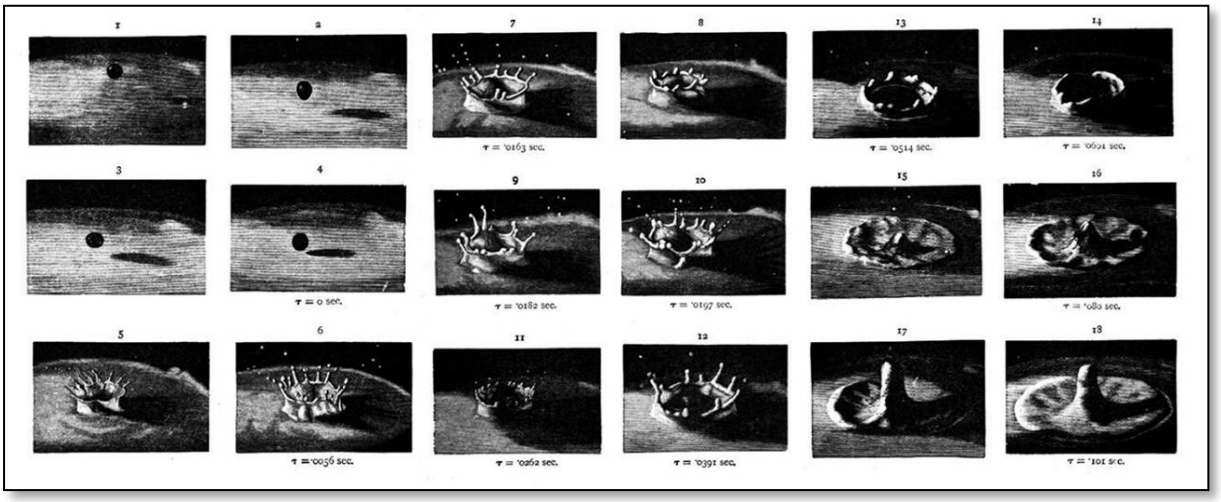


Fig. 4. Arthur Mason Worthington, *The Splash of a Drop,* 1865.

Even though Worthington explains his process, and we are informed that the images were taken independently, because of their mode of presentation we willingly *see* continuous movement. The sequential structure prompts us to integrate the separate images into the uninterrupted motion of a single object (St George 12). I address the psychology of this process in detail in Chapter 4 – this is an important aspect of Muybridge's work which has often been criticised as evidence of scientific inaccuracy. Braun and St George provide the example of Plate 299, *Playing with Ball* (fig. *5* below), where Muybridge composed images taken from three separate shoots[20] into a single sequence (Braun *Picturing Time* 240; St George 12). As a 'casual viewer' this inaccuracy is difficult to identify, as the format denotes the single movement of the model taken at intervals of the same 'moment'. But Muybridge has carefully selected images to 'fill the spaces' candidly enough so that we overlook the separate shots. As a 'sophisticated viewer' or one seeking scientific accuracy, these images fail to represent movement truthfully. I therefore argue that the sequential nature of the images helps us to see movement even when they are technically inaccurate, allowing the viewer to overlook details in order to appreciate the work.



Fig. 5. Plate 299 – *Playing with Ball* (Muybridge *Animal Locomotion*).

Not all of Muybridge's images portray movement as we would expect. He makes a distinction in the section of the book which he labelled "Analysis of the Plates", regarding "progressive motion" and a "single phase of motion" (*Animal Locomotion* 11). Here he is referring to nine plates (520-528) that explore a different approach to investigating muscle movement in the series. In these images he depicts six perspective views of the same pose taken synchronously, and calls them "foreshortenings" (Gordon "Sequence" 13; Braun "Authorship" 45). The sequential structure of the images that the viewer has become accustomed to (from the other sequences in the book) dictates our understanding that these images represent progressive stages of a movement. This prompts the viewer to find a pattern in the movement; to look beyond the single image and to source possible relationships *between* images. However, these plates present a challenge for the viewer, as they differ from the formula used for most of the image sequences. Firstly, we are presented with several rows of six images, where no visible movement can be discerned between the frames. In fig. 6 we can see how the model's pose remains unchanged throughout the sequence (in each row), and their body seems to hover in the air. The viewer is expected to shift their established mode of viewing of the sequential images, and is then forced to imaginatively project their own movement in a 360-degree manner around the figure. These nine plates challenge our understanding of *Animal Locomotion,* which claims to investigate the "consecutive phases of animal movement" and instead only presents a single phase of movement. The change in viewing practice forces the viewer to analyse the images outside the boundaries of scientific enquiry, using logic and creativity to interpret the content.

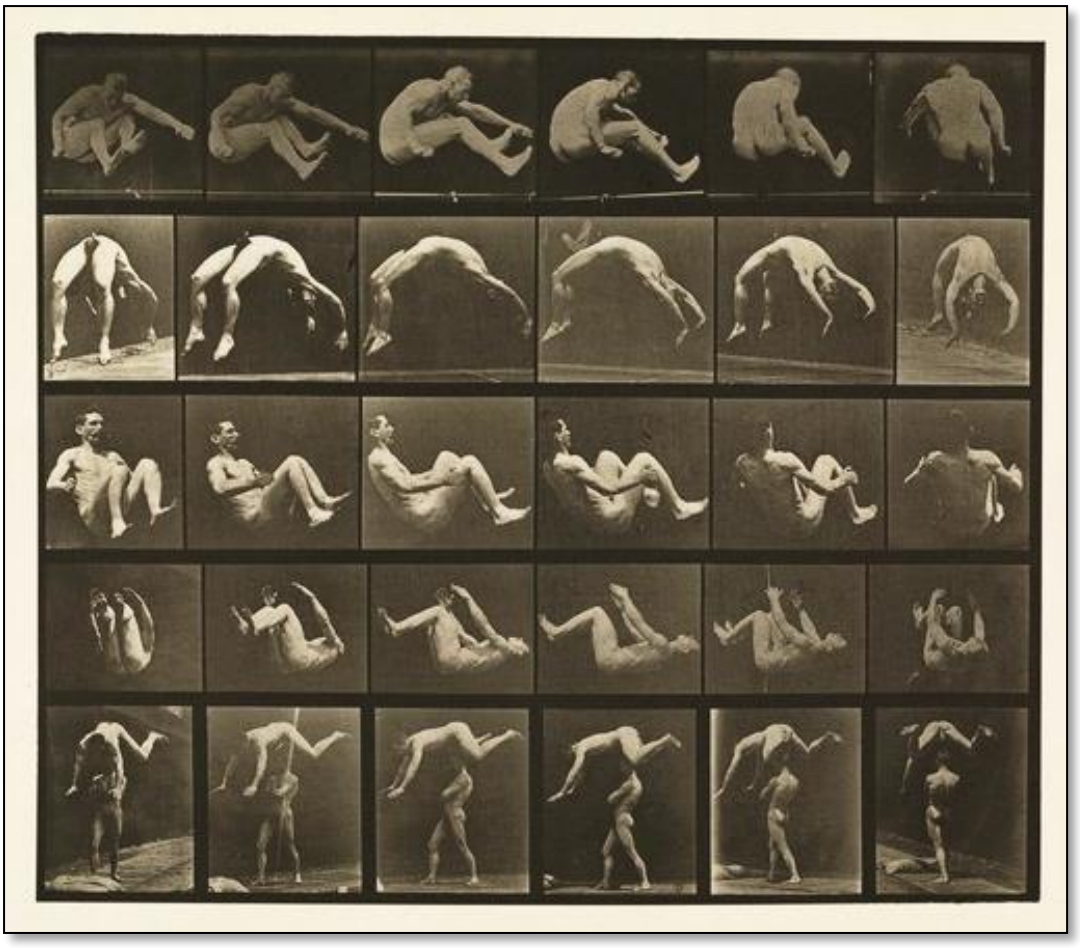


Fig. 6. Plate 522, showing five poses, each taken simultaneously from six points of view (Muybridge *Animal Locomotion*).

The technique used by Muybridge here predates the contemporary visual effect of 'bullet time' made popular in the movie *The Matrix* (1999), and informs the installation works in my creative practice, which I address in Chapter 5. What is intriguing about this approach is how it interrupts Muybridge's established viewing pattern of the *Animal Locomotion* series and raises questions around purpose. Braun suggests that Muybridge was possibly influenced by François Willème's photosculpture of 1863 – a "process that made sculpture from photographs produced by twenty-four cameras he set up to surround the subject; the results were transferred to clay by means of a pantograph[21]" (Braun "Authorship" 45). However, Gordon suggests that these images evolved from Muybridge's desire to serve artists, and I agree that these would be specifically beneficial for sculptors – or even contemporary 3D artists – interested in 360-degree anatomical studies. Gordon also draws similarities with Muybridge's San Francisco panoramas, noting how they also captured

'simultaneity', similar to the suspended bodies that rupture the logical progression of the *Animal Locomotion* series ("Sequence" 14-15). As Braun states: "They focus on the spectacular nature of the single frozen moment that only the camera could capture – that instant in which the laws of gravity no longer seem to prevail" ("Authorship" 48).

Braun addresses another way that Muybridge challenges scientific inquiry, questioning the manner in which each camera tracks the model's movements (how they move in unison), thereby cancelling any sense of movement for the viewer (*Picturing Time* 237). This makes it seem that the only moving parts are the gestures of the model, and movement needs to be constructed by the viewer from these gestures in a frame-by-frame manner. We can see the effect of this in fig. 7 below, which is caused by Muybridge's camera set-up, shown in fig. 8. The figures seem to remain in perfect profile, completely parallel to the camera in every image. As an animator, I argue that this approach is quite ingenious and resolves many perspective issues experienced during the animation process, making these images an exceptionally accurate source of reference for the animator. Often reference is captured from a single-point perspective, causing visual challenges for the animator. Although this may not serve scientific inquiry accurately, I assert that his approach may serve a more diverse purpose – one that practitioners in varying fields may find valuable[22].

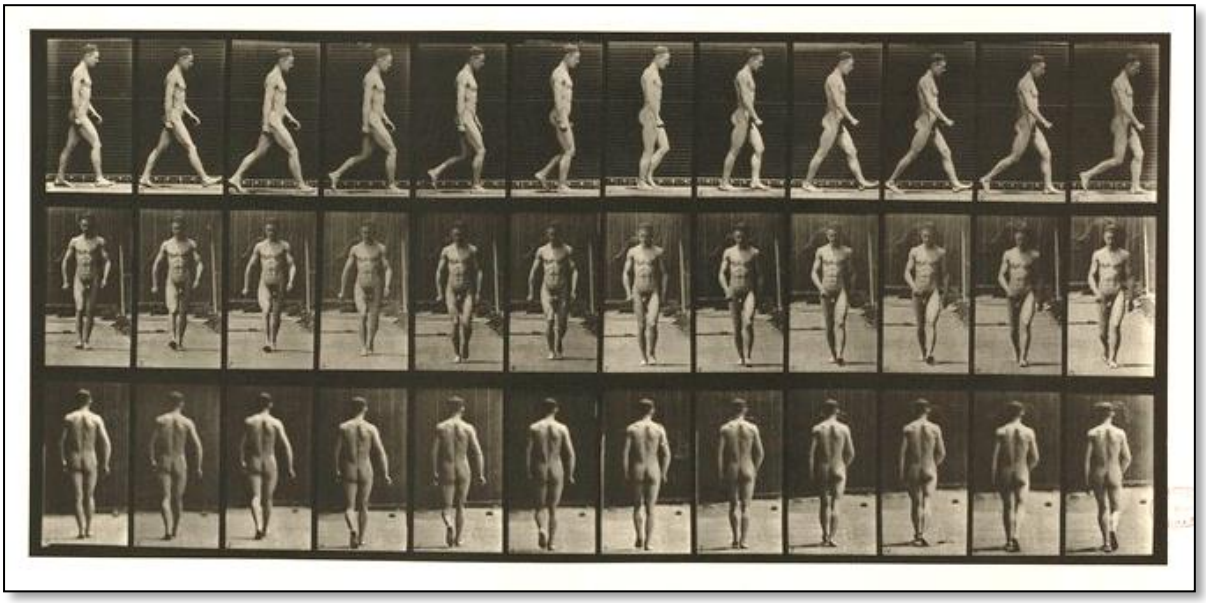


Fig. 7. Plate 1 showing the tracking of the model – an effect caused by the manner in which Muybridge set up his cameras (Muybridge *Animal Locomotion*).

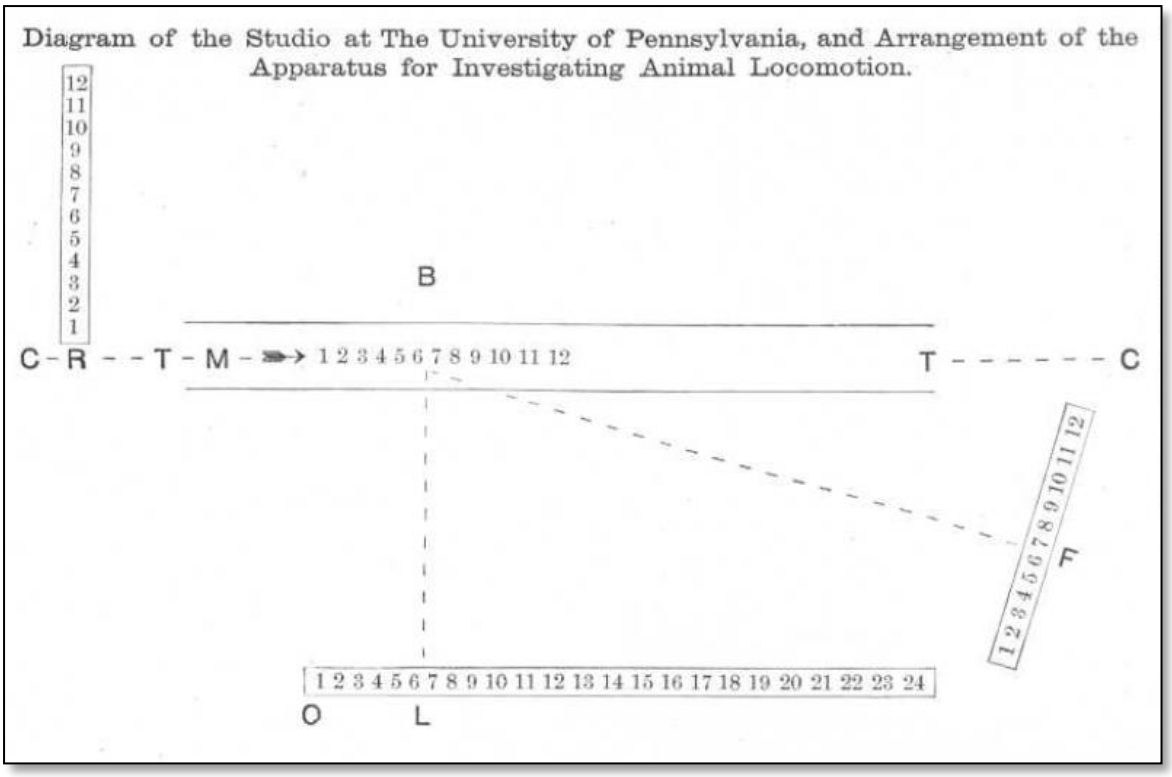


Fig. 8. Image showing Muybridge's camera set-up (Muybridge *Animal Locomotion* 6): 'M' represents the model and their movement; 'L' is the lateral battery of cameras "parallel to the line of progressive motion" (7).

As a final observation on Muybridge's modes of representation, I propose that we take an aesthetic approach to the viewing process and interpretation of *Animal Locomotion*. After many hours of studying his work, I have found that our perception seems to change when viewing the repetitive sequences of plates that Muybridge offers us in abundance. I argue that this 'change' happens both within a single plate as well as during a page-to-page examination of the book. At first, the structure of the sequential images provokes a method of scrutiny and analysis. Through a process of comparison, we start by looking for similarities or common visual elements between the images, and assess whether they are in fact representing movement incrementally, as the study proposes in each title. The similarities in poses and the subjects in the plates creates a visual 'echo' that we keenly follow with our eyes – the positions of the body and limbs, the weight shifts, muscle contractions, and visual differences in each angle of the same movement. We focus on the details and compare the differences, asking ourselves: 'Are these really the incremental positions of a jump?' 'Have the legs in fact cycled two full steps?' 'Where are the horse's hooves completely suspended above the ground?'

Once we are able to confirm these kinds of questions (or identify the errors), we are likely to start experiencing some visual fatigue. This is because of the level of inspection that these images command from the viewer. Our vision seemingly starts transforming. The constant repetition of images (on each page and then between the pages) triggers the viewer to start assessing them as one – a more holistic approach to viewing. This forces us to start focusing on the aesthetics of the sequence: the changing shapes of the positive and negative forms, the visual echoing from frame to frame, the arcs of movement across the panels – a form of visual music. To the untrained eye, the shifting viewing process tends to make identifying mistakes (insertions/duplications) less pertinent. We are led to accept them as authentic representations of movement as they become graphic, repetitive grids, interconnected through a concert of visual elements focusing on movement.

The sequential nature of Muybridge's images conditions our understanding of what we are seeing. Meaning is not supposed to be created via a single image; it is created *through* the sequence itself. It is a mesmerising experience, where the images seem to re-animate as one's vision glides over them at rapid speeds. Sometimes we pause to conduct a close examination of a certain aspect of an image, and then we reconstitute the action by moving through the sequences quickly. It is a format that commands interaction from the viewer, as we recognise that sequential imagery is not objective but an interpretive process. The viewer processes information contained in the images in order to form meaning. This can be done at varying speeds, each with a different outcome. Are we scanning quickly to get a feel for the movement, or are we scrutinising every frame to understand how the body's movement is captured in each moment? This is, of course, a process of examination that is familiar to the animator. We continually conduct a frame-by-frame analysis, and then view it in 'real-time' to assess our design of a movement in a back-and-forth manner. In this study I suggest that the viewing process of Muybridge's sequential images is analogous to the animation process which I exploit in my creative practice. The conflict between stillness and movement in Muybridge's images becomes the visual language that I use to expose animated movement in my creative practice.

2.4 Etienne-Jules Marey

Marey's approach to chronophotography was significantly different to that of Muybridge. He established his career in physiological investigation and contributed significantly to this field (Braun *Picturing Time* 4). His interest was in the "invention and development of instruments for making permanent graphic representations of movement of and within the body", and he invented a method that was the basis of all of the graphing machines that medicine depends on (Braun *Picturing Time* 4). Marey's contribution to chronophotography was therefore strongly based in science and empirical research, with no artistic influence or intentions. Braun emphasises this analytical context of Marey's work, stating that his chronophotographic images should be evaluated as scientific data rather than images created for aesthetic purposes (*Picturing Time* xvi). As an artist and animator, I recognise Marey's scientific objectives and findings, but seek to evaluate the creative potential of his images as well as further analytic implications that could benefit animators. This results in a contemporary application in a digital era, one that has not yet been addressed in animation discourse.

I focus my discussion on Marey's most significant contribution to chronophotography: the multiple exposures on a single plate that he made with his photographic gun, the "*fusil photographique"* which he developed in 1882[23]. In contrast to Muybridge's sequences of progressively arranged images, I emphasise Marey's representational format on a single plate, and argue that contained within that single photographic frame he was able to capture accurate and fluid expressions of time, space and motion – a superimposed pattern of movement rigorously grounded in scientific methodology. I argue that this format fundamentally differs from Muybridge's sequences, requiring less active participation from the viewer – although, perhaps paradoxically, this format encourages the viewer to expand their sight into a new mode of *seeing*.

In order to emphasise the significance of key aspects of Marey's multi-exposed images, it is important to consider his prior research, in order to understand how it influenced the trajectory and outcome of his chronophotographic work. Marey's earlier graphing

instruments examined and measured the "internal dynamics" of the human body[24] before moving on to the "external" observation of locomotion in animals, such as a trotting horse and the flight of a bird (Dagognet 11). He described his graphic method in *Animal Mechanism*[25] (1874) as "chronography" (French: *chronographie*) or "time writing" – a graphic record of time, which he considered a rudimentary form of chronophotography (French: *chronophotographie*) (*Movement* 1) or "time photography" (Braun *Picturing Time* 66). Marey explained chronography as a system of time measurement via diagrams that are represented by parallel straight lines of various lengths placed side by side, that serve to register the duration and sequence of an 'event' (*Movement* 1-3). He considered the method a reliable technique for recording various simple rhythms of movement, and believed that this visual 'language' was clear and easy to understand (Marey *Movement* 2-3). Braun explains how the aim of these instruments was to make visible movements which are invisible to the naked eye (like a rhythm or a pulse), by tracing them onto the surface of a smoke-blackened cylinder, transforming them into a form of writing for analysis (*Picturing Time* xvii). She confirms how these "writings" displayed the visual relationship between time and space which is the "true form of any movement", transforming them from a "single and ephemeral instant" to a "continuous and recorded event" (Braun *Picturing Time* xvii).

A key aspect to the success of this technique was that the results were automatically registered directly from the test subject (Marey *Movement* 3). However, Marey's research became limiting when the 'event' became more complex and the relations between the different parts of the moving subject were difficult to record graphically (Braun *Picturing Time* xviii). After seeing Muybridge's images of *The Horse in Motion* in 1878, Marey recognised the potential of photography as an extension of his research, as the camera offered essential visual details of bodies in an action (Braun *Picturing Time* 47). Muybridge's images allowed the viewer to assess motion visually, – a limitation of Marey's graphic method, which he initially tried to overcome using artistic interpretations of the movement derived from the graphs. But these drawings were never accepted by the scientific community because the artist's objectivity would always be "called in to question" (given this was a time when photographs were already understood as products from the machine that 'could not lie') (Braun *Picturing Time* 43). For Marey, Muybridge's photographs

confirmed the potential that the camera could offer to science as an accurate recording instrument, not subject to an artist's 'lack of objectivity'.

2.5 Marey's multi-exposed format

Marey's approach to capturing movement through the medium of photography was intended to overcome the limitations of Muybridge's study, which (from Marey's perspective) offered disconnected images representing intermittent 'moments', requiring the imaginative reconstruction of movement by the viewer. Marey was aiming for "visible expression to the continuity of movement over equidistant and known intervals, as his graphing machines had done, and to do so within a single image" (Braun *Picturing Time* xviii). This distinction between the fluid and the intermittent is the important difference between the chronophotographic work of these two pioneers. Rabinbach explains the difference as being that Muybridge's interest was in the decomposition of movement in phases, whereas Marey's was in unpacking the precise relationship between time and motion (103).

In terms of scientific method, both Braun and Dagognet emphasise Marey's rigour as a chronophotographer. They also assert that his goal of achieving quantifiable results was what guided his development of the photographic gun, where Marey focused on the following key areas:

- He aimed to capture images at regulated and timed intervals that were proportionate to the distance travelled (in a similar manner to his graphic inscriptors) (Braun *Picturing Time* 66; Dagognet 98). This was achieved by a rotating slotted-disc shutter that set the systematic intermittency (Braun *Picturing Time* 64).
- The images were taken using a single-point perspective, evading the need for the viewer to mentally reconstruct the intermediate phases of a movement. Marey wanted to accurately represent the trajectory of the movement, circumventing Muybridge's approach which in his view caused "deplorable confusion" for the viewer (Braun *Picturing Time* 53).

- The result was to be measurably precise, capturing movements at the rhythm of their own speed, producing the twelve images required for synthesis[26] (Braun *Picturing Time* 61; Dagognet 93).

Although Marey's representational format produced with this gun resulted in a single image (a format seemingly reminiscent of the "Renaissance canon of a single frame"[27]), the content of those images and how he combined Muybridge's notion of simultaneity with his own systematic approach offered the viewer a new vision, one that Braun emphasises went "beyond sight" (*Picturing Time* 66). To illustrate this notion, I analyse two of Marey's chronophotographs.

2.6 An assessment of Marey's multi-exposed image format

In fig. 9 and fig. 10 below we see two versions of images produced by Marey's fixed-plate chronophotography[28], taken a year apart. Fig. 9 is the first multi-exposed image that appeared in *La Nature* and *Scientific American* in 1882, displaying what looked like several men running in a line; it was in fact multiple versions of the same figure in the different phases of a run, captured over a short period of time. Fig. 10 pictures Marey's assistant, Georges Demeny[29], walking (1883); captured in a similar manner to the 1882 image, but incorporated some advancements with the new capabilities of his fixed-plate technique. Initially, Marey's 'new' images were difficult for the viewer to decode. Braun explains that the difficulty in reading these images was due to how society was pre-conditioned by Renaissance and Western pictorial conventions – the convention that what we see in a frame represents a *single moment* in time and space (*Picturing Time* 66) – for example, an image of a landscape or a reclining figure. This convention was further reinforced by early use of the camera that depicted similar subject matter in this way. Marey's 'new' images forced the viewer to evaluate intellectually what they were seeing, and to shift their method of reading images to a vision that went *beyond sight* – into a new mode of thinking (Braun *Picturing Time* 66).

Although the viewer was required to actively decipher the content of these images, movement did not need to be mentally reconstructed by the viewer, as was required by Muybridge's sequence of images. The sequential structure of Muybridge's representations lacked the continuity and flow represented in Marey's superimposed images. Once the subject was understood from Marey's superimpositions, movement was no longer questioned, and his photographic image presented the most accurate depiction of an action at precisely timed intervals.

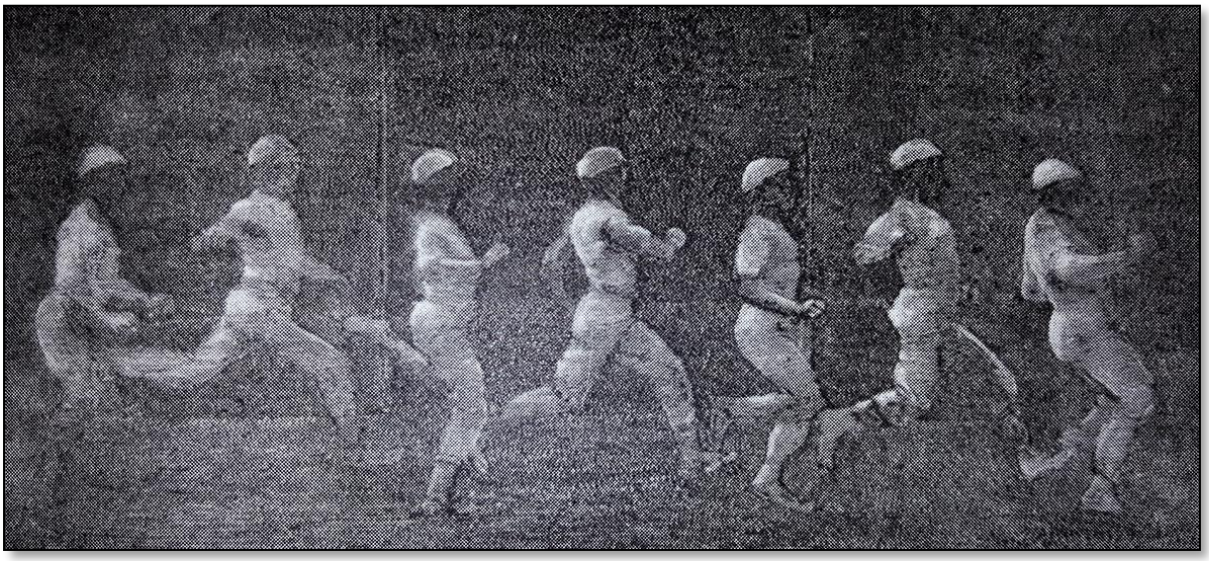


Fig. 9. Subject running in front of black background: "similgravure" made from chronophotograph, *Scientific American,* September 1882 (Braun *Picturing Time* 65).

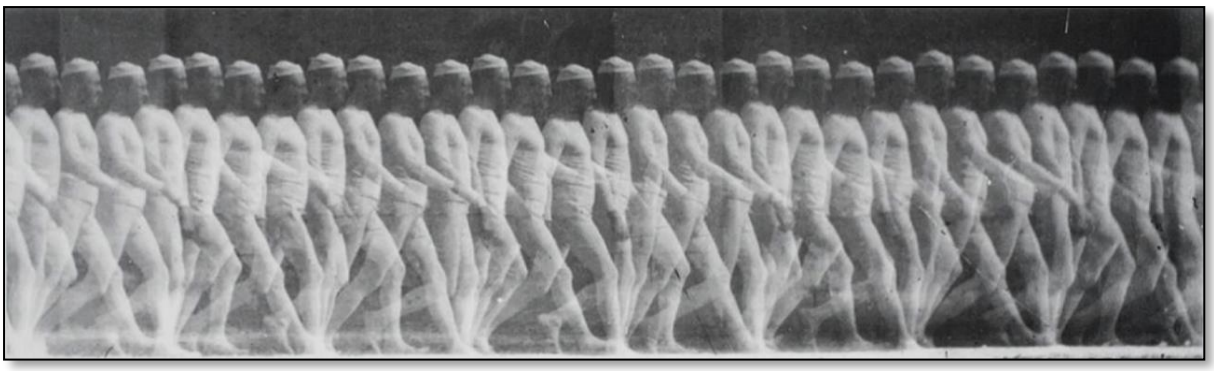


Fig. 10. *Demeny walking,* 1883 (Braun *Picturing Time* 81).

It is evident in these two images that by improving his photographic process, Marey was able to capture an increasing amount of figures in a shorter amount of time. However, this advanced process caused an overlapping of the figures that eventually began obscuring the

movement, making them unclear and difficult to decipher. To circumvent this, Marey developed a unique system of transforming his subject into a graphic representation by visually removing the flesh and volume of the body in the image to create focus on the joints and limbs – the parts of the body responsible for movement. He did this by clothing his subject in black (against a black background), marking his joints with metallic buttons, and connecting them with metal bands – thereby inventing the opportunity to photograph a "moving skeleton" (Braun *Picturing Time* 81). This method of simplification meant that Marey could increase the number of photographs up to one hundred per second, thus providing a more detailed representation of the mechanics of movement (Braun *Picturing Time* 81).

These 'geometric chronophotographs', as seen in fig. 11 below, focused on scientific evaluation, but they subsequently also provided the visual language of abstraction in Modernism, in particular Avant Garde art which was only explored some twenty years after their first appearance by artists like Marcel Duchamp and the Futurists[30]. As an animator (over a century later) I find this visual language both captivating and enlightening, as it illustrates the position of a joint and limb on each frame of a walk cycle – the flow, poses and timing of the movement. The graphic lines are comparable to a character's 'skeleton rig' – revealing the position of the joints and how these affect the flow and arcs of a movement. The representation is immediately recognisable and informative to our process, furthering the animator's understanding of locomotion in an analytical manner.

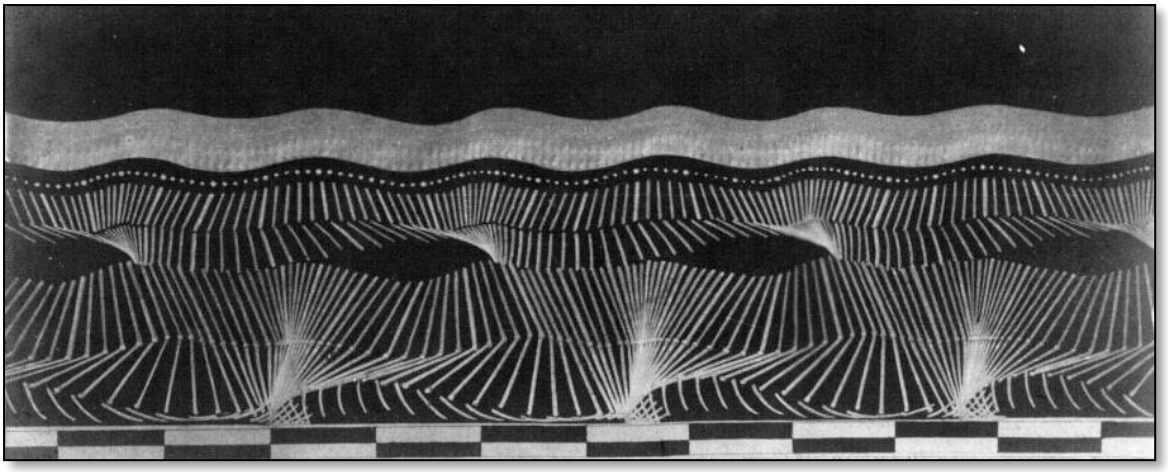


Fig. 11. *Joinville soldier walking*, 1883 (Braun *Picturing Time* 84).

Muybridge and Marey's opposing approaches to chronophotography inspired artists in different ways. Rabinbach states that "Marey's texts are embedded in the language of nineteenth-century science, but his images belong to the canon of twentieth century art" (115). In this section I address key debates and considerations of how the work of these two chronophotographers was received by artists and how it influenced their artistic practice, as these questions inform the direction of my creative practice and thought processes as an artist and animator.

2.7 Chronophotography and artistic practice

The first debate provoked by Muybridge's images of *The Horse in Motion* was the question of the camera's truth versus artistic truth. Braun discusses how acceptance of the camera's new version of reality was not universal, and how Georges Guéroult, a critic for the *Gazette des Beaux Arts,* questioned whether artists should depict movement as they see it (with the unaided eye) or as chronophotography has revealed it (*Picturing Time* 272-275). The first example I use of artistic truth is that of the galloping horse, a subject which in nineteenth-century Western society maintained a high symbolic status and was often represented in equine art (Mayer 90). Until this time, artists had been working within certain conventions established by their predecessors (Scharf 189). For example, in Théodore Géricault's *The Epsom Derby* (1821) (fig. 12 below, left), the artist depicts horses in action using the 'flying-gallop' technique, a convention that has been traced back to Mycenaean art over a millennium ago (Edgerton 179). This pose was directly related to Stanford's 'unsupported transit' theory that Muybridge was to prove photographically. However, Muybridge's image showed the horse with its legs tucked under its body in this phase of movement (fig. 12 below, right), rendering Géricault's image technically inaccurate. According to Marey, chronophotography revealed the undisguised truth – the "ugly" that offends the eye (Marey 183). This is why many artists chose to represent the movement in a different way to how chronophotography had revealed that it occurred.

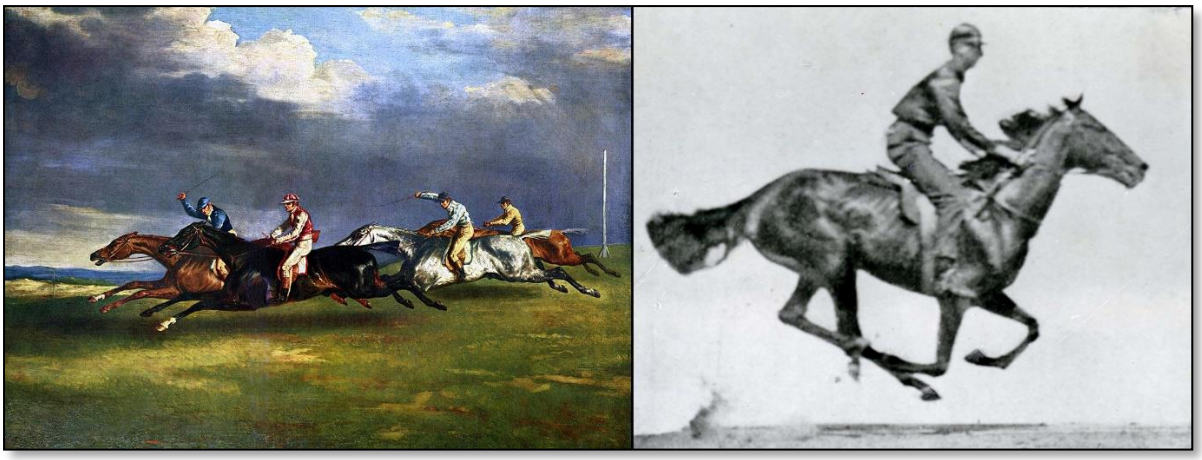


Fig. 12. Left: Théodore Géricault, *The Epsom Derby* (1821), painting (WikiArt.org Visual Art Encyclopedia); right: Eadweard Muybridge, *The Horse in Motion, c*hronophotograph (Cook, David A. *History of the Motion Picture,* Britannica.com, image courtesy of the British Film Institute).

Despite many artists rejecting chronophotography as a source of reference, others that celebrated positivism[31] embraced the accuracy revealed in chronophotographs, and used it as a reliable resource for their work. The scientific objectivity appealed to their desire to remain 'true to nature'. Artists like the French classical painter Ernest Meissonier "sought after the greatest possible degree of 'truth' in his work", and even went back to correct several of his famous historical paintings after consulting with the evidence offered by chronophotography (Mayer 98, 111).

Marey believed that artists could draw on chronophotography to "sharpen the visual acuity of painters and sculptors" (Braun *Picturing Time* 265). Although not an artist himself, he was keen to support the arts by providing reference material achieved through chronophotography. In 1893 he and Demeny published *Du mouvement de l'homme,* which was conceived as an artist's handbook (Braun *Picturing Time* 268). In addition to this, in his book *Movement* (1895) Marey dedicated a chapter to "Locomotion in Man From an Artistic Point of View", where he notes the example shown in fig. 13 below. On the left, an ancient Greek vase depicts "swift" runners in poses that are physiologically impossible[32], while on the right, instantaneous photography represents the "actual attitudes assumed" by the human body while running (Marey 180-171).

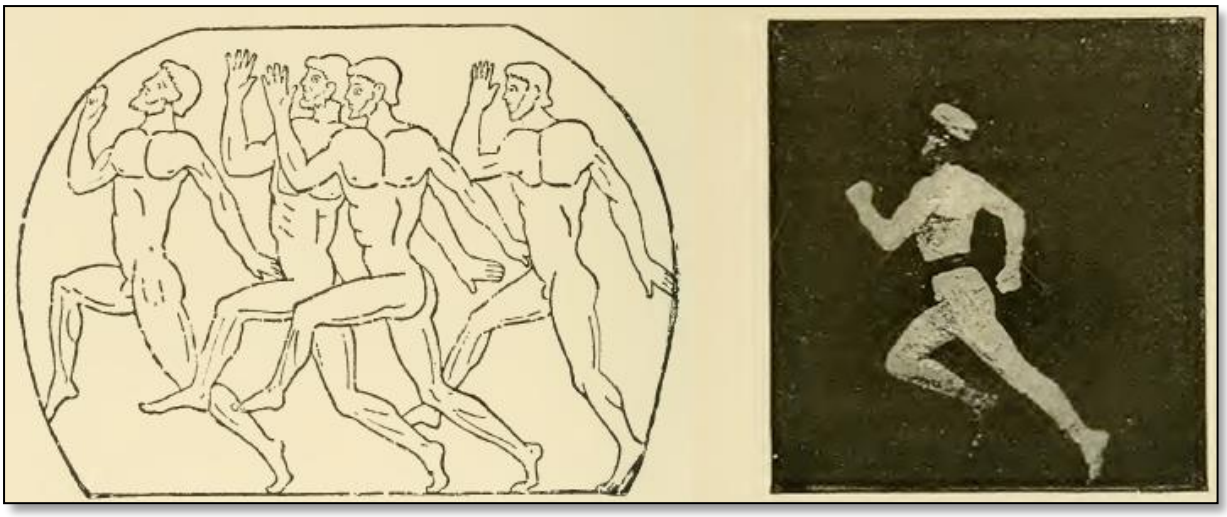


Fig. 13. Left*:* Swift runners from a Greek vase; right: Instantaneous photograph of a runner: the position of the legs is the same as that of the man on the extreme left of the vase illustration. (Marey *Movement* 170-171).

Another stream in support of 'artistic truth' lay in the clarity of the image. Guéroult made an additional observation in his discussion: that blurred images of moving figures were more characteristic of optical truth (Scharf 189). Joseph Pennell supports this notion, by giving the example of when Impressionist artists tried to simulate movement (specifically of a horse and carriage); they appeared as though no action was present, but once the artist added blurring to the spokes, the feeling of movement was restored (qtd. in Scharf 190). It can clearly be observed in Muybridge's sequences that the illusion of 'arrested motion' is evident – the figures seem suspended in time, where movement is not evident in each frame, only when viewed as a sequence. However, Braun states that the human eye perceives a fluid, blurred movement, never pure instants of immobility as Muybridge's camera did (*Picturing Time* 282). This led to the notion that the artist should represent movement as an 'ensemble' – the way we see it with the naked eye – arguing that the camera is only capable of suppling the viewer with incremental parts of the movement, the truth of detail that is imperceptible to the naked eye.

Artists working in this arena stressed the importance of art remaining subjective, as opposed to the objective nature of science. Artist Paul Souriau supported Marey's theory that artists should consult the truth revealed by chronophotography, but that they should make a choice on how to represent it. Souriau advocated for the aesthetic pleasure we take

in movement, and that an artist should *suggest* movement in their representations, not copy it (Braun *Picturing Time* 276). Souriau's enquiry entitled *L'esthétique du movement* (1889) preceded the Futurist manifesto of 1910 which echoed the same sentiments. Braun presents Souriau's values, that aimed to enlighten artists to realise that the seeing eye perceives a flying bird with four wings, not two, and a trotting horse with at least eight legs, not four – a result of rapid, alternating movement where each phase of oscillation remains on the retina long enough so that 'multiple' limbs are seen (*Picturing Time* 276). Although Souriau advocated for the use of chronophotography as a resource to achieve accurate artistic depictions, he suggested that in order to capture a sense of movement, the artists should make choices based on a subjective response. Braun discusses how he wrote that movement should be "suggested through a vivacity of stroke, a softness of outline, and the inner organisation of the painting itself" (*Picturing Time* 276). These kinds of approaches led to the expressive language of abstraction in art that was adopted by the Cubists and the Futurists[33] twenty years later.

In *Movement*, Marey presents Demeny's fencer (fig. 15) as an example for identifying the most characteristic phases of a movement for artists (177). In animation we refer to these as the 'key poses', which are fundamental to identify at the start of the animation process and for clarity of the action. Marey's observation directs the reader to Demeny's images to illustrate his point, because of the way they differ from his own. Demeny's images highlight the prominence of the "well defined positions" (or, as I call them, 'primary moments') due to the boldness of the longest exposures, in contrast to the blurred intermediary phases (Marey *Movement* 177). However, Marey's images contain "sharp and distinct" contours on every exposure, making the primary moments less identifiable (Braun *Picturing Time* 268).

The Czech artist František Kupka, who was associated with the circle of the Salon Cubists (Dalrymple Henderson 323), completed a pastel study called *Woman Picking Flowers* in 1909 (fig. 14), which echoes Marey's recommendations. The work depicts a female figure reduced to outlines in the progressive action of picking flowers. The figure is repeated throughout the action, with each figure superimposed, creating a kinetic dimension. The

simplification of the figure could be attributed to attaining clarification of the movement itself. As per Marey's suggestion, Kupka identified the three 'primary moments': sitting, standing and leaning, and emphasises these through colour and contours in a similar manner to Demeny's fencer (Braun *Picturing Time* 284).

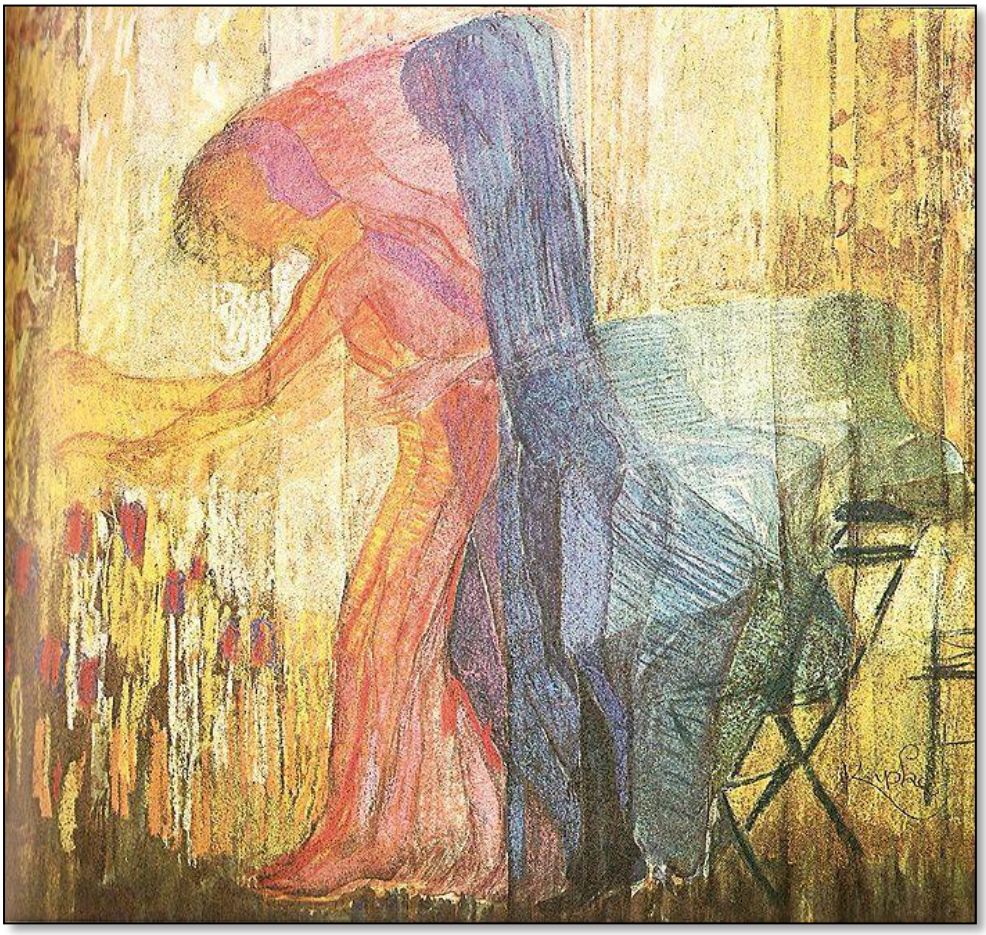


Fig. 14. František Kupka, *Woman Picking Flowers*, 1909 (*WikiArt.org. Visual Art Encyclopedia*).

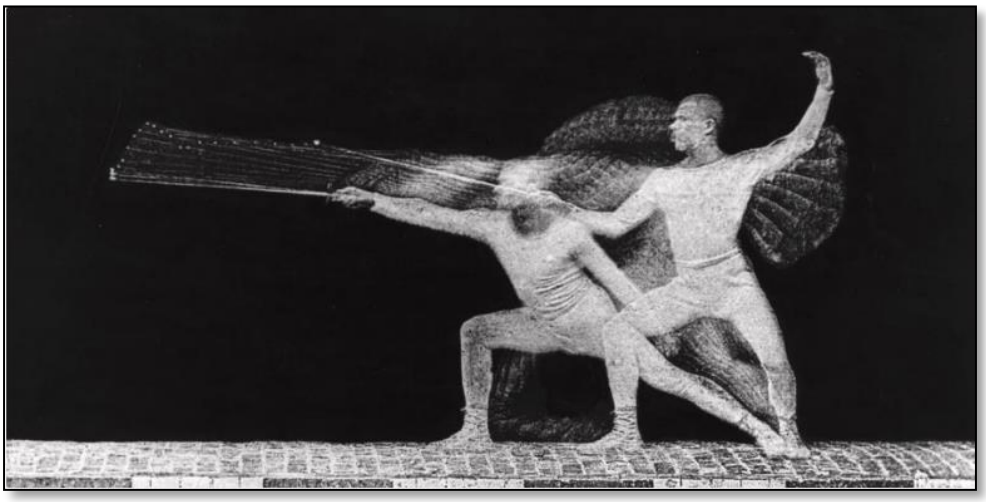


Fig. *15*. Demeny's *Movement of a Fencer,* 1890 *(Braun Picturing Time* 270).

Kupka has chosen to represent progressive movement using the multi-exposed chronophotographic style, but introduces a gradation of colour as the body moves through the poses. In most digital animation software, the representation of movement in time is treated in a similar way, by means of a tool that is referred to as 'ghosting' or 'onion-skinning'. The tool allows the user to see semi-transparent representations of an object on every frame (or a selected range of frames). The user can specify the appearance of these representations according to the key's[34] position on the timeline, by customising the visual properties of those time selections. For this, the user can specify transparency, colour and animation types (i.e. keys or in-betweens[35]).

In fig. 16 a version of the onion-skinning tool is shown. Lendenfeld's OnionSkinRenderer is a plug-in extension to Maya's Standard Viewport 2 renderer. This plug-in is an extremely useful tool for animators who find value in assessing their key poses and in-betweens visually. For some animators this approach to animation helps them to visualise the movement of a character, akin to Marey's multi-exposed images. Not all animators see the value in this method of working[36]; however, for some (like myself) it is incredibly useful. The choice of some animators to use this tool could offer further insight as to why some modern artists chose to represent movement using a similar approach in their work. Kupka's reasoning for creating *Woman Picking Flowers* was because of the frustration he experienced when attempting to paint his wife's daughter throwing a ball, and experiencing the inability to capture a sense of movement. This prompted him to experiment with a series of pastel drawings, that resulted in the work above (Braun *Picturing Time* 282).

Some animators struggle to visualise how movement looks *between* poses, and the onion-skinning tool makes this clearer. In addition to this, the timing of an action can be visually assessed using this technique – akin to Marey's systematic method of capturing precise intervals. Each increment on the animation timeline characterises the purpose of Marey's slotted-disc shutter, that established the regulated and timed intervals of his exposures.

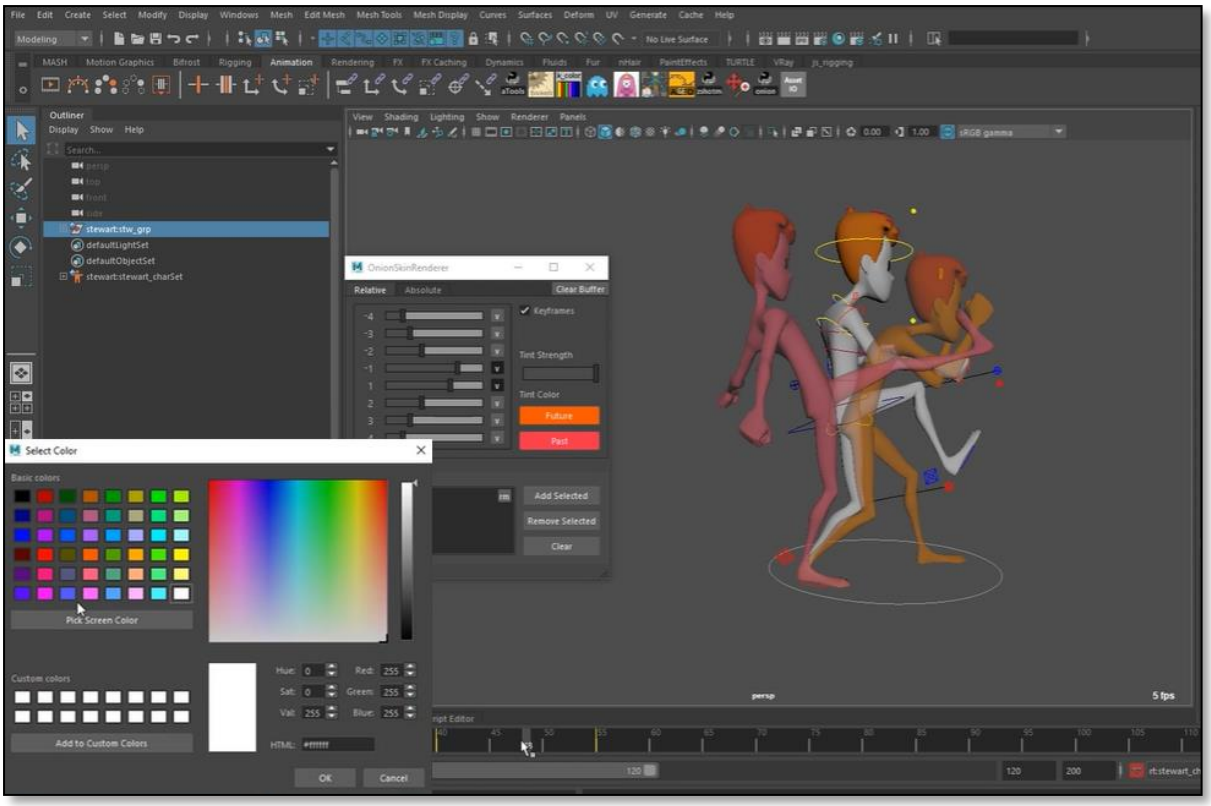


Fig. 16. Lendenfeld's OnionSkinRenderer plug-in extension to Maya's Standard Viewport 2 renderer. The screenshot demonstrates how the user can specify representations of time in the future and/or past, and how the visual properties of those time selections can be customised by colour, transparency and animation types (keys or in-betweens) ("New Onion Skin Tool for Maya Works as a Viewport Extension").

Both Marey and Muybridge's chronophotographs influenced many modern artists interested in the representation of movement in their work. In his article "Marcel Duchamp's Nude Descending a Staircase [No. 2] and The 1913 Armory Show Scandal Revisited", Michael Taylor presents an argument for Marcel Duchamp's *Nude Descending a Staircase, No. 2* as being influenced by plate 137 of Muybridge's *Animal Locomotion* series (see fig. 17 and fig. 18 below). He makes a keen distinction in the posture as an obvious reference for the work leading up to the painting, an oil sketch entitled *Nude Descending a Staircase (No. 1)* (Taylor 57). He explains how the Nude [2] was further influenced by the chronophotographs of Marey that were published in *La Nature* in 1893:

> The distorted, accordion-like appearance of the subjects found in Marey's chronophotographs are mirrored in the repeated abstract forms of Duchamp's machine-like descending nude, whose body has been reduced to a series of flattened planes and linear elements through a process that the artist later called "elementary parallelism". (Taylor 58)



Fig. 17. Marcel Duchamp, *Nude Descending a Staircase, No. 2,* 1912, p*ainting (*Fleuriet *The Grand Old Lady of Modern Art* page preceding page 1).

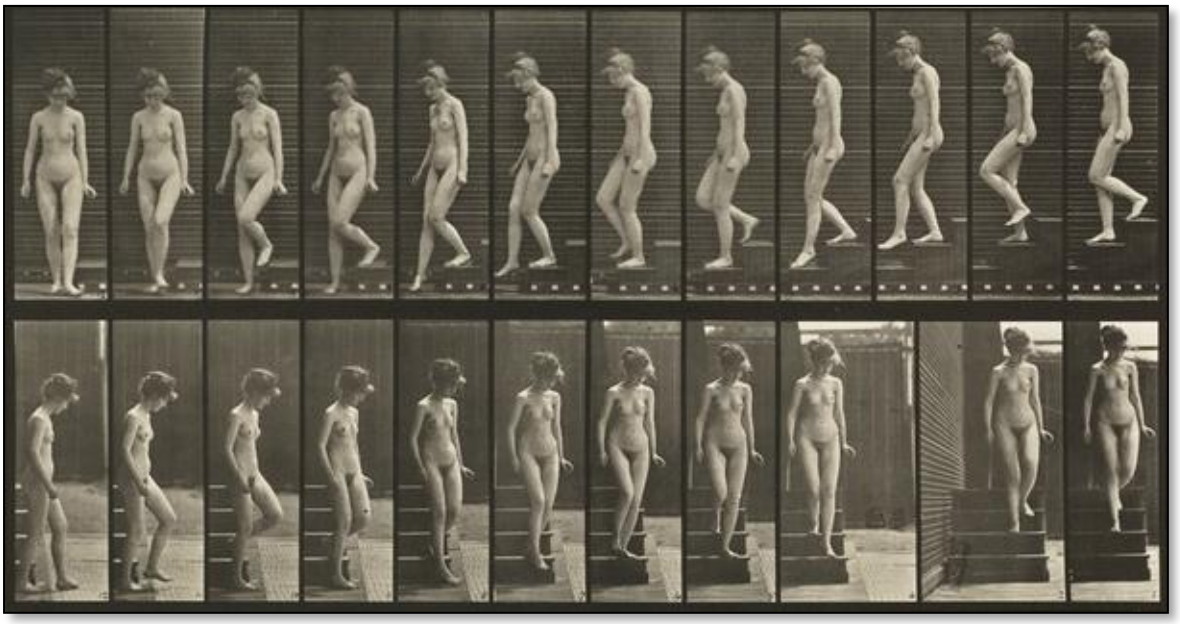


Fig. 18. Plate 137 - *Descending stairs and turning around,* 1887 (Muybridge *Animal Locomotion*).

In addition to Taylor's observations, Braun also notes the lack of colour in Duchamp's *Nude* that heightened its graphic quality, and states that Marey's "geometric chronophotography" inspired the dotted lines that articulated the joints and fanning of the legs in the painting (*Picturing Time* 291). Duchamp's approach to representing movement and his newly established visual language in the *Nude* reinforced the notions of painting as a cognitive[37] endeavour, where artists drew inspiration from other fields like chronophotography, but used them in various dynamic ways. There is an abundance of examples of how modern artists have used aspects of chronophotography in their work. The works of Giacomo Balla, Anton Giulio Bragaglia and Natalia Goncharova (to name a few) have been covered extensively by Braun in her chapter "Marey, Modern Art, and Modernism" (*Picturing Time* 264-318) and unfortunately cannot be included in the scope of this study.

Muybridge's images also had a significant impact on later generations of contemporary artists[38], especially those working in the medium of photography (Grunberg 8). In his book *How Photography Became Contemporary Art* (2021), Grunberg states that Muybridge's action studies fitted "Conceptual Art's interest in seriality like a glove" (8). For instance, Sol LeWitt went from incorporating Muybridge's figures directly into his works, to using them

more conceptually (Grunberg 58). These two distinct approaches can be seen in *Run IV* (1962) and *Serial Project, 1 (ABCD)* (1966) (fig. 19 and fig. 20 below).

In *Run IV* the viewer is confronted with linear repetitive text and images in bold colours. LeWitt uses semiotics to present the 'signifier' and the 'signified': the runner (derived from Muybridge's images) and the word 'run'. This focuses the viewer's attention on the action and the suggestion of movement from A to B (Neves 160). LeWitt has detached the image from its context, and exploited the formal presentation of Muybridge's grid-like linear layout, but removed the progression of movement from Muybridge's original work. Instead, the repetitive figure in a single phase of the motion is represented in an open-ended, repetitive interpretation of the concept of running (Neves 160).

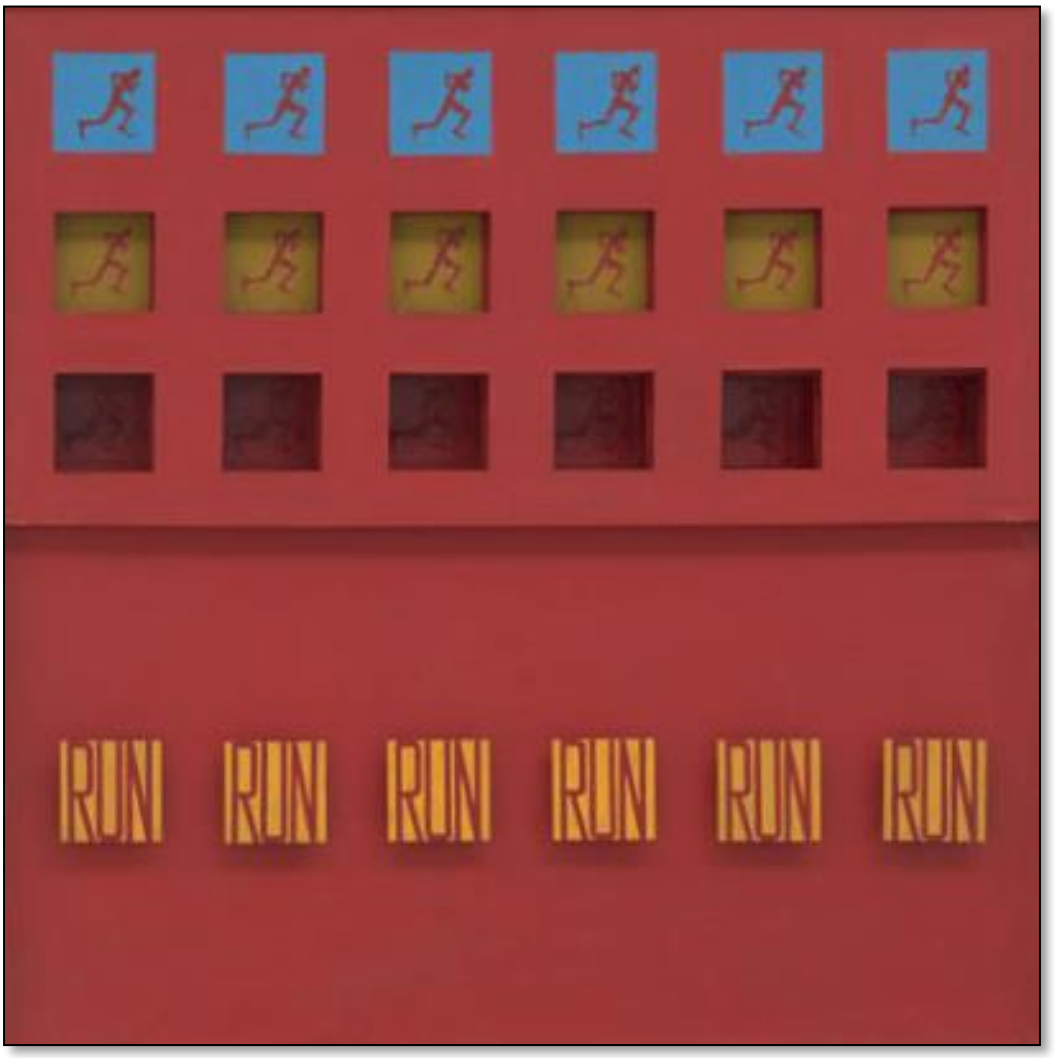


Fig. 19. Sol LeWitt, *Run IV* (1962), oil on canvas and painted wood (LeWitt Estate / Artists Rights Society, New York).

In contrast, *Serial Project, 1 (ABCD)* is an interactive piece that consists of simple geometric cubes laid out on a grid on the floor. LeWitt challenges the viewer to engage with the forms, deciphering their connections through an implicit set of rules based on viewers' understanding of a series (Grunberg 58). The viewer must look beyond what they see and read his instructions in order to unpack its meaning. There is no visual link to Muybridge's work as in *Run IV*, but its serial logic has informed the model for this work. Chronophotography has therefore been used conceptually in these works, drawing on similar understandings of seriality and multiples in order to derive meaning.



Fig. 20. Sol LeWitt,. *Serial Project, 1 (ABCD)* (1966), baked enamel on steel units over baked enamel on aluminium. (Sol LeWitt/Artists Rights Society, New York).

There are numerous other examples of ways in which chronophotography has inspired contemporary artists, which deserves a study of its own. Paul St George's curation of the visual art exhibition *Sequences* as well as the publication *Sequences: Contemporary Chronophotography and Experimental Digital Art* serves as evidence of this need. St George states that the idea for the exhibition arose when he was researching the nineteenth century inventions that "produce images and ways of viewing images that would increase our understanding of time and movement" (1). His contribution to this topic in the field of

contemporary visual art and academia is significant, and has strongly influenced the approach to my research as well as having increased my understanding of how chronophotography can impact artistic practice.

2.8 Chapter conclusion

In concluding this chapter, Braun states that "Muybridge's artistic language, the syntax of conventions he uses to portray his narratives, is realism. In the conventions of realism, the real is equated with the visible" and to direct the viewer's attention to "ideas contained in the work, seen as if through a window" (*Picturing Time* 252-253). Braun asserts that Muybridge's camera imitated the real world – what figures actually looked like – in a moment frozen in time. She acknowledges that his images are able to enrich our vision through capturing things that normally go unnoticed – something that I don't believe would have been possible without his innovations in high-speed photography, which captured the fleeting and the ephemeral.

I support this notion by recognising that each of Muybridge's individual images in a sequence display a clear, high-quality photograph of a body suspended in time, similar to standard photographic practice. I also note that outside of the entire sequence of images, movement is not apparent – each image represents a single moment in time and space. His images appealed to artists wanting to be 'true to nature' by 'sharpening their visual acuity', and replicate reality. Braun furthers her argument by stating that these elements inherent in Muybridge's work provided the conditions for cinema to emerge (*Picturing Time* 255).

However, in addition to these insights on Muybridge's relationship to realism, I propose that we consider the ingenuities inherent in his work and what sets him apart from others in his field. Through the novel presentation format of Muybridge's sequences, he initiated the analytical role of photography. He presented us with unprecedented, high-quality and detailed images of movement in a way that had never been seen before. This allowed artists to rethink the representation of movement and to question their relationship to time.

Muybridge's sequences also brought attention to our position as a viewer. His images demanded that we transform from passive viewer to active participant, becoming a 'conscious collaborator' – one that questions the layout, ordering and content of his images. Muybridge's images also force us to consider how we derive meaning from these arrangements.

As an animator and an artist, I have recognised opportunities for further expansion of Muybridge's techniques in a contemporary medium, and in this chapter I proposed a new aesthetic reading of the *Animal Locomotion* series. I emphasise that his work was never meant to be about the single image and must be understood and evaluated through image sequences. This is Muybridge's stylistic signature, and a fundamental property of my creative practice.

Although Marey's multi-exposed images are contained within a single frame, they do not reflect the traditional photographic practices of the time (Braun *Picturing Time* 254). Marey was able to design a chronophotographic process quite unlike Muybridge's, in order to capture an accurate, measurable and fluid expression of time, space and motion in a single image. The content of his images went far beyond the representation of the real – they questioned vision itself and encouraged a 'new' mode of *seeing*. His images extended past our human capabilities to examine the fundamental characteristics of movement in its own right. He developed a system that was measurably precise and extremely fast, using single-point perspective. He adopted a method of simplification to focus solely on movement – his geometric chronophotographs (graphic renderings of movement) – that challenged realistic notions of the medium of photography so that, in his words, "the illusions of the senses [have] faded but it has made way for the satisfaction of the intellect" (Marey qtd. in Braun *Picturing Time* 254). His "overlapping forms effectively destroy[ed] the Renaissance canon of the single frame", using the camera to work against a code of perspective (Braun *Picturing Time* 254). His work appealed to artists wanting to be 'subjectively expressive' and to represent movement in their respective practice, which they did by importing Marey's syntax of movement into the visual and expressive language of abstraction.

Marey's research also played an important role in revolutionising the science of labour, transforming how manual labour was executed in the workplace (Braun *Picturing Time* 320). Marey focused his later research on understanding the laws that govern the conservation of energy, so that productivity could be improved. During the Industrial Revolution time began to be measured against efficiency and output (Solnit 180). Many innovations[39] contributed to this notion, and systems like Taylorism (which focused on the division of manufacturing tasks into brief, simple movements to decrease the time required to produce tasks) became immensely popular (Solnit 212). The development of machinery aided this process, further increasing production and economic output. Taylorism had a significant influence on the animation industry, which will be discussed in detail in Chapter 3.

In this study I endeavour to use the opposing approaches and presentation formats of Muybridge and Marey to inform my practice, and draw upon their techniques to answer the question of how to reveal the construction of animation for an audience. I consider the implications that their techniques and approaches have on viewer interaction, and I ask whether revealing this movement could add to the discourse of chronophotography in contemporary arts practice.

In the next chapter I look at two key role players in the development of studio animation practice, and evaluate their approach to motion representation in the animated medium.

Chapter 3

An Aesthetic Evaluation of Motion Representation from the Golden Age of American Animation

In this chapter I unpack the visual language of animated movement and explore modes of movement representation from two of the key role players in the emergence of animation practice – the Disney Studio and Warner Bros. Studio in the Golden Age of American animation. I evaluate their varying approaches by assessing them against the chronophotographic practices of Muybridge and Marey. I present the Disney Studios' most significant innovations in the representation of movement, and argue how this approach aligns with Muybridge's syntax of cinematic realism, or "verisimilitude"[40] and classic Hollywood cinema. I also examine the Warner Studio's deviations from the Disney 'code' with their dynamic advances in motion representation, and argue for the relationship between 'Mareyism' and the Warner style, where both approaches resulted in a unique form of graphic abstraction within the realm of believability. By applying a chronophotographic understanding to these innovative modes of movement representation during this era of animation production[41], I use these observations and evaluations to inform my creative practice and consider how exposing these techniques could influence viewer engagement.

I stated in Chapter 2 that the creation of animated movement is informed by observational practice and then creatively adapted to suit a stylised character. In orthodox animation[42] each movement has a purpose, is often narrative driven, and serves to entertain or educate an audience. As animators we breathe life into our characters by creating the illusion of thought, emotion, and personality, using a number of strategies and design principles. I argue that central to all of this is *movement* itself – *how* a character moves informs the performance and subsequent reading of the work. Without movement, animation cannot exist. But this process of analysing movement through close examination and interpretation was not the standard approach at the onset of the medium, and in this Chapter I interrogate how this approach came to be adopted by animators.

3.1 Early animation and focus

In their book *The Illusion of Life: Disney Animation,* animators Frank Thomas and Ollie Johnson reflect on the Disney Studios' innovations*,* stating that early animation[43] was considered "crude" and contained no awareness of how things moved in reality: "If an arm had to encircle a large object, it merely was stretched until long enough to do the job" (35). Characters' movements did not flow, there was no understanding of their weight or even of anatomy, and time-saving techniques[44] were commonplace. For instance, the technique known among early animators as 'rubber-hosing' became popular as it offered 'great charm' to the animation:

> There was no movement in the figures in early animation besides a simple progression across the paper. No one knew how to get any change of shape or flow of action from one drawing to another. There was no relationship of forms, just the same little cartoon figure in a new position on the next piece of paper. One solution to this stiffness of action was to conceive of a figure's appendages as sections of a garden hose. Since no one knew anyhow where bones and muscles might be on a cartoon figure, this worked well—giving great looseness and a fluid movement. There was no suggestion of realism because the concept of the character was not one of realism. This type of movement fit the design perfectly and brought about some funny action and great charm. (Thomas and Johnson 45).

this approach was limiting in terms of creating expressive movement and character development, requiring further innovation to advance the medium.

In her essay 'Animation and History' in Beckman's *Animating Film Theory*, Esther Leslie[45] explains that the history of animation is complex and "too obviously manifold to set upon a single line of development" (Location 765). She elaborates on how notions of animation start and stop in many places throughout the medium's history, encompassing numerous techniques and approaches. This makes it challenging to present an all-inclusive history, without it being a study on its own. I argue that it is also dependent on how the individual places focus on their understanding of the medium. One approach is to focus on the fundamental characteristics of performance for entertainment purposes – the way we consume animation. This can include a narrative focus and how the design of the animation

supports storytelling. Another approach is to focus on the frame-by-frame movement which addresses the physical form and mechanics of the medium – the way in which animation is created.

As a character animator, I chose to focus on a specific era of American animation history known as the 'Golden Age of animation', as it underpins the fundamentals that inform 'character', personality and narrative. More importantly for this study, it is the period that produced the most significant advances in the representation of movement in character animation – advances that continue to influence contemporary cinematic animation. Prior to this era, animation "was full of weird, twisted, surreal versions of the world" (Thompson "Meep" 38). While these representations of movement in the work of early animators were certainly very dynamic and intriguing, my interest is in animated movement that has its foundations in the real: How can a character's movement be represented in a graphic medium as something innovative, vibrant, and independent from live-action film, but still be considered mimetic? Thompson argues that the animation 'revolution' happened in the 1930s when studios like Disney and Warner began to flourish ("Meep" 38). In an assessment of the reception of animation in France in the 1930s, Kristian Moen summarises the criticism of animation of this time as "a new mode of expression", "one of the highest, if not the highest, expressions of cinematic art", and "the richest, freest form not only of cinema, but of spectacle" (9). This is the focus of Esther Leslie's book *Hollywood Flatlands: Animation, Critical Theory and the Avant-Garde,* that brings attention to the links between animation, the avant-garde and modernist criticism. It was a time when animation was at the crux of its expressive and artistic possibilities.

This marks the start of the Golden Age of American animation, which began with the emergence of cartoons with sound in 1928, with Disney's *Steamboat Willie,* and ended in the 1960s when theatrical animated shorts began to lose popularity to television. I argue that in this era of animation history we can begin to evaluate how character animation and the design of a movement were being explored, with certain directors pushing the boundaries of what could be achieved by using innovative mechanisms and approaches.

In his article on the Roadrunner series “Meep Meep” (a Warner cartoon created by Chuck Jones), Thompson states how animation is a visual medium, with the ‘image’ being the central idea and the key ‘unit of meaning’ for assessment (43). He relates these images to Surrealism, as a medium that provokes thought and forces us to examine their meanings – a “visual criticism project” (43). This chapter echoes this sentiment, by examining visual methodologies emanating from the two most prolific and influential animation studios from the Golden Age: Walt Disney Productions[46] and Warner Bros. Cartoons[47]. In this discussion, I concur with animation theorists that while the ‘Disney style’ was innovative and to some degree established the medium, it placed an emphasis on mimicking cinematic realism and other elements rooted in the language of classic Hollywood cinema. I further this notion to suggest that the ‘Disney style’ of animation mirrors Muybridge’s chronophotographic syntax of realism which I discussed in Chapter 2, as work that is reliant on conventions that are recognisable in the real world for understanding. In contrast to this, I then discuss how directors at Warner Bros. Studio deviated from Disney’s mimetic realism by creating a fresh animation style, when the potential for something new in animation was yet to be discovered. I consider how experimentations[48] in motion representation by the Warner Bros. animators paralleled Marey’s innovative use of superimposed images, thereby extending the visual language of abstraction into the animated medium. I therefore examine the two different repertoires of animation techniques emanating from these two studios in order to define their significance in the advancement of animation practices.

The Disney Studio, led by Walt Disney, have always been well respected for ensuring the level of craftsmanship and technical development which they brought to animation. The Disney name has become synonymous with quality, because the company is known for producing a refined product that is based on a formula that took skilled animators decades to perfect. Walt’s critical influence, dominance in discourse and commercial success in the animation industry have been extensively analysed by many animation scholars, notably Donald Crafton, Michael Barrier, Richard Schickel and Paul Wells, to name but a few. My intention in this study is rather to focus on key aspects pertaining to the visual style of the Disney Studio that focuses on motion representation, which I use as a point of reference for critiquing the Warner Bros. approach.

Operating in a very different environment, the Warner Bros. Studio animation directors, such as Fred 'Tex' Avery and Charles 'Chuck' Jones, transformed the animation landscape by introducing dynamic abstraction of animated movement. Avery's philosophy of "anything can happen in a cartoon" informed his focus on absurdism and abstraction, while Jones emphasises character personality and logical development of a single premise. Their different approaches gave rise to what many scholars regard as the most subversive animation of this era (Thomson "Meep" 38-39). Drawing on and reacting against the Disney Studios' innovations, the Warner animators set themselves on a different path, resulting in some of the most influential work in animation. Luca Raffaelli, in his article "Disney, Warner Bros. and Japanese animation" in Jayne Pilling's *A Reader in Animation Studies*, points out that the work of the "Warner writers was a direct reaction to the language and basic themes of Disney" because of the way animation developed, with Disney at the forefront of most of its development (122). My evaluation and examples emanating from the Warner Bros. Studio typically focus on the efforts of director Chuck Jones, because I believe that he created the Warner style's most distinctive characteristics.

3.2 Innovations at Disney

The Disney Studio was prolific in many innovations that advanced animation production. As a character animator and with a key interest in the representation of movement, I concentrate my discussion on the development of what the Disney Studio called the "twelve principles of animation". These animation principles were developed to help animators to create a sense of believable movement. In their book *The Illusion of Life: Disney Animation*, senior animators Frank Thomas and Ollie Johnson recall how the need for these principles came about, and how they were developed at the Disney Studio (47). The principles began as terminology to describe animation procedures that were regularly used among the animators, and were then refined as part of a collective effort. These discussions and experimentations resulted in a number of techniques that produced what Thomas and Johnson describe as a "fairly predictable result" (47). They began to teach these principles to new staff coming into the studio "as if they were the rules of the trade" (Thomas and Johnson 46).

These techniques proved to be so effective that they have remained virtually unchanged[49], despite the shift from drawn animation to contemporary digital animation. Contemporary film director John Lasseter presents the application of the principles to 3D animation in his paper “Principles of Traditional Animation Applied to 3D Computer Animation”, which was presented at SIGGRAPH (Special Interest Group on Computer Graphics and Interactive Techniques) in 1987. In addition, the leading online character animation mentorship programme ‘Animation Mentor’ focuses their instruction on the twelve principles, stating that these take into account the rules of physics while also equally considering important topics like the character’s appeal and the timing of the shot (see animationmentor.com). At the tertiary animation college, The Animation School, where I oversee all academic programmes, we also emphasise the fundamentals of these principles in the teaching of animation.

The twelve principles are very well known in the animation industry, but their importance to this study lies in how they address the visual representation of movement in order to instil what the Disney animators called ‘believability’ for the viewer. Thomas and Johnson explain how these principles emerged from observations of movement in real life, particularly those “composed of living flesh” (47). They found that by exaggerating the natural elasticity of the human body, their characters became more engaging and appealing. Because these attributes of elasticity imbued personality, the characters became more relatable and captivating to an audience. The terms realism[50] and believability are used interchangeably in Thomas and Johnson’s book, where they explain that Walt Disney directed the animators to aim for a "caricature of realism”, and would not accept any animation that “destroyed believability” (15, 34, 65-66).

Caricature, in Disney terms[51], is understood as a form of exaggeration that is grounded in reality. By applying the laws of physics, examining anatomy, and studying movement found in real life, the Disney animators believed that their characters became more believable, allowing the audience to identify with and “actually feel the emotions of a cartoon figure” (Thomas and Johnson 15). The internationally established scholar, screenwriter and director

Professor Paul Wells addresses the topic of realism in his book *Understanding Animation* (1998), where he assesses Disney's approach (35). In his argument, he states how the dominance of the Disney style overshadows other forms of animation that have "different creative impulses and aesthetic interests" (Wells 35). In this context, Wells defines realism in film (a definition he identifies as subjective and open to interpretation) as something that assimilates "lived experience" (24). He elaborates on Disney's approach in a "fake" medium[52] that "aspires to the creation of a realistic image system which echoes the 'realism' in live action film" (Wells 25). He discusses the key 'codes and conventions by which verisimilitude is achieved in Disney terms, and states that the more an animation deviates from these, the more it will demonstrate different kinds of approaches and purpose (Wells 26).

Wells' argument concurs with the approach explained by Thomas and Johnson, but places it in a broader context that highlights the challenges it brings regarding its dominance in animation practice. In this study on the representation of movement, I argue that Disney's approach of verisimilitude or caricatured realism is necessary to establish a model – a standard by which to measure advances in or deviations from the representation of animated movement. This is comparable to how Muybridge's images set the design and visual language of chronophotography, so that innovations like Marey's multi-exposed images could be recognised and celebrated.

There were a number of innovative observational strategies that were initiated by Walt Disney in supporting his drive for verisimilitude and to achieve higher standards at the studio (Thomas and Johnson 71). Animators received training in Fine Arts to develop their skills in anatomy. 'Action analysis' classes allowed animators to analyse short clips from live-action film by isolating movements and repeatedly running them backwards and forwards. Animators aimed to "sharpen their visual acuity" by examining Muybridge's sequential images, that they believed demonstrated movements of the body in action, and advanced their understanding of fundamental animation principles such as 'squash and stretch' and 'secondary action' (Thomas and Johnson 335). As informative as these strategies were, they

presented limitations and were found to be inadequate for creating more intricate movements and the convincing action required in the animated medium (Thomas and Johnson 319).

In Chapter 13 of their book, "The Uses of Live Action in Drawing Humans and Animals", Thomas and Johnson refer to the recording of live performances to inform their animation, rather than developing it from the "artist's imagination" as had been done until then (319). Rotoscoping was a common technique in early animation (invented and used extensively by Max Fleischer) where animators traced over live-action footage, frame by frame, to produce realistic representations of actions. This mirrored the technique Muybridge used for transferring his images of the horse in motion onto his zoöpraxiscope for his illustrated lecture tour throughout the United States of America and Europe to prove "the visual accuracy of his unfamiliar bodies in motion through re-animation" and attract wealthy benefactors (Gordon "Prestige" 84).

Using live-action performance to inform animation gained popularity at the Disney Studio during production of the feature-length film *Snow White and the Seven Dwarfs* (1937), because it demonstrated great possibilities for extracting character traits and personality from the movements of a live-action actor. Thomas and Johnson concur that the process was extremely helpful for understanding movement, and recognised it for its time-saving abilities, but felt that the principles were not directly applicable to animation (319). The Disney animators found that direct application of the live-action footage (as in rotoscoping) into animation resulted in muted motions and dull performances, making it "impossible to become emotionally involved with this eerie, shadowy creature who was never a real inhabitant of our fantasy world" (Thomas and Johnson 323). What was lost was their essential "illusion of life" (Thomas and Johnson 323).

Rather than directly tracing over the footage (as in the process of rotoscoping), the Disney animators adapted and used aspects from their analysis of live action that could enrich their animated cartoons, informing the idea of the character, gestures and attitude – any "idea

that could be caricatured" (Thomas and Johnson 320-321). The Disney animators found that the live-action footage revealed the intricacies of a movement – "the precious elements of life revealed by the camera" (Thomas and Johnson 322) – as Muybridge's first chronophotographs did for Stanford's audience. Walt Disney's approach (for the revised rotoscoping process) was to print each film frame for the animators to trace on a lightbox/animation desk, thereby 'freezing time' so that movement could be analysed (Thomas and Johnson 321). One could argue that in this process they were in fact making chronophotographic studies (sequential still images of movement) to inform their craft.

Thomas and Johnson describe the effect that these investigations of movement had on their understanding:

> We were amazed at what we saw. The human form in movement displayed far more overall activity than anyone had supposed. It was not just the chest working against hips, or the backbone bending around, it was the very bulk of the body pulling in, pushing out, stretching, protruding. Here were living examples of the "squash and stretch" principles that only had been theories before. And here was the "follow through" and the "overlapping action", the changing shapes, the tensions and the counter tensions, the weight shown in the "timing", and the "exaggeration" — unbelievable exaggeration. We thought we had been drawing broad action, but here were examples surpassing anything we had done. Our eyes simply are not quick enough to detect the whole gamut of movement in the human figure (321).

In the images below (fig. 21) we can see how the Disney animators used live-action reference during the production of *Snow White and the Seven Dwarfs* (1937). It is clear how the live-action performers informed the movement of the characters and how the concept of believability became to be interpreted at the Disney Studio.



Fig. 21. Images showing the use of live-action reference during the production of Snow White and the Seven Dwarfs (1937) ('Live-action reference for Snow White and the Seven Dwarfs (1937)', Animation-Appreciation-Education. Tumblr.com.

The shift in animation (specifically in Hollywood cartoons in the 1930s) and the new 'cartoon world' that was emerging (steered by the Disney Studio) demanded a new visual language and a unique approach to the representation of movement. Specifically, the advances in narrative and engaging characters relied on aspects of the real world for interpretation, but in an environment and design context that was completely fictional and defined by its own cartoon terms and conditions. This brought about some unforeseen challenges for animators. As remarkable as the use of live-action reference was for the Disney animators, they state how if simply copied onto an animated figure, these movements often produced undesirable results (Thomas and Johnson 323). Fleischer's "Koko the clown" from the *Out of the Inkwell* series (1918-1927) did not suffer the same challenges, as his design adhered closely to the anatomy of the human body[53]. However, the Disney animators realised that the movements had to be adapted and reinterpreted to fit the design of their animated

characters: once a movement was understood, it could easily be incorporated into "cartoon terms" (Thomas and Johnson 323). What was most important was knowing what to emphasise, exaggerate and interpret – the key aspects to caricature. This is therefore a subjective process, where the artist chooses which nuances to transcribe into their animation, and is the key element that differentiates animation as a creative process rather than a standard, formulaic medium. To some extent it echoes Souriau's subjective approach to the artistic representation of movement, but it operates in a realm closer to realism than to abstraction.

Thomas and Johnson refer to their findings as creating an "illusion of life" (321); the application of these strategies rendered animated characters and their performances far more naturalistic, resulting in a very specific visual style of movement originating from the Disney Studio from this time onwards, one that reflects the realistic nature of Muybridge's chronophotography. In this sense, it aligns with Wells' notion of realism in the cartoon, where the 'degree of realism' is dependent on a number of factors. Wells states that:

> The principles of movement themselves are necessarily over-enunciated in the animated vocabulary. Disney's mode of 'squash-n-stretch' animation necessarily over compresses and elongates character movement to give it an over-determined and often comic style, but it remains that moving figures within the Disney canon correspond more directly to 'realistic' movement than work informed by other approaches (27).

3.3 A chronophotographic study of animated 'baseball pitches'

In order to illustrate this approach and make a visual assessment, I now apply chronophotographic practices to analyse an example of motion representation produced at the Disney Studio. In fig. 22 (top) an animation clip from "How to Play Baseball" (1942) directed by Jack Kinney is presented sequentially in a similar manner to Muybridge's chronophotographic sequences. The episode is the first of the famous "How to…" series starring the popular Disney character Goofy. Below this image we see two plates from Muybridge's book *Animal Locomotion*: plate 273 and 286 – two chronophotographic image sequences of the same action.

The animation sequence demonstrates Goofy pitching a baseball[54] for the viewer (00:03:50–00:03:54). Goofy's action is typically viewed cinematically at 24 frames per second (FPS) (video 3.1). This four-second shot[55] was animated on twos, meaning that the animator creates twelve frames per second of film, with each frame held for two frames to make up the 24FPS. For the purpose of the sequential study, every duplicate frame was removed to make the motion easier to analyse. By reducing the shot to 12FPS in a static format, a frame-by-frame assessment of the poses, timing and movement representation of the character can be made. Similar modes of frame-by-frame assessments[56] are standard practice in animation, and the purpose is akin to how Muybridge's chronophotography operated: to freeze time so that movement can be analysed. For the purpose of this analysis, I have removed the background elements from the Goofy shot in order to focus exclusively on the character's movements, and renumbered the frames from 01 through to 50.

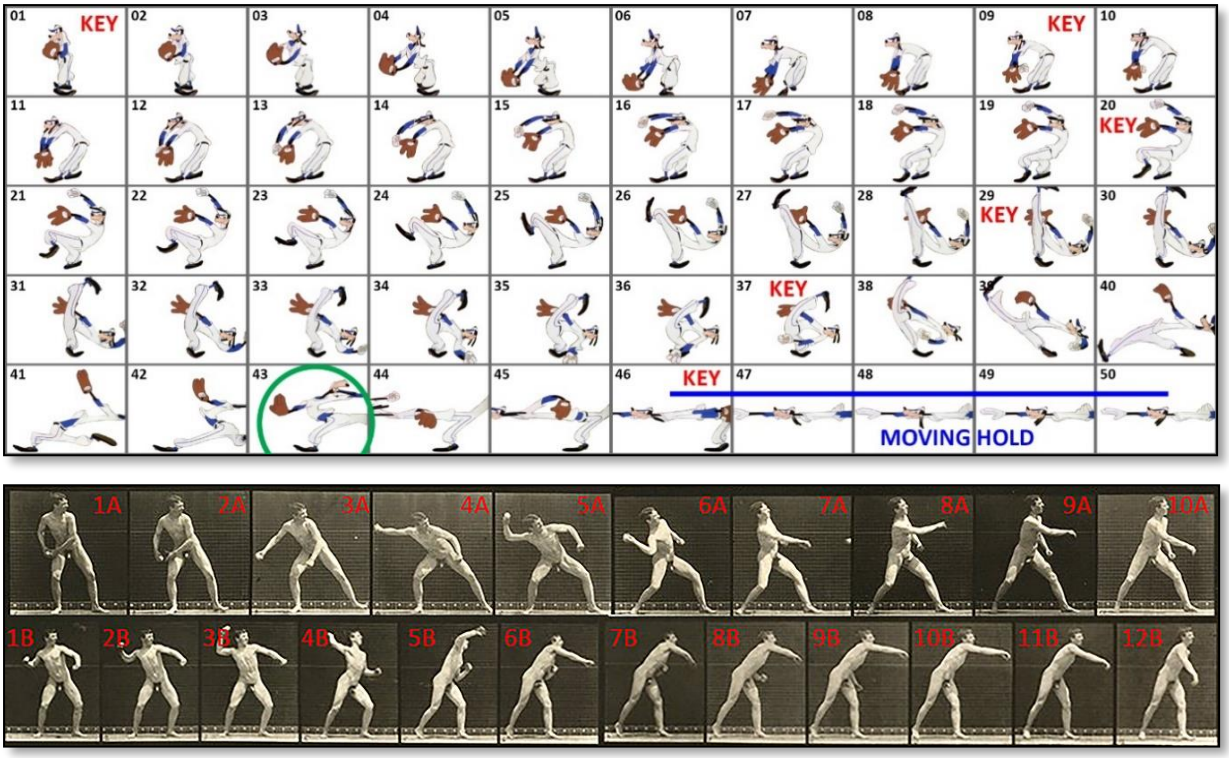


Fig. 22. Top: Sequential analysis of a shot from *How to Play Baseball* directed by Jack Kinney (1942); bottom: Plate 273 and 286: two versions of a man pitching a *baseball* (Muybridge *Animal Locomotion*).
Top: The key poses have been identified in order to assess the motion more effectively. The sequence was reduced to 12FPS for the purpose of this analysis. The objective of presenting the animated frames in this manner is so that the animated movement can be visually assessed, like in chronophotography. Bottom: The plates have been formatted to resemble the full action from the same point of view. Key poses have not been identified, as this is not the way humans operate in reality, and this is specific to animation design.

From the serial images it is evident that Goofy's animated action takes fifty frames to complete, totalling four seconds. Through comparison with Muybridge's notations, we can deduce that the photographs of the pitcher's action take roughly two and a half seconds to complete, represented in ten to twelve images (*Animal Locomotion*). In the Disney clip, the narrator explains Goofy's movement as representing a 'speed ball'; however, the animation is double the length of Muybridge's realistic representation. We can assume that the animator's intention was to contrast the speed of the ball with the slowness of the pitch – a build-up of the action, or a form of the principle of 'anticipation'. By identifying the key poses[57] it is evident that the animator made use of several incremental in-betweens[58] to define the movement. When presented cinematically, this results in smooth, flowing animation that is associated with how most human movement occurs in reality.

This flow of action is perhaps not as evident in Muybridge's sequence of the pitcher (which only contains ten to twelve images), but is visible in Marey's multi-exposed image of a man pole- vaulting (1886) in fig. 23 below. This image was taken when Marey's procedure was able to capture many figures[59] in a single image. In fact, it shows at least double the number of figures that Muybridge shows, revealing the flow of the action. The purpose of comparing these images is to show how these two approaches to chronophotography are useful for different purposes. Muybridge's sequences are valuable for assessing the poses of the body in undertaking an action, as well as the muscle contractions, weight and posture of the figure. However, they fall short of giving us information on the timing and flow of the action. Marey's images provide important information on the timing, spacing, flow and 'primary moments' of an action. Collectively, these are all important for the animator, rendering both formats essential for evaluation.

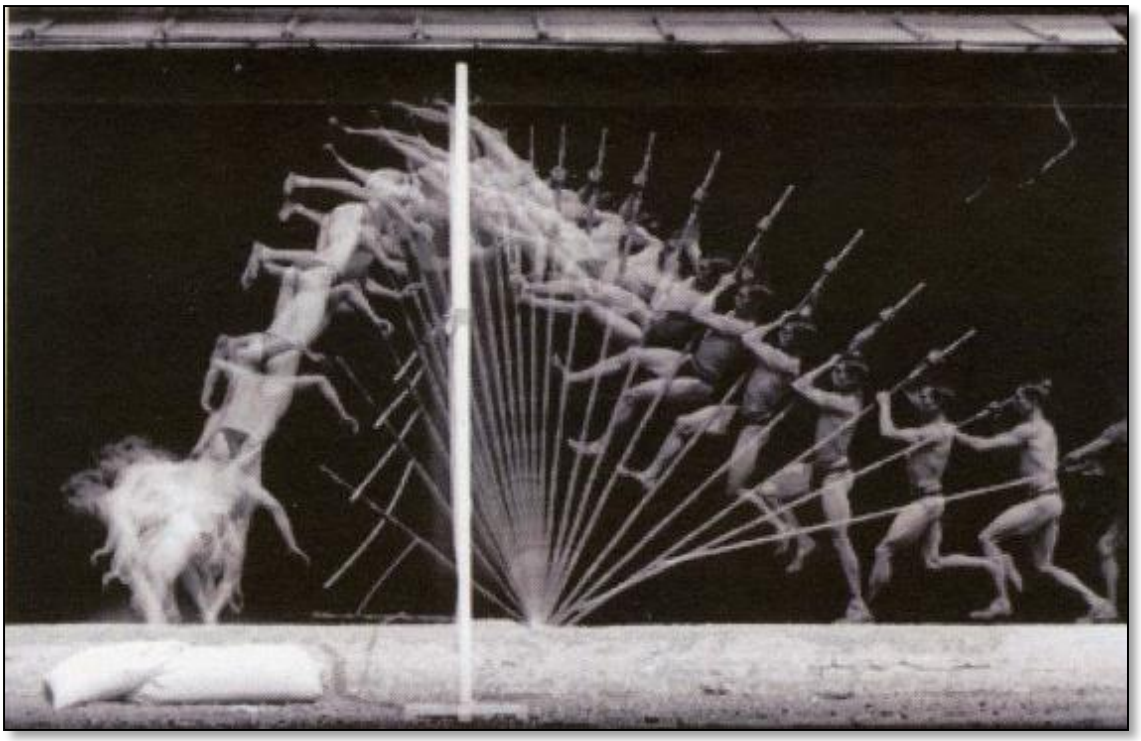


Fig. 23. Étienne-Jules Marey, *Movements in Pole Vaulting,* 1886. (Ankele *100 Photographic Reproductions*, Kindle location 158).

When comparing Goofy's poses with the Muybridge version, it is obvious how the animator uses positions that are 'extreme' and don't directly mimic how the human body moves. However, similar attitudes of movement can be identified in Muybridge's version, proving that the animation is informed in a realistic manner but has been caricatured. For instance, there is a likeness between Goofy's key poses and the Muybridge images. Also evident in the serial images of Goofy is how the subtle incremental changes of the in-between frames contrast with one extreme 'moment' used to emphasise the upcoming fast motion[60] when releasing the ball (frame 43). Because it occurs in one frame, it goes unnoticed by the viewer in standard viewing practice, but is important for rendering the character's accelerated movement.

By superimposing the frames in a manner similar to Marey's multi-exposed images, assessments of the timing, spacing, flow and 'primary moments' of the pitch can be made (fig. 24 and fig. 25 below). By splitting up each range of motion between each of the key poses[61], the slight incremental differences are also evident. Only the in-between poses contained in the fast motion (between keys 05-06) are exaggerated beyond naturalistic

movement. This demonstrates that chronophotographic techniques can be a useful tool for analysing all kinds of movement: animated movements as well as realistic movement captured through photography. Chronophotographic techniques make the fundamental characteristics of animation visible, so that the animator's representation of movement can be examined and the approach critiqued.

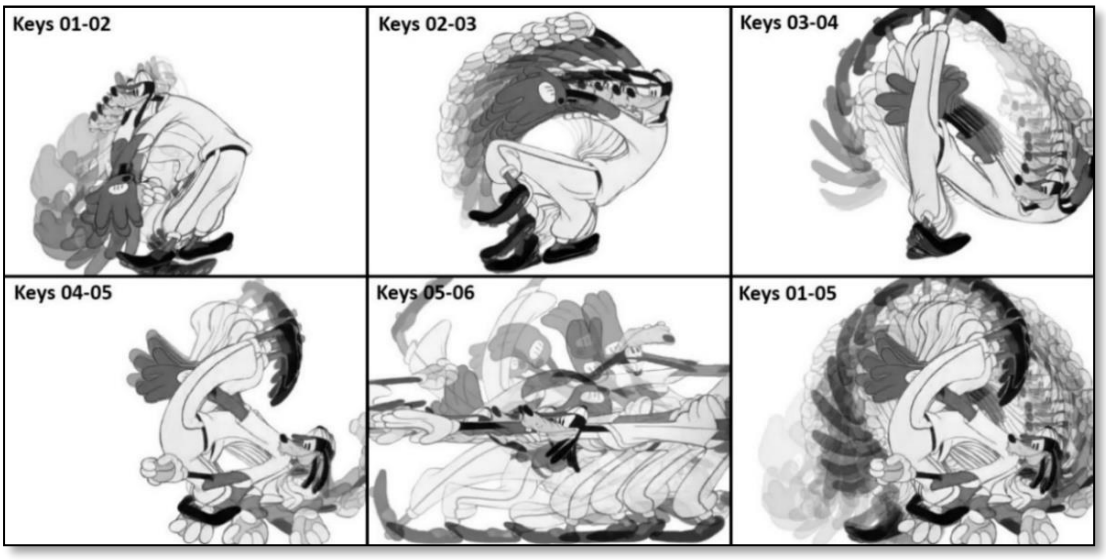


Fig. 24. Superimposed analysis (Version A) of the shot from *How to Play Baseball* directed by Jack Kinney (1942).
The moments of the action have been separated for visual clarity and analysis using a luminosity layering with incremental fall-off settings (transparency).

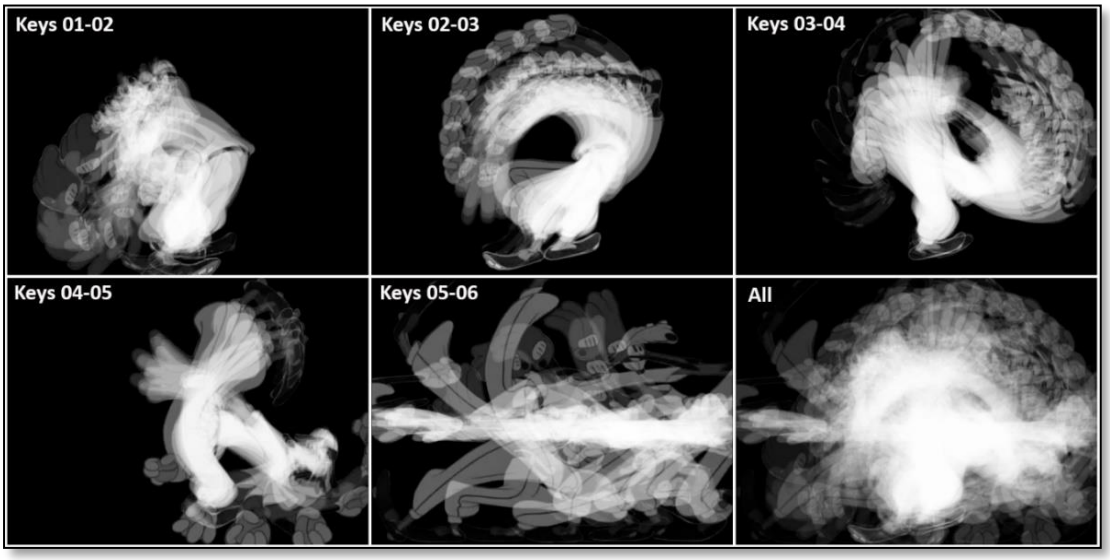


Fig. 25. Superimposed analysis (Version B) of the shot from *How to Play Baseball* directed by Jack Kinney (1942).
The moments of the action have been separated for visual clarity and analysis using screen layering with standard transparency of 40%. The clearer/whiter figures represent the holds (or primary moments of an action), where a number of frames are duplicated as a result of the hold.

The application of these animation principles eventually became standard practice for most cartoon animators in the Golden Age, especially those from the Disney Studio. However, the live-action studies and methods of working were time-consuming, and not all studios had the opportunity to take this approach. In contrast to the Disney Studio, the conditions at Warner Bros. were often described as being limited by restricted budgets and tight time constraints; animators had to "meet the quota of a six-to-eight-minute picture about every two weeks" (Crafton "Termite Terrace" 206, 217). This forced them to find new cost-cutting techniques in order to compete with the output of the more refined Disney animations, resulting in a very different style of motion representation that became the characteristic Warner Bros. Studio style.

In an interview with Chuck Jones, one of the leading Warner directors, Greg Ford and Richard Thompson question why in 1942 Jones' animations seemed to take a decisive break from the over-awareness of realism evident in his earlier work (23). Jones confirms that initially he followed the animation principles, as they taught him the language of animation. From 1942 (under the influence of fellow Warner directors Tex Avery and Friz Freleng) he took the notion of exaggeration in a new, more experimental and expressive direction. The Disney understanding of 'believability' became understood differently by Jones and the Warner Bros. animators, resulting in more experimental approaches to movement representation. Jones explains how believability came to be understood at Warner Bros.:

> **Q: There are so many disciplines just in terms of timing – the way Bugs Bunny walked must have been mathematically exact.**
> **A:** Sure, but the basic thing in animation is that you're talking about believability. You see, I was dealing with the idea of realism first, but then I realized that believability was much more important. So that with Bugs or any other character, it was the feeling of weight that mattered. One of the best examples of this is puppets or marionettes: they seem to work best if their knees don't bend when their feet touch the ground. Otherwise, they look all wrong, because there's no suggestion of gravity there. So I discovered that if you get the feeling of weight, you're all right – it doesn't really make much difference whether it's realistically drawn or not.
> **Q: In other words, the values become less literal and more abstract.**
> **A:** Sure. If you want it loose, if you want it buoyant, if you want it inflated like a balloon – well, go ahead and make it like a balloon. But if my decision is that it's a Bugs Bunny story –

then Bugs has a particular weight. So I want him to feel, as he walks across a room, as if he has this given density, this given solidity.

Q: Unless he's pulling himself out of a hat, *à la* "Case of the Missing Hare" [1942].

A: Ah ha! But even then, pulling yourself out of a hat has a feeling of weight, as you lift yourself up. This feeling of weight and believability can even be offscreen, as in *Duck Amuck* [1953] and *Rabbit Rampage* [1955] (interview with Jones by Ford, Thompson and Adamson 24).

To further illustrate the Warner Bros. approach of 'believability' that contrasted with Disney's code of 'caricatured realism', fig. 26 examines a Warner Bros. character in the act of pitching a baseball (video 3.2). The clip is taken from a Bugs Bunny cartoon called "Baseball Bugs" directed by Friz Freleng (1946), lasting just over three seconds (00:00:57–00:01:00). As stated earlier, Freleng had a significant impact on Jones' application of 'exaggeration' that radically impacted his approach. I use Freleng's work here as a typical representation of the Warner Bros. animation style, with a character in an action similar to Kinney's shot. In the analysis the same chronophotographic method[62] has been applied to this animation, but this produces new evidence regarding the representation of motion emerging from the Warner Bros. Studio compared to Kinney's application discussed above. In the sequence it is clear that the animator has made use of very strong key poses that are held or 'favoured'[63] for a number of frames each time. This has the effect that the timing of the animation becomes a lot 'snappier', which suits the fast-paced Warner Bros. style of humour. From this analysis it is also apparent that Freleng made use of extreme although almost imperceptible in-betweens (frames 19 and 36), which emphasise the action that is to follow.

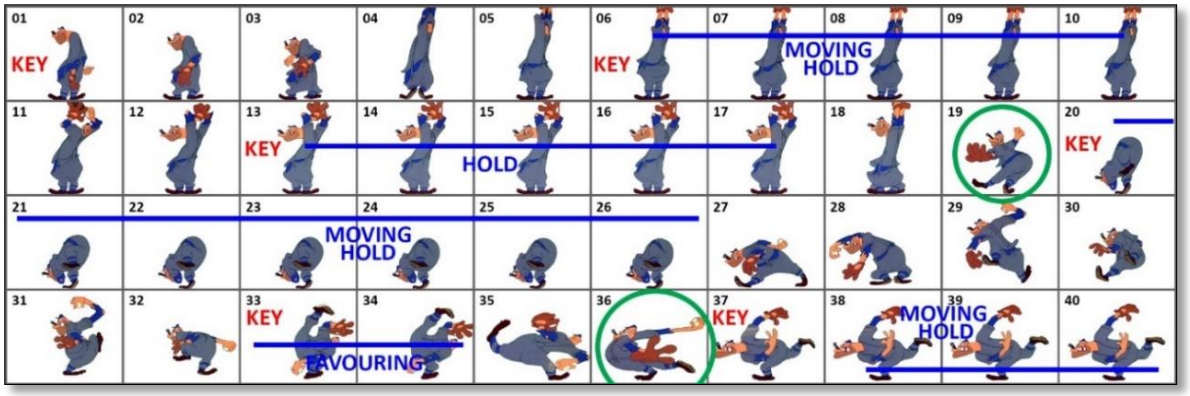


Fig. 26. A shot from *Baseball Bugs* directed by Friz Freleng (1946), analysing the Warner Bros. approach to representing movement.

Long holds and extreme pose changes are evident in a Marey-format analysis of the animated sequence seen in fig. 27 and fig. 28 below. This 'Marey analysis' shows how the animation contains very few in-betweens, removing all evidence of the fluid movement style evident in the Disney approach. The long holds place a focus on certain poses, highlighting the main actions of the character or the 'primary moments' of the action. If Freleng's animation is compared to Kinney's key frames, they are very extreme and in no way embody the realistic poses seen in the Muybridge figure in fig. 22. Freleng has taken a distinct and non-realistic approach to pose design and timing; nevertheless, the action is convincing and recognisable as a baseball pitch, as in Kinney's representation. However, Freleng's key poses are deliberately represented as absurd, and elevate the humour in the cartoon. The in-betweens evident between frames 27 and 34 make up a movement where the character runs backwards before pitching the ball[64] (a kind of build-up to or form of 'anticipation' of the main action). This is not how a baseball pitcher moves in reality – the movement is a deliberate parody to emphasise the humour in how the Bugs Bunny character pitches a ball. The timing and poses of the movement are quite extreme, rendering the movement erratic and supports the pace of the shot.

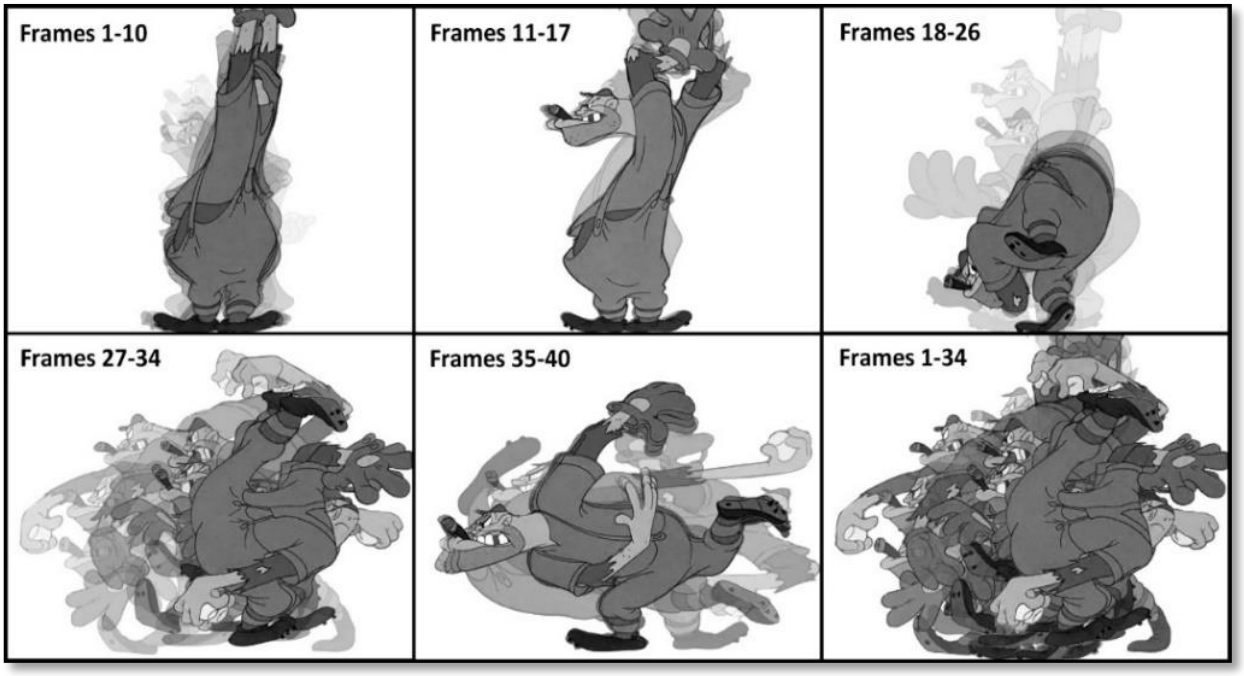


Fig. 27. Superimposed analysis (Version A) of the shot from *Baseball Bugs* directed by Friz Freleng (1946). The moments of the action have been separated for visual clarity and analysis using a luminosity layering with incremental fall-off settings (transparency).

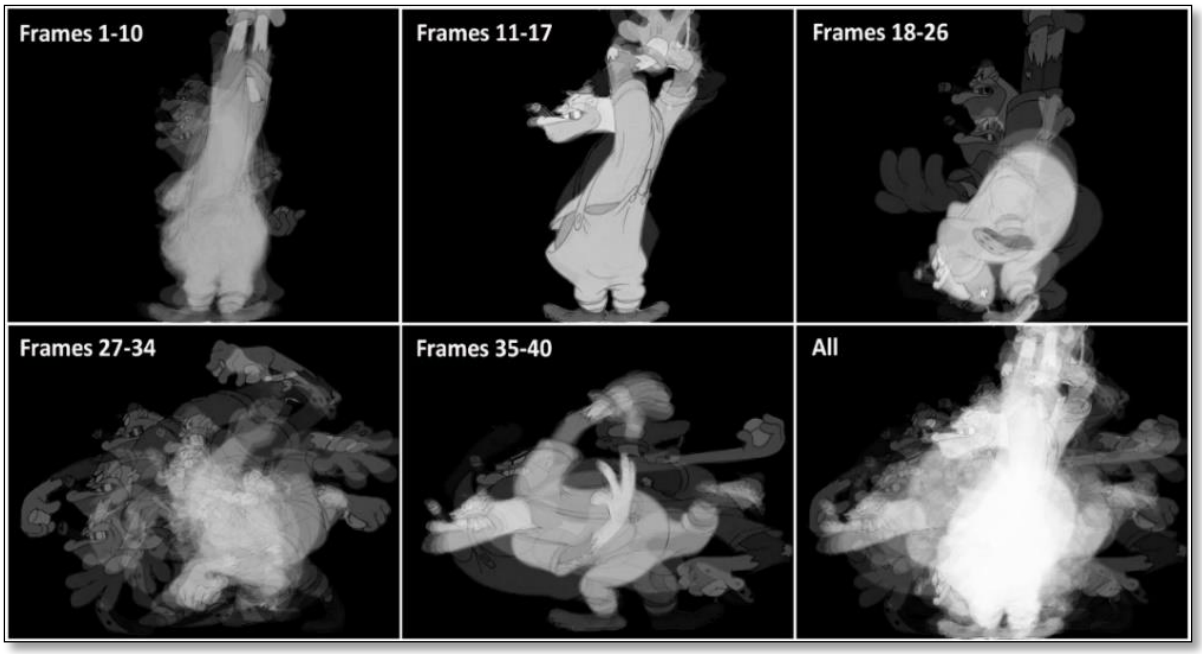


Fig. 28. Superimposed analysis (Version B) of the shot from *Baseball Bugs* directed by Friz Freleng (1946). The moments of the action have been separated for visual clarity and analysis using a screen layering with standard transparency of 40%. The clearer/whiter figures represent the holds (or primary moments of the action), where a number of frames are duplicated as a result of the hold.

3.4 Innovations emanating from Warner. Bros

What emanates from the observations noted in Freleng's approach to the animation of the baseball pitch is how he handled the principles of posing, timing and spacing. Timing is extremely important in animation, as it helps give meaning to an action (Thomas and Johnson 64; Sito location 152). Ford and Thompson point out that the timing of Jones' early cartoons was slow, due to his obsession with achieving realistic movement, shape and shading (22). But later in his career, Jones innovated the principle of timing in a few ways. Firstly, he introduced ground-breaking editing principles that increased the pacing of the film and enhanced tense situations (25). As an example, Jones discusses the noteworthy episode "What's Opera Doc?" (1957)[65] that contains 104 cuts in six minutes of film (Thompson "Meep" 38). Secondly, he used long pauses or minimal character movements to elevate humour[66], which is also evident in Freleng's example of the baseball pitch that is typical of the Warner Bros. animation style. The effect of the long pauses puts an emphasis on these key poses, where minimal movement is evident. Jones recognised the importance of calling attention to these key poses through the creative application of timing and fast, extreme in-betweens.

Barrier describes how in the episode “The Dover Boys at Pimento University” (1942), Jones “burlesqued the stiffness of nineteenth-century photographs by throwing his characters into ludicrously theatrical poses” and created an emphasis on these by “holding them on screen for much longer than normal”, “shooting from one pose to another with only a few frames of film in between” (445). It was here, in these in-between frames, that Jones introduced the ‘smear’ technique, which is an extreme form of the principle of ‘squash and stretch’. In Disney terms, ‘squash and stretch’ is the method of using contrasting shapes to define flexibility and life in animation. Without the principle, objects appear rigid, stiff and lifeless (Thomas and Johnson 47). ‘Squash and stretch’ is a form of exaggerated deformation that does occur in reality, and was noted by Thomas and Johnson as evident in the sports pages of daily newspapers, but is much more pronounced in animation (49). Fig. 29 (video 3.3) shows an example of the Disney use of the principle, where frames 01 and 04 represent the stretch poses (the body’s most extended poses) and frames 02 and 03 represent the squash poses (the body’s most compressed poses).

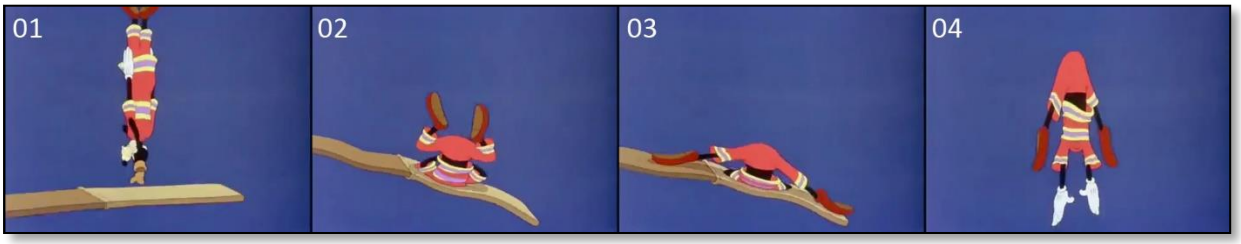


Fig. 29. Still frames from Jack Kinney’s *How to Swim* (1942), showing the principle of squash and stretch. Animated shot available in video 3.3.

This example of Goofy can be used as a basis to understand how Jones took this type of physical deformation to the next level, beginning with his introduction to the ‘smear’ in “The Dover Boys” (video 3.4). The ‘smear’ is typically an “elongated drawing that supports the transitioning of a character rapidly from one pose to another” (Carter “Exaggerated” 36). It is typically only applied over one or two frames of animation (between the key poses), and is barely noticeable to the viewer watching at 24FPS. Fig. 30 below shows three excerpts from Jones’ animation in “The Dover Boys” to show the in-between ‘smear’ frames. In a description of the relationship that this technique has to realistic motion, the ‘smear’ has been said to be the result of studying live-action footage of fast action which results in transparent blurs known as ‘motion blur’ (Carter “Exaggerated” 39). Stylistically, the blur is

visually interpreted by Jones as a solid elongated form, which is effective in rendering the concept of fast motion. However, when paused, as in the static sequence, a single frame can look rather abstract and disturbing. The limitation of human perception means that we do not see these individual frames in standard viewing practice, and just experience the rapid motion. This became one of the significant innovations that enhanced the emerging Warner Bros. style in the Golden Age. "The Dover Boys" displays a clean break from Jone's initial 'Disneyfication' period and demonstrates a new approach to believability as something distinct from realism (Kenner 35, 62; Barrier 445).

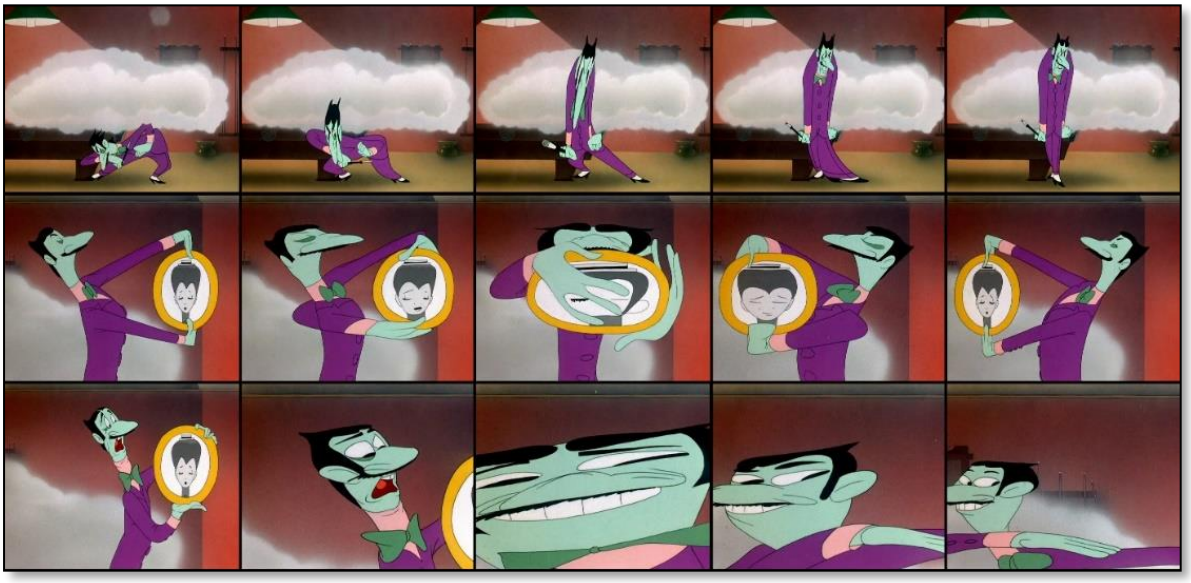


Fig. 30. Charles M. Jones, "The Dover Boys at Pimento University" (1942), showing three excerpts from the shot to reveal the in-between smear frames.
Animated shot available in video 3.4.

3.5 A chronophotographic study of a shot from "Duck Amuck" (1953)

In a final chronophotographic analysis of movement, I examine a shot from "Duck Amuck" (1953), also directed by Jones. The film has been at the centre of discussions around innovations in animated storytelling. Wells states how the animation presents a cartoon subject (Daffy Duck) and its own deconstruction (39), while Thompson asserts that the film demonstrates "the nature and conditions of the animated film (from the inside) and the mechanics of the film in general" ("Duck Amuck" 41). The film centres on the behaviour of a 'character' (Daffy Duck), who sees himself akin to a real-life actor in a narrative that, to his frustration and horror, reveals the mechanics of the animation's construction. Daffy breaks

the fourth wall and addresses the animator directly (as if the animator is the creator of this world), expressing his dissatisfaction with his attire, the environments he performs in and his audio cues. Daffy seeks stability in 'context' so that he can perform his role as an animated character. In the process, he is subjected to various forms of humiliation and feels more and more helpless the more he is subjected to the animator's absurd scenarios. Wells states that in some way "Daffy is arguing for Disneyesque hyper-realism[67] in regard to the need for a linear narrative and consistency in the design of character and environment but, clearly, the condition of the cartoon here remains subject to the animator's desire to destabilize these orthodoxies" (41). The film is a great example for intensely analysing form and meaning, but my interest is exclusively in the representation of motion.

Through Daffy's monologue[68] and humorous interactions with the animator, Daffy's frustration escalates to a point where he cannot physically contain his emotions. The representation of movement in this specific shot (00:02:41–00:02:45) is significant to analyse, as it goes against all of the animation principles set out by the Disney animators – yet is successful in terms of representing Daffy's inner turmoil. His actions do not represent those found in reality, but by focusing on the representation of movement in this shot alone, it becomes evident how effective an abstract approach (as exemplified by Jones' animation) can be.

The shot depicted in video 3.5 starts with Daffy's eyes turning red to represent his inner anger, building up to boiling point. The release of this energy is represented by the character moving across the screen in an erratic, irrational manner that is not representative of a realistic action, and certainly not possible within the laws of physics. As seen in fig. 31 below, the sequence has been prepared in the same manner as before[69] for the purpose of visual analysis.

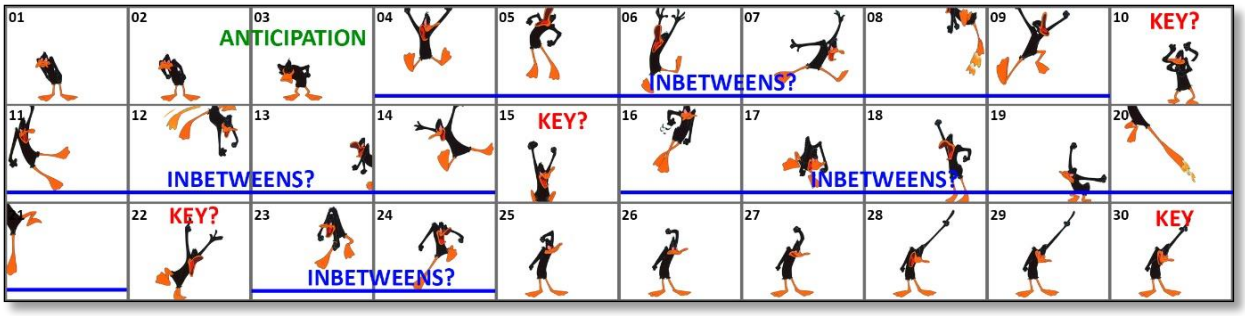


Fig. 31. A shot from "Duck Amuck" directed by Chuck Jones (1953), analysing the abstract Warner Bros. approach to representing movement
Animated shot available in video 3.5.

The first observation from the sequence is that the anticipation (frames 01-03) and the final pose/action (frames 25-30) reveal a correlation with Kinney's small, incremental in-between frames of his Goofy sequence, creating a stable start and end to the shot. However, the in-betweens and remaining key poses are unidentifiable in the sequence by standard animation analysis. Jones does not make use of holds, and each extreme pose change seems to be a key frame, with no in-betweens. It is almost as if Jones is suggesting a sequence of imperceptible in-betweens, where most of the poses bear no relationship to the previous or upcoming frames. This approach does not follow the Disney principles, and this is what contributes to the shattering of 'believability' in the Warner Bros. Studio style. In fig. 32 below we can see that there are a couple of 'moments' (over two or three frames) where there has been an attempt to link poses in ways proposed by the animation principles. Using concepts of 'line of action' and logical in-betweens, there is an attempt to follow the principles, only for them to be broken after three frames. We could assume that this was done to provide moments of 'optical rest' and maintain some form of logical action, so the viewer can get a sense of the movement being represented.

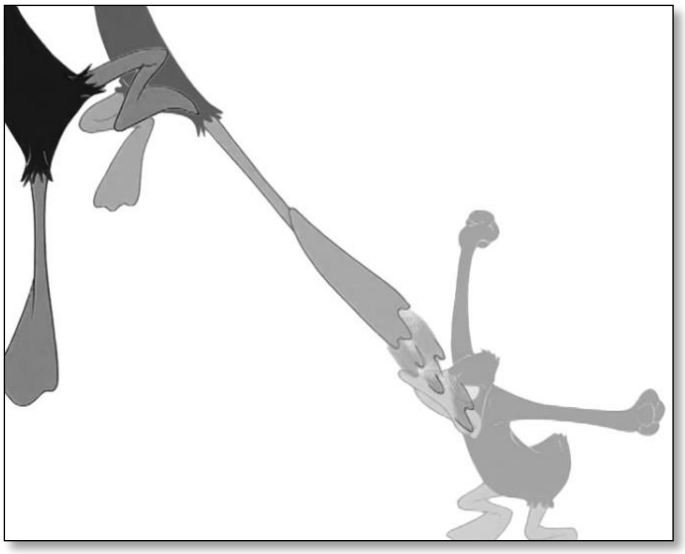


Fig. 32. Frames 19, 20 and 21 (superimposed) from “Duck Amuck” directed by Chuck Jones (1953), that display a visual relationship between poses and are linked using line of action – two concepts from Disney’s principles of animation.

In a superimposed analysis (fig. 33 and fig. 34 below), the same is revealed regarding the spacing and timing of these extreme poses. There is no flow of action, and the only identifiable primary moments are at the start and the end of the sequence.

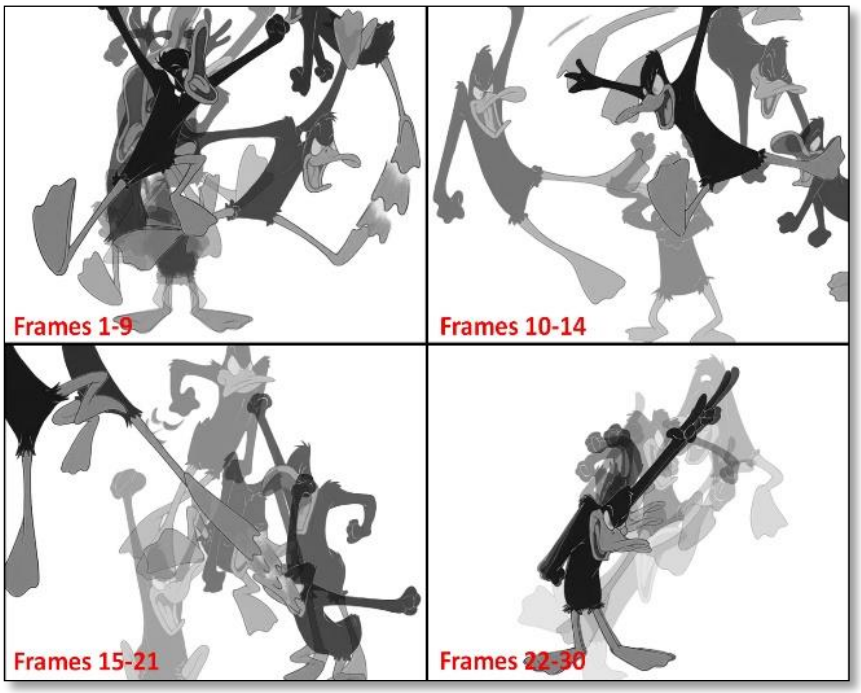


Fig. 33. Superimposed analysis (Version A) of the shot from “Duck Amuck” directed by Chuck Jones (1953).
The moments of action have been separated for visual clarity and analysis using a screen layering with standard transparency of 40%. Fewer clearer figures represent the holds (primary moments), which are only present in the start and finish frames of this sequence.

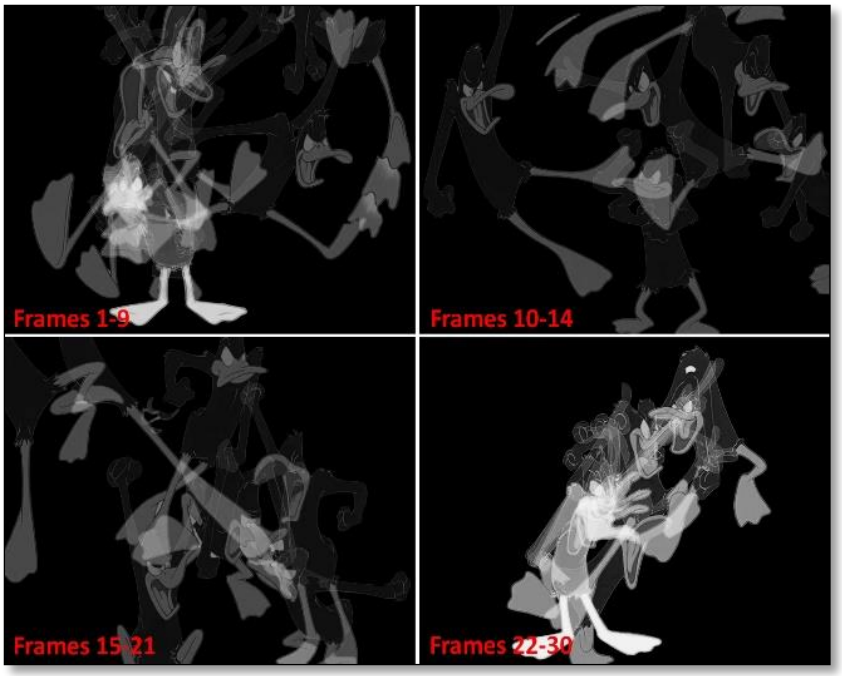


Fig. 34. Superimposed analysis (Version B) of the shot from "Duck Amuck" directed by Chuck Jones (1953).
The moments of the action have been separated for visual clarity and analysis using a screen layering with standard transparency of 40%. There are fewer whiter figures that represent the holds (primary moments), which are seen only in the start and finish frames of this sequence.

Unsatisfied with the images above, and in an attempt to find more answers regarding this sequence, I applied two different approaches to analysing the full sequence in a super-imposed manner (fig. 35). For these images, I applied different modes of superimposition and colour in an attempt to reveal a recognisable pattern of movement. However, the same findings as above are evident. In all of the assessments the shot can be concluded to be completely abstract in nature.

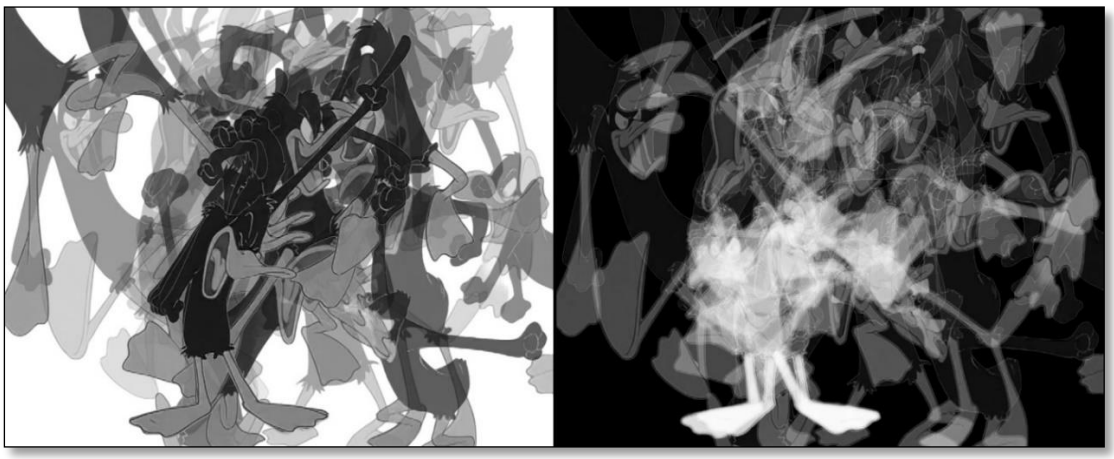


Fig. 35. Superimposed analysis (Versions A, left and B, right) of all of the frames in the shot from "Duck Amuck".

In support of this claim, Chris Carter's thesis, *Animated Mise-en-scène and Aesthetic Harmony: An Expansion of the Traditional Principles of Animation to 3D Computer Animation* (2016) focuses on 'movement style' to expand our understanding of animated movement and promote innovation in character motion using new techniques (26). Carter's thesis supports my results in that he affirms that abstract, highly stylised animation (like that emanating from the Warner Bros. Studio) uses techniques that are barely recognisable to the untrained eye, yet are critical for maintaining that specific style of motion (*Animated* 88). Jones says that "each drawing is on the screen 1/24 of a second, far too fast for the human eye, whose visual receptivity of a single drawing is about one-tenth of a second" (Jones "Chuck Amuck" location 2049). An example of this is how the notion of speed or velocity is represented in Warner Bros. animation, and how the animators further advanced animation techniques in unique and abstract ways. I explore this in a case study of the *Road Runner* series below.

3.6 Case study: *Wile E. Coyote* and the *Road Runner* Series, 1949-1966

Wile E. Coyote and the *Road Runner* were part of the Merrie Melodies franchise popular in the Golden Age of American animation. Launched in September 1949, the first season[70] of the *Road Runner* series (that was initially released in the cinema and later adapted for television), ran for seventeen years, with Jones as the Director. This allowed Jones to establish the visual style and develop the main "rules and disciplines" for the series (Ford and Thompson 31). The notion of speed as the central premise of the series is communicated within the first twenty seconds of the title sequence of the debut episode, "Fast and Furry-ous". Jones uses 'smears' and dust as visual devices to indicate the characteristic motion of the Road Runner between credits. This establishes the character's incredible speed and agility. We don't actually see the character in this sequence, but his presence is understood by the viewer. Rapidity thus becomes a fundamental attribute of the bird.

In the first scene of the "Fast and Furry-ous"[71] in video 3.6 (00:00:35–00:00:53) we are introduced to the Road Runner character in a close-up side view, depicted in three

representations of his run. First, we see him as an abstract 'moving smear', which is an adaptation of Jones' original 'smear' technique. In this version, the abstract dry-brushed[72] shapes are a visual representation of the character's body in rapid motion. The legs and feet are shown as a circulating orange oval with a horizontal blue-white-yellow stripe above in a circular arc of movement. The colours are indicative of the character's design, which is revealed in the next representation: a freeze-frame lasting over five seconds. The transition from the 'moving smear' to the freeze-frame occurs abruptly over one frame (i.e. with no in-betweens). The purpose of this is twofold: to introduce the character to the viewer in a manner suitable to our limitations (because of his speed, his motion needs to be frozen to be able to view it with the unaided eye), and to establish the style of humour that underpins the series. The final representation is a slow-motion version of his run (with visible individual frames and poses), slowly accelerating, leading into full velocity, thereby returning to the 'moving smear' representation, that exits screen right, leaving the viewer in his dust. The shot ends with a camera change (a long shot), with his 'moving smear' lifting the roadways like ribbons as he moves through the landscape.



Fig. 36. Stills from the introductory sequence of "Fast and Furry-ous" directed by Chuck Jones, 1949. Left: The 'moving smear'; middle: The freeze-frame; right: Slow-motion run.

This introductory shot is a humorous take, which visually illustrates the pure speed of the bird that is imperceptible to the human eye. In these seventeen seconds – with no dialogue, and a single inscription[73] – there is no doubt that the viewer understands what they need to about the character: he is fast. Faster than you can see! This opening freeze-frame method of representing the characters became a common technique in the series, used as a humorous device to facilitate the plot and further establish character traits. In the *Fast and Furry-ous* introduction both the message and the comedic aspect are acutely communicated, thereby establishing the cartoon as a parody of the older 'chase' cartoons

popular at the time (Chute 15). Because of the powerful (and reiterative) manner in which Jones drives the idea of speed in this series, it is more easily understood by the viewer, and led to these kinds of representation becoming more commonplace.

The use of 'smears' was not the only technique that Jones utilised to create the impression of fast movements. 'Multiples', an animation technique that uses duplicate body parts on certain frames to maintain the illusion of extreme speed, are also common in his work. These two techniques offer different results, depending on what kind of actions are being described. 'Smear' frames are generally used between two exaggerated character poses where rapid (in-between) motion is required, whereas 'multiples' are reserved for more repetitive actions (Carter "*Animated*" 183). In fig. 37 below from "Zipping Along" (1953), it can be seen that the 'smear' frames in 01 and 04 are used to illustrate the speed of the character in a running action, while the 'multiples' frame in 03 also demonstrates quickness, but of a repetitive action, like eating .

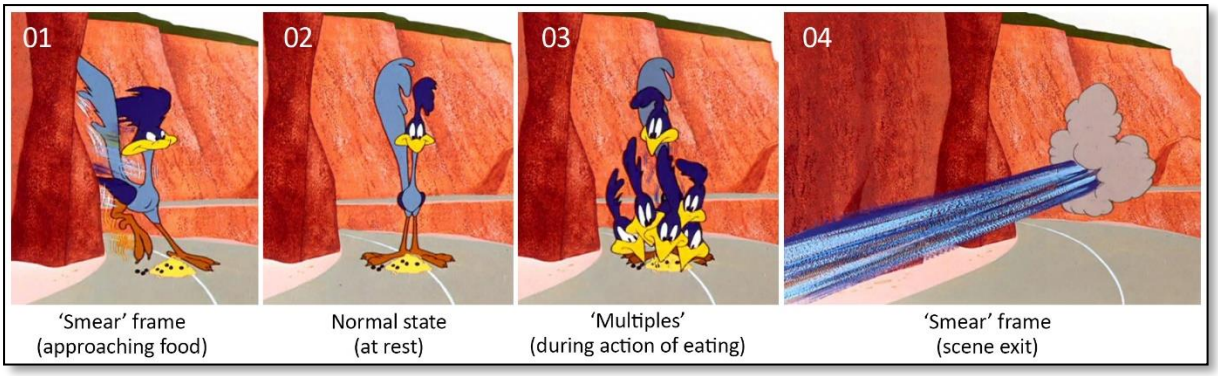


Fig. 37. Multiples versus the 'smear' in "Zipping Along", directed by Chuck Jones, 1953 (00:03:16-00:03:21). 01: 'Smear' frame; 02: Normal state; 03: 'Multiples'; 04: 'Smear' frame.

Jones has explained that his use of 'multiples' is a visual device that gives the viewer "something to hold on to, something to register the speed" (Ford et al. 27). For the animation of the Road Runner, multiples are only used in his slower movements, like the eating sequence shown in 03 above. Jones uses 'multiples' much more often in the Coyote character's faster-paced movements, perhaps as a commentary on the varying physical abilities of the two characters. This notion is immediately evident in the episodic introduction of the Coyote (video 3.7) in "Zipping Along" (1953), where Jones uses the five-

second freeze-frame method of presenting the character, but in 'multiple' form (00:00:57-00:01:12). From this freeze-frame seen in fig. 38 it can be deduced that Jones is using the technique to highlight the character's desperation, anticipation and excitement to locate and capture the Road Runner.

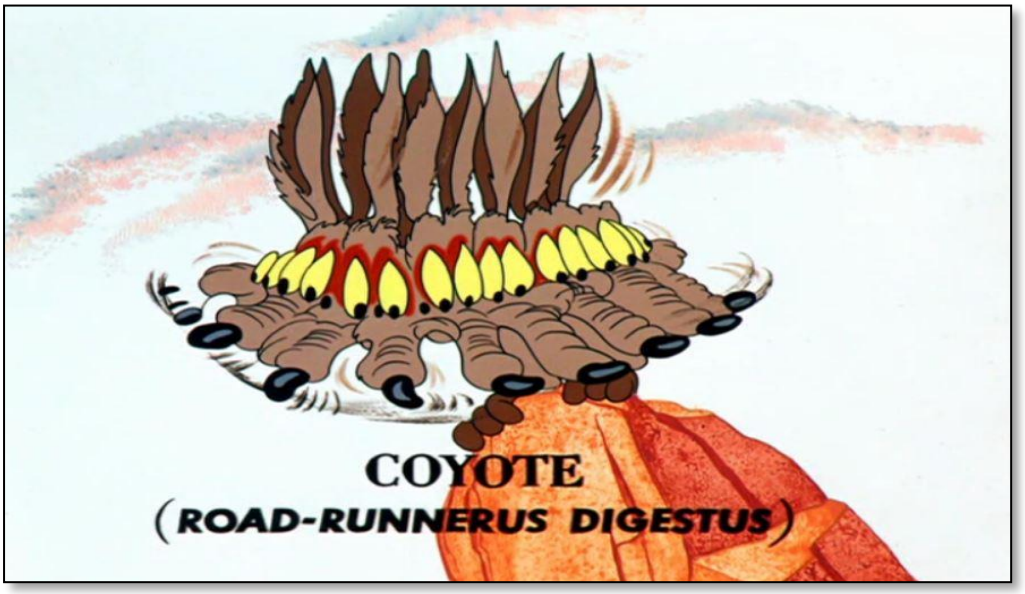


Fig. 38. Coyote 'freeze-frame' from intro sequence to "Zipping Along" directed by Chuck Jones, 1953 (00:00:57-00:01:02).

Jones' approach to representing the Coyote's run seems to vary, depending on the character's level of desperation. In the episode "Going! Going! Gosh!" (1952) we see the character in a determined run while chasing the Road Runner, with many versions of his legs depicted in the two-second shot (00:01:04-00:01:06). It is a very repetitive movement that again represents his ongoing impetus for capturing the Road Runner. If we compare this to the run representation from the "Fast and Furry-ous" (00:03:43-00:03:44) in fig. 39 below, we can see that the character's determination has increased, as made evident using the 'moving smear' technique to illustrate the movement of his legs. This representation is normally only used on the Road Runner, as indicative of his extreme speed. In this shot the type of representation increases the sense of Coyote's determination. The context is Coyote preparing himself to run through a tunnel that he painted on a cliff face; this is humorous because he knows the tunnel does not exist, yet the Road Runner has just run through it, breaking his understanding of what is real.

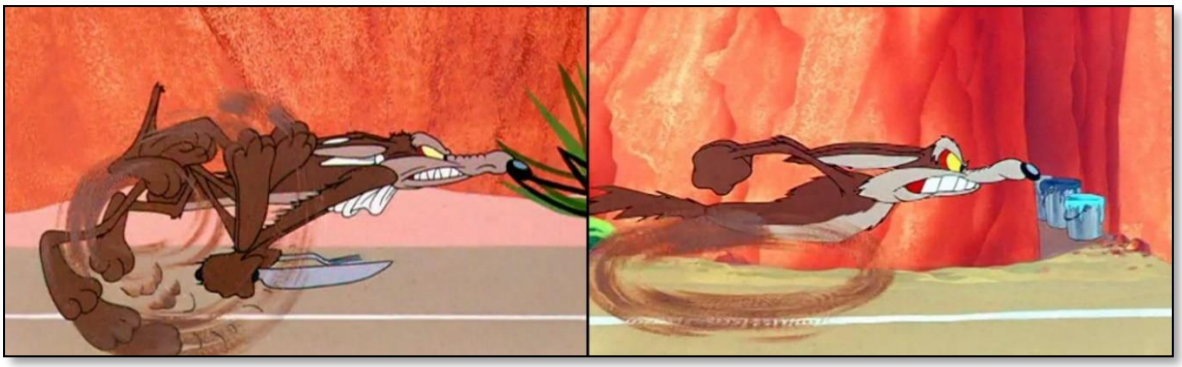


Fig. 39. Coyote run cycle showing (left) 'multiples' (00:01:04-00:01:06) in "Going! Going! Gosh!" (1952) and (right) 'moving smear' (00:03:43-00:03:44) in "Fast and Furry-ous" (1949), both directed by Chuck Jones.

In her book *Tex Avery: A Unique Legacy (1942-1955)* which focuses on the Warner Bros. director, Floriane Place-Verghnes states that according to Bergson's theory "one of the basic elements which provides for laughter is the metamorphosis of a human being into a mechanical object. In other words, we laugh each time a character loses his fluidity and becomes stilted" (location 2580). In the examples above it can be seen how the comic language of the body stems from Place-Verghnes' model of rigidity: "what is not natural is funny: rapidity is comic because it could not possibly exist in real life" (location 2640). She asserts that this characteristic is inherent in chase sequences, and is "an element of acceleration of the rhythm which can lead to total madness" in a cartoon (location 2570).

There is an additional method that Jones uses for the representation of velocity that incorporates the above techniques to create a perception of frantic rhythm and rapidity. In "Going! Going! Gosh!" (video 3.8) we see the Coyote preparing for an extreme action, better known in animation as an 'anticipation' (00:01:01-00:01:04). In order to change poses and prepare himself to catch up with the Road Runner, the Coyote needs to unwind his body from the previous gag. Jones does this over thirty-four frames, using a combination of repetitive 'smears' and 'multiples'. In the first and last frame of the action, the body is replaced by a 'smear'. The remaining thirty-two in-between frames cycle between different versions of the character in a vortex, with poses featuring multiple limbs and heads in a combination of circular smears and dust (fig. 40). The resulting sequence is not only humorous but adds more frantic action to the chase sequence to follow. It acts as an

element of acceleration of the rhythm for the shot, which implies that the sequence could escalate in action. However, Jones chooses to create an anti-climax by having the chase fail for the Coyote once again. The entire sequence is energetic, perfectly timed, and works as a cohesive whole. There are moments of strong character posing and sharp, exaggerated movement patterns, creating considerable contrast. This is typical of the Warner Bros. Studio's stylised approach to representing motion in the cartoon.



Fig. 40. Screenshot from "Going! Going! Gosh!" directed by Chuck Jones, 1952 (00:01:01-00:01:04) showing use of multiples in a vortex to represent anticipation of a chase sequence, common in the Road Runner series.

3.7 Further innovations

To fully examine the modes of motion representation emanating from the Disney and Warner Bros. studios, a few additional factors need to be considered that do not directly address the issue of movement, but inform the visual style arising from the two studios. The first of these, which was driven by Walt Disney himself, was his innovation of 'characterisation' for the animated character. Walt's drive to imbue a character with personality traits that an audience could identify with was ground-breaking. Creating

plausible responses distinct to a specific character's personality in formulated scenarios is challenging for any animator – but Mickey Mouse's 'happy-go-lucky' personality, for example, felt natural and compelling to any viewer.

Characterisation had a critical influence on the narrative conventions of early animation and future possibilities for the medium. It allowed the transient comical 'gag' formula to be integrated with story and purpose, keeping audiences engaged beyond the traditional seven-minute format. Sharpsteen (qtd. in Thomas and Johnson 34) stated that "Walt recognized the value of personality animation and he stressed it in story development." Disney narratives were focused on the traditions of moral storytelling and the re-telling of fables and fairy tales that employ the 'hero's journey' or monomyth formula[74]. Walt "insisted on verisimilitude in his characters, contexts and narratives. He wanted animated figures to move like real figures and be informed by a plausible motivation" (Wells 23). Perhaps the most profound result of this was the success of the feature-length animation *Snow White*, where the characters had to become "rounded psychological personalities" (Raffaelli 122). In his article "From Disney to Warner Bros.: The Critical Shift", White states that it was not possible to engage an audience for more than seven minutes with abstract and experimental visuals and narratives (7). Characterisation allowed the Disney Studio to tell compelling and engaging stories for ninety minutes, advancing the animated medium into a whole new form of entertainment: the feature film (White 7).

In contrast, the Warner Bros. Studio remained with the seven-minute format, introducing their own narrative innovations that incorporated characterisation in a different way. The Warner Bros. approach is distinctively different to that of the Disney Studios' "classic storytelling" techniques, and was even compared to "the European art films that, coincidentally gained favor at the same time" (White 6-7). When discussing European cinema as a comparison to Disney's approach, Schickel refers to the editing principles of the foreign films' "deftly allusive new style, with its bold leaps through time and space, its sudden juxtapositions of seemingly unrelated material, its quickness of mind and spirit, its sheer pleasure in the film as film" (219), that could very well describe the Warner Bros. style

in the Golden Age. The Warner Bros. cartoons revelled in irrationality, with characters accepting it as the norm, and this approach to narrative is legitimised by their visual style.

The language of comedy was already well established by the 1940s, and the animators at Warner Bros. knew how to draw on this knowledge rather than reinventing the wheel. When speaking about the humour in Warner Bros. animation, Jones says it is based on "the recognition in others, in a multiplied form, of something that we ourselves are capable of" (Ford et al. 38). Although this contradicts Bergston's theory of the mechanical object, it refers to another approach to humour that is familiar for the viewer. Scheib refers to this kind of film vocabulary as a way of "articulating the absurdities of Our Daily Lives" (qtd. in White 10), and it is this kind of viewer engagement that was also intrinsic to the Warner Bros. style. We watched these cartoons because we saw ourselves in them (as absurd as they were) – we could relate to them and found them somewhat cathartic and comforting. I also argue that the idea of the 'multiplied form' that Jones speaks of is a vital component of Warner Bros. animation. The Warner Bros. animators do everything that the Disney animators do, but bigger, wilder, and in a more exaggerated form.

The Disney Studio (led by Walt) were at the forefront of many other innovations, especially in the technical development of synchronised sound[75], the pencil test[76], the multi-plane camera[77] and technicolor[78], that advanced animation production. Their shift toward realistic representations and character motivation had several repercussions for the trajectory of their animation, that have been heavily critiqued over the decades. Wells discusses how these innovations led Walt to stray further away from the "distinctive aspects" of animation itself (23). He argues that "the animated film has the capacity to redefine the orthodoxies of live-action narratives and images" and that "its very language (should) represent(s) the world in an intrinsically different way" (4 and 6). Walt Disney has been further criticised for the relationship his films had to live-action filmmaking, drawing inspiration and techniques from classic Hollywood cinema (White 7). Critics labelled work emanating from the studio as "nothing particularly daring"[79], "slower, less wildly inventive" than the Warner Bros. cartoons (Schickel qtd. in White 6, 7), with its "straight-forward storytelling" techniques

(Schneider qtd. in White 7), losing the "plasmatic flexibility" of animation, which Wells says is not grounded in realism (23). Much of this criticism was directed at the feature-length film *Snow White*, but the drive for realistic representations and coherent narrative conventions persisted across Disney's productions, giving rise to the unmistakable 'Disney style' that is much loved by audiences (White 8).

3.8 Chapter conclusion

The Disney and Warner Bros. directors both refer to the importance of believability in their animation, which has a fundamental relationship to realism. In order to differentiate between the visual style emanating from each studio, I have addressed the different ways in which each studio interpreted the idea of believability in the Golden Age. This discussion extends beyond an analysis of movement, which was the focus earlier in the chapter.

The Disney approach to believability was based on the fundamental principle of viewer engagement, which drew heavily on aspects of cinematic realism. Walt wanted audiences to believe that their characters existed in some kind of fantasy world, by designing appealing, plausible and anatomically correct characters with naturalistic movements. Narratives added to this sense of realism, in that they followed a coherent structure that adhered to standard Hollywood filmmaking practice.

The Warner Bros. directors used the idea of believability differently. As previously discussed, the change in Jones' work from 1942 is attributed to his understanding of the principle of believability, which began to inform his work rather than realism. He confirms that realism affects the timing and pacing of a cartoon, making it slower; the more violent, radical character motion in his cartoons from 1942[80] was based on being less literal and more abstract in the way it was interpreted (Ford and Thompson 22, 24). It is not as much about representing movement accurately, it is about making it more believable (in its abstractness), or using principles of believability in a movement that is not possible in real life, like pulling oneself out of a hat (Ford and Thompson 24). Arguably, this approach to

believability (in conjunction with narrative structure, pacing, characterisation and their economic constraints) made Warner Bros. cartoons much more chaotic, fast-paced, daring, and humorous, with less focus on story – this becoming the distinctive Warner Bros. style.

It is unquestionable that Walt Disney perfected the studio production system, but in doing so he had to focus on commercial stability, which required branching out into feature-length animation. The scale and design of the Disney production system for this new market drew from the principles of Taylorism, focusing on systems, productivity and quality, thereby suppressing the expression of the individual artists (White 8). Disney was criticised for losing the small studio "collective" of creative artists and becoming more of a "factory" system (White 8). Studies like that of Hannah Franks attests to these production processes, where she seeks for traces of the individual artist in the convoluted studio system. However, smaller animation studios that were still focusing on the seven-minute series format, like Warner Bros., were not necessarily inhibited by this and were often compared to the European art cinema with regard to a "new critical approach: the auteur 'theory'" (White 8). This theory argues that a film represents the director's artistic vision; in animation it would affect the visual style of film – how the characters are drawn, their movement and even narrative approaches. The critics that promoted the European art cinema commended this authorship in Warner Bros. cartoons, stating that animation is "the ultimate 'auteurist' cinema, as its directors can control every element of their films' content with a precision that extends down to the individual frame" (Schneider qtd. in White 9).

Although the Warner Bros. Studio had support staff, much like at the Disney Studio, the directors at Warner Bros. worked closely with each part of the pipeline (writers, background artists, music and animators), ensuring that their vision was upheld (White 9). This resulted in animation that was "consistently personal", self-reflexive and conformed to modernist film vocabulary (Schieb qtd. in White 10). According to Thompson, they were able to give "complete, unfettered expression to their personal visions in the cartoons" that were "offbeat with anti-establishment ideas and images" (38).

This chapter compared the different visual languages and styles of movement emanating from the Disney and Warner Bros. studios in a specific era of animation – the Golden Age. Using chronophotographic practices and understanding I brought attention to these approaches to the representation of movement in a manner that is familiar to an animator, with a frame-by-frame analysis that serves to support my findings. Using the sequential and superimposed formats of Muybridge and Marey for my analysis, I was able to illustrate the varying approaches to the two studios' characteristic representation of movement, and consider the impact these have on the pacing and style of their cartoons. This also illustrated how certain techniques of animation, that only occupy a few frames of film and give meaning to the animated movement, are imperceptible to the cinema viewer. Through analysis of movement representation in the *Wile E. Coyote* and the *Road Runner* series, I demonstrated how styles and concepts of movement can help to tell a story and drive characterisation in a way that is engaging and humorous.

I have also recognised some of the extensive critical discussions surrounding the Disney and Warner Bros. studios and their approaches to the representation of movement. I acknowledged that each studio had an approach that was distinctly unique, elicited different responses, and appealed to different audiences and styles of humour. The Disney Studio was at the forefront of innovation through the advancement of animation techniques and production. Most significant was their development of the twelve principles that built a foundation for animators, and that are celebrated and used to this day. The Disney Studios' decisive engagements with cinematic realism and their drive to enrich the viewer experience (particularly for feature-length animation) had an enormous impact on the trajectory of animation. However, while the studio made huge strides in advancing the medium, their emphasis on realism was rooted in classic Hollywood cinema which, it has been argued, limited their visual style. I have also proven how this approach aligns with Muybridge's syntax of cinematic realism, where the 'real' is equated with what we see in the real world.

In contrast, the Warner Bros. directors learned from the Disney innovations but were not interested in imitating reality in their work. These directors aligned their approach with the early animators that were praised for innovations that were “full of weird, twisted, surreal versions of the world” (Thompson “Meep” 38). They understood the medium as something to be explored. For them, it was a reality of the imagination: a cartoon world where believability is more important than realism, absurdism and anarchy rule, humour surpasses narrative, and movement is the ultimate aesthetic authority. My arguments have made evident the relationship between ‘Mareyism’ and the Warner Bros. style, where the Warner Bros. directors created a unique form of graphic abstraction in the representation of their characters’ movements.

The next chapter considers viewer engagement and proposes methods of exposing the techniques discussed in this chapter in order to establish a new mode of seeing and experiencing cartoon animation, by means of a creative research project that I have called *a[CHRONO]mation*.

Chapter 4

How Chronophotographic Practices can be Used to Expose the Construction of Animation and Influence Viewer Engagement

The previous chapters investigated specific characteristics of chronophotography and animation in the context of this study. In this chapter I begin to bring these elements together to construct a method for investigating animated movement through creative practice. I also begin to unpack viewer engagement in chronophotography and, by extension, in animation – the still and the moving image. I do this in order to assess how these two modes of sequential image arrangements differ and how they can be integrated to inform a new mode of viewing animation. Through doing this I aim to reveal the construction of animation and create an aesthetic viewing experience that focuses on movement itself.

4.1 The relationship between chronophotography and animation

Before questioning viewer engagement, it is important to summarise the fundamental differences between chronophotography and animation, to begin to formulate a relationship. Chronophotography was based in scientific practice and resulted in sequences or superimposed photographic images that revealed the phases of an action. It was a static medium that aimed at freezing time in order to better understand how something moved. It was analytical and attempted to represent an objective reality. Animation is the opposite. It is a creative practice with its roots in the entertainment industry. It is a cinematic medium that consists of a sequence of images projected or viewed at a rate sufficient to creating the illusion of movement. Animation represents the idea of movement in a constructed world achieved through observation and manipulation. It represents a world of the imagination.

Chronophotographic images and animation have several relationships – but none that relate to a similar purpose or format. In fact, their core purposes reveal an inverse relationship:

one uses static images that isolate the phases of a movement, while the other requires cinematic projection to view the chronological progression of images that mimics movement. However, several similarities in content and format become apparent when viewing the preparation of individual animation frames side by side with a chronophotographic image. In fig. 41 and fig. 42 below I present these visual similarities.

In fig. 41 Muybridge's sequence of a man walking is compared to the animation frames[81] of a walk cycle in 2D animation. In these images, it is evident that each animation frame closely represents the content and format of the Muybridge sequence. Although we don't view animation like this, it represents the approach that animators take to thinking about and designing the representation of movement. Similarly, there is an abundance of examples on the internet of how Muybridge's images (like this one), have been reconstituted into cinematic sequences. Although these have mostly been done for the purpose of proving his hand in the development of cinema, these short clips of Muybridge's walks, runs and jumps are also valuable reference material for animators, as discussed in Chapter 3 (both in the still and moving formats).

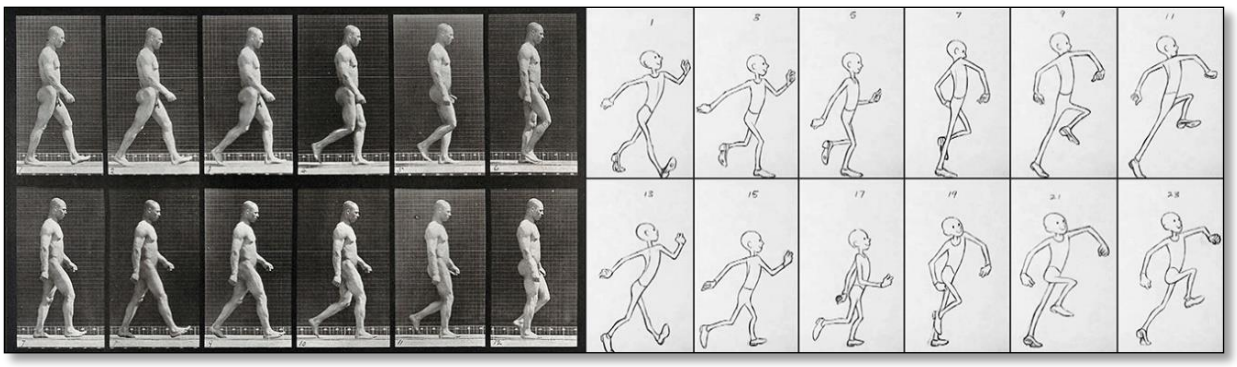


Fig. 41. Left: Plate 6 - chronophotographic image of a man walking (Muybridge *Animal Locomotion*); right: Animation drawings of a walk cycle, edited for the purpose of this study (Williams *The Animator's Survival kit* 164-165).

In fig. 42 I demonstrate another example of the similarities between how animation is created (right) and Marey's superimposed chronophotographs (left). These images show how the muti-exposed format is natural for an animator's understanding of the movement and does not cause confusion for the viewer, as discussed in Chapter 2. It is a format that the animator needs to envision in their work in order to design a movement effectively.

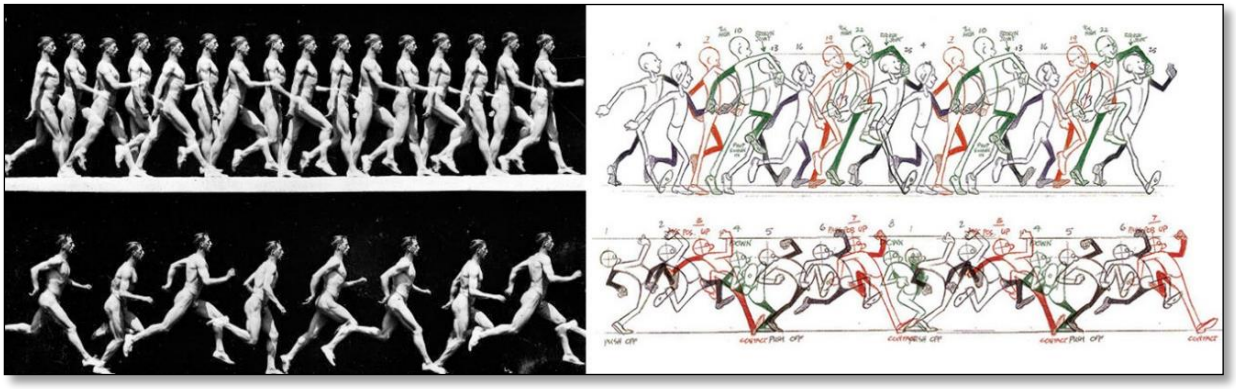


Fig. 42. Left: Chronophotographic images of a man walking (top) and running (below), edited for the purpose of this study (*Marey* Historical Picture Archive, Granger.com, i*mage no. 074894*); right: Animation drawings of a walk cycle (top) and run cycle (below), edited for the purpose of this study (Williams *The Animator's Survival Kit* 166, 190).

Due to their fundamental differences in purpose and format, bringing these two practices together seems unfeasible, if not for the purpose of referencing[82] for the animator. But one cannot ignore the visual similarities shown above, and the creative potential of their synthesis. This chapter aims to investigate the relationship between the still and the moving image, and how these different kinds of images influence viewer engagement. In this study, this equates to the relationship between chronophotography and animation. So much of animation cannot be seen by the viewer because of the limitations of human perception and the nature of how we view animation. Yet these fleeting frames are the distinctive element that we appreciate as a viewer. Animators focus their efforts on creating these unique 'moments', that differentiate their work within a saturated market. It is these 'moments' that I aim to bring to the viewers' attention, through integrating chronophotographic techniques and animation.

Tom Gunning's article "Animating the Instant: The Secret Symmetry Between Animation and Photography" unpacks the mechanics of cinema and the role that the still image plays in the viewing of animation in a manner that is important for this study. He raises questions around the relationships between the still and the moving image, and asks if placing animation in opposition to the photographic origins and indexicality of live-action filmmaking is the best way to understand its distinctive nature. He presents an argument for

how the technical nature of cinema can be used as a mechanism for interrogating his questions on stillness and movement, establishing that it is through the transformation of stillness to movement where we can really begin to understand the potential of animation.

In his discussion Gunning states that both photography and animation are able to control time and "create a novel image and experience of time and movement through technology"; "Animation reveals the dynamic nature of the instant through motion, while photography reveals its potential through stillness" ("Animating" location 1093). In short, he probes "the technical processes that makes this production of movement possible: the succession of individual frames and the parsing of time into instants, frame-by-frame animation, and the creation of an apparatus that presents these manipulations to human vision" (Gunning "Animating" location 1100).

Gunning considers how all cinematic film is subjected to a frame-by-frame projection that is made up of individual pulses – "a staccato rhythm of passing individual instants" – that are presented at a frame rate that "surpasses a threshold of human perception in order to produce motion and efface our awareness of individual frames" (Gunning "Animating" location 1042). The creation process of animation itself produces continuous motion from discontinuous instants. Gunning states that the perceptual conditions of cinema rest on the fact that in standard projection we do not actually perceive the individual frames, but rather a flow of movement made up of discontinuous instants ("Animating" location 1042). I argue that some animators exploit this condition in the way that they design movement. The Warner Bros. animators would not have been able to produce such snappy, abstract yet effective representations of motion if they did not exploit the normally imperceptible frames to enhance the movement.

In his argument, Gunning focuses on two types of movement: firstly, he differentiates between the technical process of how cinema creates motion through continuous motion picture photography, which he terms "Animation 1", as opposed to those that have been

artificially 'made to move' through a manual process, which he terms "Animation 2" ("Animating" location 1056). He argues that 'Animation 2' "plays with movement; it directs our attention to the effect of movement and explores its limits" and through doing this, can draw attention to its own process ("Animating" location 1063). He further states that it arouses curiosity about how it is done, but in a manner that does not require technical understanding, and argues that the "wonder triggered by 'Animation 2' comes from its pivot from stillness to motion, not simply conceived of as a technical process but experienced as a fundamental manipulation of time" (Gunning "Animating" location 1072). By placing emphasis on the process of producing motion by way of the instant, Gunning restores attention to the imperceptible frames, allowing the viewer to "fully grasp the adventure in time and movement" encouraged by all kinds of cinema:

> Animation reveals the dynamic nature of the instant through motion, while photography reveals its potential through stillness – but considered together these technological processes also reveal that stillness and movement depend on and transform into each other in the production of the instant (Gunning "Animating" location 1093).

Gunning also discusses how chronophotography redefined human perception by way of its instantaneous nature ("Animating" location 1158). He refers to it as "human vision plus an alien vision" where familiarity is "replaced by static poses of an ungainly sort" ("Animating" location 1165). He states that the "new instantaneous photography processed time mechanically – sliced and diced it", but in doing so destroyed it through our unfamiliarity with instantaneity ("Animating" location 1167, 1180). However, he also questions if perhaps this unfamiliarity reveals "new dimensions of time and new ways to conceive motion", stating that animation drew its inspiration and its technical process from the photographic visualisation of the instant, rather than following the freedom of traditional painting ("Animating" location 1180).

Gunning's arguments raise valuable questions around the presentation of animation. How can the animator manipulate the image (the frame) so that we can direct the viewers' attention to the movement itself? Is there a way that we can exploit the 'imperceptible'

frames that are a product of the mechanics of how we view animation? And how can we make these 'imperceptible' frames 'perceptible' for the viewer, in keeping with the cinematic nature of animation? I argue that Gunning's article demonstrates the potential for manipulating these mechanics in order to influence viewer engagement. To further probe this argument, I address Paul St George's explanation of how animation and cinema produce the illusion of continuous motion. In the introduction to the book *Sequences: Contemporary Chronophotography and Experimental Digital Art*, St George presents two aspects of chronophotography in order to analyse the difference between the still and the moving image (1-13), which are discussed below.

4.2 Spatial and temporal acuity

According to St George, 'spatial and temporal acuity' is a physical response that the body experiences when presented with a series of images in succession to each other, as in cinema (6-8). He uses a chronometric dial for his discussion, where he illustrates how "frequency" evokes an involuntary reaction to the rate at which images[83] are presented to a viewer. This involves our perceptual ability to resolve fine "gaps" (short time intervals) between images, and is known as our "perceptual acuity" (St George 6-8). The relationship between frequency and our acuity is the frame rate used in animation or cinema. If the frequency (frame rate) is too slow, the viewer experiences a fragmented staccato of images; if it is increased, the images will appear more continuous and fluid. This is out of the viewer's control and imposed on them by the cinematic creator. In animation the standard frame rate for film is twenty-four frames per second (24FPS); however, an animator can create drawings at half that rate[84] (12FPS) and still achieve smooth motion, at less cost[85]. In live-action filmmaking (a medium where the frames are not individually crafted[86] as in animation) newer technologies are allowing for frame rates of up to 120FPS[87], which creates exceptionally smooth movement.

4.3 Economic assumption and montage

St George explains 'economic assumption and montage' as a visual process in a static medium that is dependent on certain variables and the interaction of the viewer (9-12). He

presents the case of Worthington's splash and Muybridge's tennis player (both discussed in Chapter 2) as to how images can be independent[88] from each other, but if arranged and presented in a sequential structure[89], with each showing a progressive incremental change, the viewer will most likely *choose* to see movement. He labels our ability to perceive a relationship between images in a certain presentation format as our "economic assumption". It is a voluntary action, where motion is assumed by the viewer and is independent of our perceptual acuity. This viewer interaction is confirmed by Michael Mazière in his foreword to St George's *Sequences* book (vii), when he states how perception is an interpretive process where the viewer is an active participant. Another affirmation can be found in McCloud's *Understanding Comics,* where he speaks about the spatial juxtaposition of sequential images in comics (7) and how the viewer is able to "mentally construct a continuous, unified reality" by connecting these moments through a process of "closure"[90] (67). The movement experienced in the static images is a result of a cognitive process of visual continuity that is presumed through "arcs of motion that can be read from left to right as stages in a single movement, as in a chronophotograph" (Bukatman "Comics" 86).

According to McCloud, the viewer of the static image has more control over time than the cinematic spectator (104-109). In Scott Bukatman's article "Comics and the Critique of Chronophotography, or 'He Never Knew When It Was Coming!'", he further elaborates on the differences between cinema and comics (which can be interpreted for this study as animation and chronophotography):

> Cinema [animation] reconstituted the movement that one could infer from the sequence of still images, while comics [chronophotography] retained the synchronous spatiotemporal array, or 'temporal map' – but both media were fundamentally bound to the explorations of time, rhythm and tempo so characteristic of modernity (90).

To further this notion, St George states that a chronophotograph reveals information about interval, duration, speed and other derivatives of space and time (4). It reveals the mechanics of a movement and increases our understanding of the movement, whereas the

cinematic simulates an experience. In short, the still images explore the mechanics of perception, that is a voluntary process, whereas the cinematic contains an illusionary experience that is imposed on the viewer.

4.4 Case study: The still and the moving image

To interrogate these theories and put these concepts into practice I analyse visual examples that blend between chronophotographic and animation practice in both still and moving image formats. If we closely look at fig. 41, we are presented with two images. On the left is a static chronophotographic image sequence of a man walking, taken by Muybridge in 1887 as part of the *Animal Locomotion* series. On the right of this are animation drawings of the key poses of an animated walk cycle, illustrated by Richard Williams. Williams is an animator and educator whose instructional manual *The Animator's Survival Kit* (2001) has become an indispensable learning tool for aspiring animators. Williams presents a number of systematic studies of how to animate human and animal movement, making the book a crucial contribution to animation education. What is most significant about his approach is how Williams communicates the notion of caricature through movement analysis, understanding and design. When addressing the successive phases of a movement (i.e. individual images of the sequence), I will refer to them as 'frames' of the sequence.

On the surface, these two sequences look very similar: both are a representation of the continuum of movement through isolated phases; the one fundamental difference is that one is realistic (using photographs), and one is a graphic representation (using hand-drawn images). If we had to convert each individual 'frame' and project them consecutively at 12FPS as in GIF 4.1, we reconstitute the movement and experience the motion in a cinematic[91] format. St George's explanation of how animation and cinema produce the illusion of continuous motion provides an essential argument for addressing the fundamental viewing differences between the chronophotographic sequential format (fig. 41) and its cinematic counterpart (GIF 4.1). It is unquestionable that both the still and moving images in fig. 41 and GIF 4.1 are linked to time: if the static 'frames' are presented side by side, the viewer has time to choose whether to see them as images in a motion

sequence or as something else. If the viewer experiences the 'frames' one at a time as a projected sequence at 12FPS, they have no time to think about it and automatically experience movement. I assert that this difference can be used to exploit the way we see things, and in this research particularly, ***how we view animation***. St George proposes that we can use the "gaps" (the short time intervals between images, related to the frequency or rate of projection) as an opportunity to change the "picture" for a slightly different "picture", a key aspect that I exploit through my creative practice and propose later in this chapter.

A second observation to be made about the difference between the still and the moving images in the example above has to do with the poses contained in the walk cycle. When comparing the static 'frames' of Muybridge's photograph and Williams' walk cycle, they seem to have several similarities, with no extreme differences other than the character style and poses: both contain twelve 'frames' of a male in the consecutive phases of a walk. Only when viewing the examples in the cinematic format can we easily see how the emotion of those walks differs. Williams achieves this through extreme (caricatured) poses, that affect the rhythm of the walk. In the static format this is not that obvious to the untrained eye, because there is a lot of visual information to take in and make sense of. But in the cinematic format, clearer distinctions (regarding the subtleties of pace, personality, and gesture of the walk) are easier for the viewer to assess. This is where purpose of format plays an important role in viewer understanding: Muybridge's images were primarily for scientific analysis and Williams' images were for animation education. When the 'frames' are presented in a format more familiar to the viewer (i.e. the cinematic equivalents), they are easier to engage with.

When addressing the issue of realistic versus animated (graphic) representation, differences in the fluidity of motion become evident. In the cinematic format (GIF 4.1) we can see how the movement in Muybridge's sequence does not appear as fluid as Williams' – even though the in-between frames of the animated sequence are not included in this example[92]. The reason for this is quite simple: realistic movement is not planned and cannot be completely

uniform all the time. We all move differently between steps and our pace is subject to the effects of our environment. Muybridge was also working within the limitations of his photographic method. He was only able to capture the movements of the body as the cameras were triggered: his camera captured the spatial and bodily changes of the man according to how they appeared in front of his lens. In other words, he was unable to sync his cameras directly with the man's pace, thereby resulting in the inconsistency of 'key' poses throughout the 'frames'.

The animated walk cycle is different. It is 'constructed' and key poses are planned by the animator according to a timeline. As Carter points out, animation requires the "subjective interpretation of movement phases, which have been constructed from a sequence of still images" (*Animated* 40). The animator can choose what the viewer sees and sets the pace of the action. As a result, once projected the movement will appear smoother and more intentional. Rather than 'capturing' a fleeting moment, like Muybridge, Williams (in his sequence of images) is presenting a designed, predetermined version that displays the phases of a walk in the most accurate and appealing manner. Williams is able to make decisions on pace and personality, and chooses what the viewer sees. Furthermore, Muybridge's technological approach (the lateral positioning of his battery of cameras, discussed in Chapter 2) is the reason for the resulting displacement of the man in the projected loop of his images: he seems to move forward and backward slightly between 'frames', causing a 'popping' motion that is less fluid. This is a result of the rhythm of the man's pace and the position of the camera not lining up on each 'frame'. William's is able to avoid this jarring effect because of his controlled process.

This example is evidence that static sequential images (that illustrate the construction of an action) impose a complex interpretive process on the viewer, whereas the cinematic format commands this interpretation, thus changing the nature of the engagement with the represented movement. This is the difference between a *voluntary process* versus the *imposition of an illusionary experience*. My research aims to expose the gap between the still and the moving image format in order to provoke an innovative viewing experience –

one that imposes movement but forces the viewer to question the nature of its construction.

4.5 The Marey-format, or the 'gap'

In Chapter 2 I explained how not all chronophotography was presented in a sequential visual format[93] like Muybridge's. Although static images, Marey's multi-exposed chronophotographs do not conform to St George's "economic assumption" category. This is because Marey's process employed capturing the incremental phases of an action as they occurred, on a *single image*. As a result of this process, images could not be manipulated as Muybridge's were. In Marey's *High Jump 16* in fig. 43 below we can see the precise recording of the athlete's continuum of movement during the action, all superimposed onto a single image. Marey's approach created a fluidity of the action in a photographic format that is significantly different from Muybridge's system.

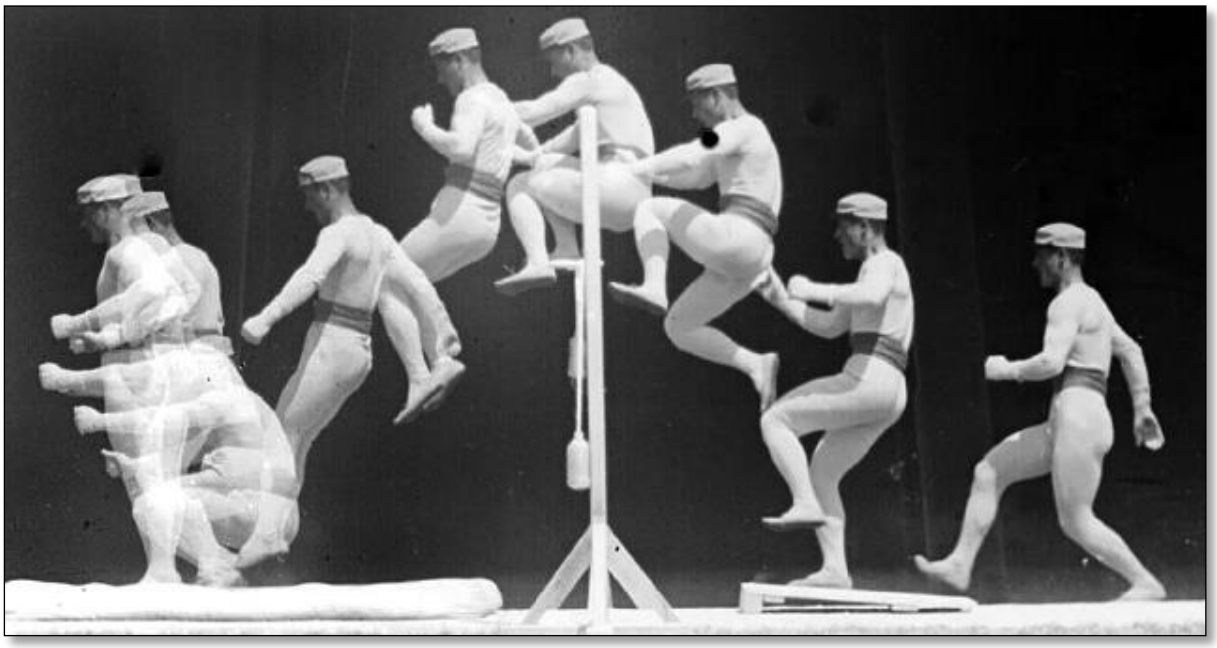


Fig. 43. Étienne-Jules Marey, *High Jump 16, 1886* (Ankele *100 Photographic Reproductions* location 157).

I also noted in Chapter 2 how Marey's images were freely adopted for aesthetic ends by artists like Duchamp and Kupka. My aim is to find a method of interpreting this aesthetic into a cinematic format: a moving image that reveals the fluidity of an action. This leads me to question how this would impact animation techniques like the 'smear', 'multiples' and

'squash and stretch'. Would the visibility of these additional frames reveal how the animation has been constructed (i.e. reveal the techniques used to create them)? Or would it reduce the impact of the action (i.e. the fundamental purpose these techniques were originally designed for)? These kinds of questions led me to search for examples that reveal movement in a manner similar to Marey's but in a cinematic format, in order to assess the potential and application in digital animation.

4.5.1 Norman McLaren's Pas de deux (1968)

Norman McLaren's short film *Pas de deux* (1968) is a pivotal example of "reanimated chronophotography" in the cinematic medium (Thain 170). The film is of a choreographed dance duet where the two dancers perform the steps together. It contains a variety of visual effects to emphasise the motion, in order to create "a new choreography based on film time" (Martin 23). McLaren envisioned the work to fulfil his fascination for "movement for movement's sake", something he referred to as "abstract ballet" (McLaren qtd. in Manning 45). Filmed against a darkened background with rim-lit figures, McLaren uses a multiple-image technique which he refers to as "stroboscopic" (McLaren qtd. in Rosenthal 12). Despite his use of this term, *Pas de deux* is clearly an example of McLaren's adaptation of Marey's layering technique in the cinematic medium of film (fig. 44).

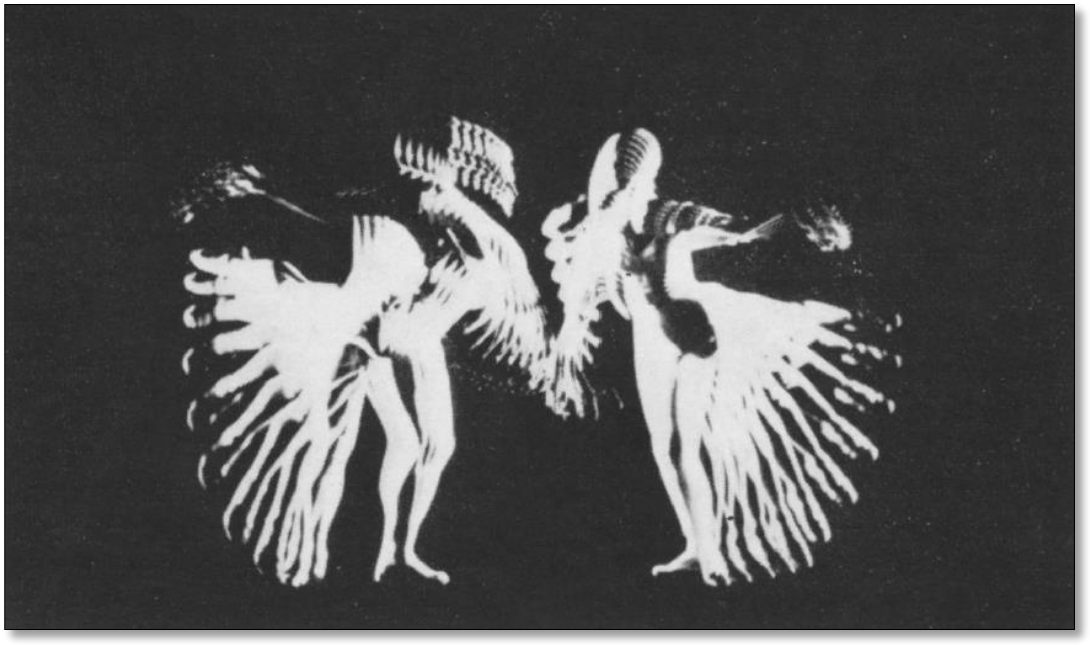


Fig. 44. Still from Norman McLaren, *Pas De Deux* (1968) (Rosenthal "Norman McLaren on Pas de deux" 8-15).

In order to create this superimposed effect, McLaren used high-contrast photography and optical printing to overlay multiple images of the successive phases of the dancers' movements. "The characters multiply across the image in the shape of the movements that they dance" (Hosea *Expanded Animation*). McLaren was meticulous in the way he created this folding and unfolding of movement and presented it in a way that complemented the motion, allowing for "maximum readability when the multiplied figures were in motion" (McLaren 45). By doing this he introduced a creative approach to how the chronophotographic aesthetic can further inform and add to the movement of the dancers. Rather than just revealing each consecutive frame for the duration of the film, McLaren chooses where to duplicate the frames and superimpose them, so that it further enhances the movement: a choreographic use of chronophotography. His interest is to animate the quality of the in-between: McLaren insists that "*How* it moves is as important as *what* moves" (qtd. in Manning 43). In her article "Coda. Interlude: Animation's Dance", Erin Manning explains how McLaren explores the notion of "movement moving", asking "how do we activate this feeling and keep it active in perception?" (43). Manning describes how McLaren chooses to focus not on the pose but rather how the "activity of the interval through which movement's pre-acceleration can be felt":

> She [the female dancer] moves alone at first. Then, her alone is met with the trace of her movements evaporating. Movement emanates from the poses of her movement stilling, traces of her becoming-movement left behind. And then she leaves the pose of her stilled body to move somewhere else. At different time intervals, the posing body follows her continuing movement, creating a refrain of past movement in future becoming. Soon these traces of the surplus of movement passing begin to take over the apparent stillness, folding through the animation's dance, landing not into the next pose, but into the surfacing of its disappearance (45-46).

4.5.2 Examples of the Marey-format in animation as a working tool

In traditional 2D or 3D animation films there are no examples that attempt to use the multi-exposed aesthetic consciously in the manner as just described. Perhaps this has to do with the mechanics of cinema itself, where animators are constrained by the standardised process of viewing one frame at a time. Or perhaps it is because, as animators, we see this

as a construction tool rather than something we reveal in the final work itself. In digital animation there are several viewing options[94] in various software packages that are part of the animator's workflow. These options are considered the building blocks and basic construction of what informs the animated movement of an object or character. One method common to this process is the 'onion-skinning' tool discussed in Chapter 2, which allows the animator to view multiple images of the character simultaneously in varying degrees of transparency or colour[95]. Each figure represents the motion of the character on a particular frame of the animation, as seen in fig. 45 below.

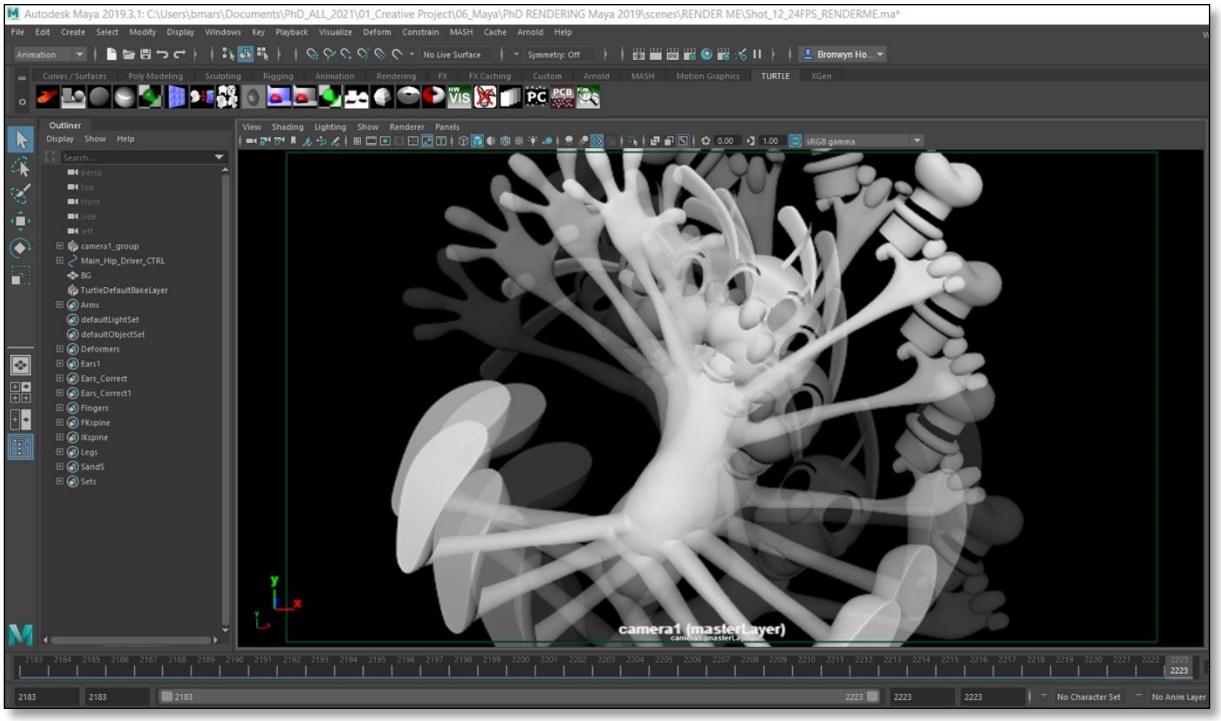


Fig. 45. Example of animation 'ghosting' or 'onion-skinning' using Maya. Screenshot taken during production of *a[CHRONO]mation,* 27 April 2019.

The purpose of this tool is so the animator can assess the poses, timing, spacing and movement of their animation, adjusting accordingly. It takes a trained eye to be able to understand these multiple images that are displayed according to the user's specifications, and are only there for workflow and motion assessment of the animated character. In most versions of this tool the user can specify which representations of time they want to see (future and/or past), and how the visual properties of those time selections can be customised (by colour, transparency and animation types, i.e. keys or in-betweens). The

final sequence of rendered images that we see on the screen are presented one frame at a time, similar to how we perceive them in real-time with normal vision.

Williams makes use of this visual technique in his book and the supporting instructional DVDs, to illustrate how an animation is created for animation students. His approach focuses on creating key poses of the chosen action, understanding how to time them appropriately, and then completing the in-betweens. Fig. 46 and fig. 47 below show William's methods for using this technique for explaining the timing, spacing and posing of a moving object or character. He uses the different colours in fig. 47 to make the different stages of animation as clear as possible for the learner (Williams 67). Video 4.1 is a clip from his instructional DVD (edited for the purpose of this study) where he demonstrates how to create a walk cycle using this visual methodology in a cinematic format.

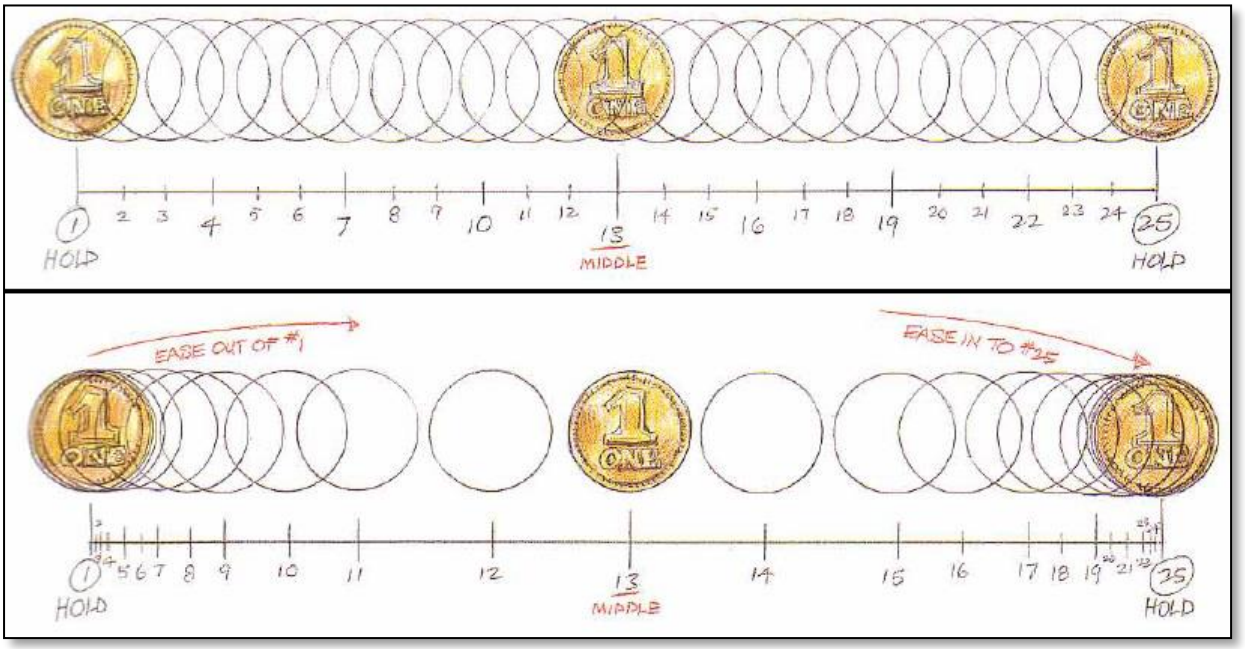


Fig. 46. Construction drawings to explain the principles of timing and spacing in animation.
Williams explains these images of the coin: each circle represents the coin's position in a left-to-right movement, using even spacing (top) versus altered spacing to give the effect of slow-out and slow-in – one of the basic animation principles related to timing and *spacing* (*Survival Kit* 38).

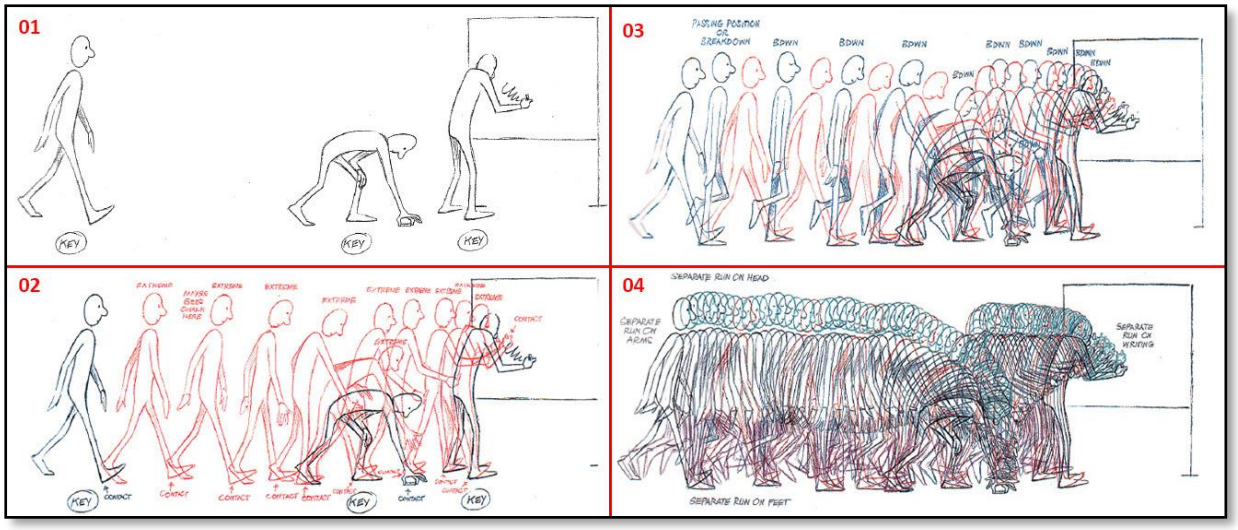


Fig. 47. Williams uses these images to explain the process of animating a shot of a man picking up a piece of chalk to write on the board.
01: Williams illustrates the key poses or the main story points required to understand the action; 02: He adds the contact positions: the actions required to be in the shot; 03: Williams breaks the action down further, adding passing positions and 'breakdowns'; 04: He adds the remaining in-between frames, all the frames needed to complete the animation. If he was animating at 24FPS this would amount to 24 drawings per second in total. If he was animating at 12FPS, this would amount to 12 drawings per second in total (Williams Survival Kit 64-66).

4.5.3 Process representation

Scholars in early animation have made several references to animated films that 'deconstruct' or expose the 'modes of their making' for the audience, something I termed 'process representation' in my introduction. In his influential book *Before Mickey: The Animated Film 1898-1928,* Donald Crafton refers to this as "self-figuration", which he explains as the "tendency of the filmmaker to interject himself into his film" (25). Crafton explains how this aspect of animated film can take several forms, from literal interpretations to symbolic imagery "designed to facilitate the process and yet to keep the idea gratifying for the artist and the audience" (26).

An example of this can be seen in the short film *Little Nemo* (1911) by Winsor McCay, where eight minutes of the ten-minute film focus on how McCay presents his process to the audience through a live-action portrayal of the manner in which he created "four thousand pen drawings that will move, one month from date" (00:03:38-00:03:43). In his film McCay emphasises the labour process that takes him "one month to complete", which he exaggerates by showing in the live-action sequence the delivery of huge stacks of packaged

drawing paper and barrels of ink to his studio, required to produce less than three minutes of animation. It is a narrative, entertaining introduction that contextualises what the viewer is about to see. Before McCay presents the animation in a cinematic manner (i.e. how it should be viewed), he uses "the hand of the artist" approach (made popular, Crafton argues, by the lightning sketch artists of the late nineteenth century) to demonstrate how he draws each image and then mounts them individually to be captured by photography.

This approach to introducing animated films was common practice at the time, and Crafton states that it provided the mechanism by which "self-figuration" first occurred (58). Animators wanted to educate their viewers on the labour-intensive animation process as well as how their work remarkably transformed still images into images in motion. This fascination is reminiscent of Western society's attraction to the early 'philosophical toys' of the nineteenth century. In his 1932 article "Disney and Others" published in The New Republic, writer and critic Gilbert Seldes discusses how the attraction of a medium can be lost through continuous interaction[96]:

> In the early days we looked at a movie and marveled that a picture could be set into motion. Now we do not think of the picture – only of the actors. The animated cartoon shows us in movement something naturally inert, and it is essentially the satisfaction of magic that we get out of it (Seldes "Disney and Others").

Crafton asserts that the animator wanted to be seen by audiences as "a purveyor of life itself", and quotes Seldes as stating that the animated form elicits satisfaction from the viewer: the pleasure of experiencing the magic in "seeing the impossible happen" (Seldes "Disney and Others"). Early animation was celebrated for its ability to imbue inanimate objects with life and the deliberate inclusion of the animator in this role of "life-giver" slowly transformed with "increasing subtlety and expertise until finally we take for granted that the animator can vivify things that could never otherwise have existed" (Crafton 26-27). Hannah Frank explains how the magic of the animators began to transform onto their creations "which were granted the ability to animate themselves; thus Felix the Cat, Oswald the Lucky Rabbit and Mickey Mouse could miraculously improvise anything" (5).

As stated above, Crafton noted how "self-figuration" or methods for filmmakers to expose 'modes of their making' for the audience can take several forms. Another interpretation can be found in the short film in the Warner. Bros' *Merrie Melodies* series, "Duck Amuck" (1953) directed by Chuck Jones. In his essay "Pronoun Trouble"*,* Thompson states that the film demonstrates "the nature and conditions of the animated film (from the inside) and the mechanics of film in general", and the film is "conscious of itself as an act of cinema" (262). In the film Jones use many devices that force the viewer to question how animation is constructed and juxtaposes this perspective with 'live-action' practices, in that Daffy is playing his role in a 'film' as an actor would. Through this imaginary interplay between the 'film director'[97] and 'actor', the viewer is able to consider how the elements of 'cartoon design' (like backgrounds, props and sound) need to work consistently in order to create a 'stable product' or coherent animated work. The inclusion of the animator's tools in action and the end-reveal of the Bugs Bunny character as the 'animator' (or in Jones' film analogy, the 'film director') and is a sophisticated example of "the hand of the artist" discussed above. However, Jones used this device to drive humour in the cartoon, whereas McCay used it as a mechanism to impress his audience.

What interests me the most about this device is the influence it can have on viewer engagement. Frank refers to these kinds of films as "self-reflexive, quasi-Brechtian" animated cartoons (5). The latter term refers to the performing arts principle of "*Verfremdungseffekt"* (the distancing effect) invented by German playwright Bertolt Brecht. The principle focuses on making the viewer a "conscious critical observer" by redirecting their attention away from the narrative to the construction of the illusion ("Distancing Effect" globalshakespeares). This can be done by breaking the fourth wall in film (as Jones has done); using strategic diversions, like the character addressing the audience/filmmaker directly; the interruption of a song; or drawing their attention to the filmmaking process.

Gunning addresses the issue in a similar way to Frank, stating that some "animated films frequently display their own processes by the baring of their devices. From Cohl to Winsor McCay to the Fleischer brothers, animators frequently portrayed (on screen) their creation

of images and motion." ("Animating" location 1048). Gunning states that it brings attention to the "invisible discontinuous frames" and reveals how the animation is created ("Animating" location 1056). I argue that the central purpose of this device (what I refer to as 'process representation') has to do with audience engagement, as it provides the viewer with insights into how the film was made. It invites the viewer to engage more deeply with the materiality of the animated film, and to question the 'constructedness' of what they are seeing. My interest as an animator and artist lies in devising new modes of animation construction to elicit such a response in the viewer.

4.5.4 Jack Kinney's "How to Play Golf" (1944).

Despite the popularity of this technique in early animation, most contemporary mainstream animation makes a concerted attempt to conceal aspects of the film that visually reveal its modes of construction for the viewer (other than in the manner Jones did in *Duck Amuck*). Contemporary animated filmmakers tend to include separate 'making of' videos/documentaries to supplement their films[98]. Beyond the period of early animation there is very little evidence of how the animation was created, apart from the visual nuances, for example, in stop motion animation where traces of the artist (fingerprints) are often visible in the photographed clay). However, in Disney's "How to Play Golf", directed by Jack Kinney in 1944, there is a section of animation that challenges this notion. In the scene where the "correct swing" is analysed, the animator "reduces the figure to its simplest form" (video 4.2): a pencil sketch (or "diagrammatical figure") that is familiar to the animator because it is commonly used during the thumbnailing[99] process (00:01:56-00:02:14). The narrator explains the construction of the action using common animation terminology like 'path of action' and 'follow-through', suggesting that animation is "harder (to produce) than it looks". In the shot shown in fig. 48 and video 4.2 the animator keeps every frame of the club's action visible, much like Marey's chronophotographs (00:02:10-00:02:14).

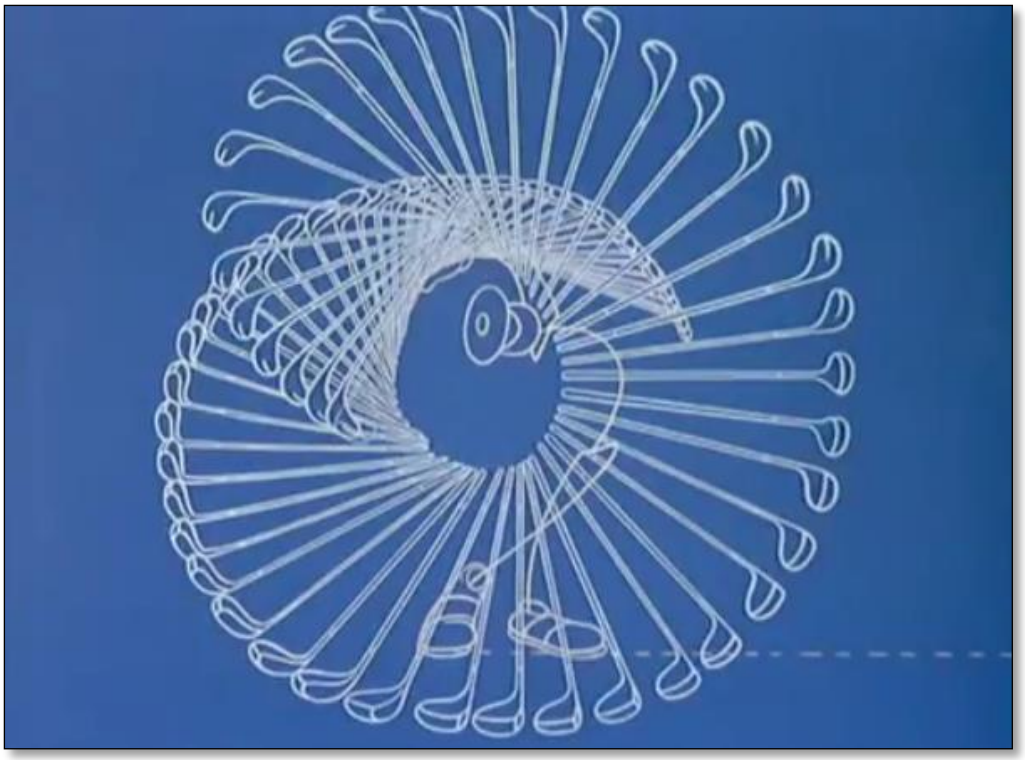


Fig. 48. Screenshot from *How to Play Golf* directed by Jack Kinney, Walt Disney Animation, 1944 (00:02:10-00:02:14). Here Kinney represents the action of an instructional character as a pencil sketch, keeping the past frames visible in order to show the movement of the golf club.

Kinney's shot suggests a strong visual reference to Marey's *Geometric Chronophotograph of the Man in the Black Suit* (1883) in fig. 49 below. However, Kinney chooses not to treat the figure in the same way (we only see one version of the pencil-sketched character in a frame-by-frame manner). We can assume this is done for the purpose of maintaining visual clarity in the cartoon. Kinney continues to use the graphic (pencil-sketched) figure throughout the episode as a secondary character that helps Goofy learn professional golfing techniques, which adds to the humour. However, the representation of his action in the rest of the episode is presented in a frame-by-frame manner that is visually easier to understand, where the 'business' of humour can be focused on. This is evidence that the purpose of this visual representation was to explore the movement of the action, with the aim of educating both Goofy and the audience. The subtle nuances and use of animation terminology emphasise this educational aspect.

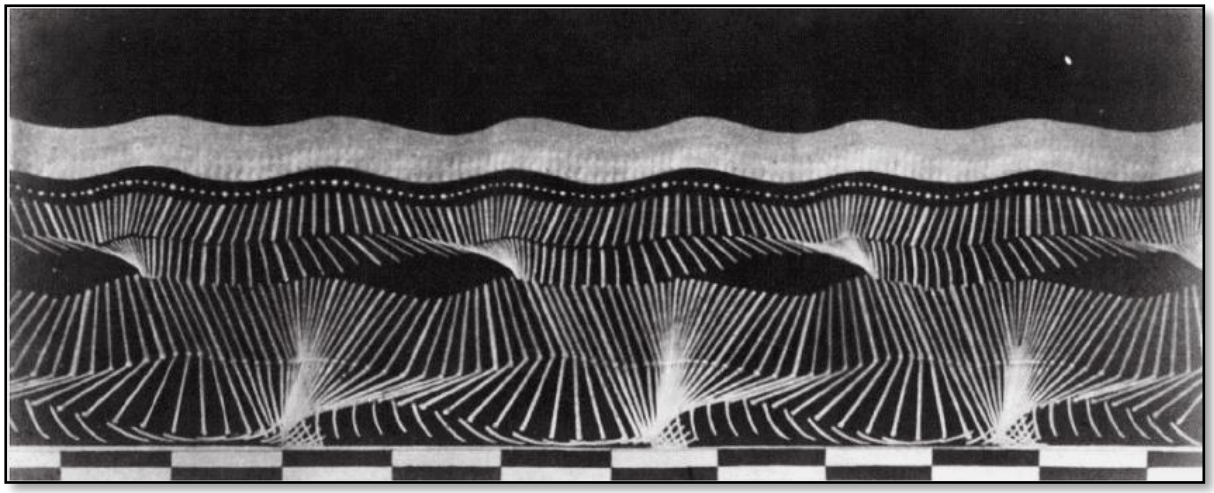


Fig. 49. Etienne-Jules Marey, *Geometric Chronophotograph of the man in the black suit*, *1883 (*Ankele *100 Photographic Reproductions* location 156).

4.5.5 William Kentridge's "drawings for projection"

Some artists working with experimental animation celebrate 'process', often revealing their 'modes of making' for the viewer, which forms part of their conceptual approach to art-making. According to Maureen Furniss in her book *Art in Motion: Animation Aesthetics*, experimental animators develop their own animation techniques and explore their "unique aesthetic potential" (32). She is an advocate of how the use of a specific technique will help to create meaning in a work (40). Using Furniss' model, I unpack an aspect of William Kentridge's charcoal animations, which he calls "drawings for projection" (Kentridge qtd. in Krauss 25). In the following discussion I present how these works are significant examples of how technique can inform meaning and relates to Marey's superimposed aesthetic.

Kentridge explains his process in a lecture presented in 1993 and published under the title "Fortuna: Neither Programme nor Chance in the Making of Images". Kentridge says that rather than creating animation sequences as in traditional techniques (i.e. making a new drawing for each frame), he creates his animation on a single drawing[100]. He does this by erasing and adding lines to the original drawing, between each photograph (Kentridge qtd. in Krauss 26). Kentridge states that this process evolved out of a need to keep his drawings as 'works in progress' rather than completed works. He discovered that it is through the *process* of drawing that the interest of the drawing may shift from what the artist originally planned to something more "incidental" (26). He states that:

> Filming enables me to follow this process of vision and revision as it happens. This erasing of charcoal, an imperfect activity, always leaves a grey smudge on the paper. So filming not only records the changes in the drawing but reveals too the history of those changes, as each erasure leaves a snail trail of what has been (Kentridge qtd. in Krauss 26).

Kentridge's animations are concerned with the political landscape of South Africa's change from apartheid to democracy (Maltz-Leca 139). Thematically, his work is concerned with time and transformation, both of which are supported by his process. In her assessment of Kentridge's work as a source of inspiration in her book *In the Making: Creative Options for Contemporary Art,* Weintraub discusses how his technique is closely related to his subject:

> Kentridge takes advantage of charcoal's smudge-and-smear quality. Charcoal permits continual reworking. Frame by frame, the drawings are added to and parts are rubbed out. Traces of people, objects and landscapes appear and disappear like memories. Residues of charcoal erasures accumulate throughout the process of re-working, allowing each drawing to record the effects of all the others that preceded it. Through this compositional strategy, Kentridge mirrors the real-life process in which current events are inevitably affected by past events. Charcoal permits instantaneous action and reaction (163).

In her article "Visual storytelling: a Progressive Strategy? The Animated Drawings of William Kentridge", Elisabeth Van Caelenberge investigates the connection between the political and psychological subject matter, and the style and medium of Kentridge's 'drawings for projection'. She relates his work to a palimpsest[101], stating that this implies that we need to consider the traces of images 'passed' that remain visible as a result of his process. She quotes Susan Stewart on the importance of the technique of palimpsest in realisation of the film's potential to look at history:

> The most obvious fact of drawing – that it unfolds in time and records that unfolding – acquires a profound significance here as a counter-narrative, an alternative speed, another opportunity to examine experience in a context where violence has obliterated the possibilities of perspective and hence made the view of history unbearable (Stewart 84).

This relationship between Kentridge's process and narrative is what inspires my interest in how an artist can reveal their 'modes of making' to create meaning in a work. In addition to this, the visual aesthetic that Kentridge achieves (fig. 50) through his process is reminiscent of Marey's superimposed chronophotographs. In her article "'The Rock': William Kentridge's Drawings for Projection"**,** Rosalind Krauss states that "we feel ourselves in the presence of Jules-Étienne Marey's photographic motion studies, with each figure generating its trail of linear traces" (58). In video 4.3 I have collated a few scenes where the chronophotographic aesthetic is most prevalent in Kentridge's work. In looking at these specific examples, it is evident how Kentridge's experimental animations have greatly influenced my creative practice in terms of revealing process as well as demonstrating the Marey aesthetic.



Fig. 50. William Kentridge, *Untitled,* 1990: drawing from the opening sequence of the animated film *Monument* (1990) showing the traces of the movement of the feet. Charcoal on paper (Maltz-Leca "Process/Procession" 152).

4.6 The strata-stencil animation technique

In reviewing ways in which contemporary animators and studios (working in the industry) reveal their 'modes of making' for the viewer, I found examples in animation practice that use an experimental technique called strata-stencil animation. These animations are mostly very short[102] experimentations of the technique, or short 'promos' or advertisements. The technique involves the use of multiple layers of paper stencils, stacked and photographed sequentially to create a paper tunnel-like effect (Blau). Strata-stencil was developed by the animator and artist Javan Ivey during his studies at the Pratt Institute, Brooklyn, New York,

in 2007, as part of a stop motion class requirement (MarBelle). Since the launch of his film, the first strata-stencil animation *My Paper Mind* on YouTube in 2007 (video 4.4; fig. 51), this animation technique has been explored using different approaches. Ivey used what I term a handmade approach, a paper cut-out technique which I consider the traditional form. He used paper[103] cut-outs[104] for each frame of the animation, where the movement is constructed according to traditional animation practices[105]. Each individual cut-out (frame) was filmed in succession using stop motion techniques on a customised filming rig, in an additive process. The rig allows each frame to be filmed and moved backwards along a 'z-axis', while the new frame is captured. The process is repeated until all the frames have been filmed, each remaining visible for a number of frames[106]. Pausing the sequence at any point in the animation will display a range of motion rather than the single, discrete frame as in a standard animation sequence. The aesthetic is comparable to Marey's multi-exposed chronophotographs or the 'onion-skinning' technique used in digital animation software. What is most significant about this technique for my research is that simultaneity and movement are inherent in its design. As I will show, animated films using strata-stencil tend to focus on exploring movement and emphasise it through their narratives. Through the additive layering technique, they present the viewer with unfolding movements in a manner that is mesmerising and captivating.

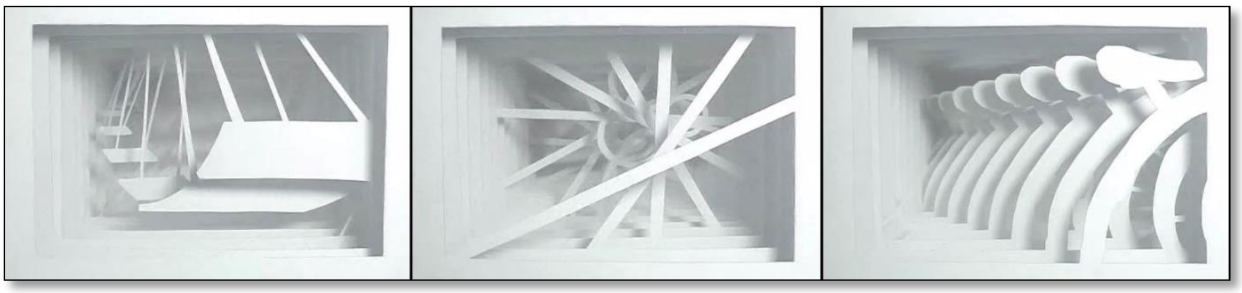


Fig. 51. Stills from Javan Ivey, director, *My Paper Mind,* experimental animation, Vimeo, 2008.

When developing the technique, Ivey drew inspiration from the strata-cut animation technique initially experimented with in the early 1920s by German animator Oskar Fischinger's 'wax slicing' technique, and later refined by Californian animator David Daniels using clay (Furniss 52). Strata-cut is a modified-base technique where the 'animation' is embedded in a mound of moulded substance (usually clay), in an intricate sculpting process. The transformation of the image occurs on the surface of the mound as it is cut away in thin

layers, like slices of bread (or an MRI scan), resulting in a flat two-dimensional surface. The camera is placed in front of the clay block and captures each layer in stop motion as each layer is sliced away. The resulting animation is predetermined by the inner nature of the sculpture itself, and does not allow for much spontaneity during the production process (Furniss 52). Daniels describes the technique as "motion sculpture" (qtd. in Ulloa), explaining it in the following way:

> Strata-cut in its simplest form is this: if you take a cone and cut it away with the camera looking down from the top, a dot becomes a larger and larger circle … That is the first principle, and everything else follows from that. It's really the controlled use of shapes as opposed to animating shapes. (qtd in Furniss 52).

Because of the way the animation is created, the animator has to have an instinctive sense of movement very different from standard animation practice. The complexity of the process lends itself to abstract imagery, and bold colour that flickers on every frame. This kinetic flickering and jarring movement is inherent to the technique, and can be visually overpowering. Daniels uses this aspect as a conceptual device in his works: "I was trying to seduce and abuse them (the audience) at the same time. It was very hypnotic and very sensual but also aggressive and angry because it is trying to keep your attention at all costs" (qtd. In Ulloa). Daniels perfected his strata-cut animations to the point where he employed pose-to-pose animation techniques in the design of the movement within the clay loaf, and is even able to apply lip syncing in his work (Daniels 00:02:32-00:02:47).

Ivey's strata-stencil technique borrows from strata-cut's concept of layering, but uses the paper stencil as a medium. This introduces negative space, which can be manipulated to explore the backward movement of the frames on the filming rig. It is plausible that Ivey could have chosen to photograph each individual frame one at a time (in isolation), but the charm of the technique and the way it directs the viewers' attention to movement would have been lost. Strata-cut is only able to display the standard 'one frame at a time' because of the nature and density of the clay, but the negative spaces allow strata-stencil animators to explore characteristics of movement that are normally imperceptible to the viewer. Ivey emphasises this in an interview describing the seductive nature of paper and the

transformation from a line to a shape, and how those shapes can then become objects that change throughout the additive process (MarBelle 00:05:05–00:05:54).

The process of a handmade strata-stencil film is quite rigid, in that the animator creates the animation traditionally in a frame-by-frame manner on paper, designing the movement according to keys and breakdowns. These shapes or figures are then cut out of the paper to create a stencil for each frame. Some animators might find it difficult to envision the outcome of this receding movement (which is not normally seen in standard viewing practice), and the resulting effect is often left up to chance. Ivey states that he prepared reference for the design of the animation digitally[107], mostly for the purpose of showing work in class and "laying things out", but not for the purpose of mimicking the receding effect (MarBelle 00:12:23-00:13:46). He elaborates on how the process of using paper is more tactile and offers more "feeling'" to the animation, bringing new ideas to the creation process (00:13:46-00:15:20). Because of these unpredictable characteristics of the handmade approach and the materiality of the process, the 'handmade strata-stencil' design and process is inherently experimental in nature. This has led many strata-stencil animators[108] to explore abstract shapes, discovering 'new' unanticipated shapes created by the receding technique (fig. 52).

Ivey's film in particular explores abstract forms and his personal "memories" in a montage style (Scully). Most strata-stencil animations employ the 'montage sequence' film technique, where varying images are joined by the dissolve effect that strata-stencil naturally employs. 'Dissolves' in filmmaking are created when one image transitions into another using editing techniques. In strata-stencil, this equates to the two images transitioning by means of the technique – that is, the receding frames become the 'dissolve'.

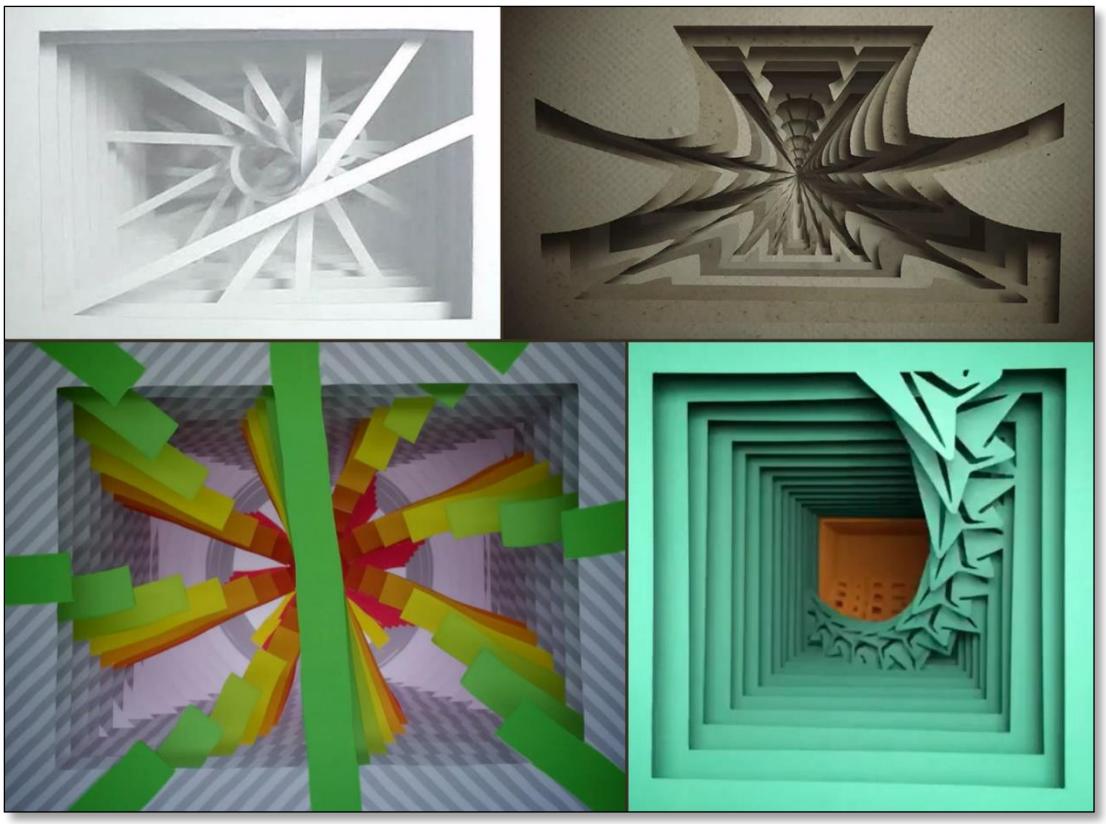


Fig. 52. Examples of the visual explorations of abstract shapes in strata-stencil films.
Top left: Ivan Ivey, *My Paper Mind* (2007) – handmade; top right: Gabriel Kempers, *Madam Butterfly* (2012) – digital; bottom Left: Elliot Jokelson, *Bonnaroo* (2009) – handmade; bottom right: Dylan Blau, *Strata Paper* (2013) – handmade.

Some strata-stencil animators have explored figurative images in their work (fig. 53), notably *The Me Bird* (2013) by Gabriel Kempers. The film is a visual interpretation of a poem that describes a ballerina on her journey towards freedom (Kempers Vimeo). Although created digitally, the animator has introduced different-coloured handmade paper textures for each 'stencil', adding to the visual aesthetic of the rather simplistic digital stencils. The introduction of texture to the digital images helps emphasise the idea of materiality in the film, even though it is a digital product. It is evident that the animator has used live-action footage for the animation of the ballerina's movements, which seem to be realistic in nature. Similarly, the design agency Fragstein Berlin employed the director Florian Stumpe to create an advertisement using the strata-stencil technique for their Sony/ATV *Happy Holidays* campaign (2012). For this work they also employed live-action footage for the animation of the characters, but used the handmade approach to the strata-stencil technique, working with paper and laser-cutting for each stencil. The advertisement uses montages of icons of live music (such as stage lights, a microphone stand, and a hand

playing a guitar), culminating in a crowd of people enjoying themselves at a live music concert. The crowd's movements are realistic, but the strata-stencil technique creates the notion of depth and the masses of people in the crowd.



Fig. 53. Examples of the use of green screen footage for the movement design of figures. Top: Gabriel Kempers, *The Me Bird* (2013) – digital; bottom: Sony ATV *Happy Holidays* Advert created by Fragstein Berlin and Florian Stumpe (2012) – handmade.

When addressing different materials that can be used for the handmade version of the technique, Ivey describes the importance of materiality in his film *My Paper Mind,* which lead him to use paper (MarBelle 00:04:34-00:05:54). He explains how the process itself was integral to the piece and that its material nature gave "texture" and "soul" to the animation (MarBelle 00:13:48-00:14:14). Other animators have experimented with various materials for their strata-stencil films. The Japanese music video for the song "Kitachi" (2012) by Shugo Tokumaru and directed by Polish director/animator team Kijek/Adamski explored the sculptural possibilities of the technique (fig. 54). In 'the making of' video available on Vimeo, the team created the frames digitally using Adobe After Effects and Illustrator and then used polyvinyl chloride[109] (PVC plastic) as a base material (Merlo). Each frame was cut out using a CNC Router. The pieces (or frames) were laid on the floor one at a time and photographed using stop motion. Kijek/Adamski chose to keep every frame of the animation present throughout the entire video, creating a sculptural work which was emphasised through varying the camera angles at certain points. Because the 'new' frames were placed in front of those which had passed, the camera needed to be moved backwards incrementally between every photograph. Although the work has not been labelled as strata-stencil, it clearly uses the same concept as Ivey's paper version, only modified and using different materials.

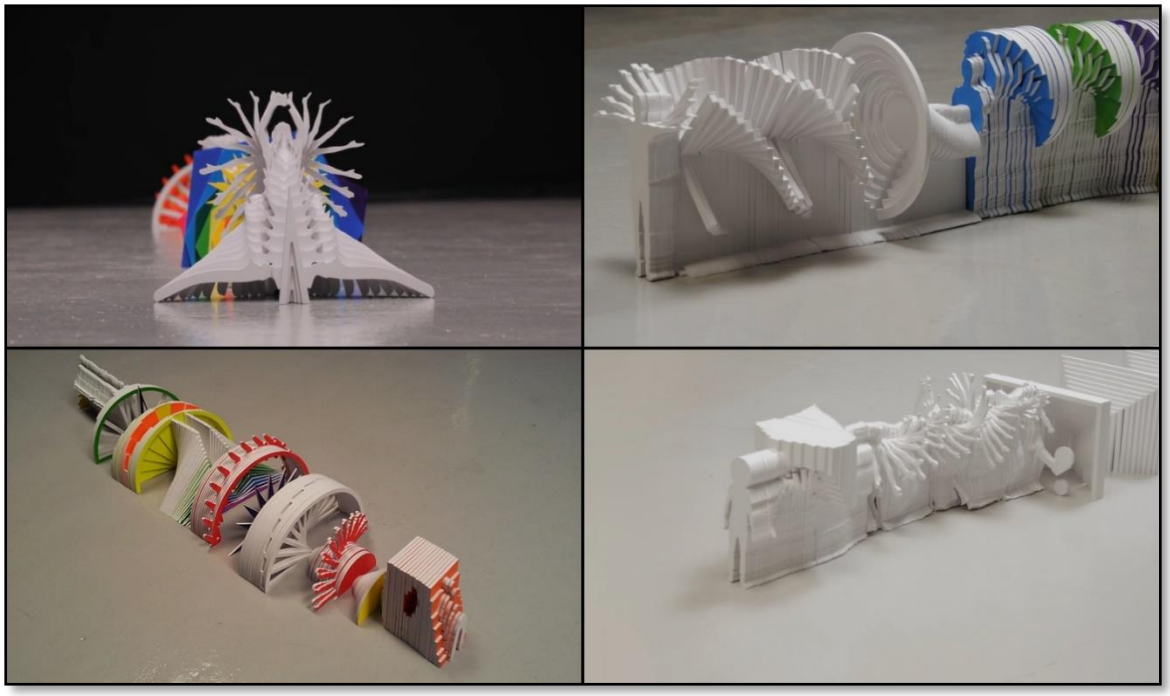


Fig. 54. Screenshots from music video *for* "Kitachi" by Shugo Tokumaru, directed by Kijek/Adamski (2013), that uses PVC as a base material for each frame.

Despite these examples, the strata-stencil technique is still relatively new and under-explored in the field of animation. There are a handful of examples on the internet (provided in Annexure A), which mostly explore the realistic movement of figures using live action/green screen footage, or abstract shapes and dissolves. Perhaps this is because of the demands of the labour-intensive handmade process, or the limits the technique has for extended narrative storytelling. However, for me the strata-stencil technique encompasses the visual elements and mechanics required to explore animated movement and its modes of construction, by revealing the consecutive frames of the animation. It is also well suited as an animation technique for examining issues of time, particularly for analysing the relationship between moments in the present and in the past, and is therefore a unique approach for experiencing motion and methods of perception in the animated medium. In addition, the materiality of the medium allows for the physical creation of each individual frame, that can provide paper frames for further analysis. This offers the possibility for exhibiting the frames in a public space, where varying presentation formats can be explored.

The material conditions that govern the process also appeal to my personal engagement as an artist with the sensual qualities of paper as a medium. As an ex-hand-papermaker[110], the physical nature of paper – its interweaving compressed fibres, the natural colours derived from its fibre source, the texture derived from the felts during the drying process, and the smell of the chemicals and fibres used in production – that is evident in every handmade sheet, will always resonate with me and inspire my passion for art making. Other than cut-out, stop motion or drawn animation techniques, there is little opportunity to explore the paper itself as a medium in animation. Strata-cut has much to offer the animator in terms of exploring time, modes of construction and materiality.

4.7 Chapter conclusion

With the examples listed above, although educational in nature the *Animator's Survival Kit*[111] offers a wealth of visual stimuli for aesthetic possibilities of revealing consecutive frames in an animated sequence. In addition, I have identified that strata-stencil animation has the potential to be the animated technique to complete the task. But in doing this, what could it reveal? What would it say about the animated action being represented? The extreme nature of the Warner Bros. Studio's animation style has long intrigued me as an animator, but I have always been dissatisfied at how most of their innovative techniques get lost in standard viewing practice. As an animator it is typical to pause and scrub through animation or live-action frames at a slower pace, in order to learn from them. This observational process began to simulate my chronophotographic understanding of animation. Revealing the poses that simultaneously make up an animated movement enabled me as an animator to better understand how animated bodies move. It also showed the potential of revealing the invisible frames or magical 'moments' that give meaning to animated movement.

What then became fundamental to my research was the question of how the aesthetics of animated movement could be explored through this process. As previously mentioned, St George proposes that we can use the 'gaps' as an **opportunity to change the 'picture' for a slightly different 'picture'**, and the strata-stencil technique offered me an opportunity to

examine the effect of keeping a frame visible for long enough for the viewer to experience the succession of frames that make up an animated movement. I therefore ask, what does this process do to the animated motion? What will it look like? What does it reveal? These are some of the questions that I address and that have been explored through the development of my creative practice.

Chapter 5 will explore this line of questioning further, by presenting and explaining my creative practice in greater detail and evaluating the results of the practice according to the questions raised in this chapter. The focus of my creative project is therefore to explore methods of exposing animation's construction by developing and expanding on the strata-stencil method of viewing. I have summarised the reasoning for this:

- Firstly, to assess if the technique bridges the 'gap' between the still and the moving image – can this method of viewing affect St George's concepts of spatial and temporal acuity and economic assumption/montage?
- Secondly, this project is an opportunity to assess whether a chronophotographic study is possible in the animated medium – can viewing 10–12 consecutives frames of an animated sequence (in motion) offer the viewer additional information about how that movement is constructed?
- Finally, to determine if the technique developed for this project offers any opportunities for further aesthetic exploration – can a process that reveals the consecutive frames of an animated sequence enrich the animation experience? Can the film become more about *how* it is viewed rather than *what* it is representing?

In this chapter I have begun to unite the concepts and practices of chronophotography and animation through an evaluation of how the viewer experiences movement in the still versus the cinematic format, and examined the creative potential of their synthesis. I argued that through altering modes of viewing practice, one can productively influence the viewer's experience. By using St George's theory of how animation and cinema produce the illusion of continuous motion, I unpacked the different visual formats of chronophotography and

animation. I argue how this understanding can be used to exploit the way we see things, and in this research in particular, ***how we view animation***. I also identified and evaluated the potential of the strata-stencil animation technique as a tool for exposing the construction of animation for the viewer, as well as its material nature for further artistic exploration. I found that the strata-stencil technique has the potential to provide the creative practitioner with opportunities to explore questions of time, space, duration and speed. By using my own development of this technique, this creative research project will address the *mechanics of perception* and *modes of viewing* through both the still and the moving animated image.

Chapter 5

The Creative Practice – *a[CHRONO]mation*

In this chapter I present my aesthetic engagement with chronophotography and the creative project that emerged as a result. Using my findings from the research, I apply my theories discussed in Chapters 1–4 to determine whether a chronophotographic study in the cinematic medium of animation is possible. Inspired by the presentation formats of Muybridge and Marey, I also explore static modes of representing animated movement. Together, these works aim to elicit aesthetic pleasure and delight from the viewer by focusing on *movement* itself. In addition to this, they serve to educate the viewer on how animation is made. By revealing my 'modes of construction', the viewer is able to observe parts of the design process that normally go unnoticed in standard viewing practice due to the limitations of perception. This creates a novel viewing experience – one that is unique to the animated medium.

St George's curatorial efforts for the exhibition *Sequences* focused on artists that explored contemporary chronophotographic techniques and the "aesthetics that operate at the intersection of time and space" (1). These artists entered a dialogue with the notion of the series, simultaneity and aesthetics. Their work represents a contemporary engagement with chronophotographic concerns, most of them using digital technologies to inform their artistic practice. Inspired by the work from the *Sequences* exhibition, I have produced work that also addresses chronophotographic issues but applied to animation, a medium that was not explored by any of the artists on the exhibition.

My engagement with chronophotography has been inspired by three aspects of the nineteenth-century practice. Firstly, I was drawn to the experimental and investigative nature of chronophotography. Mazière states that chronophotography failed "to develop as a fully resolved practice" which (I concur) inspires further experimentation using contemporary techniques and technologies (viii). This interest in experimentation led me to

develop a hybrid animation technique to address my interest in the representation of animated movement, and inspired me to circumvent the restricting conventions tied to the standardised animation creation and viewing process. My aim was not to develop a technique to replace or add to the animation pipeline, but rather to create an experimental pipeline that could provide opportunities to explore the construction of animated movement itself.

Secondly, chronophotography raised more questions about the mechanics of perception than it provided answers for. The different approaches employed by nineteenth-century chronophotographers for capturing movement, the contrasting methods they used to present their results, and how this affected viewer engagement are fascinating for me as an animator and artist. Chronophotography provided the means for investigating the visual elements of movements that are imperceptible with normal vision. This approach is also familiar to the animator and fundamental to our process of designing animated movements. My aim was to explore the relationship between the still and the moving animated image and to reveal what lies between, using varying representational practices informed by chronophotography.

Lastly, and perhaps most significantly, the aesthetic opportunities which chronophotography affords artists is alluring, and raises questions around how images speak to us. The visual aesthetic of Marey's multi-exposed images was something I wanted to emulate in moving-image practice. Like McLaren's *Pas de deux*, the potential of revealing movement as it unfolds before the viewer is aesthetically fascinating as well as enlightening. McLaren's work helped me see chronophotography as an opportunity to escape the traditional modes of cinematic representation – the practice of viewing one frame at a time – thereby challenging the viewer's customary reading of the work. In addition to Marey's multi-exposed aesthetic, Muybridge's sequential presentation of images offered further opportunities for exploring these aspects. I discovered that by applying chronophotographic practices to animated movement (in the still and the cinematic format), there was potential to educate an audience on how animation is made; a form of 'process representation' or

revealing my 'modes of making' as discussed in Chapter 4. By juxtaposing chronophotographic techniques with animated sequences in my work, I want the viewer to focus on the representation of movement in animated cartoons and make their own connections and commentaries on animated movement.

There are two components to this creative practice that address my research concerns in different ways. For the first component, I created an **experimental animated short film** using contemporary digital technologies to enrich the strata-stencil animation technique, in order to focus on animated movement in a cinematic medium, thereby revealing my 'modes of making' for the viewer. For the second component I curated the animated frames from my film-making practice for a **public exhibition** that explored various modes of static-image representation, and further questioned their validity as a chronophotographic study in contemporary animation practice. Together the work, entitled ***a[CHRONO]mation,*** encourages the viewer to question the relationship between the still and the moving image and appreciate the aesthetics of seeing the exposed movement. In addition to this, ***a[CHRONO]mation*** acts as an educational mechanism for both animation and traditional chronophotographic practices***.*** This Chapter outlines the design process that was employed in this project and critically assesses the outcomes by addressing the questions raised in the previous chapters.

5.1 Sources of inspiration

From the outset I intended to develop a hybrid animation technique that fulfilled the research requirements and would meet the materialist aesthetic I was aiming for. This became the technical approach I would use to achieve the creative outcomes for the research. As a digital artist, 3D animation was the method I would use for creating the animation. I identified that digital 3D animation would be able to fulfill the needs of the research and be easier to execute because of my experience in the software. There were also many advantages[112] to using a partially digital pipeline, that I explain in detail below.

As discussed in Chapter 4, the animation technique that I identified to address the research questions was the strata-stencil animation technique. The main reason for this choice was because of the potential which the technique offered for examining and revealing animated movement. I aimed to use Ivey's traditional method of creating each frame out of paper, because of my passion for the material and my intention for the exhibition. However, instead of hand-cutting the frames, as Ivey did for his project, I chose to introduce the process of laser-cutting each frame – the same approach taken by Fragstein Berlin and Florian Stumpe in their Sony/ATV *Happy Holidays* advertisement discussed in Chapter 4. With an abundance of laser-cutting experience[113], I identified the potential for using the digital information from the 3D software to facilitate the laser-cutting process[114], thereby bridging the technical gap between the digital and the material product.

Initially laser-cutting did not seem like a workable solution for the production of the film, because of the demanding technicalities and the rigorous nature of creating each frame individually. However, when the retail corporation John Lewis & Partners released their Christmas television advertisement in 2013 called *The Bear and the Hare*, the possibility of using laser-cutting as an animation tool was confirmed for me. This Christmas advertising campaign (that began in 2007) became an annual tradition, attracting widespread media coverage and resulting in great anticipation for its release each year. As a result of this public interest, experimental methods for creation of the advertisements were explored over the years of the campaign. Most of the advertisements use the combination of live action and animation techniques to focus their message on the 'magic' that encompasses the season. For production of *The Bear and the Hare*, the world-class animation studio Blinkink[115] introduced an animation technique that had never been used on this scale. Using traditional 2D animators to create each animated frame on paper, the characters for the advertisement were then digitised, printed and laser-cut in a frame-by-frame manner. Each frame of the laser-cut character was then placed into a hand-built set, one at a time and filmed using stop motion. Closely studying the process detailed in the 'making of' video on their website, I was able to visualise how 3D animated renders could develop into tangible animated frames. From this point, I initiated my own approach to a pipeline that suited my skillsets and interests.

As an artist, I also work with laser-cutting technologies which carry an abundance of aesthetic and material choices. Laser-cutting materials can range from paper to wood, plastic, fabrics, metals and stone, to name a few. Keeping processing times, cost, storage, framing and my previous profession[116] in mind, I decided to use paper as the base material. The paper itself comes in different colours, thicknesses, qualities and textures, each with their own aesthetic and archival properties[117] and a varying range of limitations for cutting[118]. I drew a lot of inspiration from the laser-cut artworks of Associate Professor Eric Standley from the School of Visual Arts at Virginia Tech. As seen in fig. 55 and fig. 56 below, Standley creates multi-layered stacked laser-cut artworks from paper that are delicate and extremely intricate in design. Drawing informs his compositions, which are created by removing material from each individual layer of paper and pre-visualising the sum of the layers as line, colour and space (Standley "About"). On his website, Standley explains how the layers are then assembled to form the elaborate patterns which are inspired by geometry from Gothic and Islamic architectural ornamentation(Standley "Either/Or Newmarch"). The use of colour in his work is subtle, letting the light and shadows determine the intricacies of the design. Standley is "interested in the conceptual migration from the permanence and massiveness of stone to the fragility and intimacy of paper" (Standley "Either/Or Newmarch").

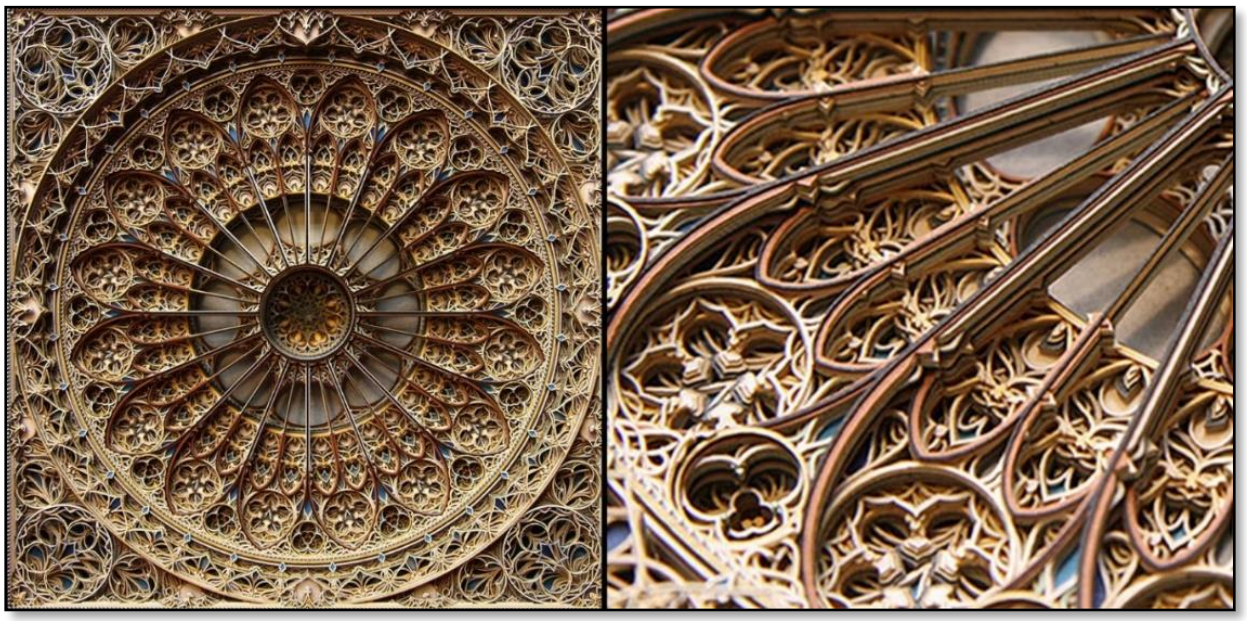


Fig. 55. Eric Standley, *Either/Or Newmarch,* 2013 (detail on right), cut paper, 20" x 20".

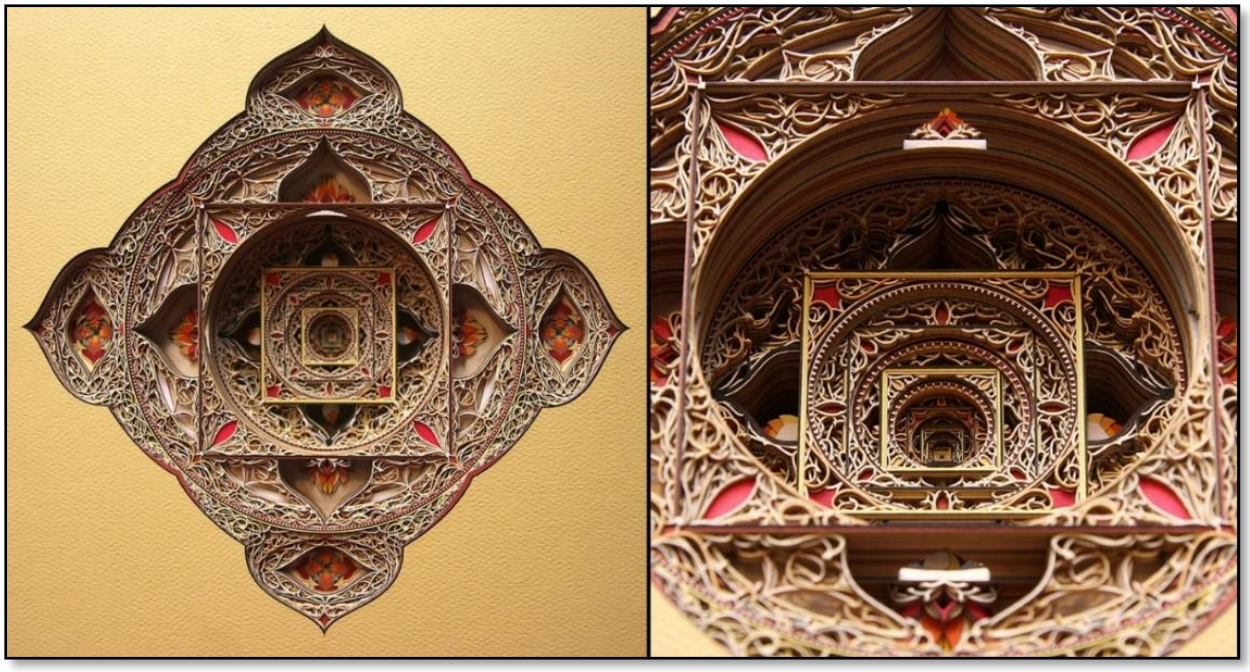


Fig. 56. Eric Standley, *Zeno of Elea*, 2013 (detail on right), cut paper,. 20" x 20", Marta Hewett Gallery, Cincinnati, Ohio.

Standley's work appealed to me for two reasons. The layering of his stencils created an effect that was visually intriguing and, to some extent, similar to the strata-stencil technique. I was drawn to the way in which each image relied on the subsequent layers to read as a complete picture. Although the work is static, non-figurative and does not address issues of time and movement, the depth and cohesiveness of the multi-layered look he achieves in his work is mesmerising. I am also attracted to the subtle use of colour in his laser-cut assemblages. Working mostly with natural papers, Standley accentuates certain aspects of his images with a few carefully chosen colours. The naturalness of the paper also emphasises the distinctive laser-cut quality: the laser-burn is slightly visible on the surface and the edge of each cut-out. Laser-cut artists often focus on different qualities of the burn to enhance their work. Standley uses it subtly, yet effectively, in a manner which enhances the depth and emphasises the layering aspect.

Another artist that uses laser-cutting in a manner that inspired my work is Anila Quayyum Agha. Her work entitled *Intersections* (2013) uses light and shadow as part of her installation. The work shown in fig. 57 below incorporates an intricately laser-cut box made

from wood, painted black with a bright light suspended inside it. The light projects the shadowed laser-cut designs onto the white walls, floor and ceiling, immersing the viewer. I am particularly drawn to the way Agha has used light and shadow to such a dramatic effect, and how this showcases the beauty of her elaborate laser-cut designs. The work was inspired by her experience of exclusion in Pakistan, where culture dictated that women were not allowed to enter the mosque, a place of creativity and community (Rice Gallery "anila-agha"). Agha's work welcomes people of all cultures, denominations, race and sexuality to experience the space, where discrimination is not present (Walley "Intersections"). I am particularly drawn to the monochromatic nature of the work. Her unobtrusive use of colour, controlled by the light inside the box and the influence this has on the environment is deeply captivating. Again, like Standley's images, although Agha's constructions have no direct relationship to the strata-stencil technique, the quality of light and shadow using laser-cut materials is was what drew me to her work.



Fig. 57. Anila Quayyum Agha, *Intersections* (2013).The work has been exhibited at several galleries, where the unique spaces have affected the look of each installation. This version was exhibited at the Rice Gallery in 2015.

5.2 The hybrid animation process

By looking at the works discussed above as sources of inspiration, I researched the artists' approaches and techniques, and conceived my hybrid[119] animation process: I would create an experimental animated film using the strata-stencil technique by animating characters using digital 3D software. Then I would convert the 3D renders into vector designs, which would be used to laser-cut each individual frame. The frames would then be captured by applying stop motion techniques, using my own approach to the strata-stencil filming rig. This section outlines each step of the hybrid animation process that I developed for the production pipeline.

Refer to the following videos for this section of the discussion:

Video 5.1 Experimental Short Film *a[CHRONO]mation*
Video 5.2 Timelapse of Creative Practice
Video 5.3 Timelapse of Strata-Stencil Process

5.2.1 The analysis of cartoon movement

The main goal of the creative project was to investigate animated movement from the Golden Age of American animation that was informed by the chronophotographic concerns highlighted in Chapters 2–4. The start of this process involved identifying films by notable directors[120] from the Golden Age that were most representative of the era, and used innovative animation techniques as discussed in Chapter 3. Through examining hundreds of short films, pertinent shots were scrutinised in a manner similar to Muybridge's visual investigations of his moving subjects. This process was done to identify the most appropriate graphic representations of animated movement to be included in my film. In this selection process I was searching for specific characteristics in the animated cartoons. Firstly, the characters' movements needed to display some unique attributes in their design in order to address the questions raised in the study. This could encompass one of the following:

- **Unusual 'pose designs'.** This refers to distinctive approaches to representing the 'moments' of an action. An example of this was discussed in Chapter 3 when

analysing Freleng's extreme poses in the action of pitching a baseball (frame 36 in fig. 26).

- **Distinctive uses of timing.** This was a primary concern of the Warner Bros. animators, as discussed in Chapter 3, both in Freleng's approach to the baseball pitch and Jones' use of timing in *The Dover Boys*.
- The inclusion of any **abstract interpretations of a movement** that could be revealed through the hybrid technique. I referred to these in Chapter 3 as the 'imperceptible frames' that go unnoticed in standard viewing practice. Examples of this are the 'smear' frames discussed in Chapter 3.
- **Humour in the shot**. The Warner Bros. directors were recognised for their distinctive, fast-paced and absurd style of humour, as discussed in Chapter 3. I wanted to use these memorable examples to evoke a nostalgic delight in the viewer.
- **Use of the principle of 'exaggeration'.** This era of animation was key to differentiating the medium from live-action film. For me, the principle of 'exaggeration' played a pivotal role in this distinction, and I wanted to make it central to my work.
- **Utilisation of graphics.** This refers to the animators' drawing techniques and the consideration of how I would interpret the technique in the laser-cut/engraved format. For instance, it was not possible to translate some drawing techniques (such as shading or subtle colour) into a laser-cut design.
- **Classic representations[121] of animated movement** where the animation principles were evident. As part of the pedagogical objective, I considered it important to include these representations in the work.

The second consideration was to identify movements that demonstrated potential for the strata-stencil technique, that is, would the movement be enhanced if the consecutive frames remained visible for one second? For this process I envisioned how each movement could look using this technique, as digital replication[122] was too time-consuming to test. As an experienced animator I have a good understanding of how a movement could look chronographically (mostly through years of using the 'onion-skinning' tool), and my

knowledge of the frame-by-frame design process facilitated this assessment. So, to achieve this multi-exposed effect using the strata-stencil technique, I was looking for shots that featured fluid arcs of movement and interesting uses of timing. For this 'flow' to work appropriately, the precise placement of the animated characters in the frame were crucial, as their bodies should not block the receding figure and obscure the movement. Shot selection was therefore a complicated, intuitive process that was informed by my training as an animator. The findings would therefore only begin to reveal themselves via the progression of the process: as the selected characters were isolated[123], then replicated[124], and the laser-cuts created and stacked in a frame-by-frame manner, only then did each animated movement begin to reveal its structure.

The final aspect that influenced shot selection was the music for the film. The music is a licenced track from the royalty-free, exclusive music library called *Premium Beat*. The tune selected is an upbeat, lively piece of music that is reminiscent of soundtracks from animation of the Golden Age. Because the track was selected first, the characters' movements needed to fit the beats and duration of the music. This became restrictive, as very specific types of movement with a precise duration[125] were required. The selected actions also needed to fit the accents of the music, adding to this complicated process.

Similar to Franks' work, this part of the research process became a close examination of the individual frames that made up the identified shots. In 'scrubbing' through the cinematic sequences one frame at a time, then reconstituting the movement in real time, and pausing/slowing time in order to understand the movement holistically, the frame-by-frame enquiry became central to my process. This kind of observation is standard practice in animation and is akin to a chronophotographic analysis, in that each frame or 'moment' of a movement is isolated and analysed by referencing the other frames in the sequence. Although each frame is not seen simultaneously, as in Muybridge's sequential images or Marey's multi-exposed format, the 'scrubbing' process provides the same kind of information required to understand a movement.

5.2.2 Character creation and animation

Character creation, animation and rendering was done using Autodesk Maya[126] software. The character design was motivated by the source footage[127] under investigation. The shots were selected for movement analysis and not for character appeal or narrative opportunities. It was intended that the movements to be examined were derived from a prescribed number of characters[128], and that they were easily identifiable by a broader audience[129] to increase viewer engagement.

When addressing my approach to the character design of the project, I considered the visual language of graphic images and the impact this can have on the viewer. In animation the graphic representation of a character can take on many varying approaches, which can be influenced by the medium[130]. In Chapter 2 of *Understanding Comics*, Scott McCloud presents an example of simplification in character representation in order to unpack the visual language of comics (24-59). For his argument he presents various levels of abstraction applied to characters, that vary from realistic to stylised/simplistic representations of a face which are still recognisable to the viewer[131] (fig. 58 below). He says that it has become embedded in our culture to respond favourably to the visual language of the cartoon. He calls it a process of "amplification through simplification", which the artist uses to focus in on the details that convey meaning (30). This becomes a 'way of seeing' rather than just a 'method of drawing' – by focusing our attention on an idea rather than what we see directly. This is also the quintessential power of animation that, if exploited, can be a powerful tool for the animation director.

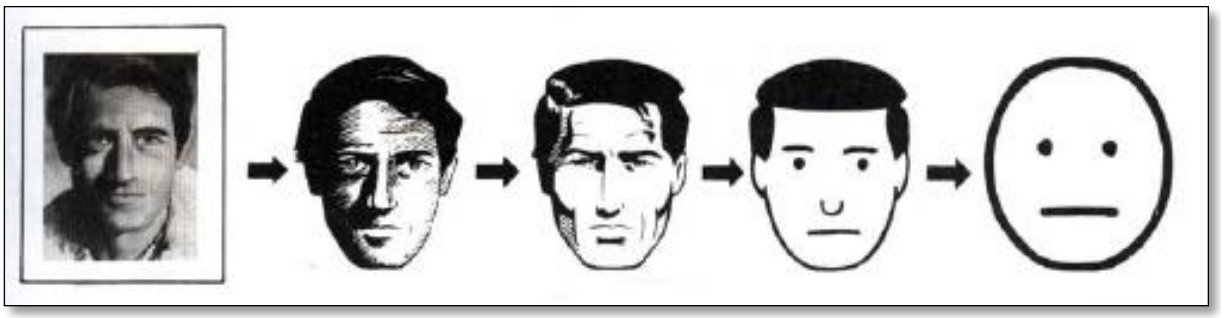


Fig. 58. Image from *Understanding Comics* (Scott 29) showing levels of stylisation of a human face from a photograph (far left) to a cartoon (far right).

This is a concept I applied and developed through representation of the characters in the film. The notion of establishing focus and exploiting an idea through methods of graphic simplification is what I aimed to achieve by using silhouetted characters[132]. By stripping the characters from their environments and narratives (fig. 59 – 01), and reducing them to simplified, silhouetted forms (fig. 59 – 03), their movements could be focused on and analysed. In the same way that chronophotography studied the movement of the body in an action, so the movements of the animated characters were emphasised through this process of simplification. It was found that the figures were more visually appealing when some details were included and this also helped clarify poses[133]. These details were interpreted as the engraved layer of the laser cuts (fig. 59 – 04).

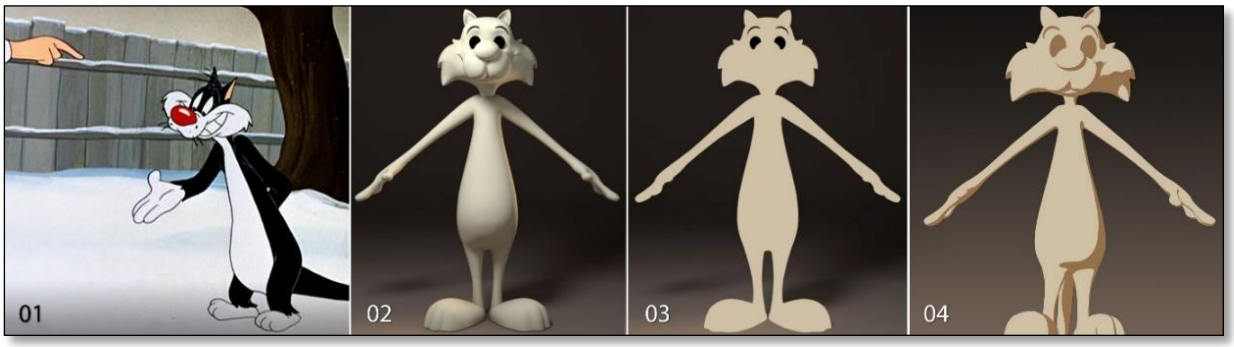


Fig. 59. The simplification process with Sylvester character:
01 shows a screen shot from *Tweetie Pie* (1947), directed by I. Freleng, with the character in context;
02 shows the 3D model, rendered with a standard Lambert shader and lighting;
03 shows the original silhouette cut-out approach, with only the eyes cut out; and
04 shows the silhouette cut-out with engraving to aid visual clarity (final look).

The reference to iconic characters from the Golden Age of animation was a deliberate decision that was made for a number of reasons other than simply as a result of motion analysis. That era launched the medium into popular culture, and in doing so remained on our television screens internationally[134] long after theatrical shorts became obsolete, lasting four decades from the 1960s to the 1990s[135] (Moss *Saturday Evening Post*). Many remember waking up to the 'Saturday morning cartoons', that included popular series like *Looney Tunes* and *Merrie Melodies.* This experience provided fond memories that many of us have cherished into adulthood. By reappropriating the characters from these films, my aim was to draw on these collective values and experiences through the reflectiveness of memory, provoking rediscovery and renewal with the characters and their personalities. Through doing this, there is the possibility of greater interest and engagement from the

viewer, allowing them to fulfil an active role in relation to familiar cartoon characters, so that a new experience and meaning can be established. By applying the silhouettes of the cartoon characters, they became instantly recognisable to the viewer. The characters are depicted mostly in extreme action sequences that contain some abstract motion representation, where the viewer is forced to question the reason for their existence in the film, further emphasising the lack of narrative and the focus on movement analysis.

Simplification of characters was further emphasised through the design that was developed to suit the 3D creation process. All the characters that were selected for motion analysis (through the frame-by-frame examination mentioned previously) were categorised into two body types: slender and tall, or plump and short. This allowed for poses to better represent the characters' original anatomy and remain visually consistent across the film. In terms of production, this optimised the 3D digital process, as only a single generic character needed to be built[136], then altered into the second body type. Once the two body types were established, the heads and feet were modified to further embody the original character. Some characters received extra components to help define them (like tails, ears, or tufts of hair). From this process only two character rigs[137] were built, with a single setting to switch between the characters' meshes, as needed. The only exception was the Road Runner character, whose anatomy was too unique to fit into either of these two body types, and a separate model and rig was built specifically for him. Fig. 60 shows the range of characters that were modelled for this project.

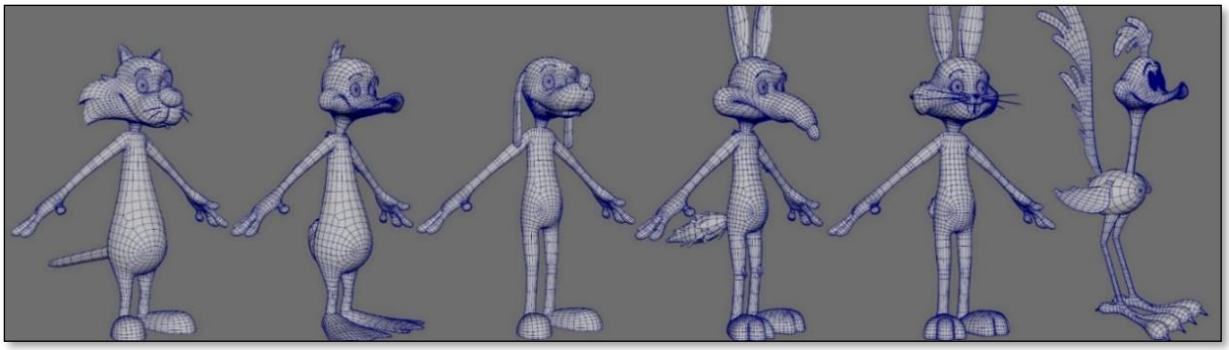


Fig. 60. The final characters modelled in 3D using Autodesk Maya.
The first two on the left show the plump and short body type and the three on the right show the tall and slender body type. The Road Runner design, that did not conform with either body type, is shown on the far right.

Fig. 61 shows the initial character adaptations and how they were planned to retain the same base head-mesh. The simplified silhouette style took the focus off personality, to shift the emphasis to their movements. The intention was to keep the visual link to their original designs, so that the viewer could make assumptions about the meaning of the work.

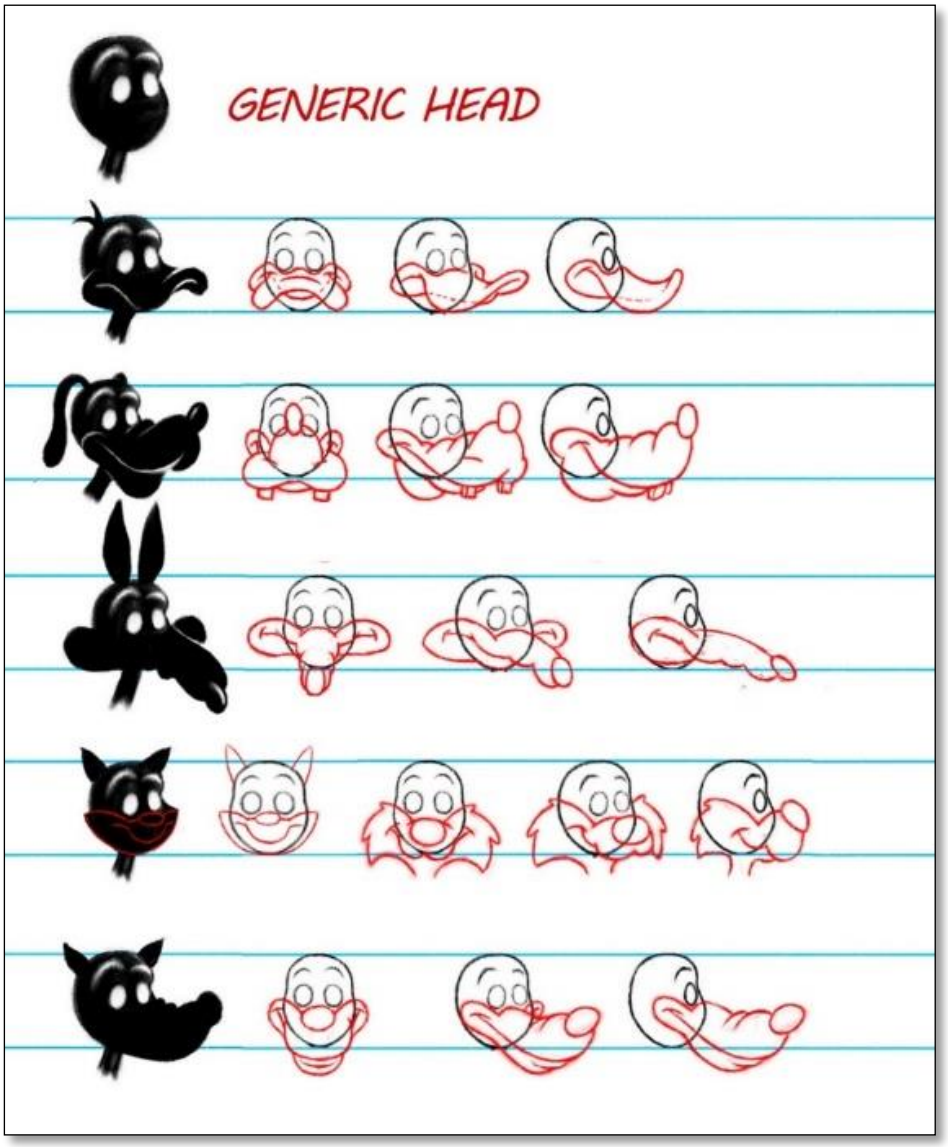


Fig. 61. Initial character sketches and mesh planning, created by Charl Smit in 2016.

Further modifications were made to the design for aesthetic reasons. Some of the characters were not appealing in 3D and required further definition (shape) to create more visual interest. Due to this technique, the characters' silhouette became the fundamental measurement for appeal and clarity of posing, which steered the design process into the final versions on screen.

When it came to animation, the first decision to be made was the choice of frame rate. Animators from the Golden Age mostly worked in twos, meaning there were twelve frames of animation created for every second of film. Each frame is then captured twice, to make up the 24FPS screened in the theatre. I therefore decided to work at 12FPS, which suited my production for two reasons: duplicate frames would have obscured a clear analysis of the original movement (derived from the source), and it equated to half the number of frames (compared to 24FPS) to be processed. Because the production is a hand-crafted process, it is extremely labour-intensive and time-consuming. Halving the number of frames made a significant difference, changing a 3800-frame film to a 1900-frame film.

Once the footage was sourced, it was used as a reference in Maya for the animation process. In video 5.2 and fig. 62 it can be seen how the animation was produced using the 3D character rigs. It was important to remain true to the original source, as an accurate representation of their movement design was essential in order to meet the needs of the project. Slight deviations in timing were only done to fit the selected music more appropriately.

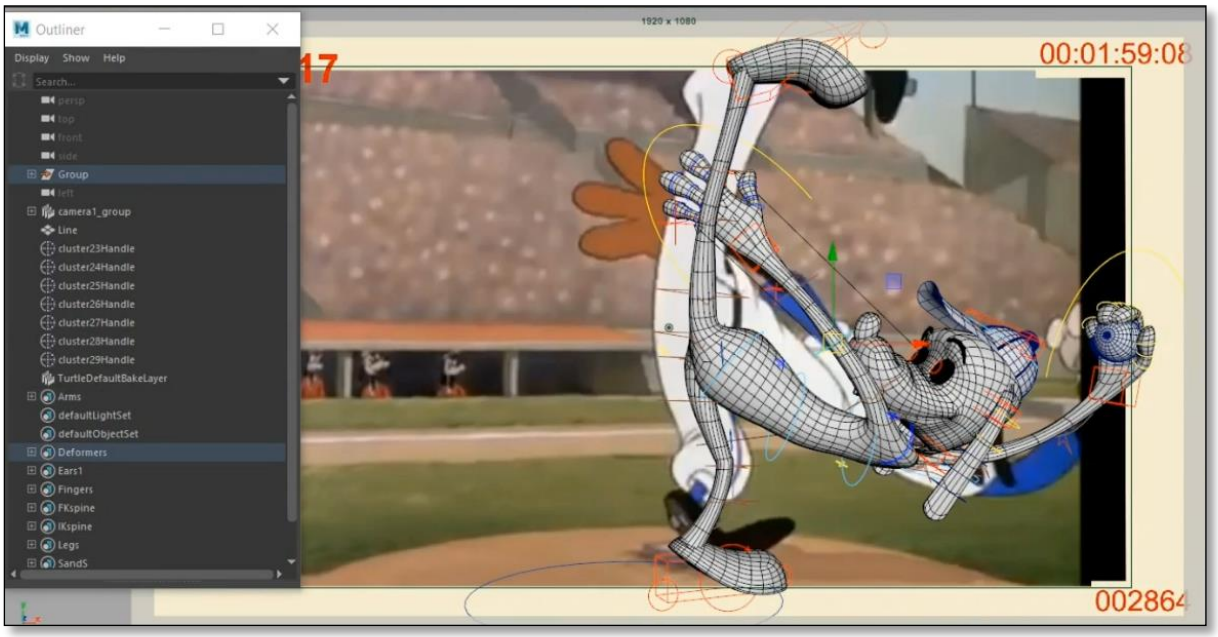


Fig. 62. A screenshot of the animation process, showing how poses and timing were reproduced from the original footage in Maya.

5.2.3 Rendering techniques

Rendering involved creating standard black and white high-resolution images to complete the laser-cutting process. This was an advantage over standard rendering processes for digital films that require the characters to be shaded and textured, with appropriate lighting in every scene. The simple black and white line information was then converted into vector images[138] for interpretation by the laser-cutting software. Fig. 63 shows an example of the final renders for a single frame. For the cut lines I only required black and white silhouetted images (left). The second pass incorporated the light-fill shader to provide the engraving information for the laser-cutter (right). The rendering of these images went very quickly, and I used Maya's built-in renderer for the process.

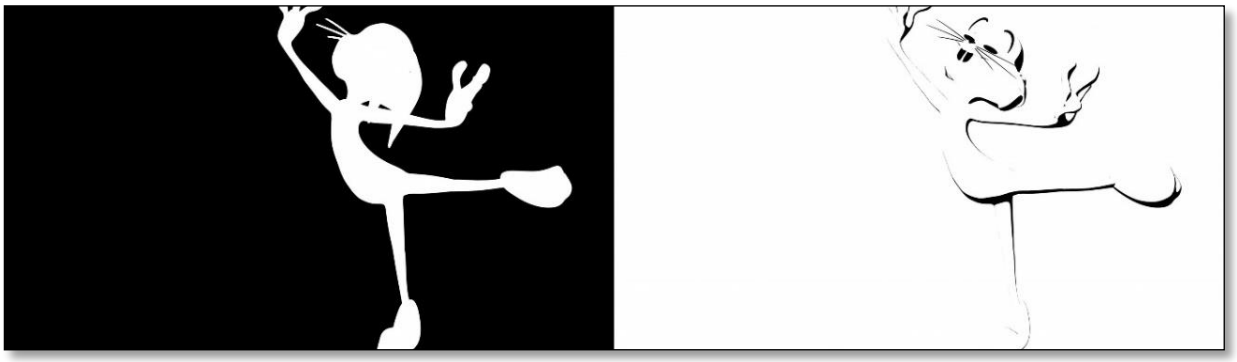


Fig. 63. The two Maya renders for a single frame of the film.
Left: The figure in black and white silhouette that provided the cut lines for the laser-cutting process; right: The light-fill shader render that provided the engraving information.

5.2.4 Vector conversion and preparation

Although the conversion of pixels to vectors is a relatively easy task when working with few images, the film required two renders for 1900 frames[139] to be processed. For this, a method of automation became essential. This was programmed using Inkscape, an open-source vector graphics editor. The vectors (two renders per frame) resulting from this process were combined and further manipulated in Adobe Illustrator[140]. Each vector was assigned varying RGB values, line thicknesses and fills, each to define a specific laser-cutting task, from processing order to cutting or engraving. The 2D effects, creation of the outer frames and animation adjustments were also completed in Illustrator, with processing times ranging from three minutes up to forty minutes per frame. Each stencil required the frame-

numbering to be engraved on it so that they could be stored in order so that the filming process could be executed seamlessly (fig. 64).

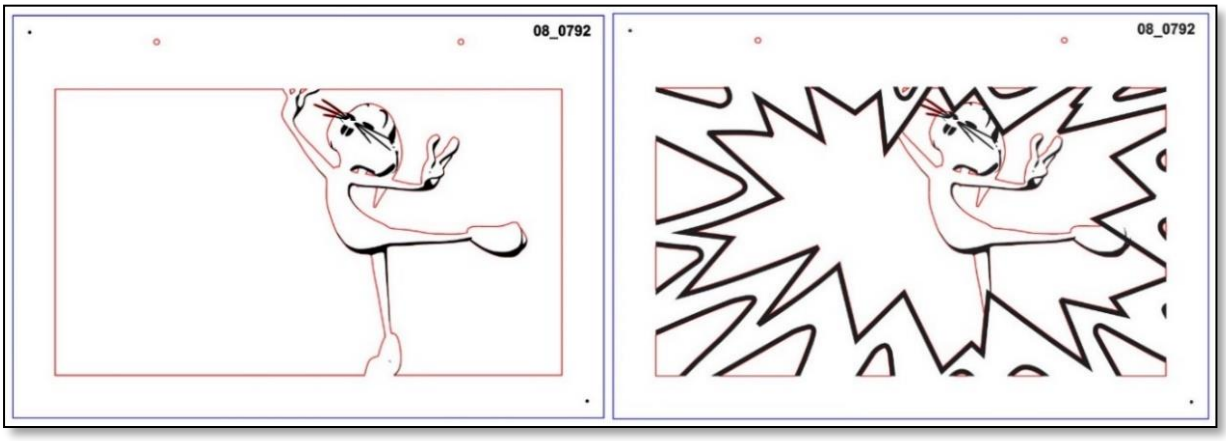


Fig. 64. Example of a completed Illustrator file for the same frame shown in fig. 63, showing the vectors required for the laser-cutter.
This specific frame required a 2D explosion that continued from the previous shot, so the vector shapes had to be further manipulated in order for the cutting to work out correctly. It also shows the engraved frame number on the top right-hand corner that was necessary to keep the sequences in the correct order.

5.2.5 Laser-cutting

Once the vectors were complete, each frame was laser-cut and engraved. For this I used the Rayjet 50, a 30 watt CO_2 laser-cutting machine. This is an Austrian design that is quite sophisticated and has high quality and safety standards. Despite the sophistication of the device, there is a very high risk of fire during processing, so the machine can never be left unattended. The process is quite manual in nature, requiring the operator to load and remove the paper before and after each cut, and to 'send the artwork' for each frame to the laser-cutter to print (much like a printing process). Despite the constant interaction of the operator to process each frame, the laser-cutting requirements complemented the digital animation process and allowed for the development of a workable production pipeline.

Suitable types of paper were tested prior to production for laser-ability, cutting quality and durability, as well as archival and structural stability, with consideration of costs and aesthetic potential. Laser-ability and cutting quality were considered the most important factors. When looking for a paper that is suitable for laser-cutting and engraving, thickness, flatness, cutting times and propensity to burn play an important role. The laser-cutting

process is defined in terms of the laser's power and the speed that the user specifies, depending on the material being processed. The thicker the paper, the slower the speed and the higher the power, thereby slowing the cutting and engraving times and increasing the risk of fire. If the paper is not environmentally stable and begins to cockle[141], it is not suitable for laser cutting, as the process comprises a focused laser beam set at a small but constant distance from the material. The laser then moves on the x and z axis of the material as it burns. If the material is not completely flat, it is in danger of being closer to the laser than required, thus being more able to catch fire (fig. 65). After all of the suitable available papers were tested, the aesthetic nature of the paper was considered, and the final paper was chosen. For this, texture, colour, potential for lighting, tonal ranges and contrast of the engraved lines were considered.

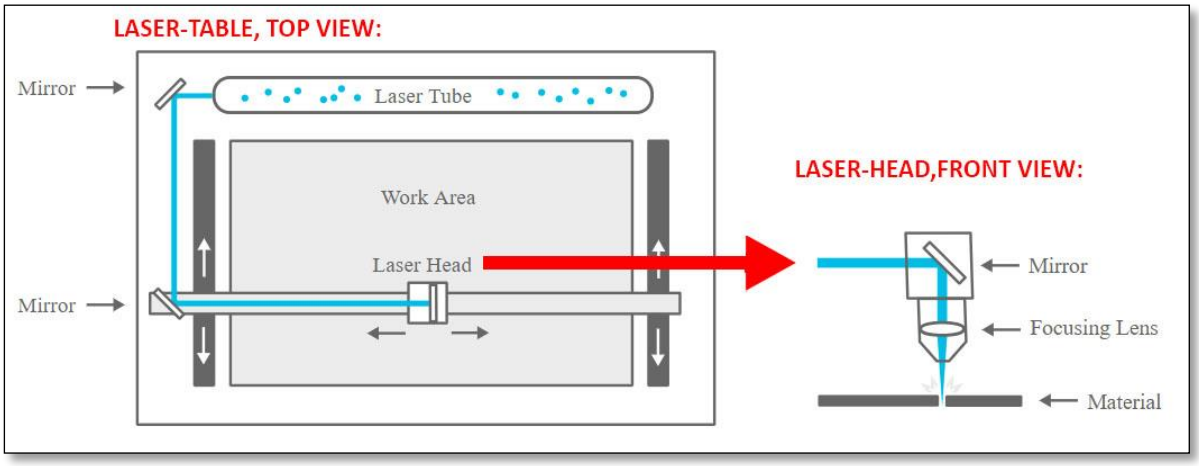


Fig. 65. Image showing the laser-cutting table from the top (left) and a front view of the laser-head. This illustrates the direction the laser moves (z and x axis) and the importance of flat materials (Maker Design Lab "How to get started with laser-cutting").

During the process the quality of the laser-cut line plays a very important role in the aesthetics of the film. Permanent in nature, they are burned into the paper, becoming the artist's tool for creating the images. Each stencil is made up of positive and negative shapes (or cut-outs), forcing the animator to concentrate on the silhouette, an important feature in the animation process. Thomas and Johnson state that animation is always clearer to the audience if the action is shown in silhouette (56). Because of this and the prominent effect it has in the strata-stencil technique, all animation went through a phase of pose-checking via black and white images, such as that seen in fig. 66.



Fig. 66. Screenshot from *a[CHRONO]mation*, showing how each stencil made use of positive and negative space and how important the principle of silhouette was to the readability of the figure.

Fig. 67 below shows how a stencil is made up of bridges[142] and islands[143] that are essential for creating the stability of the stencil. Hence image construction of each frame of the animation needed to be carefully considered. The outer frames (borders) were essential for containing each figure in action. If a figure became 'free-floating' (like an island) during a movement, it would need to be fixed with bridges, otherwise it could fall away and be unable to hang on the strata-stencil filming rig. For instance, a bouncing ball needed to be connected to a border or a character in order to remain part of the stencil.

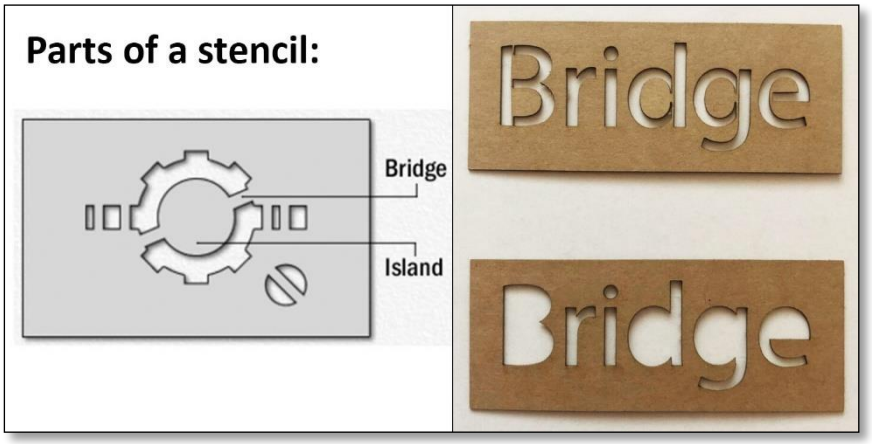


Fig. 67. Left: Graphic image showing the parts of a stencil (Vial "Painting Technique: Stencilling"; right: A laser cut showing what happens if a stencil does not contain bridges to secure the islands (Jackforge. "Beginner's Guide for Laser Cutting Stencils").

Because paper was the base material for the stencils, characters needed extra support by being connected to at least two parts of the frame, especially when the shapes were delicate or combined with larger shapes (making them unstable) (fig. 68). Connection lines (bridges) therefore became necessary to fix these objects within some of the frames. Although it was intended to edit these out in post-production, it was found that this would not be possible due to the receding nature of each frame, making this difficult. However, I felt that their inclusion was rather distinctive and further emphasised the nature of the materials used for the film – that could not succumb to further digital manipulation.

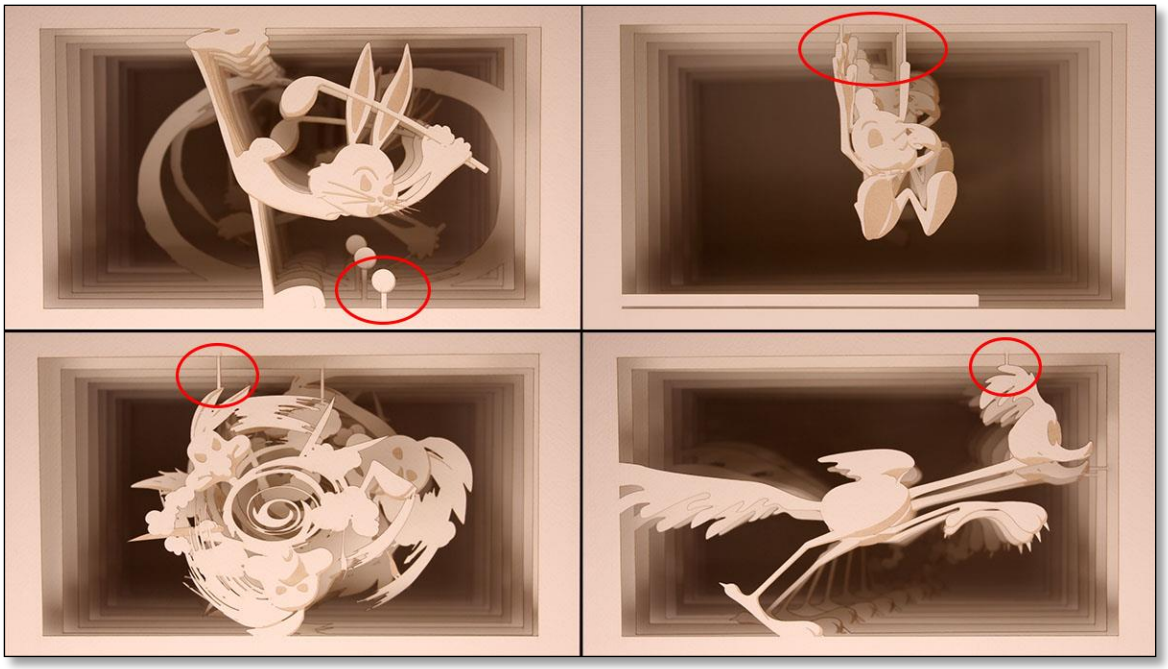


Fig. 68. Screenshots from *a[CHRONO]mation,* showing the need for connection lines (bridges) to keep the stencils intact for the filming process.

Engraving was used to add clarity to the poses and movement. Although the inclusion of engraving added significantly to the processing time, the value it added is evident in the final work (fig. 69). Had the cut-outs remained as simple silhouetted figures, I don't feel that the film would have had the same visual quality, nor would the work stand out among other strata-stencil animations. What makes this film unique is how I used laser-cutting processes to create something new and visually stimulating. On close inspection, the processing of the engraved lines provides a texture quality[144] rarely seen in creative paperwork. Even more intriguing is how the process of reducing a surface through removing a layer is applied to a

material like paper that is so thin and delicate. The amount of paper removed in the process is defined by the strength of the laser, and did make the frames more fragile. The burning procedure also creates a black residue that requires careful cleaning, further adding to the complicated production process for each frame.



Fig. 69. Laser-cut frames from *a[CHRONO]mation* showing a close-up view of the paper texture and engraving quality.

5.2.6 Filming

Once a substantial number of consecutive frames[145] were completed, filming could commence. The filming rig consisted of two fixed suspended rods, arranged so that the sequence of frames could be accurately placed in front of the camera. The lighting was made up of a single light[146] focused on a reflector board under the camera, that bounced the light onto the first frame, providing the soft shadows on the receding frames. The camera was placed at the front of the rig with the focus on the front frame to improve the readability of the images. The photographs were captured using Dragonframe, an industry standard software for stop motion animation. Because the animation was predetermined and each frame was labelled during the laser-cutting process, the filming procedure was straightforward and continuous, but labour-intensive. The average time it took to capture a single frame and move all the frames along the rods to prepare the next, was two minutes[147]. The heat of the light required additional rest sessions to preserve the bulb. In one day of shooting[148] an average of 220 frames could be captured, amounting to eighteen seconds of film per day.

The filming process was completed over two sessions lasting eight days in total, with a rotating team of six members to complete the task[149]. A number of frames needed to be re-filmed due to incorrect ordering which caused errors in the character's movement. Because of the nature of the strata-stencil technique, an error in one frame meant re-filming a full sequence of ten frames. Once the frames were photographed, I realised that very little editing could take place. The final images contained arbitrary movement which is natural in stop motion animation. In strata-stencil, this relates to the 'time gaps' between the photographs (the process of moving each stencil along the rig so that the next image could be captured – see fig. 70). In strata-stencil, the paper would hang differently off the hooks that held it in place, and matching the elements up perfectly between takes cannot be fully controlled. However, these slight movements are what make the handmade strata-stencil approach distinctive from the digitised version. It emphasises the frame-by-frame nature of the work and the inherent uncertainty of the medium. Although the team worked hard to minimise the movement, it enhanced the film by further establishing the materiality of the process and emphasising the presence of the animator.



Fig. 70. The team during the filming process. One person adds the new frame to the front of the rig, while the other moves the already captured frames backward along the rig.

The hanging mechanisms for the frames were curtain hooks placed at equal distances which were measured and their positions defined for the filming team (fig. 71). The fragility of the paper and its organic nature resulted in inconsistencies in hanging, which could only be controlled to a certain degree. Refer to video 4.3 *Timelapse of Strata Stencil Process* that illustrates the straightening process between each frame that is captured. These challenges, along with slight variances in lighting, contributed to the difficulty of executing a frame-by-frame editing process. The only editing that could be completed was slight colour correction, image placement and bringing all the shots together into a seamless sequence.



Fig. 71. Filming Rig showing the rods with the hooks and spaces that ensured that the spacing of the frames remained constant.

5.3 Curated exhibition

A fundamental concern of my creative practice is how the animation is presented to the audience. This is because audience engagement and an awareness of the animated process are critical to my research objectives. Historically, mainstream animation has always been presented cinematically in a theatre to an audience[150]. Modern television and streaming digital platforms have further endorsed animation as a product of the screen. This means that it is a medium that requires no interaction from the viewer: it is an experience that is presented to us. Yes, we get emotionally involved with the characters and transported to imaginary worlds, but it is a medium that is imposed on us with little time to make our own 'economic assumptions' and interpretations regarding the content and how it was made. Instead, our focus is drawn to the characters and narratives that are presented as a form of entertainment.

This was not the goal of my creative practice. My aim was to provide the viewer with more control over *time* so that they could make their own assumptions about the work and take a moment to enjoy the aesthetics of *movement* itself. This is what makes the exhibition fall into the realm of expanded animation and is integral to my creative practice. By presenting the animation frames in ways that make the audience question their presentation, they engage with the work in a different way. The works serve to elicit aesthetic pleasure and delight from the viewer as well as to expand their understanding of the animated medium. This is my approach to the kinds of 'process representation' as discussed in Chapter 4, Section 4.5.3. By presenting these static representations of the animated movement, the viewer has time to engage with the content and examine how it was made[151]. Because of these research concerns, I assert that it is critical to see the film and the exhibition as a cohesive single creative project, rather than as a short film and an exhibition of the production work.

5.3.1 Exhibition preparation

Once filming of the frames for the experimental animated short film was completed, they were used for further frame-by-frame analysis. By drawing on the presentation formats of

Muybridge and Marey discussed in Chapter 2, the sequential paper stencils were prepared in ways that further questioned the mechanics of perception and addressed chronophotographic concerns and techniques (fig. 72). In this creation process I used the laser-cut sequences from the film and experimented with various sequential and superimposed formats. In addition to this, I introduced installation works, a presentation format unique to chronophotography but reminiscent of the nineteenth-century optical device, the zoetrope. The final preparation was the development of material for the educational sideline to the exhibition.

For a comprehensive catalogue of the works exhibited at *a[CHRONO]mation* consult Annexure C where the full creative project is being showcased. A critical analysis of the curatorial work will be discussed in detail in section 5.4.



Fig. 72. Preparation of the works for the exhibition.

5.3.2 Opening and reception

The exhibition *a[CHRONO]mation* opened at the Wits Art Museum (WAM) in Braamfontein, Johannesburg on Tuesday 18 February 2020 at 18h00 SAST. The exhibition was set to run until 18 April 2020, but the gallery was closed on 19 March 2020 in response to the COVID-19 pandemic and related regulations set in place by the South African Government and the University of the Witwatersrand.

Since the opening, the film has since gained much attention in the international film festival market, and has been selected for screening by sixteen international festivals, received three special invitation screenings, and won 'Best Animation' at the *3-minute Film Festival* in Santa Barbara (fig. 73). See Annexure B for a list of the festival screenings and awards for the film *a[CHRONO]mation.*



Fig. 73. Screening selection laurels for film festivals and awards for *a[CHRONO]mation,* 2020-2021.

For me, the choice to show my work at WAM was crucial, because the gallery focuses on fostering engagement between academics, students and the broader art communities. The gallery hosts multiple exhibitions at a time, and over the four-week period recorded 2216 visitors, made up of guests for a number of events and walk-through clients (see Annexure D

– Wits Art Museum Gallery Report). WAM's Tertiary Programme Coordinator, Lois Anguria said that *a[CHRONO]mation* was "remarkably impactful", "drew a significant audience and was particularly beneficial (to the gallery's) education programme" (Gallery Report). This programme was not limited to scholars and university students, but included workshops offered to the public.

5.4 A critical analysis of how the work incorporates techniques of chronophotography in order to affect viewer engagement

In this discussion I assess the creative work that was produced using the concepts raised in Chapters 2 and 4 about the presentation formats of chronophotographic and cinematic works and how they can affect viewer engagement.

5.4.1 The cinematic format

The central focus of the exhibited work was my experimental animated short film that used the strata-stencil animation technique to examine animation from the Golden Age. The distinctive visual effect created by the technique is closely linked to the way that strata-stencil animation influences the viewers' experiences of time and movement in the film. Using the same method of standard viewing practice, the animation is presented to the viewer cinematically at 12FPS. This frame rate automatically generates regulated intervals, akin to Marey's systematic approach of his photographic gun. But in addition to this, the strata-stencil technique tends to slow down time for the viewer rather than freeze it completely in the way that chronophotography did. This is because in the strata-stencil technique, where even when the character is still, the receding and arbitrary movement is continuous. For this reason, movement in a strata-stencil film can never truly be frozen. The visual changes that occur on every frame (the receding and arbitrary movement) affect our 'spatial and temporal acuity', which is out of the viewer's control. Although the images are presented at an appropriate[152] frame rate (frequency), keeping each frame visible (even for just one second, as in the film) tends to affect the frequency by lessening its impact and slowing the sensation of movement. Therefore, in the short film *a[CHRONO]mation*

fragmentation does not happen in the same way that it would in standard[153] cinematic viewing practice. Because we are seeing each frame for longer, the impact of fragmentation is reduced, and a more seamless movement is experienced, creating a response of captivation in the viewer. This visual impact that affects 'cinematic time' experienced by the viewer is exclusive to the strata-stencil animation technique, and is what initially drew me to it to fulfil the needs of the research. It is the singular characteristic that speaks to the underlying ideologies of chronophotography, making the imperceptible perceptible, but in a moving image format (fig. 74).



Fig. 74. Still frame from *a[CHRONO]mation,* showing how movement is constantly visible, even when the film has been paused

What was also revealed in the making of the film is how the technique made different kinds of movement visible and even gratifying for the viewer. In fig. 75 below, paths of movement became visible for the viewer and tend to impact the animation in a different way. This is something that is rarely experienced by an animation audience, but is inherent in animation design. In the images below it is evident that a curved path can easily be compared to a linear path, both of which influence the animated movement differently. The curved paths create more flowing movements, whereas linear paths tend to emphasise the rigidity or even 'stillness' in the action. What also became observable is similar to what occurred with

the erratic movement design of the Warner Bros. animators, specifically where no path of action could be detected. Because of the nature of this movement design, the viewer is forced to try to make sense of the irrational movement in the character's action, causing a chaotic effect that is experienced differently in the strata-stencil technique than in the standard frame-by-frame viewing process.

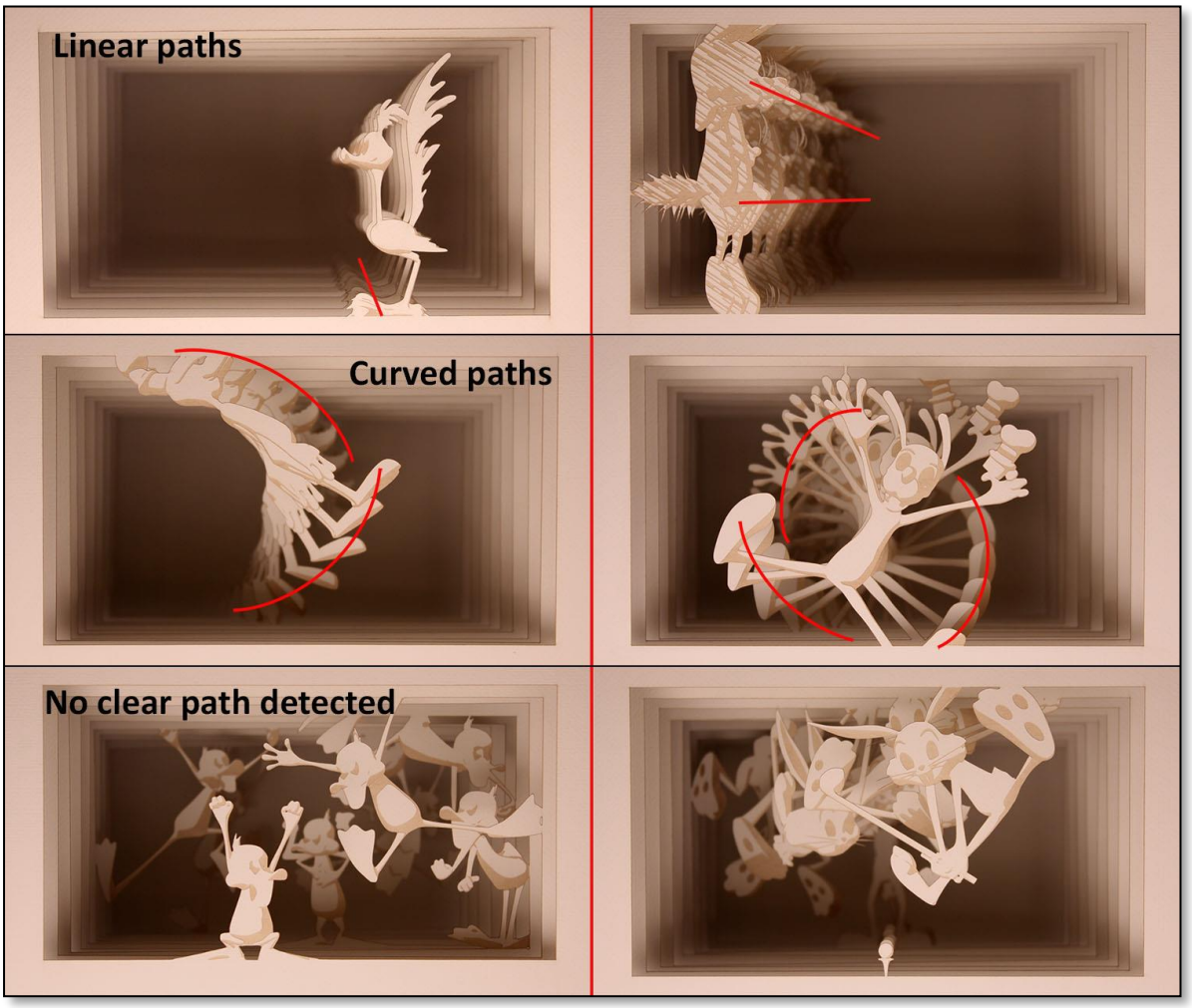


Fig. 75. Still frames from *a[CHRONO]mation,* showing how the paths of movement become visible to the viewer through the strata-stencil technique.

A last observation on how the cinematic format affects viewer engagement is how the strata-stencil technique represents Demeny's 'primary moments', discussed in Chapter 2. These were identified as the most characteristic phases of a movement, that were emphasised in Demeny's images (through the boldness of the longest exposures), contrasting with the blurred intermediary phases. In the strata-stencil technique these primary moments are represented in a similar way (fig. 76): the repetitive frame-by-frame

nature of the most prominent (still) poses tends to contrast with the more visually demanding effect of 'active' movement. This result is, however, limited because the technique can only include twelve consecutive frames at a time, unlike Demeny's single image that contained many more 'frames', but it does prove that the primary moments are identifiable through the strata-stencil technique.



Fig. 76. Still frames from *a[CHRONO]mation,* showing how the 'primary moments' of an action are represented in the strata-stencil technique.

5.4.2 The sequential image format

The exhibition incorporated a number of static works and installations using the paper stencils (or 'frames') as well as digital reproductions from the short film. In these works, the presentation format plays an important role in how the viewer experiences them. As discussed in Chapter 4, St George states that the process of experiencing a sequence of images is a voluntary action where motion is assumed or decided by the viewer, and this is where the artist can exploit the concept of the viewers' 'economic assumption'. According to Solnit, time was at Muybridge's command (3) – his images "showed what had always been present but never been seen" (24), thereby extending "vision into a new realm. Even the individual images provided utterly new information. The sequences did more" (193); "One picture showed a horse, but six pictures showed an act, a motion, an event" (194).

In *Bugs Hammer Hit* (2019) in fig. 77 below, the action sequence of the character Bugs Bunny in *Long-Haired Hare* (1949) directed by Chuck Jones has been analysed through the creative practice (00:03:20-00:03:22). The paper stencils or 'frames' that were used in the film are presented (framed) side by side in a sequential format like Muybridge's. Although Jones' film was animated on twos and screened at 24FPS, some of the fast action is animated on ones, a common practice in the Golden Age (frames 22-40, fig. 78). In my short film, the action was interpreted in 12FPS (fig. 79), thus reducing the number of frames by half but keeping the timing[154] of the original action.

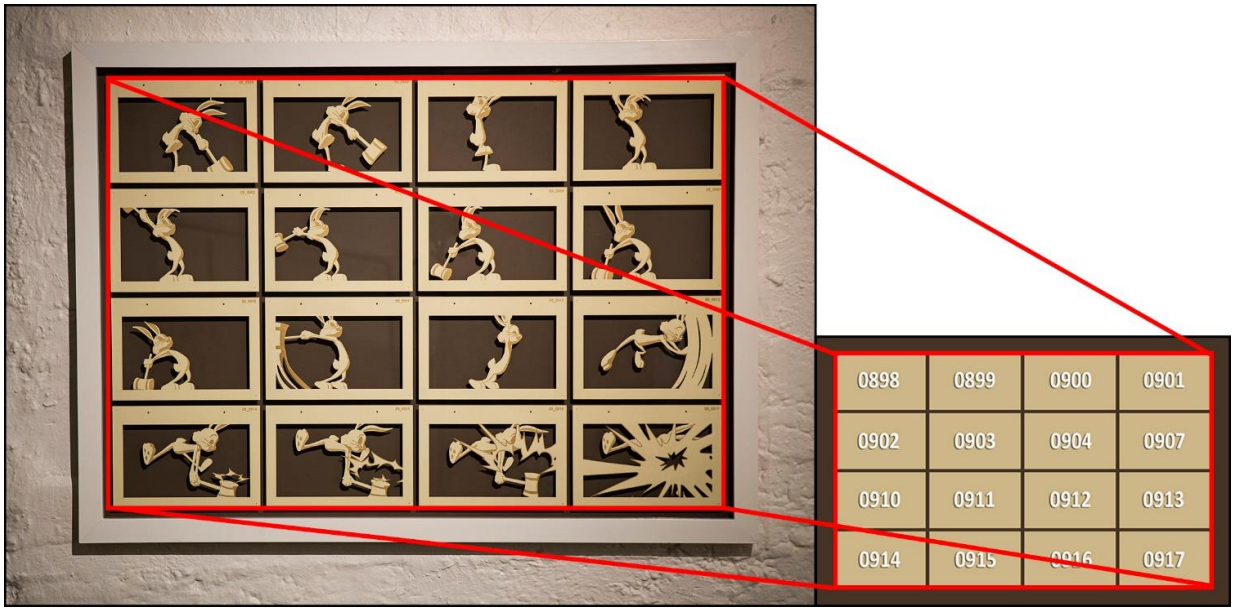


Fig. 77. Left: *Bugs Hammer Hit* (2019), 1200mm x 830mm x 60mm, framed laser-cut and engraved stencils; right: Graphic layout for artwork showing frame numbers to illustrate the four frames that were omitted from the framed work.

The action represented in the framed work (e.g. fig. 77) is made up of sixteen stencils. The reason for the exclusion of the full sequence in the framed work was influenced by Braun's assessment of Muybridge's approach to image construction in her book *Picturing Time* (237-246). Through an analysis of his work, Braun argues that Muybridge used various creative methods to assemble sequences of images, where movement is constructed by the viewer because of the way the images have been presented. Through 'economic assumption' we create an illusion of motion by finding visual relationships in the sequence and we fill in the gaps (St George 13). The viewer uses these gaps to reconstruct the motion in a participatory manner.



Fig. 78. *Long-Haired Hare* (1949), directed by Chuck Jones; hammer hit shot made up from 40 frames of animation at 24FPS – 00:03:20-00:03:22.

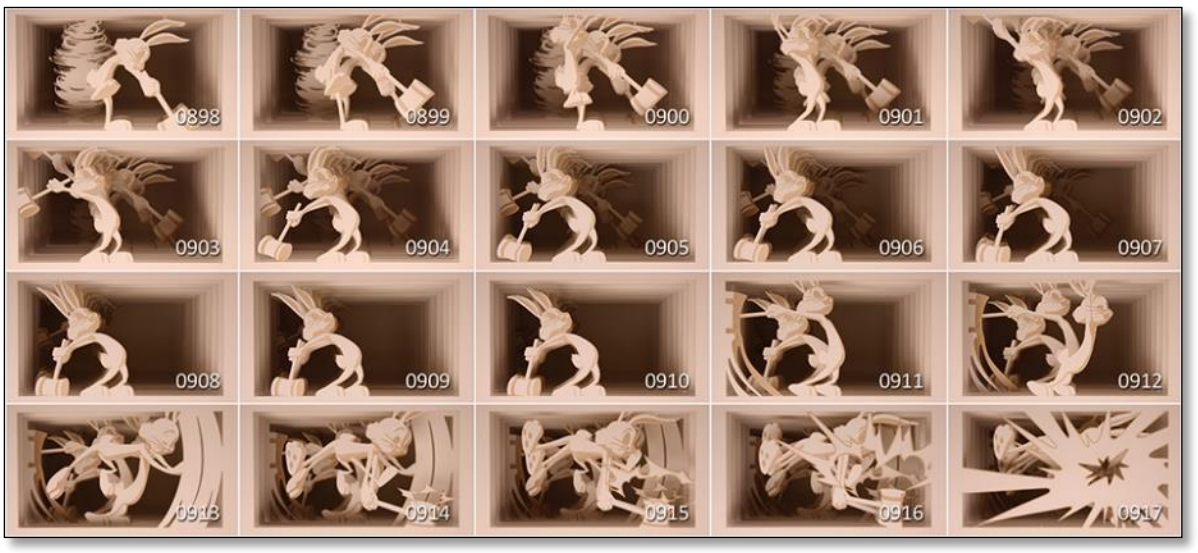


Fig. 79. Film frames from *a[CHRONO]mation* showing how the shot was made up from 20 frames of animation at 12FPS – 00:01:14-00:01:16.

In Jones' film, the forty frames (fig. 78) are necessary to render a smooth sequence of the action being depicted. In *Bugs Hammer Hit* (fig. 77) frames were excluded to make the action easier to follow for the exhibition viewer. In animation a 'hold' or slower action is created by either duplicating frames or making the incremental pose changes very small. These stencils were omitted from the framed work so that the sequence would be interpreted as a single, seamless motion where duplication or small incremental changes

would not be questioned. By doing this, I am drawing on the viewers' willingness to see movement even when the representation is somewhat inaccurate according to animation practice. The format promotes perceptions of order, logic and progression for the viewer. The uninformed[155] viewer is therefore encouraged to assess the motion in terms of its aesthetics rather than its accuracy.

In *Cartoon Study of Movement* (2020) in fig. 80 and fig. 81, the opposite approach was taken, with no frames excluded from the sequence. The printed work incorporates the full 1444 frames of animation[156] from the short film in a pictorial sequential format. Because of the manner in which the sequential layout reveals the movements in such a condensed visual layout, movement can be experienced differently to how it is revealed in the film. Patterns of movement seem to form on each horizontal line, and these movements become quite captivating to 'read' from left to right in a frame-by-frame manner (something that is impossible in the cinematic version). The scale of the work makes each image in the sequence clear to the viewer[157] when standing up close, but each is small enough to shift this clarity to focus on the collective shapes when the viewer takes a few steps back.

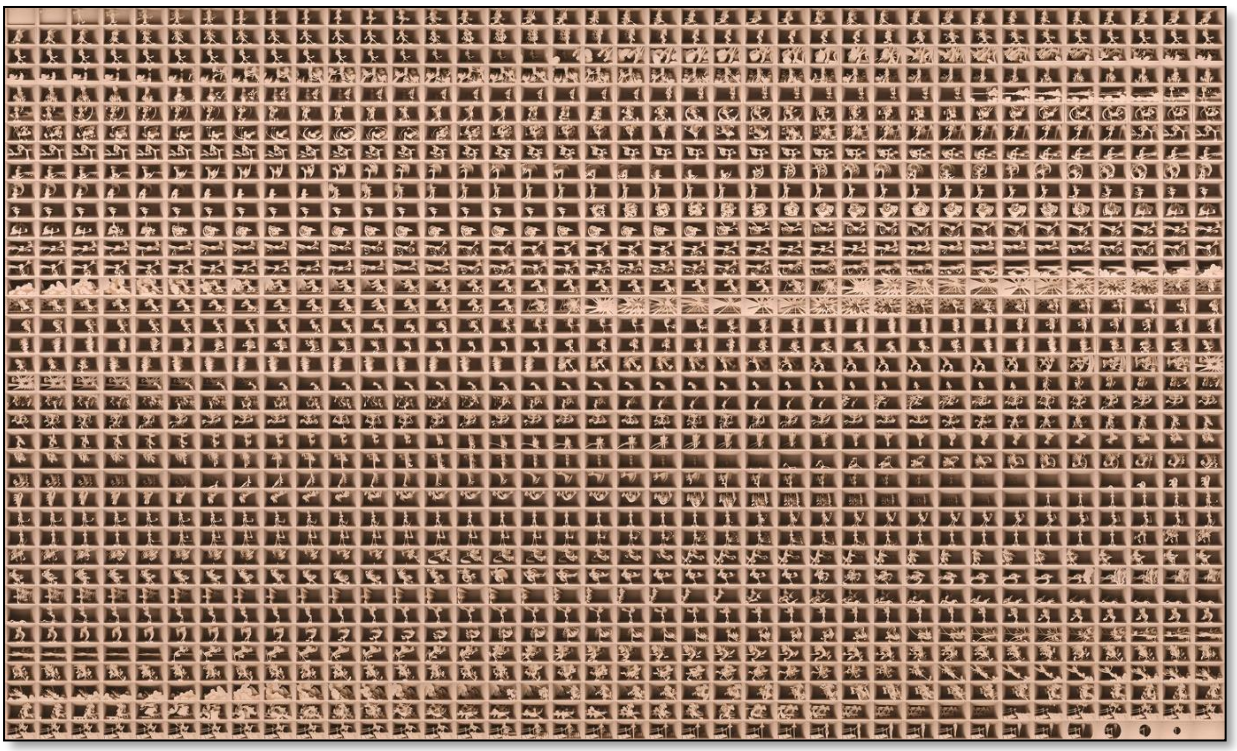


Fig. 80. *Cartoon Study of Movement* (2020), 2445mm x 1380mm, print.

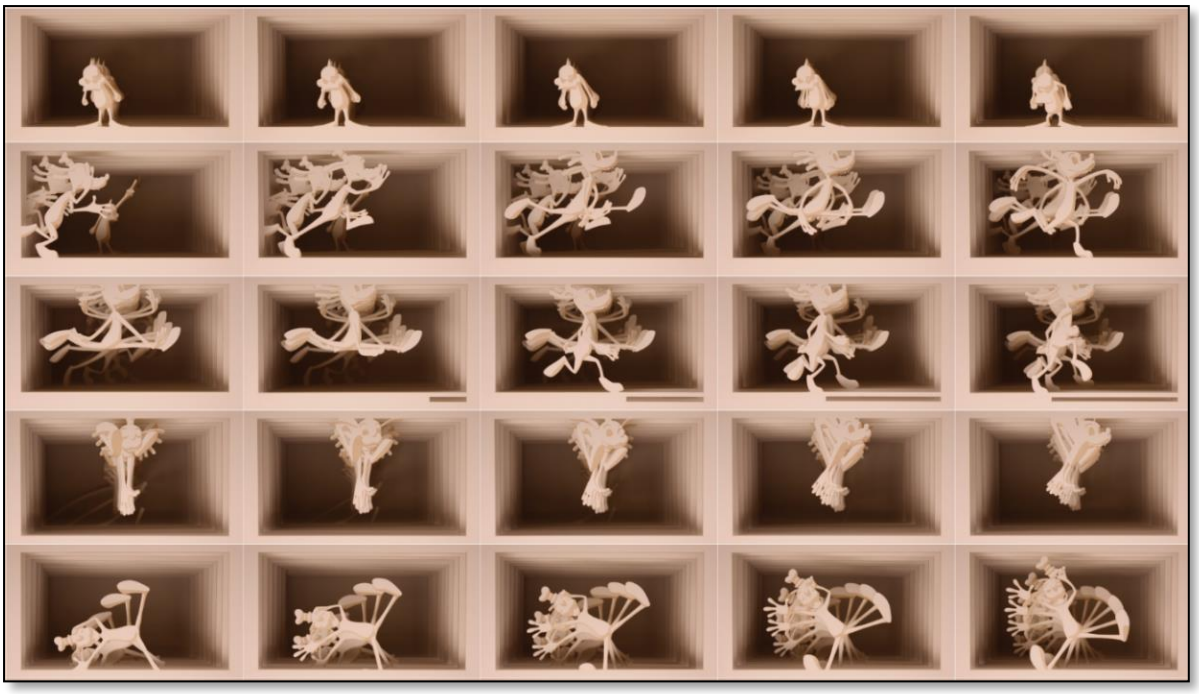


Fig. 81. Detail of *Cartoon Study of Movement* (2020), 2445mm x 1380mm, print, showing the details that can be viewed up close.

This is a novel way of viewing an animated film and is reminiscent of the viewing practice described in Chapter 2, where our observation changes from focusing on the individual frames (recognising the character and poses) to a more holistic view (focusing on the aesthetics of the sequence). This perception change is brought about by viewing an abundance of similar images simultaneously, causing visual fatigue triggered by the level of inspection which these 1444 images command from the viewer. The viewing process of the printed sequence transforms the content into a visually rhythmic experience, where the viewer must adapt their vision to appreciate the varying shapes, lines and colour derived from the individual frames.

The two static works discussed above demonstrate how they demand an interaction from the viewer that is different from their more passive role when observing the short film. Rather than receiving the information about decelerated movement in a cinematic format, the sequential format is less familiar to the viewer and requires them to analyse the images in the sequence both individually as well as in relation to each other. The format provides the viewer with the illusion of 'arrested motion', which is different to how it is experienced

in the film. Also, if the viewer is unfamiliar with how animation is made, they will attempt to unpack the design of the motion and find meaning in a way that is unfamiliar to them. This shows how the presentation format can promote an analytical role in the viewer, one that questions the images by way of their layout, ordering and content.

5.4.3 The superimposed static format

The sequence frames in fig. 82 below were created to mimic the strata-stencil structural format of the filming rig. They are expanded frames that incorporates nine stencils[158] of animation, each suspended in Plexiglas sheets (fig. 83). The laser-cut stencils were selected for their illustrative potential and, like *Bugs Hammer Hit*, do not necessarily include every frame of the animated sequence. The Plexiglas framework keeps the stencils perfectly aligned, unlike the uncontrolled nature of the stop motion process, where inconsistencies and arbitrary movement are inherent.

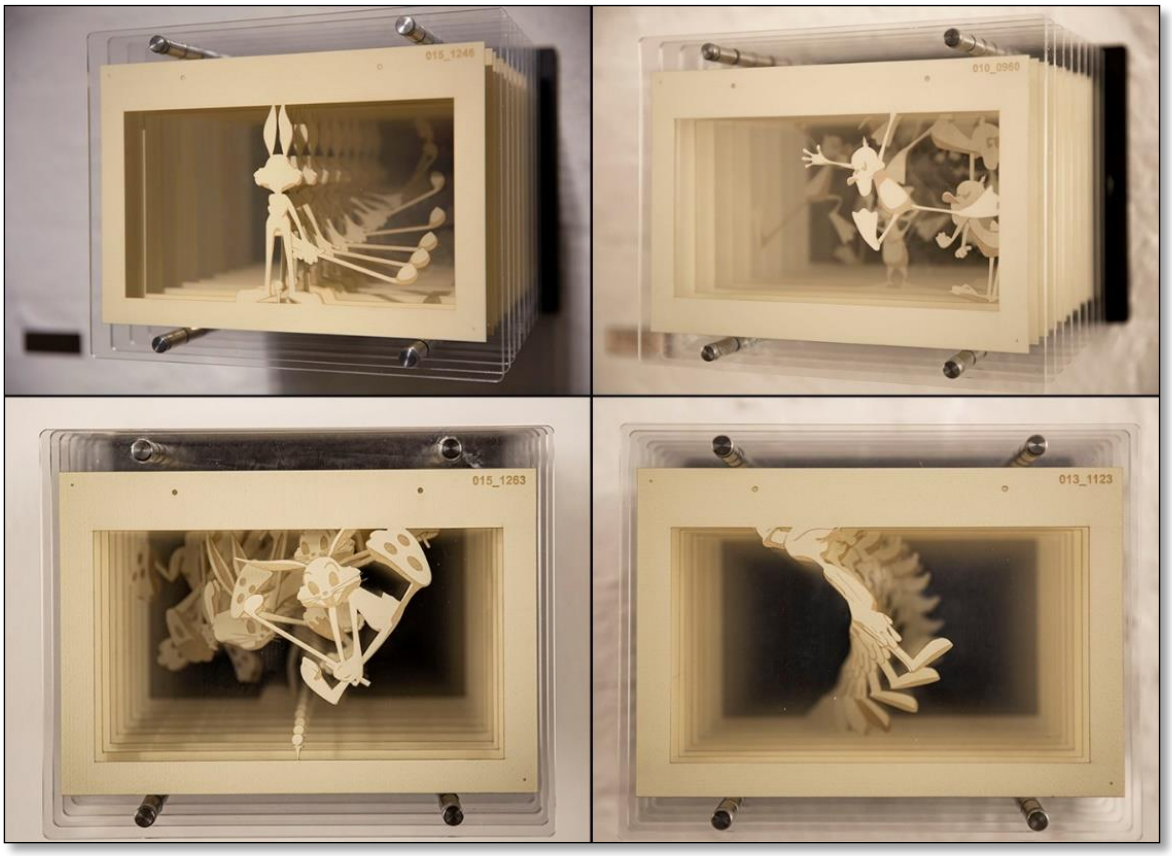


Fig. 82. Four examples of the six-sequence frames on exhibition.
Top left: Sequence study: Bugs Bunny II*, 300mm x 240mm x 360mm; top right:* Sequence study: *Daffy Duck, 300mm x 240mm x 360mm; bottom left:* Sequence study: *Bugs Bunny, 300mm x 240mm x 360mm;* bottom right: Sequence study: Goofy II, 300mm x 240mm x 360mm.

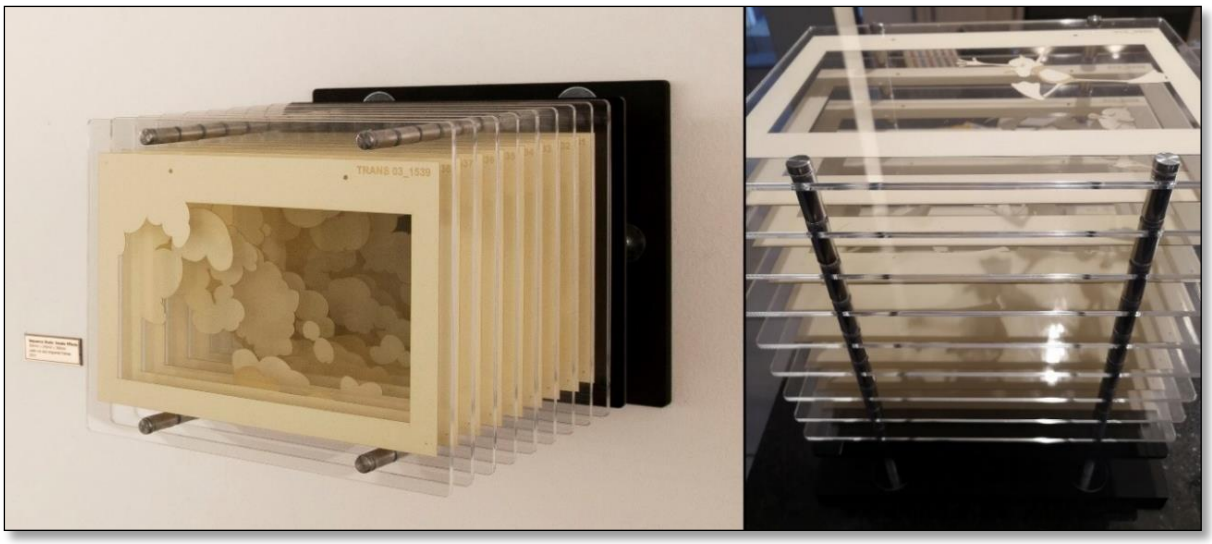


Fig. 83. Sequence frame showing the expanded structure of the frame.

These works were motivated by the aesthetic of Marey's multi-exposed chronophotographs. Braun discusses Marey's grievances with early chronophotography and the intermittent nature of the sequential photographs that represented instants of time (*Picturing Time* 62). His desire to represent movement as a 'continuous fluid passage' was lost in the sequential format. His aim was to bridge the gap between the fluid results from his graphic method and the loss of continuity in the sequential photographs. Referred to in this study as the 'Marey aesthetic', it is the visual representation of revealing movement simultaneously in a single pictorial format, that influenced artists concerned with representing time and movement in their practice.

The sequence frames aim to emulate this approach by not presenting the stencils side by side, but in a multi-layered format where the movement can be assessed as a single continuum rather than a staccato of multiple images displaying a superimposed pattern of movement. This method is closer to the cinematic understanding of St George's 'spatial and temporal acuity', in that the spaces between the stencils can be described as the 'frequency' of the images that are presented to the viewer; that is, the literal 'gaps' between the images. Our 'economic assumption' becomes less of a concern, as the representation of the action is less questionable in this format, resulting in less active participation from the viewer. Perhaps the reason for this is because of our common understanding of Western

pictorial conventions, making it easier to engage with linear sequential formats rather than those that have been superimposed. Similar to the framed sequential works, time is still frozen through the static representation of the actions. However, like Marey's images, they capture a fluid expression of movement, time and space in a single format (fig. 84).

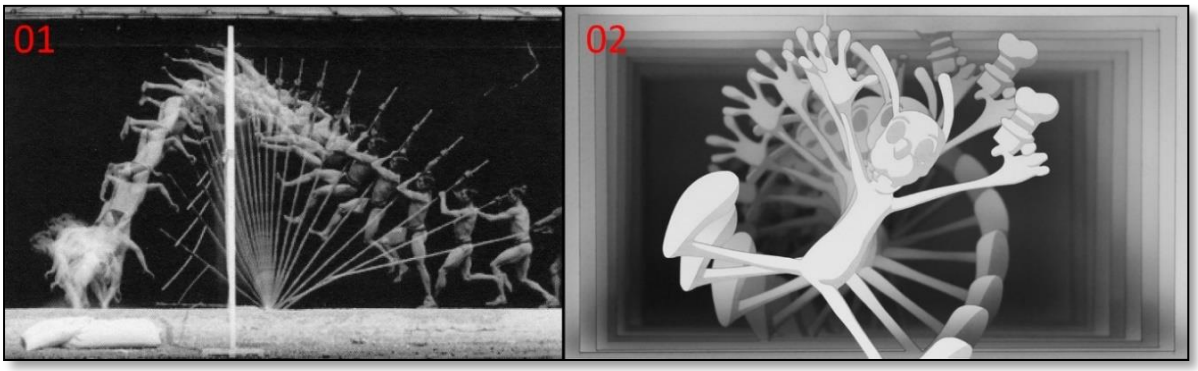


Fig. 84. Left – 01: A multi-exposed chronophotograph by Étienne Jules-Marey; right – 02: A frame from the experimental short film *a[CHRONO]mation*, showing the 'Marey aesthetic'. Desaturated in order to focus on image design.

The 'Marey aesthetic' is also evident in the stacked frames on exhibition. As seen in fig. 85 and fig. 86, several stacked paper stencils were framed in a way that displayed movement in a condensed format. Some of these works incorporated over one hundred stencils within the frame. Being able to see a vast number of frames in a single pile of stencils reveals how complex the construction of each movement can be, and uncovers their aesthetic potential. The format creates a dense continuum of the movement that happens in a reversed manner to that in the film. This is because in the film the current frame is always in the foreground, with the receding frames representing time that has passed (those that came before that action); in the stacked frames the receding frames represent the upcoming movement (that will happen after the foremost frame). Because of the increased number of stencils in the stacks, these works exceed the visual and analytical capabilities of the ten stencils shown simultaneously in the film and the nine in the sequence frames, offering the viewer new information about the construction of a motion.



Fig. 85. Stacked frames – left: *Repercussion* (2019), 340mm x 260mm x 50mm; right: *Fleeting* (2019), 340mm x 260mm x 50mm.



Fig. 86. Stacked frames – left: *Road Runner Run Cycle* (2019), 340mm x 260mm x 100mm; right: *Goofy Baseball Pitch* (2019), 340mm x 260mm x 100mm.

5.4.4 Installations

The final presentation formats displayed in the exhibition are as seen in the two installations in fig. 87 and fig. 88, where the animated stencils were hung individually from a circular frame. These stencils were ordered sequentially, encouraging the viewer to walk along the sequence in order to follow the movement represented in them. Like the other static works on the exhibition, the installations were designed and constructed in order to present the static frames in an alternative presentation format, which was inspired by the zoetrope. The 'philosophical toys' that were popular in the nineteenth-century for their entertainment value, involved the interaction of moving images in varying forms. Many scholars consider them as the precursors to cinema, because of how they present a series of images that appear to move as the user interacts with them, ultimately entertaining the viewer. The

zoetrope creates a fluid representation of motion using a rapid substitution of sequential images, and is considered one of the first forms of the animated medium. The sequential images are placed in the inner surface of a cylinder that is mounted to a handle. When spun, the animation can be viewed through vertical slits in the cylinder. It was observed that some of the *a[CHRONO]mation* exhibition viewers would run around the installations in order to try to experience the movement. They became interactive works that raised questions regarding their relationship to chronophotography, early optical toys and modes of representation.

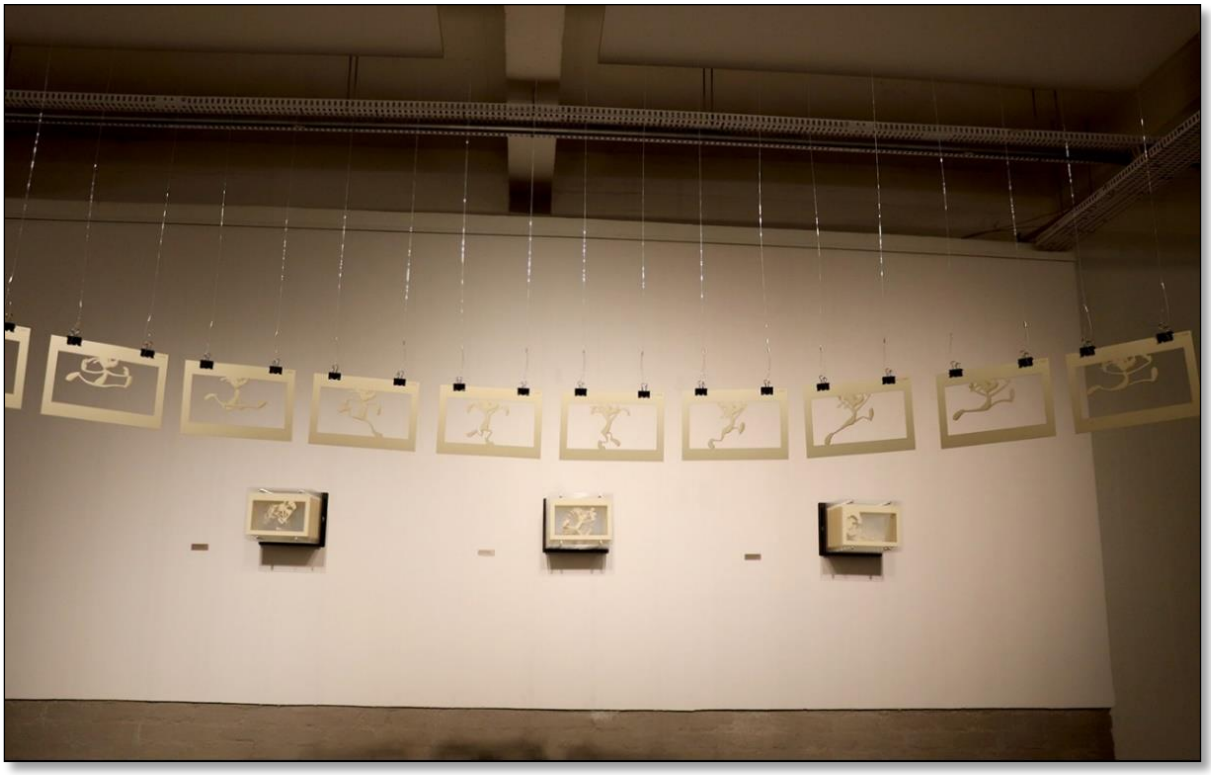


Fig. 87. *Olympic Champ Run Cycle* installation (2019), 280mm x 190mm, sequence of 28 frames.

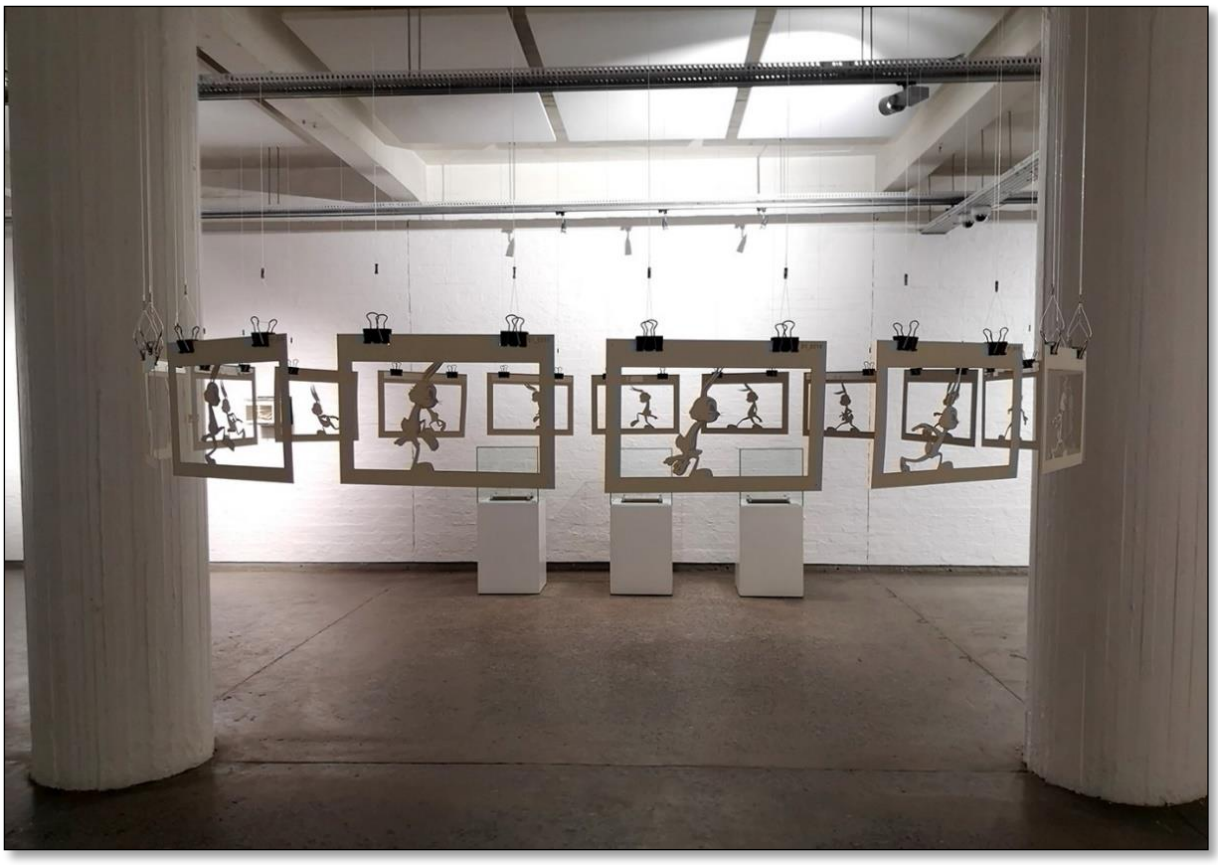


Fig. 88. *Bugs Bunny Sneak* installation (2019), 280mm x 190mm, sequence of 17 frames.

The circular installation format is also reminiscent of Muybridge's 'single phase of motion' images discussed in Chapter 2. These images of Muybridge were different to his standard sequential images in that they explored varying perspective views of the same pose taken synchronously. In these images the viewer is expected to shift their established mode of viewing (the sequential images) to imaginatively project their own movement in a 360-degree manner around the figure. In a similar way, the exhibition viewer is encouraged to move around the work in order to experience the movement. The structural format is also reminiscent of the filmmaking technique known as 'bullet time' (also referred to as 'time slicing'), where cameras are placed around the subject in order to freeze a movement. Although my work incorporates movement both in the images and by the movement of the viewer themselves, the structural format provokes a likeness to Muybridge and the film technique.

5.4.5 Educational devices

To further the educational aspect of the exhibition I included a number of optical toys, so the viewer could experience animated movement in an interactive way (fig. 89). Using sequences derived from the film[159], the devices facilitate an informed understanding, allowing the viewers to appreciate how animation is constructed through their own interaction with the frames. Although these devices and installations bear no direct relationship to chronophotography[160], they inspire further examinations of movement that require active participation by the viewer, drawing on their understanding gained from other artworks on the exhibition.



Fig. 89. Examples of optical toys created for the educational aspect of the exhibition.
Left: Phenakistoscope using a Bugs Bunny sequence; middle: Thaumatrope using two images from a Bugs Bunny animation; right: Zoetrope.

5.5 Chapter conclusion

From the works discussed, it can be concluded that each presentation format of *a[CHRONO]mation* inspired varying aesthetic responses and required distinct engagements from the viewer. The various presentation formats offer several modes of assessment, where the viewer can participate with animated movement differently and develop their own insights as to the animation's construction. In the works the 'singular' and the 'multiple', the 'still' and the 'moving' compete for prominence and help provide meaning for the work. Through cinematic, sequential, superimposed or more interactive formats, movement can be evaluated and interpreted by the viewer.

This chapter has presented my aesthetic engagement with chronophotography in the medium of animation and discussed the creative project that emerged as a result. By applying the theories discussed in the thesis, I completed a body of work that demonstrates that a chronophotographic study in animation is possible. In addition, it has confirmed that by employing the strata-stencil animation technique and exploring various presentation formats, further examinations of animated movement are possible. Together, these works evoked aesthetic pleasure and delight in the viewer, as well as serving to educate the viewer on how animation is made. The work encouraged the viewer to engage and look back on animation from the Golden Age, and question the movement design in these films. By provoking this frame-by-frame analysis of the animated movement, I have impacted on the viewers' engagement and understanding of movement design and the mechanics that make animation possible.

Chapter 6

Conclusion

> *"Animation is not the art of drawings that move, but the art of movements that are drawn. What happens between each frame is much more important than what exists on each frame. Animation is therefore the art of manipulating the invisible interstices that lie between the frames."*
>
> Norman McLaren (qtd. in Solomon and Canemaker *The Art of the Animated Image* 11).

My aim with this research was to reveal the construction of animated movement in a novel and distinctive manner. In my short film and the associated exhibition I creatively applied techniques derived from chronophotography, which I used to expand on the strata-stencil animation technique. By presenting this work in a cinematic format together with installations that interrogated different static sequential formats, I sought to influence viewer engagement through my creative practice. By foregrounding issues of materiality and process, this creative research project encouraged the viewer to focus on and appreciate the re-representation of animated movement as a distinct aesthetic experience. Through this awareness, the viewers of my film and the visitors to my exhibition were encouraged to experience movement design in a radically different format, and thus gain knowledge on how the animated movement was created.

My study has engaged with three main concerns. Firstly, I examined the work of two prominent nineteenth-century chronophotographers: Eadweard Muybridge and Étienne-Jules Marey. I contrasted their different approaches to chronophotography and how, in ways that were very significant for my own practice, this resulted in two distinct presentation formats: Muybridge's sequential images and Marey's superimposed photographs of movement. I unpacked the different ways in which these chronophotographic formats affect viewer engagement and how they have influenced visual artists concerned with the representation of time and movement in their practice. Secondly,

I unpacked the visual language of animated movement through an analysis of the animation produced by the Disney and Warner Bros. studios in the Golden Age of American animation. My analysis confirms the critical consensus that the Disney directors aligned their practice within the syntax of cinematic realism, whereas the Warner Bros. directors focused their efforts on finding abstract representations that suited their production constraints. Finally, I unpacked concerns relating to the difference between viewer engagement of still and moving images in order understand the mechanics behind human perception, and how this affects the viewer's ability to interact with the work in these two formats. Using St George's theories to inform my discussion, I proposed that through manipulating the mechanics of cinema, one could investigate the effects these have on viewer engagement and their understanding or interpretation of an animated work. Following these discussions that contextualised my research practice, in Chapter 5 I presented my aesthetic engagement with chronophotography and provided an account of the creative project that emerged. In this concluding chapter I unpack how my creative practice has addressed the main research questions raised in this study.

6.1 Does the creative practice bridge the 'gap' between the still and the moving image?

Can the proposed methods of viewing animated sequences affect St George's concepts of *spatial and temporal acuity* and *economic assumption/montage*?

The creative practice which encompasses the creation of an experimental animated short film and the curation of exhibition works collectively addresses the premise that **through altering modes of viewing practice, one can influence the viewer's experience of a work**. The animated film deviates from standard viewing practice, as the viewer is able to see more than one frame at a time, and the exhibition work presents the animated frames in a way in which we don't normally experience animation – in a static, sequential, or immersive manner. All of these formats challenge the viewer's understanding and reading of the work, and thus raise questions around how the viewer experiences movement in both the still and the moving image.

In Chapter 5 I demonstrated how the strata-stencil animation technique slows the experience of cinematic time for the viewer. This is achieved in my short film in two ways. Firstly, even though it is presented to the viewer cinematically at a rate of 12FPS, keeping each frame visible for even one second tends to affect St George's notion of the film's 'frequency' by lessening its impact and decelerating the viewer's perspective of movement. In addition, the receding and arbitrary movement of the strata-stencil technique is continuous and affects our 'spatial and temporal acuity' which (because of the cinematic display) is out of the viewer's control. Therefore, the viewer's experience of 'fragmentation' in the animated film is reduced and a more seamless movement is experienced than in a standard film, creating a captivated but passive response in the viewer.

I also found that the technique made different kinds of animated movement visible for the viewer, and impacted their experience of the movement differently. Some movements, such as those of the Disney animators, became more flowing, whereas the erratic movement design of the Warner Bros. animators remained jarring and illogical, yet strangely became more engaging. The frame-by-frame control of the flow of animated sequences was made possible by employing the strata-stencil technique. Like chronophotography, the strata-stencil technique made visible the ephemeral movements that are normally *unseen* for the viewer. Like the artists on the *Sequences* exhibition, this work continues the enquiries of the nineteenth-century chronophotographers in a contemporary medium, using new technology that has been appropriated to achieve my desired outcomes for this study.

I have also discussed how the different presentation formats of the static works at the exhibition impact the viewers' engagement, encouraging them to see movement at their own pace, but from a variety of different vantage points. In my design of the works and installations I relied on St George's notion of the viewer's 'economic assumption' to find visual relationships in the paper stencils and fill the 'gaps' between the images. In this way the viewer of the exhibition works uses these 'gaps' to reconstruct the movement in a participatory manner. In addition to this, the presentation formats promote insights into the order, logic and progression of the animated sequences. This encourages the viewer to

assess the motion in terms of the aesthetics rather than its accuracy. The viewer takes on an analytical role, and is encouraged to question the arrangement of the images by means of their layout, ordering and content. The various presentation formats offer several modes of assessment, where the viewer can participate with animated movement differently and develop their own insights into the animation's construction. In the collective works the 'singular' and the 'multiple', the 'still' and the 'moving', compete for prominence and help provide a complexity of meanings for the reception of each work in the visual research project.

6.2 Does the creative research prove that a chronophotographic study in the animated medium is possible?

Does viewing 10–12 consecutives frames of an animated sequence (created using the strata-stencil technique) offer the viewer additional information about how that movement is constructed? And in doing so, can this inspire a more analytic engagement from the viewer?

My motivation for this research was driven by my desire to expose the construction of animated movement for the viewer. This was inspired by the distinctive moments in animation that go *unseen* by the casual cinematic viewer because of the ephemeral nature of the animated movements. In this study I established how the visual language of movement was developed by studios during the Golden Age of American animation. As an animator and an artist, I wanted to critically evaluate, honour and make these techniques visible for the viewer in a manner that was unique. Nineteenth-century chronophotography was not the solution to my problem, but it provided a great deal of theoretical and practical foundations for my creative practice and inspired the aesthetic nature of the work.

Through applying a chronophotographic understanding to my assessments of animated movement from short films of the Golden Age, I was able to recognise and appreciate my subject from a completely new angle. Although a frame-by-frame analysis is intrinsic to the animation process, the interpretations and contributions to my knowledge of movement

were greatly transformed by the process of applying chronophotographic techniques to a revisioning of animated movement. As a digital 3D animator the sequential, linear visual analysis of movement informed by chronophotography was new to me. It is not typical to see a full sequence of animation frames next to each other as a chronophotographer would have presented it. For me this process transformed the way in which we analyse movement as animators. Although the multi-exposed aesthetic bears strong visual similarities to the onion-skinning tool (commonly used by many animators, like myself), my understanding of movement was elevated by the realisation of the fluidity and simultaneity which the technique offered, especially when in motion (as in the film). As animators we are taught to observe movement in a frame-by-frame approach, examining the poses and the changes in the body throughout the sequence – but the two chronophotographic modes of viewing explored in this research offered me a new understanding of movement design.

Through undergoing this chronophotographic process of analysing movement (as discussed in Chapter 3), the Disney animation style that was informed by conventions recognisable in the real world became more apparent and easier to evaluate when compared with the abstraction of movement by the Warner Bros. animators. By comparing each frame of an animation sequentially (like Muybridge) as well as simultaneously (like Marey), the differences in the approaches taken by the two studios became simpler to distinguish and subsequently evaluate. This analysis demonstrated that through their use of timing and posing, the Disney animators drew inspiration and attitudes of movement that are common in everyday life. Their innovation came in the form of caricature, which elevated these actions and performances, separating them from the live-action recording. However, the Disney animators continued to follow the Hollywood cinematic conventions and produced feature-length films that were compelling to an audience. This is what made their product sustainable and enabled Disney Studio to survive in a competitive industry. While this information on the Disney approach to referencing techniques and caricature is available in Thomas and Johnson's book *The Illusion of Life: Disney Animation*, the chronophotographic analyses provided substantial visual evidence for these claims.

In contrast to the Disney Studio style, the Warner Bros. animators exaggerated the key poses and in-betweens, manipulating the timing of the actions to service humour and suit the production constraints imposed on them. Faster, more abstract in-betweens (like 'smears') and cycling erratic movements helped them to produce their seven-minute shorts to meet their quotas. Sadly, this format was lost to the rising popularity of television animation, but is celebrated by festivals that promote the short-film format. My chronophotographic analysis makes it clear how these approaches to movement design differed considerably from Disney's representations. It provides a striking aesthetic dimension to the Warner Bros. short films, where these variations in approach can be felt via the poses, timing, actions and representations of movement in the various shots.

Through this process of assessment and applying my findings via the strata-stencil technique, I believe that I have arrived at a mode of analysis that is unique to the animated medium. By maintaining visibility of the consecutive frames in an animation, or placing them side by side in a gallery, the viewer is able to experience and question movement in a new and aesthetically pleasing manner. I have used these observations and evaluations, informed by the fundamental concepts of Muybridge and Marey's chronophotography, to guide my creative practice. I have also considered how exposing these techniques could influence viewer engagement.

6.3 Can the creative work enrich the viewing experience/offer any opportunities for further aesthetic exploration?

The work presented in this study has demonstrated that by manipulating the mechanics of cinema (by way of simultaneously revealing the consecutive frames of an animated sequence), the viewer-experience has been enriched and informed beyond standard modes of cinematic presentation.

The starting premise of the exhibition was to explore modes of representation inspired by the chronophotographic image formats of Muybridge and Marey. By engaging with the

animation frames in various static formats (simultaneously, side by side, or as installations), the viewer was able to focus on animated movement and question how it was made. Using the strata-stencil technique for the film enabled me to make the viewer conscious of the formal structure of the work by revealing its mode of construction. The repeated figures of the characters in each frame provided a communicative and informative function, demonstrating to the viewer the components that make up their movement.

The process of drawing the viewers' attention to how the animation is made takes the emphasis away from the narrative conventions of an animated film and instead allows the viewer to focus on the technique. Like Hannah Frank's scholarly work, my creative practice transforms the animated film from a process of illusion to a method of investigation, directing the viewer's attention to *how* it is made rather than *what* it is representing. It speaks to Frank's "quasi-Brechtian" approach or, as I call it, 'process representation' in animation that draws attention to the mode of production of the animation, which was both the conceptual and aesthetic goal of the visual research project.

The materiality of the paper stencils and the notion of 'making' informed my approach to creating an animation that exists outside of the digital format. These material frames direct our understanding of how standard viewing practices can be challenged in order to promote a more engaged animation viewer who sees animation differently. It is reminiscent of Frank's frame-by-frame approach and McLaren's drawn-on-film animations that focus on the individual frame and the magic that happens "between the frames" (McLaren qtd. in Solomon 11). In my experimental film I exploited the mechanics of animated film and used it as a mechanism for interrogating questions around stillness and movement.

In conclusion, *a[CHRONO]mation* has successfully altered the viewing experience and encouraged the viewer to question the nature of the construction of animation in terms of *movement*. My creative research project has shifted the focus from a projected sequence of images (seen one frame at a time) to a sequence of individual frames, viewed

simultaneously and in varying formats. In doing this, this experimental investigation has altered our perception and experience of animation to an alternative aesthetic, that of *movement* itself.

Notes

[1] The controversy was whether there were moments in the strides of a galloping horse where all four hooves were entirely off the ground. The first photographic experiments to prove/disprove this theory were contracted to Eadweard Muybridge at Stanford's Sacramento stables in 1872 and again in 1878 (Braun *Picturing Time* 45).
[2] Slow photographic exposure times required people to sit with braces to hold their heads steady, as movement resulted in blurry images (Solnit 16).
[3] These included the movement of planets, fluids, airflow and, most prevalent, the locomotion of humans and animals.
[4] Well-known examples of these are the thaumatrope, zoetrope, phenakistoscope, and the praxinoscope.
[5] Gunning explains the "complacent spectator" as "conformist citizens out of the masses spellbound before the cinema screen, like the chained prisoners in Plato's cave" (Foreword *Frame-by-Frame* xiv).
[6] Namely, Eric Dyer's *Copenhagen Cycles* (2006) where he explores a variety of cyclic ideas and themes through sculptures that are similar to zoetropes.
[7] The majority of contemporary animation exists in a digital form, where only the preparatory work for a film can be exhibited in a gallery context (where sculptures and paintings on paper are created for the character development and environment design process). Exemplary to this is stop-motion animation using puppets and hand-built sets.
[8] Also referred to as direct animation or cameraless animation.
[9] The book was published as a result of the exhibition. It incorporates a number of essays about the history of chronophotography and works from the exhibition.
[10] Either digitally using two- or three-dimensional software, or on a stop-motion model.
[11] Other noteworthy chronophotographers include Jules Janssen, Thomas Eakins, Albert Londe, Georges Demeny and Ottomar Anschűtz. Another pioneer of high-speed photography (that is not credited specifically as a chronophotographer) is physicist Arthur Mason Worthington, who was renowned for his work in fluid dynamics.
[12] A longstanding, unproven argument arose with two opposing notions: wealthy sportsmen from the East Coast believed that a horse always had at least one foot on the ground during a trot, while Stanford's West Coast friends argued that there was a point where all four feet were off the ground (Solnit 78). The first photographic experiments to prove/disprove this theory were contracted to Muybridge at Stanford's Sacramento stables in 1872 and again in 1878.
[13] In 1882 Stanford and J. B. Stillman published a version of *The Horse in Motion* using illustrated lithographs made from Muybridge's photographs, discrediting Muybridge's involvement in the project. Muybridge launched a lawsuit against Stanford for this and lost (Braun "Authorship" 44).
[14] In 1860 Sir John F. W. Herschel attempted to characterise instantaneous photography by proposing photographs produced at exposures of at least one-tenth of a second on plates that would be processed within two- or three-tenths of a second (Prodger 36).
[15] The French photographer Jules Janssen (1824–1907) was the first to take a series of automatic photographic images to represent the successive phases of a phenomenon for the purpose of scientific experiment. As Marey explains in his book *Movement* (1895), in the experiment Janssen took a series of photographs of the planet Venus as it passed across the sun (103). His explanation followed in an article published in 1876, describing the process of his photo revolver (Braun *Picturing Time* 55).
[16] Muybridge took over 20 000 images for this collection (Muybridge 4; Gordon "Sequence" 10).
[17] Braun refers to them as insertion, expansion, contraction and substitution (*Picturing Time* 238).
[18] The gutter in comics refers to the space in between two panels, similar to Muybridge's "gaps" that Gordon refers to.
[19] Not all the images are uniform in size, because of irregularities in the sequences due to failed cameras or damaged negatives.
[20] Taken on different days, some with racket, some without.
[21] A pantograph is an instrument for duplicating a motion or copying a geometric shape to a reduced or an enlarged scale ("pantograph" *Britannica.com*).
[22] In addition to the visual challenges, when animating using 3D software walk cycles are often created where the character does not traverse. This movement from point A to point B happens during a secondary process by means of a global control. This asserts that Muybridge's approach complements the animation process.

[23] The design was based on Jules Janssen's photo revolver of 1874, with modifications to create the singular image.
[24] Such as blood circulation, pulse, respiration and muscular contraction (Dagognet 21-63).
[25] Marey's first published collection on his chronophotographic studies, 1874.
[26] To synthesise the motion on the phenakistoscope, twelve images were required (Braun *Picturing Time* 61).
[27] Terminology used by Braun *Picturing Time* 254.
[28] To achieve the study in fig. 10, Marey replaced the portable system with a stationary camera (Rabinbach 106). The portability aspect was mostly designed to capture birds in flight – a movement difficult to capture in a set environment.
[29] Demeny is considered one of the founders of physical education in France, and focused his research on theories surrounding the conservation of energy and the fatigued body (Braun *Picturing Time* 66-67).
[30] For instance, Giacomo Balla's *Dynamism of a Dog on a Leash* (1912) and Umberto Boccioni's *Dynamism of a Cyclist* (1913).
[31] A philosophical system recognising only that which can be scientifically verified (factual knowledge), observed or measured ("Positivism" Business Research Methodology).
[32] The torso should counter-rotate the movement of the legs.
[33] Futurism presented the most profound relationships between painting and photography in which these artists tried to assimilate suggestions made by the mechanical eye (which was going through its own revolution of perception) (Lista 358).
[34] Animation 'keys' is the term used to explain the keyframe where the character's key positions are held.
[35] 'Keys' are the animation drawings or digital frames that define the key/most important moments of a movement. 'Inbetweens' are the frames that exist between the key poses.
[36] Or they haven't been introduced to it. This is not a standard feature, nor is it an approach to animation that is commonly used or taught.
[37] Braun refers to this as Duchamp putting painting "at the service of the mind" (*Picturing Time* 291).
[38] These include artists like Francis Bacon, Steven Pippin and Elanor Antin, to name a few.
[39] The railroads, for instance, where workers were paid by the mile of track laid; once built, they also allowed for the quick transport of goods, thereby increasing production and hence consumption (Solnit 180-181).
[40] Scholar Paul Wells refers to Disney's strive for realism as "verisimilitude" (23).
[41] It is important to note that I have situated my study in this specific era of animation, for the reasons explained in the text. I acknowledge that there is an affinity between my creative practice and the approach of the early animators, however, my interest lies within the realm of believability and methods of abstraction that fall within this space (i.e. multiples and smears).
[42] Wells originated this term when theorising different 'modes of expression and construction' in animation, labelling the most common form (using cel animation – the dominant technique in history at the time of publication) that contains recognisable figures, focuses on character and context, has a narrative progression; a unity of style and diegetic sound and dialogue as "orthodox animation" (36).
[43] Early animation refers to the period prior to the Golden Age – including animators such as Stuart Blackton, Emile Cohl, Winsor McCay and Max Fleischer, to name a few.
[44] Time-saving techniques at Disney included cycling animation, repeating actions, cross-overs, and recycling movements (Thomas and Johnson 41-44).
[45] Esther Leslie extends the discussion I make in the previous paragraph on how early animation's unrealistic distortions added to their charm and also had a strong influence on Avant Garde artists and critical thinkers of the time. She also extends her argument to how Disney's move to realism changed the medium, which I pick up on page 56.
[46] The company started as Disney Brothers Cartoon Studio in 1923, changing its name to the Walt Disney Studio in 1926, then Walt Disney Productions in 1929 (applicable during the Golden Age of animation), before officially changing its name to The Walt Disney Company in 1986.
[47] The company was founded in 1933 as Leon Schlesinger Productions, and changed its name to Warner Bros. Cartoons in 1944, by which it is more commonly known.
[48] Experimentations such as multiples, smears and creative uses of timing to represent a motion.
[49] There have been some studies that look at reinterpretation and expansion of the basic principles in order to address contemporary animation technologies, styles and techniques as the medium evolves. However, the basic principles still apply.

[50] The term 'realism' in animation is complex, time-specific and not one that everyone agrees on. In this text I use it in the context of early animation development in terms of how Disney has been evaluated with the production of *Snow White.*
[51] Implies how 'caricature' was understood by staff at the studio.
[52] By fake, Wells is referring to the fact that animation "does not use the camera to 'record' reality, but artificially creates and records its own" (25).
[53] Max Fleischer's brother, Dave, would dress up in a clown suit for the filming of the reference: "The Clown that Became Famous and then Became Ko-ko", Fleisher Studios.
[54] Because there are endless opportunities in animation to analyse, I chose to focus on a movement practised by Disney and Warner Bros. and available in Muybridge's work.
[55] This is an estimation that has been rounded off to the nearest second. The sequence depicted is fifty frames.
[56] This refers more to how animators engage with a sequence during analysis. It is not normally presented sequentially (as in the text above), but rather cinematically by scrubbing or stepping through the frames one at a time in order to assess the movement. Some two-dimensional (2D) digital software programs (like ToonBoom) offer a sequential preview of an animation.
[57] These are the most important poses that are essential for describing the movement in the action.
[58] In-betweens in animation refer to the frames that come between two key frames. These frames serve to fill the gaps of animation between the essential (action or storytelling) poses.
[59] By counting the number of poles, it is evident that over 20 figures were captured in this image that represents the full movement of the action. Because of the superimposition it is difficult to determine the exact amount of images, as Marey's notations are not available in the source.
[60] From frame 37 the animator animates on ones in order to smooth out the motion and make it appear faster. Sometimes it is effective to use more frames to resolve an action, especially when the poses are more extreme in nature.
[61] This was done for the purpose of clarity – too much overlapping movement is difficult to decipher, as can be seen in figure 3.4 - keys 01-05.
[62] The animation has been reduced to 12FPS, with backgrounds removed, presented sequentially with frame numbers (01-40), keys and holds noted on the sequence.
[63] This terminology is derived from Keith Lango's popular Video Tutorial Series starting in 2005 that describes how the in-between frames can favour a specific key pose, by slowly easing into the next pose (referring to acceleration and deceleration of an action).
[64] This is not evident with the background removed, as we cannot see the camera move, which 'sells the idea'.
[65] The film has been recognised by industry professionals as the best cartoon of all time (Preston), and was the first cartoon archived for preservation in the National Film Registry (Kausen).
[66] For this he was influenced by Buster Keaton, who popularised and used the 'pause' for comic effect.
[67] Wells defines Disney's style in animation as "hyper-realism", using it as a yardstick to measure other animated films for their degree of realism (25). I prefer not to use this term as I feel it is outdated, as the animation landscape and understanding of hyper-realism has changed with the introduction of photo-real characters since the publication of Wells' book.
[68] This conversation happens strictly one way, as the animator's identity is only revealed at the end of the film – which is Bugs Bunny, Daffy's arch rival.
[69] The animation has been reduced to 12FPS, renumbered and presented sequentially and in a superimposed format.
[70] The terminology 'season' was for the adapted television version and consisted of the first twenty four of the shorts which became to be known as 'episodes'.
[71] The shot is closely repeated in the second episode "Beep, Beep" (1952) almost 3 years later.
[72] This refers to the graphic drawing technique used to achieve the line style which is representative of dry brushstrokes.
[73] The inscription reads "*Accelleratii Incredibus*", which is a spoof of his Latin genus-species classification – a repetitive gag throughout the series, with the Coyote being titled "*Carnivorous Vulgaris*" at his first introduction in the episode (00:01:00-00:01:02). The Road Runner has also been referred to as the following throughout the series: *Velocitus tremenjus, Birdibus zippibus, Speedipus rex* and *Morselus babyfatious tastius.* Wile E. Coyote has been classified as *Carnivorous slobbius, Eatius birdius, Overconfidentii vulgaris, Poor schinookius* or *Caninus nervousrex.*

[74] In narratology the hero's journey or monomyth is a structure of storytelling popularised by Joseph Campbell. In short, it follows a basic three-act structure where the 'hero' (protagonist) goes on an adventure, is victorious in a decisive crisis, and returns home transformed.
[75] Synchronised sound was introduced by Disney in 1928 with *Steamboat Willie*. The aim was to synchronise the music with what was happening on screen (Barrier 51).
[76] The pencil test is the practice of photographing a pencil-drawn animated sequence to check the quality of movement and authenticity, before proceeding to be drawn on cels and painted, developed by Walt Disney (Wells 23).
[77] The camera has artwork placed at different levels to allow varying speeds of movement at various distances, in order to simulate depth and perspective (Wells 23).
[78] *Flowers and Trees* (1932) was the first animation to use Technicolor – a full-colour, three-strip process (Wells 23).
[79] Specifically with regard to editing principles.
[80] Heavily influenced by Avery and Freleng – he admired their sense of timing and sense of movement, and their gag structures. He felt that this approach made people laugh rather than just being amused. (Ford, Thompson and Adamson 23).
[81] These are preparatory drawings that would then be refined and inked for a final animation. They are used in the instruction of animation in order to teach the principles of movement.
[82] Referencing (in this sense) refers to using chronophotographic images of movement as a source for constructing animated movement.
[83] Each image in the sequence needs to display a progressive incremental change. Random image sequences (like those that are focussed on a subject, rather than a movement) are not included in this discussion.
[84] Some animators even reduce this further and animate on threes (8FPS).
[85] The cost of producing animation is affected by the fact that only half the amount of frames per second needs to be crafted, whereby reducing labour and time needed to complete this process. This is mostly a factor in frame-by-frame construction processes, like traditional drawn animation. In 3D animation, it would affect rendering times.
[86] Whether created by hand (frame-by-frame) or rendered, each image is not automatically generated as it is with a camera.
[87] This rate is known as HFR and is popular among certain film directors such as Ang Lee and Peter Jackson (Morrison).
[88] For this he presents how some chronophotographers like Muybridge and Worthington took some images independently (at different times) and arranged them in a way that implied movement (St George 9-12).
[89] The sequential images should be presented in rows or columns, one after another on the page or on the screen (St George 9).
[90] McCloud states that "closure" in comics is not continuous or involuntary as in film (68).
[91] Filmic, or moving image format, i.e. frames shown consecutively at a uniform rate (24 FPS or 12FPs).
[92] The sequence includes every second frame (1; 3; 5; 7; etc). The in-betweens are not always included in William's instructional animation planning, but will be added at a later stage in order to complete the animated sequence.
[93] In rows or columns, one after another on the page or on the screen (St George 9).
[94] This option is available in most digital 2D and 3D animation software programmes.
[95] These settings differ between software programmes and are usually customizable for the user.
[96] When describing the initial fascination with early animation in general, but the article focuses on American animation, specifically Disney's *Silly Symphonies*.
[97] Although Jones is referencing 'live-action' practices, the viewer is aware that the 'film-director' is in fact the animator: the person controlling Daffy's props, audio and environment.
[98] The reasons for this could become a study of their own, but perhaps it has to do with a new understanding of 'believability' in contemporary feature-length animation. Contemporary animated filmmakers tend to immerse their viewers in fantastical environments, exploiting the illusionary nature of the medium and breaking this notion of 'believability' in the film would counteract this aim.
[99] Thumbnailing in animation is a quick sketching process done in order to visualize concepts on paper. They are usually small in scale and can be for design purposes or preparation of animation or storytelling ideas.
[100] Kentridge states that "each *sequence (*as opposed to each *frame)* of the film is a single drawing. In all there may be twenty drawings to a film rather than the thousands one expects" (Fortuna).

[101] Van Caelenberge explains this as "a medieval parchment that has been written on several times, so that deciphering it implies reading all layers".
[102] Most strata-stencil animations made by hand are less than one minute in length (with the exception of the music video for "Katachi" which is 00:03:04). Those that use software to generate the technique are just over two minutes. Nothing longer form or feature-length has been found.
[103] Some have experimented with other two-dimensional materials such as cardboard and poly vinyl chloride (PVC) such as for Shugo Tokumaru's "Katachi", 2013.
[104] Images are cut out of a sheet of paper, like a stencil. The paper creates a silhouette-type image that represents a part of the narrative.
[105] Images are drawn by hand with each movement being planned out and timed according to the requirements of each action, much like Williams' approach in *The Animators Survival Kit*.
[106] This is decided by the animator and is dependent on the visuals and how long it can remain visible before visual clarity is lost. Normally between ten to twelve frames.
[107] Using After Effects.
[108] *Strata Paper* by Dylan Blau; *Bonnaroo* by Elliot Jokelson; *Sound sync- strata-stencil animation* by JUSTBUFFY; *Madam Butterfly* by Gabriel Kempers.
[109] In South Africa we refer to this as PVC or Perspex.
[110] Between 1998-2007 I worked at the University of Johannesburg (formally known as Technikon Witwatersrand) as papermaker, researcher, artist and trainer. I received a Cum Laude (Special Merit Award for Academic Achievement) for my MA research (2003) and the Vice Chancellor's Research Award for the Best Postgraduate Research Student (2002). I also curated the international group exhibition *Transformation: Works in Paper* at the gallery Art on Paper (2002); was featured in the book *Women on Purpose: Resilience and Creativity of the founding Women of Phumani Paper* (2012) and was invited by the Frans Masereel Art Centre in Kasterlee, Belgium (2005) to teach creative papermaking techniques to professional and emerging Belgian artists.
[111] Williams has also released a DVD version of the book where the practical exercises are presented in a cinematic format, supplemented with practical teaching of the content.
[112] One of these advantages would be being able to share 3D meshes between characters and evading the labour-intensive redrawing of each frame, as in traditional 2D animation practices.
[113] In 2011–2012 I managed a company that created laser-cut design products.
[114] Converting the digital renders to a paper cut-out product would have been impossible if it wasn't for the laser-cutting process. The laser cutter used the digital information to create the cut-outs by means of vectors.
[115] Blinkink is part of the award-winning British commercial and music video production company based in London, Blink.
[116] As an archival hand-papermaker.
[117] The archival nature, stability and longevity of the paper was very important for the exhibition work.
[118] Not all paper laser-cuts well. Some papers have a higher burn quality, and some leave a large amount of residue, making them more difficult to process and keep clean.
[119] By hybrid animation, I am referring to the bringing together of digital 2D animation; laser-cutting and stop frame animation techniques into a single animation pipeline.
[120] These directors were known for their unique approaches to the representation of movement as discussed in Chapter 3.
[121] The kind of representations animators learn as part of their training, like a run/walk/sneak or a head turn.
[122] A digital test using Adobe After Effects could have been conducted, but the amount of work required to remove the backgrounds and mimic the effect would have added too much time to the process and slowed the production.
[123] That is, the removal of their backgrounds.
[124] In the 3D software.
[125] Some timing of the original film was slightly altered to fit into the music.
[126] Autodesk Maya is a 3D computer animation, modelling, simulation, and rendering software.
[127] The Goofy-like character represents Goofy's movements derived from the short film under analysis.
[128] To keep the project manageable.
[129] Identifiable to viewers from all age groups.
[130] 2D drawn, 3D digital, stop motion puppets, paper cut-outs, etc.
[131] They are not completely abstract shapes, but rather retain some resemblance to a person or thing, like an icon of a smiley face representing a person.

[132] Silhouetted characters are inherent to the strata-stencil animation technique.
[133] Sometimes the silhouette style can cause visual confusion when body parts overlap, causing larger, indefinable shapes. The engraving was introduced to help guide the viewer through understanding the movement without getting confused by the silhouetted, overlapping image.
[134] These were a standard feature for four television networks in the United States, were also available in Canada and were a staple on South African television. There is no documented evidence that Europe had the same tradition of Saturday morning cartoons.
[135] In South Africa this timeline starts much later, as television broadcasting was only introduced in 1976.
[136] Modelled in 3D.
[137] A character rig is a virtual skeleton used for animating characters in 3D. The rig is composed of a hierarchical digital bone structure and manipulating curves that deform the mesh, making the animation process more efficient.
[138] Vector graphics are not made up of pixels but instead comprise paths that are derived from points on a cartesian plane. The laser cutter defines its actions via the vector paths' colour, thickness and fill properties that are defined by the user.
[139] This equated to 3800 image conversions.
[140] Adobe Illustrator is a vector graphics editing and design program.
[141] A papermaking term that defines the amount of distortion a paper can succumb to.
[142] Bridges are narrow sections of material that are not cut out.
[143] Islands are sections of material that are inside cut-out 'holes' in the stencil.
[144] Evidence of the horizontal movement of the laser can be seen in the horizontal linear make-up of the engraving.
[145] Because of the nature of the strata-stencil technique, filming was fluid and shots were required to be photographed in sequential order.

[146] The light used was a 'Red head' – a single 1000 watt bare globe open face light.
[147] This was with a team of three people. On the worst day only 115 frames were captured. On the best day 269 frames were captured.
[148] The team worked 8 hours a day.
[149] A third shoot was scheduled to re-shoot the titles and credits, as the lighting was not correct after the first attempt. This shoot only took one day with a team of two people.
[150] This statement establishes animation as a medium that is presented to the viewer in a certain way. I do acknowledge the 'self-figurative' aspect of early animations, but this is not the focus of this statement. I also acknowledge that over time the nature of the films transformed from shorts that preceded the main live-action feature, to becoming feature films themselves.
[151] The exhibition included informative videos on the animation and strata-stencil process, similar to the time-lapse videos 5.2 and 5.3 on the creative process.
[152] 12FPS, which is a common frame rate in both early animation and stop frame films, as it reduces the workload but offers the viewer enough information to experience the movement. Because it is slightly slower, it affects our spatial and temporal acuity, causing the viewer to experience a more fragmented, less smooth version of the motion.
[153] Frame by frame at 24FPS
[154] Because the sequences run at a different frame rate, timing of the action remains the same, but the frequency of images is halved in the short film.
[155] This assumes that the viewer is not an animator and is unfamiliar with how movement is created in animation (i.e. what is a hold and how many frames it encompasses).
[156] The title and credit sequence make up the remaining 456 frames of the 1900 stencils.
[157] Each frame is printed at a scale of 60mm x 35mm (width x height).
[158] This number was limited by the structural nature of the frame. If any more frames were included, the work would become top-heavy and impossible to hang.
[159] Animation that could be cycled.
[160] Chronophotographic images were used on various optical toys to reconstitute the movement for the viewer, but this was never an aim of the chronophotographers, but rather was used as a novelty for entertainment purposes.

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Annexure A

List of examples of the strata-stencil technique

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Annexure B

Festival screenings and awards: *a[CHRONO]mation*

1. **Melkbos Short Film Festival**, 28 March 2020, Cape Town, South Africa, Selected for screening
2. **California Independent Animation Film Festival**, 16 May 2020, California, USA, Selected for screening
3. **Florida Animation Festival**, 11 June 2020, Florida, USA, Selected for screening
4. **New York Animation Film Awards (NYAFA)**, 12 June 2020, New York, USA, Selected for screening, Semi-Finalist
5. **Open World Animation Festival**, 23 July 2020, Pennsylvania, USA, Selected for screening
6. **Overmountain Animation Festival**, 05 August 2020, East Tennessee State University, USA, Selected for screening
7. **6th Chaniartoon**, 11 September 2020, Chania, Greece, Selected for screening
8. **The Jozi Film Festival**, 17 September 2020, Johannesburg, South Africa, Selected for screening
9. **Animation Chico**, 17 October 2020, California, USA, Selected for screening
10. **Los Angeles Animation Festival**, 05 December 2020, Los Angeles, USA, Selected for screening
11. **Palm Springs Animation Festival**, 15 December 2020, Palm Springs, USA, Selected for screening
12. **AniMate - Australia Animation Film Festival**, 27 December 2020, Sydney, Australia, Selected for screening
13. **3 Minute Film Festival**, 5 January 2021, California, USA, Selected for screening, Award Winner: Best Animation
14. **BAM Kids Festival**, 01 February 2021, New York, USA, Special invitation screening
15. **London International Student Film Festival**, 08 April 2021, London, UK, Selected for screening
16. **Cardiff Animation Festival**, 14 April 2021, Cardiff, UK, Selected for screening (partner with CTIAF)
17. **St Kilda Film Festival - Family Animations**, 29 May 2021, Melbourne, Australia, Special invitation screening
18. **Infinity Convention**, 05 June 2021, Tallahassee, USA, Special invitation screening
19. **We Like 'Em Short - Animation and Comedy Film Festival**, 12 August 2021, Oregon, USA, Selected for screening
20. **Cape Town International Animation Festival (CTIAF)**, 01 October 2021, Cape Town, South Africa, Selected for screening and Best of Collection

Annexure C

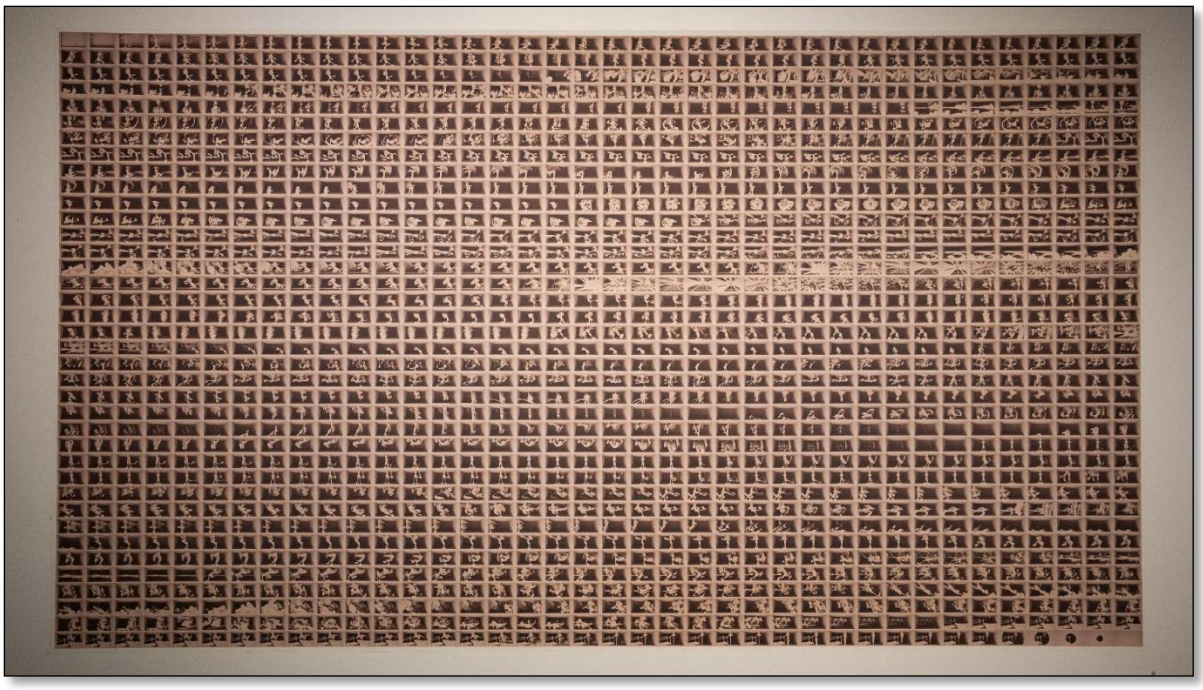
Exhibition catalogue: *a[CHRONO]mation*



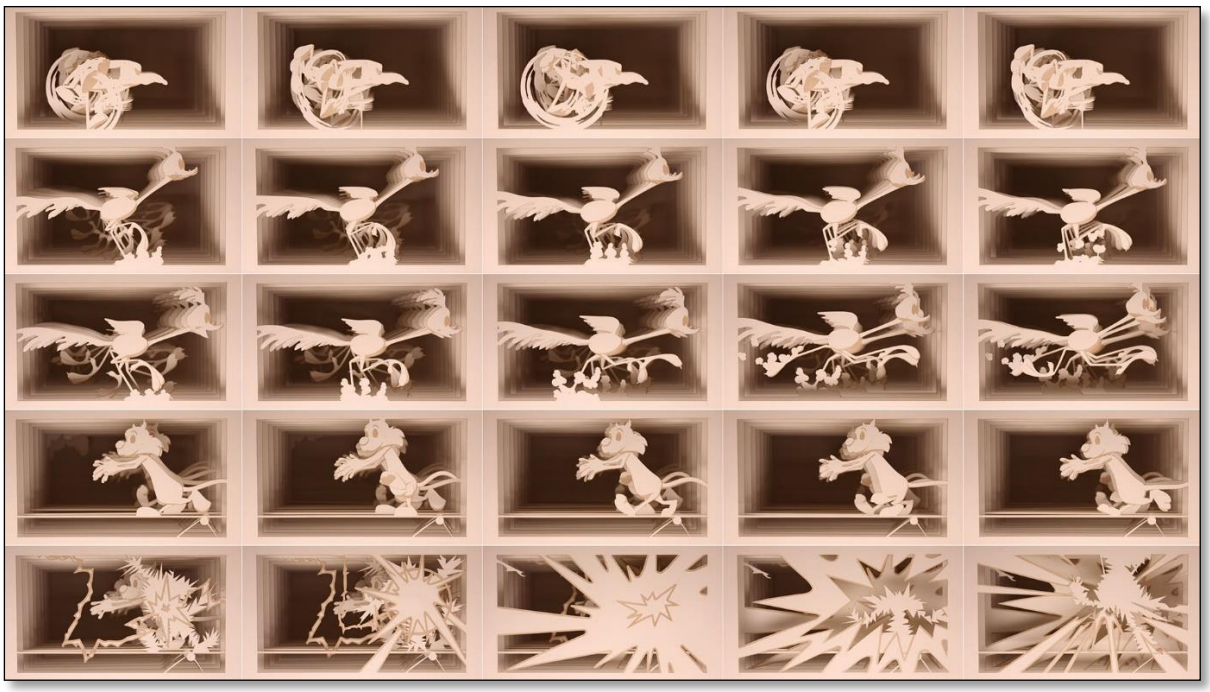
Repercussion (2019)
340mm x 260mm x 50mm, Laser-cut and engraved frames



Fleeting (2019)
340mm x 260mm x 50mm, Laser-cut and engraved frames



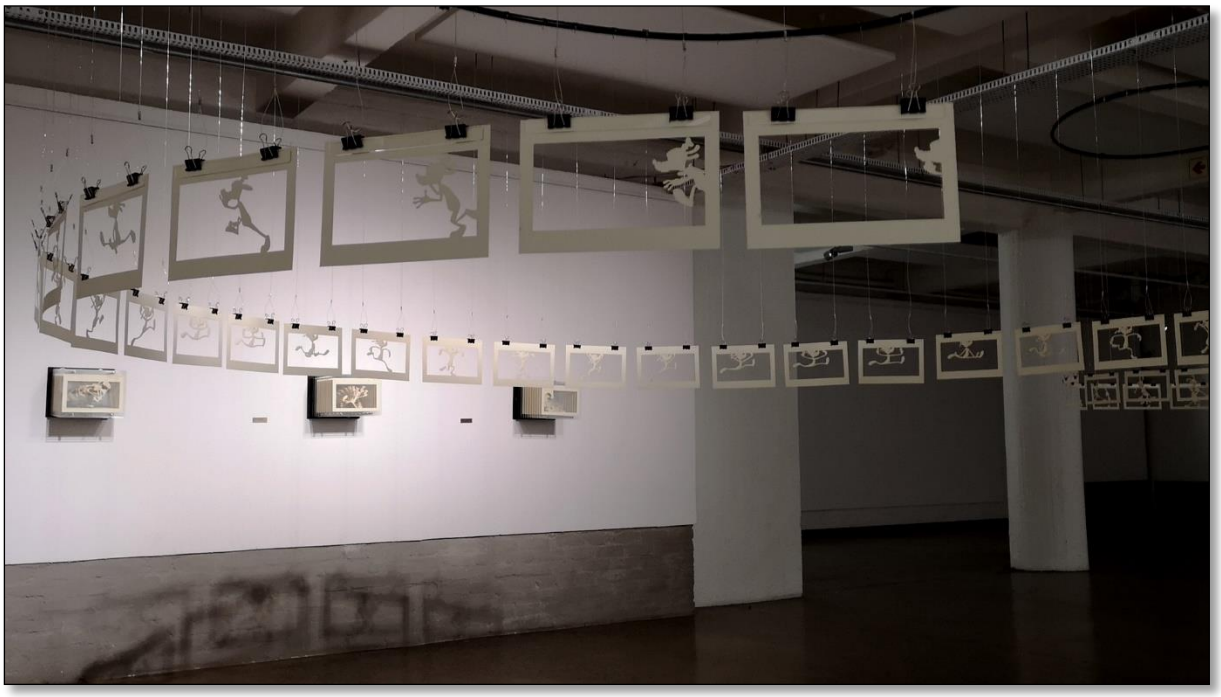
Cartoon Study of Movement (2020)
2445mm x 1380mm, Print



Cartoon Study of Movement – Detail (2020)
2445mm x 1380mm, Print



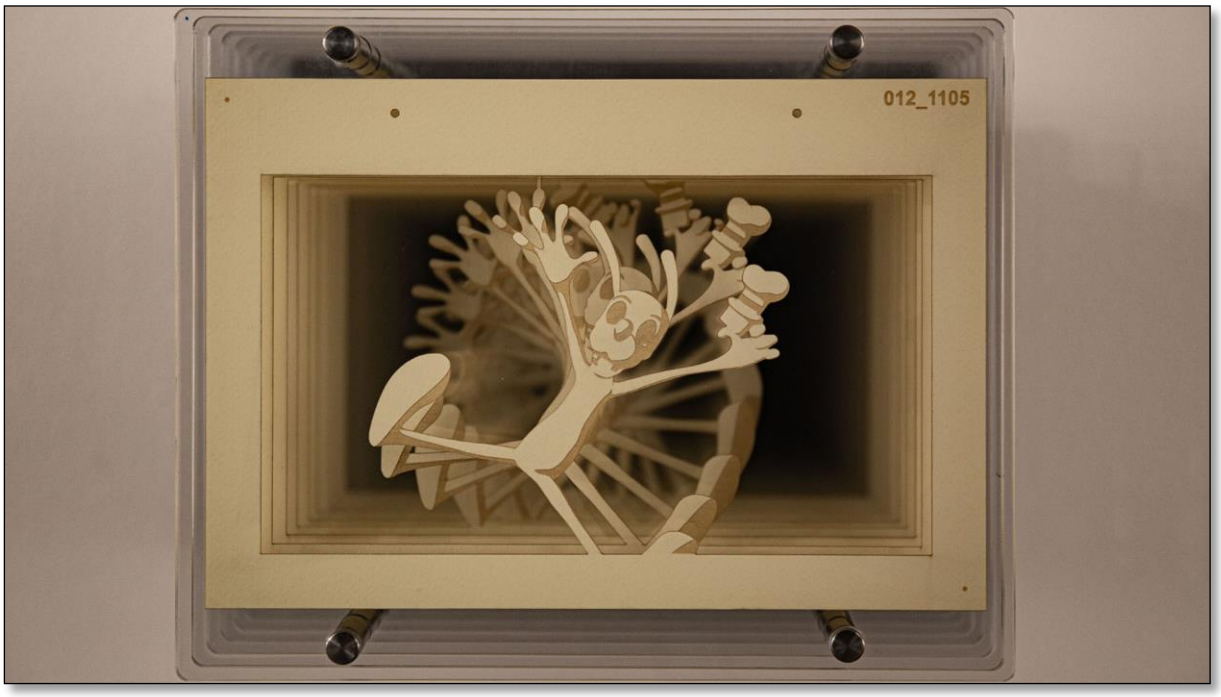
Olympic Champ Run Cycle Installation (2019)
280mm x 190mm sequence, Laser-cut and engraved frames



Olympic Champ Run Cycle Installation (2019)
280mm x 190mm sequence, Laser-cut and engraved frames



Sequence Study: Bugs Bunny (2019)
300mm x 240mm x 360mm, Laser-cut and engraved frames



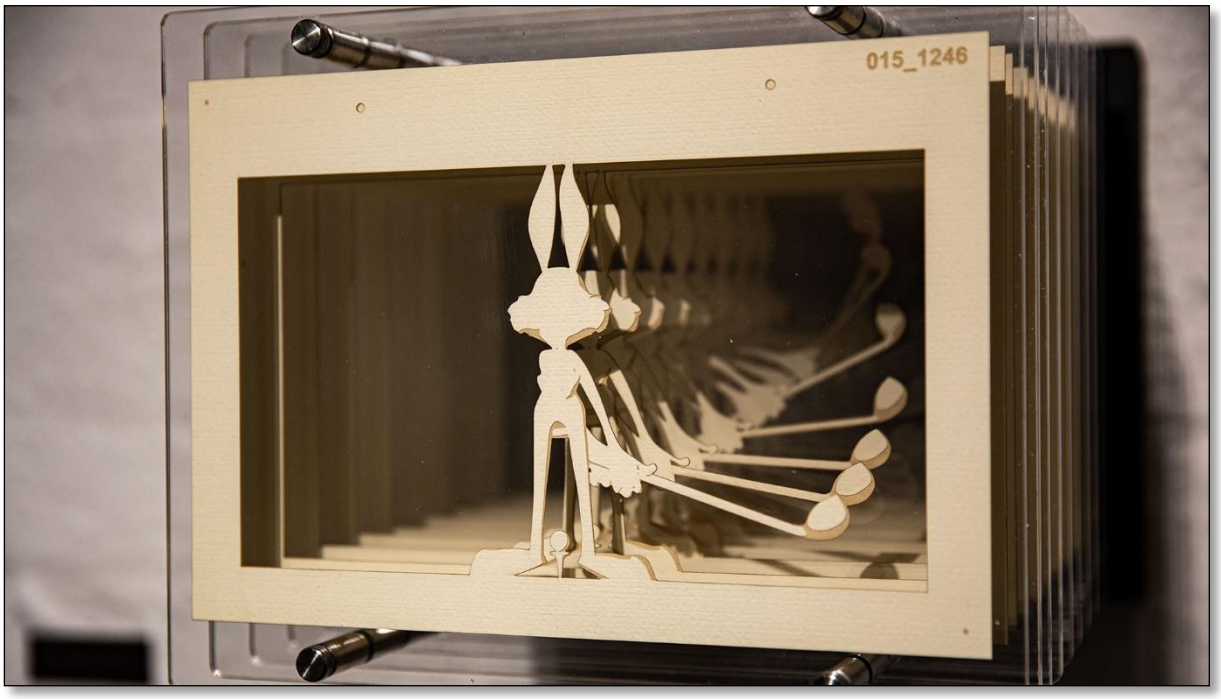
Sequence Study: Goofy (2019)
300mm x 240mm x 360mm, Laser-cut and engraved frames



Sequence Study: Smoke Effects (2019)
300mm x 240mm x 360mm, Laser-cut and engraved frames



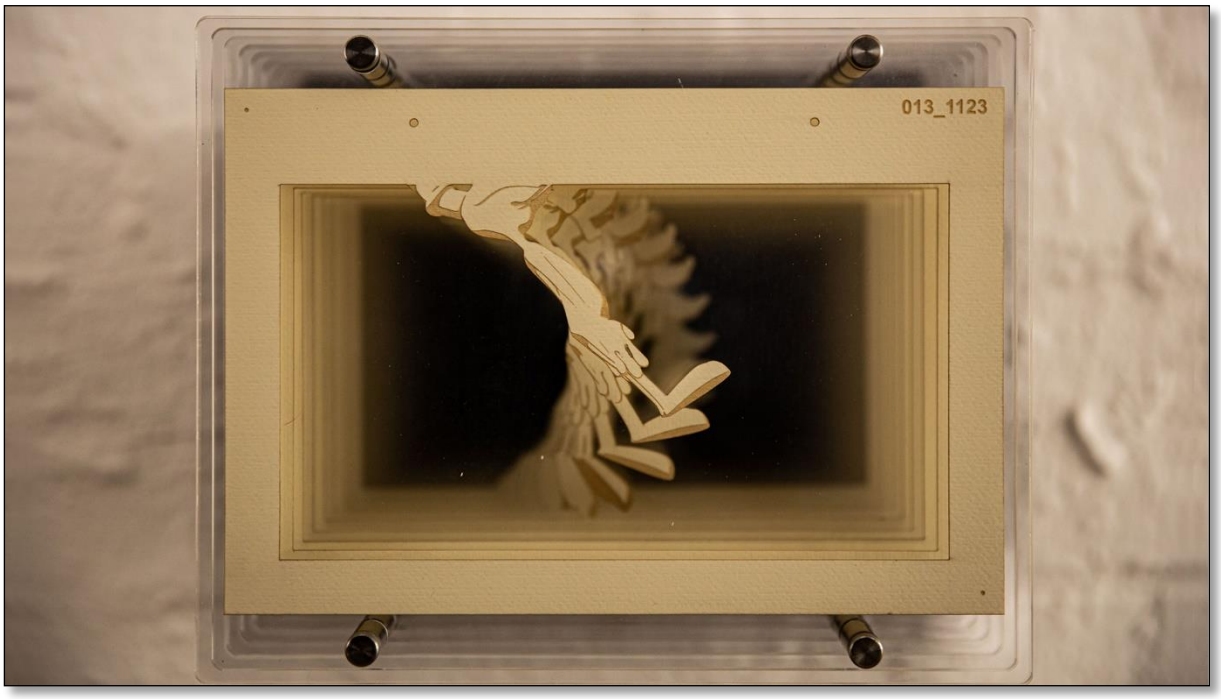
Gravity (2019)
1950mm x 830mm x 60mm, Laser-cut and engraved frames



Sequence Study: Bugs Bunny II (2019)
300mm x 240mm x 360mm, Laser-cut and engraved frames



Sequence Study: Daffy Duck (2019)
300mm x 240mm x 360mm, Laser-cut and engraved frames



Sequence Study: Goofy II (2019)
300mm x 240mm x 360mm, Laser-cut and engraved frames



Bugs Hammer Hit (2019)
1200mm x 830mm x 60mm, Laser-cut and engraved frames



Bugs Bunny Sneak Installation (2019)
280mm x 190mm sequence, Laser-cut and engraved frames



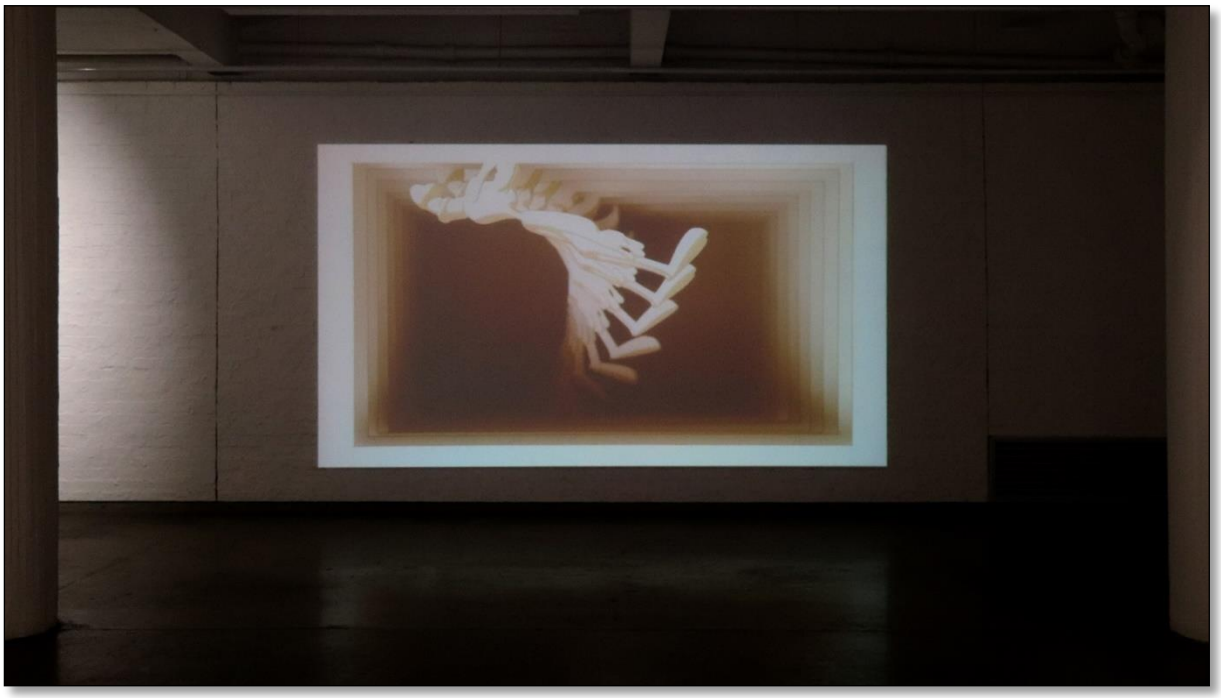
Road Runner Run Cycle (2019)
340mm x 260mm x 100mm, Laser-cut and engraved frames



Goofy Baseball Pitch (2019)
340mm x 260mm x 100mm, Laser-cut and engraved frames



Goofy Dive Run-up (2019)
340mm x 260mm x 100mm, Laser-cut and engraved frames



A[CHRONO]mation (2020)
HD 1920 x 1080 , Experimental Animation



A[CHRONO]mation Credits (2020)
2100mm x 200mm, Laser-cut and engraved frames



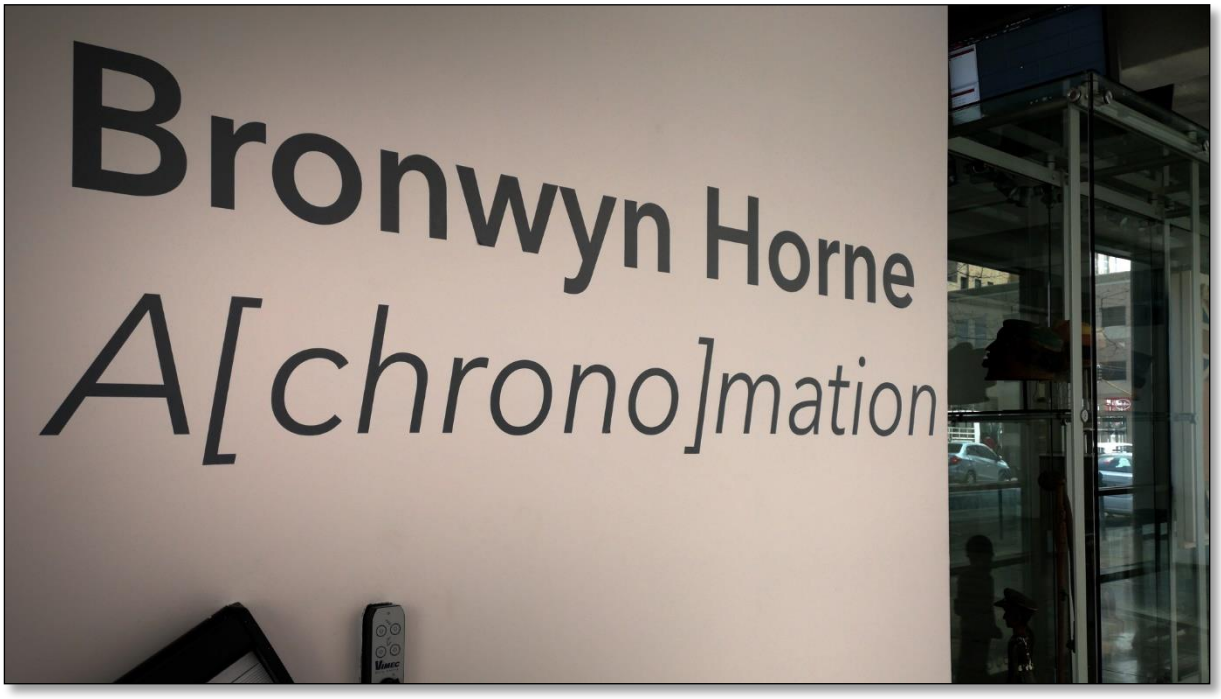
Phenakistoscope (2020)
250mm x 320mm x 20mm, Printed animation

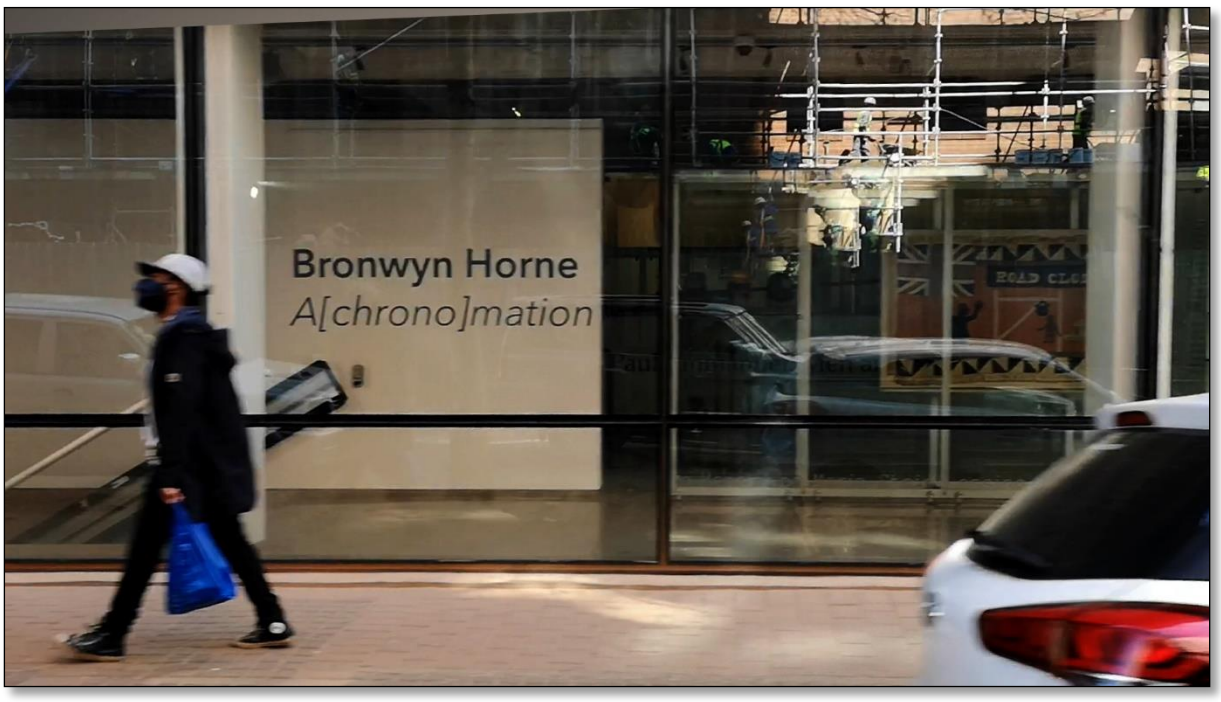


Thaumatrope (2020)
70mm x 260mm x 15mm, Printed animation



Cartoon Run (2019)
3750mm x 260mm x 50mm, Laser-cut and engraved frames





Annexure D

Wits Art Museum, Gallery Report

3 December 2020

Dear Bronwyn

I hope this finds you well.

Wits Art Museum would like to convey great thanks to you for sharing your practice with the public and us. The *A[chrono]mation* exhibition was unique in the programme, and demonstrated not only the aesthetic value of the medium but also your exceptional skill. The highlight of the exhibition was undoubtedly the short film. The film was not only entertaining, but also indicative of the command of history and skill that went into its making.

We enjoyed a busy start to 2020. *A[chrono]mation* drew a significant audience and was particularly beneficial in our education programme. This in not limited to school and university students, but also includes workshops offered to the public.

In a workshop lead by artist and educator Bronwen Findlay, participants learned about stop frame animation and made their own flipbooks. The works included in your exhibition were also integrated into the assessments of approximately 338 first year students completing degrees in Education, Architecture and others.

Your work has been remarkably impactful. As a PhD scholar, this impact will continue to compound as your research progresses, and we look forward to seeing your outcomes.

Following your exhibition, we have compiled some audience statistics for you to ascertain the reach of *A[chrono]mation.* We hope you are as pleased as we are with the success of your exhibition.

Sincerely,

Lois Anguria | Tertiary Programme Coordinator

Wits Art Museum
Private Bag 3
2050

Tel: 011 717 1446
lois.anguria@wits.ac.za

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

WitsArtMuseum

www.wits.ac.za/wam | f: WitsArtMuseum | t: @WitsArtMuseum

A[chrono]mation by Bronwyn Horne opened to the public on Tuesday 18 February 2020. The intended run time for the exhibition was until Saturday 18 April 2020. The exhibition closed to the public after Saturday 14 March 2020 in response to the COVID-19 pandemic and the related regulations set in place by the University and the South African government. Over this 4 week period, a total of 2216 visitors were recorded. WAM is open from Tuesday to Saturday, 10:00 – 16:00 and the visitor figure includes attendance at a number of events. The breakdown of these events is as follows:

18 February: *A[chrono]mation* opening event: 123

22 February: Walter Hamady talkabout with Jack Ginsberg: 15

27 February: WAM Academic Breakfast: 4

3 March: Men and Monuments by Paul Emmanuel exhibition opening: 231

5 March: First Thursday Wits Jazz Trio: 126

7 March: Make-a-Book: create a dos a dos: 27

14 March: Drop in Drawing: A(chrono)mation Flip Book Workshop with Bronwen Findlay: 26

The following educational institutions (NGO, secondary school and tertiary) visited WAM during this period:

Wits Faculty of Engineering and the Built Environment – Critical Thinking

Northcliff High

Kingsmead College

Wits Postgraduate Certificate in Education – Art Education

Wits School of Art (WSOA) - Drama

Encko Sandton Campus

Artist Proof Studio - Printmaking

Wits School of Education – Foundation Phase

WSOA – History of Art

Calibre Education

University of Johannesburg (UJ) Faculty of Art, Design and Architecture (FADA) – Multimedia Design

UJ FADA – Interior Design

Wits Social Sciences - Sociology

Wits Social Sciences - Anthropology

Ramilla Patel and Waterford School in Swaziland