Policing Sentiments: Analyzing Reddit's Response to Major Police Incidents using Sentiment Analysis Tool

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Introduction

Public opinions about policing have evolved beyond the streets and have made a significant presence on online communities. Social media platforms like Reddit have been playing a big role offering invaluable insight into the public's sentiment and attitudes towards law enforcement and their activity. This research will explore the digital realm to unravel the sentiments expressed in Reddit discussions related to policing.

Reddit's distinctive features play a significant role in shaping the dynamics of online discussion on this platform. The platform is divided into subgroups of specific topics, and users can post anonymously to express their perspective regarding a post. Furthermore, the threads of discussion and posts are laden with keywords such as "police", "policing", "law enforcement", "cops", "officer", etc making it easy to find discussions related to any topics.

At the heart of this research lies the powerful technique of sentiment analysis, a computational process designed to discern and quantify the emotional tone embedded in text data. Leveraging natural language processing and machine learning algorithms, sentiment analysis seeks to identify and categorize sentiments expressed in written communication. With the vast amount of textual data in social media platforms like Reddit, sentiment analysis algorithms serve as a tool to see the emotional landscape of online discussions.

The study seeks connections between online sentiments and real-world events. The research also places specific focus on turning points in recent news, notably major police brutality incidents like those involving George Floyd, Tyre Nichols, and Elijah McClain. By

examining sentiments before and after these events, the study will aim to find the shifts in public perception on policing in response to such incidents. To add, the study will also explore whether mass shooting incidents like the Uvalde Shooting has any major impact on policing sentiments.

In essence, the project not only explores sentiments related to policing through online discussions but also lightens the implication of these sentiments on the public's relationship with law enforcement. By incorporating digital insights with real-world context, the study will hope to contribute to a deep understanding of the multifaceted dynamics between public and policing in our society.

Literature Review

Sentiment analysis has revolutionized the study of public opinion, offering an understanding of emotionality embedded in textual data. Sentiment analysis takes an automated approach like Natural Language Processing and pattern based (Hiroshi et al., 2004, König and Brill, 2006, Nasukawa and Yi, 2003, Yi et al., 2003), machine learning algorithms such as Naive Bayes(NB), Maximum Entropy(ME), Support Vector Machine(SVM)(Joachims, 1998), and unsupervised learning. (Turney, 2002) Whereas, Sentiment analysis tool like VADER uses a simple rule-based model for general sentiment analysis, and is specifically attuned to social media data even outperforming individual human raters (Hutto and Gilbert, 2014) With the amount of data in public discourse, sentiment analysis has been applicable in understanding the attitudes of the general public faster through computation instead of manual classification.

Online discussion platforms like Reddit provide a unique space for individuals to voice their opinions anonymously. Currently, Reddit has more than 430 million active users, and more than 100,000 niche communities called subreddits. Discussions on Reddit are open to anyone unless the subreddit is private. To make an account on reddit, a user only needs a unique

username and a password. Understanding these dynamics becomes crucial when exploring sentiments towards law enforcement on Reddit, where users may feel more liberated to share their opinion freely.

In the context of law enforcement, prior research on the public's opinion on policing has been focused on traditional media, interviews, and public surveys. Past research also involves the use of a limited amount of data. For example, key research on legal cynicism, and finding why people have a negative sentiment and feeling of distrust of police involved interviewing people (Carr, Napolitano, and Keating. 2007). A study by Desmond, Papachristos & Kirk (2016) explored the influence of high-profile police brutality incidents on public perception, but the study involved examining the amount of 911 calls before and after such incidents and implying a sentiment on policing based on the frequency of 911 calls. Other works by Bradford et al. (2019) and Johnson et al. (2020) also have explored the influence of high-profile police brutality incidents on public perceptions, but these studies also relied on traditional surveys. However, with real-time information sharing on platforms like Reddit, there is a need to explore sentiments in a more immediate and unfiltered context.

With online discussion specifically related to policing, prior research has mostly focused on Twitter and other social media. A study measured public perception of police on Twitter using NLP (Oglesby-Neal, Tiry, & Kim, 2019), where they collected 65 million tweets mentioning keywords such as “police" or “cop”, classified the sentiments into positive, neutral, and negative, and did a trend evaluation. The results revealed negative sentiments after the death of a man in police custody. Another study measured geographical sentiment towards police using Twitter Data (Oh, G., Zhang, Y. & Greenleaf). The result showed violent crime, and racial heterogeneity of the area associated with negative sentiments towards police. Hand and Ching

(2019) did a study conducting a sentiment analysis of police agency Facebook pages before and after a fatal officer-involved shooting of a citizen. The study found user comments to be neutral on average after a police shooting, and police agencies Facebook posts having neutral content on average. However, the exploration of discussion on Reddit and other social media on policing remains a relatively unexplored territory.

Research Objectives

1. To scrape comment data from Reddit in posts related to policing
2. To perform sentiment analysis on the comments, and create a database
3. Comparing sentiment profiles across diverse set of subreddits containing keywords related to policing, and understanding the variations in people's expression
4. Investigating the influence of major police brutality incidents like George Floyd, Tyre Nichols, and Breonna Taylor on sentiment on policing in Reddit discussion using statistical analysis like Mann-Whitney U-Test and uninterrupted time series test
5. Investigating the influence of major mass shooting incidents like Pulse Shooting, FL, Uvalde Elementary Shooting, TX, etc. on sentiment on policing in Reddit discussions using statistical analysis like Mann-Whitney U-Test and uninterrupted time series test
6. Evaluating the effectiveness of sentiment analysis methodologies to understand the public sentiment on policing, and propose enhancement if needed in this field of study

Methodology

a. Data Collection

The comment data was collected using the PRAW (Python Reddit API Wrangler) API in Python. PRAW is a python package that provides easier access to reddit data and follows

Reddit's API rules and rate limit. The comments were collected from police centric subreddit like r/police, r/protectandserve, and r/bad_cop_no_donut, political subreddits like r/politics, r/democrats, r/conservative, and r/libertarian, and mainstream subreddits like r/dataisbeautiful, r/facepalm, r/iama, r/mademesmile, r/news, r/pics, r/thatsinsance, and r/videos. To scrape reddit post with policing related contents, keywords like police, policing, law enforcement, and cops were used. After finding relevant posts, all the comments were scraped and stored in a csv file. Each subreddit has its own csv file, and each csv file has the post name, the comment, author name, and date posted.

b. Data Cleaning

Before all the comments were passed into the sentiment analysis tool, each of them was cleaned and tokenized. Python's regex library was used to remove exclamation mark, numbers, punctuation marks, and emojis. All the comments were lowercased as well. Null values were removed from the comment database. Each unique users and post were tokenized with a unique number to increase the anonymity and help in further statistical analysis. The date format was also changed from date and time to only date format.

c. Sentiment Analysis

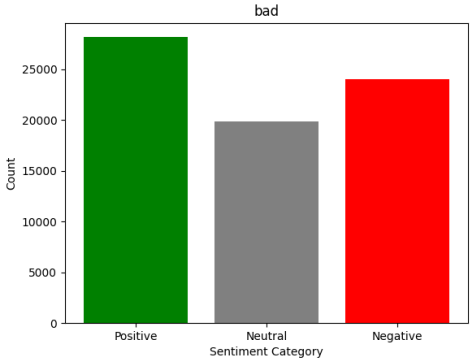
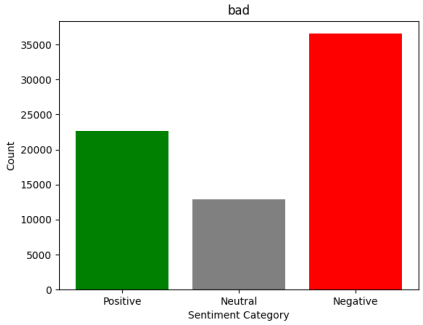
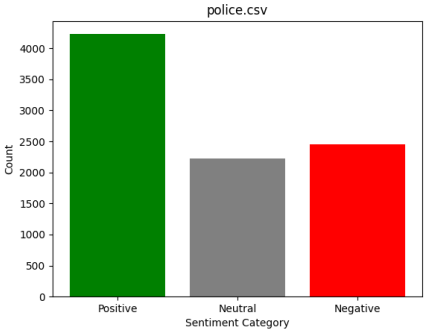
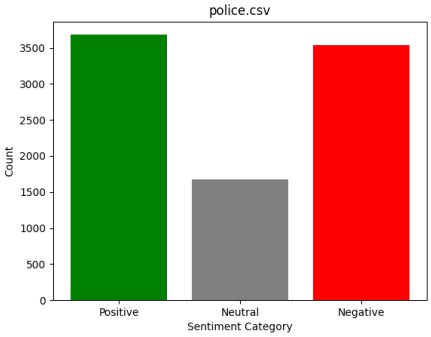
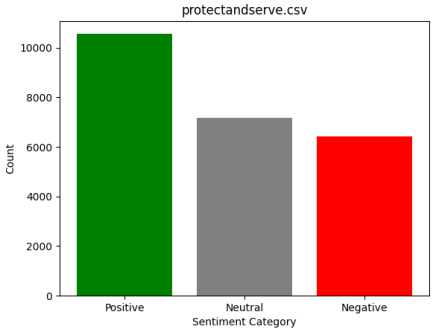
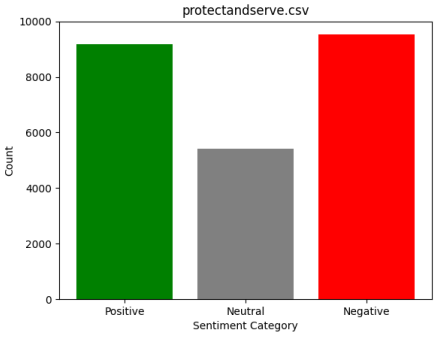
The Valence Aware Dictionary and Sentiment Reasoner (VADER) was used as a lexicon and rule-based sentiment analysis tool. VADER is specifically attuned to social media data and is sensitivity to both polarity and intensity of emotion. It provides and intensity score between -1 and 1, where -1 indicated highly negative sentiment, 0 is neutral sentiment, and 1 is highly positive sentiment. In addition to VADER, Textblob was also used initially to compare the robustness of both sentiment analysis algorithm. However, on the later stage of the study and analysis, the sentiment data from VADER was only

used because of its special feature to attune to social media data. Using its API in Python, each comment was passed through the sentiment analysis tool, and the sentiment score was stored in a different file

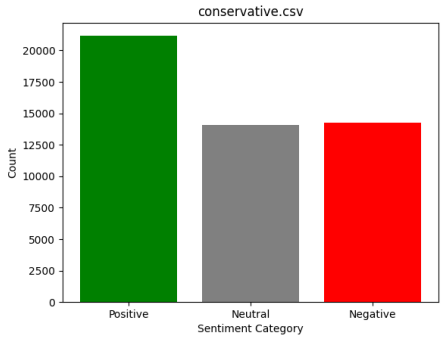
d. Statistical Analysis

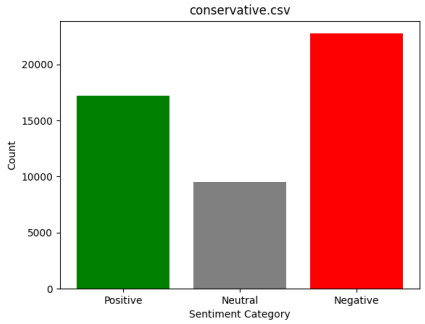
Key incident dates were found through news media and are divided into police brutality incidents and mass shooting incidents involving police. The police brutality incidents included for the analysis Eric Garner, Michael Brown, Tamir Rice, Freddy Gray, Philando Castille, Breonna Taylor, George Floyd, Duante Wright, and Tyre Nichols. The mass shooting incidents included for the analysis are Inland Regional, CA, Pulse Shooting, FL, Harvest Musical, NV, First Baptist, TX, Borderline Bar, CA, El Paso Walmart, TX, Star Ballroom, CA, Schemengees Bar and Grill, ME, Pittsburgh Synagogue, PA, Parkland Shooting, FL, Buffalo Supermarket, NY, Robb Elementary, TX, and Virginia Beach, VA. Mann Whitney U-test was conducted in timeframe of 14, 30, and 90 days before and after the key incident date with the null hypothesis that sentiments before and after the date stays the same, and alternative hypothesis that the sentiment after the incident drops down with a confidence interval of 95%. In addition to Mann-Whitney, interrupted time series analysis was conducted by comparing Z-scores of the sentiment scores before (n=20 weeks) and after (n=20 weeks). The model specification used was a generalized linear model (GLM) with robust standard errors. Analysis was performed in Stata and included analysis on main groups (mass shooting and police brutality) as well as individual incidents.

Result

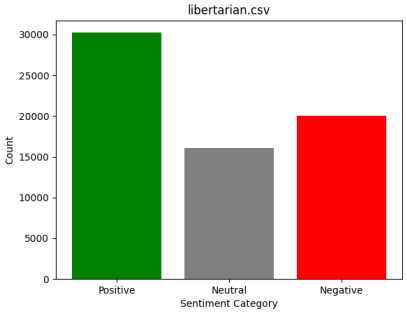
TextBlob	VADER
a. r/BadCopNoDonut	
	
b. r/police	
	
c. r/protectandserve	
	

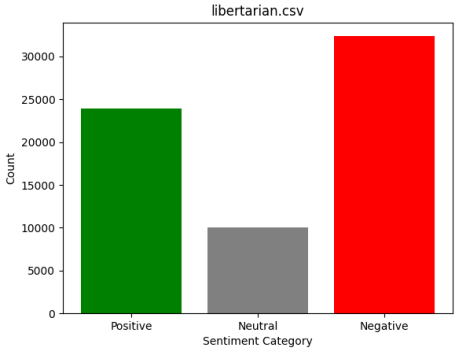
d. r/conservative



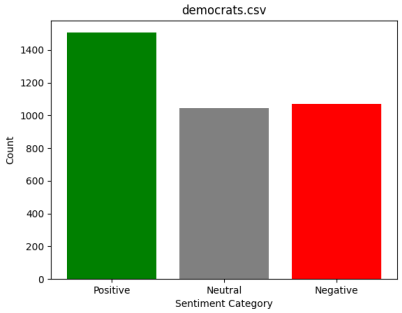


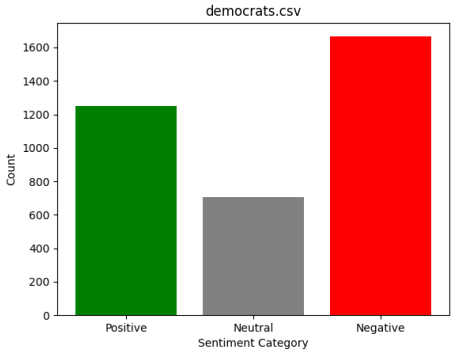
e. r/libertarian





f. r/democrats





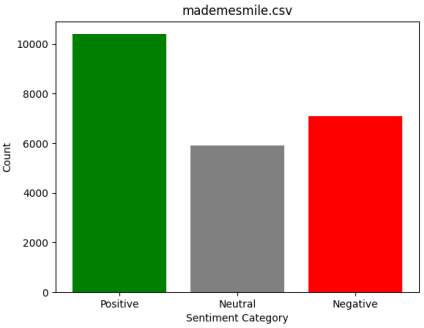
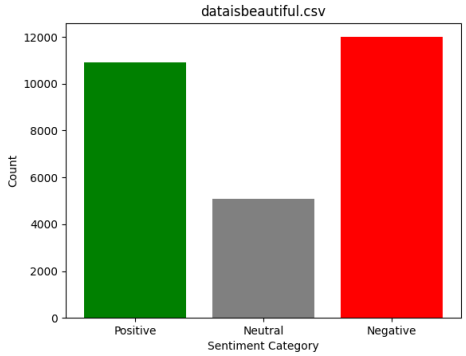
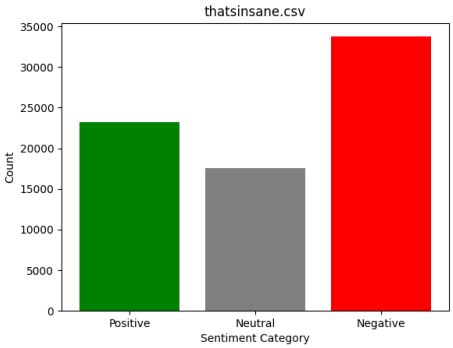
g. r/mademesmile	
h. r/dataisbeautiful	
i. r/thatsinsane	

Table 1: The table represents the result from different subreddits using two different sentiment analysis algorithms: VADER and TextBlob

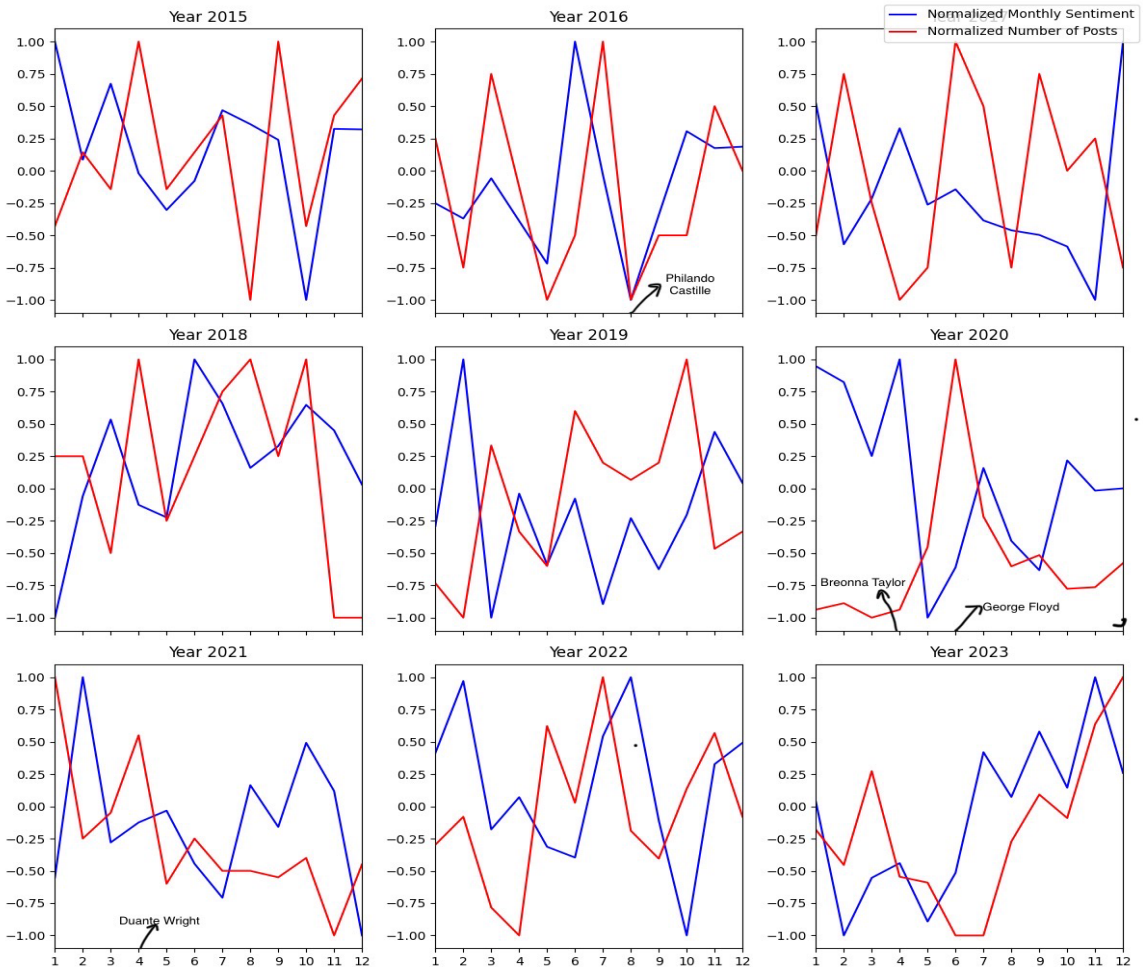


Fig 1: Graph representing the normalized post and average sentiment scores from the year 2015 to 2019

Date	Incident	Timeframe	mw_p_value	mw_Hypothesis
7/17/14	Eric Garner	14	0.95492561	No significant difference
7/17/14	Eric Garner	30	0.99999998	No significant difference
7/17/14	Eric Garner	90	1	No significant difference
8/9/14	Michael Brown	14	0.04777179	Sentiment scores are higher before the date
8/9/14	Michael Brown	30	0.10322351	No significant difference
8/9/14	Michael Brown	90	0.99990315	No significant difference
4/12/15	Freddy Gray	14	0.00403266	Sentiment scores are higher before the date

4/12/15	Freddy Gray	30	3.88E-08	Sentiment scores are higher before the date
4/12/15	Freddy Gray	90	5.85E-34	Sentiment scores are higher before the date
7/6/16	Philando Castille	14	1.51E-57	Sentiment scores are higher before the date
7/6/16	Philando Castille	30	3.24E-78	Sentiment scores are higher before the date
7/6/16	Philando Castille	90	5.15E-78	Sentiment scores are higher before the date
3/13/20	Breonna Taylor	14	0.18467019	No significant difference
3/13/20	Breonna Taylor	30	0.00962192	Sentiment scores are higher before the date
3/13/20	Breonna Taylor	90	5.14E-90	Sentiment scores are higher before the date
5/25/20	George Floyd	14	8.47E-05	Sentiment scores are higher before the date
5/25/20	George Floyd	30	0.10221523	No significant difference
5/25/20	George Floyd	90	9.85E-40	Sentiment scores are higher before the date
4/11/21	Duante Wright	14	4.59E-40	Sentiment scores are higher before the date
4/11/21	Duante Wright	30	3.07E-22	Sentiment scores are higher before the date
4/11/21	Duante Wright	90	3.77E-20	Sentiment scores are higher before the date
1/27/23	Tyre Nichols	14	6.04E-10	Sentiment scores are higher before the date
1/27/23	Tyre Nichols	30	2.97E-07	Sentiment scores are higher before the date
1/27/23	Tyre Nichols	90	7.13E-12	Sentiment scores are higher before the date

Table 2: Results from Mann-Whitney U-test on police brutality incidents on a 95% confidence interval

Date	Incident	Timeframe	mw_p_value	mw_Reject/Accept	mw_Hypothesis
12/2/15	Inland Regional Center, CA	14	0.00749163	Reject	Sentiment scores are higher before the date
12/2/15	Inland Regional Center, CA	30	0.90273934	Accept	No significant difference
12/2/15	Inland Regional Center, CA	90	0.1292514	Accept	No significant difference
6/12/16	Pulse Shooting, FL	14	0.07525433	Accept	No significant difference
6/12/16	Pulse Shooting, FL	30	1.25E-40	Reject	Sentiment scores are higher before the date
6/12/16	Pulse Shooting, FL	90	2.30E-55	Reject	Sentiment scores are higher before the date
10/2/17	Harvest Music Festival, NV	14	0.01971559	Reject	Sentiment scores are higher before the date
10/2/17	Harvest Music Festival, NV	30	2.88E-06	Reject	Sentiment scores are higher before the date
10/2/17	Harvest Music Festival, NV	90	0.00327241	Reject	Sentiment scores are higher before the date
11/5/17	First Baptist Church, TX	14	0.96974775	Accept	No significant difference
11/5/17	First Baptist Church, TX	30	0.59567871	Accept	No significant difference
11/5/17	First Baptist Church, TX	90	7.20E-05	Reject	Sentiment scores are higher before the date
2/14/18	Marjory Stoneman Douglas High School, FL	14	0.09235817	Accept	No significant difference
2/14/18	Marjory Stoneman Douglas High School, FL	30	0.94878347	Accept	No significant difference
2/14/18	Marjory Stoneman Douglas High School, FL	90	0.01097235	Reject	Sentiment scores are higher before the date
10/27/18	Pittsburgh Synagogue, PA	14	0.99687081	Accept	No significant difference

10/27/18	Pittsburgh Synagogue, PA	30	7.35E-05	Reject	Sentiment scores are higher before the date
10/27/18	Pittsburgh Synagogue, PA	90	1.28E-15	Reject	Sentiment scores are higher before the date
11/7/18	Borderline Bar and Grill, CA	14	6.97E-09	Reject	Sentiment scores are higher before the date
11/7/18	Borderline Bar and Grill, CA	30	2.03E-11	Reject	Sentiment scores are higher before the date
11/7/18	Borderline Bar and Grill, CA	90	2.68E-16	Reject	Sentiment scores are higher before the date
5/31/19	Virginia Beach, VA	14	0.99857976	Accept	No significant difference
5/31/19	Virginia Beach, VA	30	1	Accept	No significant difference
5/31/19	Virginia Beach, VA	90	0.99999993	Accept	No significant difference
8/3/19	El Paso Walmart, TX	14	0.99186245	Accept	No significant difference
8/3/19	El Paso Walmart, TX	30	0.05679279	Accept	No significant difference
8/3/19	El Paso Walmart, TX	90	0.00326774	Reject	Sentiment scores are higher before the date
5/14/22	Buffalo Market Shooting, NY	14	0.99871789	Accept	No significant difference
5/14/22	Buffalo Market Shooting, NY	30	0.24514203	Accept	No significant difference
5/14/22	Buffalo Market Shooting, NY	90	0.99992951	Accept	No significant difference
5/24/22	Robb Elementary, TX	14	9.72E-12	Reject	Sentiment scores are higher before the date
5/24/22	Robb Elementary, TX	30	0.00741816	Reject	Sentiment scores are higher before the date
5/24/22	Robb Elementary, TX	90	0.99992397	Accept	No significant difference
10/25/23	Schemengees Bar, ME	14	2.92E-12	Reject	Sentiment scores are higher before the date
10/25/23	Schemengees Bar, ME	30	0.99643045	Accept	No significant difference
10/25/23	Schemengees Bar, ME	90	0.00817632	Reject	Sentiment scores are higher before the date
1/21/23	Star Ballroom Dance Studio, CA	14	0.99999502	Accept	No significant difference

1/21/23	Star Ballroom Dance Studio, CA	30	0.22016685	Accept	No significant difference
1/21/23	Star Ballroom Dance Studio, CA	90	0.01567277	Reject	Sentiment scores are higher before the date

Table 3: Results from Mann-Whitney U-test on mass shooting incidents on a 95% confidence interval

Incident	Coefficient	z-score	P>|z|
Police brutality	-0.3990624	-3.39	0.001
Mass shooting	0.0898121	0.95	0.341

Table 4: The table represents the coefficient of z-score, z-score, and p-value of combined police brutality and mass shooting incidents using interrupted time-series analysis

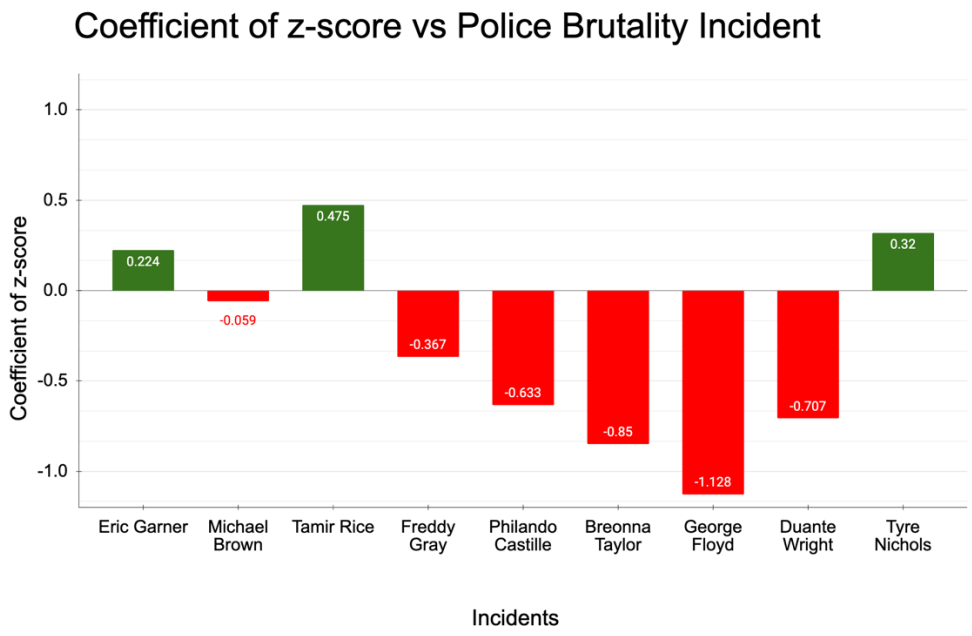


Fig 2: Graph representing the coefficient of z-score for each police brutality incidents after running interrupted time-series analysis on the average weekly sentiment 20 weeks before and after the event

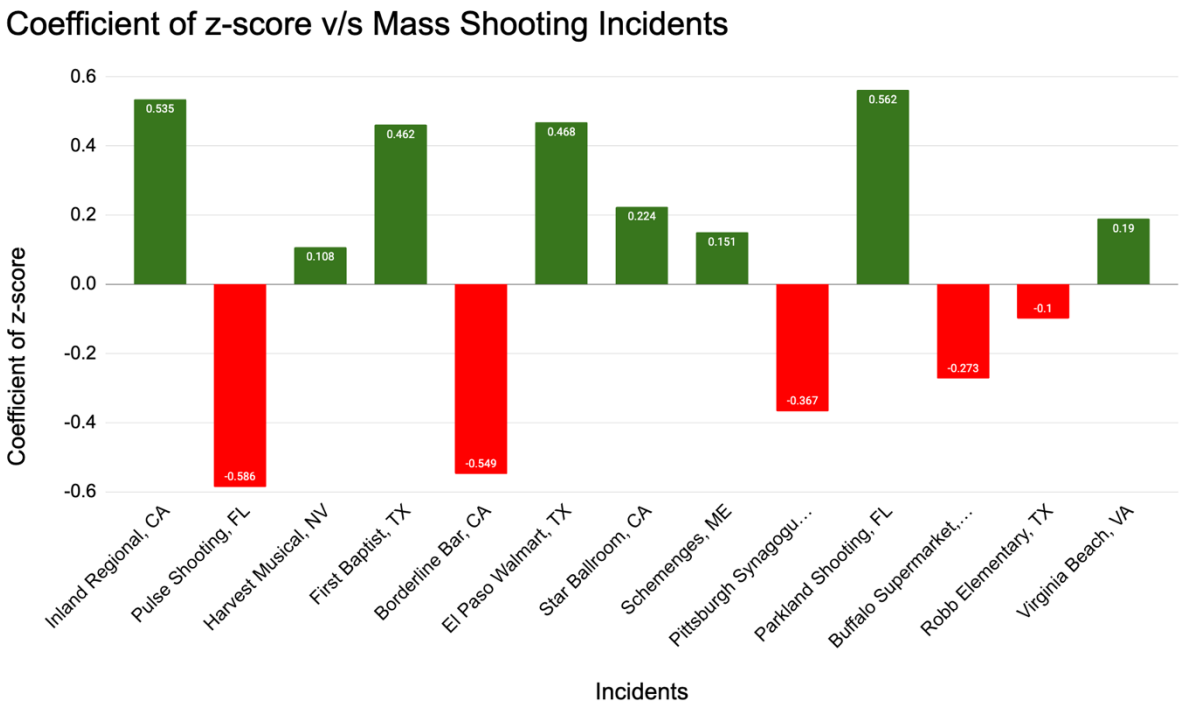


Fig 3: Graph representing the coefficient of z-score for each police mass shooting incidents after running interrupted time-series analysis on the average weekly sentiment of 20 weeks before and after the incident

Conclusion

From the graphs showcasing the results of two different sentiment analysis algorithms, VADER seems to yield a higher negative sentiment result compared to TextBlob. There appears to be a fair number of neutral sentiments from the tool in all the subreddits. Since VADER proved to be accurate in detecting a higher significance of negative sentiment and is tailored for social media data, it was chosen as the base data for future analysis.

The results of the Mann-Whitney Test indicate a significant drop in sentiments 14 days before and after incidents involving Michael Brown, Freddy Gray, Philando Castille, George Floyd, Duante Wright, and Tyre Nichols. A similar significant decrease in sentiment before and

after 30 days can be observed in incidents involving Freddy Gray, Philando Castille, Breonna Taylor, Duante Wright, and Tyre Nichols. However, for the 90-day mark, not many incidents seemed significant enough. Based on this analysis, the optimal time frame to examine before and after the incident date was concluded to be 14 days.

For mass shooting incidents, the following events exhibited a significant drop in sentiment 14 days before and after the incident: Inland Regional Center, Harvest Music Festival, Borderline Bar and Grill, Robb Elementary, and Schemengees Bar. Additionally, the following incidents displayed a significant drop in sentiment 30 days before and after the incident: Pulse Shooting, Harvest Music, Pittsburgh Synagogue, Borderline Bar and Grill, and Robb Elementary. Although there appears to be a significant drop in sentiment for a few incidents 90 days before and after the incident, the results have been disregarded due to the extended time frame and overlapping incidents. It is evident that police brutality incidents showed a more significant drop in sentiments compared to mass shooting incidents.

Although Mann-Whitney test showed significant drop in sentiment for a lot of incidents, a robust model was needed to verify this analysis. Based on the analysis of the normalized post and sentiment graph, it is evident that incidents such as those involving George Floyd, Philando Castille, Breonna Taylor, and Duante Wright led to a significant negative drop in the sentiment, indicating a strong negative impact on public perception. The trend is supported by the interrupted time-series analysis, which shows that police brutality incidents resulted in notably lower sentiments in the 20-week period following the event compared to the 20-wek period before. Among these incidents, George Floyd's case stands out with the most extreme negative z-score coefficient. Other incidents that resulted in a negative z-score coefficient are Michael

Brown, Freddy Gray, Philando Castille, Breonna Taylor, and Duante Wright. The results support the initial analysis from the Mann-Whitney U-Test.

In contrast, mass shooting incidents generally did not lead to significant decrease in sentiment, with only a few, such as the Pulse shooting in Florida, showing highly negative z-score coefficient. Some mass shooting even resulted in more positive sentiment towards police, notably the Inland Regional shooting in California and the Parkland shooting in Florida. Overall, while police brutality incidents consistently elicit negative sentiment from public, mass shootings do not seem to have a significant impact on public sentiment towards police, possibly due to their indirect relation to law enforcement except for few cases.

Next Steps

a. Scrape more comments from diverse subreddits and other sources besides Reddit, including social media pages of mainstream news channel or police forces, to have a large database
b. Use different sentiment analysis algorithms and compare them to see the difference in their robustness
c. Analyze sentiments for more incidents involving police, including news about new laws and regulations related to policing
d. Use more robust models to see if other factors affect the drop and rise in sentiment scores, including the demographics of the public, geography, and political spectrum

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