Star Stuff:
An Exploratory Case Study of the *Cosmos* Television Franchise
-- A Companion Paper to the Scalar Project

Patrick Timothy Dawson

A Master's Project submitted to the Faculty of Graduate Studies in Partial Fulfillment of the degree designation Master of Arts

Graduate Program in Communication and Culture,
York University
Toronto, Ontario

August 2022

Abstract

This paper is a companion to a web-based multimedia project that case studied the *Cosmos* television franchise. The project looked at over 60 years of space exploration through an examination of the *Cosmos* television series and other educational media. The paper documents the process that went into making the project, including why I decided to research this topic and present it in the open-source multimedia platform Scalar. This is then followed by a discussion of what I learned in the process of creating the project and how I hope it will be received by its audience. The paper will also outline the theoretical framework that informed the project's creation, along with a review of the relevant literature it is in direct conversation with. That part will place a particular emphasis on how the project relates to the fields of communication and culture studies, science communication, and political philosophy more broadly.

Acknowledgments

I would like to begin these acknowledgments by deeply thanking Kris Joseph and the rest of the staff at York University's Digital Scholarship Centre and Media Creation Lab. This project simply would not have been possible without the resources, software, expertise, and boundless generosity they have imparted on me throughout the six months I have been in Toronto.

Another person I would not have been able to reach this milestone without is my supervisor professor Philippe Theophanidis. His level-headed guidance, relentless enthusiasm, endless patience, and supernatural responsiveness to emails were all invaluable beyond words throughout these last two years.

The totality of the Communication and Culture graduate program has my sincere appreciation for allowing this kind of creative research to take place under their stewardship. Alexa Vachon and the rest of the team over at the SORCE collective also need a shout out. The platform they provided for me, along with other practice-based researchers, was immensely helpful for test driving my work ahead of defence.

The influence of my quality undergraduate education on this project cannot be understated. All my professors from Memorial University of Newfoundland's philosophy department, along with the Diploma in Stage and Screen Technique, did an incredible job preparing me for this master's.

I of course could not go without thanking my parents for supporting me all these years as my most ardent proofreaders. They also taught me the most important lesson for writing to a non-academic audience at a very early age. That was 'speaking to others as I would like to be spoken to'.

My grandparents alive and gone, uncles and aunts, cousins, and the rest of my extended family opened not just their homes but also their minds to me throughout this experience. They provided me not just with food but also planted the seeds for many of the ideas expressed in the *Star Stuff* project.

Allison, my girlfriend, can also not be excluded from this conversation. The impromptu poutine nights we shared together during the isolation of the Covid-19 lockdowns were the most soul-nourishing thing a burnt-out graduate student could ask for.

My yoga instructor Justin and all my running partners also need an honorable mention for helping me counteract the undue consequences of those poutine nights… The structure and presence they provided to my routine has helped me stay the course through a busy schedule.

Really, all my friends in St. John's Newfoundland and Toronto Ontario need a big thank you as well. Hanging out and chatting with them throughout these months was the mental reprieve I needed to recharge and refocus my energies. They also served as wonderful beta testers when the project was reaching its final stages of development!

Lastly, my childhood dog Vector, who we had to let go of just before I started this master's, needs the final mention. He taught me a lot of important lessons during the 13 years we spent together. Perhaps the most important one of all was that 'feeling and being present in something is just as important as thinking about it'.

Table of Contents

Introduction

This paper is intended as a companion to a creative research project that was made in the open-source multimedia platform Scalar. The project is entitled *Star Stuff: An Exploratory Case Study of the Cosmos Television Franchise*. In this project, I have case studied over 60 years of space exploration through an examination of the *Cosmos* television series and other educational media. The original television series *Cosmos: A Personal Voyage* was released in 1980, while the second season of the new reboot *Cosmos: Possible Worlds* aired in 2020 (Druyan & Braga, 2020; Sagan & Malone, 1980). The first season of the new series *Cosmos: A Spacetime Odyssey* was released six years prior in 2014 (Druyan & Braga, 2014). Much like my Scalar project and this accompanying paper, the television show also featured its own companion texts in the form of two books. These were *Cosmos* written by Carl Sagan and *Cosmos: Possible Worlds* written by his collaborator and widow Ann Druyan (Druyan, 2020; Sagan, 1980b). The story of Sagan and Druyan's collaboration, which began with the Golden Record placed on NASA's Voyager space probes in 1977, is an opportunity to explore the careers of two scientists on a mission to communicate their research to the public using the latest broadcasting technologies. This story is marked by a shift from public broadcasting to private broadcasting. With *Cosmos* changing networks from PBS to Turner Home Entertainment, then to 21st Century Fox, and most recently The Walt Disney Corporation. A shift that coincided with an industry wide transition from over-the-air antenna, and publicly available cable television channels, to deeply privatized digital streaming services. As a result, this study is just as much about the privatization of educational media and the challenges of researching that privatized material, as it is about *Cosmos* itself. This companion paper is separated into two parts. The first part of this paper will document the process that went into making the project, including why I decided to research this topic and

present it in Scalar. This will then be followed by a discussion of what I learned in the process of creating the project and how I hope it will be received by its audience. The second part of the paper will outline the theoretical framework that informed the project's creation, along with a review of the relevant literature it is in direct conversation with. That part will place a particular emphasis on how the project relates to the fields of communication and culture studies, science communication, and political philosophy more broadly.

Part 1 Process of Making the Scalar Project

This first part that explores the making of the project has been further divided into two smaller sections. The first is focused on how I developed the topic of my research and opted to display it in Scalar over other possible platforms and mediums. The second section follows the actual making of the project that took place over an eight-month period. I then conclude by briefly discussing what I learned in the process of making the project and how I would like it to be received by those who view it. Before I discuss the making of the project, it is helpful to understand my academic and professional background leading up to my enrollment in York and Toronto Metropolitan Universities' jointly ran Communication and Culture graduate program. While at Memorial University of Newfoundland from 2014 to 2019, I completed a Double Major in Philosophy and Communication Studies, along with a Diploma in Performance and Communications Media. The diploma's name has since been changed to Stage and Screen Technique. That diploma taught me the foundations of theatre, film, and documentary production. I then spent a year volunteering and working in the local Newfoundland and Labrador arts community to help bolster that skill set. Going into my Master's in Communication and Culture for September 2020, I wanted to use this background in media production to present research material that was academically relevant to my studies in

philosophy and communications theory. That initiative ultimately culminated in this academically sound and creatively rich Scalar project.

It should be noted that most of the project's creation process described below took place while I was studying remotely from my home province of Newfoundland and Labrador during the Covid-19 global pandemic. Although I do not specifically outline the impact Covid-19 has had on the project, it influenced almost every aspect of the creation process, including the decision to adopt Scalar as my platform and medium of choice. Before beginning work on the project, I created a set of three research objectives to help guide me. These objectives were:

1. Explore how the over 40-year evolution of the *Cosmos* franchise intersects with key historical inflection points in the legacy of human space exploration, science communication, and cultural representations of outer space in educational media.
2. Use the beginning and end of the case study as an opportunity to compare the early days of the government lead space race to the new era of 21st Century private space exploration and colonization.
3. Provide my own personal reflections on the relationship between the ownership of outer space knowledge production and the physical colonization of other planets. This includes the encouragement of participants to reflect on what role the public and private sectors should play in outer space exploration, tourism, resource extraction, colonization, and knowledge dissemination moving forward.

Those objectives were also accompanied by two principles I developed for curating what videos and images would be exhibited in the project. This included a preference for era-appropriate photos and film taken as events transpired, rather than models or simulations that were constructed years or decades later. Secondly, when selecting what parts of videos to show, I

always opted to provide the audience with a larger 10 to 20-minute segment, rather than editing or condensing them down to much smaller clips myself. This larger size allows the viewer to get a better sense of what the video is about and provides them with the agency to decide how much they would like to watch based on their own level of interest.

Topic Formation (Fall 2020 to December 2021)

Considering my previous theatre and film background, I originally entered the Communication and Culture program wanting to film a documentary. I had no set research topic in mind. However, I did have an idea for a research paper leftover from my Philosophy degree that I had been dwelling on for the last two years. That research question was, "would Hannah Arendt's criticism of Cold War space exploration still hold up against Elon Musk's renewed justifications for colonizing Mars"? In my first required course of the program, CMCT 6004: *An Interdisciplinary Approach*, I was allowed to pursue this question under the instruction of my soon-to-be supervisor, professor Philippe Theophanidis. After returning from the 2020 holiday break, I had a follow-up meeting with professor Theophanidis where we agreed that, if my research topic remained centred around space exploration, he would serve as my supervisor. My paper contrasting Arendt's Cold War critique against Musk's goals of colonizing Mars left me perplexed. The reasoning Musk provided in two SpaceX press conferences did not go beyond the need to avoid a vague but inevitable mass extinction event on Earth (SpaceX, 2016, 2017). Yet, Arendt's critique in the prologue to her 1958 book *The Human Condition* and 1968 essay "The Conquest of Space and the Stature of Man" was no longer able to fully retort these renewed ambitions (Arendt, 1968, 1998a). I determined that my documentary should explore this cultural transition from government lead space exploration to a private space industry, but I still needed to find a scope and object of research for the study.

Thus, my primary goal for the 2021 winter semester was to use my second required course of the program as an opportunity to find a specific research topic. One of the first assignments for CMCT 6002: *Research Methods* was to complete a Review of Journal Articles. This assignment required me to find 10 peer-reviewed journal articles in my area of research that were written within the last five years. I then had to summarise the arguments and connections between these articles into a 1000-word paper. One of these articles was "Screening Cosmos-politanism: The Anthropocenic politics of outer space media" by Kirk Boyle and Dan Mrozowski (Boyle & Mrozowski, 2019). This article divided a sample of popular 21st Century science fiction films into four different political ideologies. Though the paper's findings did not have a direct impact on my research, it did contain a brief critique of the digital rights management in the physical release of *Cosmos: A Spacetime Odyssey*. These remarks made me consider the relationship between the privatization of space exploration and the restriction of education media.

> When one of us took Cosmos to his university's brand-new media design lab to pull clips for a conference presentation, he discovered that the DVD was DRM (digital rights management) protected with colour desaturation so dark as to be unwatchable. Thus, while the 'Spaceship of the Imagination' of the Cosmos series functions as a kind of Hegelian video camera, a purveyor of 'absolute knowledge' that allows its narrative perspective to traverse freely through space and time, commercial limitations curtail the actual transmission of this cosmos-politanist perspective. (Boyle & Mrozowski, 2019, p. 361).

Thus, I began to see the study of the *Cosmos* television series' transition from PBS to FOX as a way to mark a cultural shift from public to private space exploration in educational media. I conducted a content analysis comparing the first episodes of the original *Cosmos* series and the new *Cosmos: A Spacetime Odyssey* as my final project to conclude the course. This project demonstrated that a larger comparison of *Cosmos: A Personal Voyage*, *Cosmos: A Spacetime Odyssey*, and *Cosmos: Possible Worlds* was a worthwhile endeavour.

With the topic and objective of my research decided upon, I then began the process of planning how I might film a documentary. Professor Theophanidis and I both agreed that, given ongoing restrictions due to the Covid-19 pandemic, it would be too challenging to create a documentary by myself without any on-campus filming or editing equipment available. We agreed that it would be in my interest to create a video essay featuring clips from both *Cosmos* series, archival footage taken during past public and private space exploration programs, and relevant stock footage for b-roll where applicable. I would even consider conducting interviews over Zoom with relevant academics and individuals who worked on the television shows if the opportunity presented itself. However, though I had filmed and edited several short documentaries previously, I wanted to refine my video editing skills with Adobe Premiere, a standard editing software in the film industry, before taking on a project of this magnitude. I emailed every graduate program at York and Toronto Metropolitan Universities that I was told had a video editing component. My hope was that I could enrol in one of their courses as my final elective in Fall 2021 or find an equivalent undergraduate course I could audit. Yet, every video editing class I enquired about was either not going ahead due to unattainable in-person requirements or would inevitably become filled up with students from its own program. I ultimately opted to take a course that my program had cross-listed with York Schulich School of Business' Arts, Media and Entertainment Management MBA program. The course was intended to teach students how to manage a television broadcasting business. It was titled ARTM 6340 U: *Managing the Broadcast & Digital Worlds* and focused heavily on the effect the analogue to digital transition had taken on the industry. While enrolled in the course, I booked appointments with a Digital Scholarship Librarian named Kris Joseph who had a background in business

history research. He was able to help me adapt my research methods and topic into something that would fulfill the learning objectives of an MBA course.

During that same Fall semester, I registered for two Scalar workshops that were advertised through the monthly York Faculty of Graduate Studies newsletter. The prospect of creating a web-based multimedia project appealed to me and I realized upon arrival in the Zoom room that Joseph was one of the facilitators for the workshop. After discussing the benefits of switching from a traditional video essay to a Scalar project with Joseph and professor Theophanidis, it was decided that I would begin practicing with Scalar and enroll in an additional series of workshops offered by Joseph. This experience would then prepare me to begin work on the project in January 2022.

The Making of the Scalar Project (January 2022 to August 2022)

Upon returning from the 2021 holiday break, my first goal was to spend the month of January developing a plan to design and build my Scalar project over the next eight months. I had been meeting with professor Theophanidis and Joseph at regular bi-weekly intervals up until the break and we agreed that we would continue this practice into the new year. I decided that I would use my Friday meetings with Joseph as the natural place for deadlines in this new schedule, as it presented the chance to reflect on what I had done thus far and plan for the next two weeks. The project milestones outline that I created is tabled below.

Star Stuff Project Milestones	Companion Paper Milestones	Due Date
Milestones & Elevator Pitch	Milestones & Outline	January 28th
Part 1 "The Space Race" Research	Project Objectives	February 11th
Part 1 "The Space Race" Draft	Relevance to ComCult Program	February 25th
Part 2 "Science Communication" Research	Framework Research	March 11th
Part 2 "Science Communication" Draft	Theoretical Framework	March 25th
Part 3 "End & New Millennium" Research	Literature Research	April 8th
Part 3 "End & New Millennium" Draft	Literature Review	April 22nd
Part 4 "New Cosmos & Private Space" Research	Desired Reception	May 6th
Part 4 "New Cosmos & Private Space" Draft	Process of Making	May 20th
Part 5 "The Future" Research	What was Learned	June 3rd
Part 5 "The Future" Draft	Rough Draft	June 17th
First Draft	Scalar Conversion	July 1st

As you can see, this table features two sets of milestones. One is for the Scalar project and the other is for this companion paper. Professor Theophanidis would oversee both aspects of the project with a particular focus on the companion paper, while Joseph would provide advice on the Scalar project. Though the making of this companion paper will not be directly discussed here, they were nevertheless both developed in tandem and mutually informed one another as a result.

The first thing I did when developing my milestones outline was divide the topics that I was interested in covering into five distinct parts. The first one was a *space race* section that would summarize the history of Cold War space exploration prior to the release of the original *Cosmos* series. The second was a *science communication* section that looked at the production of *Cosmos* and Sagan's emergence as an international celebrity. The third was an *end & new millennium* section that followed the collapse of the Soviet Union, the privatization of the *Cosmos* series by Turner Home Entertainment, and the death of Sagan. The fourth was a *new cosmos & private space* section that documented Ann Druyan's attempts to rebuild the *Cosmos* franchise at the start of the 21st Century, along with the rise of private space exploration brought

on by funding cuts to NASA. Finally, a fifth section would contain my personal research and reflections on *the future* of space exploration and science communication. However, due to the need to recap what was said in all the other sections before discussing the future, as well as a desire to differentiate a section made up of speculations from an otherwise historical case study, I decided that this would take the form of an accompanying short essay instead. This essay titled *Who Owns (the) Cosmos: An Epilogue, Prologue, and Intermission* presented an opportunity to unify the project thematically without prescribing a particular point when it needed to be read, if at all.

While still working remotely from my home province of Newfoundland and Labrador, I began compiling material on the space race section of the project that February. It was expected that the first section would take longer than the rest, as I would be developing a research and writing workflow that would become more streamlined as I went along. I first began by sifting through images and videos to exhibit from EBSCO's American: History & Life database. However, I soon realized that this material could not be presented through Scalar because you needed a university account to access it. This prevented me from using any of the material that I found in the project. I then moved on to the Internet Archive which would remain the primary source of content. The archives integration with Scalar made it possible to efficiently add material. Furthermore, they were committed to maintaining a stable location for the data Scalar draws upon. This would ensure that the links needed to display videos and images would not become corrupted. That shift in focus quickly caused my research for the space race section of the project to creep into the second half of February. It was challenging to determine what was not working and course correct as needed due to my meetings with Joseph taking place once every two weeks via Zoom. With a new Media Creation Lab in York's Scott Library opening on

March 1st under Joseph's supervision, it was decided that I would move to Toronto and stay at an on-campus student apartment that had been on hold for me since September 2020. Upon arrival, the ability to have more casual daily conversations in the hallway with Joseph about the project drastically increased my productivity.

During this time, I realized it would be more efficient to gather all my materials for each section before beginning writing, rather than write sections without knowing what would be contained in others. I then submitted the following revised milestones outline to professor Theophanidis and Joseph the week of March 25th.

Star Stuff Project Milestones 2	Due Date
Milestones & Elevator Pitch	January 28th (2 Weeks)
Part 1 "The Space Race" Media + Outline	February 11th (2 Weeks)
Part 2 "Science Communication" Media + Outline	March 11th (2 Weeks)
Part 3 "End & New Millennium" Media + Outline	March 25th (2 Weeks)
Part 4 "New Cosmos & Private Space" Media + Outline	April 8th (2 Weeks)
Part 5 "The Future" Media + Outline	April 22nd (2 Weeks)
Part 5 "The Future" Writing + Formating	May 6th
Part 5 *Who Owns (the) Cosmos W* riting + Formating	May 13th
Part 4 "New Cosmos & Private Space" Writing + Formatting	May 20th
Part 3 "End & New Millennium" Writing + Formatting	May 27th
Part 2 "Science Communication" Writing + Formatting	June 3rd
Part 1 "The Space Race" Writing + Formatting	June 10th
Home Page + User Instructions + Companion Paper	June 17th
User Interface Testing + Proof Reading	June 24th
Draft is Sent to Committee Members	July 1st

Despite this new schedule, which would have the writing take place over six one-week intervals between May and early June, my work on the Scalar project continued to not hit these personal targets I set out for myself. I asked Joseph during an early meeting on April 21st if this would become a problem. He responded that I have been applying a linear road map for completion to a project that is intended to be explored in a non-linear way. He suggested that I instead rotate my

table 90 degrees on its side and begin to think of each section as a series of percentage bars. This new workflow would treat all these sections as baskets, with me sifting through material and organizing it into those baskets as I went along. At this point, I decided that I would continue to come into the media lab at a regular ten to five schedule and rely on my bi-weekly meeting check-ins with Joseph and professor Theophanidis to keep me on track towards completion.

It became apparent while researching and organizing material using this new workflow that the five-part structure I originally had in place needed to be adjusted. I decided to split the project into three acts that spanned roughly two decades. Each decade would then get its own Scalar page for a total of six sections. Act 1 would cover major historical moments during the Cold War space race, along with Sagan's work on space probes after the Apollo 11 mission to the moon. This would start with the launch of Sputnik I by the Soviet Union in 1957 and end with Sagan's collaboration on the Voyager Golden Record. Act 2 would begin with the production of *Cosmos: A Personal Voyage* in 1980 and conclude with the death of Sagan in 1996. Act 3 would then follow the work of Ann Druyan after the death of Sagan and finish with the release of *Cosmos: Possible Worlds* in 2020. By May 20th, I had compiled all the videos and images needed for Acts 1 and 2, embedding them into the Scalar. I then needed to do the same for Act 3 and begin the written narration that would tie the project together. However, the first draft of this companion paper needed to take priority for the next couple of weeks after that, as it was due June 13th. Once that deadline was met, my attention then turned to building a fully functioning draft of the Scalar project.

The week of June 20th was spent going over and organizing all the research material I had collected from the 2000s and 2010s for Act 3. I understood that Act 3 would mark a challenging transition in the project. There was very little information about the work of Ann Druyan

between Sagan's death and the reboot of *Cosmos* in 2014. I had to rely on legacy websites created by her production company Cosmos Studios to advertise what they were doing. Most of those sites were not online anymore and could only be viewable through the Internet Archive's Wayback Machine. The archive was able to preserve the websites but much of their functionality had been compromised. After I made it out of the 2000s, the 2010s were also a challenge because I was no longer dealing with a publicly broadcasted television show. Due to copyright restrictions, not even a trailer advertising the shows could be uploaded to the Internet Archive for long term preservation. For the first time while designing the project, I had to almost exclusively rely on YouTube videos and news articles to showcase the history that had transpired. I would discuss that experience and the risk those videos pose to the project's longevity in the "Who Owns (the) Cosmos" short essay.

By July 15th, I had fully compiled all my content for Act 3 and embedded it into the two Scalar sections. I also reorganized a journal of ideas I wanted to discuss in "Who Owns (the) Cosmos". It was time to begin the process of writing the narration that would string the projects' sections together. I wanted this writing to be accessible to the same audience that watched the *Cosmos* shows, but I knew my years of training in academic writing would make this challenging. I learned during the early stages of my research that Carl Sagan wrote most of his work by dictating into a cassette tape and having the recording transcribed by an assistant. I decided to try the process myself by writing out my script in bullet points and then presenting it orally into a transcription software called Otter AI. This gave the narration the touch of informality that I believed would appeal to a non-academic community. A draft of the Scalar project was completed on July 22nd. It was then promptly sent to my committee members, as well as a group of close friends and classmates. This gave me the opportunity to receive feedback

before handing in the final version on July 26th. The days leading up to that July 26th deadline were spent adding images to the title and home pages while implementing feedback. I then upload the final copy of this companion paper into Scalar so that people who wanted to learn about the process of making the project could read it.

Learning Contribution to Professional Practice

Despite not being able to film a documentary for my research-creation project, I still developed skills that are directly relevant to the creative arts industry. My Scalar project in some ways resembles the research work a director would need to do before undertaking a miniseries that could span multiple hours. Furthermore, rather than limiting my skillset to just filmmaking, I have now also branched out into multimedia web design. This project marked my first foray into website building of this scale and coding. That multimedia work has also introduced me to the potential of non-linear experiences as a way of organizing and displaying information. It allowed me to pair the images and videos I carefully curated with an experimental writing style that could be experienced in any order the reader desired. That required me to create guiding principles that aided in my material selection process, along with a clear structure for tagging in Scalar's metadata to group items into thematic categories. This non-linear approach to storytelling may have been similar to what it was like to create a documentary for PBS in the early 1980s. Without a home video release, the original *Cosmos: A Personal Voyage* was likely experienced by many people on and off over the years out of sequence. The opportunity to watch the entire thing from beginning to end at your own pace did not formally materialize until Turner Home Entertainment released the show on VHS and Laser Disc in 1989 (Sagan & Malone, 1989).

I also learned about, and had to adapt to, the challenges of creating multimedia research within an educational framework that is still predominated by traditional thesis, dissertations,

books, and journal articles. The undertaking of this project immediately presented the risk that aspects of my project could become corrupted in the coming years and decades. If any of the media links Scalar draws from are moved or deleted online then my project will be rendered incomplete. Future viewers would then be greeted by an error message rather than one of my carefully curated videos or images as a result. This underscores the dilemma expressed in the quote from Boyle & Mrozowski I shared earlier in this paper. Though the *Cosmos* documentaries teaches audiences that their imaginations are unbounded by spaciotemporal considerations, its move from public to private broadcasting has paywalled its message behind digital rights management measures. My inability to rely exclusively on publicly accessible resources presented a problem that was ultimately irreconcilable. I could either constrain myself to use more stable public spaces such as the Internet Archive, venture into the uncertainty of unstable private platforms such as YouTube or complete a Fair Dealing Assessment in hopes that I would be legally protected when uploading copyrighted material to York's Scalar server. My reflections on these options and the dangers they pose to the dissemination of educational material were further explored in "Who Owns (the) Cosmos? An Epilogue, Prologue, and Intermission". The process of creating an ORCID iD and uploading my project to the university's York Space archive was also my first direct glimpse into academic publishing.

Desired Reception

There are several things I would like viewers to take away from this project. This applies to both the actual content of the Scalar as well as the design and distribution of the project within a broader academic paradigm. To begin with the content itself, I hope this exploration of the work of Carl Sagan and Ann Druyan showcases how the desire to know about the origins of the human species, as well as prevail in the face of ongoing existential dangers such as climate

change and nuclear war, are not new concerns. I also want to make history feel tangible by providing snapshots of historical events as they occurred, rather than retrospectives. This will give people the sense that they are participants in an ongoing history and not just observers or bystanders. The process of conducting a case study of a television franchise's transition from public to private broadcasting placed me in conflict with the very object of my research. By documenting educational media that has become increasingly privatized, it slowly became increasingly difficult for me to find publicly available research material to showcase. This has highlighted why public access to educational media is important. My hope is by documenting this experience I can provide people with a renewed appreciation for publicly accessible knowledge production. I would also like them to reflect on their own educational media consumption habits and how that may have changed as the industry has become more privatized.

Within the realm of academia, this project also serves as an example of how multimedia platforms such as Scalar are valid spaces for displaying research. It blurs the lines between traditional research and artistic practice to the point where the two are indistinguishable from one another. I have created something that offers viewers a unique way to explore my research based on their own interests. Yet, the information is also displayed in an environment that features academically sound citations and links to my sources. This project is also the first piece of published graduate student research to be created at York's new Media Creation Lab in the Digital Scholarship Centre. It demonstrates what the tools provided in that space such as Scalar can achieve. In many ways, the staff at the media lab learned just as much from the making of this project in their space as I did. Thus, the relationship that we fostered between us will now serve as a basis for future multimedia work by graduate students at York.

Part 2 Academic Context of Cosmos Case Study

In this second part of the companion paper, I will now contextualize my Scalar project within the field of communication and culture studies. The study of space exploration media presents an opportunity to reflect on how 'we' as humans conceive of ourselves in relation to the cosmos culturally. Informed by my extensive historical research of *Cosmos* creators Carl Sagan and Ann Druyan's space exploration and science communication endeavours, this project engages directly with over 60 years of ever-evolving representations of outer space in educational documentaries. It then uses this historical context to make recommendations for the future of science communication and space exploration moving into the mid to late 21st Century. Therefore, this research directly grapples with how cultural representations of outer space have, and will be, communicated through educational media in the past, present, and future.

This part of the paper is comprised of two sections, a theoretical framework that outlines the philosophy and communications theory that inspired this project, while a literature review showcases the wealth of science communication scholarship it is in conversation with. The theoretical framework highlights how the creative possibilities offered by Scalar have influenced the theory behind this research. It demonstrates how *Cosmos* as the object of study, the political philosophy of Hannah Arendt, and research of anthropologist David Valentine have all equally impacted the theory and creative design of the project. Meanwhile, the literature review will showcase how the study of the *Cosmos* series and Carl Sagan continues to be integral to the field of science communication. I highlight other case studies that have been conducted, along with ones focused on colonial narratives in *Cosmos*, and conclude by looking at other areas of research in need of further inquiry.

Theoretical Framework

When discussing the theoretical framework for this research-creation project, it is important to acknowledge the role Scalar has played in shaping my theoretical perspective. The *Scalar 2 User's Guide* provided to me by York's Digital Scholarship Centre reads, "Structure in Scalar becomes especially powerful when it's used not just as a way to organize content in a publication, but as a way to model *theoretical* relationships" (Alliance for Networking Visual Culture, 2014). In other words, the tools afforded to me by Scalar dictate how I can display the theoretical relationships in my research, in turn, shaping how myself and my audience interpret this work.

One other theoretical pillar of this Scalar project that cannot be ignored is the object of study itself. That being the *Cosmos* television franchise. Prior to the premiere of the original television show in 1980, Carl Sagan wrote a short essay titled *Cosmos: An Appreciation*. This document outlined many of the show's theoretical underpinnings. In the essay, he stated,

> COSMOS is an experiment – a hopeful one — in the communication of science to general audiences of all ages. Precisely because we have such a long cultural and biological history in which we had to figure things out, I believe there is a natural resonance between the endeavor of science and the way we – all of us — think. We long to understand. We hunger to know the origin of the world and ourselves. The deepest cosmological questions are imbedded in human folklore and myth, superstition and religion (Sagan, 1980c, p. 5).

In this Scalar project, I share many of the goals and aspirations of the original *Cosmos* series outlined in this quotation. This includes a desire to make the project accessible for people of all ages, regardless of their knowledge of the topic. I also believe that this information about how cosmology is portrayed in media is existentially relevant to all people living on this planet. Lastly, *Cosmos* and my project also share an experimental approach to academia. We both want to use communication technology, in my case the multimedia platform Scalar and in Sagan's

case television, to break down barriers between the academic community and the general public. In all these ways, my project is just as much theoretically informed by the original *Cosmos* series as it is directly studying it.

Another key theoretical figure who inspired me to undertake this project was Hannah Arendt in her 1958 book *The Human Condition* and 1968 essay "The Conquest of Space and The Stature of Man" (Arendt, 1968, 1998b). The critique of 20th Century space exploration provided in this work stands in stark contrast to Sagan's views outlined in the *Cosmos* series. For instance, one key area where Arendt differs from Sagan is in her evaluation of space exploration's role in human history. Sagan viewed space exploration as a natural evolution of the human species' origin from 'starstuff'. In the opening minutes of the first episode of *Cosmos: A Personal Voyage*, he compares humans leaving the planet to a dandelion spreading its seeds for reproductive purposes (Sagan & Malone, 1980). However, Arendt did not believe that space exploration was natural, inevitable, or even logical. Rather, she highlighted what she believed to be the unprecedented absurdity of wanting to permanently leave Earth in the prologue to *The Human Condition*.

> "nobody in the history of mankind has ever conceived of the earth as a prison for men's bodies or shown such eagerness to go literally from here to the moon. Should the emancipation and secularization of the modern age, which began with a turning-away, not necessarily from God, but from a god who was the Father of men in heaven, end with an even more fateful repudiation of an Earth who was the Mother of all living creatures under the sky" (Arendt, 1998b, p. 2)?

As a political theorist living amid the early Cold War space race, Arendt could not understand why people would want to leave the only planet in the known universe that could provide us with everything we need for survival, such as oxygen for us to breathe and the correct amount of gravity for our bodies. In *The Conquest of Space and the Stature of Man*, Arendt argues that

space exploration, and the ideological principles of European Enlightenment, are abstracting us from our natural earthly environment.

> "Every progress in science in the last decades, from the moment it was absorbed into technology and thus introduced into the factual world where we live our everyday lives, has brought with it a veritable avalanche of fabulous instruments and ever more ingenious machinery. All of this makes it more unlikely every day that man will encounter anything in the world around him that is not manmade and hence is not … he himself in a different disguise. The astronaut, shot into outer space and imprisoned in his instrument-ridden capsule where each actual physical encounter with his surroundings would spell immediate death, … [will be less likely] to meet anything but himself and man-made things the more ardently he wishes to eliminate all anthropocentric considerations from his encounter with the nonhuman world around him" (Arendt, 1968, p. 277).

Despite this disagreement regarding the motives for space exploration, Arendt and Sagan would both agree that the lack of public knowledge regarding science and technology is, in Sagan's words, "a clear prescription for disaster, especially in a democracy" (Sagan, 1980c, p. 1). However, where they differ is in their solution to the problem. Sagan believed that educating the public about science through 20th Century mass media technologies, such as the television, was the solution. Meanwhile, Arendt thought that scientists were no more equipped at dealing with issues of democracy than the general public. Rather, scientists needed to engage in the public's political discourse instead of trying to educate them on their own. A point that Arendt clearly articulates in the prologue to *The Human Condition* while discussing science's move toward replicating organic life under laboratory conditions.

> [The scientist] seems to be possessed by a rebellion against human existence as it has been given, a free gift from nowhere (secularly speaking), which he wishes to exchange, as it were, for something he has made himself. There is no reason to doubt our abilities to accomplish such an exchange, just as there is no reason to doubt our present ability to destroy all organic life on earth. The question is only whether we wish to use our new scientific and technical knowledge in this direction, and this question cannot be decided by scientific means; it is a political question of the first order and therefore can hardly be left to the decision of professional scientists or professional politicians (Arendt, 1998b, pp. 2–3).

The work of Arendt is integral to the theoretical framework of my Scalar project. Her and Sagan's concerns for political discourse and democracy weighed heavily on how I interpreted my case study in the "Who Owns (the) Cosmos" short essay. The three recommendations for the improvement of science communication outlined there were specifically focused on reconnecting science with public discourse. This was done through a discussion of how the positioning of science as apolitical, the use of defined CGI rather than speculative symbolic representations, and a move towards privatization portrayed cosmology as an already solidified body of knowledge that did not require public input. Although I have much respect for Sagan's work at educating the public and making science more accessible, I agree with Arendt's observation that the threat to political freedom posed by science and technology cannot be resolved through a more widespread understanding of science and technology alone. Thus, science communication needs to acknowledge the inherent ambiguities of what it is presenting and facilitate the development of a shared body of knowledge through direct public input.

One final, and in this case contemporary, scholar that has had a profound impact on the theoretical framework and design of my project has been the anthropologist David Valentine of the University of Minnesota. In his 2017 journal article, "Gravity Fixes: Habituating to the Human on Mars and Island Three", Valentine discusses how long-term life outside Earth's gravitational pull could impact the cultural norms and identity of off-Earth colonizers. He writes,

> "From multiple and specific places elsewhere in the cosmos, where you would need different habits to settle into different gravities, what might count as colonialism, humanness, or difference? What criteria would be in play for assembling accounts of past and future? What new forms of equivalence would be needed to resolve specific problem sets arising from relationalities shaped by general conditions unlike Earth's" (Valentine, 2017, pp. 186–187)?

What Valentine describes in this statement is a sort of social disorientation that would occur in space. In this environment new cultural perspectives and identities would emerge when the ones

formed in Earth's gravity are rendered inadequate. I adopt the work of Valentine as part of my theoretical framework because of his emphasis on how human behaviour on Earth cannot be used to determine how a colonial process elsewhere might unfold.

> What I seek here is … an escape from the assumption (whether rightist or leftist) that the encounter with space will simply produce a repetition, extension, or logical conclusion of history, human sociality, exchange relations or any other human phenomena that have emerged on the surface of our planet. … From both, it requires an engagement with contemporary human activity that is not already explained by the brief span of modern human history (Valentine, 2012, p. 1063).

The social weightlessness described in Valentine's work has also equally influenced the design and structure of my project from an artistic perspective. My project does not have a formal introduction or conclusion, nor does it have an overarching argument or thesis statement that must be understood before reading 'the body' of its content. It is organized in a linear timeline from 1957 to 2020 but exploring the project in that order is entirely optional. The audience could just as easily start at whatever part interests them and continue following those interests until they have finished viewing the entire project. I have frequently described the non-linear nature of this Scalar project as a 'master's thesis without gravity' and this sense of groundlessness is reflected in the title of the project's accompanying short essay, "Who Owns (the) Cosmos? An Epilogue, Prologue, and Intermission". In this way, my Scalar project is an exploration of what academic writing could look like when ideas are let free to float around without a proverbial gravitational pull holding them into a strict set of pages to be read in order.

Literature Review

This creative research project contributes to the field of Science Communication Studies. Science communication is an area of research that examines the way scientific concepts and ideas are, as well as historically have been, communicated to the general public through media.

Within science communication scholarship, Declan Fahy from Dublin City University recognizes Rae Goodell's *The Visible Scientists* as a foundational text (Fahy, 2017; Goodell, 1977). This book by Goodell, which served as a continuation of the research she conducted for her 1975 Ph.D. dissertation at Stanford University (Goodell, 1975), looks at the emergence of certain scientists as visible public figures in the mid to late 20th Century. She used two surveys to isolate 45 scientists known to journalists, along with journalism students, as popular amongst the American public at large. She then selected a sample of seven from those 45 to receive a more rigorous case study. These scientists were Paul Ehrlich, Barry Commoner, Linus Pauling, B.F. Skinner, Margaret Mead, William Shockley, and, most notably for my research, a then up-and-coming Carl Sagan. These case studies were also accompanied by 95 interviews conducted with academic colleagues of the aforementioned scientists, other visible scientists, and those who cover scientific news as part of the media. From this novel exploration of the then-emerging field of science communication, Goodell was able to isolate five characteristics that were common among all eight of the visible scientists in her case study. These included a "hot topic" that the public is interested in, "controversial" opinions around that topic which breed debate, the ability to "articulate" scientific concepts in lay person's terms, a "colourful image" that leads audiences to speculate about the scientist's personal life, and, lastly, a credible reputation achieved through scientific accomplishments, awards, or tenure at a prominent American university (Goodell, 1977, pp. 18–38). It is worth noting that Goodell did not determine these traits were important in isolation. She observed in her surveys that American journalists, operating within their own biases, actively sought out scientists with these five characteristics. Goodell believed these common traits amongst the visible scientist emerged from a symbiotic relationship between them and the news media. A relationship where the media wanted these scientists to behave a

particular way and the scientists adopted that behavior in order to convey their desired message to the public.

Though *The Visible Scientists* is most noted as a seminal work in the field of science communication, it is also regarded as a key text in the study of Carl Sagan. Fahy highlights this link between Sagan and the formation of science communication research in a discussion of how visibility and celebrity has evolved since Goodell.

> Visibility and celebrity were deployed by Goodell as synonyms. But since the late 1970s, a set of concepts emerged in communication and cultural studies to define and analyse fame systematically and explain the effects of celebrity culture on public life (see Turner, 2004). Goodell (1977) was alert to this changing cultural dynamic, writing that astronomer Carl Sagan, who was then best known for his appearances on American television, was 'a prediction for the future'. (p. 163) Indeed, 3 years after the book's publication, Sagan hosted the celebrated TV series Cosmos (1980), which vaulted him to international stardom. Visibility was too narrow a concept to describe the magnitude of his post-Cosmos fame. I argued with a colleague that Sagan was a pivotal figure in the history of scientific stardom, marking and personifying the shift from visible to celebrity scientist (Fahy, 2017, p. 1022).

This shift from public visibility to celebrity first achieved by Sagan has informed future science communication research up until the present. Fahy has written his own book on the topic in 2015 titled *The New Celebrity Scientists: Out of the Lab and into the Limelight* (Fahy, 2015b). That book examined eight 21st Century scientists who achieved celebrity stardom equivalent to that of the late Carl Sagan. These scientists were Stephen Hawking, Richard Dawkins, Steven Pinker, Stephen Jay Gould, Susan Greenfield, James Lovelock, Brian Greene, and the host of the new *Cosmos* series Neil deGrasse Tyson. From this case study of 21st Century science communicators, Fahy concludes that the heightened level of scientific stardom first achieved by Sagan has gone on to permanently alter the public's relationship with science for the better.

> "Stardom is seeping into all aspects of science. And that benefits science. Stardom can bring the values and interests of the public into science. The debate stirred up

> by these figures shows science that it does not stand on a pedestal and that it not somehow cut off from the public debate and discussion" (Fahy, 2015b, p. 214).

One final key thing that Fahy has noted about the science communication landscape post-Sagan is that being a celebrity scientist is no longer as stigmatizing. Early science communicators suffered from what Fahy describes as the Sagan Effect.

> [Sagan] came to starkly illustrate a feature of modern scientific fame, a feature that critics called the "Sagan Effect": the perception among researchers that the level of scientists' public fame was in direct opposition to the quality of their research work. Popular scientists, in effect, were not seen as strong scientists. Before his media career, however, Sagan had established a sound reputation as a researcher, known for his pathbreaking work that explained how Venus became boiling hot and violent windstorms raged across the surface of Mars. He accumulated five hundred career publications-an astonishing rate of productivity that averaged one published academic paper each month. The Sagan Effect, for Sagan, was false (Fahy, 2015b, p. 5).

Fahy has observed that, for the most part, 21st Century celebrity is now seen as a "source of authority" rather than a detriment to research (Fahy, 2015b, p. 217). However, this exemption does not apply to female celebrity scientists. Susan Greenfield, the only female scientist that Fahy case studied due to what he describes as the "paltry" representation of both gender and racial diversity in science media (Fahy, 2015b, p. 15), describes how she has received constant critique from the scientific community during the popularization of her research (Fahy, 2015b, p. 126). However, this is ultimately the account of one science communicator who cannot be expected to speak for the totality of her gender. In a chapter of the *Routledge Handbook of Public Communication of Science and Technology* third edition, Fahy and co-author Bruce Lewenstein acknowledge that "female scientific celebrity" is an area in need of further study (Fahy & Lewenstein, 2021, p. 47). The fact that this 'effect' first experienced by Sagan is still reported by science communicators today showcases why his work, life, and ongoing legacy make for such a worthwhile case study.

In that regard, I am not the only one who has conducted a case study of Sagan. Oliver Marsh has recently published a brief, but comprehensive journal article titled "Life cycle of a star: Carl Sagan and the circulation of reputation" as an example (Marsh, 2019). This work observes the development of Sagan's reputation throughout his career and after his death. It concludes that the reception of Sagan's work and arguments was dictated by the communication context in which it was presented (i.e., public broadcast television versus an academic research paper). There is also no shortage of case studies focused on Neil deGrasse Tyson, with Fahy offering one in his previously mentioned book *The New Celebrity Scientists: Out of the Lab and into the Limelight* (Fahy, 2015a). In this chapter, Fahy delves into some of the racism Tyson has faced as an African American astronomer through a close reading of his autobiography, in addition to news coverage and interviews with him throughout the years. He notes how, unlike Sagan, Tyson built his career by primarily serving as a science media popularizer rather than a researcher. A closer examination of race in *Cosmos: A Spacetime Odyssey* is presented in Claire E. Slattery-Quintanilla's master's thesis from the University of Denver. The thesis is titled *Advancing Sylvia Wynter's Reimagination of the Human and Counter-poetics: A Critique of Contemporary Science Discourse in Cosmos: A Spacetime Odyssey with Host Neil deGrasse Tyson* (Slattery-Quintanilla, 2017). This text analysis, supervised by the recent author of *On Black Media Philosophy* Armond R. Towns (Towns, 2022), uses the work of Jamaican philosopher Sylvia Wynter as a means to critique *Cosmos: A Spacetime Odyssey*'s portrayal of science as a racially neutral practice. It concludes that the narrative presented in the show ignores the scientific method's origins in Renaissance and Enlightenment-era white supremacy. The show refuses to acknowledge the ongoing racism faced by African American scientists such as

Tyson as a result. This, in turn, undermines any hope for meaningful dialogue or movement towards systemic changes within the scientific status quo.

Other academic writing has also sprung up in the years proceeding the release of *Cosmos: A Spacetime Odyssey* that directly compares it to its predecessor *Cosmos: A Personal Voyage*. In an academic review of *Cosmos: A Spacetime Odyssey* titled "Exhibiting Cosmos", Nasser Zakariya argues that, while the original series attempted to simulate what it believed to be verifiably sound interpretations of science and history, the newer series tends to exhibit its content as universal truth without nurturing a critical eye among its viewership (Zakariya, 2015). Zakariya ultimately concluded that *Cosmos: A Spacetime Odyssey* is an engaging update of the original show for a new subset of 21st Century viewership, but it will likely not have the same lasting cultural impact that the original was able to achieve during the public broadcasting era.

The release of *Cosmos: Possible Worlds* with Neil deGrasse Tyson in 2020 presents a renewed opportunity to re-examine the *Cosmos* franchise in light of those 13 additional episodes. This could include expanded variations of the work on *Cosmos: A Spacetime Odyssey* that I have already mentioned. However, I also think that further research could explore many of the other people involved in the franchise that were discussed in my Scalar project. This includes most notably Carl Sagan's close collaborator and widow Ann Druyan. Her *Cosmos: Possible Worlds* companion book delves far deeper into her relationship with Sagan than anything that has come before it (Druyan, 2020). It does this by providing personal anecdotes about their inspirations for the books *Broca's Brain* and *Shadows of Forgotten Ancestors* (Druyan, 2020, pp. 63, 156; Sagan, 1980a; Sagan & Druyan, 1992), as well as retelling stories of their personal romance that had been disclosed in the epilogue to *Billions & Billion* (Druyan, 1997, 2020, pp. 163-164, 354-

355). In some ways, the book acts as a summary of their career together in addition to it being a continuation of the *Cosmos* franchise.

The research of Druyan's work on *Cosmos* after Sagan presents an opportunity to explore the challenges of posthumously continuing a product of the Cold War public broadcasting era in a deeply privatized 21st Century digital space age. Few researchers have specifically focused on how this transition from public to private broadcasting has impacted the *Cosmos* series. However, other work has been able to capture how educational media has been affected by privatization in the 21st Century more broadly. "A Fantasy Made Real: The Evolution of the Subjunctive Documentary on U.S. Cable Science Channels" by Anneke M. Metz of Montana State University is one such article (Metz, 2008). In it, Metz explores how the use of ground-breaking CGI graphics in Discovery channel documentaries like *Walking with Dinosaurs* (1999) ultimately devolved into the depiction of purely fantastical creatures such as dragons in *Dragons: A Fantasy Made Real* (2004). This trend encapsulates how science communication's capacity to invoke a sense of awe in its audience can undermine its goal of conveying knowledge about the empirically observable world. Daniel Silva Luna and Jesse M. Bering of the University of Otago have explored this use of awe in educational documentaries with their article "The construction of awe in science communication" (Silva Luna & Bering, 2021).

Today many science communicators who would have primarily connected with the public through television and print have adopted social media platforms such as Twitter. In 2014 a team from the Universities of Wisconsin-Madison, Utah, Chicago, and Arizona State had nano-scientists complete a survey disclosing their Twitter activity, along with key academic success indicators such as their h-index and tenure status (Liang et al., 2014). Their article titled "Building Buzz: (Scientists) Communicating Science in New Media Environments" found that

being mentioned on Twitter could contribute to a scientist's increased success academically. These findings show that the prevalence of social media platforms should not be ignored in ongoing science communication studies. However, Neil deGrasse Tyson's success on Twitter and in television demonstrates shows that the two are not hostile to one another. They can just as easily present an opportunity for mutual cross-promotion. In addition to science communication, the study of the *Cosmos* franchise comes up in research critiquing the very project of creating a singular unified evolutionary human history. Several academics have cited Sagan in their work on this topic including Steven J. Dick of the Smithsonian Institution, Cadell Last at the Free University of Brussels, and Lucas John Mix from Harvard (Dick, 2012; Last, 2017; Mix, 2018). Likewise, the *Cosmos* series also continues to be looked at in science and religion studies. This includes articles by Lance E. Cummings of the University of North Carolina, Michael N. Keas at Biola University, and Ted Peters at the Graduate Theological Union (Cummings, 2017; Keas, 2021; Peters, 2018). All of this ongoing research demonstrates how *Cosmos*'s goal of presenting "astronomy and space exploration in the broadest possible human context" makes it widely relevant academically to this day (Sagan, 1980c, p. 1).

Conclusion

This ongoing relevance of the *Cosmos* series both academically and on television makes my Scalar project a worthwhile research-creation process. The franchise's ability to endure a 40 year transition from public broadcasting to deeply privatized streaming platforms, alongside an ongoing shift from government lead space exploration to a private space industry, is a testament to the legacy of what Carl Sagan, Ann Druyan, and so many others were able to accomplish back in 1980. In this paper, we have explored the theoretical framework that has informed my project, in addition to the literature of science communication studies that it is in conversation with. We

have also outlined the process of making the project, its contribution to my professional artistic practice, and my hopes for its reception. The information and personal reflections I have provided in *Star Stuff* have implications for the accessible distribution of educational media moving into the future. These revelations will likely only become more relevant as the *Cosmos* franchise, and science communication at large, continues. In the future, social media platforms with an emphasis on video such as TikTok and YouTube, along with virtual/augmented reality technologies like the ones produced by Meta, will play a crucial role in how science is communicated to the public. A clear understanding of the successes and challenges of communicating science on these platforms, which up until now have been primarily designed for socialization, entertainment, private data collection, and advertising, will provide clues toward enhancing information accessibility. My project demonstrates by trying to display the material from my case study in Scalar that exhibiting the new privately broadcasted *Cosmos* is tangibly more difficult than the PBS original. A disparity that will become more apparent as some of the privately accessed content from Neil deGrasse Tysons's *Cosmos* will likely become corrupted before Sagan's does. This initial analysis showcases that further comparison of current privately streamed television shows to their public broadcasted counterparts could yield interesting results. Likewise, the findings of Declan Fahy and Claire E. Slattery-Quintanilla from my literature review highlight the interplay between race, gender, and the communication of science. More can be done to research the legacies of a greater diversity of science communicators. My Scalar project showcases just some of the accomplishments and contributions Ann Druyan has made over the course of her career. In turn, this project serves as a demonstration of what is possible when the areas of science communication and multimedia web design are combined through creative research practices.

Works Cited

Alliance for Networking Visual Culture. (2014). *Scalar 2 User's Guide: Creative Use of Structure*. Scalar 2 User's Guide. https://scalar.usc.edu/works/guide2/creative-use-of-structure

Arendt, H. (1968). The Conquest of Space and The Stature of Man. In *Between Past and Future: Eight Exercises in Political Thought* (pp. 265–280). The Viking Press.

Arendt, H. (1998a). Prologue. In *The Human Condition* (2nd ed. / introduction by Margaret Canovan., pp. 1–6). University of Chicago Press.

Arendt, H. (1998b). *The Human Condition* (2nd ed. / introduction by Margaret Canovan.). University of Chicago Press.

Boyle, K., & Mrozowski, D. (2019). Screening Cosmos-politanism: The Anthropocenic politics of outer space media. *Science Fiction Film and Television*, *12*(3), 343-363,425-426. https://doi.org/10.3828/sfftv.2019.20

Cummings, L. (2017). Science and the Religious Rhetorics of the Ineffable: A Comparison Between Two "Cosmoses." *Res Rhetorica*, *4*(2), Article 2. https://doi.org/10.29107/rr2017.2.2

Dick, S. J. (2012). Cosmic evolution: The context for astrobiology and its cultural implications. *International Journal of Astrobiology*, *11*(4), 203–216. https://doi.org/10.1017/S1473550412000110

Druyan, A. (1997). Epilogue. In *Billions & Billions: Thoughts on Life and Death at the Edge of the Milennium* (pp. 268–275). Ballantine Books.

Druyan, A. (2020). *Cosmos: Possible Worlds*. National Geographic.

Druyan, A. (Writer) & Braga, B. (Director). (2014) [TV series]. In S. MacFarlane & M. Cannold (Executive Producers), *Cosmos: A Spacetime Odyssey.* Fox.

Druyan, A. (Writer) & Braga, B. (Director). (2020) [TV series]. In S. MacFarlane & J. Clark (Executive Producers), *Cosmos: Possible Worlds.* Fox.

Fahy, D. (2015a). Neil deGrasse Tyson's Star Quality. In *The New Celebrity Scientists: Out of the Lab and into the Limelight* (pp. 179–201). Rowman & Littlefield.

Fahy, D. (2015b). *The New Celebrity Scientists: Out of the Lab and into the Limelight*. Rowman & Littlefield.

Fahy, D. (2017). Historical moments in public understanding of science: 1977, The Visible Scientists identifies a new scientist for the mass media age. *Public Understanding of Science*, *26*(8), 1019–1024. https://doi.org/10.1177/0963662517732909

Fahy, D., & Lewenstein, B. (2021). Scientists in popular culture: The making of celebrities. In *Routledge Handbook of Public Communication of Science and Technology* (third, pp. 33–52). Taylor & Francis. https://doi.org/10.4324/9781003039242

Goodell, R. (1975). *The Visible Scientists.* [Ph.D., Stanford University]. http://www.proquest.com/docview/302764962/citation/B191126544E749F5PQ/1

Goodell, R. (1977). *The Visible Scientists*. Little, Brown, and Company.

Keas, M. N. (2021). Evaluating Warfare Myths about Science and Christianity and How These Myths Promote Scientism. *Religions*, *12*(2), 132. https://doi.org/10.3390/rel12020132

Last, C. (2017). Big Historical Foundations for Deep Future Speculations: Cosmic Evolution, Atechnogenesis, and Technocultural Civilization. *Foundations of Science*, *22*(1), 39–124. https://doi.org/10.1007/s10699-015-9434-y

Liang, X., Su, L. Y.-F., Yeo, S. K., Scheufele, D. A., Brossard, D., Xenos, M., Nealey, P., & Corley, E. A. (2014). Building Buzz: (Scientists) Communicating Science in New Media Environments. *Journalism and Mass Communication Quarterly*, *91*(4), 772–791. https://doi.org/10.1177/1077699014550092

Malone, A. (Director). (1980). *Cosmos: A Personal Voyage*. PBS.

Marsh, O. (2019). Life cycle of a star: Carl Sagan and the circulation of reputation. *The British Journal for the History of Science*, *52*(3), 467–486. https://doi.org/10.1017/S0007087419000049

Metz, A. M. (2008). A Fantasy Made Real: The Evolution of the Subjunctive Documentary on U.S. Cable Science Channels. *Television & New Media*, *9*(4), 333–348. https://doi.org/10.1177/1527476408315117

Mix, L. J. (2018). Philosophy and data in astrobiology. *International Journal of Astrobiology*, *17*(2), 189–200. https://doi.org/10.1017/S1473550417000192

SpaceX. (2016, September 28). *Making Humans a Multiplanetary Species*. https://www.youtube.com/watch?v=H7Uyfqi_TE8

SpaceX. (2017, September 29). *Making Life Multiplanetary*. https://www.youtube.com/watch?v=tdUX3ypDVwI

Peters, T. (2018). Science and Religion: Ten Models of War, Truce, and Partnership. *Theology and Science*, *16*(1), 11–53. https://doi.org/10.1080/14746700.2017.1402163

Sagan, C. (1980a). *Broca's Brain: Reflections on the Romance of Science*. Ballantine Books.

Sagan, C. (1980b). *Cosmos*. Ballantine Books.

Sagan, C. (1980c). *Cosmos: An Appreciation* [Online text]. Library of Congress, Washington, D.C. 20540 USA. https://www.loc.gov/resource/mss85590.050/

Sagan, C., & Druyan, A. (1992). *Shadows of Forgotten Ancestors: A Search for Who We Are*. Ballentine Books.

Sagan, C. (Writer), & Malone A (Director). (1980, September 18). The Shores of the Cosmic Ocean (Season 1, Episode 1) [TV series episode]. In G. Andorfer & R. McCain (Producers), *Cosmos: A Personal Voyage.* PBS.

Sagan, C. (Writer), & Malone A (Director). (1989) [TV series]. In Gregory Andorfer & Rob McCain (Producers), *Cosmos Carl Sagan* [VHS]. Turner Home Entertainment.

Silva Luna, D., & Bering, J. M. (2021). The construction of awe in science communication. *Public Understanding of Science*, *30*(1), 2–15. https://doi.org/10.1177/0963662520963256

Slattery-Quintanilla, C. E. (2017). *Advancing Sylvia Wynter's Reimagination of the Human and Counter-poetics: A Critique of Contemporary Science Discourse in Cosmos: A Spacetime Odyssey with Host Neil deGrasse Tyson* [M.A., University of Denver]. http://www.proquest.com/pqdtglobal/docview/1930618879/abstract/88B3B0325EFB40C4PQ/1

Towns, A. R. (2022). *On Black Media Philosophy*. University of California Press.

Valentine, D. (2012). Exit Strategy: Profit, Cosmology, and the Future of Humans in Space. *Anthropological Quarterly*, *85*(4), 1045–1067. https://doi.org/10.1353/anq.2012.0073

Valentine, D. (2017). Gravity fixes: Habituating to the human on Mars and Island Three. *HAU: Journal of Ethnographic Theory*, *7*(3), 185–209. https://doi.org/10.14318/hau7.3.012

Zakariya, N. (2015). Exhibiting Cosmos. *Technology and Culture*. https://doi.org/10.1353/tech.2015.0086