CHANGING IMAGE OF A SCIENTIST AND SCIENCE

by

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DEDICATION

To Jakub and Sara.

Thank you for being my ultimate teachers.

And thank you to all those who did not lose trust in me in the process.

TABLE OF CONTENTS

ABSTRACT

There is an emerging trend in films that represent the process of scientific inquiry through anchoring of the narrative around the scientist rather than delving deep into scientific detail. While film can help explain scientific results, it is even better suited to help us understand scientific inquiry and a way of thinking. I will present several films that exemplify this trend of adding personal stories to science films starting with *Science Is Fiction: 23 Films by Jean Painlevé,* through *Cosmos* and *Particle Fever*. We will even touch on fictional films like *The Theory of Everything.*

While we may distinguish between fiction and nonfiction in the area of science, some fiction films play a similar role in popularizing science to that originally reserved for non-fiction, especially when they present the lives and potential motivations of scientists. Presenting personal views of scientists may directly contrast with the guidelines established during the Enlightenment, which asserted that scientific discourse should be a-contextual, impersonal, factual and precise (Zerbe 33). In this study, I argue that, this new trend of presenting science as personal journey is more aligned with the postmodernist understanding of direct involvement of the author in the subject.

The advantage of presenting a scientist in a science film is twofold. Using personal stories can help us better understand scientific culture, and it can also provide audience with potential role models. As we will see from the film *My Way* these role models can inspire future scientists. This may be especially true for underrepresented population in science, whether the underrepresentation is due to their gender or their ethnic background.

SCIENCE IS FICTION?

One of the first "science" films that amazed crowds was *The Cheese Mites,* which appeared in 1904. It provided its audience with a new perspective of the world by arranging microscopic images of cheese mites in sequence to create film footage. In 1933 Jean Painlevé mesmerized audiences by showing them the lives of animals not readily available for observation with a naked eye. In his series *Science Is Fiction: 23 Films by Jean Painlevé,* we learn, among other things, about the life of an octopus and the details of its structure and habits; we are fascinated by a sea horse floating in the water; and we are invited to watch the *Experimental Treatment of a Hemorrhage in a Dog*. These observational films (Boon 12) mimic a classic scientific approach and describe a subject as a distanced, objective observer. But that is not all that Painlevé does. With captivating titles like *Sea Ballerinas* and *Fresh Water Assassins,* juxtaposing footage of fictional vampires with that of blood sucking bats, and using narration like “there is no officially sanctioned position” when discussing the sex life of the octopus, Painlevé creatively blends science with fiction.

Film as a medium has an amazing potential to record and repeatedly replay what is a unique occurrence. It can reach beyond our own capacity, to grasp what is otherwise invisible to the human eye (Silva). Early films created a new set of eyes and enabled the ability to capture information and record observations to which we would otherwise have no access. Only with the help of a camera can we see the actual movement of a hummingbird’s wings while it hovers, study a cat’s tongue as it licks water from a dish,

observe the growth of a plant or watch cells divide. We are curious, and filmmakers constantly experiment with techniques that provide us with a glimpse into nature that we do not know is there. The camera provides a new way of seeing in terms of perspective and revelation.

In a proposal on “The Popularization of Science,” written in 1949 for the United Nations Educational Scientific and Cultural Organization (UNESCO), Arthur Elton and Sinclair Road described the potential role of film in the popularization of science. They expressed concern about “the disquieting fact that [the present level of scientific understanding] is low” (Elton 1), and they worried about the erroneous ideas about science created by fiction films. However, when they talk about films used to popularize science, they mention only three subcategories: films that portray “the facts of science,” “the scientific method,” and “the application and effects of science” (Elton 8). They voice concern about the fact that most films cover mainly botany, biology and natural sciences while omitting other areas, especially technology, and deplore the lack of presentation of the scientific method. In their treatise, fiction is unsuitable for science popularization.

THAT'S FUNNY

Understanding science and the process of scientific inquiry is crucial in our modern life. Science journalist, lecturer, and editor in chief of *Scientific American*, Mariette DiChristina, in her 2014 article “Why Science is Important,” describes science as “a system for exploring, and for innovation,” and adds that “it can fuel our nation’s economic growth. It can form a path for our young people in a competitive global marketplace. And it can fire our imagination” (1).

Science is often misunderstood. In his book on postmodernism, Christopher Butler writes, “Most of us think of scientists as those who really know how things are” (49). Isaac Asimov, scientist and science fiction writer, presumably said: “What spurs new discoveries is not “Eureka!” but rather “That's funny…” (qtd. in Wainer). What drives science is the same thing that inspires us to explore: the incongruous facts of life. Science usually does not start with a final groundbreaking fact; rather it is a potentially long and tedious process, with more subtle beginnings. Scientific exploration often starts from noticing something which we do not understand, then proceeds to inquiry into those issues.

Before postmodernism, even scientists claimed that they “objectively and truthfully, and therefore with a universal application” describe “the physical reality which surrounds us” and that they were independent of any local cultural constraints or ideological motivations (Butler 49). Thomas Kuhn in his book *The Structure of Scientific Revolutions,* introduced the notion of 'normal science'. This term means “research firmly

based on one or more past scientific achievements, achievements that some particular community acknowledges for a time as supplying the foundation for further practice" (10). *Community* here refers to all the cultural and historical baggage that science carries at a particular time. Any groundbreaking or radical theory is likely to conflict with the current knowledge established by scientific exploration done so far. Kuhn further specified the parts of normal science that are sufficiently groundbreaking and open ended to attract strong scientific following as paradigms (10). As anomalies are uncovered during scientific research, which cannot be explained by current paradigm a new radical theory may arise. Once that theory attracts a strong following a new paradigm is born. (52) Thus Kuhn introduced theory of scientific revolutions and paradigm shifts (12). This explanation of scientific revolutions changed the notion of science as a linear, cumulative process.

Kuhn's theory clearly supports the postmodernist belief that a scientist cannot objectively describe and analyze the physical reality which surrounds us. (Butler 49). For postmodernists, scientific inquiry is no longer independent of cultural constraints; it cannot be assumed to be completely objective, and universally applicable; it is no longer "a disinterested pursuit of truths about reality." Suddenly, science seems to be dependent on "more or less hidden moral and ideological motivations" (Butler 48). Social values and expectations guide the choice of what is researched and what conclusions are drawn. With the rise of postmodernism, critics of science voiced worries that science was being used for political ends rather than for advancing humanity. Previous events such as the creation of atomic bomb added fuel to their attitudes, which Butler describes as

“border[ing] on paranoia” (3). They argued that science is a way to reinforce a dominant narrative, and that the financial valuation of scientific results further deepens this bias by dictating what research is actively pursued.

Another area of public distrust of science surrounds the ethics of scientific experiments. Scientists often blatantly violated moral values and were willing to do things for science which made others cringe, or took actions that were taboo or even criminal. A popular science writer, Mary Roach, in her book *Stiff, The Curious Life of Human Cadavers,* has a whole chapter dedicated to *Crimes of Anatomy*, which talks about “body snatching and other sordid tales from the dawn of human dissection” (37). Nowadays, we readily agree that dissection of cadavers was a crucial step for the advancement of modern medicine, but in England until the 16th century, such actions were considered a crime. It is beyond this paper to go into detail about what one should or should not do as a scientist. Experiments such as Stanley Milgram’s obedience experiments (Blas 958), measuring how often participants were willing to act against their own moral values because they were told to do so by an authority figure, show us that human ethical boundaries can easily shift.

The films portraying scientists can present a clearer story of what drives scientists, explain their background and allow audience an intimate view into the 'scientists kitchen'. This intimacy would be much harder to accomplish with films which only cover “the facts of science,” “the scientific method,” or “the application and effects of science.”

IMAGE OF SCIENCE

In their 1949 proposal for UNESCO, Elton and Road identify several problems with the portrayal of science. According to them, film's role in the popularization of science can be defeated if the science presented is too “remote and mysterious” and “difficult to grasp” (Elton 9). If the film is perceived as too complex the viewer can be turned off the subject

Contemporary science increasingly deals with abstract ideas and "borrows" abstract constructs from mathematics. Mathematics has clearly defined rules and methods for generating new "facts" and a clear definition of what is a hypothesis and what is a proof. Moreover, it is presumably void of any ideological and hidden moral motivations. The abstract nature of mathematics lets us accept the basic axioms and theories as mental constructs upon which we base the rest of the theory (“Axiom”). If we build one theory (T1) with a given set of axioms and then alter one or more of the starting axioms, even to state the opposite of what the original axiom claimed, we simply build another theory (T2) based on this new set of axioms. Modification of any of the axioms and the consequent change in the resulting theory does not violate our acceptance of either of the theories T1 or T2, since they are all pure abstractions.

Scientists use mathematical methods and abstractions to create new theories that appear to be independent of the observable world around us. For example, Einstein's theory of relativity, string theory and quantum theory blatantly defy the traditional notion that science is based on observable "facts." Some of the new “facts” can only be gleaned

via analysis and application of abstract methods, until we design a way to test them. This adds to the potential reluctance of public to trust scientific results, as well as making it ever harder to present science via film in a succinct and easily understandable form.
To deal with these problems, we see a shift from presenting science as a collection of data and information, to presenting it as an epistemological approach. This shift can be also seen in science films. More and more we see films that portray the scientific process along with, or in place of, presenting the final results of the research. As science becomes more abstract and thus even less understood by layman, film, even fiction, becomes an important tool to explain science.

Films like *The Experimenter*, which portray the process of research and limitations of the science as well as the human psychology of the experimenters, may help us understand both the science and scientists behind these experiments. *The Experimenter* is a bibliographical drama about social psychologist Stanley Milgram, who, in1961, conducted experiments on humans that tested their willingness to obey authority and carry out tasks contradicting their own moral values.

The Experimenter is a blend of fiction and nonfiction. To closely follow science, director Michael Almereyda directly quotes research journals and comments from the study. On the other hand, he purposefully breaks the fourth wall, ensuring that the audience is aware of the fact that the film is a human creation. He even goes as far as placing a live elephant in a hallway and using stylized photographic images for backdrops. While this potentially saves some production costs by simplifying the set design, it has another effect: the director helps us clearly separate facts from fiction. He

lets us question the personal story and details, the parts of the film which cannot be completely known as a facts, but which add entertainment value to an otherwise potentially boring reading of the research journals.

FICTION, SCIENCE, AND CREATION.

From the time when Elton and Road dismissed fiction as unsuitable for presenting science, fiction films proved to have an ever-increasing role in presenting and popularizing science. Fiction films are well suited to bridge the emotional gap between science and a layman.

In *Interstellar,* for example, we do not question an unrealistic time travel scenario or the portrayal of time space warp through arrays of bookshelves. These mental approximations can convey ideas which cannot be directly observed in real life, such as infinity or singularity. *Interstellar* is a fiction film about a scientists researching time travel and alternate universes to save humanity from inevitable destruction due to failing crops. To further their research, cosmonauts fly into the vicinity of a black hole. We watch them experience the relativity of time. During the design of the visuals for the black hole, Kip Thorne, professor of theoretical physics at Caltech, designed a simulation of a black hole which helped film audiences as well as scientists visualize black holes (Thorne 77). Thus *Interstellar* not only acts as a great teaching tool for learning about intergalactic distances and the relativity of time and space, but in its own way, it sponsored research into the nature of black holes.

Additionally, a film may spark new interest in research and attract underrepresented groups to science. Two popular TV series, *CSI Miami* and *Breaking Bad*, for instance, spurred interest in forensic science and chemistry, respectively, by taking a seemingly prosaic and slow process of analysis and data collection and

presenting it in an interesting way for the audience, thus making these fields of study more attractive (Ferris 141).

Fiction films can also attempt to bridge the gap between science world and issues of belief as in *I Origins,* a fictional story of a scientist researching the theory of evolution and the origin of the eye. Unfortunately, due to its plot, the portrayal of the scientific method in this film can get completely lost behind presentation of too many supernatural coincidences, which seem to aid the scientific process. Thus, *I Origin* hovers at the edge of mixing science and pseudoscience. However, by doing so it might help bridge the gap between the science world and those who dislike science in lieu of spirituality, by presenting these two domains as nonexclusive ("I Origins Interview").

The film starts like many other stories: boy meets girl. Ian Gray, a scientist who originally researches the evolution of the eye with a goal to discredit creationists, falls in love with Sofi. Sofi's mystic approach to life directly contradicts Ian's scientific beliefs. She has beautiful eyes and allows Ian to photograph them and add them to his collection. After Sofi's unfortunate death, Ian's beliefs start to shift. He continues his research with the help of his new wife and fellow researcher, trying to prove that the eye evolved through natural selection. Ian's newborn son Tobias is subjected to a newly developed test which checks eye patterns and looks for a potential matches in other people. It turns out that there is a person in the past whose iris pattern matches Tobias's. Moreover, Tobias reacts to the memories that belong to the person with matching irises. This gives Ian an idea to start searching for his dead girlfriend's new incarnation, based on the photograph of her eye. Eventually he finds a match. However, he is not persuaded that

this person is actually his deceased girlfriend’s reincarnation until the girl panics at the sight of an elevator. An elevator was the cause of Sofi's death, which leads Ian to conclude the historical connection between the two girls. This shows how a scientist, based on new evidence, modifies his original hypothesis, until it potentially even contradicts his original research goal of proving the evolution of an eye, and leads him to explore a new theory of persistence of memories linked to eye pattern. While the topic of research in this movie is completely fictional and the events fall more into the realm of science fiction or even the paranormal, the film presents us with strong science role models for both female and male scientists.

ROLE OF A CREATOR

The notion of trading filmic and entertainment qualities for faithfulness has haunted documentary films and film critics ever since the 1930s, when John Grierson attempted to define the documentary genre as a vehicle for presenting truth (Nichols 24). To this day, we see arguments about the trade-off between scientific precision and the impact a film can have on the audience. Creative nonfiction writer Lee Gutkind, in his anthology for writers *Keep it Real: Everything You Need to Know About Researching and Writing Creative Nonfiction* reiterates the general consensus about writing: "We are drawn to story, and the more emotional the tale, the deeper the salient information lodges in our memories. We learn from personal revelations, war stories, family legends, urban myths, campfire tales, true confessions, and gossip around the water cooler" (111). His statement is not limited to literary writing, we can easily apply it to film writing, and science writing as well. Emotions and stories can help us with future recall.

Filmmaker's attempt to mimic a classic scientific approach and describe a subject using observational documentary style may seem to warrant story's validity. “Writers employing this strategy attempt to become camera lenses, points of perception that give enough details to allow the reader to come to his or her own conclusions" (Gutkind 143). We can strive for it, but we have to be aware of the fact that behind every film or science presentation is a writer or group of writers, who despite their best intentions, inevitably insert biases into their work, even if unconsciously (Renov 49). Even films which seem to be impersonal and objective are subject to the author’s will or prejudices. The selection

of footage that will be presented, whether conscious or subconscious, the order of clip sequences, and the usage of particular cuts, inevitably influence the final outcome. Postmodernist theory further informs our understanding of direct involvement of the author in the subject. Contemporary writers "accepted as necessary the presence, personality, and perceptions of the author" (Gutkind 142) which, "far from distancing readers, can often add to a story's power to draw [audience] in" (144). Arranging stories for biggest impact is not necessarily bad. Well-crafted film can provide entertainment as well as education. In her article *5 Simple Tips on Better Science Communication*, Maddalena Bearzi, a writer, journalist, and marine biologist who founded the Los Angeles Dolphin Project, writes that science writers should learn from fiction writers, as “true stories can easily be written more like ‘fiction’ to gain some popular appeal” (4).

In her book *Dolphin Confidential: Confessions of a Field Biologist***,** Bearzi presents an example of how we can add narrative to a dolphin story. Rather than anthropomorphizing an animal, she inserts a human, herself, to tell the story from first person perspective:

> There is a bottlenose dolphin moving in my direction; it stops, inspects the bottom, and resurfaces with a large fish held firmly in his mouth. Its dorsal fin is deeply indented with a V-shaped notch. Right away I recognize Superhero, a dolphin I encountered here last year. (Bearzi 7)

While Bearzi names the dolphin, she manages to stay clear of giving him any human characteristics. Instead, she uses her own personal experiences to make the story engaging as she describes her own life with “dolphins and other creatures.” In her blog post for National Geographic she argues that “scientists shouldn’t be afraid to talk about

things personally because personal stories are better for making a connection with the public" (Bearzi). As scientists embrace the fact that they themselves need to become science communicators, we will inevitably see a rise in the genre of science films where main subject is the scientist herself.

THE THEORY OF EVERYTHING

A big weakness of conventional fiction films portraying science is the separation between the scientist and the average person. Scientists were often portrayed as old men sporting white coats and spectacles. Luckily, this Frankenstein version of a scientist became a cliché. However, we still lack good science role models in film. The *Theory of Everything* by James Marsh, illustrates a new tendency in current cinema: the humanization of the scientist. Seeing the human portrayal of one scientist moves him from the realm of crazy antisocial to a person we can relate to, thus changing our perception of scientists in general.

The Theory of Everything is a film about Stephen Hawking, a well-known scientist thanks in part to his groundbreaking theories about the universe, and in part to the fact that he has managed to publish despite suffering from amyotrophic lateral sclerosis (ALS). Also known as Lou Gehrig's disease, this progressive neurodegenerative disorder ties Hawking to a wheelchair. The grin on his face which is perpetually tilted due to the muscular weakness, and the electronic voice, coming out of his speech synthesizer which acts as his only means of speaking about the universe, seem to add to his popularity, accentuating his groundbreaking ideas.

To establish Hawking as someone we can relate to, the film opens with the portrayal of a vivacious boy racing his bicycle, growing up like any other child. We follow him through college, where he meets his wife and experiences the first effects of his disease. Rather than going into details about the science, we get to understand the

movie presents the development of Hawking's scientific theories, and see how he readily contradicts his own theories. A big part of the film is dedicated to his personal relationships and daily struggles. The director takes his time to let us feel each regression in Steven Hawking's life as his disease progresses. Marsh lets the gravity of the situation sink in as we watch each regressive step, from Hawking's initial rejection of a wheelchair, claiming that the need for the chair "is only temporary," to the devastating news as the doctors decide to perform a tracheotomy which will take away his voice. However, these scenes are balanced with happy events. Even in a wheelchair, Hawking finds a way to have fun with his kids, and never lets the disease define who he is. He even answers a question which able-bodied people often hesitate to ask: How is it possible he has kids?

After watching the film, we may not walk out of the theater with a better understanding of the theory of black holes and multiverses, but we end up seeing Hawking as a human: a researcher as well as a loving husband, father and person who is struggling with ALS in his daily life. Steven Hawking was available to come to the set and comment on the film; even his comments are mainly about the portrayal of himself, rather than about the science portrayed in the film (Hammond). This may be due to the fact that it is harder to talk about science, but it could also be due simply to our human vanity.

COSMOS

“A watershed moment for science-themed television programming" (Itzkoff) happened in 1980 with *Cosmos: A Personal Voyage*. *Cosmos* is a TV series about science based on Carl Sagan's book with the same title and hosted by Sagan himself. His groundbreaking use of special effects and clearly personal style of presentation mark a new milestone for scientific documentaries. In his last interview with Charlie Rose, he summarized his view of what is important about science: “Science is more than a body of knowledge, it's a way of thinking; a way of skeptically interrogating the universe with a fine understanding of a human fallibility” (Sagan). Sagan understood the power of entertainment for promoting science and created a science show where he poetically invites the audience to come explore the world of facts “unfettered by ordinary limits on speed and size.” Nevertheless, he makes clear that in the series he “will be careful to distinguish speculation from fact.”

The 2014 remake of *Cosmos: A Spacetime Odyssey*, hosted by Neil DeGrasse Tyson, closely resembles the original series *Cosmos: A Personal Voyage*. Tyson modernized the series using CGI, as he attempts to pay homage to Sagan’s personal voyage by inviting the audience to explore along with him as he follows in Sagan’s footsteps. He reuses many of Sagan’s original ideas like the “ship of the imagination” and the “cosmic calendar.”

The fictional elements like the Spaceship of the Imagination, from which Neil DeGrasse Tyson ‘surveys’ the universe, are used to help viewers see and remember the

facts. No one questions the scientific value of the series, even as we watch the spaceships dip into the liquid surface of Titan, Saturn's largest moon. When we see a shadow resembling a fish swim through this liquid, narration ensures that we notice the speedy flash of movement and enforces our understanding by distinguishing fact from a wild hypothesis, "without ever cheapening the quality of the information presented" (Variety). From the historical segments about early researchers such as Giordano Bruno and Isaac Newton we learn not just about these scientists' lives, but also about the research process that led to those discoveries. The series not only shows us the facts, it also emphasizes how those facts were established. This structure helps viewers understand where the theories presented came from, the value they provide for our understanding of the world, and how scientists frequently discard theories, which lack supporting evidence.

PARTICLE FEVER

Many contemporary films about science, unless they are designed to simply present facts about some particular topic, ultimately focus on stories about people. The award-winning documentary film *Particle Fever* is a film about Higgs boson and physics, but instead of just presenting science it closely follows scientists involved in the research. To make the film captivating, filmmakers chose a hugely controversial part of science, turning on the Hadron Collider for the first time. Film opens up with a big hopeful claim by David Kaplan, a theoretical physicist: “After many many years of waiting and theorizing about how matter got created and about what the deep fundamental theory of nature is, all those theories are finally going to be tested and we are gonna know something.” Indeed, as the film opens, we follow him as he visits CERN, where the Hadron Collider, the biggest machine ever build by humans, is about to be turned on. But Kaplan foreshadows the outcome in his claim that “We are gonna know something and we don't know what it's gonna be now, but we will know, and it's gonna change everything.”

Protest groups fought against the experiment, afraid it would cause Armageddon. It could also show us the proof of the God Particle, the Higgs boson. This immediately builds a conflict into the story.

The filmmaker's selection of scientists presented in the film helps drive the story. By diligently following the scientists through their small victories and defeats, taking regular side trips to fill in the details of various theories and the research on which those

theories is based, we see them as human beings, going running, explaining science to their kids, even feeling left out at the most important moment of their lives. The tension is natural, the setbacks and triumphs are presented using creative editing and a great musical score. To keep the viewer engaged through what could be a tedious scientific discourse, we see scientists butting heads with each other, arguing for their own ideas and trying to disprove others' theories, most notable difference is between scientists who try to prove the theory of multiverse versus the supersymmetry theory. However, while they may have their own beliefs, we can see that they are ready to accept the opposing truth, if there is an experiment that proves them wrong.

The film is filled with gorgeous collages of visual and musical spectacle, as well as captivating personal stories. Luckily for filmmakers, science is never a straightforward process. As we follow the research and build up to the first experiment using the collider, which culminates years of work, we learn about the role of mathematics, the opposing theories of Supersymmetry and Multiverse, and how the Higgs boson particle relates these to each other.

The climax of the story and the final resolution is the anticipated result of the experiment. Everyone holds their breath as we wait for the final collision. The film successfully piques our interest. We wonder along with scientists about the future of their research, as they "stand at the fork in the road," with results that do not point in either direction. Savas Dimopoulos, a particle physicist from Stanford University, comments that the measured mass of the Higgs boson article is "puzzling enough that it hasn't excluded any of the theories I was involved with," while David Kaplan concludes that his

models in their current form are ruled out, but if modified, they could work.

While the film gives us a general idea of what Higgs boson is, explains a little bit of mathematics, and talks about various types of spaces, it actually only lightly touches the subject. There is simply not enough room in a short, one-to-two hour-long film, to completely present and explain all the scientific details of this research. However, there is definitely enough room to sketch portraits of scientists involved in the research. Instead of getting lost in techno babble, films like these film provides us with a glimpse of scientific theories along with the people behind those theories film such as these can spark the viewer's imagination, or provide her with role models and information about how those people made their own discoveries.

A HERO'S JOURNEY

There is one area where both fiction and nonfiction films are often weak, and where science films are often the biggest offenders. This is in the representation of female role models. Many fiction films still fail the infamous Bechdel test (Bechdel). This simple test asks if the film has at least two named women in it who talk to each other about something besides a man. All the fiction films mentioned in this paper pass the test, however the documentaries and science films with a male presenter, such as *Science is Fiction* and both incarnations of *Cosmos*, would not. This failure to represent female scientists may be caused in part by the fact that there are fewer female scientists to start with, but contemporary filmmakers do have a choice in whom they choose as their film's characters.

In my thesis film *My Way*, I chose to portray a female lead scientist. Frances Lefcort, currently chair of the Department of Cell Biology and Neuroscience at Montana State University, started as a graduate student at Berkeley, then did a postdoc at UCSF at what she calls "a pretty high powered lab." She was expected to "get a job at Stanford or Cal-tech or Harvard or Duke," but working in a lab like that could also mean having no life outside of a lab.

To engage the viewer, the story uses many patterns usually found in fictional storytelling. This film patterns itself after Joseph Campbell's classic "monomyth," also called "the hero's journey." It is a narrative structure used in many stories: "A hero ventures forth from the world of common day into a region of supernatural wonder;

fabulous forces are there encountered and a decisive victory is won; the hero comes back from this mysterious adventure with the power to bestow boons on his fellow man" (Campbell 23).

Our hero, Frances Lefcort, reaches a threshold where she needs to decide whether she should continue on her prescribed path or venture into Montana, "a region of supernatural wonder," or as she calls it, "the great unknown." We meet Frances walking her dogs in the morning as she contemplates her decision to step off the beaten path and enter the great unknown. We learn that she had a child as a postdoc and see a happy, albeit a bit tired, mother. Imagery form the science lab suggests that she remained within the world of science, but we are left to wonder what happened to Frances' career.

The villain is the old-style world of science: unfriendly to women who want to have a family and a happy life. Frances has to fight her own doubts and her adviser's disapproval as he urges her to remain in the old world, the world of science unfriendly to mothers. With her decision to move to Montana she fights the established scientific culture, as she faces cold, harsh winter and loneliness of separation from the main science community. Luckily for our hero, she encounters her "mentor," Rita Levi Montalchini, who helps her along the journey. The story of Rita Levi doing her research while in exile during the Holocaust is an inspiration for Frances to take that leap of faith and persevere with her own research. Ultimately she gains her NIH grant and a great boon in the form of her lab technician, who helps her take the final step over the threshold. Where she can finally embrace her "Goddess", her ultimate love, which for a woman and mother is naturally in form of her son and her family. The film closes showing us that Frances has

indeed succeeded. Not only is she a professor and Department Head running an NIH funded lab. Frances accomplished an ultimate communion with her “Goddess”: She created a lab without maternity angst. She transferred the old world and created an atmosphere in the lab that supports retention of female scientist.

Since *My Way* is a documentary film, it may lack some of the drama of narrative plot which we cannot manufacture as easily as we can in a fiction film. It would be nice to portray stronger conflict along the hero’s journey,

With the limitation of a small budget, as is often the case in self-funded thesis films, as is *My Way,* and short film length, it may not always be possible to play up conflicts or have the best supporting visuals for the narration. However, we can ensure that we support at least some important parts of narrative structure by choosing a scientist with an interesting life story and motivations, who is articulate and looks great on camera, and by selecting to present those moments which help add drama to the narrative. While most of *My Way* is filmed with observational style, it is obvious that some cuts had to be staged. For example, closing the car doors with the match cut would be hard to accomplish without some direction to the subject being filmed. Creative camera angles and use of POV inside the lab add visual interest and show us a world not often accessible even to scientists, while animations and additional performative scenes, such as the scene where Sarah, a grad student, lifts her head up from microscope and turns around to check the image on a computer screen display, help illustrate science and historical events. Sound design helps drive the narrative. For example, to let the viewer feel the chill of the Montana winter, we are left to listen to a cold wind and watch falling

snow. The sudden, unexpected screech of a bird sends a final chill down our spine. The film is designed to present us with a female role models for future scientists, and to show potential future investigators that it is indeed possible to do both: have a family *and* a successful career. The closing remarks drive the point home as Frances proclaims, “According to all my friends I am the poster child of the happy postdoc who made the transition to professor.” Family footage is selected and ordered to add to the story. After Frances’ comment about scientists not having life outside the lab, we see her son reach for the camera lens. His big baby eyes help us feel the pull a mother has to face every day as she walks out and leaves her baby behind. This juxtaposition of baby eyes and description of old world of science drives the point home more powerfully than plain commentary could.

My Way is a film designed to present the viewer with the problems women face in academia, and potentially in other areas as the current culture makes them choose between a career and family, as well as to show a role model from whom future scientist can drive their inspiration.

CONCLUSION

A science film can help us understand and function in the modern world. In her interview with Friona Gruber for *Cosmos* magazine, Sonia Pemberton, an award-winning science documentary director, stresses the importance of creating a truly engaging film. Similarly, writer and director Randy Olson stresses the need to make science entertaining. He comments that if we present dry facts and create a boring documentary, it will likely do a disservice to the subject being explored. Unfortunately, many science films fall short on the entertainment value index despite the fact that "even science, when done properly, is great entertainment" (Usborne).

Using film's visual and emotional language and classic storytelling techniques to teach science may directly contrast with the original assumptions about scientific discourse established during the Enlightenment. Yet, in contemporary scientific writing and film, violation of these assumptions might lead to greater impact and a more memorable learning experience. Film is a medium of narrative, and as Umanath, Butler, and Marsh point out "The memory of the film, which is rich in sensory information, is more highly accessible than the memory of the accurate content from the text" (557). We seem to better retain the information presented in an entertaining way.

In this paper I have attempted to show an emerging trend in science film and point out how even films embrace personalization of the scientific information by including even personal accounts of scientists themselves. They add an emotional content to films which was in past reserved for fiction films.

Not all science movie will necessarily include human element to drive the narrative. Many movies like *Battlefield Cell* actually steer in complete opposite direction and remove any human story from the final narrative. The development of 3D and animation techniques will lead to an increase in a completely different medium: we might soon see the rise of experiential films, where we can visit the inside of human cells or dive into the oceans, or recreate experiments using interactive tools. Those films will provide yet another form of learning through entertainment, however we will definitely see a rise of scientists themselves becoming characters in the movies.

Almereyda, Michael. *Experimenter*. Magnolia Pictures. 2015. Film.

"Axiom." *Wikipedia, the free encyclopedia*. 3 Dec. 2012. Web. 13 Dec. 2012.

Battlefield Cell. Writ. Rosenthal, Adam, and Makin. BBC/Discovery channel. 2012. Film.

Bearzi, Maddalena. *Dolphin Confidential: Confessions of a Field Biologist.* University Of Chicago Press. 2012. Print.

---. "5 Simple Tips for Communicating Science." *National Geographic* 11 Oct. 2013. Web. 24 Apr. 2015.

Bechdel, Allison. "Dykestowatchoutfor.com» Blog Archive» Testy." Web. 13 Apr. 2015.

Berkshire, Geoff. "TV Review: 'Cosmos.'" *Variety*. 7 March 2014. Web. 1 Apr. 2015.

Blas, Thomas. "The Milgram Paradigm After 35 Years: Some Things We Now Know About Obedience to Authority." *Journal of Applied Social Psychology.* 1999, 29, 5, pp. 955-978

Boon, Tim. "Films of Fact: a History of Science in Documentary Films and Television." *Wallflower Press*, 2008. Print.

Bush, Vannevar. "As We May Think." *The Atlantic Monthly.* Issue 176, No. 1. July 1945. Pages 101-108.

Butler, Christopher. *Postmodernism*. Sterling, 2010. Print.

Cosmos: A Personal Voyage. Sagan, Carl. PBS. 1980. Film.

Cosmos: A Spacetime Odyssey. Tyson, Neil DeGrasse. Fox. 2014. Film.

Campbell, Joseph. "The Hero with a Thousand Faces." *Princeton University Press.* 1949.

DiChristina, Mariette. "Why Science Is Important." *Scientific American.* July 22, 2014, Web. April 10, 2014

Elton, Arthur, and Road, Sinclair. "Popularization of Science through Film." *UNESCO.* 1949. Web. 1. April. 2014

Ferris, Amber L. “Examining the 'CSI Effect': The Impact of Crime Drama Viewership on Perceptions of Forensics and Science While the 'Technologies and processes detailed on these shows at times parallels science fiction more than actual science'” Ph.D. Thesis, Communication Studies, Kent State University. 2011. PDF file.

Glass, Jennifer L., Sassler, Sharon, Levitte, Yael, Michelmore, Katherine M. “What’s So Special about STEM? A Comparison of Women’s Retention in STEM and Professional Occupations." *Social Forces.* September 2013. Web 1 April 2015.

Gutkind, Lee, ed. “Keep It Real: Everything You Need to Know About Researching and Writing Creative Nonfiction.” *New York, N.Y.: W.W. Norton & Co.*, 2009. Print.

Hammond, Pete. “Hot Trailer: First Look At Oscar Contender 'The Theory Of Everything' — An Unexpected Love Story About Stephen Hawking.” *Deadline Presents AwardsLine.* 6 Aug. 2014. Web. 1 Mar. 2015.

I Origins. Cahill, Mike. Verisimilitude. 2014. Film.

“I Origins Interview: Director Mike Cahill Explains The Ending And More.” *Slashfilm.* 2 August 2014. Web. 13 Apr. 2015.

Itzkoff, Dave. “Fox Plans New ‘Cosmos,’ With Seth MacFarlane as a Producer.” *The New York Times* 5 Aug. 2011. Web. 1 Apr. 2015.

Kuhn, Thomas S. *The Structure of Scientific Revolutions.* 3rd ed. University of Chicago Press, 1996. Print.

Particle Fever. Dir. Levinson, Mark. Anthos Media. 2014. Film.

The Cheese Mites. Dir. Duncan, F. Martin. Charles Urban Trading Company. 1904. Film.

The Theory of Everything. Dir. Marsh, James. Working Title Films. 2014. Film.

Nichols, Bill. *Introduction to Documentary.* Bloomington: Indiana University Press, 2001. Print.

Interstellar. Nolan, Christopher. Warner Bros., Paramount Pictures, and Legendary Pictures. 2014. Film.

Science Is Fiction: 23 Films by Jean Painlevé. Painlevé, Jean. Criterion Collection, 2009. Film.

"Pemberton, Sonia. Interview by Friona Gruber." *Cosmos*. Society. 26 Aug. 2013. Web. 1 April 2015

Olson, Randy. "TRIBECA '06: Trying to Make Science Entertaining in 'The Flock of Dodos.'" *Indiewire*. 2 May 2006.Web. 24 Apr. 2015.

Renov, Michael, ed. *Theorizing Documentary*. New York: Routledge. 1993. Print.

Roach, Mary. *Stiff: The Curious Lives of Human Cadavers.* W. W. Norton & Company. 2004

Sagan, Carl. *Carl Sagan's Last Interview with Charlie Rose (Full Interview)*, 2012. Film.

Sharknado. Dir, Ferrante, Anthony C. Syfy Films. 2013. Film.

Silva, Jason. "Are We All Cyborgs? Talk With Futurist and Filmmaker Jason Silva About *RoboCop*." *The Huffington Post*. 3 Apr. 2014. Web. 11 Apr. 2015.

Thorne, Kip, and Nolan, Christopher. *The Science of Interstellar*. 1 edition. W. W. Norton & Company, 2014. Print.

Umanath, Sharda, Butler, Andrew C., and Marsh, Elizabeth J. "Positive and Negative Effects of Monitoring Popular Films for Historical Inaccuracies." *Applied Cognitive Psychology*. 26.4 (2012): 556–567. Web. 11 Dec. 2012.

Usborne, Tim. "Making TV science documentaries: 'It's all about storytelling'" *The Guardian.* 30 March 2012. Video.

Wainer, Howard, Lysen Shaun. "That's Funny." *American Scientist*. Issue July-August 2009, Volume 97, Number 4.

Wong, Connie C et al. "Non-Invasive Imaging of Human Embryos before Embryonic Genome Activation Predicts Development to the Blastocyst Stage." *Nat Biotech* 28.10 (2010): 1115–1121. Print.

Zerbe, Michael J. *Composition and the Rhetoric of Science: Engaging the Dominant Discourse.* Carbondale: Southern Illinois University Press, 2007. Print.