Moving in an Instant:
The Paradox of Monet’s Motion Paintings

by

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Introduction

Change, in a strict definition of the word, implies a period of time over which something evolves. We can think of this as change between time A and time B. Yet the concept of instantaneity means that we are looking at only one point in time, so time A and time B would have to occur at the same time. But how can we see or represent change over a period of time if the endpoints of that timespan are concurrent? Painting a singular, still, moment of changing time is inherently impossible; it is showing an instantaneous moment of change, which in and of itself is contradictory.

In the case of concurrent endpoints, the time span over which to consider change is infinitely small. We can consider differential calculus as a sort of model for this kind of thinking. Calculus is the mathematical field of studying continuous change, and one branch of calculus focuses on derivatives, or the calculation of an instantaneous rate of change. But this is conceptually impossible. How can we measure change at a single, unchanging point in time? Change seems always to imply a period of time. Calculus solves this problem by calculating this change quantity while the size of the interval becomes incredibly small, approaching zero.

As a mathematics student, I have found myself thinking about change in realms other than the purely quantitative. This led me to the following questions: How does the representation of change work in art? Is there some form of a comparable method by which artists can show instantaneous change with the same level of success as a mathematician? This seems theoretically impossible. How can we
simultaneously show movement over time but in an image that inherently does not move? Is this possible?

Change over time is not the sole “problem” related to the realm of painting that has puzzled artists. Indeed, before the 15th Century, there was no real mechanism for accurately, proportionally, and convincingly displaying the three-dimensional world in which we live, on a two-dimensional surface. Linear perspective solved this problem by using a sort of sleight-of-hand to make the viewer see all three dimensions. Same sized objects set farther are not actually smaller; they only appear to be. This works with just as much accuracy for transforming three dimensions to two as mathematical derivatives do for calculating an instantaneous rate of change. This mathematical invention, applied to the artistic realm of painting, transformed art forever. Can we achieve this sort of accuracy for transferring a moving image onto a still one? It would seem so, as this was the aim and ultimate achievement of Claude Monet and the Impressionists.

One of the leading avant-garde art movements of the late 19th Century was Impressionism, which held a core tenet of attempting to portray fleeting moments of light. Impressionists had the desire to capture the mystical quality of the air and light as they saw it around them. They recorded what they saw as brief “impressions” with oil paint on canvas. These paintings were created outdoors, or en plein air, and were painted as rapidly as possible. By reducing the time in which it took to construct these primarily-landscape paintings to a minimum, the painters could better ensure that they were genuinely capturing an instantaneous moment in time. But how did this actually play out for the Impressionists?
This thesis explores the ways in which artists, especially Claude Monet, sought to tackle this idea. Monet’s artworks in the late 1800s exemplify these ideals excellently. His drive behind his idyllic creations was to depict the constantly changing light at a given point in time. To best study Monet’s works and the inherent paradox they present of imposing a moving image onto a still one, I have presented my ideas in three parts.

First, I will provide the reader with the necessary historical, contextual information. Chapter 1 starts with a brief history of France in the late 19th Century. The Industrial Revolution in England spread to France and led to drastic changes in industrialization and urbanization. French urbanization, especially, had a considerable impact on the Impressionists. Among the repercussions of urbanization was Georges-Eugène Haussmann’s redesign of the city of Paris, called the Haussmannization of Paris, and increased transportation between Paris and the surrounding suburbs. The emergence of modernism was a result of these factors and is clearly exemplified in art, particularly Impressionism.

Chapter 1 also provides a background and chronology of Impressionism. Impressionism originated as a reaction against the two previous prevailing art movements, Romanticism and Realism, and as a rejection of the Salon, an institution created by the Royal Academy to exhibit artworks. Impressionism focused on the instantaneous of nature. This art movement was made possible partly by the expanse of the railway systems and technological advancements, such as the invention of the paint tube, new discoveries in optics and color theory, and the development of photography. There was a growing system of art schools and apprenticeship programs
to spread the ideals of Impressionism. The works and philosophies of the Impressionists were further spread through the art dealer Paul Durand-Ruel and the Impressionist cafés. These cafés were a product of the Haussmannization of Paris, and they provided a place for sharing ideas among artists.

The first chapter concludes with biographical information about Monet and addresses the elements that informed his groundbreaking painting style. Monet’s goal throughout the majority of his career was to paint the transient, fleeting quality of light he saw around him every day. He was taught the strict methods of academic painting but eventually strayed far from this in an effort to incorporate motion and the passage of time into his works. Monet soon became one of the foremost plein air painters of the late 19th Century, developing a painting style that was far removed from those that he learned in his formal education.

The second chapter covers the scientific and formal analyses of Monet’s paintings of motion. We, as viewers of two-dimensional works of art, are subjected to the specific viewpoint that the artist wants to showcase. We cannot peer around the corner to get a different view, as the perspective we see is fixed by the artist and the nature of the work. This is true in both photography and painting. Moreover, different artists approach the depiction of the same scene differently. This not only includes the framing of a scene but also which parts of the subject are emphasized and which are made to blend in.

Chapter 2 also explores the numerous ways in which Claude Monet tackled this matter of collapsing a moving image onto a still one. First, I provide the reader with a basic background for the biology of the eye and optics, and how this affects
what we see. This covers how we distinguish between color and brightness differences, how the distribution of photoreceptors affects peripheral vision, and how the close succession of high contrast lines relates to motion. Our understanding of seeing is comprised of what we see in both our eyes and our brains. In “perspective,” the eye sees different sizes and non-parallel lines, but the brain sees added element of depth and the third dimension. Similarly, the ways in which we see motion in art really occur in the brain. Our eyes see a specific image, an illusion, and our brains interpret this as motion.

To relate the above optical and biological concepts to painting, I introduce several of Monet’s paintings as examples that aptly demonstrate these methods. Monet used the juxtaposition of equiluminant colors (colors of equal brightnesses) to show motion, and the mixing of particular colors to show the effect of an exact time of day. The eye sees colors and images on the canvas, but the brain corrects them to be what we know to be true. A white building at dusk might appear to be a golden-red in our eyes, but our brains know that the color of the building does not actually change as the sun sets. Monet exploited this fact and used it to his advantage to trick the viewer into seeing different effects of lighting and the passage of time.

This chapter also introduces Monet’s series paintings as a mechanism for displaying motion in art. While the individual paintings in each series show motion using the methods described above, the passage of time and, with it, the changing light, is most evident when viewing the paintings all together. Additionally, I discuss the result of the contemporaneous invention of photography, which introduced Monet and the other Impressionists to the “photographic blur,” thus providing them
with another mechanism for depicting motion. Although Monet broke with the
previous, longstanding academic traditions of painting, the methods he employed in
his art allowed him to depict the motion of fleeting light convincingly.

While Chapter 2 outlines a number of possible options for depicting motion in
art, this list does not exhaust the potential tactics for how to transform a moving
image onto a still one. There are different ways in which humans can perceive
movement visually. One common technique, not used by Monet, is through repetitive
stimulation of the retinal receptors in the eye. This can be done through something as
simple as a repeated flashing light or a line moving across a screen. The intuitive
approach to showing motion through this method would be through some kind of
video or other media in which there are multiple frames. However, in a painting,
Monet did not have these kinds of fast-moving frames – he only had one, still frame.
To do this in a single frame, an artist could, perhaps, distort the image, so it no longer
holds visual integrity, but it conveys the concept of motion.

This is the most common manifestation of motion in art, as demonstrated in
the final chapter of my thesis. For other painters (than Monet), it was almost
imperative that they distort the subject of the painting in some way, just to depict
motion in a still painting. This renders the subject inaccurate, unbelievable, and
sometimes even unreadable. In these cases, the viewer is reliant on prior knowledge of
the subject and contextual clues to recognize the image. While these sorts of
demonstrations of movement, called stroboscopic motion, are not incorrect, nor of
any lesser value, they do not keep the integrity of the subject intact.
Chapter 3 describes alternatives to Monet’s representations of motion by introducing works by other artists and art movements. By exploring the possibility of compressing multiple frames into one image, these artists achieve a different kind of motion than Monet did. Artworks with stroboscopic motion, which depict the subject as if we were taking stop-motion photographs or long-exposure photographs with a strobe light, are seen done by a number of artists, such as Étienne-Jules Marey, Eadweard Muybridge, Marcel Duchamp, and Giacomo Balla. Another method for showing motion in art is compressing multiple viewpoints into one image as if the viewer were shifting vantage points while viewing the work. This is best exemplified through the paintings of Pablo Picasso and Georges Braque, the sculptures of Umberto Boccioni, and the photocollages of David Hockney. The last method for depicting motion addressed in Chapter 3 is the mathematical, abstract, flashing patterns shown in Op Art, which takes further advantage of optics and how our brains are tricked into perceiving motion.

I present calculus as a metaphor, or model, for Monet’s inherent conundrum of condensing changing time and fleeting light into a still image. The weakness in a calculus derivative at an instant is that it represents the rate of change, not the actual time interval of change. Similarly, a high shutter speed photograph represents an instant, not a period of time, and so, actually leaves out the changes over that time interval. For example, imagine a high shutter speed photograph of a racecar at 100mph. The short, quick exposure would make the car appear to be parked, even though it obviously is not. The sleight-of-hand effect disappears in a photograph like this.
Depicting the change over a period of time was ultimately the task at hand for Monet, which was quite a feat. A photograph with a long exposure time could do this too, but not in the way Monet presented changing time in his paintings. His paintings are not just blurry, as a photograph would be, and his methods were much more sophisticated than that. Monet’s techniques extended past calculus. He went beyond representing just the snapshot of the fleeting light and managed to represent both the still image and the interval over which the light is changing, the methods of which are explored in this thesis.
Chapter 1
Rise of Impressionism and Claude Monet

Context of Impressionism

All movements in the history of art develop as reactions to their artistic predecessors. Impressionism was no exception, but to understand this art movement’s roots, we must first understand the styles that preceded it. The 18th Century in Europe introduced Neoclassicism in art and Rationalism in thought, looking back to antiquity for aesthetic inspiration and rational thought processes in daily life. There was a strong emphasis on logic and observation-informed thought processes, and a turn away from religion as the rationale for the validity of an idea. Following this shift towards reason and classical tradition, the 1830s brought Romanticism in art and philosophy. Romanticism exemplified the revolt against the established order of things, signifying a reversal of the trends seen in Neoclassicism and Rationalism. There were no more precise rules or formulas to follow. Historian Gordon Wright summed up the sentiments representing Romanticism, noting, “A mood or movement whose central characteristic is revolt, and whose stress is on self-expression and individual uniqueness, does not lend itself to precise definition.”¹

The next art movement that began as a reaction to the previous one was Realism (c. 1850s). There were two main elements of Realism that made it a new, unique style: subject matter and painting style. In 1861, leading Realist Gustave

¹ Wright, France in Modern Times: From the Enlightenment to the Present, 172.
Courbet said, “Show me an angel, and I'll paint one.” This quote emphasizes a primary tenet of Realism – paint only what you see with no abstraction or made-up figures. The principles of Realism led to the Realists painting subjects that previously were not deemed worthy for paintings. This included images of the working class, everyday subjects, and peasant life. Realist painters depicted these subjects on the scale of History Paintings, meaning they were larger-than-life-sized portraits.

Realism also brought in the idea of calling attention to the painterly process. Painting was no longer illusionistic, which was the primary goal of painting in decades past. Painters used a more impasto-like painting technique, meaning they coated the canvas with thick brushstrokes and larger clumps of paint. However, Realism was not well-received by the public at the time because of its mundane content and abrasive style. “Because people widely recognized the power of art to serve political means, the political and social agitation accompanying the violent revolutions in France prompted the French people to suspect artists of subversive intention.”

Impressionism was next in the sequence of 19th Century art movements that rejected their predecessors. It developed as the art of urban Paris. This new painting style had one of the most significant impacts in Europe of all painting movements. The only comparable movement in terms of notability and influence was the Renaissance, which really extended far beyond the realm of art and aesthetics. Impressionists freed art from its principles. There was a conscious attempt to paint what they did see, not what they thought they saw or what they should have been seeing. While Realism focused on the present, Impressionism focused intensely on a

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3 Ibid., 857.
single moment. Although this will be discussed in greater depth in the following chapter, this idea is best understood in the example of color corrections in the brain. Think about the minutes just after the sun sets when the world appears blueish. Our eyes see blue hues, but the brain takes over and maintains that a white building is still white. Previous painters might paint this building as white, but Impressionists would have painted it with blue tones, as that is the natural truth that the eye observes. This philosophy also carried into the 20th Century and was defining for future art movements as well.

The Impressionist movement was established by about twenty young, Paris-based artists that all knew each other well. Bernard Denvir notes that these artists were a “product of a unique cultural environment, which molded them as much as they influenced it.” The span of Impressionism is noted today from 1830-1926; the starting date being the birth of Camille Pissarro and the concluding being the death of Claude Monet. Across that time period, there was a variety of different political atmospheres. This time span saw two major wars, several minor ones, and a brief civil war, which resulted in the crushing of the Commune, a radical socialist and revolutionary government that ruled Paris from March 18 to May 28, 1871. In addition, during this era, France took control of a number of colonies in Africa and the Far East. They went from being a primarily agricultural country to an industrial country. The mercantile middle class also expanded and gained a great deal of power. On the whole, the Impressionists (with a few exceptions) stayed relatively apolitical. These artists were either grands or petits bourgeois in origin. This means that none of

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them came from peasantry or the proletariat, and the Impressionist patrons were, too, from the bourgeois.

All of the previously mentioned factors in the latter half of the 19th Century naturally led to the development of Modernism in all forms of art. Modernist artists were aiming “to capture the images and sensibilities of their age”\(^5\) Yet, modernism extends beyond just capturing the present, as it also incorporates the self-critical artist who questions and reflects upon the premises of art itself. Influential art critic Clement Greenberg states,\(^6\)

Realistic, illusionist art had dissembled the medium, using art to conceal art. Modernism used art to call attention to art. The limitations that constitute the medium of painting – the flat surface, the shape of the support, the properties of the pigment – were treated by the Old Masters as negative factors that could be acknowledged only implicitly or indirectly. Modernist painting has come to regard these same limitations as positive factors that are to be acknowledged openly.

The notions of art for art’s sake, art recognizing the artistic process, and the expansion of the role of the art critic as an integral component to art movements, were all strengthened in the establishment of modernism. Modernism paved the way for the development of the \textit{avant-garde}, cultivated by “artists whose work emphatically rejected the past and transgressed the boundaries of conventional artistic practice.”\(^7\)

During this time, Europe also saw new philosophies that pervaded through societies, encouraging people to adopt new ways of thinking. German political thinker Karl Marx published \textit{The Communist Manifesto} and \textit{Das Kapital} in the mid-1800s. Marxism and other principles established by these texts inspired uprisings as well as

\(^5\) De La Croix, \textit{Gardner’s Art Through the Ages}, 855.  
\(^6\) Ibid.  
\(^7\) Ibid.
social and economic changes. This thinking also led to the rise of trade unions and socialist groups. Additionally, many European nations were colonizing on the rationale of industrialization and Social Darwinism. This was the theory that people should be subjected to the same laws of natural selection as animals and plants. It was frequently used in the late 19th Century and early 20th Century to validate imperialism and deter reform and intervention.

France in the late 1800s also saw an increased emphasis on science. Because of the newfound belief in Rationalism, which had served as the foundation for the Enlightenment in the previous century, more people recognized the connection between science and progress. As a result of Enlightenment ideology, people understood that more science theoretically led to more progress for society. There was more support for empiricism during this time, which meant using observation and experience to inform decisions, rather than turning to other sources, such as religion. The increased interest in science eventually led to Darwin's popularized theory of evolution and natural selection, which is credited with sparking a curiosity about science among the public. This created a groundwork upon which further scientific theories and practices could grow and eventually spread through the creation of art.

This time period in Europe ushered in industrialization, urbanization, and increased economic and political interaction with other countries around the world. The modern era began with the age of the machine, or the Industrial Revolution. Beginning in the 18th Century in Great Britain, the Industrial Revolution changed production methods. Rather than hand-crafted commodities in small workshops, things were made for lower prices and larger quantities by machines and factories.
This had significant effects across continental Europe throughout the remainder of the 1800s.

The Industrial Revolution spread through the rest of Europe. The “Second Industrial Revolution” arrived in France in the late 1800s. It focused more on steel, electricity, chemicals, and oil and less on textiles, steam, and iron. This led to the invention of the radio, electric lights, telephones, and electric streetcars. Above all, the Second Industrial Revolution initiated an increase in urbanization across France. People began to move from an agricultural, rural life in the countryside to cities. There was an explosive growth in the sizes of cities since they offered new work opportunities in factories, as well as better health and living conditions than did rural life.

One consequence of the increased industrialization was significant improvements in transportation. From 1850-1900, French railways were expanded from about 1,850 miles to 8,000 miles. This allowed the French, including the Impressionists, to travel more frequently between cities and towns throughout the country. They were able to paint in more locations, and the trains (and associated entities such as bridges, railways, train stations, smokestacks, etc.) became subjects of great interest to the Impressionists. The transalpine tunnels, including the well-traveled Mont Cenis Tunnel, were built to provide more access to Italy and the cross-Atlantic steamer made it easier to travel to the United States. The first regular steamship service between smaller cities in France (including Monet’s city of Le Havre) and New York began in 1864. The result of all of this was the cultivation of a

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new generation of collectors in America that were exposed to and interested in Impressionism.

There were a number of technological advancements that paved the way for Impressionism to become a leading style of art. Malleable-lead paint tubes were invented in 1841 by American portrait painter John G. Rand. Prior to Rand's invention of the paint tube, artists frequently struggled to keep oil paints from drying out before using them. They used the bladder of a pig, tied off with a string, which the painter would prick with a tack to use the paint. However, there was no sure way of completely sealing off the pouch after use, and the pig bladders did not travel well. They often burst open accidentally, to no surprise. Rand's collapsible paint tube was resealable with a screw cap and made for easy storage and reuse. This impacted the Impressionists drastically – painting outside was now a viable painting technique. Additionally, the discovery of a new range of dyes led the way to a new color range for painters. Chemist Eugene Chevreul came up with innovative theories about optical combinations of colors. This ultimately changed painting techniques for Impressionism, Pointillism, and Divisionism.

Another technological feat that benefitted artists was photography, which was on the rise in the 1800s. Its influence is seen in a number of different art movements and artists. Edgar Degas said that photography reinforced the Impressionist ideas of capturing the “magical instantaneity.” Photography improved visual literacy among all, which changed paintings. It allowed for the extensive proliferation of accurate reproductions of art. Adolphe Braun, a French photographer, specialized in photo

9 Hunt, “Never Underestimate the Power of a Paint Tube.”
reproductions of artworks from the Salon. He "[made] an increasing number of people realize that the naturalistic realism of traditional art was not the old acceptable visual idiom." Additionally, in 1863, Felix Nadar gave Parisians a new visibility and sense of their city when he published the first aerial photographs of Paris. This newfound perspective expanded Parisians’ mindsets and their awarenesses of Paris as a large metropolis that was becoming increasingly connected to other parts of France.

Technological advancements also manifested in more sophisticated mechanisms for printing. There were more widespread periodicals and papers, and with that, more demand for journalistic writing about art. This improved literacy, thus changing the demographics of people who had an interest in art, and ultimately created a new facet in art that was significant in the 19th Century: the role of the art critic. Monet said, “Today, nothing can be achieved without the press; even intelligent connoisseurs are sensitive to the least noise by newspapers.” Even the name “Impressionism” was coined by an artist/critic, Louis Leroy, in a review of the 1874 exhibition put on by the Société Anonyme des Artistes where Monet’s *Impression: Sunrise* (Figure 2.1) was on display. However, there was also a fair amount of bribery in the field of art criticism. Artists paid for complimentary reviews in catalogues to ensure their success within the public sphere.

Paris was a booming city by the mid-1800s, as a result of the above-mentioned factors, such as urbanization and industrialization. Between 1850 and 1867, the population of Paris grew by 800,000. Emperor Napoleon III responded by hiring urban planner Georges-Eugene Haussmann to modernize Paris. He requested that

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11 Ibid.
12 Ibid., 13-14.
air and light be introduced to the center of the city, the unification of different neighborhoods, the beautification of the city, and other urban amenities such as a central market, parks, schools, hospitals, asylums, prisons, and administrative buildings.\textsuperscript{13} Haussmann’s response was to reconstruct and reshape the entire city of Paris, now referred to as the Haussmannization of the city.

While the Haussmannization of Paris displaced many and utterly changed the “personality” of the city forever, there were some more positive lasting aspects of the redesign. Lining the newly-widened boulevards were new cafés, restaurants, and concert halls, all new facilities that were available to every class level of Parisians.

There were new, popular department stores that allowed lower class women to buy nicer clothes for more affordable prices. These women became the subjects of many Impressionist paintings. As Paris grew, it quickly became the art capital of the world.

It was known for its easily accessible art, with the Louvre as the main source. Artists, including Impressionists, could very easily obtain the necessary permission to paint their own copies of the legendary paintings on the Louvre walls. In doing so, they had access to all of the artistic legends of the past, right at their fingertips. Learning by doing, or by copying others, was a common tactic at the time (and still is) for budding artists and there was no better place for this than Paris.

The Haussmannization of Paris also affected the actions of the revolutionaries during political revolts. In previous political revolts (1789, 1830, 1848), these revolutionaries became infamous for taking over parts of Paris and overcoming suppression by building barricades. Due to the twisting, narrow streets of Paris,

\textsuperscript{13} Harris and Zucker, “Haussmann the Demolisher and the Creation of Modern Paris,” and Willsher, “Story of cities #12: Haussmann rips up Paris – and divides France to this day.”
barricades made Paris uncontrollable and proved to be a very effective way to fight the government. Haussmann, nicknamed “The Demolisher,”14 intentionally widened and straightened the streets significantly, aligning them to a radial grid. This meant that the revolutionaries could no longer use barricades as a viable method for destabilizing the French government and the streets now facilitated the uninhibited movement of French troops. Yet simultaneously, the wider streets allowed for an improved flow of commerce, thus helping businesses, despite the displacement and suffering of the poor as a result of Haussmann’s reconstruction of the city. Regardless of one’s opinion on the controversial urban planner Haussmann, he drastically changed the city, ultimately affecting every aspect of life, including the Impressionists.

One of the most apparent beneficial consequences of Haussmannization for the Impressionists, specifically, was the Impressionist cafés. By 1867, Impressionist cafés were built all over the city, eventually amounting to 24,000 cafés in the Paris area. Impressionism indeed flourished because of these cafés. Haussmann’s reconfiguration of Paris ushered in a new trend of wide pavements in the boulevards, which allowed for more leisurely space to relax outside the café. This made the cafés even more enticing. They attracted Parisians who felt isolated within the overwhelming industrial city. These people were looking for an escape from the bustling city life, seeking a bit of serenity and tranquility. The Impressionist painters frequented these cafés. Monet said,

Nothing could have been more stimulating than the regular discussions which we used to have there, with their constant clashes of opinion. They kept our wits sharpened, and supplied us with a stock of enthusiasm which lasted us for weeks, and kept us going until the final realization of an idea was

14 Harris and Zucker, “Haussmann the Demolisher and the Creation of Modern Paris.”
accomplished. From them we emerged with a stronger determination and with our thoughts clearer and more sharply defined. This was the type of atmosphere that encouraged creativity – creativity and novel artistic ideas that pushed the boundaries of aesthetics as they were known at the time. Without the spaces provided by the Impressionist cafés, the movement might not have taken off as successfully as it did.

Another facet of the art scene that shaped Impressionism was the established apprentice system, through which student painters were able to receive training. The best way to become an artist in the city was to work in the Louvre in any capacity – this often meant working for an artist in their atelier (studio). In 1843, Swiss artist Charles Gleyre took over French historical painter Paul Delaroche’s studio, where he went on to apprentice 600 students. Among these 600 were the prominent painters Frédéric Bazille, Claude Monet, Pierre-Auguste Renoir, Alfred Sisley, and James Abbott McNeill Whistler. He generally had about thirty students at a time in the studio but his fees of ten francs per month were too low, and he was eventually forced to close his studio. Each atelier had a leading student, called the massier, who had additional responsibilities. They took charge of posing the male and female models that the students practiced drawing each week, and they were in charge of the finances and management of the atelier. Apprenticeship students also practiced copying drawings, engravings, and paintings by the Old Masters either in the Louvre directly or from reproductions in the studio. Although, in Gleyre’s studio specifically,

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there was an emphasis on the importance of originality in art, learning by copying the techniques of previous artistic greats was an effective way to better one’s skills.

An alternative to apprenticeships in studios was art schools, such as the Académie Suisse, which Monet attended for a short time. This school was founded by a student of Jacques-Louis David. There was much less instruction and supervision in an academy like this than in Gleyre's atelier. Paris had more art schools than any other city, by far, and there were even 20 for women by 1872. Hundreds of foreigners (Americans, British, Dutch) came to Paris seeking an artistic education.

Although there were independently-run art schools in France, the official art instruction came from the State-sponsored school. The French government had operated full control of the art scene in the country since Louis XIV’s reign in the late 17th and early 18th Centuries, which meant that there was significant State support and encouragement over the arts. The central part of this system was the École des Beaux-Arts, founded in 1648, which was a highly prestigious art school. In theory, anyone from France between ages 15-30 could enroll. In reality, one needed to have a connection to get in and then pass an entrance examination. Eventually, there were changes made to the École des Beaux-Arts. The role of the French government in the school expanded and they took charge of appointing professors, lecturers, and administrators. In addition, the students had to be French (ages 15-30), and foreigners were rarely accepted.

Even further than the State-sponsored French art school, the sole entity that had the true monopoly over the Parisian art scene in the 19th Century was the Salon. This was the official art exhibition connected to the École des Beaux-Arts, which was held in the first week of May every year. It was the most critical event in French art,
not to be missed by the artists, public, or critics. It also served as a market for artworks, where artists' reputations could be built up, and prices were determined for their works. All Impressionist painters worked to have their paintings shown at the Salon. In March of 1881, Impressionist Pierre-Auguste Renoir said,

There are scarcely fifteen collectors capable of liking a painting without the backing of the Salon. And there are another 80,000 who won’t buy so much as a postcard unless the painter exhibits there. That’s why every year I send in two portraits, however small. The entry is entirely of a commercial nature. Anyway, it’s like some medicine — if it does you no good, it will do you no harm.\footnote{Ibid., 21.}

This shows a firsthand example of the sentiments surrounding the Salon — it was all-consuming in the art world and almost impossible to reject because it had such strong domination in society.

According to the Ministry of Fine Arts, the Salon recorded huge numbers in attendance. In 1863, the Salon offered free admission on Sundays, which resulted in 30,000-40,000 visitors. By 1876, the total number of visitors was up to 518,892. The press coverage of the Salon equaled its abundant attendance. The Salon became the subject of 12 articles by Ernest Chesnau in \textit{Le Constitutionnel} and 13 articles by Théophile Gautier in \textit{Le Moniteur universel}. It was featured by Louis Leroy in 18 issues of \textit{Le Charivari} and mentioned 137 times in other newspapers such as \textit{Fine Arts Quarterly Review} and \textit{The Times} in London.

The strong domination of the Salon banded the Impressionists together, many times in protest. They did not necessarily reject the Salon because of its aesthetic tastes; rather it was the strict, limiting way in which it operated. “What they objected
to about official art was not so much its style as its machinery,” noted Denvir.\textsuperscript{17} It was a core tenet of the Impressionists to be free to show whatever artworks they desired, and these artists did not like that they could not create art that did not fit within the stringent guidelines that the Salon maintained. The fact that lesser-known artists only had an outlet to show their art by submitting it to the Salon jury conflicted with the freedom-of-any-art philosophy. But unfortunately, there were next to no opportunities for them to show their art outside of the Salon. Eventually, the strict Salon requirements and the frequent rejections of Impressionist paintings led to unease in the art community. “That the dominant role of the Salon should have at first united the Impressionists and then been a cause of disunity is an example of the pressures that provoked them to rebel against the conventions of the Parisian art world of their time.”\textsuperscript{18} All Impressionists, however unruly, disruptive to societal norms, and devious they may have seemed, were fervently dedicated to their art.

From the start of 1863, these attitudes of revolt around the current art and the Salon were on the rise. In January of 1863, the French government began to impose further limitations on the Salon. Each artist could not submit more than three entries, and artists that had previously won medals did not even need to submit their works to the Salon jury at all. In time for the Salon’s opening, the jury accepted 2,217 of the 5,000 works submitted (40\%) from 983 artists, which was a drop from the year prior. All paintings by a leading Realist of the time, Edouard Manet, were rejected from the 1863 Salon, including \textit{Déjeuner sur l’herbe} (Figure 1.1). In response, \textit{Le Moniteur universel} published, 

\textsuperscript{17} Ibid.  
\textsuperscript{18} Ibid.
Numerous complaints have reached the Emperor on the subject of works of art which have been refused by the [Salon] jury... His Majesty, wishing to let the public know the legitimacy of these complaints, has decided that the rejected works are to be exhibited in another part of the Palais de l'Industrie. This exhibition will be voluntary.  

This exhibition of rejected works would soon come to be known as the Salon des Refusés. In May of 1863, the Salon opened, but the Salon des Refusés opened as well. It showcased paintings by Marie Bracquemond, Paul Cézanne, Édouard Manet, and Camille Pissarro. Manet’s *Déjeuner sur l’herbe* caused a great deal of commotion, making him the leading nonconformist of the art world at the time.

Another venue that further increased the popularity of Paris and its vast offering of art was the Universal Exhibitions. These exhibitions, now commonly referred to as the World’s Fair, were (and still are) to showcase the achievements of different countries. Taking over Paris in 1855, 1867, 1878, 1889, and 1900, these exhibitions raised exposure to art and architecture in the city. These events were distinct from the Salon, as they were not held in Paris each year and they were not connected to the French art academy. The Universal Exhibitions that were held in other countries helped to spread French art abroad and made it more widely recognized, and the ones held in Paris gathered large crowds of art supporters to the already-growing city, thus exposing them to the variety of things Paris had to offer. There were sections of the exhibitions that were dedicated to France’s colonized land to showcase non-European cultures and aesthetics. These exhibits ultimately inspired European artists to incorporate elements of non-Western art.

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19 Ibid., 24-25.
During the mid-19th Century, art was being marketed in a new way that was more sophisticated than ever before, using public relations methods from commerce and industry. Art dealers were on the rise, and by 1861, 104 companies served as art dealers in Paris. These people were now serving as the bankers and promoters for their clients, rather than just holders of the artworks. This system was more enticing to artists. One of the most prominent art dealers was Paul Durand-Ruel, who put considerable effort into promoting the Impressionists. His father owned a stationery shop and often traded customers' artworks in exchange for brushes, paints, and other materials. This propelled his father into the realm of art dealing incidentally. After Durand-Ruel's father died, his son took over the business and started selling artworks and collecting them in exchange for art materials.

Paul Durand-Ruel, as well as many others, including Monet, fled to London during the Franco-Prussian War (1870-1871). Durand-Ruel showcased many of the Impressionists' works in London. Eventually, his business became so popular and profitable that he sent the Impressionists' paintings all over Europe and to the United States. Durand-Ruel made a very detailed catalogue of his art collection, even including illustrations. Durand-Ruel advertised his collection in some of the most notable magazines, such as Revue Internationale de l'art et de la curiosité. His approach to art dealing was to establish a monopoly over the work of individual artists by collecting large stocks of their paintings and publicly promoting them constantly. However, artists often switched dealers and tried to avoid paying any commission to Durand-Ruel by selling directly to buyers. Unfortunately, he was not too praised by the artists, or at least not as much as he had hoped.
In 1871, Durand-Ruel exhibited Monet’s and Pissarro’s paintings at an exhibition in London. This practice became successful enough for Durand-Ruel to continue to show French art in London numerous times in the following years. In March of 1873, Paul Durand-Ruel held his sixth Society of French Arts exhibition in London, showing works by Degas, Manet, Monet, Pissarro, and Sisley. By the end of that year, there was a meeting of a group of artists at Renoir’s studio to approve the establishment of the Société Anonyme des Artistes. This was a collection of artists that formed to promote art sales through group exhibitions. The purpose of this was to hold group art shows without the interference of a jury selection process, like the Salon.

By 1874, the Société Anonyme des Artistes had organized their first exhibition at 35 boulevard des Capucines in Paris, which was prominent early photographer Felix Nadar’s studio. The exhibition was open for a month in the springtime. It was open during the day, but also at night (8pm-10pm) so that the working-class patrons could visit the gallery. The Société Anonyme des Artistes wanted to exhibit their works on their own to be free of the strict restraints of the Salon and the State. Their intentions were not to promote a new style of art, although that did occur as a side effect. Artworks were displayed in alphabetical order and by the size of work, unlike in the earlier days of the Salon where they were hung by notability of the painter. The artists made money by keeping 10% of the sales on the paintings. Monet submitted five oil paintings and seven pastels to the exhibition, despite the limit of two pieces per artist. He earned a total of 200 francs from painting sales. There was a total of 3,500 visitors to the exhibition in 1874, but they did not turn a profit after covering each of the artists' dues to be in the Société.
Where there were positive reactions to the exhibition, there was a plethora of negative ones as well. Louis Leroy published “The Exhibition of the Impressionists” in a satirical magazine (*Le Charivari*). As mentioned earlier, it was in this article that he incidentally coined the term “Impressionists” to denote this set of artists. This title was directly influenced by Monet’s vivid painting, *Impression: Sunrise*. Leroy used the imagined character of “M. Vincent” to write a hostile critique of the exhibit in this memorable article. In response to the exhibit, Jules Claretie said, “[The artists] appear to have declared war on beauty.” An anonymous review in *La Patrie* said, “Looking at the first rough works – and rough is the right word – you simply shrug your shoulders; seeing the next lot, you burst out laughing; but with the last ones you finally get angry. And you are sorry you did not give the franc you paid to get in to some poor beggar.”

In 1875, Renoir, who was a member of the not-too-lucrative Société Anonyme des Artistes, suggested that the Impressionists hold an auction at the Hôtel Drouot to sell their works. This was a failed venture. There was a very unruly crowd with more attendees than anticipated, but they did not all buy paintings. The works that did sell ended up selling for far less money than the artists had initially hoped. Monet’s paintings sold for about 233 francs each, which was quite high compared to some of the other painters. Renoir had to buy some of his own paintings just to prevent them from selling for too little. By the time the Société Anonyme des Artistes had organized their first action, Paul Durand-Ruel’s London Society of French Artists gallery had come to an end after its eighth exhibition that September.

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20 Ibid., 88.
21 Ibid., 89.
Biography of Claude Monet

Oscar-Claude Monet was born in Paris, France on November 14, 1840, as the second son to Claude-Adolphe and Louise-Justine Aubrée Monet. He lived for 86 years, leaving behind more than 500 drawings, 2,000 paintings, and 3,100 letters. His parents called him Oscar, and he signed his paintings with that name until his early twenties. His infamous letters, however, were always signed "Claude," never "Oscar." By 1862, the 22-year-old artist had dropped the name Oscar, and it was never seen again.

Monet grew up in Le Havre, a town on the northern coast of France. Claude-Adolphe had moved the family there so he could work in wholesale grocery. Commerce in Le Havre was continuously growing from 1840-1860, and by the 1860s, the town was directly connected to the United States through the aforementioned regular steamship service. Le Havre housed warehouses for a broad cross-section of industries. This environment is where Monet's artistic career truly began and from which he got much of his inspiration. Monet studied in the College Communal du Havre starting at the age of 10. Although it is unclear when Monet left this school or if he even graduated, he studied the typical curriculum of Latin, Greek, history, French, and mathematics, in addition to drawing. It was at this school that he learned to draw, under instruction from Jacques-François Ochard, a student of the well-known, highly-revered Neoclassical painter, Jacques-Louis David. One important attribute to note is that Monet preferred to be in control of the details of his

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22 Ibid.
23 Ibid.
own biography, so we do not have much extensive information about his early years, and the facts that exist are not necessarily very telling.

Later in life, Monet claimed that he did not like school and preferred drawing to reading and learning in an academic setting. As a young student, he filled his schoolbooks with designs and drawings. He declared that he did not practice the traditional method of learning to draw with “mechanical renderings,” but the evidence in his drawings shows otherwise. There are three surviving sketchbooks from his school days that show him copying images from drawing manuals and attempting to utilize standard drawing practices for a student of his time. Monet drew images of the countryside near his home, rustic cottages hidden in trees, clusters of rocks and bushes, fishermen, gardeners, and country children. These sketches were too skilled and perfect to be his first attempts and suggest that he had some sort of prior training.

In addition to fantastical designs and landscapes, Monet also sketched caricatures of his teachers in his schoolbooks. These drawings, dubbed “sassy marginalia” by Paul Hayes Tucker, were done mostly between ages 16-17 and were sold for money. Monet sometimes played the satirical artist, drawing notable Parisians, residents of Le Havre, and rival artists. These sketches were witty and innovative. They showed his detail-oriented eye and his interest in people and their characteristics. This was Monet’s way of highlighting his humorous, self-deprecating side.

One noteworthy aspect of Monet's sketching practices was that he dated his drawings very specifically and recorded distinct locations. This showed his early

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25 Ibid., 9.
interest in the specificity of time and place, even though his subjects were displayed with great generality, and in pencil. Tucker notes, "What all of [the drawings] suggest is Monet's clear preference for picturesque, non-modern subjects that affirmed the continuing charm of rural existence." Monet deliberately did not choose to depict the actual city of Le Havre, which was rapidly growing with more industrialization and commerce.

The first known painting that we have by Monet was painted in 1858, titled *View of Rouelles* (Figure 1.2). Much like his sketches and drawings, *View of Rouelles* is too skilled to be his actual first attempt at painting. The landscape features a very subtle color scheme and a tangible quality in the light and atmosphere. Monet painted this work when he was only 17½ years old. Here, we have evidence that from the start, his talent was comparable to that of the leading landscape painters of the time. This painting is in the style of the Barbizon School, a part of the Realist movement that painted picturesque, soft, quiet, and calm landscapes. The tranquility in Monet’s artwork is depicted through loose brushstrokes, harmonious colors, and a smooth-surface canvas. Although it was a short trip away, *View of Rouelles* shows a scene that distinctly contrasts the lively city hustle and bustle of Le Havre.

Claude Monet was mentored by the famous Barbizon painters, Camille Corot, Constant Troyon, Théodore Rousseau, and Charles-François Daubigny. In the 1830s-40s, these older artists started to shy away from the city bustle, especially Paris. They focused more on the serene, quiet landscapes of rural towns and picturesque scenes of nature. Monet followed along. He was in favor of learning his

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26 Ibid., 7.
craft from his predecessors, though later in life he claimed he was a self-made artist. Monet’s primary teacher was a French landscape painter, Eugene Boudin (1824-1898), who was one of the originators of painting outside. Boudin is often credited with convincing Monet to move beyond his teenage “habit” of caricaturing and to settle into landscape painting. A young Monet, with his notably large personality and ego, said, “[Boudin’s] paintings inspired me with an intense aversion, and without knowing the man, I hated him.”\(^{27}\) Yet, Monet's painting style eventually became reasonably similar to that of his mentor’s.

One painter who had a significant influence on all of the Impressionists was the previously mentioned Barbizon painter Charles-François Daubigny (1817-1878). His style was influenced by Dutch and English landscape painters, and he was ultimately the pioneer of *plein air* painting. He assisted the Impressionists by ensuring that their works were accepted into the Salon since he was on the Salon jury.\(^{28}\) Daubigny was especially influential for Monet. The two shared similar painting styles, color palettes, and painting techniques, such as a sharp contrast between light and dark in their paintings. This specific style is evident in both Monet’s *View of Rouelles* and Daubigny’s *The Banks of Oise* (Figure 1.3). Both works of art display a light, airy sky contrasted with the darker tones of the leaves and branches. Daubigny’s painting was evidently inspired by a small painting of a similar style that was owned by Monet’s aunt.

\(^{27}\) Ibid., 11.

\(^{28}\) All of the above in this paragraph from Denvir, *The Chronicle of Impressionism: A Timeline History of Impressionist Art*, 258.
Even though he had a natural affinity for the scenic countrysides over city life, Monet did not ignore the aspects of landscape painting that were not picturesque. He also painted industrial scenes from 1858-1859, such as in *Landscape with Factories* (Figure 1.4). This subject was very rare among French painters in the 1850s, but it fit into Monet’s contemporary style. Although industrialization was rampant across Europe during this time period, these images as painting subjects were often considered too mundane and boring to have any artistic or aesthetic value. It is noteworthy that Monet painted them at all. It is possible that Monet could have been inspired by authors (such as Honoré de Balzac) who wrote about these less-attractive subjects in great detail. Some argue, however, that these paintings of industrial life could have been Monet’s way of mocking traditional landscapes, much like his caricatures.

Regardless of whether he was painting idyllic landscapes, images of train stations, or industrial scenes, critics and art historians tend to agree that the subjects of Monet’s works did not matter; it was about how they were revealed by the light. They say that the real subject of his works was how light manipulates different surfaces at different times of days and in varied environments. They support this claim by noting that Monet only infrequently mentioned the importance of his subjects. “[Monet was] concerned with air, light, and particular moments in time rendered spontaneously in heightened color and broken brushwork.”29 This is an accurate, but oversimplified, description of Monet’s work. His color-mixing methods and his painting techniques showed how much time and dedication he put into each canvas. For example, in one

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of his most well-known paintings from 1877, *The Gare Saint-Lazare: Arrival of a Train* (Figure 1.5), the areas of black in the painting show a mixture of at least nine distinct colors. Eventually, in his career, Monet became so consumed with discovering the best way to capture the fleeting light he saw around him, that he built a studio boat in Argenteuil to allow him to paint brief “impressions” of nature, as seen from his boat. Ultimately, this aim to depict ephemeral, transient light came to be the most defining quality of Monet’s paintings and his style within the Impressionism movement. But had he not been exposed to the multitude of influences above, the iconic canvases of Claude Monet as we know them today would be entirely different.

However, there was a disparity between the serene, at-ease life Monet depicted in his art and his actual life. This is not uncommon for artists. He was very cryptic and driven by an undefined inner motivation to express his emotions through nature. Monet had a large ego and sought constant praise. He was hyper-aware of how French art was being talked about in newspapers, periodicals, novels, and historical accounts, and that apprehensiveness extended to how his own reputation was relayed. Monet was not only frequently concerned with how he was depicted in the Paris press, but also with his standings among other Impressionists. Throughout the 1870s, he often claimed to be impoverished, even though he actually made more money than Parisian doctors and lawyers. But it was not that he was not making enough money to get by. Monet was particular and preferred to live an extravagant life, yet he was not good at saving money. This was also his way of garnering sympathy from others, depicting himself as the "poor artist."

The letters Monet penned to his mentor, Boudin, showcased key personality traits that were useful throughout his life. He had the ability to get what he needed.
This trait got him the kind of studio space and artistic instruction that he needed. To access free studio space, Monet struck a deal with still-life painter Charles Monginot through a mutual friend from Le Havre. But sometimes it was not convenient deals or strategizing that got him what he wanted. Monet was often just in the right place at the right time to get what he needed. If sheer luck did not prove successful, he utilized his charm and persistence to get his way. He was also excellent at exploiting connections and acquaintances that he knew. According to Tucker, “[Monet] was not necessarily the kind of person one would want for a friend.” He was maneuvering and somewhat manipulative. He was sometimes helpful to others but generally looked out for himself and often felt that he deserved more than others.

One example of his persistent, tenacious attitude essentially set his whole career in motion. Monet, with the help of his father Claude-Adolphe, twice wrote to the Municipal Council of Le Havre, in 1858 and 1859, to request a grant to study art in Paris. They rejected his proposal in 1858. They, again, rejected his proposal in 1859 but did recognize Monet’s caricaturist reputation, which may have ultimately hurt him. However, Monet did not wait around for this response to arrive from the Council. In the two months between sending the second application request and the rejection, he headed off to Paris, regardless of the Council’s impending decision. He arrived in Paris in May, just after the opening of the 1859 Salon. Upon arriving in the city, Monet recorded all of his observations, which are the earliest of his 3,100 letters. These letters were addressed to Eugene Boudin.

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30 Ibid., 14.
On his first visit to Paris, Monet visited the Salon regularly, as well as studios of prominent artists. Troyon, whose studio he visited, urged him to become very skilled at drawing. He told Monet to draw in studios, draw at the countryside, and draw copies of what he saw in the Louvre.

The young painter appreciated what he saw at the Salon, in certain aspects at least. He liked the displayed landscape paintings by Troyon, Daubigny, and Corot. He specifically noted the active movement in Troyon’s *View at Suresnes* (Figure 1.6), exemplifying Monet’s impressively mature observations for his age. While he was inspired by much of what he saw, Monet also had a fair share of negative remarks about the paintings in the Salon. He claimed that other works by Troyon had too high a contrast, Rousseau was better at depicting details in the painting than the whole image, Émile Lambinet was “all glare and glitz,” and Eugène Delacroix too sketch-like. Monet also deliberately pointed out his distaste for seascapes, calling them hypocritical, pretentious, and knowing nothing about nature. Overall, his remarks were riddled with negativity but exhibited the type of confidence needed to succeed in the art world, even at such a young age. Following his Salon visit, Monet’s corresponding letters to Boudin urged him to come to Paris to take advantage of the Salon and city life, but also so that he could show his paintings. Monet also relayed to Boudin that the Salon had an absence of quality seascapes, which in turn, was one of Boudin’s specialties in terms of painting subjects.

While in Paris, Monet eventually joined the Académie Suisse, an art school founded by Charles Suisse that instructed a group of rising artists on the Île de la Cité.

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31 Ibid., 13.
The structure of this academy was much looser than the others in Paris. There was no strict schedule, no formal exams or critiques, and no demanding professor from the École des Beaux-Arts. This was the exact setting Monet was looking for, especially compared to “the dirty city of Le Havre,” as he described his former city in a letter to Boudin.

Just because Monet had finally made it to Paris, the heart of the art world in the 19th Century, did not automatically mean he had made it as an artist. In 1869, all of Monet’s submissions were rejected by the Salon. That same year, both Monet and Renoir painted their own renditions of *La Grenouillère* (Figure 1.7a and Figure 1.7b). Both painters’ canvases depict a popular bathing place on Croissy Island near Bougival (outside Paris). There were two converted barges there, for a restaurant and dancing. The similarities between Monet’s and Renoir’s paintings end at their subject matter, though. Renoir focused more on the figures and the object of the inlet, whereas Monet’s is more anonymous in this way, more distant. Instead, Monet highlighted the texture of the water – his subject is the water, which he painted with a silky, rhythmic pattern, moving ever so gently. The two artists painted these pictures together, and it was not by chance that they picked the same subject, as they worked closely together during this time period. But even though they shared the experience of painting the same subject side-by-side, the results on their respective canvases were highly varied.

Monet worked closely with a number of painters, such as the above example with Renoir, and many of his closest friends were very involved in the other arts as

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32 Ibid., 15.
well, such as musicians and actors. Before Monet traveled to Paris, he and Bazille painted seascapes and flower still lifes in Honfleur and the Le Havre area. The letters between the two painters showed their shared camaraderie. When they traveled to paint in Chailly together in 1865, Monet injured his leg. Bazille painted *Monet in Bed After His Accident* (Figure 1.8), showing the fondness between the two painters in the intimacy of the painting.
Chapter 2

Formal and Scientific Analysis

Seeing establishes and contextualizes our place in the world, but seeing and comprehension of the visual sights do not always go hand-in-hand. John Berger explains, “Each evening we see the sun set. We know that the Earth is turning away from it. Yet the knowledge, explanation, never quite fits the sight.” Our sense of touch is static; seeing is not. We can physically touch one to two objects at a time, but we can see a multitude, all at once. Our vision is constantly changing depending on where we turn our heads. It is always in motion and determines how we situate ourselves within a given space. Vision answers questions such as, “Are we large or small for the area?”; “Are we in the center or on the edge?”; “What is close and what is far?”

In all works of art, including photography, we, as the viewers, are subjected to the viewpoint which the artist wants to feature. This means that we are at the mercy of the artist’s way of seeing. Even photography does not provide an objective record. There is an infinite number of other possible angles from which to photograph any given scene, thus making the one that the photographer selects unique, and uniquely their own. An artist’s way of seeing is also reflected in their choice of subject. “Images were first made to conjure up the appearances of something that was absent. Gradually it became evident that an image could outlast what it represented.”

33 Berger, Ways of Seeing, 7.
34 Ibid., 10.
notion articulated by Berger is key in Impressionism. Monet sought to capture fleeting moments that were gone within seconds of seeing them, yet Monet “immortalized” these moments with oil paint and canvas and the moments he depicted are still fleeting 140 years later.

Paintings do not actually show the way a subject appears. They show how others see it. For example, Monet and Renoir both painted their own renditions of La Grenouillere while sitting next to each other, yet their paintings are entirely different. The consciousness of increasing individuality began during the Renaissance in Europe, and it had a lasting effect. In terms of artistic freedom, more artists depicted what they saw as an individual, rather than what others might have seen. “An image became a record of how X had seen Y.”35 One could argue that cameras, which made art reproducible, took away the uniqueness of art and uniqueness of the artist's perspective, and yet, two photographs of the same scene by different photographers are entirely different. It is impossible for an artist not to impose their own image of a scene onto their work of art. For Monet, this image was the constant flux and fleeting of light and air.

To better understand the mechanisms used by Monet to illustrate the fleeting light he saw around him, a concrete understanding of the biology and physics of vision is essential. There is a common misperception about vision, referred to as the "homunculus fallacy." Taking its name for the Greek translation for "little man," this fallacy says that the eye records a small picture of what we see, like a little camera, and sends it to the brain to be interpreted by a little man. This represents the notion

that the eye acts as a camera. In reality, the visual system serves to process light and light patterns in useful, informative ways. This information is used by the brain to interpret reality. Light enters the eye through the pupil, a small opening in the eye. The lens, which is immediately behind the pupil, focuses the image on the retina, the back lining of the eyeball made of layers of neural tissue.

There are two kinds of photoreceptors in our eyes: rods and cones. Cones are used primarily for daylight vision and are less sensitive to light. The three types of cones each have different functions in the eye, as they are each capable of detecting different wavelengths of light: red (longest wavelength), green, and blue (shortest wavelength). If we had only one cone type, we would only be able to differentiate between different levels of luminance, or apparent brightness; our vision would be monochromatic. If our eyes were equipped with only two cone types, then human vision would not be capable of distinguishing certain color combinations of light. The color of the light is detected by the cones, and the response of each cone depends on the wavelength and intensity of the light. The three colors that rods are sensitive to, red, blue, green, are the building blocks of light. They are considered Primary Colors. What decides which colors are Primary, for light or for paint, is based on the biology of the eye rather than the physics of light.

Conversely, rods are used in dimmer conditions; they are more sensitive to light. Rods are also more spread out through the peripheral vision. Unlike cones, there is only one kind of rod in our eyes, so we cannot distinguish between colors that are dim. The way in which we see colors and brightnesses is a direct result of our visual system's network of photoreceptors.
The brightness as perceived by the human eye is referred to as luminance, perceived lightness, apparent brightness, or value, in the realm of color theory. There is a common misunderstanding that luminance is calculated by the number of photons, or amount of light, seen by our eyes. This is not correct. Luminance is dependent on the sensitivity of our eyes to a given color. This part of the visual system helps us determine depth perception, three-dimensionality, movement versus stillness, and spatial awareness. These aspects of one’s awareness are independent of color, but do rely on the perceived brightness of an environment. Measuring the amount of light reflected by an object (a quantity measured by physicists) is not the same as measuring how humans respond to light (as measured by psychologists, neurobiologists, and artists).

It is difficult to discern the distinction between color and luminance accurately. There are biological reasons why these two are entirely separate. Different parts of the visual system process color and luminance, several inches apart within the brain. Each is responsible for different facets of visual perception. Margaret Livingstone notes in her book, "They are as anatomically distinct as vision is from hearing." There are parts of the brain that are just for color processing, and these exist exclusively in primates. The luminance system is older, evolutionarily, and is shared by all mammals. Therefore, the most basic visual information is found in luminance variations. These variations do not depend on color since this part of the brain is, literally, colorblind.

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Distinguishing different luminances with an untrained eye is not an easy feat. Artists sometimes utilize luminances that are not found in the real world to create the illusion of brightness, depth, impermanence, and movement. To better understand this artistic technique, we need to be able to visually separate color and luminance. One method of doing this is by looking at an image in grayscale, such as in Monet’s 1872 painting, *Impression: Sunrise* (Figure 2.1).

*Impression: Sunrise* depicts a port scene of Le Havre, as seen from a hotel window. As mentioned in Chapter 1, Le Havre is where Monet grew up and got much of his inspiration. The port city was home to booming industrialization in the mid-1800s, the effect of which is evident in *Impression: Sunrise*. The eponymous painting was among the set displayed at the inaugural Impressionist exhibition in 1874, but it was not initially received well by the public. It was a new style of painting to which the public was not yet accustomed. Monet said, “It really can’t pass as a view of Le Havre.” He did not aim to depict a realistic depiction of the scene he saw. Instead, he intended to capture the inexpressible feeling of experiencing the Le Havre scene in person. This painting shows a different style from the rest of Monet's paintings. It is much more restrained in color and Monet applied the paint in thin layers, rather than disconnected brushstrokes of contrasting hues. Impasto, or a thick application of paint, is only used to show the scene's reflection upon the water – it enhances the softness of the water. However, the boats in the foreground appear to be driven by the movement of the water itself, which points to the future of Monet's

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37 Claude Monet: Paintings, Biography, and Quotes, “*Impression: Sunrise* by Claude Monet.”
painting style of illustrating motion and encouraging the viewer’s gaze to travel all across the canvas.

Figure 2.1 shows the painting in its original colors, but Figure 2.2 shows *Impression: Sunrise* in grayscale, as if the viewer’s cones were turned off. In Figure 2.1, the sun is truly “popping.” It pulsates, vibrates, and shimmers, appearing as a genuine source of light in the painting. It somehow, paradoxically, seems both light and dark, giving it an eerie, supernatural quality. In Figure 2.2, notice how the sun almost entirely disappears. The sun now becomes “equiluminant” with the clouds in the background, meaning it appears as the same shade of gray. The lack of luminance contrast explains the peculiar quality of the sun in the painting. The part of the visual system that is more primitive and deals with motion and position sees the painting only as it is shown in grayscale, where the sun is nearly invisible. The other part of the visual system, which incorporates color, sees the painting normally, with a fully-visible sun. Because these two parts of the visual system are not in agreement, the sun takes this peculiar, floating quality. Since the part of the visual system that deals with motion does not see the sun in the painting, the sun’s position is not well-defined. The brain has trouble fully locating it. It appears to be pulsating and almost hovering.

Figure 2.3 shows when the sun is made *artificially lighter* than the sky, as it would appear in a completely realistic image. In this manufactured example, the sun no longer holds this popping effect. In a paradoxical result, this edited version of the painting seems less bright than the original, even though the sun’s color has been swapped out for a brighter one. The sun now looks like a cutout, pasted on top of the clouds in the painting.
Although this “experiment” of testing luminances in Monet’s paintings is convincing using the images provided in Livingstone’s book (the same painting reproductions in this appendix), one must be wary when thinking about color details of paintings. Not all colors look the same under different lighting conditions. The luminosity response curve (Figure 2.4) tells us that the luminosity for the same amount of light is different for different colors. “[U]nder daylight conditions, a given amount of blue light (wavelength = 450 nanometers) produces about one-twentieth the response as the same amount of green (wavelength = 540 nanometers) light.”38 Therefore, under different levels of illumination, color perception changes.

Photoreceptor response increases as the amount of light increases – the brighter the light, the stronger the response. However, this positive correlation between brightness and response of photoreceptors is not uniform for all wavelengths (which are colors) of light. Photoreceptors are most sensitive to green and yellow light (about 530 nm to 570 nm). This means that we need more photons from red and blue light to get an equivalent luminance. We can see luminance both during the day and at night but what makes our night vision weak is that it is colorblind. The brain interprets a pure luminance signal as shades of gray, rather than varying shades of colors. As mentioned above, rods are more utilized in dimmer environments but are not used for detecting colors.

Rods and cones are inherently different. Rods are more sensitive to blue light and less sensitive to red light. This explains why the luminosity response curve is shifted to the left, i.e., lower wavelengths of lights. "The rod curve indicates that in

38 Livingstone, Vision and Art: The Biology of Seeing, 40.
dim light, a given quantity of blue light will seem 100 times brighter than the same quantity of red light."\textsuperscript{39} The result of this is that in dim lighting, shades of blue look lighter and shades of red appear darker than they both look in daylight. One result of this is that the lighting in museums and galleries must be very regulated and specific. It means that detailed examinations of the colors in works of art (like this paper) are difficult to do, since the lighting environment of the viewer will be affecting how the colors in the art appear. There is no "correct" answer for how colors should appear. As the level of ambient light fluctuates, so does our perception of brightness, which changes how colors appear.

Another optics concept that affects how we see motion is the difference between foveal vision (the center of our gaze) and peripheral vision. As briefly mentioned previously, photoreceptors in the eye are not evenly spread out.\textsuperscript{40} They are concentrated centrally, leaving very few along the periphery. Even further, cones are more concentrated than rods. The ratio of cones to rods changes in our peripheral vision, since in this area, the ratio of rods to cones is higher than anywhere else in the eye. Photoreceptors communicate with retinal ganglion cells (the neurons, RGCs), but these RGCs are also not evenly distributed. At the center of our vision, which is called the fovea, each photoreceptor sends information to a single RGC, so there is a one-to-one correspondence between photoreceptors and neurons. This gives us the sharpest possible image with the highest acuity. At the periphery, the opposite is true. There are multiple photoreceptors in the periphery of our vision communicating with one

\textsuperscript{39} Ibid., 43.  
\textsuperscript{40} All information in this paragraph is from an in-person, informational conversation with Associate Professor of the Practice in Astronomy and Integrative Sciences Roy E. Kilgard on February 7, 2019.
neuron. This results in RGCs that are overwhelmed with visual information and therefore cannot differentiate between the information coming from the different photoreceptors. This leaves us with low acuity vision in the periphery. We are constantly filling in the gap of visual knowledge in our peripheral knowledge with information from previously looking around. Since our periphery is mostly rods, where we have poor color acuity and useful assessment of motion, faint and fuzzy features are easier to see with the periphery.

When tricking the eye into seeing motion, rods in our peripheral vision are used in optical illusions. Spatial imprecision of peripheral vision gives some Impressionist paintings a striking effect, such as *The Rue Montorgueil in Paris: Celebration of June 30, 1878* (Figure 2.5), painted by Monet in 1878. It depicts the June 30 celebration for a festival that honored “peace and work.” This was an event organized for the third Universal Exhibition in Paris. It symbolized the recovery of France after the defeat of 1870 during the Franco-Prussian War. This painting is a depiction of pure French pride and the rising strength of the Republican regime. The three colors of modern France are immediately apparent in the painting to emphasize the sentiment of French nationalism. *The Rue Montorgueil* marks the rise of a democratic society in contemporary France. In this work, Monet acted as both a painter and a reporter of a current, political event that is recognizable to the public. Perhaps surprisingly, this urban scene is portrayed from a far-off viewpoint, above the crowd. Monet placed the observer as a spectator above the scene, rather than one

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41 Musée d’Orsay, “Claude Monet: The Rue Montorgueil in Paris.”
who is mixed in with the crowd. Nevertheless, the waving flags and the flurry of the crowd appear animated on the canvas.

The details in this painting are jumbled through the space. The canvas has the signature “unfinished” look (or at least unfinished compared to Realism) of a Monet Impressionist painting that was so heavily criticized by the public. Red, white, and blue brushstrokes that make up the thousands of flags flanking the center boulevard are convincing upon first glance but staring right at the flags breaks the illusion that they are really flags. The viewer sees that the brushstrokes are not consistently aligned with one another, or are not even neighboring one another. This is called “illusory conjunction,” which “occurs when items are presented either peripherally or transiently.”

The flags look complete at first because our spatial imprecision lets illusory conjunction “fix” the objects in our brains. Livingstone notes, “[L]ow spatial precision may lend vitality to a painting because the visual system completes the picture differently with each glance…The spatial imprecision generates a vitality because it is consistent with a single glance, a moment in time.” This allowed Monet to create a painting that is entirely in line with the core ideas of Impressionism, showing just one moment in time. Spatial imprecision allows for fleeting transience in the painting; it is associated with an instantaneous moment in time.

To provide a contrasting example, consider Poussin’s 1630 painting, *Rape of the Sabine Women* (Figure 2.6). This canvas appears completely static because every single detail is visible. Its hyperrealism leads the viewer to see the painting as a photograph with incredibly high shutter speed, but no sense of the fleeting, transience of time. Art

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43 Ibid.
historian William Seitz says that the Monet painting is “very [different] from a camera image – which would freeze such a scene in a thousand details that no participant could experience.” Monet painted the ephemeral. Monet painted what would have been experienced by those in the street on June 30, 1878. Future Fauvist renowned painter Henri Matisse said, “Movement seized while it is going on is meaningful to us only if we do not isolate the present sensation from that which precedes it or that which follows it.” Eventually, the spatial imprecision of Impressionism led to the development of Cubism.

Color processing also affects our ability to see light in motion in Monet’s paintings. “To determine…by what modes or actions Light produceth in our minds the Phantasms of Colours is not so easie,” said Isaac Newton on the topic of color processing. There is a great debate among experts in the vision field about whether the three-cone photoreceptor method or the opponent-color complements process is more critical to our perception of color. Margaret Livingstone argues that both are right. The first stage in color processing is the activation of the photoreceptors, notably the red, blue, and green cones, which also mark the three primary colors of light. The second stage is distinguishing colors by opponency, or complements.

In most flat (two-dimensional) representations of color charts, like Newton’s color wheel, the information we are missing is the third measurement of color: luminance. Looking at Newton’s color wheel (Figure 2.7), the position around the circumference of the circle is the hue. Hue, independent from brightness, can be

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44 Ibid., 76.
45 Ibid., 77.
46 Ibid., 85.
quantified on its own as a function of both the activity in the red cones versus the blue and green cones together (red-cyan axis, as blue and green form cyan), as well as the activity in the blue cones versus the red and green cones together (blue-yellow axis, as red and green form yellow). The distance from the center measures saturation of a point on the color wheel. However, luminance is missing on these color scales.

The difference between brown and yellow, or maroon and pink, is luminance. Luminance represents the position of the color along the black-white axis. “[T]he maximum information about the shape of an object is contained in its edges. Just as you don’t need to define the color at every point inside a homogeneously colored expanse; you only need to define the colors at every color-change contour.”

For example of this painting technique, consider the colored shadows in Monet’s *Haystacks* (Figure 2.8).

Between the summer of 1890 and the spring of 1891, Monet created about thirty paintings of the haystacks near his house in Giverny. The *Haystacks* series eventually was the first set of series paintings that were exhibited together, when half of them were shown at the Galerie Durand-Ruel in Paris. This series is well known for using the haystacks as a prop for showing differences in light across various seasons, times of day, and weather. Monet noted in a letter to the critic Gustave Geoffroy, "I am working very hard, struggling with a series of different effects (haystacks), but at this season the sun sets so fast I cannot follow it…The more I continue, the more I see that a great deal of work is necessary in order to succeed in rendering what I seek.”

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47 Ibid., 92.
48 Metropolitan Museum of Art, “Haystacks (Effect of Snow and Sun), 1891.”
What Monet was attempting was mixing blue, orange, and brown hues to depict the haystaks in winter daylight in *Grainstack in the Morning, Snow Effect* from 1891. While the viewer easily recognizes the lower swath of color below the haystack as the haystak’s shadow, the color of paint Monet used was actually blue, which we know not to be the accurate color of a shadow. This blue-colored shadow contrasts with the yellow sunlight to give the effect of dawn lighting. Surrounding the blue shadow, Monet used yellow splotches of paint to further contrast the colors in the shadow and emphasize the early morning light.

Another method of using luminance differences to show motion in paintings is through shading and chiaroscuro, which describes heavy shading with high contrast in paintings. This method of converting the three-dimensional into a two-dimensional image on a canvas is best understood through example, such as Monet’s renowned series paintings of the Rouen Cathedral (Figure 2.9), painted between 1892 and 1894. Within this span, he painted more than 30 works of the same cathedral in Rouen, which is about an hour and a half northwest of Paris, by train. Painted over two winters and two springs, he would return to each canvas multiple times for days in a row to finish the paintings. He rented a studio across the street from the cathedral. This allowed him to paint in the rain, or at any time of day, more efficiently. Later in Monet's career, he was not as concerned with capturing images instantaneously, though he was still painting the instantaneous. “The irony is that as he is capturing something that is fleeting, he is taking longer and longer to paint it.”

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touch-ups and additions. This is evident through thick layers of paint that were piled on top of one another.

Monet took the solidity of the Rouen Cathedral, a medieval cathedral with significant religious symbolism and meaning, and made it light, airy, and lacking the cathedral's three-dimensionality and structural integrity. This subject was appealing to him because of the complexity of the way light and shadows touched the surface of the cathedral's façade. When viewing all of the paintings together, the viewer can see parts jut out and retreat differently based on the changing light. The building's appearance is very much dependent on the way it is struck by the light. The light takes control of the structural recesses of the Rouen Cathedral and alters the architecture. This series of paintings exemplifies the "triumph of the optical over the physical."\(^{50}\)

The building itself, built starting in 1030, is entirely made out of beige stones. Therefore, there are not any contrasting tones that are naturally present in the structure without the assistance of varying light angles and shadows. In turn, these paintings, as well as Monet’s *Haystacks* series, are really about light and shadows, not the building itself or the stacks of grain. Some of the Rouen Cathedral paintings seem less three-dimensional than others. These are the works that have very little contrast in luminances across the canvas when looking at the paintings in grayscale. “These images and the effects they create all reflect the fact that depth from shading requires luminance contrast because the Where system, which is responsible for the ability to see shape from shading, is colorblind and sensitive only to luminance changes.”\(^{51}\) The


“Where system” is how Livingstone refers to the part of the visual system that deals with where things are located rather than what they are (in other words, rods versus cones). Because there is no luminance contrast, these works have a “shimmery appearance”\footnote{Ibid.} on the canvas, appearing flat and lacking depth.

One distinctive element of Impressionist paintings that makes them especially unique is the shimmery look of their paintings. The Where system is responsible for detecting motion and position, and it cannot distinguish between equiluminant colors, so when there are equiluminant colors in a painting, the Where component of our visual processing system will interpret this as motion. Bright, equiluminant colors are detectable and differentiable by the What system, indicating the difference between the hues on the canvas, but the Where system will be inactive, making the forms unstable and jittery on the canvas.

*The Poppy Field near Argenteuil* (Figure 2.10) shows a clear example of this mechanism in action. Monet painted *The Poppy Field near Argenteuil* in 1873 while living in the small town of Argenteuil from 1871-1878. During this time, he was supported by his art dealer, Paul Durand-Ruel. The bright landscapes around him frequently inspired him. This eventually allowed him to declare himself dominant in the realm of *plein air* paintings, which, recall, means to paint outdoors. The painting was exhibited at the first Impressionist exhibition in Nadar's studio in 1874. It shows a step towards abstraction with contour lines that are almost entirely absent. The lower half of *Poppy Field near Argenteuil* is structured around a diagonal. This connects the mother and child (who are most likely Monet's wife, Camille Doncieux, and their son, Jean) in the
foreground with the brightest red flowers, ending with the concentration of trees in the distance. Compositionally, the image is stable, but the palpable atmosphere in the painting brings the viewer back to the feeling of constant motion. The viewer can practically feel the breeze and the crisp air that fills the scene.

The red flowers, green grass, and gray-blue skirt in this painting are all equiluminant. The What system can distinguish these features as different objects on the plane because of their different hues, but the Where system loses this information since the colors are equiluminant. This makes their position uncertain. They seem movable as if a gust of air or swift breeze could alter their position on the canvas. This painting encapsulates the experience of illusory instability. Margaret Livingstone notes that it is unclear if this was intentional or if it was a byproduct of the paints Monet had accessible, although this was a common theme in his paintings.

The Where system makes the world appear stable, despite our constant wandering eyes. If we move our eyes across an area where the colors are equiluminant, then the Where system cannot activate, and that area will appear in motion. We move our eyes more than we realize. If it were not for the Where system, Livingstone notes that "our perception of the world would look like a movie, shot with a camera held by someone riding a pogo stick if our visual perception simply reflected the images our eyes send to our brains." If one moves their eyes rapidly across the surface of The Poppy Field, the flowers appear to be moving.

Claude Monet is especially admired for his depictions of water. He consistently presented the viewer with the image of moving bodies of water in a still

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53 Ibid., 157.
image. One example of this is *Les Glacons (The Ice Floes)* (Figure 2.11). The winter of 1892-1893 was an especially brutal one, with very low temperatures and ample snowfall. Monet’s home in Giverny provided him with an apt view of the Seine, which had frozen over mid-winter. This inspired Monet to paint a series of paintings entitled, *Les Glacons (The Ice Floes)* in 1893. By January 23, 1893, the frozen river began to thaw, thus interrupting Monet’s plans to paint a full series of these paintings. He wrote in a letter to Durand-Ruel, “[T]he thaw came too soon for me…the results – just four or five canvases and they are far from complete.”

Monet overcame this issue by painting views of the now-melting ice floes, rather than just the frozen ones.

These paintings, specifically the one pictured in Figure 2.11, have areas of high luminance contrast adjacent to areas to low luminance contrast or equiluminance, all in the water. This juxtaposition technique produces a movement effect. Repetitive lines of high contrast result in motion perpendicular to their own direction. In this painting, the water has repetitive lines that move through the river, parallel to the bottom edge of the canvas. This means that the river appears to be in motion perpendicular to these lines, producing the proper effect of gushing water in a river.

*The Argenteuil Bridge* (Figure 2.12) has a similar effect of water in motion on a still canvas, due in part to high-contrast lines that Monet painted to represent the ripples in the water. This work was painted by Monet in 1874, and it depicts a suburb of Paris, Argenteuil, where the painter lived briefly. New suburban towns, like this one, were made possible by the growing wealth in Paris and were easily accessible to

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54 Metropolitan Museum of Art, “*Ice Floes, 1893.*”
Parisians by train. Suburbs served as a place of escape from the bustling Paris city life with leisurely activities such as boating, fishing, and picnicking.

In this painting, the light of the summer day is very evident. This style of painting turns away from, and rejects, hundreds of years of traditions of the way to paint trees and water. In creating this work of art, Monet utilized a new technique, made possible by the new tubing method of oil paints, in which he painted en plein air. This showed a shift in common practice for painting techniques as this new method for painting outdoor light soon became popularized by the Impressionists.

Art historian Steve Zucker says, "What is important is not the thing [Monet] is painting, but it is the optical experience of seeing that is critical here." Monet was ignoring what his brain was telling him to see and ignoring the elements of the image that would have been noted at the Academy. He painted as if he was viewing the outdoor scene with a "naked eye." It is impossible to "turn off" the brain, but Monet painted as if his brain had not yet interpreted the image his eye was seeing. This is understood through patches of green, patches of blue, and dabs of purple. He does not use a technical painting formula, as dictated through academic painting.

*The Argenteuil Bridge* also uses colors that would have been omitted from an academic landscape painting. There, they would have been muted and mixed. The green in the tree and the tree's reflection are equally bright, which would not have been depicted as such in academic painting. Monet painted with a sketch-like quality, depicting figures with loose brushstrokes. This was radical to see in the 1870s, as contemporary viewers thought it made the painting look unfinished. This painting

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55 Harris, “How to recognize Monet: The Basin at Argenteuil,” 1:14
shows an accurate impression of what it was like to be on the water at the Argenteuil Bridge at that exact moment.

Another method of depicting motion in paintings that Monet employed was through the use of multiple canvases, rather than just one. Monet did not just paint one painting at a time. By using a series of canvases simultaneously, he was able to move between them as the light on the scene changed. This allowed him to capture the fleeting effect at distinct times of the day. Within each canvas, Monet still used his usual painting techniques of depicting an atmospheric, airy scene with seemingly atypical colors, but the true effect of changing light in his series paintings is viewed by looking at all of the canvases next to each other. In this way, it is as if each canvas is one frame in a video that is focused on the same subject over a whole day, capturing different snapshots of the effect of light at varying times of the day.

In addition to the aforementioned series paintings (Haystacks and Rouen Cathedral), the Poplars series (Figure 2.13) encapsulates this effect of multiple canvases (each showing the image of an instantaneous moment of light) coming together to depict light changing over time. Monet painted the Poplars in 1891. According to Monet’s friend, the painter only had seven minutes to paint the scene before the light changed too much. Poplars was painted from a small rowboat near his house. The boat was specially designed so that he could bring along a number of canvases. At the time of painting this work, the land's owner sold the poplars to have them cut down for wood. Monet paid the owner to hold off on chopping so he could finish his painting series. He was not painting what he knew of the poplar in terms of the tree's shape, leaves, bark, etc. He painted the atmosphere and light on the poplar trees.

"This is something that interested Monet from the very beginning of his career, the
optical experience at any given moment and being incredibly attuned to it, working to forget what he knew. Instead of trees, river, meadow, sky, these became shapes and colors.”\textsuperscript{56} This idea of “working to forget what he knew” was crucial for Monet’s painting style. This painting depicts canopies of background poplars as pink. The surface of the canvas is evidently heavily-worked. The \textit{Poplars} is not one of the briefly-painted “impressions” like his earlier works were. The built-up, \textit{impasto}-like surface shows evidence of layered strokes of paint. This “build-up” of paint is also seen in his other series paintings. These are paintings that represent the momentary but have been built up over time.

For his \textit{Poplars} series, Monet said that the particular effect of light lasted “until the sunlight left a certain leaf,”\textsuperscript{57} after which he would trade out for a different canvas. Degas once recalled seeing Monet arrive at his painting location and say, “I’m half an hour late; I’ll have to come back tomorrow.”\textsuperscript{58} Monet was serious about brevity – he recognized that light is continuously changing, even if our eyes do not notice it immediately, but that working concurrently on multiple canvases was a significant workaround.

Another method of showing motion that was used by Monet came along with one of the most significant innovations of the 19\textsuperscript{th} Century: photography. When photography was first invented, photographers only had the capability for long-exposure photographs, since earlier photographic plates had very low sensitivity and required longer contact with the light. The first photographs with a shutter speed

\textsuperscript{56} Harris, “Claude Monet, \textit{Poplars},”
\textsuperscript{57} Dunstan, \textit{Painting Methods of the Impressionists}, 53.
\textsuperscript{58} Ibid.
below 1/50 of a second were only introduced twenty years after photography was invented. The extent to which a photographed image is blurred, appearing as a “smear” across the paper, decreases as the exposure time decreases. Impressionists, including Monet, were well-aware of this fact, and incorporated this notion into their paintings to depict motion. Monet’s *Boulevard des Capucines* (Figure 2.14) provides an apt demonstration of this concept.

*Boulevard des Capucines* was painted by Monet from 1873-1874 in Paris. It presents the viewer with an authentic peek into the bustling life of the French city. He painted this scene from the viewpoint of Felix Nadar’s studio. Recall, Nadar’s studio is where the first Impressionist exhibition was held, the spring after Monet painted this view. Monet used short brushstrokes to elicit the idea of a quick “impression” as Parisians moved all over the scene. The painting accurately suggests the dynamic energy and movement felt in the city. Art critic Ernest Chesneau responded to this painting,

> At a distance, one hails a masterpiece in this stream of life…But come closer, and it all vanishes. There remains only an indecipherable chaos of palette scrapings. Obviously, this is not the last word in art, nor even of this art. It is necessary to go on and transform the sketch into a finished work. But what a bugle call for those who listen carefully, how it resounds so far into the future!59

As alluded to by Chesneau, Monet’s painting is covered with quick brushstrokes to evoke the feeling of chaos and motion in the city. These fast-moving figures seem to “mimic the ghostly smudges”60 that were so prevalent in early photographs.

59 Metropolitan Museum of Art. “*Boulevard des Capucines*, 1873 or 1874.”
Chapter 3

Motion Alternatives to Monet

“How can one depict motion in a medium where none can exist?” – James E. Cutting

How we contemplate, evaluate, and ultimately write about art raises a critical question: “Can any aspect of art, which is a creative and subjective experience, be studied objectively?” If perfect objectivity in art were feasible, then there would not be much to discuss. We would see art representing exactly what we see in the world. This cannot be true, because we know that different artists replicate identical scenes in diverse ways. Also, as noted in the preceding chapter, what the human eye sees and what the brain interprets are not in constant agreement, so objectivity is difficult to attain. "The brain takes the incomplete information about the outside world that it receives from our eyes and makes it complete." It ignores some information in an effort to do this. This is especially true when considering motion and how we perceive motion.

Depicting motion is always a challenge for artists. Creating movement in a still image is a nontrivial task and presents the fundamental problem of representing a span of time in a medium which does not allow for that. Some solutions to this problem, meaning ways to depict movement, make it easier to represent motion but they often "sacrifice the accuracy of the motion represented.”

61 Kandel, Reductionism in Art and Brain Science: Bridging the Two Cultures, 17.
62 Ibid., 20.
63 Cutting, "Representing Motion in a Static Image: Constraints and Parallels in Art, Science, and Popular Culture," 1165.
In Chapter 2, we explored the tactics which Monet employed for depicting motion in his paintings. For example, he used the juxtaposition of equiluminant colors, color mixing, sequences of contrasting lines, simulated photographic blur, and series paintings to display the motion he saw around him. However, there are many other artistic techniques for providing a sense of movement, manipulating the subject in such a way that we lose information about the subject.

“While the problem of space and its representation in art has occupied the attention of art historians to an almost exaggerated degree, the corresponding problem of time and the representation of movement has been strangely neglected.”  

The challenge of representing the three-dimensional world on a two-dimensional surface puzzled artists for hundreds of years, but it was eventually “solved” by the innovation of perspective. The analogous problem, as 20th Century art historian Ernst Gombrich presents it, of preserving the notion of movement in a still image, has not had the same level of success.

Before the mid-19th Century, art was often created in a way such that the events depicted would occur over a period of time. This was seen in triptychs, murals on chapel walls, scroll paintings, tapestries, etc. Psychologist James E. Cutting explains the difference between an “instant” and a “moment,” where the latter comes from pre-photography art. But with the technological advancement of photography, we see the introduction of the “instant” into society. “Before [the] work [of the earliest photographers], few had ever thought about motion captured in an instant; after [photography] no one would ever mistake the fact that instants were quicker than the

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64 Gombrich, "Moment and Movement in Art," 293.
human senses could register.” A moment represents a larger, broader segment of 
time, encapsulating an event, though still small. An instant is an infinitely small slice 
of the moment that was more easily comprehended in the 19th Century as technology 
advanced.

This newly realized concept of an instant was soon adapted into artists’ 
practices. By overlaying images of multiple instances of a moving object, an artist 
could show the viewer the motion of the subject. Cutting presents this idea as a 
solution to representing motion in art: “If one image does not work to represent the 
motion an imagemaker desires, perhaps two or more will do. Unlike a single image, a 
series of discrete static images can sometimes render the impression of motion without 
sacrificing the resolution, or visual clarity, of the moving object.” Though this shows 
motion, this statement is not necessarily true; overlaying multiple images indeed 
detracts from the visual clarity of the subject. This method alters the structural 
integrity of the subject, with the shapes and forms distorted to portray movement.

Perceptual psychologist Rudolf Arnheim explains that the visual experience of 
运动 is caused by three things: physical movement, optical movement, and 
perceptual movement. “If someone could observe what goes on in my eyes while I 
examine the various parts of a painting on the wall, he would find that each time I 
change the fixation of my glance, the entire picture moves on the retinas in the 
opposite direction.” The constant movements of our eyes can be recorded in 
stroboscopic motion. As Arnheim explains:

65 Cutting, "Representing Motion in a Static Image: Constraints and Parallels in Art, Science, and 
Popular Culture," 1165.
66 Ibid., 1173.
All motion perception is basically stroboscopic. When a bird flies through my field of vision, its physical displacement is continuous. What I see of the flight, however, derives from a sequence of recordings by the individual receptors or ‘receptive fields’ in the retina. As the bird arrives from the left, the receptors on the retinas’ right side will be activated first, the ones to the left, last. The nervous system creates the sensation of continuous movement by integrating the sequence of these momentary stimulations, none of which records anything but a static change... [T]he basic fact is that the experience of mobility derives from a sequence of immobile inputs.68

This exact process for showing motion was utilized in William George Homer’s invention in 1834. He created the zoetrope, or Daedaleum, a children’s toy. It used stroboscopic images viewed through slots in succession while a cylinder with the images rotated. This eventually led to the modern motion picture.

Although we really do see in stroboscopic motion, we do not actually see motion in the way stroboscopic motion is portrayed. This is because the visual system’s ability to detect motion and images over a span of time is a result of "the intermittent stimuli presented to the eye, [which] are perceived as separate only if the presentation rate is below a certain threshold, defined as the critical flicker-fusion frequency."69 If the picture frames in Horner’s zoetrope were moving at a slow speed, then the images would appear in our eyes as distinct frames, since they would have a flicker rate below the threshold of fusion in our vision (as in “fusing” frames together). But when the speed of the zoetrope increases, or when watching a modern movie, we see continuous, moving images, since these use a higher flicker rate than that of fusion in our vision threshold. “The purpose of [stroboscopic motion] representation is not

68 Ibid., 387.
to trick the visual system into seeing motion; instead, it is merely to suggest to an observer, sometimes a well-informed one, that motion has occurred.”

Stroboscopic motion was quickly adopted by artists to demonstrate movement in art. The first example of stroboscopic motion in a picture was from Descartes’s *Meditations* (Figure 3.1) in 1680. This image shows the pendulum motion of a swinging object, which was illustrated to accompany his text that he felt could not do this motion justice on its own, because of its uniqueness. Notice that the hand in the image is entirely stagnant. This enhances the legibility of the image. Throughout his writing, Cutting repeatedly emphasizes the importance of "the condensation of coordinates,” referring to the need for something to be still in a display of stroboscopic motion.

One French scientist played an instrumental role in the development of photography, Étienne-Jules Marey. He pioneered the technique of chronophotography (“chrono” meaning time-based), which highlights stroboscopic motion. His chronophotographic gun was able to take twelve consecutive photographs per second, with all frames documented on the same image. In Marey’s stroboscopic images (Figure 3.2), the thing that stays still is the camera. “Using a single set of environmental coordinates generated by the still camera, Marey typically superimposed images in a single photograph, much like those of Descartes, creating a technique that has been used most effectively elsewhere in art and in science to depict motion.”

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70 Cutting, "Representing Motion in a Static Image: Constraints and Parallels in Art, Science, and Popular Culture," 1190.
71 Ibid., 1175.
72 Ibid., 1175.
“For hundreds of years, artists had to rely on their powers of observation and their skill to create images containing implied motion. However, the advent of high-speed photography made natural images of implied motion available and introduced a realistic standard against which to compare traditional artistic depictions of implied motion.”

Photography, specifically Eadweard Muybridge’s stop-action photographs, had a significant effect on artistic depictions of motion. Muybridge changed the way artists depicted horses galloping. Typically, horses are presented in a “rocking horse” or “flying-gallop” pose, but as revealed by Muybridge’s photos of a horse (Figure 3.3), the animal does not ever actually reach this position while galloping. In this “flying-gallop” pose, all four of the horse’s legs are off the ground simultaneously in an outstretched position.

Muybridge’s experiments were commissioned by Leland Stanford, a wealthy landowner. Stanford wanted to settle an argued assertion: there is an instance when all of the horse’s legs are off the ground at the same time. He decided he would use Muybridge’s photographs as proof of this fact. While it turned out that this claim is valid, the horse’s legs do not all leave the ground at the same time in the position that was previously assumed. The "flying-gallop" position, which was so frequently used to signify a horse in motion, actually does not exist. Muybridge’s photographs were published, artists took note of the lack of the “flying-gallop” pose, and they removed the images of this incorrect position from their future works. This is a prime example of the invention of photography influencing other art forms. Although people had seen horses in motion, they had never seen a horse at an instant, a new phenomenon.

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allowed by the camera. "Photographic evidence may not correspond to our conscious experience of movement. If the aim of art is to be true to human experience rather than to photography, then photography should not be relevant. However, the ubiquity of photographic images in modern society has created its own, dominant standard of truth, a photographic truth."  

While these examples show motion wherein the object is moving, a groundbreaking art movement developed from the notion that the viewer could be the one moving. Cubism originated from the idea that each object should be stationary, but depicted from a moving perspective, as if it is seen from multiple angles simultaneously.

From the time of Masaccio [(the first painter to use linear perspective in 1425)], painting had been assumed to give, in one- or two-point perspective, a fixed and complete ‘view,’ in which everything in all places, forward and back, appears simultaneously with everything else. But this is only true if we the observers are stationary; our view of the picture, as well as the scene pictured, is the result of a great number of eye movements.

Cubism aims to present forms from multiple viewpoints at once, with discontinuous planes, thus shattering the longstanding tradition of perspective, established before the Renaissance. Additionally, many art historians note that Cubism adds a layer of time to spatial dimension, since the objects are represented in chronological sequence, rather than as they are seen at any one instance.

The first example of a Cubist painting was Les Demoiselles d’Avignon (Figure 3.4), painted by the renowned Cubist, Pablo Picasso, in 1907. In this painting, Picasso contorts the bodies into ambiguous planes. “Gone is the traditional concept of an

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74 Ibid., 94.
75 De La Croix, Gardner’s Art Through the Ages, 1047.
orderly, constructed, unified pictorial space that mirrors the world. In its place are the rudimentary beginnings of a new representation of the world as a dynamic interplay of time and space. The multi-angled perspective in this painting is best exemplified in the seated figure on the lower right portion of the canvas. This woman is shown from three distinct viewpoints: three-quarter back view from the left, a similar view but from the right, and a face-on view of her head, suggesting a frontal view of the whole figure as well. This work initiated the movement of Analytic Cubism (as opposed to Synthetic Cubism, which incorporates materials other than paint into the works) and served as great inspiration for the other prominent Cubist, Georges Braque. Braque’s and Picasso’s future Cubism paintings evoke a kaleidoscopic effect on the subject. These works depict concurrent images that cannot exist simultaneously.

One artist, Marcel Duchamp, sought to combine the ideas from analytic cubism and motion. He painted *Nude Descending a Staircase, no. 2* (Figure 3.5) in 1912 to fulfill this goal. The painting shows “dislocated plates of a single figure into a time continuum, suggesting the effect of a primitive motion-picture technique.” The painting appears to show the figure moving in stroboscopic motion, and the arcs and dotted lines indicate the movement patterns of the largest parts of the body. Duchamp's painting serves as a sort of "description" of how the form moves within specific, successive intervals. *Nude Descending a Staircase* does not resemble nature. It distorts the form of the figure. It uses a similar color palette to those of Picasso’s and

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76 Ibid.
77 Ibid., 1054.
78 Ibid., 1055.
Braque’s Analytic Cubist paintings. It aims to “minimize the optical effects of color and emphasize, instead, a revolutionary new conception of space.”\(^{79}\) This is a Cubist painting that adds the elements of photography, as inspired by Muybridge and Marey.

Indeed, this work is often referred to as a “Cubo-Futurist” work.\(^{80}\) Although the label "Futurism" is conventionally designated to describe Italian poets, painters, and sculptors, Duchamp's painting is quintessentially Futurist. The Italian Futurists believed in using their art for revolution, and their artworks were usually riddled with overt political overtones. Futurism began in 1909 and was influenced by the 20\(^{\text{th}}\) Century’s newfound speed and “engines of modern power.”\(^{81}\) These painters believed that “art must exhibit motion in time and space; it should reveal the simultaneously present perceptions that comprise any given event in any given place.”\(^{82}\)

Futurism aimed to represent action in paintings by showing different phases of movement simultaneously. This was not unlike the chronophotographs of Marey, discussed earlier. Many Futurists adopted the methods of Cubism but altered the aim slightly to incorporate the ideas of modern technology, movement, and speed. As Umberto Boccioni stated in the *Technical Manifesto on Futurist Painting* in 1910, “A running horse has not four legs, but twenty, and its movements are triangular.”\(^{83}\)

Futurists used a multitude of different methods to depict motion in their works, including evoking the sense of motion in their viewers through language.

\(^{79}\) Folland, "Marcel Duchamp, Nude Descending a Staircase, No. 2."
\(^{80}\) Ibid.
\(^{81}\) De La Croix, *Gardner's Art Through the Ages*, 1055.
\(^{82}\) Ibid.
\(^{83}\) Bozzolla and Tisdall, *Futurism (World of Art)*, 3.
Stefano Mastandrea and Maria A. Umilta conducted a study in which they examined the relationship between title and amount of perceived motion in Futurist paintings. They found that when the study’s participants were presented with the work’s original title and, also, the work’s “increased” title (meaning the title had an added adjective to intensify the sense of dynamism), the artwork was more likely to be perceived as having more movement.

In 1912, prominent Futurist Giacomo Balla painted *Dynamism of a Dog on a Leash* (Figure 3.6). In this image, the observer is stationary (contrast to Cubism), and the dog and its owner are moving. The subjects are not shown as fragmented, as in Duchamp's *Nude Descending*. The motion in this painting is shown through repetition of shape. This is seen in the legs of the dog, the dog's tail, the dog's leash, i.e., the parts of the dog that move fast. This artistic technique for showing motion is also employed by cartoonists to create the effect of motion, but also to add a comical element.

Evidence of the technique as mentioned earlier, stroboscopic motion is seen in Balla’s painting. Cutting acknowledges one notable drawback of stroboscopic displays to show motion. Although they are “so effective at representing motion that even preschoolers seem to understand them,” we lose one aspect of motion that is crucial to our understanding of movement. Motion is a vector. It is both magnitude and direction. Stroboscopic motion adequately demonstrates an object's speed but not direction, unless the viewer has prior familiarity with the nature of the object. For example, in Balla's *Dog on a Leash*, we are familiar with the fact that a dog walks in the direction of its head, so we clearly see the dog walking towards the left. But this pre-

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84 Cutting, "Representing Motion in a Static Image: Constraints and Parallels in Art, Science, and Popular Culture," 1177.
exposure to the subject may not always be available. While Cutting admits that this directional distinction may not seem of great importance to the average viewer, it detracts from the accuracy of the portrayal of motion. Achieving both accuracies of the subject's depiction and the subject's motion is not a trivial feat. An artist must choose to sacrifice one or the other in order to convey motion.

Futurism in art was not limited to paintings. Boccioni used similar abstraction methods to Balla in order to depict motion in an obviously still sculpture. “What we want, he claimed, is not fixed movement in space, but the sensation of motion itself.”85 Boccioni created *Unique Forms of Continuity in Space* (Figure 3.7) in 1913. In this sculpture, he focuses on the formal and spatial effects of motion, instead of the fact that the figure he is depicting moving through space is a human. Only the blur of the moving human remains. This is no longer a human with the identifiable contours that compose our understanding of a person – arms, legs, feet, torso, etc.

Op Art, or Optical Art (Figure 3.8), is another prime example of an art movement that focused on displays of motion. This was an abstract art movement in the 1960s that used visually simple forms to stimulate the visual and motion systems of our brain specifically. It employed mathematical images, made of shimmery patterns that flicker in our eyes. "Op Art exploited contemporary advances in our knowledge of how the brain processes visual information and perhaps was also an expression of the uncertainty and disturbance created in society by the rapid scientific advancements of the time."86 Op Art patterns were quickly integrated into pop culture, as the designs were welcomed into the fashion industry.

85 De La Croix, *Gardner’s Art Through the Ages*, 1056.
A final artistic example to examine that incorporates movement is David Hockney’s collection of photographic polaroid collages. Hockney, a contemporary British artist, currently residing in Los Angeles, is known for his works in a variety of different styles, one of them being his photocollages, or "joiners," as he called them. Hockney said, “Photography is all right if you don’t mind looking at the world from the point of view of a paralysed cyclops – for a split second.” His photocomposites (Figure 3.9) encourage the viewer’s eyes to wander all around the image – side to side, up and down. Initially created accidentally, Hockney noticed that his polaroid composite photos seemed to illustrate a narrative as if the viewer were moving through the scene. He intended to “overcome the limits of eye-vision” by presenting the viewer with multiple perspectives concurrently.

Hockney combines the shifting vantage points from Cubism and the adoration of movement of Futurism to show the viewer a new perception of their surrounding world. “He admitted himself that his works were very Cubist, moreover, they often reference Cubism with their distorted perspective and iconography, mixing homage and parody in one.” Mather notes, “[T]he use of Hockney’s multi-perspective composition by an artist may be a tacit acknowledgment of the very localised nature of visual experience. As the eyes move about the painting, they arrive at different viewpoints. The scene is not apprehended as a whole, but as one view at a time dictated by the pattern of eye movements.”

87 Harris, “David Hockney – Photography will never equal painting!”
88 Michalska, “David Hockney and The Camera: A Composite Polaroid Reality.”
89 Ibid.
Looking at Hockney’s *Merced River* photocomposite (Figure 3.10), we can recall Monet’s *Ice Floes* (Figure 2.11), discussed in the previous chapter. Monet's painting elicits the feeling of instantaneous motion in this almost-indescribable way. The viewer knows the impossibility of moving paint on a canvas, yet the water has such a shimmery quality that it seems to be flowing. The paradoxical nature of the image makes this kind of motion hard to articulate, making the quality of movement even more believable. In contrast, Hockney's representation of motion water stimulates a different feeling. There is no doubt for the viewer that they see the rushing water of the Sierra Nevada mountains, but this water does not move in the same way as Monet's *Ice Floes*. This photo collage captures the experience of being at the river, but for some span of time – not an instantaneous moment.

In all of the aforementioned artistic techniques of motion, we see movement, as desired by the artist. But we sacrifice a significant element of the art: true form. The original shapes and contours help inform the viewer of what they are seeing, but in the above examples, the original configuration and appearance of the subject are forfeited for a convincing display of motion. Sure, we can easily tell that the dog in Balla’s painting is moving, with a wagging tail and twirling leash, but this is not what a dog looks like, nor a tail, nor a leash. Boccioni’s quote that a running horse has twenty legs, not four, is an amusing, playful idea, but it is not true. All of the examples above excel at displaying movement but do not preserve the structure of the forms they are representing.

Connecting this back to the primary focus of this thesis, Claude Monet was able to achieve the impossible: depicting motion while preserving the forms of his subjects. While it is not an essential requirement of art that it replicates nature,
Monet's ability to convey the perception of motion while simultaneously keeping the subject whole is a notable accomplishment, and one that is not seen often in the history of art. Art can certainly be molded to fit whatever purpose the artist desires. Deliberately depicting forms in motion in a still image would typically require that the forms be distorted in some way. That is acceptable in art. However, Monet rejects this sort of alteration of forms, yet keeps the ability to present the viewer with a moving image. This incredible feat, painting a moving image on a still surface while preserving the subject's integrity, is nearly unimaginable, adding a further elegance to Monet's paintings and his techniques.
Conclusion

We can distinguish between artists who aim to represent the fact that motion has occurred and artists who aim to create the motion in the brain. The artists mentioned in Chapter 3 fall into the first category, where they use techniques in their art to inform the viewer that motion has happened. These artists utilize methods such as incorporation of stroboscopic motion and merging multiple perspectives into one to describe the motion to the viewer. Their techniques represent motion and the passage of time, but they do not represent those phenomena in the brain, where the real perception happens. Claude Monet, however, was an artist of the other type, where he used the methods described in Chapter 2 to “trick” the viewer’s brain into perceiving motion in his painting.

To compare this to the somewhat-comparable, aforementioned "problem" of transforming the three-dimensional world onto a two-dimensional canvas, linear perspective drawings actually work. Not only does linear perspective imply that the scene we see is three-dimensional, but the volume is actually perceived by the brain, despite the fact that the canvas is two-dimensional. The illusion is so complete that even after we know that the painting is two-dimensional, we see the third dimension. We cannot turn off the brain’s function in seeing.

However, we have seen throughout this thesis that motion and time are much more difficult than space to condense onto canvas. Monet was not only trying to imply that motion has occurred, but he was aiming to get the perception in the brain to include motion. Through the use of various painting techniques, such as painting equiluminant colors side by side, mixing particular colors to evoke a specific time of
day, painting contrasting lines in close succession, constructing a paint imitation of photographic blur, and splitting up a time span over a series of paintings, Monet created the perception of motion in the viewer’s brain. Yet, while achieving this impressive feat, he also managed to keep the subjects he was painting intact. The motion generated in the artworks of Balla, Duchamp, Picasso, and Hockney is overt and unmissable. The motion practically jumps off the canvas. Monet’s works, in contrast, show motion in a much subtler way. By creating the movement in the viewer’s brain, rather than explicitly on the canvas, Monet was able to preserve the integrity of the subject he was depicting. Distorting the subject to show movement surely informs the viewer of motion, but achieving an impression of motion, an experience of motion in the brain, while presenting the subject in its true form, is a genuine triumph.
Figure 1.1. Édouard Manet, *Le Déjeuner sur l’herbe*, 1862-1862, oil on canvas, 6’10” x 8’8”, Musée d’Orsay, Paris.
Figure 1.2. Claude Monet, *View at Rouelles, Le Havre*, 1858, oil on canvas, 1’6” x 2’2”, Private collection.

Figure 1.3. Charles-François Daubigny, *Banks of the Oise*, 1863, oil on canvas, 2’11” x 5’4”, Saint Louis Art Museum, St. Louis.
Figure 1.4. Claude Monet, *Landscape with Factories*, 1858-1859, oil on wood, 9” x 1’4”, Private collection.

Figure 1.5. Claude Monet, *The Gare Saint-Lazare (Interior View of the Gare Saint-Lazare, the Auteuil Line)*, 1877, oil on canvas, 2’6” x 3’5”, Musée d’Orsay, Paris.
Figure 1.6. Constant Troyon, View from the Hilltops of Suresnes or, The Grape Harvest at Suresnes, 1856, oil on canvas, Musée Municipal, Limoges.
Figure 1.7a. Claude Monet, *La Grenouillère*, 1869, oil on canvas, 2’5” x 3’3”, Metropolitan Museum of Art, New York.
Figure 1.7b. Pierre-Auguste Renoir, *La Grenouillère*, 1869, oil on canvas, 2’2” x 2’8”, Nationalmuseum, Stockholm.
Figure 1.8. Frédéric Bazille, *Monet After His Accident at the Inn of Chailly (The Improvised Field Hospital)*, 1865, oil on canvas, 1’7” x 2’0”, Musée d’Orsay, Paris.
Figure 2.1. Claude Monet, *Impression: Sunrise*, 1872, oil on canvas, 1’7” x 2’1”, Musée Marmottan Monet, Paris.
Figure 2.2. Claude Monet, *Impression: Sunrise in Grayscale*, 1872, oil on canvas, 1’7” x 2’1”, image from Livingstone, *Vision and Art: The Biology of Seeing*, 39.
Figure 2.3. Claude Monet, *Impression: Sunrise with Enhanced Colors*, 1872, oil on canvas, 1'7" x 2'1", image from Livingstone, *Vision and Art: The Biology of Seeing*, 39.
Figure 2.4. Luminosity Response Curve from Livingstone, Vision and Art: The Biology of Seeing, 41.
Figure 2.5. Claude Monet, *Rue Montorgueil in Paris, Festival of June 30, 1878*, 1878, oil on canvas, 2'8" x 1'8", Musée d’Orsay, Paris.
Figure 2.6. Nicolas Poussin, *Rape of the Sabine Women*, 1634-1635, oil on canvas 5’3” x 6’10”, Metropolitan Museum of Art, New York.

Figure 2.7. Isaac Newton’s Color Wheel, ca. 1665.
Figure 2.8. Claude Monet, *Grainstack in the Morning, Snow Effect*, 1891, oil on canvas, 2’2” x 3’0”, Museum of Fine Arts, Boston.
Figure 2.9a. Claude Monet, *Rouen Cathedral: The Portal (in Sun)*, 1894, oil on canvas, 3’3” x 2’2”, Metropolitan Museum of Art, New York. (grayscale image from Livingstone, *Vision and Art: The Biology of Seeing*, 128.)
Figure 2.9b. Claude Monet, *Rouen Cathedral Façade*, 1894, oil on canvas, 3’6” x 2’ 4”, Musée d’Orsay, Paris. (grayscale image from Livingstone, *Vision and Art: The Biology of Seeing*, 129.)
Figure 2.10. Claude Monet, *Poppy Field outside of Argenteuil*, 1873, oil on canvas, Musée d’Orsay, Paris.
Figure 2.11a. Claude Monet, *Ice Floes (Les Glaçons)*, 1880, oil on canvas, 3'2” x 4’10”.

Figure 2.11a. Claude Monet, *Ice Floes (Les Glaçons) in Grayscale*, 1880, oil on canvas, 3’2” x 4’10”, image from Livingstone, *Vision and Art: The Biology of Seeing*, 161.
Figure 2.12. Claude Monet, *The Argenteuil Bridge*, 1874, oil on canvas, 2’0” x 2’7”, Musée d’Orsay, Paris.
Figure 2.13. Claude Monet, *Poplars*, 1891, oil on canvas, 3’0” x 2’5”. Philadelphia Museum of Art, Philadelphia.
Figure 2.14. Claude Monet, *Boulevard des Capucines*, 1873, oil on canvas, 2’8” x 2’0”, Nelson-Atkins Museum of Art, Kansas City, Missouri.
Figure 3.1. René Descartes, *Illustration from Meditations*, 1641, image from Cutting, “Representing Motion in a Static Image: Constraints and Parallels in Art, Science, and Popular Culture,” 1175.
Figure 3.2a. Étienne-Jules Marey, *Running Lion Tamer*, 1886, chronophotograph.

Figure 3.2b. Étienne-Jules Marey, *Man Clearing a Hurdle*, 1892, chronophotograph.
Figure 3.3. Eadweard Muybridge, *Horse in Motion*, ca. 1886, photograph.
Figure 3.4. Pablo Picasso, *Les Demoiselles d'Avignon*, 1907, oil on canvas, 8'0” x 7’8”. The Museum of Modern Art, New York.
Figure 3.5. Marcel Duchamp, *Nude Descending a Staircase, no. 2*, 1912, oil on canvas, 4’10” x 2’11”. Philadelphia Museum of Art, Philadelphia.
Figure 3.6. Giacomo Balla, *Dynamism of a Dog on a Leash*, 1912, oil on canvas, 2’11” x 3’7”, Albright-Knox Art Gallery, Buffalo.
Figure 3.7. Umberto Boccioni, *Unique Forms of Continuity in Space*, 1913, bronze, 3’7” x 2’11” x 1’4”, Museum of Contemporary Art, University of São Paulo.
Figure 3.8. Examples of Op Art works, mid-20th Century.
Figure 3.9a. David Hockney, *Mother*, 1986, photocollage.

Figure 3.9b. David Hockney, *Don and Christopher*, 1982, photocollage.
Figure 3.9a. David Hockney, *John Kasmin*, 1982, photocollage.

Figure 3.9d. David Hockney, *Jerry Diving*, 1982, photocollage.
Figure 3.10. David Hockney, *Merced River*, 1982, photocollage.


