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To the Moon:
Using Creative Nonfiction Techniques to Explain Space Technology

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Abstract

In this project, I identified how creative nonfiction techniques are applied to science and technology writing. The reason that this project was important was because, while there is research about science creative nonfiction, there is a lack of information regarding technological creative nonfiction.

Science writing differs from technological writing not only in available writing, but also in the general understanding of concepts by the audience. Science is usually better understood by public audiences where less is known about technology. The challenge then became explaining technology in a way that the public would understand without losing the credibility by the science and technology communities.

I argue that writing technological creative nonfiction is feasible by translating science writing practices to technology and integrating this with creative writing methods. I used these approaches in order to then write an effective short article that explained to people the ways in which NASA has affected daily life. I analyzed scientists' views on communicating scientific/technological information to the public. I investigated effective methods to writing science and technology. These analyses were applied to technical information about the Saturn V rocket and Dr. Wernher von Braun. The result was an article I wrote emphasizing the benefits and importance of space programs to the public by explaining technology behind the Saturn V rocket.

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1 Introduction

Today technology is everywhere. People use it when driving, talking, going to school, and cooking. While people Worldwide use it on a daily basis it often is overlooked in the writing field.[1] Science and technology is also imperceptible in the US Government. The United States 2010 budget for Federal Outlay programs was $3.456 trillion with only .89% going to the General Science, Space, and Technology division. Specifically, the Space subsection received only .5% of the total budget. While in the next six years the entire Outlay programs budget will increase by estimated one billion dollars, the General Science, Space, and Technology division will only see an increase of roughly 2%. The Space subsection will actually decrease in funding over that period. In order for budget to increase for the science and technology fields there must be an increase in public interest. Comparatively, in 1969 at the height of space travel, the budget for Space flight, research and supporting activities was 2.22% of the entire Federal Outlay budget. Today, science and technology programs, especially space travel has been set on the back burner and fails to receive government funding and support.

The correlation between NASA's budget and public support is complex. The general opinion was that the budget increased as public support increased, explaining why the 60's was more monetarily prominent. However, it isn't that direct. In "Public Opinion Polls and Perceptions of US Human Spaceflight" Roger Launius examines several polls conducted rating the public's favorability towards NASA and their budget. Since 1965 public support for NASA has remained relatively unwavering at around 80% with the only noteworthy change occurring in

[1] Bookstats, an organization that tracks published book statistics, found that in 2011 fiction genre sales nearly doubled from $585 million in 2010 to $1.27 billion. Consumers were reading e-books but not reading about the technology itself. Both People and Cosmopolitan Magazines rank in the Top 20 magazines circulated in the United States while Popular Science doesn't even reach the Top 50.

the early 1970's (4). While the public supported NASA the majority did not approve of the amount of money they were costing the government. Launius mentions that throughout the 1960's between 45-60% of Americans felt the government was spending too much on space exploration (1). One reason the American public is so divided when it comes to supporting NASA but not its budget, Launius argues, is largely attributed to their being uninformed (12).

Steinberg, like Launius, reasons in "Space Policy Responsiveness: The Relationship Between Public Opinion and NASA Funding" that lack of understanding on the public could attribute to mixed policies and funding (5,6,7). Through a series of polls Steinberg examines the public's acceptance of NASA's budget and the government's reaction. One study indicated that from 1992-2000 the public's spending tolerance was either increasing or stable, however, NASA's budget actually decreased (3). Steinberg presents a method to help explain some of the discrepancies.

Since government budgets are submitted prior to the year of enactment, public opinion in that year cannot be reflected in the budget (3). A two year delay in response, notes Steinberg, shows a better correlation (4). So if, in a given year, the public is tolerant of the spending then this acceptance is enacted in following years budgets. However, even the lag delay is not a direct representation. In fact since most Americans only see the dollar value instead of the percentage of NASA's budget compared to the overall spending Congress is able to appease both sides of the public. Space policy has become both responsive and nonresponsive at the same time (5). When Americans are more accepting of space policy budget then the budget increases in terms of dollars but decreases in terms of overall budget percent (4). Yet most Americans don't even know how much of the federal budget is allotted for space policy. In 1997 a poll was conducted that asked Americans what percentage of the budget went to NASA. The average answer was

20% when in reality NASA has less than 1% of the federal budget (5). So Congress can appeal to the public who supports space policy spending by raising the dollar amount that NASA receives while also catering to those who oppose by decreasing NASA's percentage of the overall budget because most people are grossly uninformed (5,7). And while there might not be a direct correlation between spending and public opinion both Steinberg and Launius agree that an even more serious issue is the lack of education for the American public on space policy.

Since the American public vote not only on issues related to science and technology policies but also for the individuals who enact such policies it is important for them to understand at least a basic science behind their vote. People often disregard areas of technology due to its complexity, terminology, and intricacy. However, scientists are often hesitant to interact with the public. In a survey conducted by The Royal Society it found that 20% of scientists who completed science communication work were degraded by their peers (Mizumachi, Matsuda, Kano, Kawakami, & Kato, 2011). Another study conducted with scientists who participated in the Madrid Science Fair from 2001-2004 mentioned they are often perceived as "…having nothing better to do…" if they interact with the public (Martín-Sempere, Garzón-Garcia, & Rey-Rocha, 2008). Scientists in the same survey also responded that while they agreed the public should be more informed they didn't feel that as researchers they were the best qualified. Because science and technology carries its own specialized language used for communication within that field the problem then arises that not everyone possesses the level of education required to understand scientific documents. Writing in these fields is usually dense with factual and statistical information making it less interesting to the average voter. Whether done on purpose or accidentally it creates a gap between science and technology, the scientific

community, the general public, and voting bodies. People cannot make an informed decision on scientific policies if it is not fully explained at an adequate level of understanding.

In one year fiction genre e-books doubled. Scientific writers are now taking elements of writing that attracts readers to fiction and applying them to the non-fiction genres. The result is creative nonfiction. Creative nonfiction is a method of writing now being used to communicate in areas such as journals, newspapers, and academic books (Roundtable: What is creative nonfiction? two views.2000). It keeps the factual information while presenting a story and inserting a human interest piece. More and more areas of nonfiction writing are adopting this style as an effective way to communicate once uninteresting material. Several books have been recently written about science including New York Times Bestseller, *The Immortal Life of Henrietta Lacks* by Rebecca Skloot. It tells the personal story behind the HeLa cells commonly used in science. A common element to creative nonfiction is the use of personal narrative, how the story relates to the author. It also has the human interest aspect in order to relate to a wider audience. The Best American Science Writing 2011 features short pieces by various authors who tell stories and explain the relative science. One author explains the policy behind comprehensively informing patients and their guardians before performing surgeries such as inserting a pacemaker. It had directly affected her because her father had a pacemaker, a device her mother had allowed to be implanted because she was not fully made aware of the consequences. Another author describes how the BP oil spill in the Gulf of Mexico affected a large portion of the World and describes his journey of discovery. All of these stories include the personal narrative by the author, the human interest aspect, as well as the scientific information.

It has been especially difficult finding research pertaining to the creative nonfiction of the technological arena. General audiences typically do not get excited to learn the innovation

behind their iPhone 5, just as long as it functions. Similarly people do not find an interest in how their tax dollars are being spent by NASA and contracted companies to create telescopes that can view deep space. There is no longer a serious national focus on space travel and, therefore, pieces are not written directly relating the engineering innovation to how it affects the average American.

However, scientific writing is an area that is lacking in interest and understanding. The general public disregards areas of science due to its complexity, terminology, and level of intrigue. Effective communication through writing could help to alleviate some of the confusion regarding scientific principles, policies, and concepts. Creative nonfiction is being effectively applied to other areas of factual communication so why not introduce this method to the world of science (Roundtable: What is creative nonfiction? two views.2000; Rita Berman, 1997)? Living in a democratic society, the public elect officials who create policies and vote on laws. Some of these laws and policies are scientific in nature and have the ability to impact, not only the nation, but also the world. Without a decent level of interest or comprehension the voting public cannot make informed decisions about scientific regulations. Science is a field that affects every person in one facet or another and can both harm and improve the wellbeing of life. Unfortunately, in order to read general scientific writing one must understand multiple fundamentals and concepts in that particular area before being able to grasp the idea and message being conveyed. If creative nonfiction is effectively communicating in areas that once lacked in interest then science should also be employing these same strategies to reach more individuals and convey their message.

The purpose of this Major Project is to effectively communicate a scientific topic to members of the public and successfully engage the audience in order to stimulate interest,

awareness, and concern in the subject. To accomplish this task the method of creative nonfiction will be employed as the chosen dissemination of scientific material. The goal of this paper will be to inform a targeted audience of a specified scientific accomplishment or process while using personal narrative and creative language to maintain interest in the subject. The targeted audience is college educated individuals with a level of understanding only through undergraduate studies, who are active in community and civic duties. The goal is to be able to communicate the importance of science to an audience of individuals with the status, drive, and ability to influence, positively, the scientific community. A literary or scientific journal will be selected based on the target audience criteria and focus of the journal. The chosen journal should accept submissions in narrative nonfiction with, possibly, an emphasis on historical, political, or scientific focus. To begin this process a few questions will need to be researched and addressed in order to grasp a full understanding of the audience, subject matter, and writing style.

There are several key questions posed when addressing the challenge of how to convey scientific material through creative nonfiction to a general public audience. A particular hurdle is the degree of vocabulary used by scientists, mathematicians, technologists, and engineers. Using language only discernible to those with a significant background in the subject prohibits the interaction and discussion of those could have an interest but are unsure due to the absence of comprehension. This directly correlates to what is the level of understanding of the general voting public that influences the scientific community? Without distinguishing the knowledge of the specified audience then there is no possible way to write an article that can affectively target their understanding. Understanding and interest also go hand in hand. If an individual grasps a topic then they are more likely to become involved in the subject. Ascertaining the level of human interest in science will aid in making sure that the article is written concentrating on the

appropriate matter. Choosing which material to focus on and communicate is also a difficult decision relating to writing styles and methods. With science data and information there are often multiple principles and theories each piece of science is based on. Determining how to make the material interesting to people with little to no background in the subject will prove to be difficult. However, analyzing what makes creative nonfiction styles compelling will lay way to the appropriate method for my selected topic. A style that has appeared numerous times in both short and long pieces is the insertion of the personal narrative into nonfiction writing. An important question is how to integrate the author and human interest piece into scientific information while maintaining balance and factual integrity. This will have to address commonalities between both the author and selected writing subject, making sure to not let the personal narrative not take precedence over the point of science. Another point of discussion is the civil understanding of the scientific community. What is the view on involving and informing the public of scientific issues from the standpoint of scientific members? All of these questions will need to be answered in order to author a creative nonfiction piece regarding a scientific topic.

The structure of this major project focused on communicating, through creative nonfiction, scientific principles and history, will be as followed: an introduction stating the purpose of the project, research questions regarding the specifics of the paper, as well as the targeted audience; a literature review will follow that aims to answer all research questions and discover the appropriate method for which to write the paper; the next chapter will be on basic, factual scientific data for the topic that will be creatively explored. This section will state the facts behind the science in order to determine which scientific fundamentals and concepts need to be explained or elaborated upon. The following section will then be the paper itself, a nonfiction piece explaining a scientific idea using narration and creative styles. Finally, a conclusion will

analyze how the paper was written, reviewing successes and shortcomings of the project, and evaluating the attained objectives laid out by the research questions. These five sections will be the submitted Major Project to be considered for completion of a Bachelor's of Science degree in Professional Writing at Worcester Polytechnic Institute.

2 How Creative Nonfiction Successfully Engage Audiences

Creative nonfiction writing is a genre that has been increasing in popularity due to its versatility. The same techniques used to capture audiences in creative writing are now being applied to other genres. Nonfiction writers have adapted this style as a way to engage audiences and better communicate their message. Some of the methods employed by writers to adhere to creative nonfiction include adding personal narrative, describing settings, and moments, as well as integrating action and using dialogue. Use creative techniques such as appealing to the senses and intimately describing the atmosphere and characters to make raw data appear more interesting to readers. Employing specific creative practices to fact-based information will help engage audiences, stimulate readers, and inform people in an enjoyable way.

One shift in creative writing has been its application to areas of factual and data intensive arenas. In "Toward a Definition of Creative Nonfiction", Lott mentions that creative nonfiction is being applied to obituaries, journals, and letters (5). Berman, author of "Creative Nonfiction Writing", states that now creative writing is being extended to encompass political pieces, social challenges, and travel articles (3). Typically these articles are very straightforward, delivering specific information in a quick formal style. However, writing is changing from simply providing facts to telling a story (4). As Berman notes, this is when creative nonfiction is being applied (4).

Another area where creative nonfiction has begun to have a presence is within the science community. Lee Gutkind, editor of the journal Creative Nonfiction and author of several books and articles, including "Why I Chose the Creative Nonfiction Way of Life", suggests that people within the science realm are often the best at writing creative nonfiction due to the enthusiasm

for their subject (16). Since individuals outside of the traditional creative writing sect have chosen to use this method to enhance and broaden their writing the original techniques needed to be transferred from one genre to another.

A reoccurring trend that appears in creative nonfiction books, short stories, and articles is the presence of the author throughout the story. Despite that the premise of the piece is not about the author directly, they routinely will appear within the story making transitions, explaining processes, or demonstrating complex ideas. For Catherine Gourley, author of "Use the 5 R's: How to Write Creative Nonfiction", the use of the author is important because of their individual viewpoint (28). Ranly, similar to Gourley, argues in "Know the 8 C's of Effective Nonfiction: Follow These Tips to Entertain Your Readers with a Creative yet Credible Story", that to really connect the audience with the subject the author must "appeal to the senses" (35). The author must use descriptions of touch, sight, sound, etc. as a way to allow the reader to become a part of the story.

Rebecca Skloot, author of The Immortal Life of Henrietta Lacks, describes HeLa cells and the story behind the scientific discovery. While the story itself is based around the Lacks family, Skloot is continuously embedded in the plot describing the process she went through in learning the science behind the cells and meeting with family of the patient from which they were taken. During Skloot's research she talks about visiting the town where Henrietta lived, a now deserted area near Baltimore, Maryland. Instead of listing the location Skloot describes her own experience in Turner Station. "As I drove in circles looking for Speed's Grocery, children stopped playing in the streets to stare and wave," (69-70). She goes on to describe the house where Henrietta used to live as "…a brown brick building…" "…with a chain link fence, several feet of grass out front…" (70). Skloot immediately establishes her presence and then describes

what she sees and hears. By creating this connection with the audience it allows the reader to become a part of the setting, to see what the author is experiencing.

In *The Best American Science Writing 2011,* Katy Butler talks about the policies and ethics in the medical industry with a particular focus on the installation of pace makers. The story is about Butler's father who was surgically implanted with a pace maker and how her mother was forced to care for him. The emphasis is on the ethics of medical practices dealing with heart devices, however, Butler appears to shed light on how the system directly affects patients and their families (15).

The emphasis on integrating the author into the story is a very important aspect since it helps connect the audience to writer. Lott, Berman, and Gourley all agree that inserting the personal narrative into your story helps to enhance the connection with audience. Creative nonfiction encourages use of first person narrative because of its ability to pull in the reader and identify with specific experiences (2). Berman also points out that using "I" in nonfiction leads way to connections with your audience and, as a direct result, has allowed daily activities such as finance and medicine to become interesting (2).

In "The Estrogen Dilemma", a story from *The Best American Science Writing 2011,* author Cynthia Gorney explains the scientific battle with estrogen use through her own personal experiences. She describes how, upon hearing that medicinal doses of estrogen for menopausal women cause an increase in heart attacks, stroke, and cancers, became very aware of the estrogen patch sticking to her back. The issues that ensue explain the "…midlife hormonal upheaval…" that occurs to Gorney when she decides to rid herself of estrogen supplements (108). The intimate descriptions Gorney provides about her personal experience allow her not explain the

science behind estrogen supplements but also connect with a wide audience range. The issue resonates with women because they could find themselves in this situation one day if they have not already. The author also explains her family's reaction to her ordeal, allowing men to associate with the story. In science writing this becomes crucial because the writer uses personal experiences to relate very technical and data heavy information in an understandable manner to their readers. The connection lies in the human interest. Both Lott and Gourley stress that the individual viewpoint of the author is the thread that aids in binding together both nonfiction information and creativity.

A professor at Missouri School of Journalism Don Ranly suggests, there are very specific aspects to effective nonfiction writing:

- Credibility
- Conciseness
- Consistency
- Being clear
- Correct
- Coherent
- Complete
- Creativity
- Being concrete

In order to make your work credible you must be correct in your subject, grammar, research, and audience (1,2,3). Ranly also notes consistency as determining factor in maintaining audience attention. Not only does the consistency apply names and abbreviations but also

viewpoint (4,5,6). James Hansen applies this principle in *First Man: The Life of Neil A. Armstrong*. While explaining the aerospace engineering education Armstrong received at Purdue University Hansen also describes what is taking place in the field of aeronautics at the time. He explains that "…NACA activated the country's first hypersonic (capable of Mach 7) wind tunnel" and "…an army rocket team…launched a V-2 missile…to an altitude of seventy miles" (54). His descriptions are brief yet informative and paint a picture of the historical accomplishments that were relevant to what the main character, Armstrong, was interested in pursuing. Oppositely, in *Fundamentals of Aerodynamics* by John Anderson, Jr. the author gives an example of a Mach number for a Northrop T-38 jet trainer by explaining "…drag coefficient for this airplane is given…as a function of the Mach number ranging from low subsonic to supersonic" and "…the value of C_D is relatively constant from M=.1…" (83). Unless you have background with the aerospace field the latter information will not make sense while the information presented by Hansen is much easier to understand.

As seen above an issue that arises in science/technology writing is the use of technical language. This creates a barrier between the author and audiences who are unable to understand scientific/technical jargon. Remaining clear in language, structure, and material allows for the message to be communicated without deterring the reader from the subject. Ranly indicates one method to clarity is being, not necessarily short, but concise (12). To retain readers interest in typically data heavy subjects keeping nonfiction writing coherent and complete requires that the author anticipate readers' questions ahead of time and immediately address issues (16,17). This also requires smooth transitions from topic to topic in a logical and well thought out fashion (13). Hansen could have taken pages to explain the intricacies of launching a V-2 missile or how a

supersonic wind tunnel operates but the reader would have become confused and disinterested. Instead he uses Armstrong's education to briefly explain current technology of the era.

Keeping the reader informed is effectively done through use of clarity and consistency but if the reader is not engaged then the interest in the topic is lost. Interest is instigated through the use of creativity (18). According to Ranly "…the challenge of the nonfiction writer— [is] to stretch the limits of creativity within the boundaries of credibility" (19). When applying creativity to nonfiction writing, it is also important to keep details, settings, characters, and actions concrete. Ranly references fellow author Rudolph Flesch in saying that the steps to maintaining specifics in writing are that "you find a problem, you find a person who is dealing with that problem, and you tell us how he is doing" (22). When explaining a person or problem it is also helpful to use the senses. Use common items that people understand and make intimate connections between what is known and what is not (31). Gorney creates this scientific connection in "The Estrogen Dilemma". In the study of how estrogen effects women's brains rat's brains are used for scientific study. While talking with a scientist who is looking at rat brain mitochondria Gorney describes their interaction in the petri dish as "…like shooting stars…winking and zooming [around]" (105-106). This relation to the audience is what Ranly describes as "effective nonfiction" (35).

Similar to Ranly, Gourley, also has a systematic approach to tackling creative nonfiction writing. She explores five aspects that need to be adhered to when composing nonfiction. Gourley credits Gutkind with creating the 5 R's to writing and explores how they are effectively used in nonfiction applications. One of the first steps is to identify specifics such as clarifying a person or problem that you wish to discover in greater depths (9). Since personal narrative is a common thread in creative nonfiction, it is critical that the author explores what the subject

means to them directly (11). Ascertaining and reflecting upon real life events allows the author to consider initial reactions and emotions inflicted by the story. Once you have a story selected, then you can begin setting the scene, describing characters, and discovering the challenge presented in narration. Just as Ranly emphasizes the need for credibility so too does Gourley. She mentions that writers must "do their homework" and research their story for credible, factual information (20). Setting the scene for the reader immerses them in the story. Skloot attracts the audience to the main character Henrietta by explaining her story. When doctors 'steal' Henrietta's cells it echoes with the reader because they too have trusted their doctor. Skloot pulls the reader in through empathy and then takes the reader with her as she explores the story herself. Earlier when she describes Henrietta's old house you can actually see the dilapidated brown building with overgrown lawn. If you take away those elements then the audience does not feel as connected to the author or main character.

3 How Writers Integrate and Balance Personal Narrative and Factual Information in Technology Writing

A key component in creative nonfiction is the presence of the author. However, since the focus of the writer is not typically the emphasis of the piece it is crucial the subject still be prominent. To accomplish this task the author must recreate moments, establish milieu, define characters, and explain difficult concepts. Appealing to the senses, using dialogue, and making comparisons lend way to effectively explaining a subject and engaging the audience. To maintain author presence they must offer explanations from their unique point of view. How the author felt about situations or what they think about a subject is also a tactic employed to help keep audiences intrigued. These techniques and practices help in balancing two prominent aspects of creative nonfiction, narrative and factual information.

Utilizing the author's viewpoint employs a fictional genre technique and creates a connection between the audience and a nonfiction subject or plot. In "The State of Narrative Nonfiction" author Robert Vare describes this genre as "…a marriage of the art of storytelling and the art of journalism…" (1). Author Rita Berman, like Vare, agrees that creative nonfiction acts as a bridge between the fiction world and straight fact telling. By not using "I" in nonfiction writing, Berman states that the reader becomes detached from the author (2). The insertion of personal perspective allows the reader to make connections between the human aspect of the author and the factual plot of the writing (Berman, 2).

The dangers of using personal narrative, the "I", cautions Darrell Caulley is that it can detract from the story. In Caulley's article, "Making Qualitative Research Reports Less Boring:

The Techniques of Writing Creative Nonfiction", he notes that using third person narrative is more effective if first person causes the story to jump around and diminishes the narrative (20).

In his book ,*Writing Creative Nonfiction: How to Use Fiction Techniques to Make your Nonfiction More Interesting, Dramatic, and Vivid,* Theodore Cheney points out that an author should choose a particular viewpoint and stick to it since multiple perspectives only confuses the audience (120). Ranly also supports this approach mentioning that once an author has chosen their perspective they should make this viewpoint apparent early in their writing (5). This argument is supported by Hansen's book about Neil Armstrong. Had he inserted himself into the story it would have taken away from the emphasis on Neil's life. The author interacted with author through several interviews, however, kept the story completely in Neil's third person.

A commonality behind the emphasis of using personal narrative is the individuality behind each author. When author Steve Silberman went to write his first nonfiction book, he asked fellow friends and authors if they had any advice. One author, David Shenk, offered that the importance in inserting yourself into the story is that you have your own unique experiences and thoughts (12). Catherine Gourley points out that, while subjects in creative nonfiction are endless, one aspect that should remain constant is the author's standpoint because each person has a "…unique view of the world." (28).

An example of this insertion is the book by author Rebecca Skloot, *The Immortal Life of Henrietta Lacks*. The story is centered around the Lacks family and how they are still affected by the immortal cancer cells taken from their relative years ago. While the plot remains firmly rooted in explaining the science behind the famous HeLa cells and their impact on the family, Skloot describes her journey over 10 years of researching and piecing together the story. She

shares how she felt, what she saw, and how she reacted to events that unfolded. When Skloot travels with Henrietta's daughter Deborah to see a scientist who can show them Henrietta's cells Skloot inserts herself only minimally. She describes the scene as she witnessed it but keeps the main focus on Deborah and thus still around the main plot. However, Skloot's presence keeps the reader united with Deborah. After Skloot and Deborah see Henrietta's cells Skloot writes "Deborah and I stood in silence, watching him walk away. Then she put her arm around me and said, 'Girl, you just witnessed a miracle.' (267). In reading the story it helps the audience connect with a scientific plot and empathize with a family they have never met.

Personal narrative is a central element in writing communicable nonfiction. However, the facts and story still need to be present and focused in order to communicate the message. To distinguish straight facts from a story, Berman explains that authors should "take those facts and filter them through your eyes." (6). One method to balancing the author's viewpoint and credible information is to provide specific details, appeal to all senses of your audience. Vare speaks to the power of blending both facts and fiction techniques as a way to describe complex characters and establish the setting and mood of the feature (1). For Rachel Toor, "Creative Nonfiction", it is these techniques, taken directly from fictional implements still aim to tell the truth and explain reality (15). Besides establishing well explained characters and settings, Ranly stresses that authors should be sensual in their writing and "appeal to the senses." (35). In explaining aspects of the specific story Ranly further mentions the importance of showing the audience the meaning as opposed to simply describing what is occurring (36). He argues this will tend the way to more "...creative and credible." writing (36). The credibility of vivid description is evident in Sarah Vowell's recount of her trip to Dry Tortugas in *Assassination Vacation.* Vowell's boat trip to an old prison south of Florida is an attempt to understand the people who played a role in former

President Lincoln's assassination. Her motion sickness paints a very colorful picture of her "…opening up [her] third paper barf bag to catch what's left of the key lime yogurt…" (67).

Effective explanation of the subject is a critical aspect of nonfiction writing. Without this aspect the main purpose of the story is lost. Information must be reliable and credible but also engage the audience, less they lose interest. One way to communicate challenging information is by making comparisons. These comparisons, Ranly states, is a way to "…take readers from what is known to what is unknown." (32). Tim Folger, author of "The Data Trail", an article in *The Best American Scientific Writing 2011*, tags along with a retired probation officer who has hiked thousands of miles through the deserts in Southwestern United States. As Folger takes a hike with the Dave Bertelson, the ex-officer turned naturist points out various desert plants. When explaining the impressive amount of rain water some plants can hold Folger recounts that "…a single mature saguaro might hold as much as eight tons" (197). While a reader might not know how much an 'impressive amount of rain water is' Folger relation to metric units gives the audience a precise amount. Relating unknown events, actions, or objects to what is readily understood helps the audience grasp key concepts and ideas (33).

Besides comparison, other practices used to disseminate complex information include flashbacks and dialogue. If the author has done interviews and has direct quotes from characters then, Berman argues, it is a way to add contrast to a nonfiction piece (21). She also comments on flashbacks as an effective tool for increasing the depth of a composition (27). In addition this method has the ability to jump between the past and the present without confusing the reader (28).

As Berman and Gourley point out the genre of narrative nonfiction has paved the way to write creatively about almost anything. Once boring subjects are now transformed into something interesting, in large part due to the personal narrative. However, prominent author and editor of *Creative Nonfiction* journal, Lee Gutkind, found it was members of the science community who were some of the best writers of creative nonfiction (16). He credits passion and interest in the subject as a strong motivator for successful writing (16).

4 How Writers Convey Technical Material and Terms Through Creative Nonfiction

Jargon is an element of the technical and scientific communities. However, if poorly adapted for public communication it can create tension and cause trouble for all involved. Several methods to effective use of jargon include keeping writing as clear and concise as possible and explaining any confusing terms and formulas. If used appropriately, technical terms can be used to demonstrate complex ideas to the public while still maintaining a balance with members of the field. When writing technical material the author must be very cognizant of reader's understanding. A significant obstacle with science or technology writing is the data heavy and specialized language.

The challenge with science or technical writing is that it comes with its own terms, language, and science specific phrases. Lyle Erb in "Writer's Notebook" states that technical writing, especially writing done for government purposes, is often densely written with technical jargon and complex phrasing (4, 9). The problem for audiences is the confusion dense jargon writing causes (6). Judith Humphrey states that writing jargon laden pieces forces the readers to guess what the author is trying to say (Taking the Jar out of Jargon, 3). If readers are left guessing for meanings then they struggle to find clarity in the writing (4).

This issue of confusing the reader with jargon is also prevalent in space policies and mandates. In recent years the government, as well as international groups, have placed more of a focus on managing the debris in orbit around Earth. The "NASA Procedural Requirements for Limiting Orbital Debris" was a mandatory enactment for government launched space vehicles. However, the language used is specific to the aerospace field and could confuse a reader outside

the field. A section devoted to End-of-Mission requirements contains very precise wording. "When significant capabilities affecting the spacecraft's planned ability to passivate, maneuver, or reenter at end-of-life change either through graceful degradation…." (19). Further, in a section on mission operations a subsection reads, "Conjunction assessment analyses shall be performed using the USSTRATCOM high-accuracy catalog as a minimum" (21). Complex terminology and abbreviations cause a loss of focus and the policy's message is not conveyed to the audience.

For Steuart Henderson Britt in "The Writing of Readable Research Reports" the responsibility is on the author to connect with the audience and effectively convey their message (1). He argues that both the author and the subject constitute the message, making the author equally as important when writing compositions (1). This point is also supported by authors Gourley in "Use the 5 R's: How to Write Creative Nonfiction" and Berman in "Creative Nonfiction Writing". Gourley states that the subject should be told from the author's perspective because each author has a different view (28). Berman echoes this idea by mentioning the need to explain subjects by "…filter[ing] them through your eyes" (6). The author is the only element that stands between the audience and the subject. If the author fails to convey difficult concepts and terminology then the reader will fail to understand the material and the message will be lost.

Specialized language only connects with people within that field. For audiences without a background in that area it serves to alienate them from the group. Author G. A Marken in "Public Relations' Biggest Challenge: Translation" states that technical jargon is used in writing when authors don't understand the material themselves (3). An interesting angle Marken takes is that technical writing is a translation from jargon into easily understood terms, similar to obvious language translations such as German to Spanish (25, 27). And, as Jameson tells us in "Teaching Graduate Business Students to Write Clearly About Technical Topics", translations are necessary

because, currently, technical documents assume readers have a background in technical subjects that they might not (2). For Hansen, author of *First Man: The Life of Neil A. Armstrong,* translation of technical material results in a brief but concise explanation. While describing instrumentation and aircraft that Armstrong used in his career Hansen also describes the evolution of aeronautical principles. He explains, "…H. Julian Allen predicted that reentry-heating problems for missiles and spacecraft could be avoided by changing their nose shapes from sharp to blunt…Apollo 11 spacecraft would be built around the "blunt-body" principle…" (55).

One way to help convey the message to readers, several authors agree, is to keep writing as simple as possible. For Erb this means the author needs to ask themselves how simple they can make their writing (10). Similarly Humphrey says that jargon should be eliminated from writing where ever possible (5). Use of jargon can be directly determined by the audience you're writing for. From Marken's perspective, in order to bring material down to the audience's level, the audience must be identified first (18, 19). Further, Britt warns to be careful of the language and understanding of your readers because "they are the receivers of your message, not you" (2).

However, a danger with simplicity, scientists fear, is that their work will lose its meaning and thus fail still to convey the proper message. A survey of scientists who participated in Science Cafes in Japan were aware of this potential danger (Mizumachi, Matsuda, Kano, Kawakami, & Kato, 2011). One male PhD student was interviewed saying, "If we had used complex scientific details in answering a question from the public, that would have caused confusion. Therefore, we often used simplified terms. However, I feared that such simple expressions would cause misunderstandings or misrepresentations" (5). Another survey conducted of scientists participating in the Madrid Science Fairs voiced similar concerns

((Martín-Sempere, Garzón-Garcia, & Rey-Rocha, 2008). There, scientists attributed their reluctance to public science communication to the fear that their research would be "trivialize[d]" (357).

Russel Hirst offers another way to approach the problem of jargon (Scientific Jargon, Good and Bad). He argues that jargon itself has two facets that need to be examined before determining which style has been used in a composition.1) Jargon can be viewed as good when it identifies the special terminology used in a profession or field. 2) However, it can carry a negative connotation when it offends readers, alienates groups, or is unethical (2). For Hirst jargon is condescending if it is too long, difficult to pronounce, a misplaced metaphor, or not used consistently (15). In contrast, jargon is helpful and necessary to science and technology because it explains specialties within fields (17). Examples of good jargon include symbols, acronyms, and abbreviations (17). These can quickly turn into bad jargon if not adapted to exigency or audience (18). In contrast to other authors Hirst pushes the use of correctly used jargon for purposes of precision, economy, flexibility, and cohesion (20). In *First Man,* author Hansen elaborates on any terms used. Before freely using commonly accepted abbreviations Hansen expands what they mean, "…the National Advisory Committee for Aeronautics (NACA), NASA's predecessor…" (53).

Like Hirst, Humphrey also identifies bad jargon that should be avoided by authors. Abstract words, Humphrey notes, are dangerous because they are often used to inflate writing, however, they distract from the real message and cause confusion for the reader (8). In keeping writing simple, another jargon dense element that should be avoided includes the use of big words (9). Humphrey quotes Mark Twain saying "I never write metropolis for seven cents, because I can get the same price for city" (9). *Mechanics of Aerospace Structure* by C. T. Sun

often uses complex words when simpler ones would be just as efficient. In the sentence "in order to utilize the material…" utilize is employed instead of the simpler word use (6). In addition the word "termed" is used instead of called, "the quantity EA is termed the axial stiffness…" (2). Unnecessary verbiage adds to the complexity of subject and can aid in confusing the reader. Additional examples of jargon that Humphrey warns to avoid include misusing metaphors, buzzwords that carry multiple meanings, and acronyms that have not been clarified (10, 11, 15).

To correctly use jargon for the purpose of easy and efficient communication, Britt offers three options to choose from. The first approach is to explain any specialized terms or phrases used in writing (4). He cautions against talking down to your audience, but explaining technical words after introducing them allows the reader to connect with the special term and apply the explanation in future use (4). Vowell uses this approach in *Assassination Vacation* by explaining what Seward's Folly was before introducing the term. "…there's another Seward plaque commemorating," Vowell explains, "…when Seward…signed the treaty with Russia to purchase…Alaska…" (35). She continues that it would called "…'Seward's Folly' and 'Seward's Icebox' for years" (35).

Another method Britt offers is to explain the term first and then provide the reader with the terminology (4). This sets the reader up to understand material even before it is introduced. In "The Estrogen Dilemma" author Cynthia Gorney introduces the term Mitochondria and then proceeds to tell the audience that they are "…cellular energy generators of unfathomably tiny size…" (105). This technique initially registers the terminology with the reader and then explains the meaning.

The third approach Britt recommends is to completely avoid technical terms altogether (4). This final approach contradicts Hirst's argument that jargon is vital in any communication involving science or technology. Audiences will never identify with terminology if it is never introduced or explained at some point.

A problem, Hirst reasons, with not using any specialized languages involving is that it has the opportunity to offend members of that field. Tension can arise between scientists and the public when scientific jargon is disregarded completely (6). With the scientific and technical communities relying so heavily on specialized language and formulas for day to day communication, there is often a hesitance to remove it completely from scientific rhetoric because scientists can also be the audience. Again Hirst stresses the need to use jargon appropriately to meet the needs of both the science and technology communities as well as the general public (9).

5 How Individuals in STEM Fields Understand Their Civic Responsibilities

Science and technology communication with the public has been a growing area in that last several decades. The increased attention to this arena is typically placed on the shoulders of members of the STEM community, scientists, technologists, engineers, and mathematicians. Their reaction to this focus has received mixed reviews. Some scientists enjoy time spent engaging with non-scientific audiences while others regard this as a required duty inflicted upon them by superiors or general field understanding. In "Civic Scientists/Civic Duty" authors M.R.C Greenwood and Donna Gerardi Riordan credit Dr. Neal Lane with coining the phrase "civic scientist" (28). A former director of the National Science Foundation, Dr. Lane recognized the need to interact and engage with public audiences as a way to educate others (29). Several other prominent members of the science and technology fields have also expressed the obligation scientists have to communicate with society including a member of NASA's administration Dan Goldin and, in particular, Bruce Alberts, former president of the National Academy of Sciences. Alberts argued that scientists and researchers need to communicate with the public in order to "…improve science education and science policy decisions to influence people's lives…" (29). Alberts played an influential role in reversing the Kansas State Board of Education decision to make teaching evolution in classrooms optional (29).

Glennda Chui, a journalist, interacts with the scientific community on a regular basis. In the article "Cultivating the Civic Scientist" she stresses that the public is interested in learning about science (58). Therefore, she recognizes the need for scientists to publicize their work with other communities. She notes that personally she has been fortunate to converse regularly with researchers who are willing to take time to explain their work (57, 58). Similarly another

journalist mentioned in the article, Charles Petit also interacts routinely with civic scientists. While he notes many scientists aid his assignments they are not very publicly visible. However, he says when he calls for information scientists "…respond magnificently" (59, 60). One such scientist is Stanford University researcher Michael Riordan. He argues that civic science should include acts like public advocacy. Since scientists possess the expertise in their field they should employ their competence to help enact better policies (60, 61). Riordan maintains that since the country and government supports scientific research by providing funding and facilities it requires scientists to use their research to better the nation (61). Further he notes that America would have a better democracy if the people, especially the voting constituents, were better informed about science and technology (61).

Authors M.R.C Greenwood and Donna Gerardi Riordan mirror the opinion of civic scientists in their article "Civic Scientist/Civic Duty". Scientists should engage with public audiences not just because they are citizens of their country but also because their research and development is paid for by taxpayers (32). Another who agrees with this approach is Mary Wolley, President of Research!America, who feels that when scientists are asked the question "What do you do?" they should respond with "I work for you" (31, 32).

While several prominent members of the science and technology community have stressed the communication between scientists and the public, not everyone shares the same view. A survey conducted in Spain regarding scientists and researchers who participate in the Madrid Science Fair yielded differing results in regards to this civic duty. Authors Martin-Sempere, Garzon-Garcia, and Ray-Rocha, of the article "Scientists' motivation to communicate science and technology to the public: surveying participants at the Madrid Science Fair", conducted in person interviews with 220 scientists who contributed to the Madrid Science Fair

between 2001 and 2004. The participants were comprised of senior researchers, technicians and support staff, post and pre doctoral individuals, and temporary technicians. In answering questions regarding their views of public communication scientists offered interesting opinions. All groups were unanimous in wishing to increase the public's appreciation of science and technology (356). However, there was a divide between scientists who saw this as a duty to society. Senior researchers were strongly motivated by what they felt was their "sense of duty" to communicate with the public, whereas younger scientists did not see this as a concern (356). One researcher was quoted saying "We should present our work to society, so that society demands greater support for science" (356).

Regardless of whether the participants recognized the obligation to engage with public audiences the majority of scientists agreed that any communication done with the public should be the responsibility of someone other than themselves (356). Further, in "Scientists' attitudes toward a dialogue with the public: a study using 'science cafes'" Mizumachi, et al. found a similar reaction among young scientists who participated in Japanese science cafes. During science café sessions, researchers interacted with small audiences about current scientific issues in a setting designed to spark discussions (2). The majority of scientists noted that they required the help of special science café communicators to keep their audience engaged, suggesting that scientists were unsure how to interact with the public (5).While most scientists agreed with the importance of science discussions they felt it should be appointed to trained scientists skilled in public engagement (5). This mirrored the attitude of researchers contributing to the Madrid Science Fair who felt that communication with non-field audiences should be dictated to others (356). They offered the idea that a middle man should exist as a go-between with scientists and

the public (356). This mindset limits researchers' motivation to participate in public science events.

Another limiting factor in scientists' willingness to participate in public discussions is the perspectives of colleagues. Scientist Michael Riordan in, "Cultivating the Civic Scientist", noted that public scientific discourse is not always viewed as respectable within the field (62). Researchers in the Madrid Science Fair interviews echoed this argument saying they are often perceived as "…having nothing better to do…" or "…aren't good enough for more important activities…" (358). Unfortunately, this negative image garnered by colleagues can act as a hindrance in the push for public communication in science and technology fields.

6 Technical Information

6.1 Dr. Space: The Life of Wernher von Braun; Author: Bob Ward

Wernher von Braun was born on March 23, 1912 to Baron and Baroness Magnus von Braun of Germany. In 1929 he graduated from high school at the age of 17 and immediately advanced to college. Just three years later he received a Bachelor's of Science degree in Mechanical Engineering with an emphasis in aeronautical engineering. Two years later, at the age of 22 he obtained his PhD.

Due to his work with aerospace materials in the mid-1930's von Braun was recruited to work for Adolf Hitler and Nazi Germany designing military missiles. While working as an SS member of the Nazis, von Braun and the engineers who worked under him designed and built the V-2 rocket. Germany used the rocket as a missile capable of traveling 216 miles with a one ton missile. It was used to heavily bomb other European countries such as Great Britain.

As the war drew to an end in the early 1940's von Braun looked for a plan to escape war impoverished Germany. He was ordered by high commanding SS officials to destroy all documentation created for missiles and rocket designs. Instead they hid the V-2 rocket designs in an abandoned mine shaft and blew the mine closed.

On May 2, 1945 von Braun and his engineering team surrendered to the Americans. Their decision to surrender to the United States greatly upset Russia, Great Britain, and France who were all interested in the talented engineering team. Before the American's would proceed with immigration to the United States von Braun was interrogated by a Cal Tech astrophysicist named Fritz Zwicky. It was at this time von Braun mentioned his idea of creating a multi stage rocket. This idea would later become the famous Saturn rocket series. After interrogations the German

engineering team retrieved the V-2 rocket documentation from the mine shaft and brought it with them to the United States.

Once in the United States, Wernher and his team worked at the Army Ballistic Missile Agency (ABMA) in Huntsville, Alabama. It was during this time that they created the Redstone and Jupiter rockets. In 1958 they launched the first American satellite, Explorer atop Juno I, designed after the Jupiter rocket. That same year marked the formation of the National Aeronautics and Space Administration (NASA). A year later the Saturn Vehicle Evaluation Committee was created and chaired by Abe Silverstein. By March 1960 von Braun and most of his team was transferred from ABMA to NASA's Marshall Space Flight Center (MSFC) also located in Huntsville. This marked the first time in von Braun's career where he wasn't working for the military creating missiles. As a well-respected scientist, von Braun became director of MSFC whose primary focus was on propulsion and launch vehicle development.

The engineers at MSFC immediately began working on the Saturn project, rockets called super boosters designed to lift large quantities into space. Von Braun named the rocket Saturn because the team's first large rocket was called Jupiter and as von Braun noted, Saturn was the next largest planet. It was around this time that Yuri Gargain became the first man in space. Von Braun congratulated the Soviet space agency and told reporters, "we are going to have to run like hell to catch up!"

Eight days later, on April 20, 1961, President Kennedy asked Vice-President Johnson to create a "specific national space project that could produce 'dramatic results.'" Johnson wrote letters to leading NASA and defense members asking for input on what the nation should do. Letters were sent to von Braun, Bob Gilruth at NASA, and US Air Force General Bennie

Schriever. Von Braun wrote back a 10-page letter indicating that the US had an "excellent chance" of landing a man on the moon before 1970. Vice-President Johnson supported the idea and, on April 29, a formal report was given to President Kennedy signed by Johnson, NASA administrator Jim Webb and Defense Secretary Robert McNamara.

On May 25th President Kennedy spoke to both the American public and a joint session of Congress. "First, I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish." This address came just twenty days after the first American, Astronaut Alan Shepard, spent fifteen minutes in space. Von Braun declared that it finally "puts the program into focus." "Everyone," he said, "knows what the Moon is, what this decade is, what it means to get some people there—and everyone knows a live astronaut from one who isn't." However, former President Eisenhower saw it as "a mad effort to win a stunt race. To spend $40 billion to be the first to reach the Moon is just nuts!" Von Braun's reply was that the Apollo-Saturn program would be the "wisest investment America has ever made."

The Saturn series was comprised of several rockets, the Saturn I, Saturn IB, and the Saturn V. The Saturn V was originally called the C-5 and designed by von Braun to have four F-1 engines in the first stage. The Saturn V rocket has three stages or sections, each with a separate propulsion system. Each engine generates 1.5 million pounds of thrust. Despite this amount of thrust it decided that the first stage needed five F-1 engines. NASA officially declared that five engines would be used in December 1961.

Normally rockets are tested at various levels to ensure that everything works properly. However, when George Mueller became head of NASA Office of Manned Space Flight he declared that the Saturn V tests were to be done all at once with all three stages of the rockets live. Von Braun's team was unhappy with this decision but later realized it was necessary in order to meet the decade deadline.

Since the rocket was so massive von Braun's team used comparisons to accurately understand it. They dubbed her the "Mother of All Rockets." One fuel pump for one of the F-1 engines had equivalent force to 30 locomotives. When all five F-1 engines were running together they generated the power equal to 85 Hoover Dams.

All that power was expensive but that wasn't how von Braun and his team looked at it. "The NASA budget," he said, "is not being spent on the Moon. It is, rather, being spent right here on Earth. It provides new jobs, new products, new processes, new companies, and whole new industries." High employment was a benefit of the Apollo-Saturn program. Overall, the project involved roughly 350,000 working at 20,000 companies. NASA itself employed 34,000 people during the 1960's.

The hard work paid off when, on July 16, 1969, the Saturn V lifted off the launch pad with the Apollo 11 capsule and three astronauts on board. At 9:32pm the first stage ignited and the Saturn V sat clamped to the pad while the F-1 engines reached full capacity. Then the Saturn V was released. Five days later, when Astronaut Neil Armstrong first set foot on the Moon von Braun acknowledged that is was a "pretty emotional moment."

Walter Cronkite, a reporter at the time, referred to Dr. Wernher von Braun as Christopher Columbus and proclaimed that "five centuries from now, I believe that the one date that will be

remembered from our century is 1969—the year that the human race first journeyed from the Earth to the stars." For von Braun it was all about a promise. As he told one reporter, "I told you we could, and we did it."

6.2 Moon Machines-The Saturn V Rocket Documentary; Director: David Copp

The Saturn V rocket is a multistage vehicle. Stage 1 consists of five F-1 engines, each burning three tons of fuel per second. Each engine also produces 1.5 million pounds of thrust for a combined total of 7.5 million pounds of thrust. This generated 160 million horsepower. The first stage was designed to get the Saturn V rocket to a height of 35 miles. After stage one is finished it is jettisoned and falls back to Earth, landing in designated spot, typically the ocean. Once, stage one is released, stage two uses five J-2 engines to propel the rocket higher into the atmosphere. The final stage, stage three is a single J-2 engine. This is fired once to reach a parking orbit around Earth and then fired a second time to remove the Apollo spacecraft from Earth's parking orbit and put it on a trajectory to the Moon. In total, the rocket fired for less than 15 minutes.

6.3 Saturn; Author: Alan Lawrie

When President Kennedy committed the United States to the Moon in May 1961, the first rocket in the Saturn series, Saturn I had not even flown yet. On January 10, 1962 NASA announced it was in the process of creating the biggest rocket ever attempted. It would include the F-1 engine that had been developed since 1958 and the J-2 engine, developed since 1960. In total there were fifteen rockets built at a cost of over $7 billion. The Saturn rocket project was given to the Marshall Space Flight Center (MSFC) in Huntsville, AL on January 25, 1962. Launch responsibilities were given to Kennedy Space Center in Florida and Apollo spacecraft and crew development was assigned to the Manned Spacecraft Center in Texas.

MSFC decided on the Saturn V rocket idea in late 1961, early 1962. It was be comprised of three stages since this seemed the most realistic in order to get the Apollo spacecraft to the moon. Ultimately the idea was that the Saturn V could also be used for other space missions apart from a lunar landing.

The Saturn V rocket was 365 feet tall with the Apollo spacecraft integrated into the structure. When fully loaded the rocket weighs approximately 6.1 million pounds. Three stages are used to propel the rocket out of the atmosphere.

The first stage weighs 300,000 pounds empty was 33 feet in diameter and 138 feet in length. Five F-1 engines burn 203,000 gallons of RP-1, refined kerosene, fuel and 331,000 gallons of LOX, liquid oxygen. The burn time for the entire first stage is 2.5 minutes. Once the fuel is consumed the first stage is finished and jettisoned from the remaining Saturn rocket. The jettisoned stage returns to Earth by falling through the atmosphere and landing in the ocean.

The second stage weighs 95,000 pounds empty and more than one million pounds fully loaded. It is 33 feet in diameter and uses five J-2 engines. The five engines produce one million pounds of thrust and burn 260,000 gallons of liquid hydrogen and 83,000 gallons of LOX. The burn time is approximately 6 minutes. Once the engine has finished it's burn, it too is jettisoned from the remaining rocket.

The third, and final, stage is 21 feet 8 inches in diameter and 58 feet 7 inches in length. It weighs 34,000 pounds empty and 262,000 pounds loaded. A single J-2 engine produces 225,000 pounds of thrust. The third stage would burn twice, once for 2.75 minutes to get the Apollo spacecraft into a parking orbit around the Earth and again for 5.2 minutes to put the spacecraft on a path towards to the moon.

An instrument unit sits on top of the third stage and weighs 4,500 pounds. It contains electronic gear and controls engine ignitions, engine cutoffs, steering, and any additional commands required by the Saturn V rocket. It is 21 feet 8 inches in diameter and 3 feet in length.

Atop the instrument unit sits the Apollo Spacecraft. The entire spacecraft consists of the service module, command module, lunar module, and launch escape system. It is approximately 80 feet in length.

Launch occurs at Kennedy Space Center in NASA's Launch Complex 39. First propellant is added, and then astronauts board the Apollo spacecraft. The NASA control center is in charge of launch operations up until the last two minutes, and then it becomes fully automatic. Once the Stage 1 engines are fully operational they accelerate the rocket at four and a half ties the force of gravity. Mission Control Center in Houston, Texas is in charge of all terminations and stage separations. As each stage is finished they give the command to release the stage so the next one can ignite.

Stage 1 propels the rocket to an altitude of 38 miles then is released and Stage 2 ignites. The second stage gets the rocket to an altitude of 115 miles and almost to an orbital velocity of 15,300 miles per hour. Once the second stage is finished it is released and Stage 3 ignites. The third stage pushes the Apollo spacecraft into an orbital velocity of 17,500 miles per hour. Then the third stage powers down while the Apollo spacecraft is in an Earth parking orbit. The third stage reignites to put the spacecraft from a parking orbit around the Earth to a translunar trajectory. The third stage propels the spacecraft to a speed of around 24,500 miles per hour. Once the spacecraft is in translunar trajectory the third stage engine cuts off and the stage is released from the Apollo Spacecraft. At this point the Saturn V rocket is complete.

7 Creative Nonfiction Article

This chapter is the culmination of creative nonfiction technique analysis with the communication of technology. It incorporates personal narrative to interweave the author, myself, into the article. Creative nonfiction methods were applied, including the use of settings, emotions, descriptions, comparisons, and similes. These were paired with approaches to writing science and technology, including explaining all acronyms and field specific language, grounding abstract ideas in concrete examples, and use simpler words in place on complex text.

The result is an article explaining the technology and engineering behind the Saturn V rocket. The article serves to emphasize the benefits and demonstrate how crucial the space program is to everyday life.

Demonstrated Use of Creative Nonfiction Techniques

To the Moon: The Engineers and Technology behind the Saturn V Rocket

I see a woman going on a jog in the morning outside my apartment window. Every morning her feet hit the pavement one after another, over and over again. I envy her the time. For once, I would like to put down my aerodynamics textbook and join her on the street. I want to smell the early-morning dew and feel the cold

- This paragraph utilizes the use of personal narrative and senses. By describing settings and moments it allows the material to seem more interesting to audiences.

air enter my lungs. But alas, I need to get back to the readings due today. Before I turn away from the computer and take another sip of my now tea, I glance down at her feet. And smile.

Her feet are protected because of temper foam material developed by NASA's space program—a material originally designed to protect astronauts from the gravity forces experienced during space launches. The foam absorbs the shock and then will eventually retain its original shape. Since its first use in the 1960's, temper foam has gone on to make airplane seats more comfortable, amputee patients better protected from the rough material of prosthetics, better protection in Dallas Cowboy football helmets, a better night's sleep on temperpedic mattresses, and, in this case, more comfortable footwear. With each step the jogger outside my window takes, her shoe absorbs more impact from the hard, rigid pavement and protects her foot. Her knees are thanking her right now. They should be thanking NASA.

- Here a connection is formed between the reader and technical information. Relating the technology to a common concept forges a bond and keeps the reader engaged.

I close my book and pick up my tea, enjoying the moment to reflect on one of my favorite topics: The technological progressions of America's own NASA. The developments or spin offs created from the National Aeronautics and Space Administration (NASA) are embedded in everyday to ensure comfort, protection, leisure, and safety. The whirring sirens of a fire truck screech past with several firemen inside. Their clothes

- It is important to explain all acronyms so the audience doesn't feel disconnected from the information. Here NASA is explained to be the National Aeronautics and Space Administration. This way the reader understands what the reference is when the acronym is used later on.

are lighter and more fire resistant because of material used for astronauts landing on the moon. They have clearer face masks and lighter oxygen tanks because of technology created for NASA's lunar landing program. My cousin feeds her toddler with baby formula enriched with algae based oil that will help with improving mental and visual development. Algae based oils were researched for food, oxygen sources, and recycling processes during long manned space flights. My roommate is shopping online for a new pair of shoes. Her financial information is safer and the checkout process quicker because of software developed for Apollo space missions' procedural programs. While the budgets of these programs can run into the billions of dollars, medicine is less invasive, sports are safer, and response teams are better equipped.

The benefits from the space program are in the luxuries and necessities we take for granted every day.

- Separating meaningful and impactful sections of the writing serves to drive home critical ideas.

I often tell, to anyone who is listening, that Neil Armstrong's famous quote, "One small step of man, one giant leap for mankind", spoken when he set first set foot on the moon, seems more applicable to what happened right here on Earth. For example, while the Apollo-Saturn mission created to get astronauts to the Moon, the benefits can be seen from the moment that we wake in the morning: surgical tools with precision flow of

medication, cordless tools, high intensity lighting, and water pumps for high speed boats and ships.

7.1 "I want to be an astronaut!"

Let me not underrepresent the magnanimity of this early flight. The aerospace technology created to get astronauts to the Moon is an impressive feat of engineering ingenuity while the race to the Moon connected people across the country.

- Allowing the reader to view concepts and topics through the author's eyes creates a personal relationship with the audience.
- Specific details create visuals for the audience in the absence of pictures.
- Flashbacks are also useful for a change of pace in the writing.

The connection to the space race continues to live on in younger generations through movies and books. While the race for the Moon ended long before I was born, it still impacted my life. When I was three years old, my parents took me to The Museum of Flight in Seattle, WA. The long glass paneled building with the words FLIGHT in large letters at the entrance houses aerospace artifacts such as an SR-71 Blackbird, several Boeing airplanes, and the National Aeronautics and Space Administration's (NASA) Full Fuselage Trainer actually used to train the Space Shuttle astronauts. At the end of our visit, I was allowed to pick out a book from the gift shop. Later that afternoon, I sat with my mom on our large brown striped couch as she read me my new book *I Want to Be an Astronaut* by Byron Barton. The sound of her voice was mellow and comforting and she smelled of cookies. It didn't matter what my mother read; she could make anything sound like an exciting adventure. However, with this book, adding excitement

wasn't necessary; for me it was already very exciting. This book still sits on a shelf of my bookcase.

As my mother closed the book with the finishing words "I want to be an astronaut" I looked up at her and echoed the many children before and after me: "Mom, that's what I'm going to be when I grow up!"

My parents were always supportive and encouraging of my younger brothers' and my adventures, but I'm sure in that moment on the brown striped couch in 1994, my mother didn't assume my proclamation would stick. After all, children cycle through a dizzying array of future careers in the course of a week. Nevertheless, while my classmates in kindergarten wanted to be rodeo queens, princesses, firefighters, or animals, I consistently and proudly went around declaring that I was going into space when I grew up. The dream didn't change regardless of how many times I switched schools, towns, or friends. I think it became a little more real for my parents when I finally applied for colleges under the pretense of studying aerospace engineering.

However, in my family, I was not the solo space enthusiast. My mother hung posters on the wall detailing the solar system and how the universe progressed from the Big Bang. My father built

- As referenced in the literature review, author Catherine Gourley, empathizes using reflection and real life stories in order to differentiate creative nonfiction from formal essays and newspaper articles.

models and shared stories of our personal family connection with the space industry.

My favorite stories went all the way back to the Saturn-Apollo space era when man first journeyed to the moon. My stern-faced father would sit in his blue swivel computer chair gluing landing gear on his latest World War II airplane model, recounting the time his father, a mechanical engineering contractor, traveled all through the southern United States to work on the components for the Apollo-Saturn space program. One of my favorite stories, although brief, was when my grandfather had lunch with Dr. Wernher von Braun, a German scientist and key engineer behind the United States' space travel success.

- One way to relate to your audience is by sharing personal emotions. Indicating my excitement for space travel gives the reader the opportunity to share what I am feeling.

7.2 A Controversial Figure in History

Perhaps, first a little background and historical context on Wernher von Braun. Dr. von Braun, a controversial figure in the history of space exploration, also dreamt of going into space as a child. He built models and studied engineering in school. Having grown up in Germany during the 1930's, he became involved with the wrong side of history in World War II. As a young and intelligent engineer, von Braun was charged by Nazi Germany to do what he did best, design rockets. However, the rockets von Braun built in the early 1940's were not for space exploration—he and his team created the V-2 rocket used to bomb European

countries. The V-2 rocket was capable of carrying a one ton missile as far as 216 miles. From September 1944 to March 1945 they were heavily used to bomb France, Great Britain, and Belgium.

As the war ended, von Braun saw a way out of the war-devastated country by surrendering to the Americans. Sweet home Alabama became the new home for Wernher and around 100 of his team, and they moved *en masse* to Huntsville, Alabama to begin working for the U.S Army designing missiles. In March 1960, the German engineers and scientists moved from the Army Ballistic Missile Agency to NASA's Marshall Space Flight Center (MSFC) still in Huntsville. From the depths of such evil and destruction rose the engineering greatness that became the United States space program. This was the first time in his career von Braun was designing rockets, not for military use but for civilian exploration.

- Setting up the background for stories allows writing to be complete. Explaining who, what, when, where, and why clears up any questions the reader could have.

7.3 Race for the Stars

While von Braun's migrated to the US, the Space Race was taking position at the starting line. The race to the stars began in 1957—the starting gun sounded and the Soviet Union launched the first artificial satellite into Earth orbit, Sputnik. A year later, NASA responded by sending up their own satellite, Explorer 1, launched on a rocket designed by von Braun's team. By April1961 the first man in space was Russian cosmonaut, Yuri Gargarin.

- Similes and metaphors engage the audience in an interactive and creative way. This component also helps distinguish creative nonfiction from straight technical writing.

Dr. von Braun's reaction to how the United States was doing on the space front was summed up when he told reporters, "We are going to have to run like hell to catch up!" It was just eight days after Gargain became the first man in space that former President John F. Kennedy set out on a plan to make sure America was still in the running for the history books.

7.4 President Kennedy's Declaration

Growing up, I remember watching YouTube videos of President Kennedy's famous speech to Congress calling for a national plan of action for putting a man on the moon (Yes, I'm young enough to have watched major historical events on the internet throughout my childhood). But it wasn't until I was older and doing more concentrated research on the space program that I realized von Braun was directly involved in the President's bold initiative.

- When going from subject to subject it is important to create transitions in a linear style. This eliminates unwanted surprises for the reader.

On April 20, 1961, President Kennedy asked then Vice President Lyndon Johnson to create a "specific national space project that could produce dramatic results." The vice president decided to write to key members of the space industry at the time and seek their input on where the country should head in terms of space exploration.

Von Braun was among the people Johnson asked for input.

Von Braun jumped on the opportunity to push an aerospace agenda he'd nurtured since he was a little kid. In a ten-page letter to Vice President Johnson, von Braun explained the United States had an "excellent chance" of putting a man on the moon before 1970.

Less than two weeks later Vice President Johnson wrote to President Kennedy, detailing the best choice for enthusiastic space support would be a manned lunar landing. Two other key government individuals—NASA administrator Jim Webb and Defense Secretary Robert McNamara—also signed the report to the president. By May 10, 1961, President Kennedy decided on the supporting a lunar landing, and on May 25, just fifteen days later, he made his famous speech:

"First, I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth. No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish."

President Kennedy's speech was impressive not only because of the magnitude of the national charge to reach the moon but also because of the timing. Just twenty days earlier, the first

- As author Dan Ranly mentions, be concrete in writing. Giving dialogue and scene setting adds purpose to the reader.

American, Astronaut Alan Shepard, had spent just fifteen minutes in space. Let me repeat that: fifteen minutes. And now Kennedy wanted people to fly to a foreign destination, walk around, collect samples and data for science, and then come home for a nice meal with their family. A tall order, some might say.

While Kennedy was in Washington D.C, roughly 700 miles away in Alabama, Dr. von Braun declared, "Everyone knows what the Moon is, what this decade is, what it means to get some people there-and everyone knows a live astronaut from one who isn't." With that, von Braun and his team set out to create one of the greatest engineering feats of all time.

- In the article, "The State of Narrative Nonfiction", author Vare emphasizes the marriage between storytelling and journalism. Interweaving multiple characters into the story adds a comprehensible level of complexity.

7.5 "The Mother of All Rockets"

It was just a couple years later in 1964-65 that my father recalls living in Huntsville. My grandfather worked tirelessly on the Apollo-Saturn project. However, the resultant Saturn V rocket—the one that would eventually boost astronauts to the Moon—was not the first in the Saturn rocket series. Two earlier designs, the Saturn I and the Saturn IB, had been under engineering construction for several years, and numerous components ideas and structural designs were used to build the behemoth of a rocket, the Saturn V.

The Saturn V is still seen as a giant in the aerospace industry. Not only did it have advanced engineering by

contemporary standards, also its immense size earned it the endearing nickname “Mother of All Rockets” by her engineers. This rocket stands 365 feet tall, 60 feet taller than the Statue of Liberty. The rocket is divided into three sections which the engineers called stages, and each stage contains its own propulsion and engine system designed to boost the Apollo spacecraft that sits on top of the rocket to a higher and higher altitude. At liftoff the rocket weighs 6.5 million pounds. Now this is where it gets impressive: it’s over fourteen times the weight of the Statue of Liberty, and they needed to fly it. Six million pounds alone was attributed to propellant. The 70 miles of wiring needed to operate each stage is enough wiring to stretch from downtown New York City to the middle of Long Island, NY.

- Multiple sources articulate the strong use of comparisons. This again goes back to the use of the concrete. Comparing an object that many aren’t familiar with an object easily identifiable lends credibility and engages in the reader with the information.

Due to the sheer size of the rocket, engineers at MSFC needed to create an engine strong enough to propel the mammoth rocket upward. The F-1 engine was originally designed by the aerospace company Rocketdyne for use in the Air Force during the late 1950’s. Rocketdyne was again contracted to work on the engines once the project was transferred to NASA for use on the Saturn V. Rocketdyne was not the only subcontractor on this project. Indeed, many companies were used as contractors to build the Saturn V, creating not only new technology but also strong employment.

"The NASA budget is not being spent on the Moon." Von Braun once asserted, "It is, rather, being spent right here on Earth. It provides new jobs, new products, new processes, new companies, and whole new industries." During the Apollo-Saturn era, contracting work done between NASA and other aerospace companies brought the total to roughly 350,000 people at 20,000 companies. NASA alone had around 34,000 employees. All of this makes me think of the economic data that depressingly gets reported in newspapers every day. The budget for NASA keeps getting cut. In 2010, Congress reduced government space funding to .5% of the federal budget. In 1969, space funding was 2.22% of the federal budget. When I put this into the context of employment numbers, innovation industries, and scientific knowledge, I sigh.

- When explaining an idea, especially abstract ideas, give examples that are common. Following points with examples grounds the writing in familiar areas.

While building the Saturn V, NASA employees were busily working to solve the issue of how to get the rocket off the ground. Dr. von Braun's team originally decided to have four F-1 engines in the first stage, but by December 1961, it became apparent that four engines wouldn't be enough to move the giant off the launch pad, so a fifth engine was added. To put this into context, the commercial jet Boeing 777 engine holds the Guinness Book of World Records for "World's Most Powerful Commercial Jet Engine" with 127, 900 pounds of thrust. With all five F-1 engines firing at the same time, they produce 75,000,000 pounds of thrust,

almost 59 times the thrust of the world record holding jet engine. Achieving that magnitude of thrust, required the use of hundreds of thousands of gallons of fuel. Each fuel pump had the force of 30 locomotives, and together, the F-1 engines generated the equivalent power of 85 Hoover Dams. For von Braun, this immense power was more than just for reaching the moon: "we built it to explore all of space—to reach for the stars."

- Technical writing typically uses specialized language or jargon. This can cause confusion and force the reader to lose interest.

- Earlier in the article I explain what a stage is and go on to indicate how exactly it is used in context of the Saturn V rocket. Then later on when I reference the specialized language again, such as a stage, the reader will understand.

7.6 Lunch with a German Engineer

Carefully, my father sands down the fuselage on his model airplane, holding the rough paper in his left hand he slides it back and forth across the drab gray surface. The crunch of course grains against the fuselage fills the room. He quietly tells about the lunch my burly, rotund grandfather shared with Dr. von Braun.

The large conference room held prominent engineers from various companies contracted to build the Saturn V. At the head of the large wooden table sat Wernher, jovially sharing stories with his colleagues. My grandfather stood in the middle of a group of engineers, munching ham and turkey sandwiches from plain, white, ceramic plates. They all resembled one another, dressed in either brown or black suits and wearing thin ties. Conversation was upbeat and enthusiastic as they compared different designs and ideas for the Saturn V. It was an honor to be at one of these luncheons and it was a topic my grandfather mentioned right

before he passed away. My grandfather fit into the drab, sterile room perfectly. Like many engineers, he was brilliant in his ability to solve complex design issues but at times lacked common sense. Von Braun too encountered this issue.

Once, when von Braun was having his hair cut, his son was playing with a toy airplane at his feet. When the batteries popped out of the small, plastic craft Wernher was unable to get them back into place. His young daughter patiently took the plane from her father, replaced the batteries with ease, and returned the toy to her brother. My grandfather was similar. A friend once remarked that my grandfather "was the most brilliant engineer he'd ever met, but the man should not be allowed to operate a bicycle."

- Using descriptive words helps set the mood and tone for the article. Allowing the reader to picture the setting and experience the action makes the article more persuasive in its meaning.

7.7 Rocket City, USA

Huntsville came to be called Rocket City, USA, and my father, a gangly, red-headed 10-year-old boy, would dream of worlds beyond the stars as he watched launch tests and interacted with the engineers. He would walk from the family apartment on McVay Street SW, in the section of Huntsville where mostly German engineers lived. Then down to the section of the Redstone Arsenal complex where they would test the F-1 engines.

Settling in about a mile from the test sight, he would watch as they fired up the 19-foot-tall engine. Having once lived in California, he said the only comparison to the engine test was the

feeling of an earthquake, but it still paled compared to the giant F-1. The ground shook as the sound traveled over the barren surface. The noise vibrated in his chest, shaking his small body. A billowing cloud of exhaust plumed into the sky from the sides of the rigid test structure. The putrid smell of exhaust eventually seeped into his nostrils, and he could taste the burnt kerosene fuel in his mouth. The sound consumed every sense and seemed to fill the entire world with noise. Abruptly it would end, the noise carrying over the rock covered ground. As the valves on the engines closed they created a high pitch shriek that seemed to reach into every fiber of his bones and pierce his eardrums.

- Again here is the use of the senses. The description of the noise reverberating through my father's chest and the smell that seeps into his nose offer connections to the technical information that are absent from data writing.

Testing is an important aspect of rocket design. Single components are tested, assemblies are tested, and eventually the entire rocket is tested. However, when George Mueller became head of NASA's Office of Manned Space Flight, he dictated that the Saturn V would be assembled and all three stages tested at once. This was very controversial and revolutionary. It was also very risky. If something went wrong in one of the stages when they tested the rocket, they could lose the entire assembly.

Testing procedures were not the only controversial aspect of the Apollo-Saturn space program. Money was a topic of hot debate, and many people were unhappy at how much money the race for space was costing the American taxpayers. Even former

President Dwight D. Eisenhower viewed a lunar landing as "a mad effort to win a stunt race." He exclaimed "To spend $40 billion to be the first to reach the Moon is just nuts!"

Wernher von Braun was quick in his response to the former president, declaring that the Apollo-Saturn mission would be the "wisest investment America has ever made."

- Here is the use of dialogue again. Between several paragraphs span a non- direct conversation that lends weight to the message of the article. It also serves to keep general ideas more specific and relatable.

7.8 Toothpaste and Airplanes

There is no way anyone could have foreseen all the advancements made to various facets of daily life. The technologies developed in 1950's and '60's are ubiquitous in our everyday life. Ingestible toothpaste is one such advancement. My mother is a health-conscious dental assistant, always insisting that everyone brushes their teeth, regardless of where they are. The other day, after eating a meal in the car, my mother thrust a toothbrush in my face. She smiled when I remarked I had nowhere to spit out the toothpaste. "You can swallow it," she said politely. It was my turn to smile as I informed her that she could thank NASA for her obsession with oral hygiene. Ingestible toothpaste was created for astronauts because it was easier to swallow the toothpaste then spit it out in zero-gravity.

- Personal narrative creates direct associations between sometimes inconceivable topics and everyday occurrences. Many people can relate to having their mother hound them about brushing their teeth.
- The connection then allows readers to grasp the idea behind NASA needing to create ingestible toothpaste.

I went off to college 3000 miles away from my home to study aerospace engineering. Flying back and forth in commercial airliners is a regular occurrence for me. An impressive

accomplishment that directly affects millions of people daily is the contribution made to improved commercial air travel. Ever wonder why the tips of wings are bent upward? They're called winglets. And they were created by NASA engineers to reduce the drag experienced on airplanes and allow them to fly more efficiently. As of 2010, it is estimated that winglets have saved 2 billion gallons of jet fuel. That's enough jet fuel to travel on a Boeing 747 from New York to Los Angeles about 143,000 times! Since it also saved about $4 billion dollars, imagine what the cost of a plane ticket would run these days if we didn't have NASA engineers and scientists.

- Flying is an integral part of society and many people fly every day. The relationship between a common occurrence and the space technology developed gives the reader a quick connection between the technology and an experience they would be familiar with.

For Dr. von Braun and his team, using taxpayer money for what some believed was a stunt was absolutely going to pay off for the American public. He was reported once happily announcing "I am absolutely convinced that the $23 billion spent on the manned space program has not made the United States $23 billion poorer but many billions richer in new knowledge acquired."

- Creative nonfiction also incorporates words and phrases not found in technical writing. Examples such as "flung herself towards the heavens" add embellishments that differentiate narration from reporting.

And on July 16, 1969 the United States was on its way to acquiring an entirely new celestial body of knowledge.

At 9:32am the five F-1 engines were ignited and for nine seconds the Saturn V rocket sat clamped to the launch pad as the engines reached they're maximum 7.5 million pounds of thrust. In

an instant the clamps released their grip on the mammoth machine and she flew upward. At a peak velocity of 6000 miles per hour—about eight times the speed of sound—the Saturn V flung herself towards the heavens with three astronauts perched enclosed at the top.

After two and a half minutes, the first stage, or section, is finished and released from the rest of the rocket, falling back to Earth from an altitude of 38 miles. The second stage fires to life and propels the astronauts farther into the darkness of space, cutting off after six minutes and an altitude of 115 miles. The second stage falls back to Earth revealing the third and final stage used to send astronauts to the Moon. What is unique about the third stage is that it actually fires twice. The first time is to get the Apollo Spacecraft and astronauts into what is called a parking orbit. It means that the spacecraft will reach a certain altitude and circle the Earth. Then the third stage will fire once more before falling away, or jettisoning, from the spacecraft, causing Apollo to leave Earth's orbit and travel on a trajectory to the Moon. After that, it's just the Apollo spacecraft alone on her way to the Moon without her enormous sturdy guardian to guide her. In total, the three stages burn for just over 16 minutes.

- I keep the details concise but relevant. It informs the audience but without being so drawn out that they lose interest.

7.9 We Did It

On July 21, 1969 my mother, a rambunctious and curious nine-year-old, sat perched on the concrete steps of her house. Binoculars were glued to her eyes as she personally tried to witness history in the making. As Astronauts Neil Armstrong and Buzz Aldrin stepped onto the surface of the Moon, my father looked upwards while running the hot, paved streets of Southern California for cross country practice. My grandfather had moved on to another project, removed from the intensity of the space race.

Reporter Walter Cronkite, who was on air at the time of the moon landing, later referred to the great engineering feat with admiration. "Five centuries from now," he pronounced, "I believe that the one date that will be remembered from our century is 1969—the year that the human race first journeyed from the Earth to the stars."

Over forty years later, I go to take my last swallow of tea. It's cold and bitter now. I sigh and get up, grabbing my favorite London Olympics glass as I walk to the fridge. Opening it, I take out my Britta and pour water, smiling again as I thank NASA. Water filtration was technology developed from the Apollo-Saturn program. Taking a sip of clean water, I walk back over to my kitchen table, sit down, and look outside again. The moon is pale in the light blue morning sky and sits low on the horizon. I still

- The final paragraph ties in many aspects of creative nonfiction including personal narrative, scene description, emphasizing key ideas, sharing technical information, and relating important topics to common objects.

hope to put my own footprints up there, next to the others still etched into the surface, and chuckle at the promise Dr. Wernher von Braun made to the American public: “I told you we could,” he said, “and we did it.”

8 Conclusion and Discussion

A big challenge while writing this project was trying to integrate creative nonfiction techniques while still retaining sufficient technical information to convey the message. Not having written a large scale, creative nonfiction article before proved difficult in inserting my personal voice. Since my focus in college was on removing myself from information and just reporting data, it was challenging to insert my personal experience in the story.

Research was also an interesting area. There exists significant writing about how science and creative techniques merge. However, I encountered little research about the interaction between creative writing and technical information. It was also important to clearly distinguish the two types of writing, science and technology. To find a balance, I used the science writing research and translated it into technical writing.

One aspect of creative nonfiction is establishing various characters essential to the story, adding positive complexity to the topic. A key character in my technological topic of the Saturn V rocket was German engineer and scientist, Dr. Wernher von Braun. He served during World War II as an officer in the Nazi SS and designed rockets used to bomb European countries. However, he was also an integral part in the United States space race success. An issue that I originally didn't consider was the ethical implications of highlighting his accomplishments as an engineer. Trying to balance his ingenuity and innovation while still considering and recognizing the horrific impacts his work caused was challenging. Eventually I ended up reducing the number of times he was mentioned and changed how I introduced him into the story. The

removal of several sections about Dr. von Braun also allowed the article to focus more on the Saturn V technology, which was a primary goal.

Specialized language used in a field is a component of technical writing. However, it alienates audiences who have little background in the subject. Using research on writing technical subjects for general audiences, I explained specialized language so readers could understand. This included explaining all acronyms, relating difficult to grasp concepts to easily relatable objects, and using easier words instead of unnecessarily complex text.

Overcoming these challenges showed me how the balance between creative writing and technical writing is difficult and tricky, but possible. My final product consisted of a short article, "To the Moon: The Engineers and Technology behind the Saturn V Rocket."

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