Thoughts on Similarities Between Artists and Scientists and the Benefits of Studying Visual Art in the Healthcare Field

Logan Weihe

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HONORS THESIS

Certificate of Approval

Thoughts on Similarities Between Artists and Scientists and the Benefits of Studying Visual Art in the Healthcare Field

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Approved to fill the requirements of HON 437

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Thoughts on Similarities Between Artists and Scientists and the Benefits of Studying Visual Art in the Healthcare Field

Submitted in partial fulfillment of the requirements for the Murray State University Honors Diploma

Logan Weihe

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Being someone who has a strong interest in both art and science led me to explore the similarities between the types of thinking, processes and various impacts artists and scientists have on society. My goal of becoming a certified medical illustrator made it feel natural to present the connections between art and science, to show how their combination may provide a more fulfilling educational experience for medical students. In this paper I discuss the benefits of studying visual art during professional training for a healthcare profession. I also correspondingly assess how scientists use the visual to examine evidence and explain the natural world. These scientific visual aids are linked to my personal explorations in my studio work and my senior art exhibition, ‘Beloved Microcosm’. While art and science absolutely have important differences, it is critical to realize that the abundance of emotional associations with one or the abundance of empirical associations with the other are not so black and white.

**The Importance of Visualization and the Use of Abstraction in Both Art and Science**

Science is very difficult to define and can be quite broad, but as I refer to science in this paper, I will be referring to “the use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process” as defined by the National Academy of Sciences in 2008 (36). Additionally, within this definition, natural phenomena could include a very wide range of subjects. I am considering humans to be natural, as well as their products, thus included in the study of science. The subjects that scientists study, falling in the category of natural objects and their laws, preexist humanity; but science as a study is something that human beings do.
Figuring out how to study natural phenomena is a task that humanity evolved in order to try and understand the natural world, and visualization has been an essential part of science since its inception (Wilson, 48). Early scientific thinkers illustrated everything by hand, visually mapping out subject matter as a way of recording, describing and learning from an existing specimen. For example, early bark drawings created by aboriginal tribesman in Australia demonstrate hints of internal anatomical structure of many fish species, possibly used as a tool for education (Ford, Calhoun, 12). Furthermore, “Historia Animalium” is an encyclopedia of plants and animals compiled in the 1550’s by Conrad Gessner, a Renaissance medical doctor, once scientific illustration became sophisticated enough to be considered its own practice (Rosen, 41). This early book is an attempt to compile illustrations of every animal known, to create a sort of visual database. From early scientific illustration to contemporary scientific and medical illustration, visualization is used to denote observations and record imagery that we know to exist. Visualization as a form of imagination occurs in our brains as we piece together ideas and information that may not appear visual in nature. A human’s perception of reality can consist of a combination of their own perceptual experience (including their senses), preexisting principles for interpretation, the naming and classification of things based on historical and contemporary understanding, and the operation of their brains at a pre-verbal level. Our construction of the world as we experience it is something that science cannot escape, as it helps to organize natural realities involving visualization and imagination.

Visualization is a common process for most human beings, and scientists and artists rely upon it and develop it more than most. Both scientists and artists use abstract models and the practice of abstraction to understand the world. As French physicist Louis de
Broglie sought to find the proper imagery for the atomic domain, he focused on finding visual images of the atomic world that were abstractions from phenomena we see daily (McLean, 30, pg. 28). De Broglie developed a promising alternative to the orthodox version of quantum mechanics at the time by stepping away from conventional ways to visualize the atom. Many scientists study microscopic events that are only observable through the use of a visual aid, commonly requiring an optic device that can effectively describe tiny organisms and particles that humans cannot see with their naked eyes (Hicks, 17). For example, the process of looking through a microscope to see a tiny organism or virus can require abstract thinking in that the scientist must recognize that it is real even though they cannot see it on their own. This distance pushes scientists’ imagination as they visually experience something that humans do not see in everyday life, and can never see without technological assistance. The ability to understand that everything is made up of microscopic elements is an abstract scientific reward and is the result of experiences with optic devices and digital imaging. An indexical relationship is established when looking through an optical device, as the visual portrayed through the lens has a relationship with what is actually there, even though the scene may seem foreign (Sonesson, 43). By an indexical relationship, I mean that there is a contiguity between the image presented to the viewer through the lens of a microscope and what is being studied under the microscope, that is present in reality. The optical device becomes a sort of a “carrier” for the image, and a mediator between reality and the lens of the microscope (Sonesson, 43). What is being studied is what is seen, even though magnification through a lens is necessary for observation. Optical microscopes act as high-powered magnifying glasses, and other microscopes, such as the electron microscope, use a beam of electrons to magnify what is
being studied, the interaction between the electrons and the sample creating the image (LeFurgy, 24). Our perceptual ability to truly see, without trying to connect the foreign visuals to common landscapes that we experience directly, requires scrutiny and practice. In ‘The Contribution of the Artist to Scientific Visualization’, artist Vibeke Sorensen points out that creating an intellectual bridge between abstraction and aesthetic consideration is essential to both artists and scientists (Wilson, 48, pg. 19).

Often times when we look at digital models of molecules in our studies we forget that a human had to make the perceptual and aesthetic decisions in creating the model, based on deductions from their scientific knowledge (Kemp, 21, pg. 119). These models, and any visuals that demonstrate the structure of molecules, viruses etc., remain important as the visualization of structure often reveals function, and therefore reasons for dysfunction. These constructed visualizations of things that cannot be seen with the human eye alone, solidify the fact that microscopic events and organisms are found everywhere.

In visual art, certain types of abstraction allow for the exploration of ideas in a way that is non-naturalistic in a similar way that microorganisms may seem to the non-scientist. Some types of abstract art depict concepts and forms that are not seen in everyday reality. As I delineated what I meant by science previously, I must now do the same for art. Throughout this body of work, I will be speaking on behalf of art that attempts to have some sort of relationship with aesthetics and is two-dimensional. More specifically, in my introduction to abstraction in art, I am referencing abstract art that involves the extraction of abstractions from nature. Instead of developing an entire narrative, this type of abstraction allows pure forms and the natural teleology of the visual and pictorial field to reach self-realization (Mitchell, 32). Abstract Expressionist artist Arshile Gorky wrote that,
“Abstraction allows man to see with his mind what he cannot physically see with his eyes. Abstract art enables the artist to perceive beyond the tangible, to extract the infinite out of the finite. It is the emancipation of the mind. It is an explosion into unknown areas” (The Art Story, 1). While Gorky was an Abstract Expressionist artist who produced abstract paintings relevant to psychology, non-communicability, and semiotics, not specifically extraction from nature, the way he spoke about abstraction as a whole remains a useful description. Even when an image is abstract, it remains a result of nature and reality, but becomes an intellectual exploration beyond mere appearance. This desire to reveal meaning in nature and phenomena is pertinent to both scientists and certain types of artists, as they work to disclose nature as a multi-faceted reality, not always reducible to what we can visually perceive (Biederman, 3).

Paul Cezanne was an artist who was influenced by the contemporary scientific discoveries during his time that were related to sight. Cezanne lived in a time marked as one of the most energetic periods in the advancement of modern physical and biological science, as well as a time of closer acquaintance with science as a procedure (Ione, 19). Cezanne’s newfound understanding and interest in the eyeball’s map of light and its transformation, instigated his compilation of subtle geometry, similar to lines sensed by the visual cortex. Cezanne used abstraction in his work based on his scientific knowledge of the process of seeing, and the idea that “if we saw with the impersonal honesty of our eyeballs, then we would see nothing but lonely points of light, glittering in a formless space” (McCabe, Castel, 28).
Art and Science: Similarities in Their Societal Influence, Process and Creativity

In modern times, it is important that we realize that while art and science have their differences, they may have similar social and philosophical dimensions as well. Both artists and scientists may actively seek to influence societies or do so passively as a result of the meaning of their work. Scientific research is often thought of as specialized technical inquiry, but because scientific research has a creative and philosophical dimension, it has the potential to become cultural commentary in the way that art does. When talking about culture in these instances, I am referring to the general set of shared values, interests, habits and attitudes found amongst a group of people. Recent research on embryonic stem cells has sparked a debate amongst groups of people who argue for scientific progress and others who argue that this research is morally wrong (Flatow, 11). The controversy over this scientific discovery involving the possible benefits of using embryonic stem cells to treat disease illustrates the way empirical evidence can cause a group of people to reevaluate their beliefs, beliefs that often affect habits, mindsets and personal values (Flatow, 11). These values, attitudes and trends a society develops can be shaped based on the quantitative facts and empirical data collected through scientific means. This communicative and impactful dimension science possesses as translated into political form relates it closely to artistic practice and emphasizes the common collection of knowledge used to interpret and interact with the world.

Practicing science and creating art are both part of the overall human struggle to find meaning in reality and existence. A large part of everyday life includes dealing with the precedents of fundamental policy and organization laid out by the larger governmental
structure. Discoveries made in the field of science have an effect on this bureaucratic structure and the government’s interaction with the public. Bureaucrats use science to guide policy decisions, and the media reports on recent discoveries to keep the public informed. “Science provides an area in which we attempt to come to terms with much deeper issues- the relationship between capitalism and the environment, the meaning of risk, the role of expertise in a democracy” writes Daniel J. Hicks, philosopher of science (17). Hicks describes that science communication is important for trust, transparency and public understanding of science, and visuals are a pertinent communication tool to convey complex scientific information (17).

The idea of science shaping culture is well illustrated by thinking about how the scientific revolution of the 17th century created the conditions for the industrial revolution of the 18th century. The scientific revolution cultivated advances in machinery, agriculture, transportation and warfare. The scientific revolution is an example of how discoveries in the field of science changed the entire landscape of the world and affected all aspects of life culturally, socially and economically. The new ideas of the earth revolving around the sun, the invalidation of God being important to the sciences and the pursuit of science itself instead of philosophy are all changes that pushed culture from being comfortable in their medieval scientific philosophy, to reacting to a severe new era of academic thought (Kent, 22). The collaboration of people from different academic backgrounds such as science, philosophy, math and astronomy, became more widely accepted and new methods for scientific experimentation became pertinent to discovery and its relation to the public (Kent, 22). Later in the 19th century, newer technologies related to electrical generation, the internal combustion engine and industrial processes linked to chemicals promoted the
growth and spread of industrial and international trade (Musson, Robinson, 34). All in all, the industrial revolution represented a practical application of the newly developed scientific methodology that occurred in the scientific revolution, helping to increase agricultural and industrial production, create new manufacturing methods, improve health, and generate new sources of power (Musson, Robinson, 34).

Russian avant-garde artist El Lissitzky believed that “art is not meant to be merely art, but to enhance society as a whole, and to accomplish this, artists should take their place alongside scientists and engineers” (Miller, 31, pg. 19). Lissitzky was influenced by changes in politics, mathematics and physics within a movement in Russia known as Constructivism (Perloff, Lodder, 39). These changes prompted Lissitzky to say that artists had “stepped into the ranks of those organizing life” referring, in part, to scientists (Perloff, Lodder, 39). Artists continue to creatively incorporate political and cultural ideas as well as advocate for the freedom of speech and expression. Artists take numerous positions on society and cultural issues, and often use these ideas about the world to fuel their creative practice. An example of an artist taking a position on societal issues is Pablo Picasso and his piece, Guernica [Figure 1], which is based on the Spanish Civil War and speaks about the war’s inhumanity (Martinique, 27). This work of fine art has served as an inspiration for the modern human rights movement (Martinique, 27). Artists and their work also take positions on things such as Feminism, as demonstrated by Judy Chicago and her exploration on women’s position in culture, or the AIDS pandemics as explored by artists Keith Haring and Robert Mapplethorpe (Martinique, 27). Similarly, while science is understood as a rigid, empirical, truth-seeking field of study, there are many ways to practice science in terms of ethics, process and ultimate goals. The differing positions taken
by artists are culturally expected, but as we move into a day and age where science greatly affects policy and culture, it is important to realize that there is not one singular unified scientific attitude either (3). Additionally, the difference between science and advocating for science lies within whether someone carries out experimental procedures to illuminate facts about natural phenomena or merely speaks out about the need to explore certain phenomena. In terms of scientific attitude, I am speaking of the way a scientist goes about their process of hypothesizing, experimenting and concluding as well as how they present their findings, not attitudes about science held by non-scientists.

![Guernica by Pablo Picasso](image)

Figure 1 Pablo Picasso, *Guernica*, 1937, Oil on Canvas, 138” × 306” (Museo Reina Sofia, Madrid)

In science lie deep roots of intuition; scientists decide what to test and study based on hypotheses that they have about the world, which often develop in spontaneous ways. For example, German-American physicist Albert Einstein’s discovery of the Theory of Relativity was based on a response to aesthetic discontents with what he found in physics.
This intuitive notion that there was something not right about the field due to his perception of aesthetics and symmetry led to his remarkable scientific discoveries (Miller, 30, pg. 9). While intuition is a big part of scientific process, the end result includes the testing of empirical data and fact. In the end, the final product flips and presents an absence of intuition to present conclusive results. Many artists also heavily rely on intuition in their processes of discovery. Artists such as sculptor John Chamberlain, abstract painter Larry Poons and conceptualist Sol Lewitt use their intuition to arrive at their specific subject matter as well as to guide the process of creating and translating ideas into visual marks/parts. Sol Lewitt speaks of his work as conceptual art, where the idea is the most important part of the piece. Lewitt says his work is “intuitive, as it is involved with all types of mental processes” and that if he worked with a preconceived plan, “the plan would design the work” (26). Lewitt’s construction of many cube-grid structures was fueled by both mathematics and intuition. Lewitt spoke about the quasiscientific systems shaping his cage-like structures saying, “With such systems, you could create forms that you wouldn’t normally imagine”, demonstrating that his logical systems were arrived at arbitrarily (Garrels, 14). Sol Lewitt is just one example of an artist relying on their intuition to shape their work and take part in their means of discovery, as he allowed his intuitively derived systems to dictate the forms of his objects.

Both the practice of art making and the study of science involve the conception and construction of creative products that are often unique solutions to problems. Artists and scientists make, invent and discover as part of this process of solving problems. Aesthetic and conceptual problems are often solved through the investigation of media in art, just as natural phenomena are explored through experimentation in science. Established laws and
Theories in science are just as much “the scientist's own” as a work of art is “the artist's own” (Tang, Leonard, 47). The original innovator of a potent aesthetic solution or a scientific theory used his or her creative skills to reveal an aspect of reality.

A large number of artists employ their own intuition when creating work, a practice that definitely occurs in my studio, but artists also devise technical experiments to execute their work and ensure the performance of their media. For example, artists carry out experiments to decide on the most fitting materials, type of mark making, composition, etc. to use alongside their skills and conceptual interests. Observation of the world becomes influential within the experimental phase of both scientific discovery and artistic practice.

Many artists and scientists value the observation of environments in order to gain information through the senses. Process for both groups involves organizing large amounts of data and finding unusual relationships between events/images/phenomena (Wilson, 48, pg. 19). The scientific method summarizes the processes both scientists and artists use. The scientific method involves a process of experimentation used to explore observations and answer questions, all things that scientists and artists do, even though they may ask questions, research, hypothesize, analyze and communicate results in different ways.

Renowned artist Paul Cezanne once said, “all things, particularly in art, are theory developed and applied in contact with nature” (Mitchell, 31). This statement absolutely includes science as well, as hypotheses are formulated and tested using the laws and materials of nature.

Hypotheses, as I mentioned above, are intuitive and creative acts of discovery. The development of a scientific hypothesis involves many things that conceptual and visual planning does for artists, including practices such as observation, imagination and guessing.
(Tang, Leonard, 47). In the next phase of scientific discovery, ideas are tested and reorganized, a process seen in both scientific experimentation and the making of a work of art. The amount of intellectual freedom and imagination required to develop theories and inventions is on the same high level for both artists and scientists, even if their theories and inventions differ in subject matter and material. Paul Tang and Arne Leonard write in their essay ‘Creativity in Art and Science’ that, “Students of science should be made aware that there is, intrinsic to science, a legitimate, indeed vital role played by "daydreaming." Letting one’s mind wander 'beyond the realm of the possible’ is something to be encouraged in science and is not the sole province of the artist” (47). Overall, science and art are both expressions of human creativity, intuition, and interaction with the material world (Tang, Leonard, 47).

**The Study of Visual Art as Shown to Improve Scientific Knowledge and Skill**

**The Use of Visuals as Evidence in Science**

Renowned artist and scientist Leonardo Da Vinci is credited with the invention of multiple key techniques in scientific illustration, including the exploded view and solid section for the disclosing of natural structures (Kemp, 21, pg. 20). Often, using forms of visual representation to portray a subject convinces the viewer of the physical truth in observations. Visuals become a sort of evidence for scientific theories and information that might become daunting and confusing when expressed solely through language. Once the
spatial terms of an observable object or process are figured out, humans view scientific evidence as more concrete (Kemp, 21, pg. 66).

Many scientists seek to explore and explain natural phenomena, which create patterns that can be better analyzed visually. Paleolithic cave paintings are simultaneously evidence of the first significant act of painting as well as one of the first illustrations of scientific observation (Wilson, 48, pg. 40). From the Paleolithic period onward, there have been demonstrations of art making that solidify and demonstrate human knowledge of natural phenomena, which scientists study. The concrete nature of visual representations allows us to record information in a way that communicates faster and more successfully across language barriers (or before language as we know it). An example of a more contemporary use of visuals to back scientific information is the experimentation done by psychologists David McCabe and Alan Castel, demonstrating that images of the brain have a persuasive influence on the public perception of research on cognition (28). Experiments conducted in this project concluded that displaying brain images with articles on cognitive neuroscience research resulted in higher ratings of scientific reasoning than articles without images. Furthermore, the authors of this study speculated that the images of the brain were especially influential because they are physical representations of abstract cognitive processes (McCabe, Castel, 28). This increase in the believability of science due to visuals becomes important in the way scientific discovery is presented to the public, a topic that can be explored further.

The Study of Visual Art to Improve Observational Skills
Healthcare professionals who remain open and observe honestly have a better chance of understanding a patient’s needs and reaching an accurate diagnosis. It is common for humans to fall into the trap of making assumptions about what they are seeing based on what they think they should be seeing, instead of meaningfully discerning what is in front of them. Human perception of the world is selective, biased, and malleable. This being said, those in the medical field especially need to practice the careful act of observation, with the removal of selection, bias and change, as the future health of individuals is placed in their hands.

A good historical example to illustrate the benefits of careful observation and the elimination of assumptions is the work of Galileo. Galileo is also an example of a person who was a leader in the scientific revolution, an astronomer, a physicist, an engineer, a philosopher, a mathematician and, at the same time, remained someone who was active in the arts and the study of optics (Gopnik, 16). When Galileo began to describe the moon, many philosopher-theologians dismissed his statement that the moon was full of prominences and cavities much like the mountains and valleys on the earth (Kemp, 21, pg. 40). A large number of people, including scientists, philosophers and the general public alike, continued to maintain their perceptions of the heavens as immaculate and refused to really look at what Galileo was describing. While Galileo did have a slightly more high-powered telescope than others of his time, he also possessed the freedom from adhering to the prevailing dogmatic theories of the time, as well as observational strength due to his study of art. Galileo was a member of the artist’s Academia del Disegno in Florence and a friend of the leading artist, Ludovico Cigoli, so he was well aware and practiced in depicting light and shadow in landscape according to the angles and direction of the sun relative to
the observer in many landscape works (Kemp, 21, pg.40). Eliminating preconceived notions from the act of forming observations has the ability to improve the accuracy of those interpretations of the world.

Increasingly today, more and more medical schools and institutions are integrating the study of visual art into their curricula. While this practice may seem unusual at first, there are many skills that the study of visual art can teach developing healthcare professionals. The implementation of the study of visual art into medical students’ curricula allows for students to improve their critical observational skills (Windsor, 49). While students are taught the ins and outs of clinical diagnosis in medical school, the actual focus on observing honestly is left behind. This kind of looking is often assumed. An observation-based program has been shown to strengthen students’ visual-spatial skills, including the ability to understand, reason and remember the relationship amongst parts (Shapiro, 42). In order for doctors and others working in healthcare to provide the most accurate physical diagnosis possible, one’s observational skills must be strong and discerning enough to notice key criteria. Acute observational skills are often acquired after a few years of experience in the field (Dolev, 9), but the possibility of gaining them before the completion of schooling would be very beneficial to beginning physicians.

Craig Klugman and Dianna Beckmann-Mendez experienced students initially making assumptions about what they were seeing when teaching and evaluating a course called “Art Rounds”--a course that involved both nursing and medical students from the University of Texas Health Science Center in 2014 (7). Students gathered in the McNay Art Museum and were assigned “art patients”, or paintings, which they evaluated, researched and collaboratively discussed. After pre-tests and post-tests, the directors found that the
students discussed less emotion and used more medical terminology in their diagnoses after their interaction with art, even though no new terminology was introduced or encouraged. Students told fewer narratives about the patients that they were seeing and only used the evidence presented in front of them visually, which suggested an elimination of bias during diagnosis. This is an important discovery as it runs contrary to the dominant narrative that art is solely associated with emotion. Furthermore, the total number of observations each student made increased after working with the artwork in the McNay Museum (7).

In addition to aiding students’ visual-spatial skills, medical professionals’ visual literacy must be strong in order to discern the specific details on which accurate diagnostics rely. The teaching of visual literacy enhances clinical inspection skills by strengthening students’ ability to find meaning in imagery; for someone entering the medical field, visual literacy can more explicitly mean the capacity to reason physiology and pathophysiology from careful and unbiased observation (Naghshineh, 35). At Harvard University, professors implemented a program named ‘Training the Eye: Improving the Art of Physical Diagnosis’ to demonstrate how the study of visual art can improve one’s visual literacy skills in a nine week program encompassing medical and dental students (Naghshineh, 35). The goal of this program was to increase the students’ observational skills, while also strengthening their knowledge of fine art concepts. The intended outcome was to give them the tools to implement specific language into their descriptions and patient care routines. Medical and dental students who participated in this program were evaluated for overall improvement, compared to a control group of students who were not in the program. They were measured for frequency of accurate observation and thematic
content within descriptions. After studying in the Boston Museum of Fine Arts with art educators trained in teaching visual thinking strategies, the results of the program and study indicated that students increased their number of observations, increased the sophistication of their descriptions, and increased the inclusion of fine arts concepts such as color/light/shadow/symmetry etc. to provide more thorough and detailed diagnoses (Naghshineh, 35).

The visual literacy strategies taught in the program included approaches used to find meaning in a work of art: the implementation of these can help medical students put their thoughts and observations into words and help stimulate cognitive thinking, teamwork and critical reasoning. The teaching of visual literacy strategies has the ability to help groups of healthcare professionals form cohesive ideas about diagnoses and treatment, as well as to serve as a creative way to link feelings with reasoned observations (Reilly, 40). Additionally, having the ability to describe physical observations using fine art concepts can help medical professionals to denote the nature of those observations in a clearer and more well rounded manner.

Another study, designated as the ‘Yale Center for British Art Project’, had first year medical students study and describe representational paintings based solely on visual evidence in order to improve their observational skills (Dolev, 9). When compared to groups of students that only attended lectures with radiographic images etc., the students who studied the paintings in person, at the museum, received the higher scores, as well as higher amounts of improvement in pre- and post-observational tests. As this study shows, using representational paintings allowed instructors to capitalize on the students’ lack of familiarity with the artworks, removing all bias as to which visual attributes were more
important than others (Dolev, 9). This means that because the students did not know much about the subject matter in the paintings they were looking at, their observations had the potential to be more honest and sensitive, as predetermined ideas were removed from the situation. In order to work towards understanding a work of art in terms of what it is trying to describe, it is necessary to look for visual clues and subtle details that could point the viewer towards concepts with which they may not be extremely familiar. Teaching students to observe their patients the way they would a work of art teaches the importance of really looking before having any other response, actively problem solving to draw meaning from things such as skin coloration, dermatological lesions, changes in breathing, etc. (Christenson, 5). Often medical students are asked to describe something without interpreting it, while working with visual art gives them the ability to implement the practice of both (Elder, 10).

*The Study of Visual Art to Improve Empathy*

Another pertinent benefit of studying visual art before entering the healthcare field is its ability to teach empathy. Learning about how individuals experience and extract meaning from their illnesses, especially when they involve suffering, is very different from the way organ systems and diseases are taught in a medical school’s classroom (McLean, 30, pg. 2). Art is a way to bridge that gap in this kind of understanding.

It is common to feel empathetic towards a figure, event or object when looking at a piece of art. Recent research describes that this empathetic engagement with art is due to mirror neurons located in the ventral premotor cortex and posterior parietal cortex of the
brain (Freedberg, Gallese, 13). Simply put, the same neurons discharge when an action is observed as do when the same action is executed. Mirror neurons even respond to the suggestion of an action that is not completed. These neurons allow us to experience physical empathy concerning parts of the body that are engaged or suggested in the work of art. This feeling of physical empathy quickly translates to emotional empathy for the object or person depicted. As art historian David Freedberg and neurophysiologist Vittorio Gallese have shown, even if there is not a figure depicted in the artwork--for example in Italian artist, Lucio Fontana’s ‘Cut Canvases’ [Figure 2]--imagining the emotional force involved in slashing the canvas summons a sense of the empathetic movement that coincides with the gesture that produced the tear (13). If looking at art creates consistent empathetic responses both physically and emotionally, the practice of looking at art can strengthen health professionals’ overall sense of empathy. Students’ study of visual art intensifies their observational skills. In that way, students can better understand patients’ needs in a clinical sense. At the same time, empathetic practice helps doctors understand patients’ needs in an emotional sense.
Furthermore, implementing the study of visual arts into the trained development of health professionals can help them better communicate with patients from all social and ethnic groups. Art illustrates social issues, humanitarian struggles and cultural practices. The development of a relationship between the health sciences and art can push students to learn special human caring skills. Factors such as concern, empathy, compassion, assurance and other humane qualities of the doctor, which may be termed the art of medicine, are human caring skills that studying art can foster (Panda, 38). Healthcare professionals also come into contact with a wide variety of people on a day-to-day basis. The study of artwork that speaks about a variety of humanitarian struggles can help the developing healthcare professional relate to a wide variety of patients. The Society for the Arts in Healthcare in Washington D.C. stated in their 2009 field report that, “Works of art,
both classical and contemporary, can be used to increase understanding of the complex nature of human beings and their conditions” (45). Studying visual art has the ability to improve observation skills, while simultaneously exposing viewers to a variety of situations and environments with which they may not be personally familiar.

Reflecting on paintings that illustrate illness can even further strengthen the understanding of a doctor-patient relationship and the ability of doctors to express themselves to their patients in non-technical terms. In a study done at Weill Cornell Medical College, medical students began by examining painted portraits, then applied the same observational surveying to analyze photographs of faces (Bardes, Herman, 2). Evaluations displayed that not only had their observational skills increased from the pre-to the post-test, but also that students exemplified an increased awareness of emotional character and expression in the human face (Bardes, Herman, 2). Students were encouraged to discuss the emotion that they read from the portrait paintings, along with why the included figure could have been feeling that emotion. Additionally, emphasis was placed on interpreting the characters’ emotional and mental state instead of possible medical diagnoses (Bardes, Herman, 2). The focus on portraiture and reading facial expression in paintings allowed participants to connect with actual patients more wholly and with more empathy than before the program. Furthermore, in this study, students were prompted to discuss the emotional state of figures in the artwork. This encouragement along with the fact that the program was focused around portraiture could be why more emotion was taken into consideration, while students involved in the observational programs mentioned earlier in this paper discussed less emotion. As these studies have shown, visual art has the ability to
teach empathy as well as unbiased observational skills at the same time, allowing an opportunity for distinct differentiation between the two during instruction.

Being able to identify as well as respond to a patient’s problems involves considering variables such as the patient’s beliefs, concerns, expectations and social/environmental circumstances (Lazarus, Rosslyn, 23). Many of the visual art programs integrated into healthcare curricula include discussion-based sessions that center around discovering indications of emotion from figures in the art work and putting together ideas of possible medical histories, everyday experiential conditions and personal backgrounds. In the ‘Art Rounds’ program at University of Texas Health Science Center described above, students researched the artwork and artists in which they were studying and described many observed details to each other to practice their listening skills (7).

Having strong listening skills can help doctors more fully understand and see their patient as a whole person (Oxford Dictionaries, 37). Empathetic physicians respond better to patients emotional needs, provide more quality end-of-life care, are more successful at making patients adhere to treatment regiments and elicit more complete medical histories that improve the accuracy of diagnosis (McLean, 30, pg. 2). When doctors are more involved with their patients’ narratives, they absorb more vital information necessary for clinical assessments. Empathy can be practiced verbally and non-verbally. For example, “a doctors caring touch as opposed to a diagnostic touch is perceived as conveying clinical empathy and promotes healing” (Montague, 33). Moving away from specifically patient care and more towards the larger network of healthcare professionals allows a correlation to be drawn between art and the medical community. Arts and cultural activities have the ability to help build team cohesion, expand tolerance for dealing with unexpected
situations, and increase empathy. Art draws connections amongst communities and remains powerful enough to rally individuals in support of common causes to improve community health overall (Cleveland Clinic, 6).

The Study of Visual Art to the Improve Interpretation of Medical Testing

As current research has shown, studying visual art as a developing healthcare professional is important in this day and age where the interpretation of medical imaging devices and tests is common and essential. Visual literacy enhances and improves a medical professional’s ability to interpret imagery. These skills are more sought after in today’s digital, image-based realm of medicine (Glatter, 15). With the improvement of observational skills from the study of visual art comes the ability to more accurately interpret the high tech images and tests needed to make a correct diagnosis (Jones, Peart, 20). Much of contemporary diagnostic medicine is reliant on images formed without the normal act of seeing. Often, life or death decisions are made from observing and interpreting these images.

Visuals created to represent non-visible emissions, artificial perceptual systems, and computerized cognition are very common and facilitate our own struggles to see and know (Kemp, 21, pg. 128) Many times these visuals are produced through technological assistance. An example of using technology-generated images to understand physical phenomena is the scanning of breasts for tumors. X-ray Mammography produces difficult imagery to analyze, as “the image can be sharpened in such a way that the fuzzy edges of a malignant growth acquire the defined boundary of a benign tumor” (Kemp, 21, pg. 128).
The complexity of breast tissue ends up producing a poor “signal to noise ratio” (Kemp, 21, pg. 128). Commonly, the x-ray photons blur definition, different depths of the tissue are superimposed and the compression of the breast during testing results in the relocation of features. All of these factors contribute to the difficulty of reading mammogram results and the importance of careful analysis. The improvement of testing and imagery produced through testing, along with the careful scrutiny of these images is essential in continuing to accurately diagnose women with breast cancer at vital stages. This is just one example of why healthcare professionals could benefit from studying visual art, both to improve observation and to understand abstractions produced in digital image testing.

**Medical Illustration and its Connection to My Studio Work**

The medical field is saturated with technical scientific information and language, so patients often need a sort of ‘translator’. Medical Illustrators are “artist scientists” that communicate complex scientific information through the use of visuals (Association of Medical Illustrators, 29). Illustrations have the ability to simplify medical text for healthcare students but also have the ability to break down the complexity of medical information within other contexts such as law, advertising, and patient care. Medical Illustrators provide specific visuals for the specific needs of a company, doctor, medical institution, etc. While photography might seem to be an alternative to illustration, a drawing’s ability to break down parts of the body into clear sections and in a communicative manner sets it apart. Anatomical details can often get lost in photographs or language, but illustration allows these to be included and even highlighted. Medical
illustrators use story telling arrangements, the depiction of microscopic events and graphic dissection to solve communication dilemmas (Association of Medical Illustrators, 29).

My interest in medical illustration as a career, along with my fascination with the body, inspired the collection of work found in my senior art exhibition ‘Beloved Microcosm’. I intend to explore processes of the body through illustration in the future, but I am currently interested in learning about the millions of events going on inside of us in an abstract way. Abstractly exploring microscopic bodily processes seems only natural to me, as I am interested in abstractions in science, especially involving imagery that cannot be seen with the naked eye. This separation intrigues me, and I take advantage of the fact that no one has ever witnessed these cellular bodily processes with their own eyes, allowing me the liberty to invent coloration and specific spaces. I make oil paintings that speak about microscopic processes visualized through advancing scientific technologies so as to juxtapose the contemporary use of visual technology with a very traditional way of creating. Additionally, I am infatuated with the elements that our bodies are made up of, and employing the gesture of painting, using my physicality to create the image is exciting for me. I strive for my audience to see their own body as something remarkable, in its intricacy and flawless execution of thousands of processes.

Studying both science and art in undergraduate school has allowed my studio art classes and science labs to overlap and feed off of each other. Moving from analyzing cells under a microscope to working in my painting studio in the same day allows my creative practice to be fueled by my scientific studies. Being successful in my science labs as well as painting classes has involved the same attention to detail, experimentation with materials, and analysis of abstract communication. Dissecting a specimen relies on careful
observation, as does noticing successful composition and color blending. Experimenting with different genetic pairings while breeding fruit flies involves an analysis of cause and effect. Testing the size and weight of brushstrokes used to communicate a certain layering of space in a painting involves the same cause and effect analysis. Understanding that the complex patterns seen through the microscope are skin cells that cover our body requires a similar level of abstract thinking that inventing and executing a dimensional space on a flat canvas entails.

To demonstrate the conversation between science and art within my work, I will explore a few specific paintings I have created, and describe the process of making them. I usually start with a general bodily process that interests me, and that I want to explore on an intellectual, abstract and visual level. For my painting, ‘Mortal Coalescence’ [Figure 3], I wanted to investigate the moment of fertilization of the egg by a sperm cell. Before I start the painting itself, I do additional research on the topic to gather information and specific aspects of the natural process that I could translate into visual form. The melding of the two nuclei, the development of a new nuclear envelope, the creation of a barrier to other sperm by cortical granules and the protruding corona radiata were all events that I became interested in trying to depict in an abstract way. I knew that all of these moments had the potential to become visual in nature. I intuitively interpreted this physical process into visual form, with the researched scientific details serving as a foundation and place of reference. My color choices are based on levels of saturation needed to bring certain elements closer to the viewer in the space, as well as emotional and natural associations. My compositions, color and brushstrokes are developed from the intention to depict actions, often involving opposing spaces to create tension and to highlight differences
within the specific process. For example, in the painting discussed above, I chose complementary colors, thick brushstrokes and a central location to emphasize the action in the painting: the melding of the two nuclei in the newly fertilized egg. The rest of the painting serves as a space in which the action can exist, based on details in the actual microbiological space, as well as my own interpretation of microscopic images.

Figure 3 Logan Weihe, “Mortal Coalescence”, 2017, Oil on Canvas, 48” x 48”

Another of my paintings, ‘Inevitable Dispersion’ [Figure 4], is a loose interpretation of diffusion occurring inside the body. My method of honing in on one generalized bodily
process and doing research to extract imagery from scientific text and microscopic photographs remains the same in most of my paintings. In 'Inevitable Dispersion', I knew I wanted organic shapes to appear to be moving to and from a more concentrated area and a less concentrated area through a barrier. I created opposing spaces on the bottom and top of the canvas to emphasize the more fluid areas and the more condensed areas. My experimentation with the size and weight of my brushstrokes, along with the hue, allowed me to discover that darker hues and thicker paint caused areas to look more concentrated while thinner paint and lighter hues made certain spaces look less concentrated.

Figure 4 Logan Weihe, *Inevitable Dispersion*, 2016, Oil on Canvas, 60" x 36"
My studies in both biology and fine art (particularly in painting), have led me to create a body of work I dubbed ‘Beloved Microcosm’. A microcosm is a smaller world, and the human body is commonly thought of as a microcosm of the larger universe, with many parallels between form and function. This body of work I created speaks to the interesting intersection between art and science as well as to the human body as a machine that I can barely fathom, even with the abundance of biological and anatomical knowledge I have gained over the years. All in all, science and art are the driving forces behind my thirst for knowledge, and these fields have many interesting junctures for both artists and scientists to think about and possibly explore. I know that I will get to explore their crossroads as I continue into the field of medical illustration, serving as an example of a type of health professional who studies visual art to aid her further endeavors. Visual art’s power to improve observational skills, improve empathy and improve the interpretation of medical testing are all important outcomes of studying art before or while in medical school.

"Helping doctors learn how to look is something that is notoriously hard to teach in medical schools," said Alexa Miller, co-creator of Harvard Medical School’s Training the Eye Program "art is one place where these skills are easily developed” (Bunn, 4). Learning how to look is just one skill that art can teach scientists, but there many other ways artists and scientists can learn from each other’s similar use of abstract thinking, intuitive and experimental processes, creativity and yearning to bring something new into the world.

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