

Analysis of Elon Musk's Tweets in 2022

Elon Musk is likely the most infamous figure of the year: from his comments regarding the Russia vs Ukraine war, to his half-year long Twitter acquisition, along with his various opinions on subjects such as cryptocurrencies and business ventures, it's evident that his remarks polarize his followers and direct a lot of publicity towards him. No better is this seen on his (now) own platform - Twitter. We will analyze Elon Musk's tweets from the beginning of this year to October 27th - the day that Musk closed the Twitter deal, through natural language processing and sentiment analysis. The dataset used for analysis was gathered by Marta Castrillo¹, published on Kaggle.² The tweets were collected using Tweepy, a Python library for interacting with the Twitter API. In particular, the cleaned tweets were processed through the removal of all emojis, non-punctuation symbols, and through forcing all characters to lowercase. The dataset also includes the number of likes and retweets gained by each tweet, along with a timestamp.

Since the tweets were cleaned already, they were passed through spaCy's English Core Model³ to remove stop words and tokenizing them into individual words. The words' frequencies were calculated, and the resulting word cloud was formed from the results:

¹ <https://github.com/MartaCadelg/>

² Marta Castrillo, "Elon Musk's Tweets Dataset 2022", updated Oct 27, 2022.
<https://www.kaggle.com/datasets/marta99/elon-musks-tweets-dataset-2022>

³ <https://spacy.io/models/en>

[illegible]

The above word cloud shows the top 350 words in Elon Musk's tweets. "Tesla" as the largest/most frequent word makes sense, as Tesla is one of Elon's most notable and successful companies. "Twitter" and "Starlink" also stand out – two companies/causes that Elon also places a great deal of importance in. It is clear from the visualization that the largest/most frequent words seen are all business and positively oriented to little surprise, as Elon would preferably want to share his successes in various ventures to his followers. Surprisingly, despite being at the center of controversy regarding his views on the Ukraine-Russia war, neither countries are in the top 20 most tweeted words.

We are also interested in seeing the relatedness of certain topics in Elon’s tweets. To do this, a network graph was created by calculating the frequency of all length 2 combinations of words in Elon’s tweets. A minimum frequency of 7 was set as a threshold in the creation of the network graph.

save for the connection between Starlink and Ukraine, Elon tends to separate business versus personal/political beliefs in his tweets.

Sentiment analysis was performed on the tweets using VADER (the improperly thought out acronym of “Valence Aware Dictionary and sEntiment Reasoner”) to calculate a polarity score for each tweet, a measure for how positive or negative a tweet is. Tweets were then classified based on their score – scores greater than 0 were assigned as positive tweets, scores less than 0 were assigned as negative tweets, and scores that were 0 were assigned as neutral tweets. A pair of visualizations was made with the information:

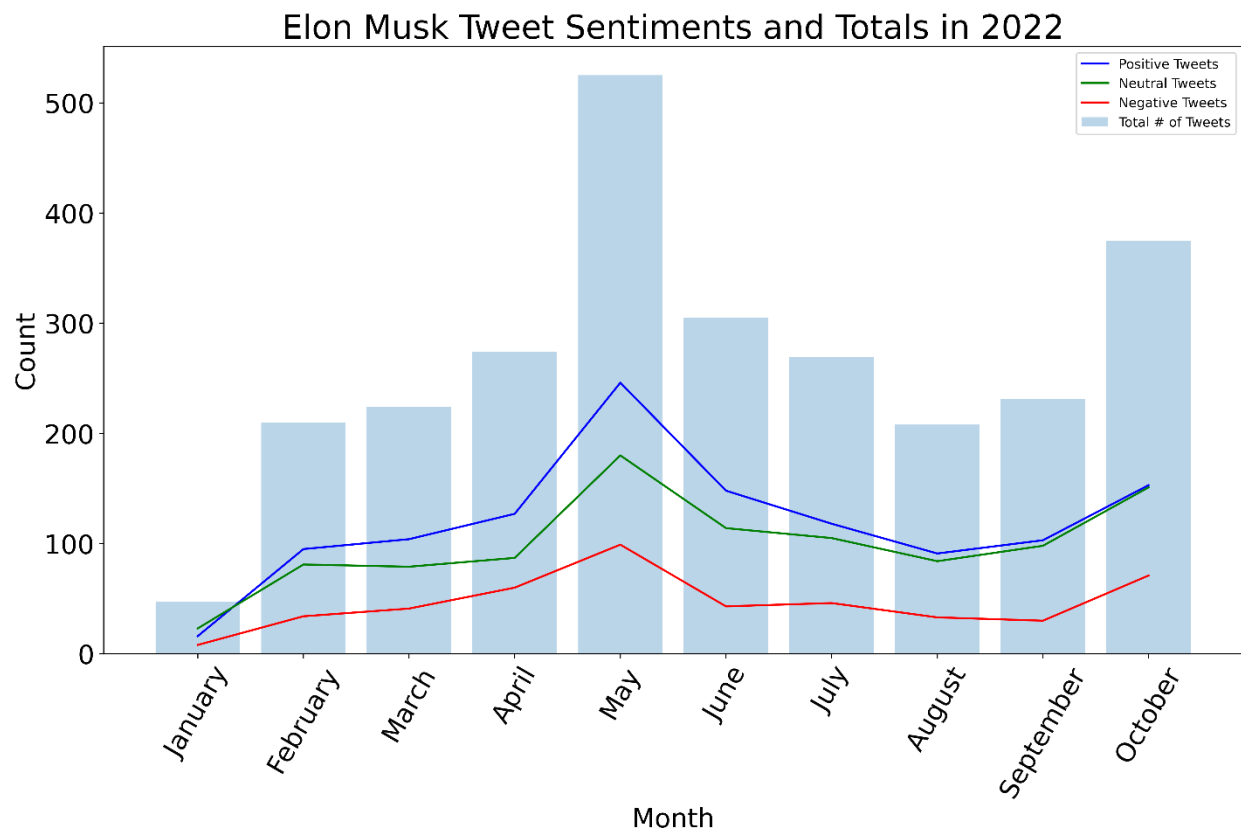


Figure 3: Line and bar chart representing the count of different types of tweets. The different polarities of tweets follow about the same trend month by month, although starting from May the relative count of positive tweets per month begins decreasing up to October. The only month with more neutral tweets than positive tweets is January.

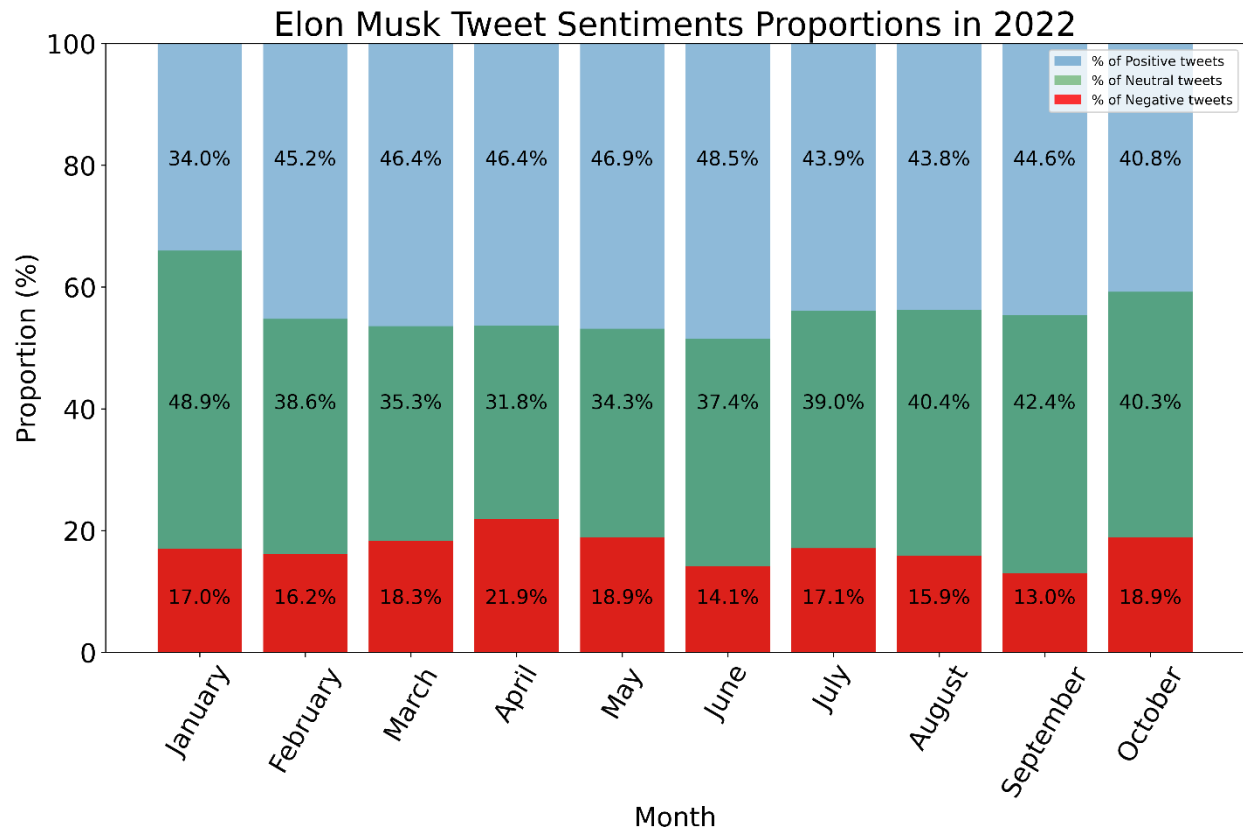


Figure 4: Proportion bar chart of different polarity tweets per month. From the graph, we can see that Elon was the most positive (highest % of positive tweets) in June, the most polar (highest % of positive + negative) and negative in April, and the most neutral in January.

The above figures illustrate the counts and proportions of different polarity tweets month to month in 2022, displaying both magnitude and composition respectively. May was the hottest month for Elon's twitter, tweeting nearly 2 times the amount from the previous month, which is probably due to the formal announcement of his Twitter acquisition at the end of April.⁵ Based on the figures, we see that Elon does not generally post negative tweets, having around 2-3 times the number of positive tweets than negative ones. Although the line plot is best at displaying magnitude and numerical trends, the proportion plot is best for understanding the composition of Elon's tweets. The relative proportions of different sentiments don't change drastically month by month. As the caption states, most of Elon's more polar months have been in the spring season,

⁵ ABC News, "A Timeline of Elon Musk's tumultuous Twitter acquisition", November 11 2022, <https://abcnews.go.com/Business/timeline-elon-musks-tumultuous-twitter-acquisition-attempt/story?id=86611191>

from around April to June, which is probably due to the hype regarding his potential twitter acquisition.

Finally, we are interested in checking the engagement of Elon's tweets versus the sentiment. Although Twitter calculates an engagement score with the sum of Likes and Retweets, the scales of the two values differed by 1-2 degrees of magnitude, so they were plotted separately from each other.

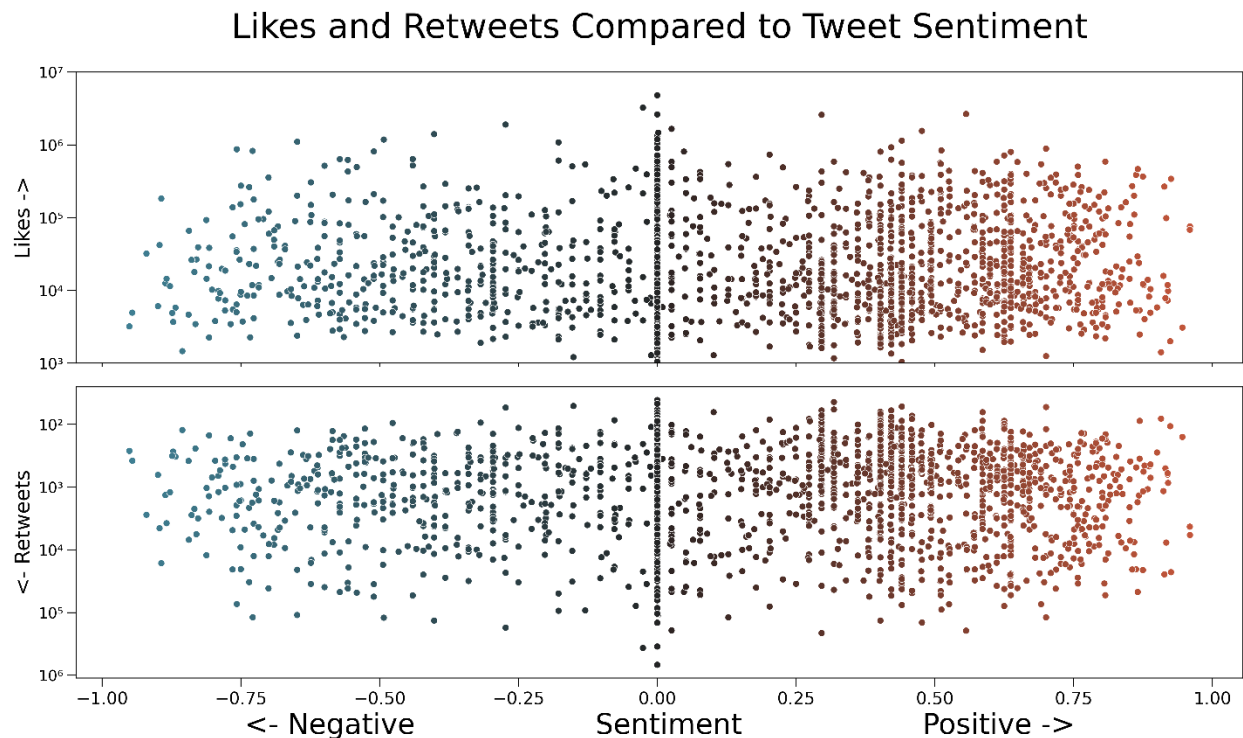


Figure 5: Dual scatter plot showing the relationship between tweet sentiment and likes and retweets. More polar tweets (i.e: more positive and more negative) tend to get less likes or retweets overall. Likes and retweets follow a similar pattern and relative trend changes, albeit at a different level of magnitude.

The scatter plots above display each tweet's sentiment to the number of likes and retweets it received. Overall, there is no strong overarching trend between tweet sentiment and likes/retweets, although there does seem to be a weak relationship that as a tweet gets more polar (for example, more positive towards 1 or more negative towards -1) it receives less engagement from followers. The shape of the max/outer boundaries of likes and retweets follows a shape akin to a sinusoidal curve, where the local maximums of likes and retweets exist somewhere in the centers (± 0.50 polarity and 0)

Overall, Elon Musk is a prolific tweeter with a wide variety of interests, although he tends to talk about a few things a lot, as seen in our word cloud and network graph. There is a clear separation in business ventures and personal ideologies on his Twitter. In his tweets, Elon tends to stay positive, potentially due to wanting to keep a good public image for himself and his companies, and major events in his life seem to affect the polarity of his tweets. Lastly, there does not seem to be any major linear correlations between tweet sentiment and the amount of engagement Elon receives on his tweets, although the general trend is that the farther away from neutral a tweet gets, it will on average receive less likes and retweets.

It would have been interesting to see the tweets for the month of November, as that is the month where large business decisions were made on behalf of Twitter (such as massive layoffs, reorganization of management, etc.) that certainly would have made an impact on our overall term frequencies and connections. Another trend worth looking at is the sentiments of specific terms – for example, are tweets with the subject/topic “twitter” generally more or less positive? It would have been interesting to calculate and model LDA and TF-IDF for the various term frequencies seen in the tweets, although these models are not as intuitive to interpret than networks and word clouds. The potentially largest weakness for the creation of the visualizations is the sentiment analysis. Although VADER is a strong sentiment model, it is still imperfect in that it is difficult for it to capture nuances in language such as sarcasm, sardonicism, cynicism, etc. For example, VADER classified a tweet with the text, “Peace. Peace? I hate the word. Those who do care about peace (myself aspirationally included) don’t need to hear it. And those who don’t care about peace? Well ...” as having the second highest positivity score at 0.9593, the highest being 0.9595. Although these false positives are rare, it is still somewhat up to human interpretation whether or not a tweet can be classified as positive or negative.

Critique by Annabel Mendoza:

This analysis of Elon Musk's tweets, both in terms of tweet content and tweet performance, is very informative. I thought Figure 1, the word cloud, was very interesting, as although it is not a common form of visualization, it is effective at highlighting the most frequently used words through the use of size, an easy-to-interpret encoding channel. I also found Figure 4, the proportions plot to be quite informative. One way that I believe it could be improved, however, would be to change the order of the legend to match the order of the stacked bars. I noticed that the highest proportion of negative tweets was in April, while the next month, May, had a large spike in total number of tweets, as shown in Figure 3. Richard noted the astute observation that Musk's bid to buy Twitter was accepted in late-April, and thus may be a contributing factor to the high number of tweets in May. Given that Musk typically tends to tweet more positive messages about his companies and initiatives, like Tesla and Starlink, perhaps the rise in negative tweets in April could be attributed to negative statements about the flaws of Twitter which he pledged to improve. As for the likes and retweets shown in Figure 5, I was surprised to not see more of a distinct trend, as I would expect more polarizing tweets to garner more attraction in the media. Perhaps this can be attributed to the typical difference in likes between tweets and replies – given that replies typically receive significantly less likes and retweets than standalone tweets, perhaps accounting for this before performing the analysis would reveal a stronger trend between tweet sentiment and performance, as well as would reveal whether Musk's most polarizing messages are typically replies or tweets. Overall, I thought that this report was very intriguing and that a variety of unique visualizations were used to effectively communicate the data.

Legend was fixed after critique!