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The New Frontier or a Billionaire's Joy Ride? Artificial Intelligence Driven Analysis of Twitter Conversations of the SpaceX Company

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The New Frontier or a Billionaire's Joy Ride?
Artificial Intelligence Driven Analysis of Twitter Conversations of the SpaceX

Company

By

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Submitted in Partial Fulfillment
of the Requirements for
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Abstract

In recent years, space travel has become less of a vision for select individuals in the field of research and is now on the cusp of becoming an experience available to paying customers. The purpose of this study is to determine Twitter users' perceptions of SpaceX during the COVID-19 pandemic period from March 2020 to December 2021. We identify Twitter sentiment and emotions regarding such a new and abstract notion of a service that could be more widely available in the future. To achieve these goals, we collected tweets related to SpaceX using Brandwatch – a tool allowing the search of content from multiple social media platforms, including Twitter, as well as artificial intelligence-based analytics of audience sentiments (positive, negative and neutral) and emotions (joy, fear, anger, disgust, neutral, sadness and surprise). Data was analyzed to estimate (1) the distribution of positive, negative, and neutral sentiments towards SpaceX, (2) distribution of seven emotions (joy, fear, anger, disgust, neutral, sadness, surprise), (3) specific events/figures associated with peaks in positive/negative sentiments and emotions, and (4) authors in terms of their type (experts vs. non-experts), number of tweet posts, and the influence. Statistical analysis was conducted to examine the relationship between the variables. We found that most tweets (66.25%) showed neutral sentiment regarding SpaceX; however, positive sentiment (27.41%) appeared more frequently than negative sentiment (6.34%). Tweets expressing an opinion about SpaceX garnered significantly fewer impressions compared to neutral posts, and there was no statistical significance of positive or negative sentiment based on the author type - experts vs. nonexperts. A greater number of authors were nonexperts (83.32%); however, the tweets by experts generated 96.9% more impressions than those by nonexperts.

The New Frontier or a Billionaire's Joy Ride?

Artificial Intelligence Driven Analysis of Twitter Conversations of the SpaceX Company

Introduction

Space travel has become less of a vision for select individuals in the field of research in recent years and is now on the cusp of becoming an experience that is available to paying customers. In 2002, Elon Musk founded SpaceX, an aerospace company with the purpose of reducing costs and increasing accessibility of space transportation, with an overall mission to colonize Mars. "You want to wake up in the morning and think the future is going to be great - and that's what being a spacefaring civilization is all about," Musk said. "It's about believing in the future and thinking that the future will be better than the past. And I can't think of anything more exciting than going out there and being among the stars" (SpaceX, n.d.). This mission of space travel with a for-profit business model is unprecedented. Thus, the public have responded accordingly to this new age of space exploration.

The public's perceptions of this mission are crucial to the success of the company. Without a positive image, a company can quickly lose its market share and customer loyalty. As explained by a study of corporate reputation and customer retention among three service industries, "the degree of customer loyalty has a tendency to be higher as the perceptions of both corporate image and corporate reputation are strongly favorable" (Nguyen, 2001, p. 227). When the public views a corporation's image in a positive light, the company is likely to have a larger number of customers and a greater sense of customer loyalty. Considering the costs and inherent risks involved with space travel, it is crucial that companies in the private space sector have positive reputations and a brand identity that reflects safety. Without these elements, companies such as SpaceX cannot survive in such an expensive and competitive market.

The rise of social media as a communication tool for the public to express its opinions and feelings of a company or organization can be both incredibly powerful as a research tool or serve as a weapon of destruction for a brand. With social media, “the public [can] participate actively in crisis communication. Such intense and negative crisis communication among the public has the potential to create broad and profoundly negative effects for firms in crises; it also challenges firms’ ability to recover from a crisis” (Zheng et al., 2017, p. 56). Considering the speed at which information can spread on social media, it poses a risk to a company or organization to fall behind the frenzy and suffer severe reputational damage. In such a risky sector, where the smallest of mistakes can lead to catastrophic failure, the perceptions the public holds of a business need to be consistently managed and improved. Thus, the technique of measuring public sentiment on social media has become increasingly popular among businesses, organizations, and political campaigns.

The process of using AI (Artificial Intelligence) to monitor and track public sentiment based on specific parameters can help a business identify how the public feels about its practices and what specific events, products and crises have had an impact on its reputation. This resource is incredibly popular for studying potential projections for election results. In a sentiment analysis of citizens’ political preferences in Italy and France, the researchers’ results indicated that “[there is] a remarkable ability for social media to forecast electoral results, as well as a noteworthy correlation between social media and the results of traditional mass surveys. We also illustrate that the predictive ability of social media analysis strengthens as the number of citizens expressing their opinion online increases, provided that the citizens act consistently on these opinions” (Ceron et al., 2013, p. 340). Outside of elections, this tool can serve as a guideline of

where a business needs to make improvements and address unfavorable sentiment to improve its corporate reputation and thus increase the likelihood of the company's survival.

As the space sector continues to become privatized, and private companies prepare to send customers into space, public opinion of these companies, as examined through social media, will greatly affect the viability of private space companies and their business practices. This project aims to examine this current viability through a comprehensive content analysis of social media conversation on SpaceX. In particular, we aim to identify (1) the sentiment regarding SpaceX expressed in related tweets, (2) the emotions and key themes surrounding SpaceX tweets, and (3) the predominant influencers of SpaceX-related conversations on Twitter.

Review of Literature

New Space Age

In recent years, there has become a refortified interest in the idea of space as a new frontier, especially among entrepreneurs in the United States. Expanding on the 1960's vision of making space travel a possibility, this "new space age" views the next frontier as letting regular people, not just famed astronauts, travel among the stars. This is evidenced by the increasing rate at which people are investing in space-related ventures. According to analytics firm BryceTech, "investments in space startups nearly doubled from 2018 to 2019... and space companies raised a record \$14.5 billion in 2021, reported CNBC..." (Nguyen, 2022). This significant jump indicates a trust in the possibility of making space travel more regular, and eventually commercial.

In the past few decades, multiple companies, such as Jeff Bezos's Blue Origin, Virgin Galactic, Space Adventures Ltd., and SpaceX (this study's primary focus), have led the movement to make spaceflight available to paying customers. Whether for the sake of

entertainment or in response to growing concerns of climate catastrophe on earth, the movement to bring ordinary individuals to space has become a frequently trending topic on social media, especially surrounding company-related launches. Thus, there is a need to examine these conversations to gain insight into the feelings and opinions expressed by individuals in response to these innovations.

SpaceX

Elon Musk founded SpaceX in 2002 with the mission of commercializing spaceflight and eventually bringing humanity to Mars. What sets SpaceX apart is the ability of its rockets to withstand reentry into Earth's atmosphere, land, and fly again, when most rockets burn up on reentry by design. It is the first private company capable of returning a spacecraft from low-Earth orbit. To date, SpaceX has had 152 total launches with 114 total successful landings, and 91 of those launches being re-flown rockets (SpaceX, n.d.). This reusability cuts down on costs for SpaceX, as they do not have to build a new rocket every time they choose to do a launch as NASA and other space programs have had to do in the past. Currently, SpaceX's Falcon9 rocket is capable of landing on special landing zones near their launch pads or on an autonomous spaceport droneship in the middle of the ocean.

SpaceX currently uses one main rocket, the Falcon 9, and one main spacecraft, the Dragon. The Falcon 9 was the "first orbital class rocket capable of reflight" (SpaceX, n.d.). The rocket has been launched a total of 147 times, 87 of which being reused rockets, with 107 total successful landings. It is designed to be reusable and contains two stages. The Dragon spacecraft is attached to the top of the Falcon 9 rocket and is used to carry both cargo and a total of seven passengers. The spacecraft has been launched a total of 33 times, with 29 of those launches being visits to the International Space Station (ISS). Of those 33 launches, 13 used reflown rockets.

Looking forward, SpaceX plans to use the Starship spacecraft and Super Heavy rocket (collectively referred to as Starship) for its missions, especially those to the moon and beyond. Since January 2020, SpaceX has built 10 prototypes of Starship and conducted six suborbital flight tests and four high altitude flights (SpaceX, n.d.). The Starship will be fully reusable and capable of refueling in orbit without returning to Earth. SpaceX's website claims the Starship "will be the world's most powerful launch vehicle ever developed, with the ability to carry in excess of 100 metric tonnes to Earth orbit." SpaceX plans to use the Starship to deliver satellites into orbit, ferry people and cargo to and from the ISS, carry cargo to the moon, and eventually be an affordable vehicle for interplanetary transportation (SpaceX, n.d.). The Starship will be powered by the Raptor engine, which was first tested on the prototype Starship rockets in July 2019.

Business Model. SpaceX earns revenue through contracts with NASA to carry astronauts and cargo to the ISS, contracts with other private companies to ferry satellites and other cargo to space, and through their budding commercial spaceflight program. SpaceX has been transporting cargo to and from the ISS since 2012, and in 2020 they began ferrying astronauts to the ISS through NASA's Commercial Crew Program. In total, SpaceX's Dragon spacecraft has made 20 trips to the ISS. On April 8th, 2022, SpaceX launched its first all-private crew to the ISS on the Ax-1 mission (Knutson, 2022). The crew spent 21 hours in the Dragon capsule before docking with the ISS. The mission was funded by Axiom Space and lasted 10 days in total, with eight days spent conducting experiments on the ISS. SpaceX is looking to continue bringing private crews to the ISS in addition to fulfilling its contracts with NASA, and therefore knowing the consumer sentiments from stakeholders involved in both of these endeavors, especially those of

experts and government officials, is important for SpaceX to know whether their stakeholders approve of their plans and if they can expect to continue their ventures in the future.

SpaceX plans to bring commercial spaceflights to Earth's orbit, the moon, and eventually Mars. Customers will have the ability to choose their destination and customize their trip accordingly. A customer wishing to orbit Earth can expect to be in the Dragon spacecraft over 300km above Earth's surface with up to six other people. The Dragon will fully orbit Earth every 90 minutes, and the orbits can be customized so that passengers can fly over any location they wish. This spaceflight itinerary was accomplished by the Inspiration4 mission, which launched on September 15th, 2021. The Inspiration4 mission was the world's first civilian mission to orbit, and the crew orbited as high as 590 km above the surface of the Earth, which is the highest anyone has gone since the Hubble telescope missions (SpaceX, n.d.). The crew consisted of commander and pilot Jared Isaacman, founder and CEO of Shift4 Payments, medical officer Hayley Arceneaux, a physician at St. Jude Children's Hospital, mission specialist Chris Sembroski, an Air Force veteran and aerospace data engineer, and mission pilot Dr. Sian Proctor, a geoscientist and entrepreneur. The mission had two objectives: to raise \$200 million for St. Jude and to study the human body in space, both of which the crew accomplished. The crew spent three days in Earth's orbit before splashing down on September 18th, 2021.

Customers can also choose to use SpaceX's Starship system as Earth-to-Earth transportation. The Starship can travel up to 27,000 km/h, which means that customers can get anywhere on Earth in under an hour, with most long-distance trips lasting thirty minutes or less. For example, a flight from Los Angeles to London covers 8,781 km, a trip a commercial airline can make in 10 and a half hours (SpaceX, n.d.). With the Starship, the trip would only last 32 minutes. The Starship would travel outside of Earth's atmosphere, providing passengers with a

fast and frictionless flight with no turbulence or weather delays (SpaceX, n.d.). Passengers would ride a ferry to one of SpaceX's autonomous spaceport drone ships in the ocean and then board the rocket for their quick, stress-free flight.

Another future destination for SpaceX customers is the moon. Riding the Starship, customers can spend 6-7 days on a lunar mission, which can involve orbiting the moon or landing on it. SpaceX expects to make its first commercial moon mission in 2023 with Japanese billionaire Yusaku Maezawa (Chang, 2021). This trip would only be a flyby of the moon but would nevertheless be a milestone for the private spaceflight company.

SpaceX's ultimate destination is Mars. Musk hopes to colonize Mars and feels that SpaceX is on "the road to making humanity multiplanetary" (SpaceX, n.d.). The Starship system would again be used to fly passengers to this planet, which would be a journey lasting six months. Given Mars' natural water and carbon dioxide resources, the Starship rockets would be able to refuel on Mars itself, with additional on-orbit refilling stations in low-Earth orbit.

Reputation's Impact on Business

Organizational reputation has become a crucial tenet of both success and destruction of the organization. In the business context, corporate reputation can either help a business weather a storm or sink it into oblivion. Among many, Horn et al. (2015) defined reputation as "an intangible asset that is of financial value for an organization and can influence the attraction of customers, the motivation of workers, the generation of investment interest, and positive media coverage" (Horn et al., 2015, p. 195). The better an organization's reputation, the better these facets generally are regarding the organization. This is especially true in niche and high-risk markets. According to Harvard Business Review, "in an economy where 70% to 80% of market value comes from hard-to-assess intangible assets such as brand equity, intellectual capital, and

goodwill, organizations are especially vulnerable to anything that damages their reputations” (Eccles, Newquist, & Schatz, 2007). This level of risk makes every move an organization makes especially crucial, and SpaceX is no stranger to this level of uncertainty. As an exceedingly unique organization with a high-risk and expensive product offering, a mistrust or lack of faith in its mission could cause irreversible damage. Its stakeholders should thus be a leading insight in decision making and the direction the company must take, as positive reputation can help predict its profitability and success. This is reinforced in the *Strategic Management Journal*, with researchers finding that firms with consistently positive reputations have a much easier time maintaining profits and good feelings from stakeholders as years progress (Roberts & Dowling, 2002). If social media content relating to SpaceX is overwhelmingly or consistently positive, this could predict a greater sense of brand loyalty as it gets closer to achieving its vision of bringing humanity to space. Yet, there is a scarcity of research investigating the public's support or opposition to the SpaceX project.

The importance of reputation is greatly impacted by the level of control the public possesses due to the democratization in the flow of information created by social media. Explained by Horn et al., “in a world where consumer time zones have become invisible and communication increasingly immediate, the power shifts away from a company towards the consumer... the democratization of communication, that is, the shift of power towards individuals and communities, as one of the most important results of the wide adoption of social media by the public. Due to this empowerment, consumers often confront companies with their social, ethical, and commercial responsibilities” (Horn et al., 2015, p. 196). This shift in power makes reputation harder and harder for companies to control, and thus, they must be conscious that their actions are ethical and live up to the expectations of their stakeholders. “The influence

of social media... allows users to post content or get interactive without any permission... consumers use new media to contribute to all parts of the value chain, ranging from superficial articulation (reviews on retail or fan sites) to extensive co-creation..." (Horn et al., 2015, p. 196). Consumers can start conversations or respond to millions of people worldwide with little restriction, if any. This can be great for organizations by creating free publicity and spreading the word about its product or service; however, if the conversation is overwhelmingly negative, it can be a cause for crisis.

This can be strongly related to the snowball effect that opinions shared on social media can have. As noted by a survey in China of social media responses impacting reputation regarding a health crisis, participants were more likely to express their thoughts on social media if their posts and comments seem to reflect a similar viewpoint (Zheng et al., 2017). If a user senses a generally negative view of a certain organization, it can be assumed that if the individual agrees with this sentiment, they may be more prone to post. This tendency is similar to the bias found in surveys based on social desirability theory, which explains people's desire to fit in and seem more socially acceptable. For instance, people may answer survey questions dishonestly if they think a truthful response will make them look bad (Latkin et al., 2017, p. 133). The desire to conform bleeds into social media use and can likely impact the sentiment around a certain product or organization. Thus, studying the sentiment of social posts should be considered a crucial element of reputation analysis and a tool for decision making within an organization. Hence, we aim to assess the relationship between the sentiment in SpaceX social media conversation and the company's popularity.

AI and Social Media

Social media is no longer just a source of entertainment and communication. Given social media's extensive impact on much of society, with Pew Research Center noting that 72 percent of U.S. adults use at least one social media site, it serves as a viable resource for garnering a persons' thoughts and opinions for research purposes (Pew Research Center, 2021). Researchers and organizations have recently discovered the power of public posts as data for analysis. In recent years, artificial intelligence platforms, such as Brandwatch (the platform utilized in this study), have been developed to gather data from various social media sites and blog posts for analyzing tweet volume, sentiment and emotions. According to Etter et al., "this method bases on the techniques of natural language processing, text analysis, and computational linguistics, and measures the affective orientation of sentences toward an object (Pang & Lee, 2008). It, therewith, gives indication about "affect-based responses" through which ordinary citizens bestow legitimacy to organizations (Haack, Pfarrer, & Scherer, 2014, p. 634). The method allows assessing judgments about organizations (a) in large amounts of social media data, (b) to develop time-sensitive measures, and (c) to access judgments about understudied organizational issues by important actors of civil society..." (Etter et al., 2018, p. 63). This powerful tool can both serve as a guiding resource for organizations in their future efforts and as a glimpse for the public of what the general sentiment around an idea or product is. Further explained by Etter at al., "judgments in social media are impactful because ordinary citizens increasingly use them as information sources to assess and negotiate the appropriateness of organizational actions." As Twitter users rely on social media comments to assess the trustworthiness of organizations, companies can inversely use these expressions as a resource to assess the public's feelings of their business and adjust accordingly.

Given SpaceX's incredibly unique product offering, it's unsurprising that its launches consistently trend on Twitter, with thousands of tweets being posted monthly. The concept of spaceflight is so unique and abstract to the public that it is a fascinating subject worthy of discussion. Will ordinary people ever really make it to space? Is it safe? If so, would it be interesting to go? Many of these questions have paved frequent discussion of the company.

This newness can also develop a sense of fear in those that are hesitant of change. Based on the Innovation Adoption Curve, a theory developed by researcher E.M. Rogers, when people adopt new concepts or products, about 34 percent of people are considered late majority adopters and 14 percent are laggards (Petan, G., 2021). Late majority adopters generally only consent to adoption after continued peer pressure. They want to ensure that something is safe before consenting. Laggards, more intensely, are almost entirely resistant to change, but are generally a part of the older population and would theoretically not ever take to spaceflight. While the percentage of individuals in each adoption population varies based on the concept or industry, the late majority and laggard populations could pose a significant concern for a company with a product offering such as SpaceX's. Despite the potential of AI in quantifying people's emotions as appearing on social media data, there is a lack of research applying AI in understanding the public's emotions towards SpaceX. We aim to address this gap.

Previous Research

Scholars have only begun to analyze the public perceptions of SpaceX. Platt et al. (2020) conducted focus group interviews with 81 college students and revealed doubts regarding feasibility, concerns related to cost, and an individualized sense of risk that outweighed more generalized benefits. Similar to this study, Ganesha and Sinnoor (2021) analyzed tweets including *#SpaceTourism*, including from SpaceX, posted between August 11 to August 13,

2021. They suggested a higher proportion of positive sentiments about space tourism, which could be a temporal response right after the successful landing of a Falcon 9 craft to Earth.

Despite this previous research, there are no published research findings on perceptions of SpaceX on a long-term basis on social media, specific events/figures associated with positive or negative sentiments/emotions, and people or organizations facilitating or leading relevant conversations on social media. Our research will address these limitations in existing literature and expand the current body of work by analyzing SpaceX related tweets posted in the U.S. from March 2020 to the end of 2021. This date range is significant due to the COVID-19 pandemic's impact on daily life during this time. With many individuals spending most of their time at home, social media became an even more significant source for expression, thus leading to more available tweets from which to gather sentiment.

In addition, there were critiques of SpaceX and other commercial space travel development projects during this time. While most industries were shut down or restricted, the aerospace industry was supported by the U.S. government. According to Grush, "in the US, [the government] classified many aerospace companies as "essential," since they held contracts with NASA or the Department of Defense. This allowed companies to continue to bring employees on site to continue working on all their projects, both government-related and commercial... [the government] also provided a lifeline in the form of contract payouts...that kept a lot of organizations afloat until investment picked back up again... and after a second quarter slowdown, the third quarter of 2020 became 'one of the biggest quarters on record for investment and growth in infrastructure space...' (Grush, 2020). The contrast between restricting or closing more commonplace businesses while simultaneously funding an industry that has little to no effect on daily life was not always received well among the public. In response to the industry's

“critical business” status, space research firm Astralytical’s founder Forczyk expressed: “it’s a free-for-all... and it’s less to do with public health and more about economics” (Wattles, 2020).

Many individuals were frustrated with this preferential treatment and its seeming disregard for issues happening on earth, such as food insecurity and a lack of medical resources. It has yet to be studied if these frustrations have impacted sentiment of the aerospace industry. Thus, this study aims to garner whether pandemic-related frustrations have affected trust in the SpaceX company.

In summary, this thesis aims to understand the sentiment, emotion, key themes, and influencers of SpaceX-related conversations on Twitter to provide implications for not only the company’s business, reputation, and stakeholder management but also policy makers’ future regulatory actions on commercial space travels. We aimed to answer the following research questions:

RQ1: What are the sentiments (positive, negative, and neutral) towards the SpaceX project?

RQ2: What are the key events or figures associated with positive and negative sentiments?

RQ3: Who are the individuals or organizations leading the conversation?

RQ4: What are the emotions (e.g., joy, anger) and associated events/figures?

Methodology

The intention of conducting this sentiment analysis was to illuminate potential leading thoughts and opinions of the viability of commercialized space travel among Twitter users. Based on the sentiments expressed by vocal Twitter users, the research hoped to determine if there is an expressed trust or distrust in the SpaceX mission among Americans. An advantage of this method

of research is the sheer volume of data that can be collected from an artificial intelligence platform. Even with a sample rate of only five percent, we still gathered over 20,000 tweets from over a 22-month period. Having such a significant amount of data available from users across the United States more strongly allows for study results to be generalized for that population.

Data Collection

To obtain Twitter data for this project, we were granted access to the University of South Carolina's Social Media Insights Lab's Brandwatch software. Within this platform, we created a query outlining certain parameters to best collect tweets containing relevant discussions of SpaceX throughout the pandemic, in this case ranging from March 2020 through December 2021. This date range was selected due to query volume constraints and the increase in social media use during the pandemic as a result from increased downtime throughout the world. As for search parameters, our query included the following:

```
((SpaceX OR Falcon9 OR Transporter-3 OR spaceflight) AND country:"USA") NOT (Tesla OR Starlink OR news OR dogecoin OR Neuralink OR brain OR chip OR car OR ISS)
```

We only collected data from United States users since SpaceX, and most other commercialized space firms, are U.S.-based companies. Based on its proximity, American users may have a greater interest in the successes or failures of SpaceX's launches.

To best target tweets needed for this analysis, our query required each tweet to mention at least one of the following: SpaceX, Falcon9, Transporter-3 or spaceflight. This was intended to ensure that collected tweets had a direct connection to SpaceX and launches meant to further the progress of the company's mission to commercialize spaceflight. Conversely, the query also disregarded tweets mentioning the following terms: Tesla, Starlink, news, dogecoin, Neuralink, brain, chip, car, or ISS. This was done with the intention to separate tweets that may be influenced by outside factors, especially relating to SpaceX's founder, Elon Musk. The

entrepreneur is a frequent subject of fascination among Americans and consequently frequently trends on Twitter. With this in mind, other businesses or technological ventures that Musk participates in were disregarded to potentially eliminate bias that could stem from others' perceptions of the businessman.

Collected at a five percent sample rate, we gathered over 20,000 tweets from this query. After removing retweets without replies, since they do not contribute original thoughts, our final sample consisted of 2,806 original tweets.

Measures

Once the 2,806 tweets were gathered and two researchers checked for inter-coder reliability, the data was coded for further analysis (see Appendix A for coding manual).

Author type. Tweets were first filtered for expert affiliation. Those labelled *experts* were users that were noted as having a Ph.D. or another form of involvement in the space travel industry. Authors who did not claim expertise were categorized as *non-experts*.

These were additionally separated based on the physical organization (such as NASA) and individuals. The accounts with noted professions were then coded based on industry. The possible industries of interest were as follows: (1) SpaceX affiliated; (2) NASA affiliated; (3) Other aerospace agencies but SpaceX & NASA (e.g., Blue Origin) affiliated; (4) News reporters/Journalists (CNN, Fox, XX news) affiliated; (5) Education/research/science institution (e.g., university) affiliated; (6) Marketing and (7) Politician/Legal. It is important to note that not all authors' professions could be identified by the Brandwatch software. Additionally, not all professions were classified due to a lack of relevancy to the project.

Sentiment. Tweets were manually coded for sentiment of SpaceX. All tweets were classified as positive, negative or neutral. Tweets given a *positive* classification were those

whose tone viewed SpaceX in a constructive or trustworthy light. If the content was clearly favorable of SpaceX, it was classified in this category. An example from this study's sample includes:

“@SpaceX Of Course I Still Love You 🚀😍@SpaceX 😎#Falcon9 landing never gets old.

<https://t.co/aIaHDgMG60>.”

Tweets classified as *negative* were those whose tone viewed SpaceX as bad or detrimental. If the tone or wording communicated distrust, it was classified as negative. An example includes:

“@daily_pool @HopelessLiberal There is no “style” in space. It’s harsh, dangerous, and we are not meant to be there.”

Tweets classified as *neutral* were those that communicated general updates without expression of additional emotion. Neutral tweets served predominantly as news-like updates regarding SpaceX and its actions. The tone of these tweets was straightforward and lacked strong wording. An example of a neutral tweet from this data set includes:

“NASA #LaunchAmerica Campaign as USA returns to Space with the new era of human spaceflight when NASA astronauts fly on SpaceX’s Crew Dragon spacecraft Falcon 9 rocket 4pm, May 27 to the space station
<https://t.co/7wbjv8vgwz> #nasa #spacex #dragonspacecraft #elonmusk #spacestation <https://t.co/zmO71YUUuQ>.”

If a tweet did not express either a positive or negative emotion in its wording or tone, it was classified as neutral.

Emotions. Brandwatch assigns six different emotions to the mentioned data it collects. According to Brandwatch, it uses a “list of six basic emotions as defined by the famous psychologist Paul Ekman to classify mentions: anger, disgust, fear, joy, surprise, and sadness... emotion is assigned to mentions automatically by the system, using a custom statistical classifier which was created in-house by our team of data scientists” (Taylor, 2019). The measure is then developed into an interactive dataset that can show the volume of each emotion and how it

changes over time. The classifications for emotion by the AI software could not be adjusted by the researchers and were entirely determined by the software.

Impressions. Brandwatch defines impressions as “a measure of the potential number of times a tweet may have been seen...[it] is the sum of the followers of the tweet author and the followers of any retweeting authors” (Stata, n.d.). Accounting for the number of impressions that a tweet receives shows how popular the sentiment associated with the tweet is and how widespread different sentiments are.

Data Analysis

Once coded, Stata, a statistical data analysis software, was used to analyze the data to examine the relationship between expert affiliation and impressions, professions and sentiment and which sentiment had the greatest impressions.

Findings

Sentiment. Of the 2,806 tweets in our sample, 1,859 were categorized as neutral, amounting to 66.25 percent of the total. 769 tweets, or 27.41 percent of the total, were positive, while only 178, or 6.34 percent, were negative. Appendix B shows a histogram visualizing this breakdown. Upon reviewing a time series analysis of tweet volume by sentiment, key events associated with positive sentiments were launches and subsequent splashdowns of various missions, especially the launch and return of the Inspiration4 mission. Appendix C shows a timeline of the sentiments of the total sampled tweets, meaning those including retweets. The Inspiration4 mission, which occurred between September 15th through September 18th, 2021, demonstrates a 26,000-tweet spike in Twitter conversations about SpaceX, which includes 6,000 positive and non-neutral tweets. A larger spike of positive sentiment appeared at the beginning of the pandemic in March 2020, as many tweet authors expressed a desire to go on a civilian space

flight to escape Earth and the pandemic. Negative sentiments also arose around launch times as people discussed the issues of SpaceX and commercial spaceflight, but the increase in negative sentiment was very small. Appendix D shows the same graph from Appendix C, but without neutral tweets, to better show how the volume of the non-neutral tweets changed over time.

Authors and sentiment. In our sample, ordinary individuals or non-expert authors tend to express their thoughts or spread information about launches more frequently. Non-expert authors were defined as those who were not experts or news affiliated. Experts were defined as those who listed their profession as scientist or researcher, had a Ph.D., or were found to be directly affiliated with SpaceX, NASA, or another organization related to the spaceflight industry. Within our sample, 83.32 percent of authors were non-experts, 5.74 percent were experts, and 11.33 percent were affiliated with news media (Appendix E). These non-expert individuals contributing to the conversation also include authors who run accounts dedicated to reporting information about SpaceX and their activities, such as user Falcon9Block5 and user SpaceflightNow. In fact, 88.52 percent of sampled tweets were authored by individuals, whereas only 11.48 percent were authored by organizations (Appendix F). Organizations contributing to the conversation included NASA's main account, various NASA subsidiary accounts, and news outlets such as user Newspapercup. 81.37 percent of the 322 tweets authored by organizations were neutral, while 15.84 percent were positive and only 2.80 percent were negative (Appendix G). Therefore, most positive and negative tweets were authored by individuals.

Tweets from non-expert authors, who were the majority, were 64.03 percent neutral. This group had the highest proportion of non-neutral tweets; 29.47 percent of their tweets were positive, while 6.50 percent were negative (Appendix H). Given that non-expert authors consist of the majority of stakeholders that SpaceX would target its commercial spaceflight services

towards, the fact that they have the largest proportion of positive tweets is a very good sign for SpaceX. This means that in addition to non-expert authors tweeting neutral, news-related announcements of SpaceX missions, they have the largest proportion of positive tweets, which shows that they tend towards approving of the business in addition to being interested in SpaceX.

The sampled tweets included 161 expert authors. The expert authors included astronaut Victor Glover and astronaut Cady Coleman along with various NASA affiliated accounts. 69.57 percent of the tweets authored by experts were neutral, while 26.60 percent were positive and only 6.83 percent were negative (Appendix I). The large proportion of neutral tweets suggests that expert authors discuss SpaceX and its missions in a purely scientific, informative way. The combination of the high percentage of neutral tweets, very few negative tweets, and the decent number of positive tweets suggests that while expert authors may not feel overly strongly about SpaceX, they do wish to discuss it, which means that they feel it is notable and successful enough to merit a discussion. This implies that while experts might not outright approve or disapprove of SpaceX, they do view it as legitimate and a mainstay contender in the commercial spaceflight industry, which is a tremendous vote of confidence for SpaceX. Additionally, since SpaceX currently earns revenue from contracts with government agencies such as NASA, positive opinions by experts increase the likelihood that NASA will want to continue to give SpaceX contracts, which will keep SpaceX going until it can gain more revenue from commercial spaceflight itself.

A chi-square test was conducted to determine if there was a relationship between being an expert author and sentiment. We found a chi-square value of 0.103, which, since it is less than the calculated test statistic of 2.52, shows that there is a statistical significance between an expert author having different sentiments as opposed to a non-expert author. A regression further

evaluated this relationship (Appendix J). We found that being an expert as opposed to a non-expert author is associated with a 0.53 percentage point increase in the probability of a tweet having a negative sentiment. Being an expert author as opposed to being a nonexpert author is associated with a 3.6 percentage points increase in the probability of a tweet having a neutral sentiment. Positive tweets, however, did not have a statistically significant difference between expert and non-expert authors.

Impressions by sentiment. Additional statistical analysis was conducted to determine additional relationships between the variables. Regressions were run in Stata to determine whether the number of impressions differs by type of sentiment. A regression was run with positive and negative sentiments as the independent variables and the log of impressions as the dependent variable (see Appendix K for the regression equation and hypotheses and Appendix L for the regression's output before its log transformation). According to this regression, after going through an additional log transformation, positive tweets received 57.15 percent fewer impressions than neutral tweets. Negative tweets received 66.79 percent fewer impressions than neutral tweets. Therefore, neutral tweets received the most impressions out of the three sentiments, followed by positive tweets, with negative tweets having the fewest number of impressions. This means that neutral tweets, in addition to being the highest proportion of our sample, are most likely to be seen by other Twitter users. An F-test was run to determine whether positive or negative are statistically different. This F-test generated a p-value of 0.0319, which is statistically significant at the alpha level of 0.05. Based on this, we can reject the null hypothesis that the relationship between having a positive or negative sentiment relative to having a neutral sentiment is associated with the same decrease in the log of impressions at the 5% level. Therefore, we can conclude that negative tweets are associated with fewer impressions than

positive ones. A second regression was run with expert authors as the independent variable and the log of impressions as the dependent variable (see Appendix M for the regression equation and hypotheses and Appendix N for the regression output). This regression found that being an expert as opposed to being a non-expert author is associated with a 96.9 percent increase in the number of impressions the author's tweet receives. Since expert authors, especially those from NASA, have more Twitter followers on average than non-expert authors, we wanted to see whether this was the cause of the increased number of impressions that expert authors received, as it was possible that the number of Twitter followers was causing omitted variable bias. When controlling for the number of followers the expert account has, being an expert as opposed to being a non-expert author is associated with a 20.45 percent increase in the number of impressions the author's tweet receives. When adding the log of the number of Twitter followers an author has, we found that even conditional on the number of Twitter followers authors have, experts had more impressions than non-expert authors. Therefore, the reason experts have more impressions does not seem to be solely because of their larger number of Twitter followers; it is possible that they receive more impressions because others value tweets from experts more than tweets from non-experts.

Discussion

Based on the tweets obtained in this study, there does not seem to be a significantly negative view of the SpaceX company. There is also not an indication of a major lack of trust in the company's mission or the idea of commercialized spaceflight. This is interesting considering some previous research does reflect a minor hesitation among its surveyed population. In a study of Americans conducted by Wright in 2021, one in four surveyed did not believe space tourism to be an ethical business venture for reasons predominantly due to financial and environmental

concerns (DeMarco, J., 2021). This hesitation, though noted in some tweets within the study's sample, was not as predominantly expressed. Additionally, findings regarding this study's four research questions regard the SpaceX company and mission as positive, which could lead to future success for the business.

To answer our first research question, the sentiments toward SpaceX were overwhelmingly neutral for all different classifications of authors. Neutral tweets mainly consisted of announcements of launches, mission updates, and sharing articles about SpaceX (see Appendix O for examples of neutral tweets). The large number of neutral tweets implies interest in the company, as it demonstrates stakeholders' interest in discussing the company. It also implies that SpaceX is here to stay, as the high level of communication about it suggests that the population accepts it as a mainstay in the commercial spaceflight industry.

Our second research question addresses the events associated with purely positive and negative tweets. As seen in Appendix D, the first main spike of positive tweets occurred around May 30, 2020, which was SpaceX's Demo-2 launch of the Falcon9 rocket and Crew Dragon spacecraft. This was a 63-day mission aboard the ISS and was the last test mission required before NASA would certify SpaceX for operational crew missions to and from the ISS (SpaceX, n.d.). A spike occurred again around August 2nd, 2020, which was the splashdown and recovery of the Demo-2 mission. Given the mission's success, NASA gave SpaceX its certification, which generated many positive tweets for SpaceX. The next large spike occurred around April 24, 2021, which was the launch and docking of the Crew-2 mission to the ISS (SpaceX, n.d.). This mission was the first human spaceflight mission to reuse a both a rocket (the Falcon9 rocket used to power the Crew-1 mission) and spacecraft (the Dragon spacecraft used on the Demo-2 mission), which was an enormous step in the evolution of spaceflight. The ground-breaking

nature of this launch caused this spike in positive sentiments, which implies that stakeholders are interested in discussing the technological innovations that SpaceX has created. The last major spike in positive sentiment occurred during the September 15-18th, 2021 Inspiration4 launch. This was SpaceX's first all civilian flight, so naturally it was a big topic of conversation. The fact that it generated a large spike in positive sentiment and only a small increase in negative sentiment suggests that people are excited about commercial spaceflight and generally view it in a positive or neutral way. The negative tweets generated criticized a billionaire paying to go to space or how expensive the commercial missions are, so even some of the negative tweets express a desire to be able to experience spaceflight (see Appendix P for examples of positive and negative tweets). This is great news for SpaceX because it indicates that people are interested in their service and view it in a positive light, and their only major points of contention are the exorbitantly high cost or with Elon Musk himself.

Our third research question was to discover the individuals who are leading the conversation about SpaceX. As discussed above and demonstrated in Appendices D and E, most authors were non-expert individuals. However, there were many instances of non-expert individuals who had an amateur interest in space or SpaceX itself and created blogs and Twitter accounts to post about these topics (see Appendix Q for an example of a SpaceX related blog account). These individuals lead the conversation and were among the highest amount of repeat tweeters.

Our fourth research question asks about the emotions associated with SpaceX related events. The Brandwatch software generates graphs relating to emotions over time; however, it does not include the emotion associated with a tweet in a data download, just the sentiment. Therefore, the emotions could not be analyzed in the same way as sentiment. Appendix R shows

the Brandwatch generated graph of emotions of SpaceX related tweets over time. For an easier viewing experience, Appendix S shows the same graph but without joy so the fluctuations in other emotions can be seen. The spikes in emotion occur around the same launch dates mentioned above. The highest spikes are joy, which is a very good indicator of SpaceX's future success. However, it is interesting to see in Appendix S that fear, sadness, and anger also spike around these launch times. The spike in these three emotions, however few the tweets associated with them are, is an interesting finding that could be further investigated using a more developed AI platform.

Conclusion

The implications of this study could have significance to the SpaceX business model. The tweets sampled in this study reflect a more neutral or positive view of the company and its efforts. This could indicate that there is a substantial degree of trust in SpaceX and that individuals could visualize a world where commercial spaceflight is a reality. If this is the case, as SpaceX continues to have successful launches and innovation that brings it closer to making spaceflight an affordable and regular occurrence, the public could reasonably follow suit in its support of the brand. However, this will likely take time and more convincing among late majority adopters, as these individuals may or may not already be involved in spaceflight dialogue on social media platforms such as Twitter. These concerns are further addressed in our limitations.

Limitations

There are limits to this study that need to be addressed. Due to restrictions on Brandwatch's downloading capabilities and the time constraints of this project, our desired tweets could only be collected at a five percent sample rate over the short date range of March

2020 to December of 2021. Thus, the data collected may not completely reflect the sentiment of Twitter users regarding SpaceX and its mission to make spaceflight accessible to the public. However, with a sample of nearly 3,000 unique tweets, the sample is robust enough to consider the results to be reasonably capable of generalizing to the studied population.

Another limitation to this research is the imperfect capabilities of the Brandwatch software. In 2020, the *Journal of Advertising* published a study examining the effectiveness of Brandwatch (then named Crimson Hexagon), with alarming results. According to the researchers, “[while] analyzing a random 10,000-post sample of the conversation around the Nike “Dream Crazy” ad featuring Colin Kaepernick, findings reveal Crimson Hexagon’s AI tools to be woefully unreliable in terms of brand identification as well as detection of post and brand sentiment polarity, specific emotions, and brand outcomes, demonstrating the hazards of blindly relying upon conclusions drawn from black-box social media listening platforms” (Hayes et al., 2020, p. 81). This finding is worrying for researchers, as it calls into question the accuracies of their findings and requires them to take additional steps to verify data. However, the method in which the Brandwatch software is taught to analyze language has been updated for greater accuracy. According to Brandwatch data science manager Colin Sullivan, “customers can [now] expect to see an average accuracy of around 60-75 percent, but this will always vary with the type of data being looked at... My team is tasked with calculating sentiment for posts from over 100m data sources, so we try to evaluate with a wide variety of data sets...” (Taylor, 2022). Brandwatch’s team is continuously teaching its platform the nuances of language, but for now, the software is only so accurate.

When testing for inter-coder reliability after collecting the data in this study, it was found that certain tweets’ categorization by the software as positive, negative or neutral were incorrect.

Certain elements of tweets, such as all capitalized text and the use of generally negative words, such as “can’t,” would lead the software to incorrectly label some tweets’ sentiment as negative when the tweets were actually positive. This is likely due to the newness of the software, as it takes time for artificial intelligence to learn the intricate nuances of language. To resolve some classifying issues within this project, each tweet was read and manually corrected if errors were found. Of course, this may not have prevented all errors, as some inaccuracies may not have been verifiable. For example, the software may have missed certain users’ professions or misclassified emotion, both of which could not be manually corrected. Thus, all results should be regarded with minor skepticism.

Naturally, there are limitations to the use of social media data regarding generalizability of study results. Despite social media’s “public forum” capabilities, only so many individuals are actively participating in discussions on these platforms. According to a study conducted by the Pew Research Center, only about 22 percent of Americans are active Twitter users (Wojcik & Hughes, 2019). Less than a quarter of the American population are users of this platform, and thus, a significant portion of this study’s desired population is not reflected in its results. Therefore, this data may not be entirely generalizable to the American public’s sentiment and attitudes regarding SpaceX and its mission. However, given the capabilities of collecting data across the entire United States, this data collection method was more successful in gathering data that varied in location, demographics, and volume than other data collection methods would allow, as surveys and interviews are typically much more difficult to collect data from.

Additionally, about 80 percent of all Twitter content is posted by 10 percent of its most active users. These users were found in this study to have different attitudes than general users. For example, “members of the top 10 percent of tweeters also have distinct attitudes, behaviors,

and personal characteristics compared with those who use the platform less often... prolific tweeters are more likely to be women... these most active tweeters are much more likely than others to say they post about political issues... 69 percent of the... most prolific tweeters say they have tweeted about politics, compared with 39 percent of Twitter users generally... 42 percent say they have tweeted about politics in the last 30 days, compared with just 13 percent of other users..." (Wojcik, & Hughes, 2019). These users are highly emotive and are far more vocal about their opinions regarding different topics than a general Twitter user. This could indicate that the opinions expressed in this study may not entirely reflect accurate feelings regarding SpaceX among Twitter users; however, the significant portion of neutral tweets gathered in this sample reflects that this sample is likely not hyper-expressive and ungeneralizable to Twitter users. Regardless, this potential limitation should be addressed and resolved in future studies.

Additionally, considering Elon Musk's notoriety as a major public figure with multiple unrelated projects and widely viewed public actions, some sentiment was likely impacted by outside bias of SpaceX's founder. While we took careful consideration to eliminate keywords relating to outside influences, the artificial intelligence software cannot reasonably eliminate all mentions of other Musk projects and cannot check for internal bias that is not directly expressed the wording of a tweet. Therefore, there is a possibility that some sentiment could be attributed to something other than the idea of commercialized spaceflight and the SpaceX mission. Though, with the extensive number of keywords that were restricted from the Brandwatch query, this effect is likely negligible.

Directions for Further Study

With SpaceX's continuing innovations in the world of commercialized spaceflight, further research into perceptions of the spaceflight company must be made. First, while this

study went beyond previous research in terms of scope, more long-term sentiment analysis should be attempted. Given an artificial intelligence platform that has the capability to collect data from a greater timespan, such as SpaceX's creation of its Twitter account in 2009 to present, it would be interesting to examine if sentiment has changed over time with SpaceX's progress in innovation relating to its mission. Especially with its successful recent missions such as the Inspiration4 launch in September 2021, it would be interesting to see if increasingly successful launches have changed the proportion of positive and negative sentiment and various emotions over time. As this project only spanned the previous two years, a greater time length of data could be incredibly beneficial to examining changes overtime.

Another facet of research that could be examined is the possibility and effectiveness of micro influencers in the industry of commercialized spaceflight. In recent years, micro influencers, or small-scale conversation leaders, have been used by brands to launch new products and build trust in a company or brands. In the very new and high-risk market of commercialized spaceflight, the use of influencers is not particularly existent; however, it would be interesting to examine whether the use of influencers in marketing regarding SpaceX actions could affect sentiment and trust in SpaceX on social media.

Outside of social media research, studies should be conducted into the perceptions and feelings of children and teenagers regarding SpaceX, as this demographic is more likely to see the evolution of space travel become a standard experience offering. It is important to see whether this demographic, frequently labelled "Gen Z," is informed of SpaceX's actions and interested in traveling to space with the company. Many people in this generation have already expressed a general interest in space travel. According to research conducted by Wright, 63 percent of Gen Zers are interested in going into space, and 32 percent of which would be willing

to accrue debt to do so (DeMarco, 2021). Based on these results, it would be interesting to compare this interest with the trust or lack thereof this age group may have with a specific commercialized spaceflight company. The proposed research could be conducted with surveys and interviews to garner a deeper understanding of this demographic's motivations and perceptions of space travel and the SpaceX brand.

In the afternoon of April 25, 2022, SpaceX's founder Elon Musk purchased Twitter from its previous owners. This major purchase, as well as the controversy leading up to it, occurred outside the study's targeted date range. Thus, it would be imperative to examine how this major event could affect current and future expression on the platform regarding the SpaceX company and Musk's other creative and business ventures. It would be interesting to examine if the entrepreneur's action would cause any change in discussion surrounding his spheres of influence now that this platform is influenced by his ownership.

Another route for further analysis would be to compare sentiment analyses of leading national and international commercialized spaceflight companies. By analyzing across the industry as a whole and by each individual company, researchers can gather data regarding if people trust certain companies more than others. It could also indicate whether the generally neutral or positive sentiment found in this study can be related to commercialized spaceflight overall or just to the SpaceX company and its actions. Additionally, mentions of international space travel companies can draw in data regarding sentiment towards spaceflight outside of the United States, where SpaceX is based. It would be interesting to study whether citizens of foreign nations have the same interest or view of companies such as these and whether commercialized space travel could be a global phenomenon in the future.

From further research into the attitudes and perceptions of SpaceX and the concept of commercialized spaceflight, researchers have the potential to gauge future responses to this new product offering and predict the success of the SpaceX business model.

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Appendix

Appendix A: Researchers' Coding Manual

CODING MANUAL

[Coder] 1 = Researcher One 2 = Researcher Two

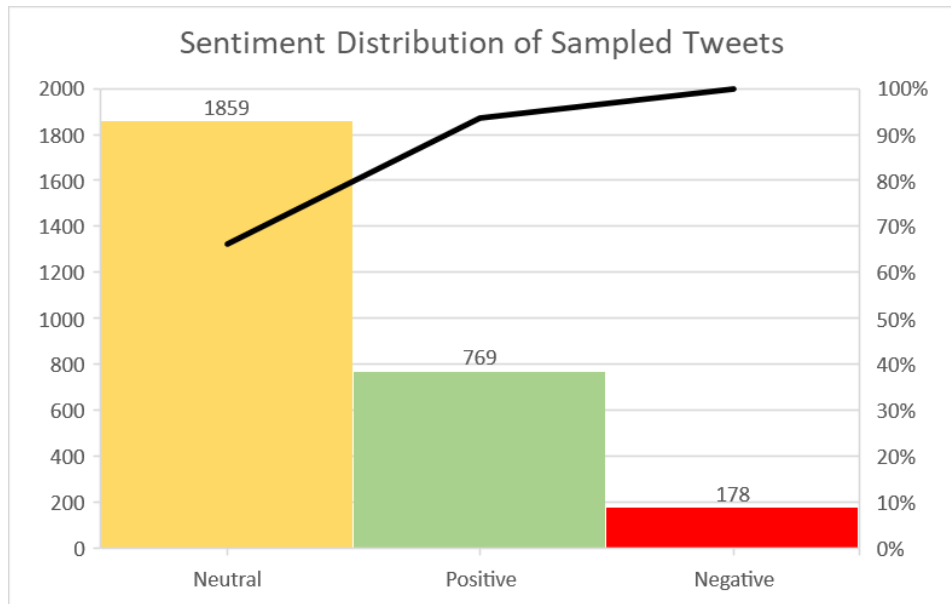
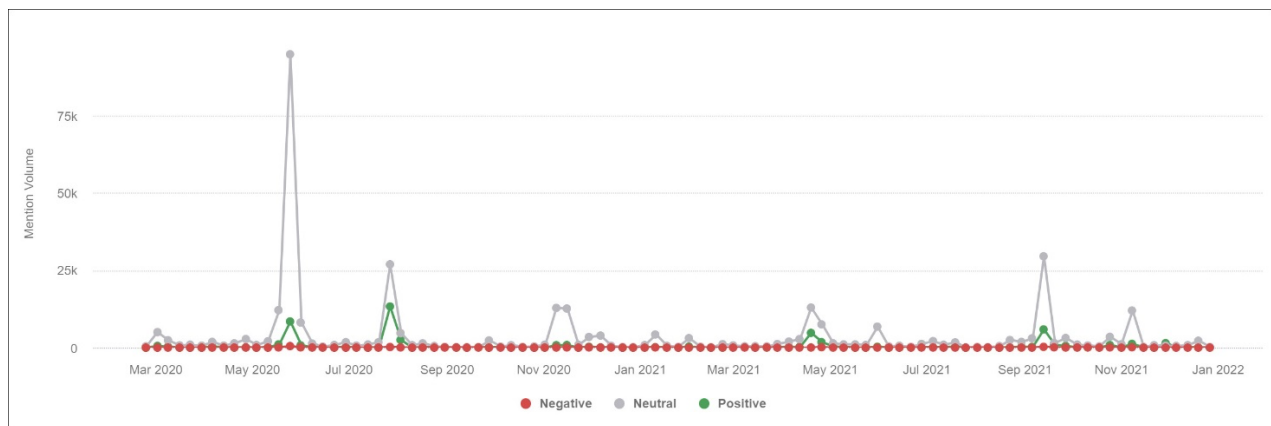
[Expert/Science] code (1) if the personal indicates expertise in the fields (e.g., Ph.D., NASA Dr, specifying the author's involvement in the profession) **Column BK** or (individual) if not (Column M)

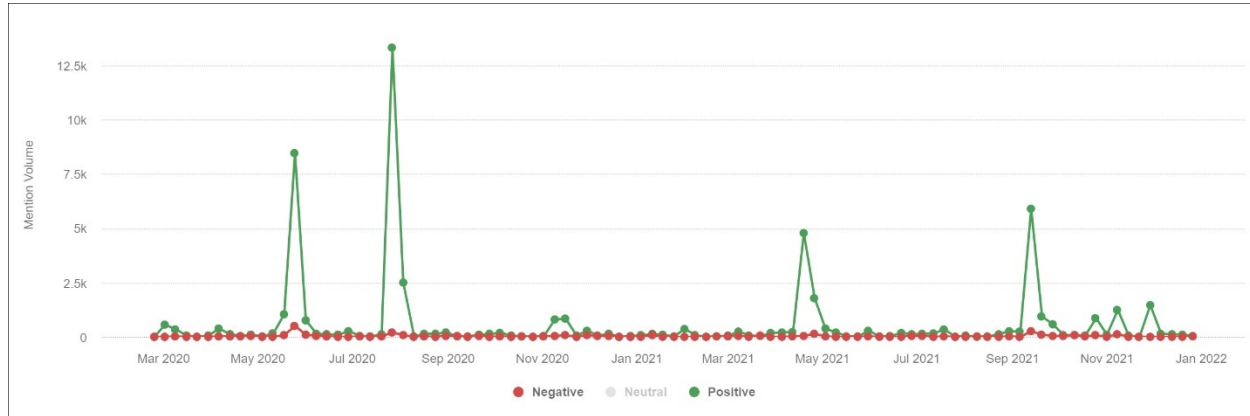
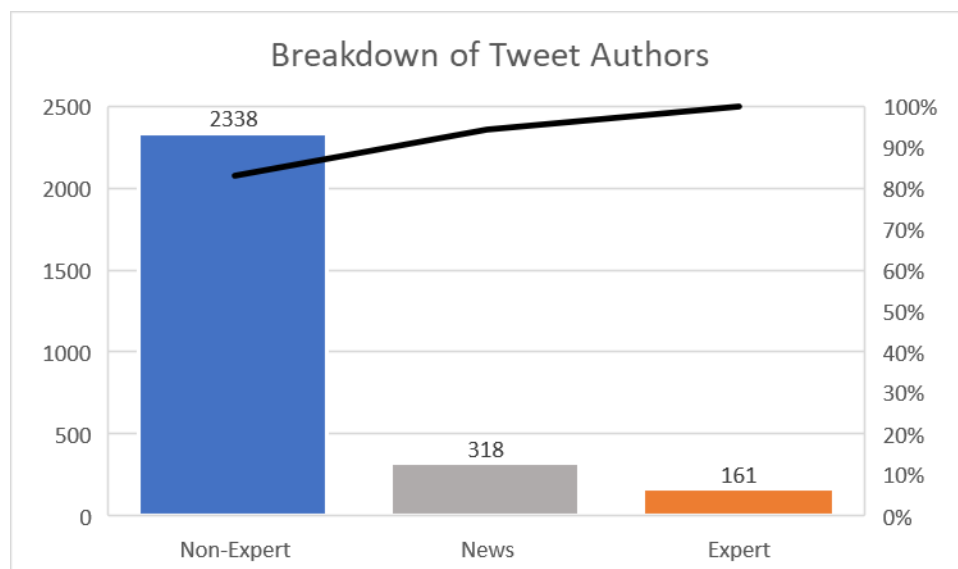
[Profession] select ONE only for personal accounts given the profile and posting (e.g., I work for XX)

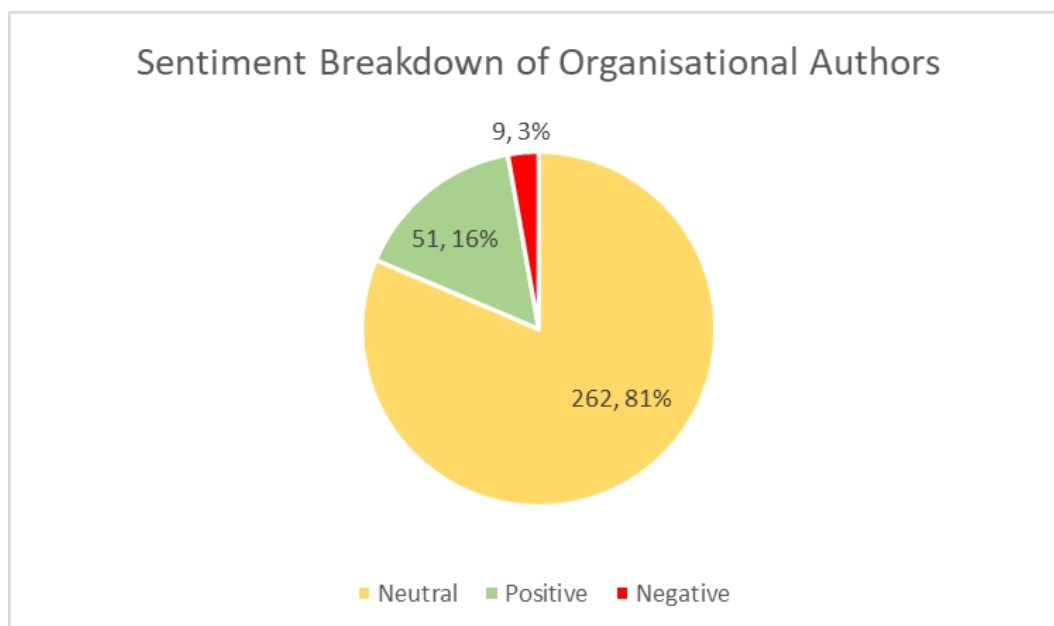
- (1) SpaceX affiliated (None in sample)
- (2) NASA affiliated (**Column BK**)
- (3) Other aerospace agencies but SpaceX & NASA (e.g., Blue Origin) affiliated (NONE IN SAMPLE)
- (4) News reporters/Journalists CNN, Fox, XX news) affiliated (**Column BL**)
- (5) Education/research/science institution (e.g., university) affiliated (**Column AH**)
- (6) Marketing (**Column AK**)
- (7) Politician/Legal (**Columns AG and AJ**)
- (6) Others - multiple, none N/A

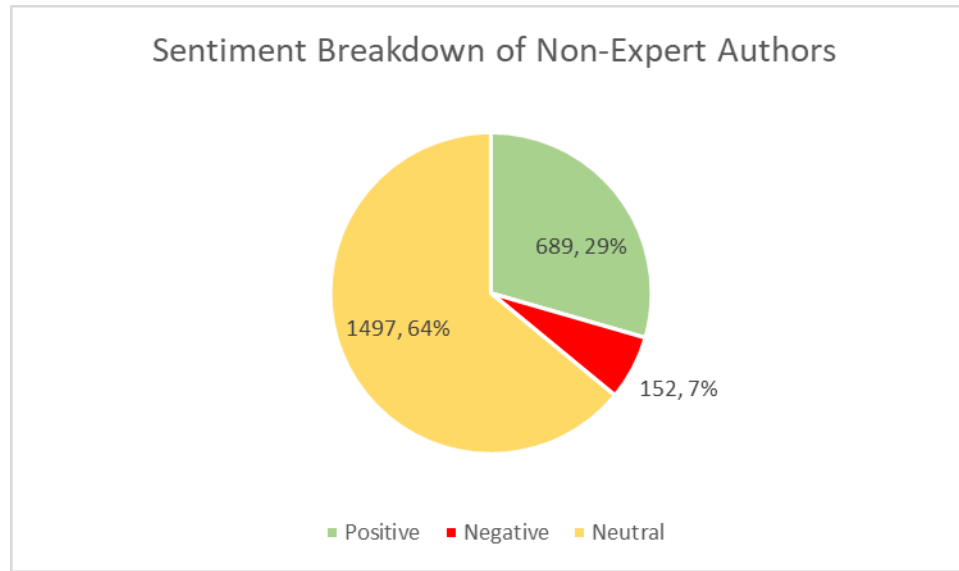
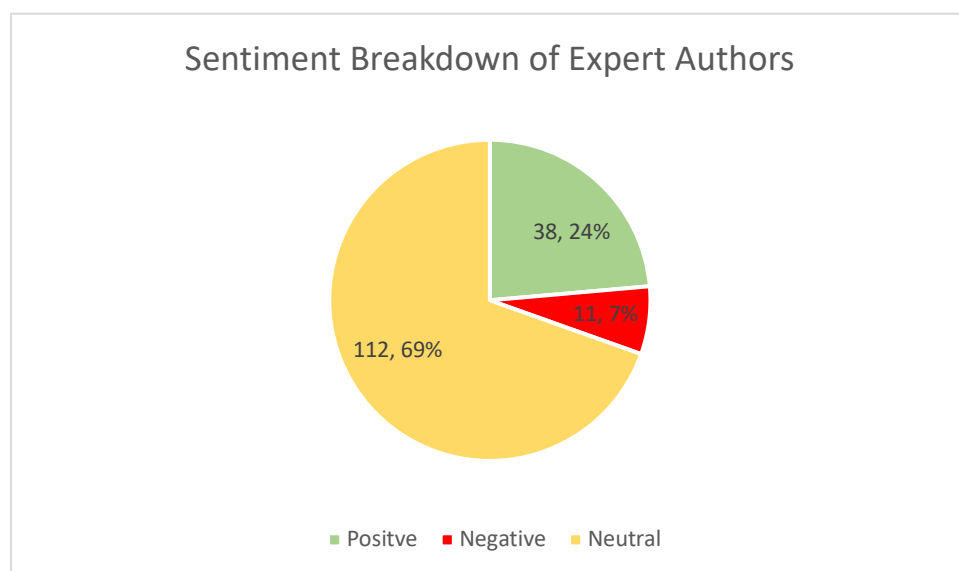
[Sentiment] overall attitudes towards Space X project – **Column G**

- (1) pro: Space X is good, positive, beneficial for the society/future (G306)
- (2) anti: Space X bad, risky, harmful for the society/future (G307)
- (3) balanced/mixed: both pro- and anti- valence are almost equally presented, and one is not stronger than the other)
- (4) none: no prominent attitudes (either pro- or anti-Space X) are observed (G305)

Appendix B: Sentiment Distribution of Sampled TweetsAppendix C: Sentiment Over Time of Total Sampled Tweets

Appendix D: Sentiment Over Time of Total Sampled Tweets, Excluding Neutral TweetsAppendix E: Breakdown of Tweet Authors

Appendix F: Individual v. Organizational AuthorsAppendix G: Sentiment Breakdown of Organizational Authors

Appendix H: Sentiment Breakdown of Non-Expert AuthorsAppendix I: Sentiment Breakdown of Expert Authors

Appendix J: Output of the Impact of Expertise on Sentiment

Impact of Expertise on Sentiment			
	(1)	(2)	(3)
Dependent Variable:	Positive	Negative	Neutral
Expert	-0.040 (0.034)	0.005** (0.020)	0.036** (0.037)
Constant	0.276 (0.009)	0.063 (0.005)	0.659 (0.009)
Observations	2,810	2,810	2,180
Adjusted R-squared	0.0004	0.000	0.0003

Note: In columns (1), (2), and (3), the dependent variables are indicators for whether the tweet was positive, negative, or neutral in sentiment, respectively. “Expert” is a dummy variable that equals one if the tweet’s author was found to be an expert in space, SpaceX, or commercial spaceflight and equals zero otherwise. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix K: Regression One Hypotheses and Regression Equation

$$\log(\text{Impressions})_i = \alpha + \beta_1 \text{positive}_i + \beta_2 \text{negative}_i + \varepsilon_i$$

$$H_0: \beta_1 = \beta_2 \text{ and } H_a: \beta_1 \neq \beta_2$$

Appendix L: Regression One Output

Impact of Sentiment on Impressions	
	(1)
Dependent Variable:	Impressions (Log)
Positive	-0.847*** (0.114)
Negative	-1.102*** (0.199)
Constant	7.516*** (0.066)
Observations	2,758
Adjusted R-squared	0.024

Note: In column (1), the dependent variable is how many impressions a tweet received, logged. "Positive" is a dummy variable that equals one if the tweet's sentiment is positive and equals zero otherwise. "Negative" is a dummy variable that equals one if the tweet's sentiment is negative and equals 0 otherwise. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix M: Regression Two Hypotheses and Regression Equation

$$\log(\text{Impression})_i = \alpha + \beta_1 \text{Expert}_i + \varepsilon_i$$

$$H_0: \beta_1 = 0 \text{ and } H_a: \beta_1 \neq 0$$

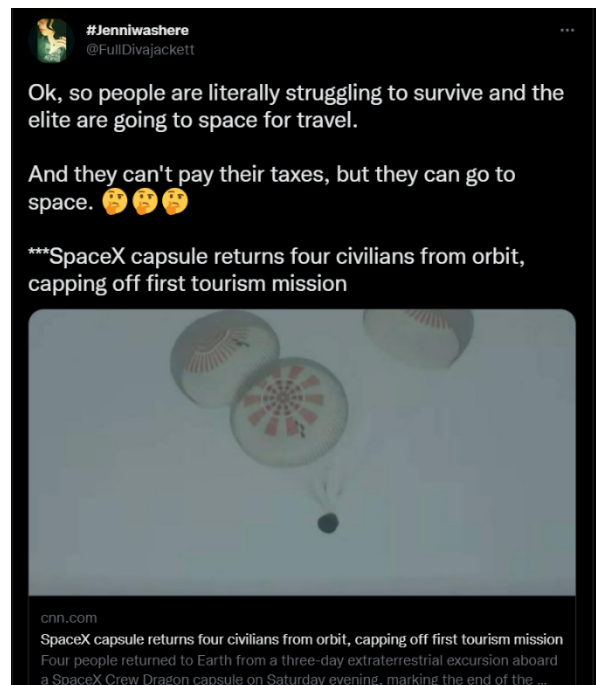
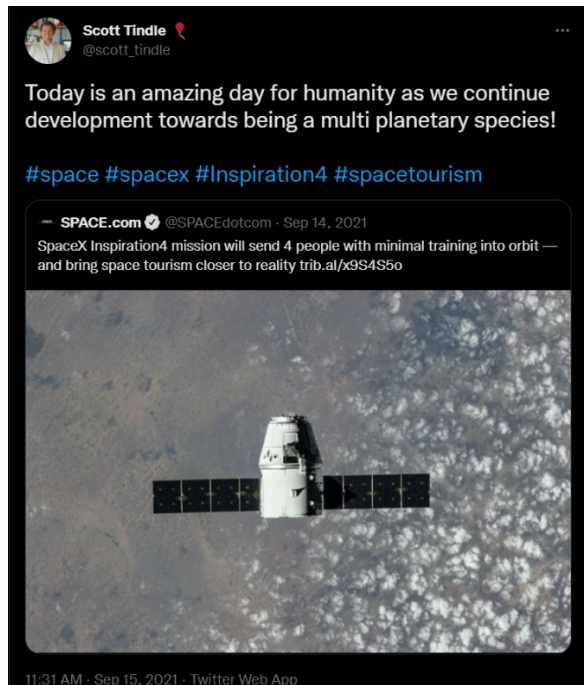
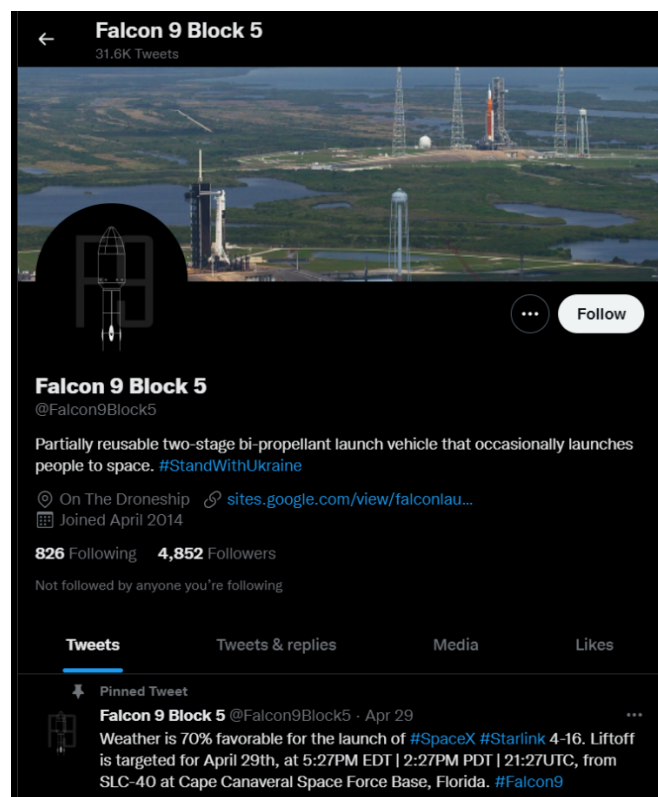
Appendix N: Output of Regression Two

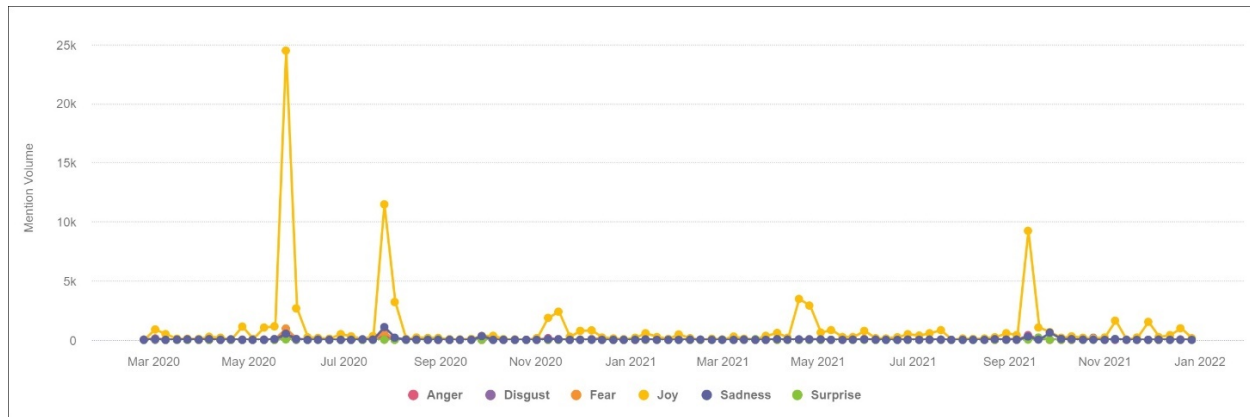
Impact of Expertise on Impressions

	(1)	(2)
Dependent Variable:	Impressions (Log)	Impressions (Log)
Expert	0.969*** (0.254)	0.205** (0.097)
Twitter Followers (log)		1.012*** (0.006)
Constant	7.161*** (0.054)	0.220*** (0.049)
Observations	2,758	2,758
Adjusted R-squared	0.006	0.895

Note: In columns (1) and (2), the dependent variable is the natural log of the number of impressions a tweet receives. “Expert” is a dummy variable that equals one if the tweet’s author is an expert and equals zero otherwise. The second regression includes a control for the log of the number of Twitter followers the author has. Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix O: Example of a Neutral Tweet

Appendix P: Example of a Positive and Negative TweetAppendix Q: Example of a SpaceX Related Blog/Twitter Account by a Non-Expert Individual

Appendix R: Emotions Over TimeAppendix S: Emotions Over Time without Joy