

Understanding the Impact of Social Media on Mental Health using Subreddit Sentiment and Emotional Analysis

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Abstract - Reddit is a popular social media platform for online discussions with various communities, called subreddits, that are specialized in particular topics. Our project works by collecting information on posts and comments spanning a wide range of subreddits across multiple diverse fields. We intend to address some questions: Are the subreddits displaying predominantly positive or negative emotions? Across these subreddits, what is the prevailing mood and how does it differ? Furthermore, we have uncovered common subjects people debate about and their association with emotions and attitudes shown by community members. In this study we have analyzed top subreddits representing a wide array of topics, utilizing web-scraping techniques and various NLP models (like VADER, Latent Dirichlet Allocation (LDA), and Empath) to perform sentiment analysis, emotional assessment, and topic modeling respectively. This comprehensive analysis will help us understand which types of discussions correlate with specific emotional outcomes, ultimately offering insights into the impact of social media on mental health.

Index Terms - Emotional Analysis, Empath, Latent Dirichlet Allocation(LDA), Natural Language Processing(NLP), Valence Aware Dictionary and Sentiment Reasoner(VADER), Sentiment Analysis

INTRODUCTION

In today's modern age and society, social media has become a very important part of our lives. Social media and networking sites give us a sense of community, belonging and relatability. These apps make us feel seen and heard. It also offers varied spaces for discussions on a wide range of topics, and one such space for this is Reddit. Reddit is a hub of online communities popularly known as subreddits. Each of these subreddits focuses on specific themes and interests for discussion among the users. Within these subreddits users interact with each other and engage in sharing experiences, expressing their opinions and offering a rich source of data to study human behavior and social trends.

In this project we have aimed to dive deeper into the impact of social media, particularly Reddit on mental health by analyzing sentiments and emotion patterns across

several categories of subreddits. Our goal is to identify the dominant attitudes and topics of discussions within these Reddit communities and explore how they are related to the psychological impact. In this study we have used a combination of web-scraping techniques and NLP models like Latent Dirichlet Allocation(LDA), Valence Aware Dictionary and Sentiment Reasoner(VADER), and Empath. We seek to provide insights on the correlation of online discourse and mental health of the users.

Enhancing previous studies that have looked at emotional and sentimental analysis on Reddit we expand on our scope of project by including a diverse array of subreddits from news and politics to humor and entertainment. By using techniques like LDA we discover the underlying patterns of the user data and determine how they represent our societal sentiments and attitudes.

Through our findings and results we aim to answer key questions regarding the presence of positive and negative emotions in the various subreddit groups, the associations between the user response and discussion topic, and overall impact of online discourse on mental health. By establishing relationships between these interactions and dynamics we aim to contribute towards a deeper understanding of how social media shapes an individual and ultimately we hope to promote a healthier online environment and foster supportive digital spaces.

BACKGROUND

Abro, Shah, and Abbasi conducted a detailed analysis of Reddit data to investigate the impact of the COVID-19 pandemic on intellectual health [1]. They employ natural language processing algorithms to investigate opinions expressed in distinct Reddit communities, with a focus on variations during unique epidemic periods. They created a dataset that includes data from January 2019 to August 2021, with mental health and non-mental health subjects analyzed. Their examination focused on sentiment and emotional analysis, which revealed an increase in negative attitudes, particularly anxiety and dissatisfaction, during large-scale pandemic outbreaks. The research shows how the epidemic exacerbated pre-existing negative sentiments. Even though they encountered challenges in retrieving facts after September 2021.

Kamarudin, Beigi, and Liu investigate the language usage in the online mental health community by examining reddit posts and comments [2]. Based on prior research, they divided the 52 subreddits related to mental health into 5 groups for examination. Using the VADER (Valence Aware Dictionary and Sentiment Reasoner) tool, they initially conducted sentiment analysis on a variety of mental health subreddits and discovered that, on the whole, the communities' sentiment is more positive than negative. After that, they used the Latent Dirichlet Allocation method to perform topic modeling. They discovered a number of correlations between the topics discussed and the sentiment level, as well as the fact that while the subreddits have a fair amount of topic similarity, they also tend to differ, particularly depending on the community subcategory. They also employed the Linguistic Inquiry and Word Counts (LIWC) program to examine the subreddits' scores on several emotional metrics, including ones like "happy", "angry" and "sad," and to illustrate the variations in distributions within the subcategories. Regarding its objective and methodology, this study is fairly similar to our own in that it aims to identify general subjects that elicit happy or negative feelings when addressed, but we also wish to examine subreddits of all kinds rather than just those that are dedicated to mental health.

In order to investigate how opinions regarding the Russia-Ukrainian conflict changed over time, Nandurkar, Nagare, Hake, and Chinnaiah looked towards reddit posts [3]. Based on pertinent keywords, they selected many subreddits and looked at comments from 2022 to gauge how positive or negative people were regarding different parts of the dispute. They accomplished this by labeling comments as good or negative using the pretrained VADER tool, and then training a Multinomial Naive Bayes Model to carry out their sentiment analysis. Using these techniques, they discovered that a significant portion of reddit users' comments about the conflict were critical, with the majority of those criticisms being aimed at Russia rather than Ukraine.

In-depth analysis of the linguistic and psychological trends seen in Reddit discussions was conducted by Solomiia Albota [4], with a particular emphasis on responses to the actor Irfan Khan's death. This study carefully examines the emotional and cognitive expressions in user comments by utilizing the powerful features of the Linguistic Inquiry and Word Count (LIWC) programme. It seeks to illuminate the nuanced ways in which language on digital platforms reflects the general attitude, mood, and cognitive processing of news. Through an analysis of ten discussion threads, the study illuminates the complex relationship between textual communication and psychological dynamics in online communities, providing insights into how people negotiate and communicate sorrow, memory, and solidarity in the virtual space.

Michael M. Tadesse and colleagues use advanced machine learning and natural language processing (NLP)

approaches to try and find signs of sadness within Reddit posts [5]. The programme analyzes textual patterns that reflect depressing sentiments by utilizing a highly advanced combination of machine learning and natural language processing (NLP) technology. By utilizing a range of feature extraction techniques, including LIWC for psycholinguistic analysis, LDA for topic modeling, and N-gram analysis for contextual insights, the study seeks to identify the subtle linguistic and semantic markers of depression. In addition to increasing the model's precision in identifying information related to depression, this all-encompassing strategy creates new avenues for early intervention and treatment, highlighting the potential of digital platforms to raise mental health awareness and provide support. The research highlights the significance of ethical issues and privacy while utilizing technology for health monitoring and support, with the goal of improving both public health and individual well-being.

Behavioral trends in community-driven discussion sites such as Reddit have been analyzed by Sachin Thukral, Hardik Meishri, Tushar Kataria, and other authors [6]. On community-driven discussion sites like Reddit, the article attempts to methodically examine individual and group behavioral trends, with an emphasis on post-statistical behavior and user interaction modeling. The analysis classifies posts according to user interaction patterns, identifies user behavioral tendencies, and investigates post evolution patterns over time. The study sheds light on inactive posts, short-lived yet very active posts, and the nature of activity around highly active posts, all of which lead to a better understanding of Reddit user behavior. The study aims to shed insight on how social media has evolved over time, particularly in respect to Reddit. The findings could be useful in a variety of domains, including advertisement placement, summarizing viral subjects, and understanding information spread dynamics.

Empath [7] is described by its creators as a tool that generates and validates lexical categories from a set of seed terms. Basically, given a text, it will analyze the terms within it to come up with categories for topics and emotions that the text is related to, a mix of topic modeling and emotional categorization. It draws connections between words and phrases using a deep neural embedding of over 1.8 billion words within modern fiction. The words in each category are discovered using unsupervised modeling, and then validated using a crowdsourcing approach. The creators boast that Empath generates categories very similar to categories that are hand-crafted and psychometrically validated by humans.

The main example of such an approach is Linguistic Inquiry and Word Count (LIWC), which Empath aims to improve upon and compete with. One issue with LIWC in the context of our project is that its hand-crafted dictionaries are proprietary and thus not openly available for use. In addition, the Empath paper notes that LIWC is relatively small with its only 40 topical and emotional categories (compared to over 200 in Empath), a large number of which have less than 100 words in them. In

addition, there are potentially useful categories (social media, violence) that don't exist in current lexicons. Empath's deep neural network approach aims to alleviate this with the ability to generate and validate new lexical categories on demand. They also show that "Empath's data-driven, human validated categories are highly correlated ($r=0.906$) with similar categories in LIWC" [7].

METHODOLOGY AND IMPLEMENTATION

I. Data Extraction and Preprocessing

To collect data for our project we utilized the Python Reddit API Wrapper(PRAW) which provides access to Reddit's API for extracting and web scraping posts and comments from various subreddits. We have focused on four main categories here: Humor, Media, News, and Politics/Philosophy, each comprising specific subreddit topics. For data extraction in each category we identified which are the most relevant subreddits. We have considered subreddits in categories as: for Humor: r/funny, r/memes, r/showerthoughts, for Media: r/gaming, r/music, r/movies, for News: r/news, r/UpliftingNews, r/worldnews, and for Politics/Philosophy: r/politics, r/philosophy, r/unpopularopinion.

Using PRAW, we retrieved posts and comments from these subreddits, along with essential attributes like post title, score, URL, number of comments, text content, user age (in days), comment text, and comment score.

Hence the structure of our dataset includes the following fields: subreddit: Name of the subreddit, post_title: Title of the post, post_score: Score (upvotes - downvotes) of the post, post_url: URL of the post, post_num_comments: Number of comments on the post, post_text_content: Text content of the post, post_user_age_days: Age of the user who posted (in days), comment_text: Text content of the comment, comment_score: Score (upvotes - downvotes) of the comment, comment_user_age_days: Age of the user who commented (in days).

Now, we preprocess the data to utilize it for further modeling and drawing insights. Firstly we have removed special characters and stopwords where we eliminate non-alphanumeric characters and common stopwords ('the', 'is', 'and') and focus on meaningful words.

Next we perform tokenization and lemmatization on our comments. Tokenization includes splitting of text into individual tokens or words. While lemmatization ensures that we reduce the words to their base or root form. An example for lemmatization can be given as: 'running' -> 'run', 'cats' -> 'cat'.

By implementing these techniques for data scraping and preprocessing we were able to create a structured dataset ready to be modeled for sentiment analysis. This dataset forms the foundation for the next steps of our implementation.

II. Latent Dirichlet Allocation

The process begins with topic modeling on Reddit comments across multiple major themes using Latent Dirichlet Allocation (LDA). Latent topics in a set of documents can be found using a generative statistical model called Latent Document Analysis (LDA).

Firstly, we import all necessary libraries i.e NLTK, TextBlob, Matplotlib, pandas, gensim. These libraries offer features for sentiment analysis, natural language processing, topic modeling, and data manipulation, in that order. The data for each major topic is loaded from relevant CSV files after the libraries have been imported. These datasets comprise Reddit comments from several subreddits including news, humor, politics/philosophy, and media. After that, the text data in each dataset is cleaned and standardized by preprocessing.

Preprocessing includes tokenizing the text, removing stopwords, extracting punctuation and non-alphabetic words, and lemmatizing the text to make it more standardized. The text data will be ready for additional analysis thanks to this preparation stage. The gensim library's LdaModel is used to apply LDA once the data has undergone preprocessing. In this stage, the preprocessed text data is used to create a corpus and dictionary. Although each document is recorded as a bag-of-words vector in the corpus, the dictionary translates words to distinct integer IDs (bag-of-words).

Once the lexicon and corpus are ready, the dataset is subjected to LDA training on the corpus to find latent subjects. The model iterates to assign words to topics and documents to distributions over topics, with the number of topics given as a parameter (which is set to 15). The top words for each subject are recovered once the LDA model has been trained, offering insights into the themes and concepts that each topic represents. These key terms aid in the interpretation and labeling of the subjects that the model has determined.

Moreover, TextBlob's sentiment polarity function is used to do sentiment analysis on each topic's top words. This study assesses the emotions that each topic's linked words represent in order to provide insight into the emotional tone that each topic conveys. Moreover, the computation of each subject's contribution to the dataset signifies the significance and predominance of each topic in the dataset. This contribution analysis aids in determining the relative relevance of various issues and in setting priorities.

To assess the general sentiment associated with each major category, additional graphs were plotted. Using the results from these analyses, we identified the category with the most pronounced positive and negative sentiments. We then conducted a deeper analysis into this category, performing LDA on its subcategories to pinpoint the subcategory and subreddit that exhibited the strongest positive and negative sentiments respectively. This methodical approach allowed us to effectively dissect the sentiment dynamics within and across the various categories and subcategories in our dataset.

III. VADER

We conducted sentiment analysis on Reddit subcategories using the VADER algorithm by first aggregating comments from similar subreddits. We grouped these into specific categories such as Media, Politics/Philosophy, News, and Humor. During the preprocessing phase, we cleaned the text to improve analysis quality. This involved removing excess whitespace, converting all text to lowercase, stripping URLs, and omitting any entries that were empty. Notably, we chose not to remove emojis and emoticons since VADER can interpret these elements to enhance sentiment detection accuracy. After preprocessing, we applied the VADER sentiment analysis tool to the consolidated text blocks. VADER uses a lexicon with pre-scored sentiment terms and incorporates adjustments for punctuation and capitalization, which can affect sentiment intensity. This analysis generates a compound score for each text block, categorizing the overall sentiment of the block as positive, negative, or neutral. We stored these sentiment scores in a pandas dataframe and calculated average sentiment scores for each Reddit subcategory. This allowed us to identify the dominant emotional tones within each category. Lastly, we visualized the results using matplotlib, creating visual representations that depict the varying sentiments across different subreddit categories. This process effectively highlighted the emotional landscape of the subreddits, providing insights into the predominant sentiments within each subcategory.

IV. EMPATH

For the Empath algorithm, first we loaded the Reddit data from each of the subreddits, and combined the comment text from subreddits corresponding to the same subcategory (e.g. Media, Politics/Philosophy, News, Humor) into a single block of text data. For each of these subcategory text blocks, we stripped the whitespace, converted the text to lowercase, removed URLs, and dropped empty rows. Things like emojis and emoticons were fine to leave in because Empath is built to handle them and they can serve to add emotional context to the text data. Then we created an Empath object and analyzed the text blocks using the Empath lexicon, also using their built-in normalization, and handling empty analysis results by creating empty categorical dictionaries. We then converted these results into a pandas dataframe, and took the mean category values from it to determine the top emotional sentiment or topic categories represented in each Reddit subcategory based on highest mean scores. Then we plotted

these top categories and their mean values for the subcategories and visualized them using matplotlib.

RESULTS

I. Latent Dirichlet Allocation

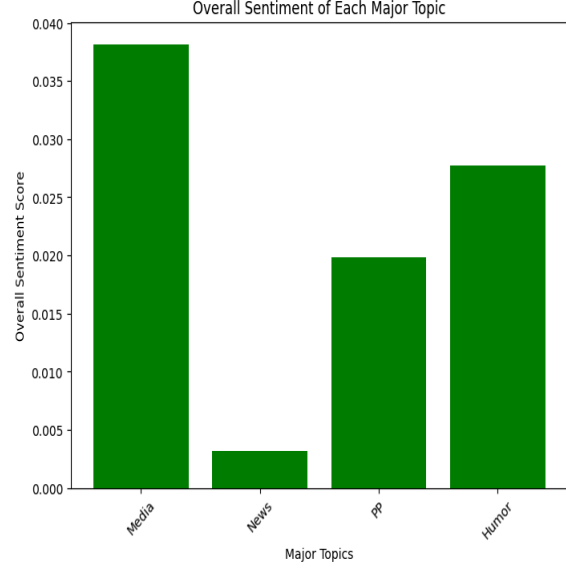


FIGURE I.A

LDA OVERALL SENTIMENTAL ANALYSIS

For LDA, we have run sentimental analysis on each topic and retrieve overall sentiment of this major Category which is shown in Figure I.A. Media shows the most positive overall sentiment achieving a score around 0.38 while news tends to have least positive sentiment scoring around 0.0025. The politics/philosophy and humor having a relative of approx 0.02 and 0.027.

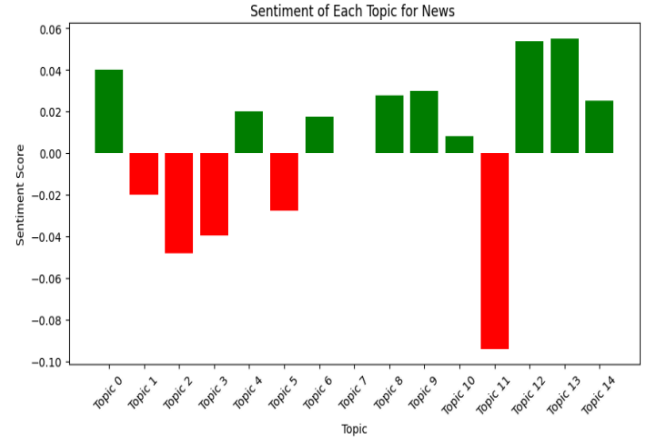


FIGURE I.B
LDA NEWS TOPICS MODELING ANALYSIS

Figure I.B shows an interesting insight about sentimental analysis; topic 11 is revealed as having the most negative sentiment amongst all categories. Based on the set of words in that topic we found that it relates to “Controversy discourse and Social critique” which makes sense as most of the critique tends to be negative or involve hate words.

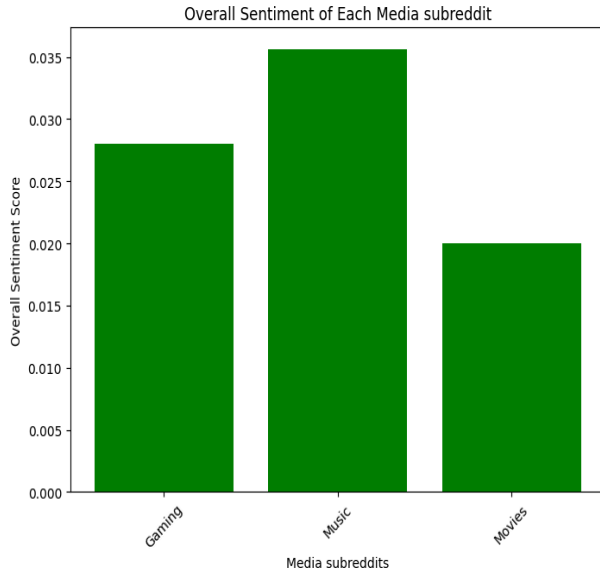


FIGURE I.D
LDA MEDIA SUBCATEGORIES SENTIMENTAL ANALYSIS

We took a deeper look into the Media category and ran LDA on the individual subreddits (e.g. gaming, movies, music). The graph clearly showcases that users of “music” subreddit tend to show the most positive sentiment, scoring around 0.035. This insight agrees well with reality, as in real world interactions most of the people tend to enjoy music or consider it therapeutic.

II. VADER

For the Vader algorithm, across all the extracted topics: media, politics/philosophy, news, humor. The most negative vader score was calculated for News at a score 0.085. Vader scores are compound values, calculated based on allocating a sentiment score for each word using a dictionary also known as Vader lexicon in which each word has a preassigned sentiment score. The average compound value is then calculated by analyzing these scores. Media scored a whopping 0.109 and has the highest scores across all categories. The Politics/Philosophy and Humor have similar Vader scores. The sentiment score is derived from the positivity or negativity of a slang. Extracted the most frequent words from the entire dataset across all topics.. Then that word list is categorized in positive like 'love', 'great', 'good', 'wonderful', 'best', 'fantastic', 'amazing', 'awesome', 'nice'. For negative, 'hate', 'bad', 'terrible', 'worst',

'disappointing', 'awful', 'poor', 'negative'. Similarly for neutral, 'okay', 'fine', 'average', 'neutral', 'mediocre'. This summarizes that News tends to attract more negative information and media has the upperhand in spreading positivity.

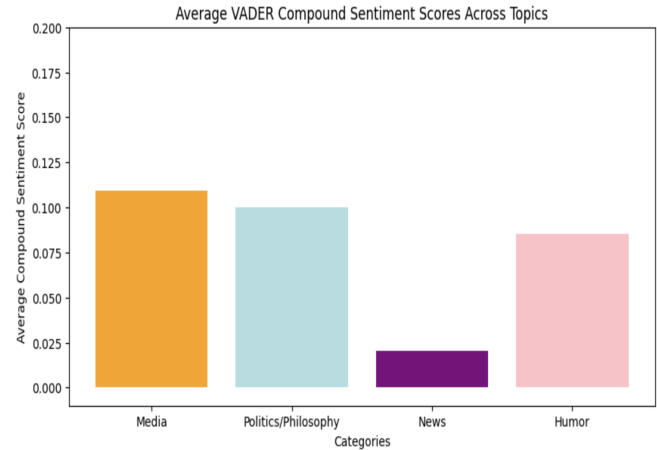


FIGURE II
AVERAGE VADER COMPOUND SENTIMENT SCORES ACROSS TOPICS

III. EMPATH

For the Empath algorithm, within the media Reddit subcategory, the top Empath category was “negative_emotion” at a score of (approximate scores listed) 0.012, followed by “positive_emotion” at around 0.0075. “Music”, “listen”, and “speaking” were all in the top 5, most closely being associated with the r/Music subreddit but also having overlap in topic with video games and movies. “Swearing_terms” and “violence” were within the top 15 categories, perhaps because of either the content of the media being discussed within the subreddits or the negative emotional sentiment of the users doing the discussion. For the politics/philosophy subcategory, once again “negative_emotion” (0.011) was the top category, however “positive_emotion” was instead the fourth highest category (0.0065) behind “speaking” (0.0085) and “communication” (0.007), which make sense as big categories in subreddits focused on discussing complex topics in depth. There are also some positive leaning discussion categories in the top 15 like “giving”, “friends”, “trust”, “optimism”, and “family”. For the News subcategory we see the highest differential between the number one “negative_emotion” (0.011) category and the number two “positive_emotion” (0.006) category of any of the reddit subcategories. We also see many financial categories like “business”, “money”, and “economics” in the top 15, as well as low and order categories like “government”, “law”, and “violence”. Even in the humor reddit subcategory “negative_emotion” (0.0105) is at the top followed directly by “positive_emotion” (0.006). We see more social categories in the top 5 however like “speaking”, “communication”, and

“friends”. We do also see the rowdier categories like “swearing_terms” and “violence” together in the top 15 similar to the media subcategory.

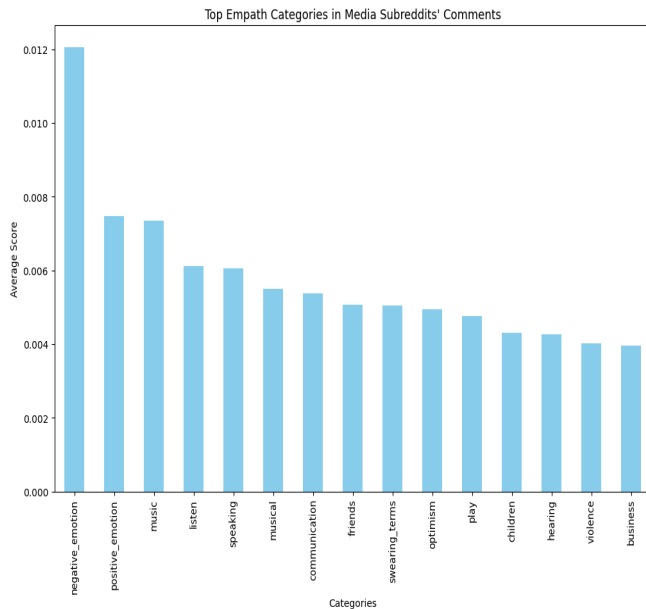


FIGURE III
TOP EMPATH CATEGORIES IN MEDIA SUBREDDITS' COMMENTS

CONCLUSION

Our Latent Dirichlet Allocation (LDA) analysis reveals the media categories that resonate most positively or negatively with audiences. Within our study, it is evident that the Music subreddit within the media subcategories showcases the most positive sentiment. This could be attributed to music's inherent qualities, often perceived as relaxing, calming, and therapeutic, which likely contribute to its favorable sentiment scores., calming and therapeutic effects of music. On the other hand, the News subcategory has the most negative overall sentiment in which topic 11 (i.e. Controversy discourse and Social Critique) shows the most negative sentiment throughout .

The VADER sentiment analysis of Reddit subcategories offers a detailed glimpse into the emotional dynamics of online discussions, highlighting a predominant presence of negative sentiments across various topics. This pattern is notably present even in subcategories typically associated with lighter, humorous content, where negative emotions still overshadow positive ones, illustrating a broad trend of negativity in internet discourse. Particularly, the news subcategory exhibits a stark negative tilt, recording the highest negative Vader compound score. This suggests that discussions in this area often focus on more serious, contentious topics, which naturally engender a more negative sentiment among participants. Conversely, the politics and philosophy subcategory, despite an overall negative sentiment, surprisingly contains some of the most vibrant positive discussions in the analysis. This indicates a wide spectrum of emotional responses, from strong

negativity to significant positivity, likely fueled by the passionate and polarizing nature of political and philosophical debates. This analysis not only reveals the overarching emotional climate of Reddit subcategories but also underscores the diverse emotional reactions that different topics can provoke among users. Such insights are essential for researchers, marketers, and platform moderators aiming to better understand and engage with online communities, offering a window into the complex interplay of content, context, and emotional response in digital conversations.

The biggest conclusion from the Empath analysis of the Reddit subcategories is that negative emotion definitely seems to significantly trump positive emotion in all forms of online discussion. The differentials are surprisingly similar across the subcategories for this, with even the humor subcategory having negative sentiment significantly outweigh positive sentiment. In terms of the worst (most negative) category for this differential, if you are looking at absolute difference then news is the most negative, however if you are looking at ordering then politics/philosophy has the worst outlook. The most positive learning categories are contained within the humor and politics/philosophy subcategories, making politics/philosophy both one of the most negative and the most positive subcategories (seemingly the strongest emotions are displayed here). Each of the subcategories has plenty of top Empath categories relating to negative things like violence and swearing. Ultimately, from these results it seems like internet discussion tends to be rife with negativity regardless of what is being discussed, with a few variations in topics, and some more 'positive' categories for discussion mixed in.

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