

# Changes in the Sentiments and Metaphors in COVID-19 News Discourse (2019-2024)

Yolanda Honglei Guan<sup>1</sup> and Winnie Huiheng Zeng<sup>2</sup>

<sup>1</sup>Department of English Language and Literature, Hong Kong Shue Yan University, Hong Kong SAR

<sup>1</sup>232703M@hkysu.edu.hk

<sup>2</sup>Department of Chinese and Bilingual Studies, The Hong Kong Polytechnic University, Hong Kong SAR

<sup>2</sup>winnie-huiheng.zeng@polyu.edu.hk

## Abstract

This study investigates the diachronic changes in the sentiments and metaphorical frames in a corpus of news discourse on COVID-19 as a case study to examine the potential implication for applying sentiment analysis in corpus data and its interaction with metaphorical framing changes over time. The corpus contains COVID-19 news articles covering the entire cycle of the pandemic from 2019 to 2024 in Hong Kong. The sentiment analysis of the corpus was explicitly presented. We found that the sentiments of the news are overall objective and slightly positive. The diachronic changes and the interaction between the sentiments and metaphor polarities were discussed with empirical examples from the corpus, aiming to establish an operational approach for exploring the connection between metaphor polarities and the sentiments in large-scale of discourse data.

## 1 Introduction

Over the past five years, the COVID-19 pandemic has had a huge and lasting impact on the public's health, economy, and society. In the domain of public discourse, researchers are studying the language used to address pandemic issues from various perspectives using different techniques. For example, sentiment analysis has been increasingly utilized in the COVID-19 discourse to uncover the synchronic or diachronic polarity and subjectivity patterns. Figurative framing, such as metaphorical framing, is another central focus of studies on COVID-19 discourse, as metaphors are not only a rhetorical device but also a tool for reasoning and persuasion (Burgers, Konijn, & Steen, 2016). Metaphors have been shown to evoke public emotions, shape perceptions, and influence the public's interpretation of social phenomena (Lakoff and Johnson, 2008; Group, 2007; Steen et al., 2010; Ahrens and Zeng, 2022; Zeng and Ahrens, 2023;

Zeng et al., 2021). It permeates the discourse of the COVID-19 pandemic and is crucial for media, institutions, and governments (Fu, 2024).

This study aims to investigate the sentiments and metaphors in a large corpus of news discourse on COVID-19 in the context of Hong Kong. Understanding the functions of sentiment and metaphors and their interactions in news discourse can enhance and improve our understanding and comprehension of their role in establishing COVID-19 perception. Despite the previous many studies on this topic, the novelty of our study is 1) the use of a complete COVID-19 dataset covering the entire cycle of the pandemic for diachronic change analysis of the sentiments, 2) the focus on the metaphor polarity analysis, 3) the focus on the interaction between sentiments and metaphor polarity. The study thus contributes to the field with methodological and practical implications by providing a detailed sentiment and metaphor analysis of COVID-19 discourse in the context of Hong Kong.

## 2 Previous work

### 2.1 Sentiment analysis

Sentiment analysis includes the examination of positive and negative emotions, and is the process of extracting emotions and feelings from textual data (Bhardwaj et al., 2024; Pang and Lee, 2008; Saad and Saberi, 2017). This complex process utilizes natural language processing, text analysis, and statistical methods to evaluate human emotions and classify them.

Sentiment analysis has been applied across numerous social, economic, and political domains of discourse, as opinions and perspectives are fundamental to nearly all human activities. It serves as a crucial component for comprehensive investigations in real-world applications, such as forecasting stock market trends (Khan et al., 2022), monitoring mental health conditions (Benrouba and Boudour,

2023), polarity analysis of tweets about COVID-19 (Yin et al., 2022). These insights offer a panoramic view of the populace across diverse social and economic sectors, enabling relevant organizations to implement reforms accordingly.

Since 2000, various techniques have been adopted to perform sentiment analysis (Liu, 2010). In Yin et al. (2022), sentiment analysis is performed on tweets about COVID-19 vaccination, and popular topics are mined from positive and negative tweets. Wicke and Bolognesi (2021) also conducted sentiment analysis in online COVID-19 tweets and found that the (possible) negative emotions appearing in tweets gradually increased with the development of the epidemic and the increase in daily cases.

## 2.2 Metaphor analysis of Covid-19 discourse

The news text itself is a rich and diverse source of metaphorical analysis (Steen et al., 2010; Krennmayr, 2011). Extensive research has been conducted to explore the persuasiveness of metaphors and the underlying ideologies conveyed in news discourse covering various topics (Krennmayr, 2011). Since the outbreak of the global coronavirus crisis, media and politicians have mostly resorted to WAR metaphors to describe the impact of the virus and how people cope with it (Amaireh, 2022; Fu, 2024; Lakoff, 1993; Wicke and Bolognesi, 2021). According to Colak (2023) and Fu (2024), COVID-19 has been depicted as ‘an animal’ or ‘a disaster’ in the media coverage. These metaphors have had a negative impact on the objectivity of the COVID-19 pandemic (Fu, 2024; Colak, 2023). They found that almost all metaphorical frameworks for COVID-19 emphasized the uncertainty of the pandemic in a negative way, which could have a significant impact on the public’s psychology, leading to pessimistic attitudes (Colak, 2023).

DISASTER and WAR are common metaphors for COVID-19 in both Chinese and English news contexts (Xu, 2023), and this similarity shows that the public has similar understandings and values in the face of the COVID-19 epidemic. However, certain metaphors, such as ZOMBIE are common in English culture but not common in Chinese culture. The difference could be caused by various factors, including distinct ways of cognition and understanding among people with different cultural and historical backgrounds. The same metaphorical framework, such as WAR and DISASTER, can be used to express different or even completely oppo-

site views on COVID-19 due to different political stances (Chen et al., 2022; Liu, 2023; Liu and Tay, 2023). Furthermore, Roberts and Bolognesi (2024) demonstrates that WAR metaphor has a negative impact on the emotional state of the citizens and may prompt people to propose stricter epidemic prevention measures to reduce the virus, compared with JOURNEY metaphor. Political orientation of the speakers also influence people’s reasoning about the pandemic, e.g., the right-wing participants are more susceptible to COVID-19 WAR metaphors and will take relevant steps to counter this pandemic war (Panzeri et al., 2021).

While most of the news is about the impact of COVID-19 on public health, the economic and social impact of COVID-19 is also huge. For instance, economic metaphors such as MACHINE and EQUIPMENT are ‘breaking down’ and ‘declining’ (Busso and Tordini, 2022). Metaphor can influence the public’s attitude toward vaccines to some extent (Flusberg et al., 2024). Confronting with the COVID-19 pandemic could be considered as WARS, HUNTING, GAMES, and GAMBLING (Pedrini, 2021; Khaliq et al., 2021; Kozlova, 2021). According to Pedrini (2021), vaccines could be described as ANTIDOTES, FIREWALLS, OR MIRACLES, OR AS RAINCOATS, CASTLES, SEATBELTS, and BANKS (Flusberg et al., 2024). Vaccines have been conceptualized as an UMBRELLA in the rain, a MESSENGER, a TAPE RECORDER, and an EXTRA SECURITY, showing a gradual cognitive changes in perceiving this concept among the public (Guliashvili, 2024).

## 2.3 Advancements beyond previous work

Previous studies have extensively analyzed metaphors before 2023, primarily emphasizing the diachronic changes in metaphorical framing of the pandemic during the beginning and middle phases of the pandemics. To conduct a more comprehensive analysis of the pandemic discourse, the data used in this study covers the whole process from the beginning of the pandemic to the post-pandemic (2019 to 2024). In addition, although there are research focusing on the pandemic metaphors or the emotional attitudes of the public, the relationship between metaphorically related vocabulary and the emotional attitudes of news media and its diachronic changes haven’t been explored. In this research, the connection between metaphorical vocabulary and sentiment analysis is the key aspect that will be explored. We aim to address the following research questions:

- 1) What are the diachronic changes in the senti-

ments of the news discourse covering COVID-19 in Hong Kong from 2019 to 2024?

2) What are the diachronic changes in the sentiments of the COVID-19 metaphorical frames of COVID-19 in Hong Kong news discourse from 2019 to 2024?

3) What is the interaction between the fluctuation of sentiment analysis and the fluctuation of metaphors in Hong Kong news discourse from 2019 to 2024?

### 3 Methodology

#### 3.1 Data

This research focuses on news from the online newspaper - Hong Kong Free Press (HKFP) for the corpus building. Since the outbreak of COVID-19 in 2019 to the present, there has been much news about the epidemic on the Hong Kong Free Press website, offering sufficient data for analysis. The news articles about COVID-19 have been obtained using the web crawler method through Python (based on the Requests library) by searching the keywords ‘COVID-19,’ ‘vaccine,’ ‘pandemic,’ and ‘virus’ on the website <https://hongkongfp.com/>. A total of 2,541 news about COVID-19, covering the time span of December 31, 2019, to August 16, 2024, were obtained. The total word count of the corpus is 1,749,884. After data collection, all initial data is preliminarily cleaned, filtered, and named in sequence by date.

#### 3.2 Sentiment Analysis

This study adopted a sentiment analysis method based on natural language processing to systematically preprocess and analyze text data. We first explored the relationship between sentiment polarity and subjectivity in text content and examined the distribution characteristics of the two with samples. To this end, the study designed a series of data processing and visualization steps to ensure the reliability and interpretability of the analysis results.

First, we used Python’s NLP toolkit, including nltk and TextBlob, to preprocess the text data. Through a custom function, we batch-read all text files from a specified folder and stored the contents in a Pandas data frame. The text preprocessing process includes removing special characters and numbers, unifying text to lowercase, word segmentation, removing stop words (such as ‘the,’ ‘and,’ ‘is,’ etc.), and restoring the word form. This process

aims to clean up the original text data to make it more suitable for subsequent sentiment analysis.

After the text preprocessing is completed, we use the TextBlob library to perform sentiment analysis. TextBlob provides sentiment analysis functions based on sentiment polarity and subjectivity, where sentiment polarity indicates the intensity of the positive or negative sentiment of the text, ranging from -1 (extremely negative) to 1 (extremely positive), while subjectivity indicates the degree of subjectivity of the text content, ranging from 0 (completely objective) to 1 (completely subjective). We analyzed the preprocessed text content, extracted each text’s sentiment polarity and subjectivity scores, and saved the results into a CSV file for further analysis.

In order to more intuitively display the results of sentiment analysis, we used matplotlib and seaborn libraries to create a series of visualization charts. First, we drew a scatter plot to show the relationship between sentiment polarity and subjectivity (Figure 1). This chart provides the distribution of each text in these two dimensions, helping us to initially understand whether there is a specific correlation between sentiment and subjectivity. Secondly, we also drew histograms of sentiment polarity and subjectivity, which show the distribution of the two variables in the sample, including the central tendency and dispersion of the data. These visualization results provide a basis for subsequent statistical analysis.

Third-order polynomial regression formula is used for the regression analysis. After calculating the emotional score, we determined the most appropriate function to describe the emotional changes that occur in tweets over time. For this, we first use polynomial regression ( $f(x) = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_Nx_N + \varepsilon$ , where  $\varepsilon$  is the unobserved random error). Specifically, we performed a regular least squares regression to increase the polynomial degree until we explained most of the data variance with significant confidence. It is worth noting that higher polynomials provide better fitting, but they cannot serve our survey to determine a simple trend and can overfit our data.

#### 3.3 Metaphor analysis

Following the Metaphor Pattern Analysis approach (Stefanowitsch, 2006), keywords associated with the source domain of WAR were searched in the corpus using Python libraries (Pandas and Matplotlib). We included lemmas under the keywords of ‘protec-

tion,’ ‘fight,’ ‘strategy,’ ‘combat’, and ‘victory’ into the group of positive *WAR* keywords, and lemmas under the keywords of ‘war,’ ‘threat,’ ‘violence,’ ‘struggle’, and ‘attack’ into the group of negative *WAR* keywords.

## 4 Results and Discussion

### 4.1 Sentiment analysis

To address the first research question, we first analyzed the relationship between emotional polarity and subjectivity. Figure 1 shows the distribution of a large number of text data points, with the horizontal axis representing emotional polarity and the vertical axis representing subjectivity.

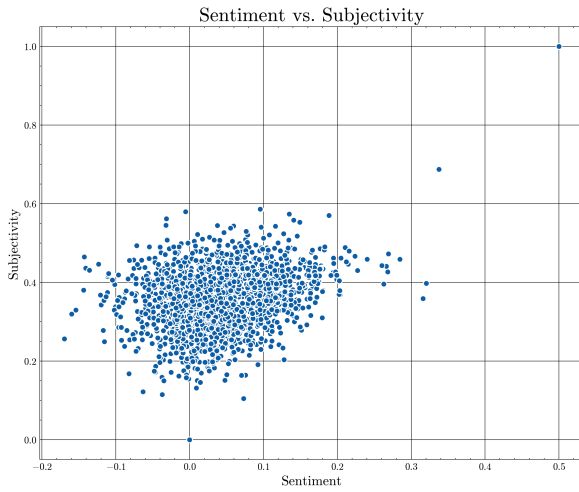


Figure 1: Sentiment analysis

From the overall distribution in Figure 1, most of the data points are concentrated in the range of polarity from -0.2 to 0.4, and the value of subjectivity is roughly between 0.2 and 0.5. This distribution indicates that the vast majority of texts have neutral or slightly positive emotional tendencies, while the subjectivity of these texts exhibits moderate to low characteristics.

We also observe that although there are some data points that deviate from the main population, no extreme negative emotions (i.e., polarity values far less than 0) or extreme subjectivity (i.e., subjectivity values close to 1) has been observed. This further illustrates the mildness of emotions and the limitations of subjective expression in the sample text. The emotional polarity of the text did not show significant positive or negative differentiation, and the subjectivity did not show excessive bias, reflecting the cautious and moderate expression of personal emotions in the analyzed

text content. It is worth noting that although there is a certain correlation between emotional polarity and subjectivity, this relationship is not very strong. This phenomenon may indicate that the subjective expression of text is not always accompanied by strong emotional tendencies, but rather revolves more around neutral or mild emotional expressions. This observation is of great significance for further understanding the complexity of emotional expression in texts, especially when analyzing texts such as news articles or objective descriptions.

Overall, this scatter plot provides us with preliminary insights into the distribution of textual emotions and subjectivity, emphasizing the neutral tendency of textual emotions and their relatively low subjective expression. In the subsequent analysis, it is possible to further explore how the emotions and subjectivity of these texts change in different contexts, in order to obtain a more comprehensive understanding.

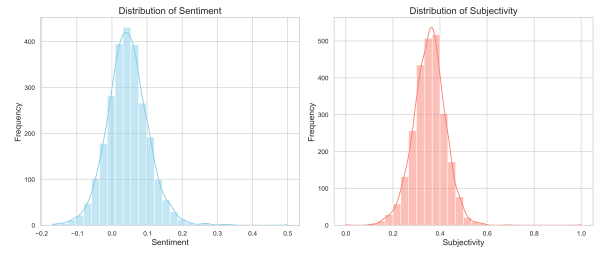


Figure 2: Distribution of sentiment polarity and subjectivity

Figure 2 reveals the distribution of sentiment polarity and subjectivity, which provides important insights. Firstly, the sentiment polarity histogram on the left reveals that the distribution of data roughly follows a normal distribution pattern. The majority of the text’s polarity values are concentrated around 0, slightly biased towards the positive side. This indicates that emotional expressions in the analyzed text samples tend to be neutral or slightly positive, while the number of texts with negative emotions is relatively small. This distribution may reflect the balance and neutrality of the text content, possibly due to the emphasis on objectivity in writing and avoiding strong emotional tendencies.

The subjective distribution map on the right also shows a shape close to normal distribution, but its peak is slightly shifted to the right, concentrated between 0.3 and 0.4. This means that the subjectivity of most texts is in a moderately low range, indicating that these texts are more based on facts, and although there is a certain degree of subjective

expression, overall, they still maintain relative objectivity. It is worth noting that the number of texts with extreme subjectivity or extreme objectivity is relatively small, further indicating the moderate expression of subjectivity in the content of the text.

Comparing the two distribution maps, the analyzed text exhibits a tendency that most texts are emotionally mild and biased towards neutrality while also being moderately subjective in expression. This feature may be related to the type of text, especially if these texts are essentially objective content such as news reports or academic articles. Thus, the gentleness of emotions and the objectivity of expression complement each other, making the overall text present a stable and impartial style.

Overall, these distribution maps provide important information about text emotions and expression styles, indicating that balance and neutrality are dominant features in these texts. In further research, it can be explored whether these features are consistent across different categories of text or whether there are significant changes in sentiment polarity and subjectivity in certain contexts.

Figure 3 is an analysis of the daily sentiment scores from December 2019 to August 2024, aggregated and averaged by month. It illustrates that sentiment tends to be positive most of the time, initially decreasing until reaching its lowest point in June 2021 and then gradually increasing and leveling off.

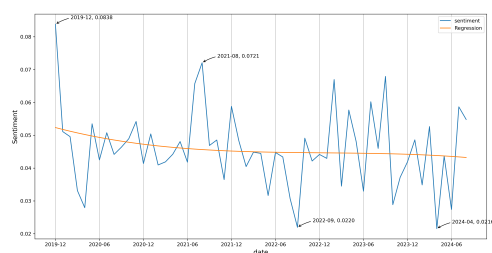


Figure 3: Sentiment fluctuation chart from 2019 to 2024

The overall sentiment polarity over five years emerging from the news corpus is slightly positive ( $>0$ ). The polynomial regression indicates that the average sentiment reaches the most positive in the first two months of the pandemic (from December 2019 to February 2020), while it decreases to the lowest during the period March 2020 to March 2023. It is then increasingly positive from April 2023 to August 2024. According to Figure 3, the curve from December 2019 to August 2024 reveals

the emotional fluctuations in the pandemic. The highest value is 0.0838, and the date is December 2019. The lowest value is -0.0220, and the date is September 2020.

On July 10, 2023, the booking volume of Hong Kong's tourist tickets exceeded expectations by giving away free tickets, and the tourism of Hong Kong was revitalized and promoted again after the pandemic. Meanwhile, to boost the city's morale and economy, the government has launched an HK \$20 million "Happy Hong Kong" campaign. These measures by the Hong Kong authorities demonstrate that they are determined to revive the economy and thus also show optimism and positive feelings. For example:

*(1) Airline HK Express will launch its free flight giveaway at 10. 30am on Tuesday, with round-trip tickets to destinations in Japan, South Korea, Thailand, Vietnam, and Taiwan on offer - the latest phase of a campaign aimed at rebooting tourism after years of Covid travel restrictions. Open to people living in Hong Kong, HK Express's campaign is giving away 21,626 complimentary tickets to 19 Asian destinations from July 11 to July 24 on a first come, first served basis. (July 10, 2023, Hong Kong Free Press)*

The second highest value is 0.0721, and the date is June 2023. On June 14, 2023, Hong Kong authorities planned to introduce 20,000 workers to deal with a labor shortage in the wake of the pandemic. This reveals that Hong Kong's economy is generally recovering and improving to some extent. For instance:

*(2) Hong Kong is set to import around 20,000 workers in a bid to alleviate the labour crunch in the construction, transport and aviation sectors, the government has announced.....The low-skilled labour force fell by around 160,000 people, Secretary for Labour and Welfare Chris Sun said. "Therefore, after the return to normalcy, many industries in Hong Kong are facing the challenge of labour shortages," he said. (June 14, 2023, Hong Kong Free Press)*

The lowest value is -0.0220, and the date is September 2020. On September 24, 2020, due to the coronavirus, the number of infections and deaths in many countries rose, such as Brazil. Meanwhile, almost every government and agency invested a lot of funding and resources in developing an effective vaccine (see example 3).

*(3) Clinical trials of the CoronaVac coronavirus vaccine developed by Chinese laboratory Sinovac*

have “reached the efficacy threshold” demanded by the World Health Organization, the Brazilian institute charged with its production and distribution said on Wednesday. However, the Butantan Institute didn’t publish the results of those trials — the last before authorization. .... Immunization has been a highly politicized issue in Brazil, where far-right President Jair Bolsonaro has repeatedly said he won’t take a vaccine while he’s also tried to discredit the CoronaVac jab. Brazil has suffered the second-largest number of coronavirus deaths in the world after the US with 188,000 dead. (December 24, 2020, Hong Kong Free Press)

The second lowest value is -0.0216, on the date of April 21, 2022. Here is an example. The number of cases in Hong Kong is increasing almost every day, which has affected people’s lives and work. For example:

(4) Hong Kong’s John Lee has tested positive for Covid-19 after returning from the Asia Pacific Economic Cooperation summit in Thailand. He is now undergoing quarantine, the government announced early Monday morning. He returned to the city from a four-day trip to Bangkok on Sunday night and underwent a polymerase chain reaction test at the airport upon his arrival. The test came back positive, the Chief Executive’s Office announced on Monday. (November 21, 2022, Hong Kong Free Press)

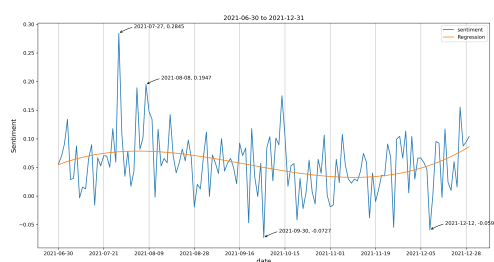


Figure 4: Sentiment fluctuation from June 2021 to December 2021

In Figure 4, the lowest value is -0.0727, and the date is September 30, 2021. Due to the pandemic, the number of delivery personnel is rapidly increasing, which has triggered attention to the plight of this group (see example 5):

(5) The coronavirus pandemic and resulting lockdowns sent demand for meal delivery services soaring: the sector is now worth 664 billion yuan (\$100 billion), according to a report from the China Hospitality Association. The nation’s competitive app-

based services have expanded into nearly every aspect of modern life, with digital-savvy consumers used to instantaneous service and fast delivery due to a ready flow of cheap labour. But after years of unrestricted growth, China’s Big Tech is coming under fire from Beijing, with Tencent, Didi, and Meituan all targeted over anti-monopoly rules. Earlier this year, Alibaba was fined a record \$2.8 billion after an investigation found it had abused its dominant market position. (November 14, 2021, Hong Kong Free Press)

The second lowest value is -0.0593, and the date is December 12, 2021. Strict quarantine measures and closed-loop management during the Beijing Winter Olympics prevented the spread of the epidemic, which is bound to have a negative impact on the economic benefits of the Games. For example:

(6) Next year’s Winter Olympics in Beijing will be held without spectators from overseas, with tickets restricted to fans living in China because of the Covid-19 pandemic, the International Olympic Committee said Wednesday. The IOC said only fully vaccinated participants would be exempt from a 21-day quarantine. Athletes who can provide a “justified medical exemption” will have their cases considered. All attendees will enter a strict bubble upon arrival that covers Games-related areas and stadiums as well as accommodation, catering, and the opening and closing ceremonies. (September 30, 2021, Hong Kong Free Press)

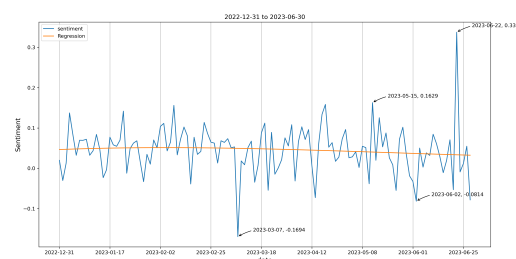


Figure 5: Sentiment fluctuation from December 2022 to June 2023

In Figure 5, the highest value is 0.3375 on the date of June 22, 2023. The public began to celebrate the Loong Boat Festival after three years of interruption. For example:

(7) Around 1,600 people signed up to race during Hong Kong’s Dragon Boat Festival - or Tuen Ng Festival - on Thursday. Crowds gathered in Stanley to watch over 56 teams brave the heat, after a three-year hiatus due to the Covid-19 pandemic.

(June 22, 2023, Hong Kong Free Press)

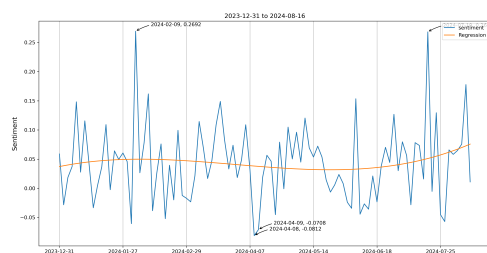


Figure 6: Sentiment fluctuation from December 2023 to August 2024

The Figure 6 shows sentiment change in the pandemic from December 2023 to August 2024. Positive attitudes are obvious in the period. The epidemic prevention measures of various pavilions have disappeared, and whether wearing a mask is necessary has become the focus of discussion (see example 8).

(8) *This is a question that keeps cropping up in Hong Kong, which is currently one of the last places in the world where universal mask-wearing in all public settings is compulsory. Universal masking has been one of the most recognisable features of public life in Hong Kong in the last three years. Most other local Covid control measures have been dropped, which makes the mask mandate stand out even more. So, it is natural to wonder: how much longer do we need to wear our masks? This seemingly simple question is actually asking two different things: a) Are masks helping Hong Kong's public health at this stage of the pandemic? b) Do masks need to be mandatory? People debating this issue often conflate these two questions, but this is not appropriate. For example, proper mask-wearing can be useful (even essential) in certain situations, but that does not automatically make mask mandates necessary. (February 27, 2023, Hong Kong Free Press)*

By the end of the pandemic, the economic situation improved, and stocks rose. Although not as good as before the pandemic, various signs indicate that various industries in society are gradually recovering. For example:

(9)....*He became HSBC's permanent CEO in March 2020, when the bank's shares in Hong Kong tanked sharply at the beginning of the Covid-19 pandemic. The firm's share price has risen more than 40 percent since then but has yet to reach its pre-pandemic peaks..... (April 30, 2024 Hong Kong*

*Free Press )*

The second highest value is 0.00756, and the date is August 10, 2024. In the post-pandemic era, young people are increasingly concerned about their physical health, and health products and supplements have gained their favor. This is also one of the subsequent impacts brought about by the pandemic. For instance:

(10) *Popping supplements, drinking herbal teas, and signing up for lifestyle classes, China's youth are turning to the wellness industry as work stress and pandemic memories spur a growing interest in health. These new habits are part of a global wellness boom. However, the traditional concept of "yangsheng" — literally meaning "cultivating one's life force" — has given the trend a unique cultural twist in China. In Shanghai, Annie Huang sat in a trendy cafe-like establishment that sold traditional herbal teas, sipping a bitter concoction purported to protect the body against the summer heat. (August 10, 2024 Hong Kong Free Press)*

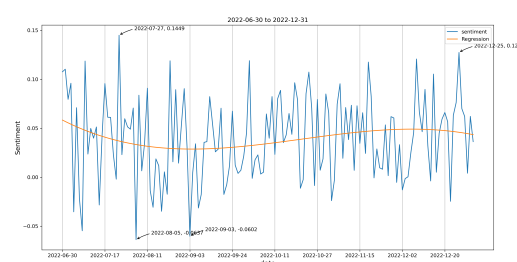


Figure 7: Sentiment fluctuation chart from June 2022 to December 2022

The Figure 7 above depicts the distribution of emotions from June 30 2020 to December 31 2022. The highest value above is 0.0682, and the date is November 8, 2022. On this day, Hong Kong's premier music festival, Clockenflap, would return to the Central harbourfront this March after a three-year hiatus because of the pandemic. A whole festival experience, with multiple outdoor stages and F&B outlets, is in the works, alongside a diverse line-up of international, regional, and local acts. The citizens of Hong Kong eagerly anticipated the revival of this long-awaited music festival. For instance:

(11) *Hong Kong's premier music festival, Clockenflap, is to return next March to Central Harbourfront after a three-year hiatus. Organisers say it is "100 percent confirmed" for Friday March 3 until Sunday March 5, 2023. A full festival ex-*

perience, with multiple outdoor stages and F&B outlets, is in the works, alongside a diverse line-up of international, regional, and local acts. The 12th edition of Clockenflap comes after it was cancelled in 2020 and 2021 owing to the Covid-19 pandemic and was axed in 2019 due to the pro-democracy protests and unrest. (November 8, 2022, Hong Kong Free Press)

## 4.2 Metaphor analysis

To answer the second research question regarding the diachronic changes in the sentiments of the COVID-19 metaphorical frames over time, we modeled the changes in the occurrence of the keywords associated with the source domain of WAR in the corpus using Python libraries (Pandas and Matplotlib). We included lemmas under the keywords of ‘protection,’ ‘fight,’ ‘strategy,’ ‘combat,’ and ‘victory’ into the group of positive WAR keywords, and lemmas under the keywords of ‘war,’ ‘threat,’ ‘violence,’ ‘struggle,’ and ‘attack’ into the group of negative WAR keywords. Figure 8 lists all the lemmas of the four keywords searched for WAR.

WAR Keywords	Lemmas of WAR Keywords					
PROTECTION	protect	protects	protected	protecting	protection	protections
FIGHT	fight	fights	fought			
STRATEGY	strategy	strategies				
COMBAT	combat	combats	combating			
VICTORY	victory	victories				
WAR	war	wars				
THREAT	threat	threats	threaten	threatens	threatened	threatening
VIOLENCE	violence	violent				
STRUGGLE	struggle	struggles	struggling	struggled		
ATTACK	attack	attacked	attacking			

Figure 8: List of lemmas searched for the words associated with WAR metaphors

Figure 9 shows the standardized number of positive and negative WAR keywords per 10,000 words during the time period between 2019 to 2024.

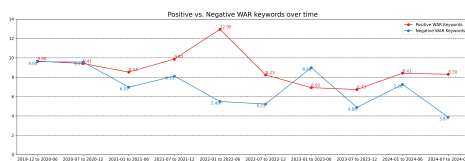


Figure 9: Standardized number of positive and negative WAR keywords (per 10,000 words) over time

From January 2021 to June 2022, there is a peak period of positive WAR keywords in the chart. This period is also the most positive stage for words associated with metaphors. During this time, the frequent use of positive words related to WAR metaphors, such as "protect" and "strategy," in news articles aims to boost the public's confidence in winning the fight against COVID-19 and overcoming the fear of the virus. For example:

(12) Chief Executive Carrie Lam has confirmed that the next phase of Hong Kong's COVID-19 Vaccine Pass will go ahead as scheduled on May 31, despite experts urging the government to relax the requirement for those under 60. In response, Lam said that although vaccination could not prevent COVID-19 infections, it remained the most effective way to protect against serious illness and ensure that public hospitals would not be overburdened. Lam also said that only around half of those eligible had received a third dose. "Therefore, it remains necessary to provide more motivation and incentive, in the hope that those who have not got the third jab will... get vaccinated," she added. (May 17, 2022 Hong Kong Free Press)

The example reveals positive words associated with war metaphor have been adopted in news to improve the confidence of the citizens for the 'WAR' with the virus.

From January 2023 to December 2023 is the peak period of negative words in the table. Negative words contain STRUGGLE, THREAT, WAR, and so on. In other words, it is also the most negative stage for words related to metaphors. For instance:

(13) Through my research and solidarity work with the Asian Migrants Coordinating Body (AMCB) and other migrant-led organisations during the pandemic, I saw how their members and leaders struggled. They lost parents and siblings to the virus, could not manage to send home enough money to cope with inflation, had their contracts terminated when their employers had financial trouble or left Hong Kong, and went for years without visiting their own young children due to travel restrictions, and faced increased demands in their work due to school closures and work from home policies. (May 21, 2023 Hong Kong Free Press)

## 5 Discussion and Conclusion

In summary, the study attempts to comprehensively investigate the diachronic changes in the sentiments

and metaphorical frames in the news discourse covering the entire cycle of the COVID-19 pandemic from 2019 to 2024. The overall emotional polarity of the corpus was slightly positive and overall objective. Polynomial regression reveals that the average mood becomes increasingly positive from 2021 to 2024, while it drops softly from 2019 to 2021 during which the general attitude of the news tended to be slightly negative and pessimistic. During the period of 2019 to 2021, many countries were under lockdown, and authorities typically implemented strict quarantine measures. At the same time, there were new deaths and infections every month, making the public fearful of the unknown. However, proactive protective measures and the promotion of vaccines have also given people confidence and hope so that the emotional inclination is slightly pessimistic. In the period of 2023 to 2024, with the gradual reduction of infections and deaths, large-scale public events such as music festivals have resumed, and most citizens have been vaccinated in an orderly manner. News attitudes toward the pandemic have gradually become optimistic. Applying sentiment analysis in corpus-based discourse analysis thus can reflect the fluctuations in the emotional tendencies of news media writers towards specific societal issues. The overall fluctuation is small, and the objectivity of the news is strong. These findings reveal the changes in the attitude and emotions of the media and to some extent, the public toward the progressing of the pandemic.

Furthermore, this study contributes to the limited body of research examining the changes in the sentiments associated with metaphors by categorizing metaphorical keywords into positive and negative polarities. It explores the interaction between the sentiments of metaphors and the emotional attitudes of news media, providing an operational approach for analyzing the relationship between metaphor polarities and the sentiments expressed in large-scale of discourse data.

## References

- Kathleen Ahrens and Winnie Huiheng Zeng. 2022. Referential and evaluative strategies of conceptual metaphor use in government discourse. *Journal of Pragmatics*, 188:83–96.
- Hanan Ali Amaireh. 2022. Covid-19 is war, water & a person: Metaphorical language of the coronavirus disease in "the jordan times" newspaper. *Theory and Practice in Language Studies*, 12(7):1286–1293.
- Ferdaous Benrouba and Rachid Boudour. 2023. Emotional sentiment analysis of social media content for mental health safety. *Social Network Analysis and Mining*, 13(1):17.
- Manju Bhardwaj, Priya Mishra, Shikha Badhani, and Sunil K. Mutoo. 2024. Sentiment analysis and topic modeling of covid-19 tweets of india. *International Journal of System Assurance Engineering and Management*, 15(5):1756–1776.
- Lucia Busso and Ottavia Tordini. 2022. How do media talk about the covid-19 pandemic? metaphorical thematic clustering in italian online newspapers. *Preprint*, arXiv:2204.02106.
- Tianen Chen, Minhao Dai, Shilin Xia, and Yu Zhou. 2022. Do messages matter? investigating the combined effects of framing, outcome uncertainty, and number format on covid-19 vaccination attitudes and intention. *Health Communication*, 37:944 – 951.
- Figen Unal Colak. 2023. Covid-19 as a metaphor: Understanding covid-19 through social media users. *Disaster Medicine and Public Health Preparedness*, 17:e159.
- Stephen J. Flusberg, Alison Mackey, and Elena Semino. 2024. Seatbelts and raincoats, or banks and castles: Investigating the impact of vaccine metaphors. *PLOS ONE*, 19.
- Feifei Fu. 2024. Analyzing metaphor patterns in covid-19 news pictures: A critical study in china. *PLOS ONE*, 19(2):1–26.
- Pragglejaz Group. 2007. Mip: A method for identifying metaphorically used words in discourse. *Metaphor and Symbol*, 22(1):1–39.
- Nino Guliashvili. 2024. "what's covid-19 vaccine like?" - from a cognitive frame to a simulative proposition. *European Scientific Journal, ESJ*, 20:174.
- Mohammed Khaliq, Rohan Joseph, and Sunny Rai. 2021. #covid is war and #vaccine is weapon? COVID-19 metaphors in India. In *Proceedings of the 18th International Conference on Natural Language Processing (ICON)*, pages 431–438, National Institute of Technology Silchar, Silchar, India. NLP Association of India (NLP AI).
- Wasiat Khan, Mustansar Ali Ghazanfar, Muhammad Awais Azam, Amin Karami, Khaled H. Alyoubi, and Ahmed S. Alfakeeh. 2022. Stock market prediction using machine learning classifiers and social media, news. *Journal of Ambient Intelligence and Humanized Computing*, 13(7):3433–3456.
- Tetyana Kozlova. 2021. Cognitive metaphors of covid-19 pandemic in business news. *SHS Web of Conferences*.

- Tina Krennmayr. 2011. *Metaphor in newspapers*. Ph.D. thesis, Research and graduation internal, Vrije Universiteit Amsterdam.
- George Lakoff. 1993. *The Contemporary Theory of Metaphor*. Cambridge University Press, Cambridge.
- George Lakoff and Mark Johnson. 2008. *Metaphors We Live By*. University of Chicago Press, Chicago.
- Bing Liu. 2010. Sentiment analysis and subjectivity. *Handbook of natural language processing*, pages 627–666.
- Yufeng Liu. 2023. (re)framing to (re)evaluate: metaphors in cross-national covid-19 news translation. Master's thesis, Hong Kong Polytechnic University.
- Yufeng Liu and Dennis Tay. 2023. [Modelability of war metaphors across time in cross-national covid-19 news translation: An insight into ideology manipulation](#). *Lingua*, 286:103490.
- Bo Pang and Lillian Lee. 2008. *Opinion Mining and Sentiment Analysis*.
- Francesca Panzeri, Simona Di Paola, and Filippo Domaneschi. 2021. [Does the covid-19 war metaphor influence reasoning?](#) *PLOS ONE*, 16(4):1–20.
- Giulia Pedrini. 2021. [The “vaccine race”: Metaphorical conceptualizations of the search of an immunization against covid-19](#). *Rivista Internazionale di Tecnica Della Traduzione*, 23(1).
- India Roberts and Marianna Bolognesi. 2024. [The influence of metaphorical framing on emotions and reasoning about the covid-19 pandemic](#). *Metaphor and Symbol*, 39:55–74.
- Saidah Saad and Bilal Saberi. 2017. [Sentiment analysis or opinion mining: A review](#). *International Journal on Advanced Science, Engineering and Information Technology*, 7:1660–1666.
- Gerard Steen, Lettie Dorst, J. Herrmann, Anna Kaal, Tina Krennmayr, and Trijntje Pasma. 2010. *A method for linguistic metaphor identification*. John Benjamins Publishing Company.
- Philipp Wicke and Marianna M. Bolognesi. 2021. [Covid-19 discourse on twitter: How the topics, sentiments, subjectivity, and figurative frames changed over time](#). *Frontiers in Communication*, 6.
- Qingshu Xu. 2023. [Comparing covid-19 metaphors in chinese and english social media with critical metaphor analysis](#). *Frontiers in Psychology*, 14.
- Hui Yin, Xiangyu Song, Shuiqiao Yang, and Jianxin Li. 2022. [Sentiment analysis and topic modeling for covid-19 vaccine discussions](#). *World Wide Web*, 25(3):1067–1083.
- Winnie Huiheng Zeng and Kathleen Ahrens. 2023. [Corpus-based metaphorical framing analysis: War metaphors in hong kong public discourse](#). *Metaphor and Symbol*, 38(3):254–274.
- Winnie Huiheng Zeng, Christian Burgers, and Kathleen Ahrens. 2021. [Framing metaphor use over time: ‘free economy’ metaphors in hong kong political discourse \(1997–2017\)](#). *Lingua*, 252:102955.