Beyond Spectacle: Shaping Responsible Sociotechnical Imaginaries in Space Exploration

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

Not too long ago, in April 2025, pop star Katy Perry ventured into Low Earth Orbit on a mission sponsored by Blue Origin. Alongside other high-profile women, Katy Perry was part of an effort to project an image of diverse female figures exploring space. From watching interviews with each of the all-female crew to seeing the high-glam photoshoots, I uncovered something fascinating: space is not just science. It is spectacle, aspiration, and fantasy. With further research, I learned visuals produced by events like this are part of a larger phenomenon: sociotechnical imaginaries. These visuals propagate into collective visions of future worlds: worlds that could be enabled by specific technological advancements. These visuals resulting from events like this space venture shape the public's expectations for what space missions should look like, who should be going, and why these missions are relevant to our societal goals.

As defined by Sheila Jasanoff in Dreamscapes of Modernity, sociotechnical imaginaries are "collectively imagined forms of social life and social order reflected in the design and fulfillment of nation-specific scientific and/or technological projects" (Jasanoff, 2015). Jasanoff acknowledges that this definition has limitations and does not account for all the ways in which technological visions play a role in social life. Per Jasanoff, sociotechnical imaginaries can be propagated by corporations, social movements, and larger groups of people.

In this paper, I examine the evolution of sociotechnical imaginaries in space exploration. Jasanoff asserts that imaginaries can result from 'visions of single individuals or small collectives, gaining traction through blatant exercises of power'(Jasanoff, 2015). I focus on how such visions—from single individuals, small collectives, and powerful institutions—shape collective imaginaries for the future. I argue that today's dominant imaginaries, influenced chiefly by private space firms and nationalist rhetoric as well as popular culture, do not emphasize addressing an urgent need for sustainable innovation in the aerospace industry. Instead, they prioritize finding a new home for humanity and feeding scientific curiosity. I use this paper to explain what fuels current imaginaries about space and propose deliberate reimagining to shape them into ones rooted in ecological responsibility, global equity, and reusability principles. I will utilize sociotechnical imaginaries to analyze this connection between propagated imaginaries and what the public expects of human interaction with space going forward.

Historical Foundations of Sociotechnical Imaginaries

In October 1947, a rocket-engined, hypersonic aircraft called the XS-1 was flown by Captain Chuck Yeager. Weighing less than 500 lbs, the aircraft was proof of concept that the first stage of a rocket could be replaced by this vehicle. The plane had a vertical takeoff and reached a high suborbital altitude. When the aircraft's cruising speed crossed Mach 1, Chuck Yeager had broken the sound barrier. Even in 1947, the coverage of the event was prominent, with cameras recording the flight both inside and outside the aircraft. The 2.5-minute flight was set to mark a significant moment in history (Bob van der Linden, 2022). The videography was accompanied by a style of music chosen to enhance the drama, reminiscent of a soundtrack from a science fiction movie. Shots were taken of Chuck Yeager standing outside the plane with his crew, where they posed like models. An article by SpaceNews was released in 2007, commenting on the achievement accomplished by Chuck Yeager, titled "Fastest Man Alive"—a title in the '90s that, for science fiction comic book lovers, was reserved for Barry Allen, the Flash. They appealed to an audience of comic book enthusiasts with backgrounds in space-based stories and vibrant imagery of space life, creating an imagination where a human could travel at speeds typically associated with superheroes.

Thirty years later, NASA's Space Shuttle Program created a reusable launch vehicle, establishing an image of routine space travel and a more democratized system (Vaughan, 1990). The solid rocket boosters were recovered and refurbished after each successful flight, but the high up-front costs prevented the technology from spreading for several decades. The imaginaries that formed around it sparked reactions from the public. While not experts in every aspect of the space program, Americans maintained a largely positive view of it, with over 70% reporting a 'favorable impression' from 1978 to 1999. It is suggested that 1995 marked the peak of Americans' belief in the space program's importance, a sentiment linked to the Shuttle docking missions and the Apollo 13 feature film (Launius, 2019). This indicates that a blend of intentional storytelling and related imaginaries can potentially boost public interest in the concepts of commercial space travel and space exploration.

President Kennedy argued that human spaceflight demonstrates "the best of our abilities" (Shelhamer, 2017). His remarks hinted at the potential for these efforts to enhance the nation's image and showcase American ambition. This indicates that during that era, the aim of space exploration extended beyond potential technological innovations; it was also about uniting the nation to achieve extraordinary feats. Society drove technological progress, which, in turn, advanced the nation. In the 80s and 90s, public opinion focused on economically efficient space endeavors, positioning the United States as a leader in this emerging domain (Shelhamer, 2017).

Another influential moment was the 1990 deployment of the Hubble Space Telescope, which captured the public imagination with surreal images of deep space. Scientific curiosity has been a driver of many spacecraft launched into space. However, the resulting photography from

the Hubble outshone previous imagery of deep space, provoking a sense of wonder with 'spectral portraits' of cosmic objects (Chaisson, 1990).

SpaceWorks Engineering and Abstract Knowledge characterize space exploration as involving "periods of 'punctuated equilibrium,'" noting that crucial turning points and achievements have expanded the possibilities for further exploration (Thompson, 2020). The launch of Hubble, the Apollo moon landing, the Space Shuttle Program's successes, and the Challenger and Columbia disasters all serve as significant turning points.

The unfortunate events of both the Challenger and Columbia disasters introduced the real risks involved in human spaceflight, leading to a loss of public trust (Launius, 2019). After the tragic disintegration of Columbia in 2003, there was a clear shift in favor of robotic missions over manned ones. This new ordeal was not just about keeping humans in orbit; it prioritized technological advancements while promoting safety. Ethical questions about whether existing laws could keep up with the pace of new technologies were being asked (Boisjoly, 1989). This developed an imaginary different from the ones surrounding the Hubble or Yeager's flight, one where scientific exploration persists, but not at the risk of human life. Transitioning from space race-driven missions and geopolitical rivalry to collaborative efforts like the International Space Station led to imaginaries grounded in scientific neutrality and diplomacy (Weinzierl, 2018).

Private and Public Industry: The New Commercial Imaginary

Elon Musk, founder of SpaceX, has introduced a vision at the nexus of two opposing futures, characterized by 'sociotechnical optimism' and 'planetary pessimism' rooted in fears of global environmental change (Tutton, 2021). Silicon Valley entrepreneurs like Musk have devoted many resources to promoting specific visions for the future and demonstrating how technology can enable those imaginaries. These visions are linked to the state of the planet and the potential necessity for an alternative one. Counter-campaigns like 'There is no Planet B' provide an opposing perspective by directing financial resources to combat climate change (Nicholson, 2025). However, the views expressed by companies like SpaceX highlight the need to colonize other planets. Musk and others envision humanity's future in space, expanding our imagination. The company's website has a simplistic aesthetic, emphasizing high-quality graphics of rocket launch trajectories and the physical components themselves. Phrases like "alter humanity's access to space" and "to make life multiplanetary" evoke images of rockets launching toward other planets and society preparing for life on a different planet (SpaceX, 2025). A survivalist rhetoric enabled by rocket technology innovations aligns with imaginations that frame space as a place for 'elite technical saviorism' (Goessler, 2020). The imaginaries that result from this sort of rhetoric create a sense of urgency that the Earth will not be enough and that the frontier should be colonized.

Jeff Bezos, founder of Blue Origin, is part of the billionaire space race. Jeff Bezos grew up watching Star Trek, and his venture is a clear product of many of his imaginings about space. In 2021, coincidentally or not, Bezos sent up William Shatner, a member of the Star Trek cast (Kaun 2023). Blue Origin reflects much of Bezos's imagination for space exploration, increasing access to space, and commercializing space. By invoking the American pioneering spirit, the company has created a pro-environmental image through hydrogen cell fuel usage and has argued for heavy industry to be moved off-planet (Ready for Reuse, 2020).

Rocket Lab, a newer endeavor, has contributed to the imaginaries developed by the private industry through its marketing of responsive launch services and efforts to follow Blue Origin and SpaceX in the deployment of reusable rocket technologies (Access to Space, 2020). On January 21, 2018, Rocket Lab launched its reusable launch vehicle, the Electron, featuring a

disco ball-shaped Humanity Star. Its reflective surface shined in the night sky and served as a reminder to "look beyond our immediate situation, whatever that may be, and understand that we are all in this together as one species, collectively responsible for innovating and solving the challenges facing us all," as CEO Peter Beck stated (Mann, 2019). It remained in orbit for two months, serving as a beacon of hope for collaborative space exploration. The Humanity Star represents a vision where humans unite in collaboration as they begin to explore space, and where our collective future lies in all our hands. For younger generations and enthusiasts of ideas such as Mission to Mars, events like this serve to strengthen the individual imaginations they may possess.

All three ventures have created gasp-worthy narratives surrounding their missions and the motivations behind the development of their technology. These narratives develop into imaginaries of futuristic societies in space, and that time on Earth might be limited. The technological developments of reusable rocket technology and alternative fuel cells help them to execute the imaginaries they propose through their mission statements.

These imaginaries by top industry powers can inspire future startups and entrepreneurs and encourage positive visions for the public. However, these companies and their proposals have struck a more negative impression in the eyes of NASA scientists and other informed audiences. Many in the scientific community are worried about the rocket stages left in low Earth orbit after completing missions. For instance, in 2007, approximately 90% of accidental satellite breakups were attributed to floating launch vehicle stages and rocket components. Many scientists fear that Kessler Syndrome—a situation in which low Earth orbit becomes overwhelmed by collisions and debris, rendering the orbital region unusable—may become a

more pressing reality if we continue to see repeat instances of launch vehicle stages being left in LEO or exploding (Lumia, 2025).

The billionaire space race has involved many instances of personalities like Musk and Bezos publicly claiming their next goal. For example, following the launch of 7,000 satellites by Starlink, Amazon claimed that 3,000 satellites would be sent over to create its own communication services. Dr. John Crassidis, a professor at the University of Buffalo who works with NASA, claims that 50 years is a reasonable time frame for Kessler Syndrome to develop into a reality if the problem is not corrected (Loftus, 2025).

With these concerns from credible scientists, the image of satellites covering the Earth in Low Earth Orbit, travelling at speeds around 17,000 mph, is frightening and counters the more exciting imaginaries. It is one of many harsh realities that could play out if we are not careful.

Cultural Media: Media, Storytelling, and Spectacle

Movies and television are powerful engines for building space imaginaries. Consider, for example, Interstellar, a Christopher Nolan film that captures the story of an ex-NASA pilot searching for a new habitable planet for humanity. The outstanding cinematography made it challenging to remind me that the visuals depicted dreamt-up worlds rather than ones observed in reality. A memorable scene is on Miller's planet, where the nearby black hole, akin to ocean waves and our moon, controls massive waves. Its depiction of time dilation, planetary ruin, and quantum communication creates an imaginary world where space exploration is imperative to our survival as a species. Climate collapse and the real consequences of climate change on Earth are vividly portrayed in this movie, which helps build the urgency to find a new home (Lewis, 2014). Interstellar's impact extended beyond breathtaking visuals, influencing standards for cosmic representations of black holes and wormholes and even catalyzing black hole research. In

making the film, physicist Kip Thorne worked with the visual effects team, and the result was the discovery of black hole modelling, with much of the code licensed by Warner Bros (Kane, 2025).

Science fiction movies not only spark imaginations about the possibility that Earth may one day become unsustainable, but they also offer a glimpse into what it might look like for us to become a multiplanetary species, building relationships and establishing a new world structure. Frank Herbert's Dune is a science fiction epic set in a distant future where noble families hold power in a galactic empire. The world created on the planet Arrakis is not merely waiting to be claimed or colonized; its inhabitants have cultivated an understanding of the environmental knowledge and cultural traditions that exist there.

Other television shows and films like *The Martian (2015) and Star Trek (1966 - 2017)* evoke emotional responses with visuals of futuristic spacecraft and space technologies. Hover mobiles and extravagant lunar cruises that are significantly exaggerated, potentially leading to public frustration regarding our advancements in space exploration. The term 'grandiose visions' coined by SpaceWorks Engineering describes the imagery presented by entertainment media (Charania, 2002). While much of this content comes with a casual disclaimer highlighting its fictional nature, the media still plays a crucial role in shaping the audience's perception of what space travel might entail. Such grandiose visions may also distract viewers from the current realities of the industry, as images of unattainable technology gain popularity. Nevertheless, it is essential to consider the perspective of filmmakers and those distributing these narratives. They aim to meet public demand and recognize that people yearn for excitement about future possibilities, seeking to expand the types of futuristic imagery they can explore and develop.

Cinema, theme parks, and museums are all popular avenues for engaging the public, and examining the visuals these spaces offer reveals much about public interest and desires. From

early childhood, people encounter various depictions of possible relationships between humanity and space exploration. Mission: Space at Disney's Epcot takes you on a mission with the X-2 Deep Space Shuttle, making you feel like a heroic astronaut. Attracting younger audiences, attractions like this make younger people aspire to travel and explore, even as far as space. The Kennedy Space Center plays a huge part in conveying national narratives and downplaying commercial involvement. The Kennedy Space Center also acts as a platform for things like SpaceX launches, allowing visitors to come close to the world they might have only experienced through a screen. Live coverage of these launches is usually done from the space center (Neale, 2025). An image of wonder is formed at this place from seeing full-scale rockets, looking over to the launch site, and being near the heart of the chaos.

The audience may lack knowledge about the complexities involved in executing space missions or explorations in general. The media could address this by showcasing spacecraft that are more accurate to scale and reflective of the vehicles we have available for space travel. Such representations often diminish the understanding of the logistical and technical challenges associated with completing both manned and unmanned space missions.

Outside the entertainment industry, many news platforms also shape public perceptions of space exploration and related technologies. Several CEOs come to mind when discussing space exploration and travel. Elon Musk has been in the news more recently due to his work with the government. Still, more importantly, his conversations with Fox News correspondents about his goals reveal a lot about his future aspirations. Musk stated his goals for Mars: "It is not about going to Mars to visit once, but to make life multiplanetary... in the hopefully unlikely event that something happens to Earth, so there is continued consciousness on Mars" (Sherratt, 2025).

Individuals like Elon serve as bridges between scientific communities, companies, and the general public.

Their social media presence, elaborate launch events, and insights into their mindsets have made the objectives of industry leaders much more transparent. As social media and news outlets can function as two-way communication channels, CEOs and industry leaders are acutely aware of the public's perceptions of their companies' activities as well as other companies' activities. An example was when Firefly Aerospace's Alpha rocket launched seemingly successfully until the stage 2 lightning engine nozzle took a hit, and the rocket did not have enough thrust to reach orbital velocity. The root cause was hard to determine, and a mystery was created around the visual of 'a bright cloud of white vapor', causing alarm to those watching (Clark, 2025). In addition to comparing the launch to other minor failures of private firms, the news was sure to include a statement by Peter Beck, Rocket Lab's founder, saying the Firefly's Alpha is a "no man's land" in the launch market and that "it is too small to be a useful rideshare mission" (Clark, 2025). These opinions assist them in shaping their media and public presence, often prompting them to respond to or clarify potentially misleading statements.

One drawback for CEOs who maintain a near-celebrity status with the public is that while successes in the space sector can quickly gain attention online, failures can also damage the company's reputation and that of its prominent leader. Any backlash these executives face may influence contracts with agencies like NASA, and even minor setbacks can attract significant scrutiny. This creates a concerning atmosphere regarding imaginaries that point to the commercialization of space, as the spectacle often overshadows critical technical, ethical, or collaborative discussions.

Public Opinion Data: Imaginaries in Tension

As of 2023, seven out of ten Americans agree that it is essential for the nation to remain 'a world leader in space.' Furthermore, 65% of adults say it is crucial for NASA to continue its involvement in space exploration and related activities instead of relying on private companies (Pew Research Center, 2023). The findings of this survey also suggest that Americans may not be well-informed about the inner workings of private companies, including their efforts to limit space debris. Additionally, 69% of Americans believe it is vital for the United States to become a global power in space (Borowitz, 2023).

In similar surveys, many Americans commented on private companies and their roles in 'making important contributions to space exploration' and 'building reliable spacecraft and rockets.' Americans prioritized activities such as monitoring asteroids, collecting climate data, testing the effects of space travel on human health, and searching for new materials/resources as top priorities for NASA. Furthermore, 35% of Americans expressed interest in traveling on a private spacecraft to orbit the Earth (Pew Research Center, 2023). This indicates that many Americans may view private spacecraft as neither particularly accessible nor urgent. However, this does not suggest they do not support the private sector's significant initiative to broaden public access to space.

Discussion

As an engineer and someone mesmerized by space, I have concluded that the sociotechnical imaginaries we promote profoundly shape public opinion and the kinds of futures we imagine and build. Growing up 20 minutes away from the Udvar-Hazy Center, I spent many weekends wandering around rockets and airplanes. At the end of the day, my family and I would head to the IMAX theater in the same building and immerse ourselves in cinematic spectacles like

Interstellar. Having both educational experiences and space-themed movies under the same roof shaped how I viewed setting goals for space exploration. Fictional worlds on-screen and the tangible technology displayed in the museum exhibits created a powerful combination of knowledge and exploration.

At the same time, I was captivated by comic books and science fiction novels. Captain America and Iron Man comics were not just a source of entertainment- they were my first introduction to engineers who had no limitations. Advanced technology was used to protect humanity, and a sense of responsibility is something all heroes who make their tech are written with. Since then, I have wanted to use engineering as a way to contribute to building a sustainable future.

My experiences and the research above fuel a belief that influential narratives that drive collective action must be constructed the right way. Our visions for the future should be centered around ecological responsibility and global equity, from designing new technologies to our overarching goals for space exploration. We should leverage tools like movies, television, and popular culture as avenues to reach people with new narratives. The sustainable imaginaries that need to be developed start with highlighting and offering praise to the technologies that support this future, like reusable rocket technology. Engineers must remember that embedding sustainability into their designs' most minor nuances can make huge differences. When thinking about space exploration, the images that come to mind should be of rockets with reusable parts, alternate propulsion like hydrogen fuel cells or electric propulsion, and mission statements that reflect a sense of curiosity and urgency, but pay respect to the planet we still have to protect.

In addition, private industry and its leaders should be held responsible for shaping public expectations in reasonable directions. It is essential that the public feels that someone is watching

out for them as we explore this new frontier, and that nightmares like the Kessler Syndrome are unlikely. The ethical responsibility to contribute to positive images of sustainability and equity combines with the need to gain the trust of the proportion of the public that might be otherwise apprehensive towards space exploration.

Lastly, our commitment to protecting Earth should be reinforced. The imaginaries should encourage an appreciation and responsibility toward our home, not an urgency to replace it. Earth best accommodates humanity's ecological and social needs (Pompili, 2023). Therefore, it is imperative that efforts in space exploration complement efforts to sustain the planet.

Conclusion

In assessing the evolution of sociotechnical imaginaries surrounding space travel, key moments such as the hype and visuals from Chuck Yeager's flight, the unfortunate incidents of the Challenger, and the fantastical images from the Hubble telescope impact the formation of these imaginaries. I gathered examples of commercial space films, museums, and other reflections of art to see how these forms of media can impact imaginaries around space. I was able to draw connections between societal perspectives on space exploration and the information put out by media sources, as well as the goals set by private industry. The narratives and their ability to guide both careers and ethical responsibility, like it did for me, were discussed, and the importance of shaping those narratives was asserted. A set of priorities and conditions that I think should be met was established that reflect values of reusability, equity, and ecological responsibility.

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