THE WORLD HEALTH ORGANIZATION IN A POST-COVID-19 ERA: AN EXPLORATION OF PUBLIC ENGAGEMENT ON TWITTER

THIERRY **WARIN**

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Abstract/Résumé

This article analyses the conversations on Twitter related to the World Health Organization (WHO). We collect the text of the discussions as well as the metadata associated with each tweet. Our dataset is exhaustive as it includes all the tweets produced by WHO. Likes, retweets, and replies capture the level of engagement. The goal is to quantify the balance of likes, retweets, and replies, also known as "ratios", and study their dynamics as proxy for the collective engagement in response to WHO's communications. Our results demonstrate a higher engagement of the public receiving the information pushed by WHO. This engagement translates into a more balanced reaction with still a more likely favorable opinion vis-à-vis WHO, but with also more challenges. This protocol based on quantitative measures to serve as a proxy to the legitimacy concept seems to hold its promises. In particular, we also perform a simple sentiment analysis to check the robustness of our conclusions.

Cet article analyse les conversations sur Twitter relatives à l'Organisation mondiale de la santé (OMS). Nous recueillons le texte des discussions ainsi que les métadonnées associées à chaque tweet. Notre ensemble de données est exhaustif puisqu'il comprend tous les tweets produits par l'OMS. Les mentions " j'aime ", " retweets " et " réponses " permettent de mesurer le niveau d'engagement. L'objectif est de quantifier l'équilibre entre les likes, les retweets et les réponses, également appelés "ratios", et d'étudier leur dynamique comme indicateur de l'engagement collectif en réponse aux communications de l'OMS. Nos résultats démontrent un plus grand engagement du public qui reçoit les informations diffusées par l'OMS. Cet engagement se traduit par une réaction plus équilibrée avec toujours une opinion plus probablement favorable vis-à-vis de l'OMS, mais avec également plus de défis. Ce protocole basé sur des mesures quantitatives pour servir de proxy au concept de légitimité semble tenir ses promesses. Nous effectuons également une analyse simple des émotions afin de vérifier la robustesse de nos conclusions.

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1. Introduction

This article is about the use of social media, and Twitter in particular, to assess the evolution of the legitimacy of the World Health Organization (WHO).

In this article, we test a protocol to empirically assess the legitimacy concept. The growing discipline of *computational social science* is heavily reliant on the investigation of socio-technical systems and their impact on our increasingly linked society.

Online Social Networks (OSN) are, in this day and age, where a significant amount of the public political dialogue takes place (Antonakaki et al., 2017). Text can be transformed in a corpus, which can then be analyzed through various Natural Language Processing techniques or statistical analyses as in this article. Indeed, a text-as-data approach opens up a series of new research questions, which may benefit from NLP or quantitative-based analyses of the corpus. For instance, it is possible to determine the prevalent topics that were discussed on the OSNs, as well as observe how some topics generated more clout than others. In what follows, we are particularly inspired by the literature about political conversations on OSNs and Twitter in particular.

Our objective is twofold. First, we want to assess the change in legitimacy during the Covid-19 era. We think it is particularly interesting to study WHO's legitimacy before Covid-19 and during Covid-19. Covid-19 represents an exogenous shock to WHO. It is not different in nature than other pandemics, but it is different in magnitude. As a consequence, we use Covid-19 as a natural experiment for the impact on WHO's legitimacy and the potential change to WHO'S legitimacy. Second, and related to the first objective, we want to build a protocol based on an OSN, namely Twitter, and NLP techniques to transform text into data in order to have a potential quantitative legitimacy index. With such an index, we can then assess when changes occur, as well as the characteristics of the changes: duration, magnitude, topics, etc.

This legitimacy index will be built in order to measure the responses to WHO'S posts on Twitter by WHO's followers, broadly defined. These responses will vary through time in terms of velocity, variety, and volume, also known as the three Vs of Big Data. Quantitatively measuring these responses in these three dimensions, will help evaluate the followers' engagement. Engagement metrics for social media postings are crucial to everyone, from corporate branding to political campaigns to international organizations, and they are measured differently. Despite Twitter's recent ban on political advertising, the data it collects may be useful as an early warning system for customer satisfaction and reputation management. The number of interactions a post has had in the digital realm may be used to determine its level of engagement (e.g., clicks on a link, profile views, mouse-hovers, etc.). Comments, likes, and favorites, as well as replies and likes, are all instances of social media responses to content that have been shared. They are all representative of certain user behavior, such as praising or condemning a particular piece of content. The fundamental activity ratios, according to some researchers, can be utilized as proxy indicators of public reaction polarity to a particular message (Minot et al. 2021).

Inspired by Minot et al. (2021), we will focus our attention to a quantitative representation of the legitimacy index, unlike a sentiment analysis. We shall look at the progression of the metrics relating to the dialogues sparked by WHO'S postings in the future. On Twitter, retweets, likes, and comments are all taken into consideration when calculating the ratio value. The ratio of retweets to replies appears to be more typical of public reactions than the ratio of likes; thus, in this article, we will look at the ratio of retweets to replies.

Instead of judging a post's success by how many comments or likes it receives on other social media sites, such as Facebook, where a huge response is indicative of a post's success, Twitter judges a post's success by how many tweets it receives or how many likes it receives. That something went badly wrong becomes increasingly apparent the longer the conversation lasts.

However, the precise numerical specifications of the ratio are arguable, but in general, it goes as follows: If the number of answers to a tweet significantly outpaces the level of engagement, as measured by likes and retweets, then something is seriously wrong with the dialogue. According to O'Neil (2017), there is an unofficial Twitter rule that states that a tweet is horrible if the number of comments to it considerably outnumbers the number of retweets and likes on the tweet itself.

This is the strategy that will be employed in this essay to assess the change in the legitimacy of the government. In the next part, we will offer a brief survey of the literature on the idea of legitimacy. The data collecting process will be

discussed in detail in the next part, which will be followed by a section on methodology. An additional robustness check portion will be included at the conclusion, which will include an emotional intelligence (EI) analysis to account for any potential negative sentiment linked with certain tweets and to confirm our legitimacy index technique.

2. Literature review

2.1. International Organizations' Legitimacy

According to Buchanan (2011): "Legitimacy in the normative sense is usually understood, at least in the case of the state, to be the right to rule." The term 'legitimacy' is frequently used in international legal and political science literature to refer to the widely held view that a government or institution has the authority to rule.

Legitimacy is a notion that may be interpreted in a variety of ways, depending on the context. A set of standards that may be used to determine the legitimacy of an international organization is laid forth in this article for the purpose of determining such validity. Traditionally, there have been two distinct paths to legitimacy that may be distinguished. The first option is the more traditional method of approaching the problem, being a normative approach.

Dingwerth, Schmidtke, and Weise (2020) found that international organizations are increasingly reliant on democratic narratives. Ultimately, they came to the conclusion that organizations that are subjected to more examination by the media, as well as public outcry from those who are adversely impacted by their actions, are more sensitive to the demand for democratic legitimacy.

According to Hurd (2019), it is not the manner by which an international organization succeeds in establishing its legitimacy, and with it, the degree to which its rules are followed, that is significant, but rather the degree to which its rules are obeyed. In contrast to this, an organization's legitimacy should be gained by exerting a positive influence on those who are influenced by the policies of that organization.

Hooghe, Lenz, and Marks (2019) study the role of national political contestation in delegitimization processes, which they conducted in the past. There is a common thread running across all of this research: a decline in the legitimacy of international agreements is connected with a decline in support from those who are negatively affected by such accords.

The development of moral standards to aid in the assessment of the legitimacy of a regime, regardless of whether or not people believe in said legitimacy, is central to this normative, philosophical approach, as previously stated. This is true even if the immediate motivation to discuss norms can be found in audiences' diminishing belief in the legitimacy of such an arrangement. They play a role in determining legitimacy in conformity with generally recognized standards of conduct. It enables the establishment of a link between the way a particular arrangement performs and the question of how it ought to function. Howse and Nicolaidis (2003) present examples of such research.

Among the other authors who have taken a normative approach that could be useful to the study of international organizations' legitimacy are Buchanan and Keohane (2006), who are concerned with the question of whether a certain institution has the authority to rule. It is necessary, according to Buchanan and Keohane, to determine whether or not people see a certain institution as legitimate, but it is also associated with an organization's capacity to create normative norms that must be met by that organization.

According to Buchanan (2011), we need to consider the inner dynamics of reciprocal legitimation. For instance, it is incorrect to hold that a state's internal legitimacy is entirely dependent on the relationship between the state and its citizens. Rather, whether a state is internally legitimate can be determined in part by whether or not its exercise of power respects the human rights of people in other countries. Another way in which a state's participation in international organizations can help to strengthen its legitimacy is by helping to ensure, among other things, that "(1) it does not treat its own citizens with excessive partiality at the expense of the rights of noncitizens, that (2) it provides its own citizens with the goods and protections against harms that they rightly demand, and that (3) it provides reliable protection of the constitutional rights of its own citizens." When a state participates in the appropriate international organizations, it may avoid behaving in ways that threaten its legitimacy while simultaneously providing its citizens with the certainty that their government is legitimate. Also, when international organizations contribute to the legitimacy of states, they can also contribute to their own legitimacy. As a result, a theory of international legitimacy should recognize the legitimacy that exists between states and international organizations.

The main criticism leveled against the use of a normative yardstick to assess legitimacy is that it relies on the assumption that a rational person would have to agree to the principles. According to Beetham (1991), this results in a scenario in which not the current societal norms are taken into consideration, but rather universal standards are formed without

taking the context of a particular culture into consideration. It is exactly because of this setting that the question of legitimacy is of interest to social scientists in general.

However, just as the motivations for constructing normative yardsticks may be social in nature, empirical methodologies frequently recognize the importance of norms in their investigations. Tallberg and Zürn (2019), for example, although using an empirical approach, acknowledge that the normative principles that may or should guide an organization are equally crucial since they influence how people see an institution. Hurd (2019) believes that international organizations should be given far greater attention for what they do and how they operate on the output side than is now possible within the Tallberg and Zürn framework.

In what follows, we propose an empirical strategy to potentially measure legitimacy through data science techniques, mobilizing data, code and domain knowledge.

2.2. Legitimacy and Data Science

We are inspired by Tallberg and Zürn (2019) who propose an empirical approach to define legitimacy. It is one of the goals of this paper to develop a framework that will assist us in better understanding how international organizations (IOs) gain and lose legitimacy, specifically through their own characteristics (authority, procedure, and performance), which have an impact on the process of legitimacy acquisition and loss. All of these characteristics have implications for the way in which organizations are communicated by their audiences - as well as the way in which they communicate with their own audiences - and, as a result, have an impact on the level of trust that audiences have in the legitimacy of organizations. In this article, we propose a data science perspective based on text-as-data for that matter.

In the early 2000s, when social media first gained widespread popularity, it offered users a new means of connecting with one another. As a result of online social media platforms such as Facebook and Twitter, which are utilized by millions of people, millions of individuals have almost infinite access to information and relationships with one another. Taking social media communication as an example, it has a real-time impact on the offline, physical world, affecting everything from social and political concerns to emergency and disaster response in the process.

New routes for information transfer have emerged, resulting in the rapid dissemination of information throughout a userbase that is capable of responding in real-time to the information being transmitted. NLP techniques have been used, combined with text-as-data, to analyze for instance speeches from central banks (Warin et al., 2020). In other instances, by evaluating the most obvious signals from presidential accounts from the United States, for example, researchers have an excellent opportunity to investigate socio-technical phenomena in a domain of politics that is becoming increasingly important by evaluating the most obvious signals from presidential accounts from other countries. Minot and colleagues expect to be in the year 2021. A number of attempts have been made in the past, with varying degrees of success, to undertake extensive investigations into the online behavior of voters during the election season. In some cases, the goal of these studies was simply to uncover recognizable patterns that could be used to detect a person's or a post's political leanings or ideological orientation, whereas in other cases, the goal was to ascertain the political leanings or ideological orientation of a person or a post. Tweeter had fast development and establishment as a forum for individuals to voice their political ideas on a broad variety of themes, notably in the media, during President Barack Obama's administration (2009–2012). When O'Connor and colleagues (2010) conducted research, they discovered a statistically significant relationship between sentiment analysis on Twitter and Obama's popularity ratings in the United States. Gayo-Avello (2013) presents a comprehensive survey of the literature on this topic.

Data Science techniques, combined with text metadata, can also be used to analyze potential networks and their characteristics (Warin et al., 2018). Network analysis of OSNs can be a powerful tool as well in analyzing characteristics of networks that may impact an international organization's legitimacy.

3. Data Collection

Due to the fact that our technique is entirely observational, we cannot rule out the chance that it may contain certain flaws: for example, other talks outside of our sample may have an impact on the dialogues and the themes pushed by WHO. Our sample includes the whole population of tweets from the World Health Organization, but not the entire population of tweets concerning a public health debate. We are unable to control for homophily when it comes to other information sources. For example, the sample may be skewed because to a low rate of survival.

There are a number of aspects to consider while obtaining information, and all of these are discussed in this paper.

Regarding the research approach, there are two fundamental classification techniques in this field: one based on the number of tweets and the other based on sentiment analysis. In this post, we will concentrate on the first method because our objective is to develop an indication or a group of indicators in the first place.

Twitter's response volume is perhaps the most useful measure for determining how the platform's user base reacts to new content. These values, in addition, are immediately obvious to users, which may affect their behavior if they wish to impact the collective reaction to a communication. Understanding how users react to varying levels of activity volume and temporal dynamics necessitates first developing some discrete scales on which to measure their behavior (Minot et al., 2021).

There are a variety of other indicators that are worth considering. The number of persons who have reacted to a given tweet is indicated by symbols at the bottom of each tweet. These symbols also serve as a means for users to communicate with one another through an interface. These numbers serve as a measure of a tweet's popularity and/or controversy, depending on the context. With the original tweet's cultural context in mind, the ratio of these factors may be used to evaluate tweets using "ratiometrics," which is a statistical technique. It may be possible to reduce the response activities of the user base to aggregated measurements of their reaction as a consequence of this reduction. Additionally, it enables the comparison of Twitter response habits between accounts as well as over the course of time. Next, we can begin to examine tweets based on their content by referring to the ratio data as a guideline (Minot et al. 2021).

Calculating the public reaction activity counts is a good starting point, but it falls short of a comprehensive study of ratiometrics' full potential, as demonstrated in this paper. The "ratiometer" is a combination of technologies that may be used to better understand how people respond to tweets, according to the creators. When determining the activity counts for a tweet, it is crucial to take into account the user's regular activity ratios as well as the age of the tweet. It is necessary to examine a user's tweets and subsequent reaction activities in order to have an understanding of the typical response an account receives. Determining the typical response volume at a certain time step since the tweet was sent is an additional challenge that must be addressed (Minot et al. 2021).

The tweets and associated metadata (date, username, retweets, and hashtags) of WHO have been gathered for this study since the organization first began tweeting.

We do not execute any content tampering or re-engineering as part of our protocol, which consists just of monitoring the Twitter stream (with no information filtering, prioritizing, ranking, or any other process) as per Ferrara and Yang (2015). The postings made by WHO serves as our null model, against which we can measure the number of likes, responses, and retweets received. In this approach, we may test the legitimacy of the theory by studying the responses of various individuals to different messages on the internet.

The information was acquired through the use of an R-based application that queried the streaming Application Programming Interface (API) of the Twitter service. It comprises 46,667 messages that were sent between April 23, 2008 and November 8, 2021, according to the dataset. The commencement date corresponds to the first tweet sent out by the World Health Organization. From that point on, we may participate in the evolution of the tweets provided by WHO.

A number of different levels of interest are evoked. Indeed, it is fascinating to see the rate (first and second derivatives) at which the World Health Organization (WHO) tweets. It is most likely linked to recent global health crises. Later in this post, we shall discuss the Covid-19 period in further detail.

It is possible to determine which subjects have been retweeted and loved by the public by analyzing the dynamics of the dialogues and issues promoted by WHO on Twitter.

This initial step involves completing an exploratory data analysis that is primarily focused on volumes: the total number of tweets made by WHO, followed by the total number of likes, replies, and retweets. This stage will continue until the end of the project. In our next stage, we will look at the ratio of retweets to responses on Twitter.

Figure 1 depicts the evolution of the publicly available number of tweets generated by the World Health Organization over time. Despite the fact that we cover 11 months out of 12 months in 2021, we can notice a substantial spike in the number of tweets made by WHO in 2020, followed by a decrease to levels similar to those of prior years in the following year.

By examining the number of a user's tweets, it is possible to gain an understanding of his or her political leanings. Figure 1 depicts the number of tweets by year, day of the week, and month by year and in 2021, as well as in previous years.

Figure 1. Number of tweets by years, days of the week, and months by year and in 2021.
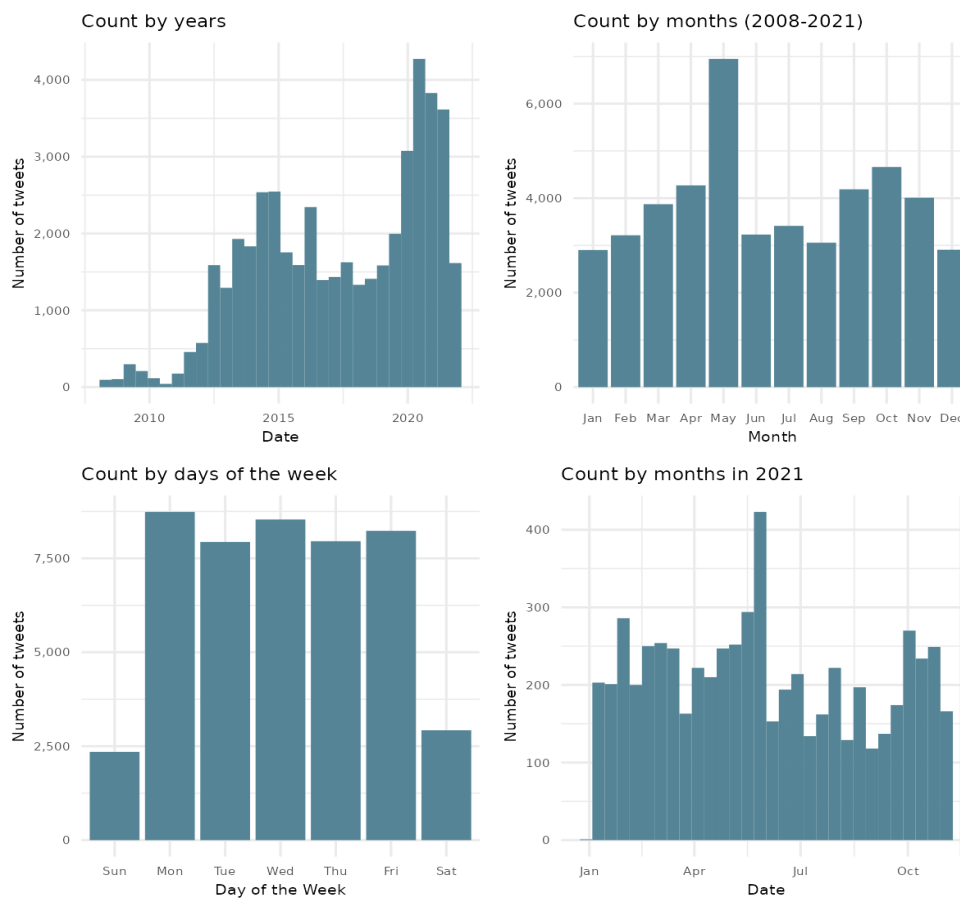
Let us now concentrate on the action of the conversations: the use of likes, retweets, and responses. We know that 44,682 tweets have received at least one retweet (with a maximum of 52,439 retweets), 41,881 tweets have received at least one reply (with a maximum of 15,180 responses), and 44,100 tweets have received at least one like (with a maximum of 53,831 likes) (see Table 1).

Table 1. Number of retweets, replies and likes for the overall period.

	Category	Count	Proportion
Retweets	At least one retweet	44,682	95.7%
	No retweets	1,985	4.3%
Replies	At least one reply	41,881	89.7%
	No replies	4,786	10.3%
Likes	At least one like	44,100	94.5%
	No likes	2,567	5.5%

Table 2 shows the number of tweets, retweets, responses, and likes received in a given year.
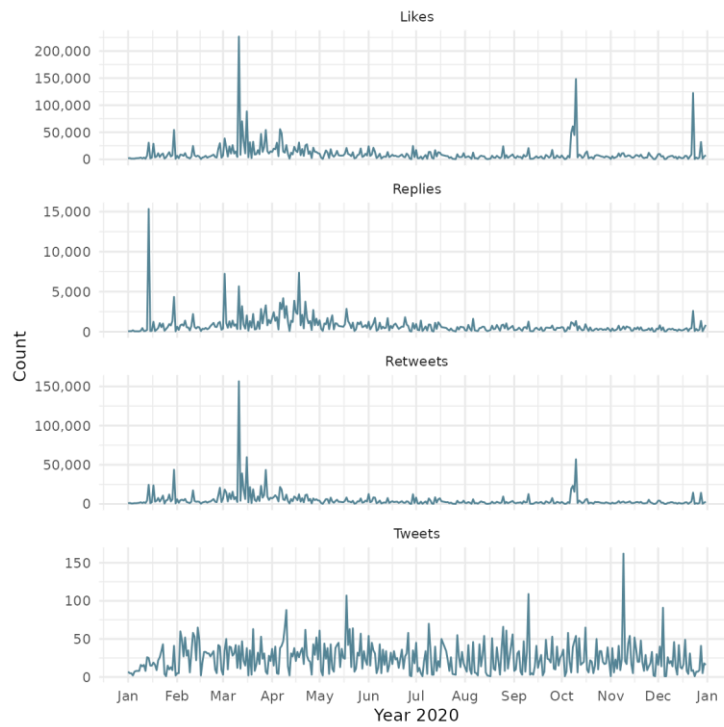
Table 2. Number of tweets, retweets, replies and likes per year.

| Year	Tweets	Likes	Retweets	Replies
2008	199	16	4	3
2009	513	373	135	1
2010	170	348	2,939	0
2011	723	2,309	20,638	765
2012	2,991	16,087	139,731	6,467
2013	3,737	30,509	177,663	12,438
2014	5,090	122,541	355,772	25,609
2015	3,718	204,364	404,247	18,694
2016	3,882	345,566	520,396	17,670
2017	3,445	637,237	639,682	26,846
2018	2,986	831,974	640,625	32,478
2019	4,113	782,309	466,499	27,572
2020	8,894	3,725,855	1,769,577	278,107
2021	6,206	1,310,300	500,999	131,937

This section focuses on the last two years of our dataset, namely the years 2020-2021, which are the Covid-19 years of our data. Twitter activity is depicted in Figures 2 and 3 as the number of tweets, retweets, responses, and likes received

each day in 2020 and 2021, respectively.

Figure 2. Number of tweets, retweets, replies and likes per day in 2020.

Figure 3. Number of tweets, retweets, replies and likes per day in 2021.
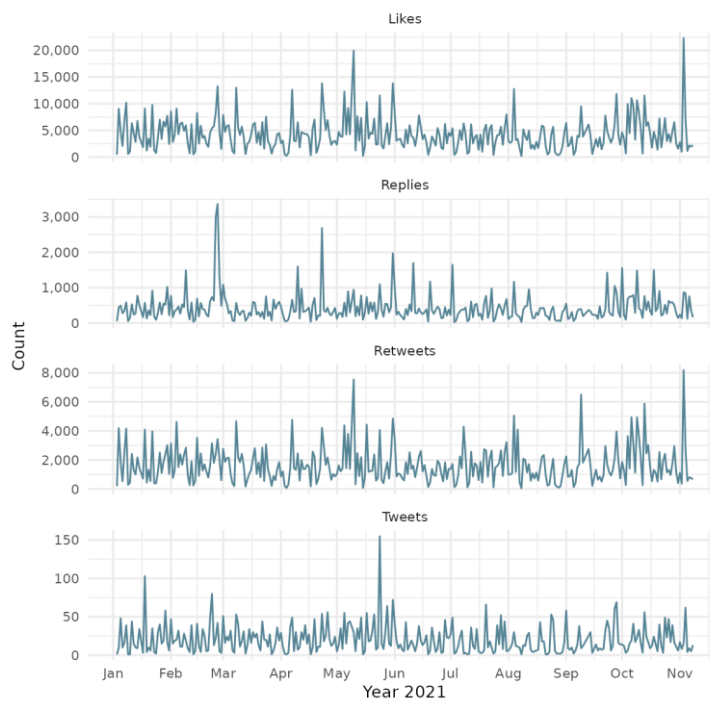
4. Methodology

4.1. Theoretical background

According to Buchanan (2011), a legitimate account of power should take into account at least three aspects of the legitimacy concept's application in political contexts: first, that agent justification (being justified in exercising political power) is necessary (though not sufficient) for legitimacy; second, that legitimacy implies authoritativeness (rule recipients should regard the institution's rules as providing content-independent reasons for acting); and third, that legitimacy assessments can have implications for policy.

By proposing an approach based on text-as-data and OSNs, we respond to the first two conditions. The third point is more in the hands of WHO or any other international organizations and the lessons learned for further policies.

Because the responses to each original activity include timestamped counts for a variety of metrics, such as replies, likes, and retweets, it is possible to create a historical timeline of events using this information. In what follows, we will use this timestamp to create daily aggregate measures when necessary. As in Minot et al. (2021), when the term "activity" is used in this study, it refers to any user action that has been documented in the historical sample, including original tweets, retweets with comments, and answers to those tweets.

Thanks to this historical timelime, we can look at counts but also changes of the various count measures. We propose to look at the second derivative of the various activities (retweets, replies and likes). The second derivative will help us capture the acceleration or deceleration of an activity. We will focus in particular on the second derivative of retweets as the literature favors this indicator to measure the degree of a conversation's interest.

In order to conduct an empirical investigation of the distinctive time scale of response activities, we look for occasions where the second derivative of retweet counts decreases below zero,

$$\frac{d^2}{dt^2} N_{retweet}(t_{i-1}) > 0 \ and \ \frac{d^2}{dt^2} N_{retweet}(t_i) < 0 \tag{1}$$

Because of the slowing rate at which new activities are created, it is believed that these points indicate that response activity is beginning to diminish or 'roll-over'. The term "inflection point" will be used to describe these points in the future (Minot et al. 2021).

To demonstrate the ternary ratio values, a ternary plot (2-dimensional simplex) is employed, in which the values of activities at each time step add up to one at the end of each time step,

$$\sum_\tau R_\tau(t) = 1 \tag{2}$$

We will standardize our approach by looking at each activity in relationship to the overall sample of activities. Temporal activity values are derived by dividing each activity count by the sum of all activities at a given time step in a certain time step. For activity type t at time step t, the ternary ratio value may be calculated as:

$$R_\tau(t) = \frac{N_\tau(t)}{N_{retweets}(t) + N_{likes}(t) + N_{replies}(t)} \tag{3}$$

where $N_\tau(t)$ is the number of times the activity occurred at the time step t. A three-dimensional vector reflecting the normalised activity values associated with a tweet is created for each observation in the manner described above (Minot et al. 2021).

4.2. The ratios

In what follows, we present the various metrics built upon the previous equations.

Figure 4 depicts the characteristic time scale for the overall dataset. The graph on the right represents the cumulative second derivative.
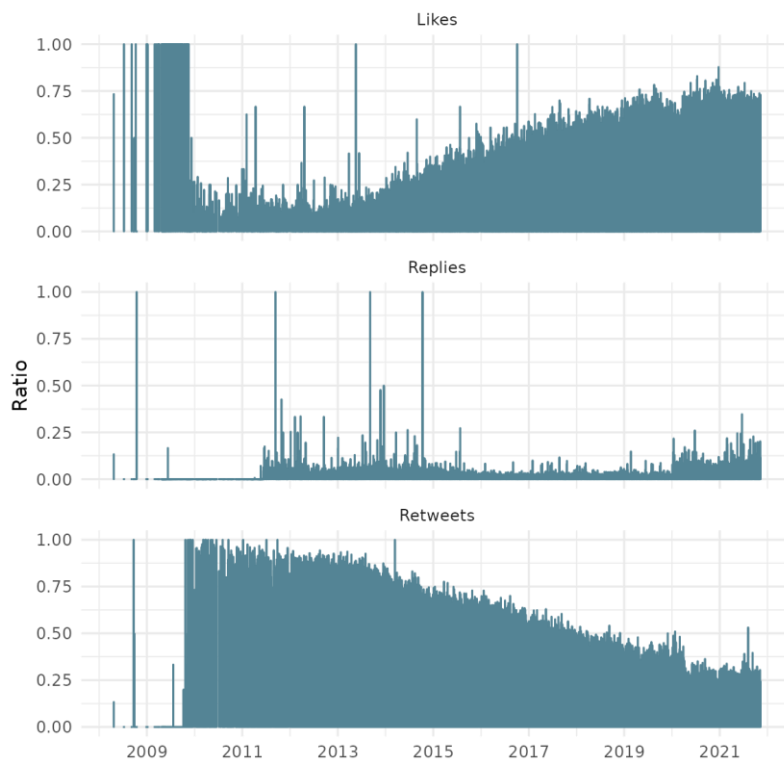
Figure 4. Characteristic Time Scale of the Overall Period.
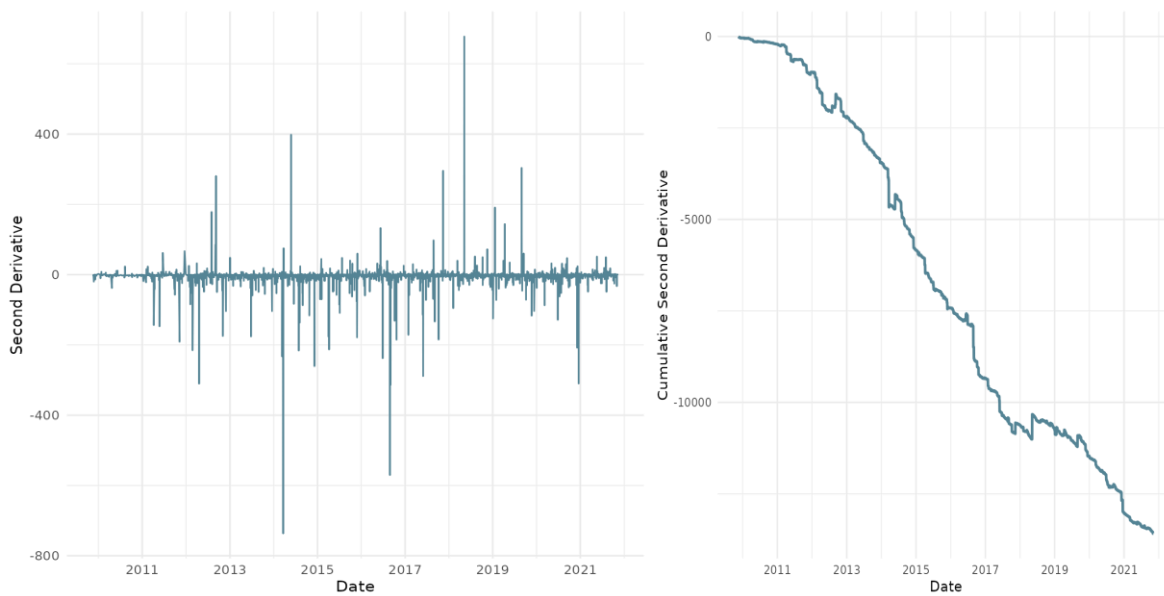
On Figure 5, we represent the ternary ratio of likes, replies and retweets for the overall dataset. We will then have a look at just the evolution of the metrics for the Covid-19 years, ie 2020 and 2021.

For the overall dataset, we see an increase in the ternary ratio for the likes and replies. We observe a decrease for the retweets. This is sign of a stronger engagement following posts from WHO.

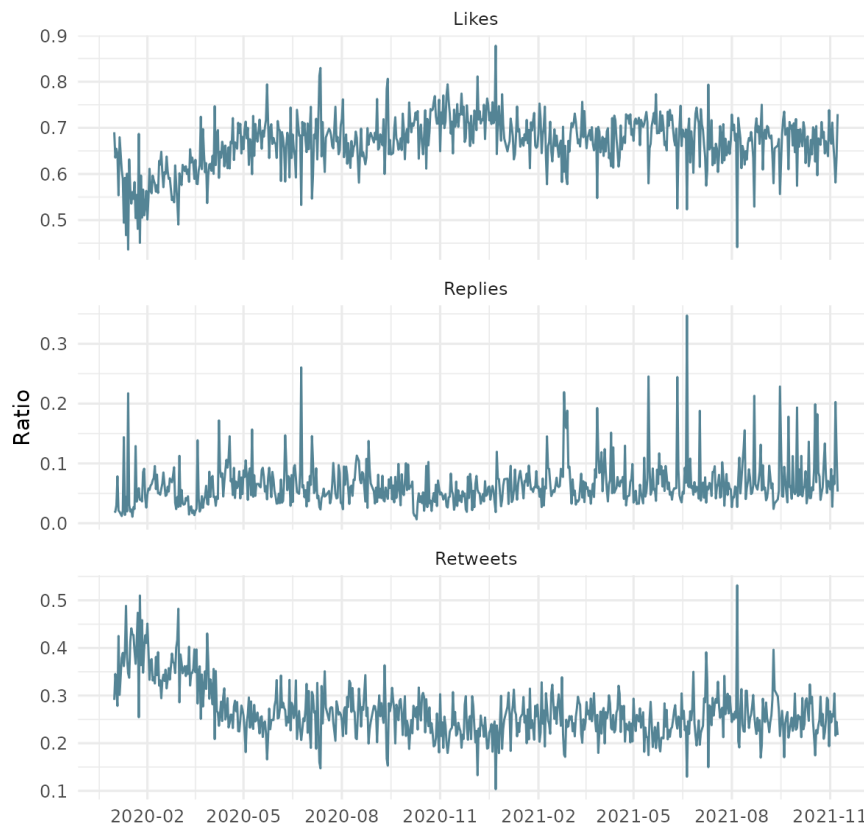**Figure 5.** Ternary Ratio of the Overall Period.

In what follows, we focus on the latest two years of the dataset covering the Covid-19 years: the years of 2020-2021. We first focus on the latest two years of our dataset for the characteristic time scale and then for the ternary ratio.

Figure 6. Characteristic Time Scale of 2020-2021.
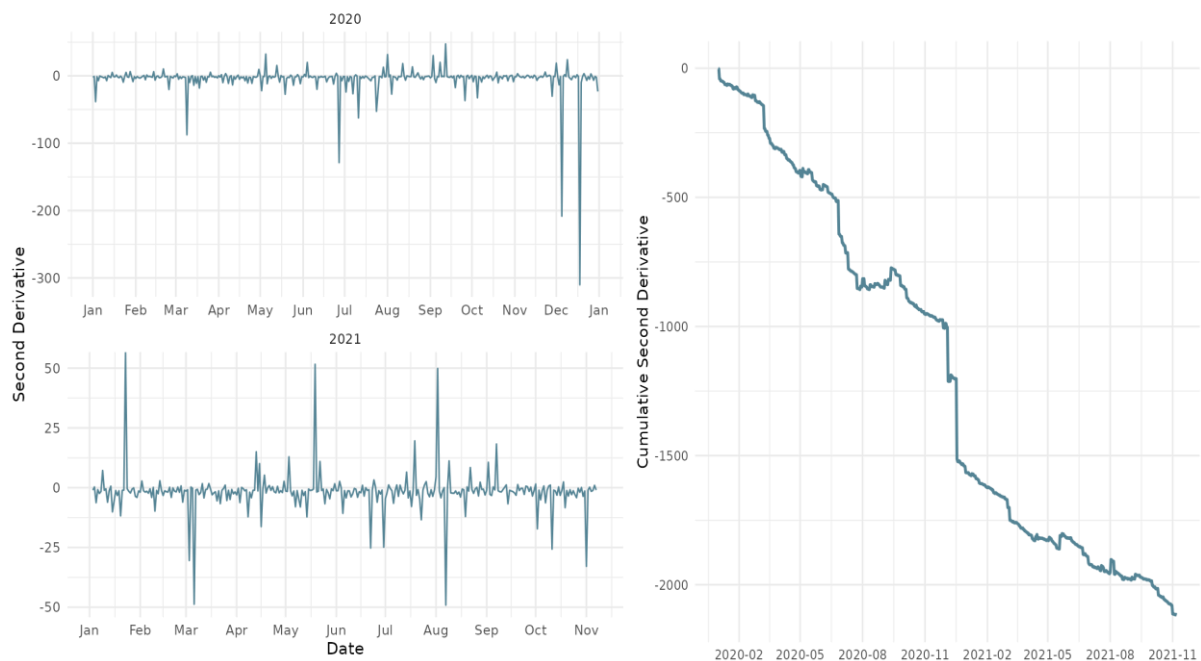
Figure 7. Ternary Ratio of 2020-2021.

In conclusion, with this first step, we observe a true difference between the years before and after Covid-19. Covid-19, unsurprisingly, has triggered an increase in the audience's engagement with WHO's communications on Twitter.

4.3. Cumulative indicators

Our goal is to build an indicator or a set of indicators to measure WHO's legitimacy through time. The change (first and second derivatives) seems more important to our purpose than the absolute values. We can extend our legitimacy ratio with more information coming from the cumulative indicators.

In what follows, we consider 3 stages: (1) first, we need to have a good idea of the count of retweets and replies, but this time through the cumulative function. (2) Second, we compute the ratio retweets/replies to have a sense of the level of engagement and the type of engagement. (3) Third, we check the conclusions from the second stage by considering the cumulative function of the ratio retweets/replies.

We will apply these three stages by considering everytime the whole dataset and then we will focus on the Covid-19 years, ie 2020 and 2021.

Cumulative Sum of Retweet and Reply activities

Figure 8 represents the cumulative sum of retweets and replies per day. We summed the number of retweets and replies per day then we calculated the cumulative sum.

Figure 8. Cumulative sum of retweets and replies for the overall period.
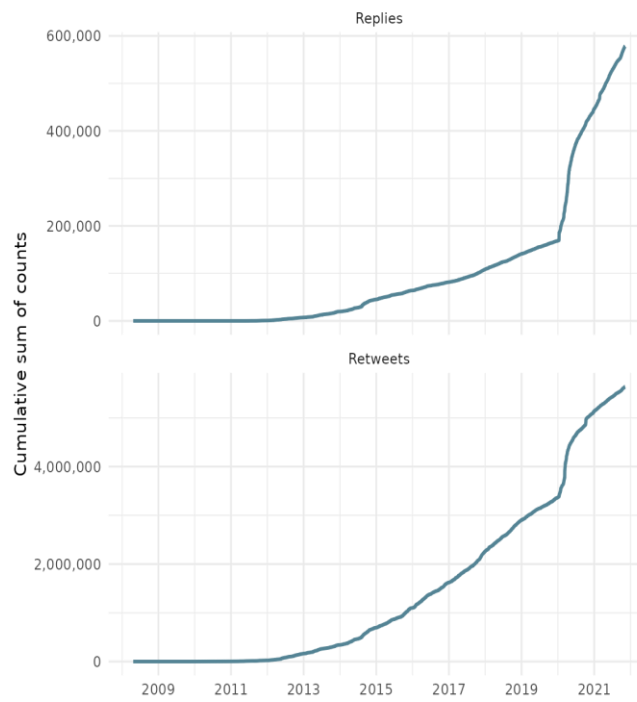
On Figure 8, we observe a dramatic increase in replies, even greater than the retweets. We also observe a negative second derivative for retweets during the Covid-19 years (See Figure 10).

Figure 9. Cumulative sum of retweets and replies for the year of 2020 (left) and 2021 (right).
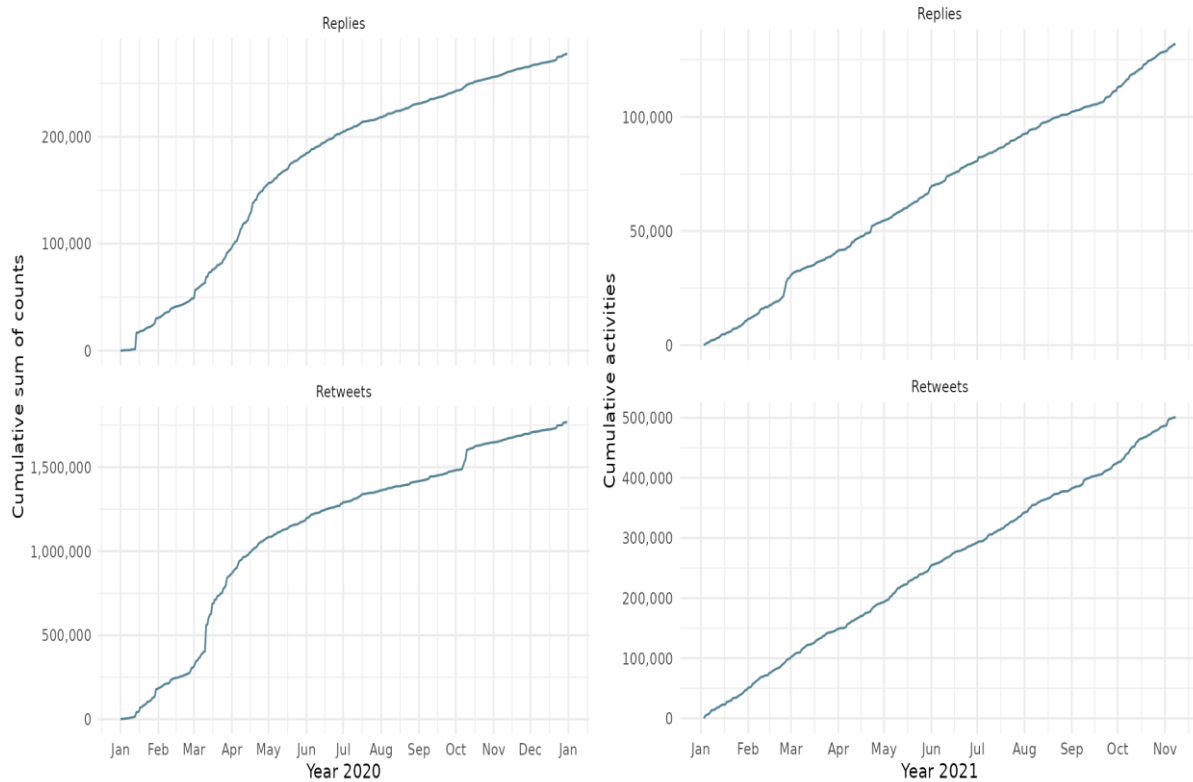
Ratio of Retweets/Replies

As aforementioned, the ratio of retwees/replies is a recognized metrics in the literature since its evolution is a good proxy for the change in the positive perception of a post from the organization. The retweet-to-reply ratio can be interpreted as: the higher it is, the less controversial the topic.

Figure 10 represents the ratio of retweets/replies. First, we summed the number of retweets and replies per day then we divided the sum of retweets per day by the sum of replies per day to obtain the ratio of retweets/replies.

Figure 10. Ratio of retweet/reply for the overall (left) and 2020-2021 (right) period.
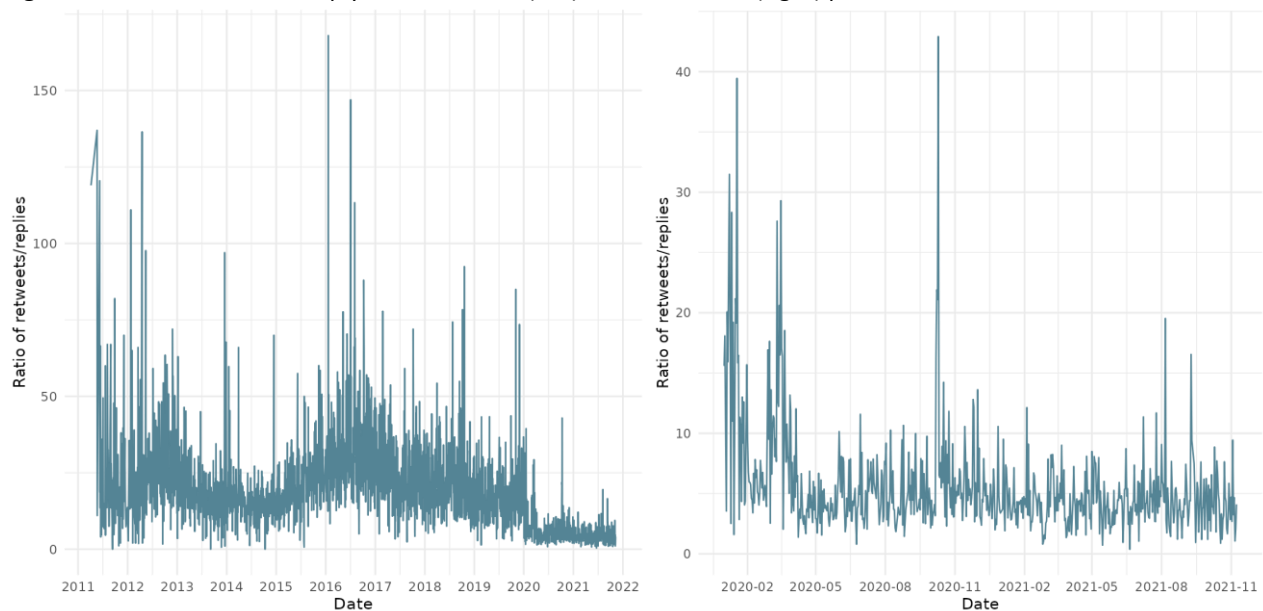
On Figure 10, we observe a reduction in the ratio of retweets/replies, which is a first indication of a more challenged conversation than in previous months. To be a bit more precise, we need to consider the cumulative ratios.

Cumulative Ratio of Retweets/Replies

Let us now consider the cumulative ratios of retweets/replies in order to consider the changing pace and have a more precise perspective on the audience's engagement.

Figure 11 depicts the cumulative ratio of retweets to responses on a given day. We began by adding up the number of retweets and responses received each day, and then divided the total number of retweets received each day by the total number of replies received each day to produce the ratio of retweets to replies. Finally, we deleted all day with a non-existent or infinite ratio in order to determine the cumulative proportion of retweets to responses.

Figure 11. Cumulative ratio of retweets/replies for the overall (left) and the 2020-2021 (right) period.
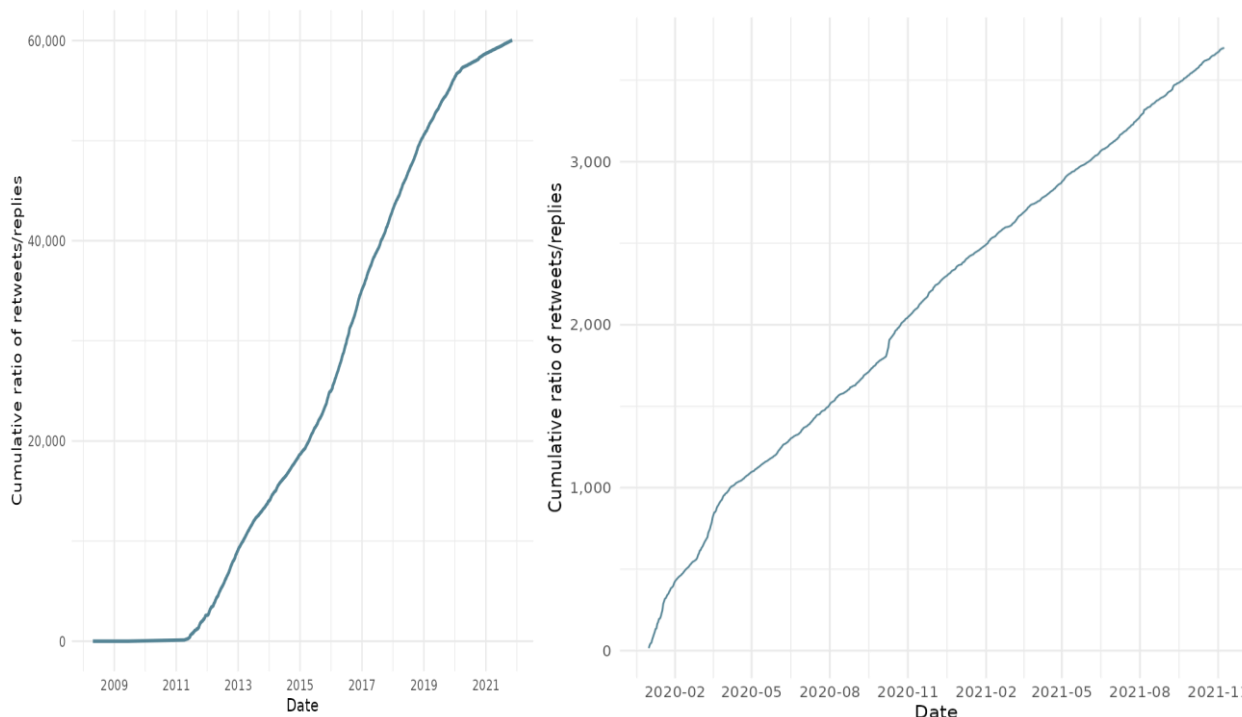
To conclude, with no surprise, we see a reduction in the second derivative in 2020 and 2021 compared to the previous years of the retweet/reply ratio. This demonstrates a higher engagement of the public receiving the information pushed by WHO. This engagement translates into a more balanced reaction with still a more likely favorable opinion vis-à-vis WHO, but with also more challenges. This protocol based on quantitative measures to serve as a proxy to the legitimacy concept seems to hold its promises.

5. Robustness check: sentiment analysis

As previously stated, there are two main classification approaches for measuring engagement based on OSNs and text-as-data: one that is based on the number of tweets, and another that is based on the sentiment of the tweets. The combination of these two strategies is the most often used methodology in modern scientific study. Although it is feasible to assess the effectiveness of a discussion by counting the number of tweets, studies have shown that this is unsuccessful without using sentiment analysis. We do not believe it applies in our scenario because we utilize Twitter and rely on Minot et al. (2021), but we are employing a sentiment analysis as an extension in what follows.

It is the process of doing sentiment analysis utilizing specialized dictionaries that contain terms that are either positive, negative, or neutral in nature that is referred to as "sentiment analysis." In order to determine the frequency of these terms over a wide variety of linguistic parameters in the given text or hashtags, researchers employ these dictionaries.

To do sentiment analysis on the material, we make use of the tidytext package in the R programming language. Additionally, it is perfectly suited to the emotive character of social media websites generally as well as to the affective

nature of Twitter in particular. A reader's ability to discriminate between a text that contains both positive and negative sentiment, as well as the strength of each feeling, is required while reading a text that contains both positive and negative sentiment.

When it comes to analyzing the viewpoint or feeling portrayed in a piece of writing, there are a variety of methodologies and dictionaries accessible. You may be able to access a number of sentiment lexicons through the use of the tidytext package. These three lexicons are intended to be used for a variety of purposes: AFINN, bing, and nrc.

Unigrams, which are single words in and of themselves, constitute the foundation of each and every one of these vocabularies. A vast number of English terms are included in these lexicons; however, the words are assigned evaluations depending on whether they convey a good or negative mood, in addition to possible emotions such as joy, fury, grief, and so on. It is used to categorize words into categories such as positive, negative, anger, anticipation, disgust, fear (including phobias), joy (including happiness), sadness (including sadness,) surprise (including surprise), and trust using a binary classification approach ("yes/no") (including trust). Using a binary classification system, the bing lexicon divides words into positive and negative categories (Bing, 2012, 2015), with the former being the more prevalent of the two. When a word is awarded a score in the AFINN lexicon, the value ranges between -5 and 5, with lower values signifying negative emotion and higher values indicating positive emotion.

It was decided to employ the AFINN lexicon for the sentiment analysis in order to obtain an overall score based on the amount of tweets received each day. Each day, we computed the score in two ways: by adding up the totals and by taking the mean of the results.

Figure 12 depicts the positive second derivative of retweets in order to be able to visualize accelerations of conversations per day. We have also created a daily corpus aggregating all the texts from all the tweets posted in a day. We have run our sentiment analysis on each daily corpus. It allows us to easily visualize correlation levels between an acceleration of conversations and whether it is related to negative or positive sentiments. We also present only the Covid-19 years of our dataset.

Figure 12. Positive second derivative of retweets and the sum of sentiment associated to the tweet per day
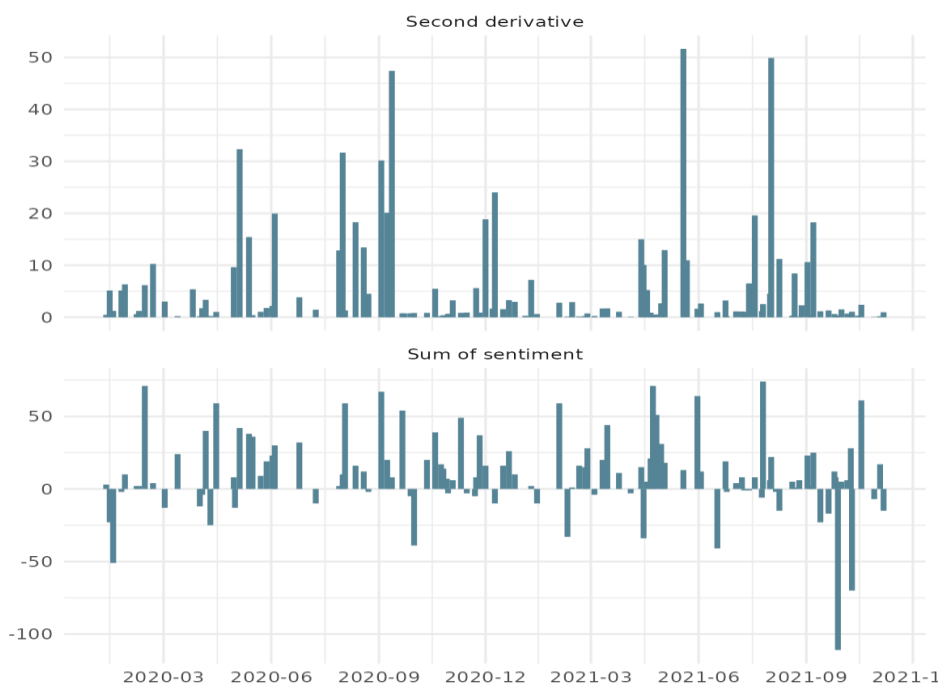
On Figure 12, it is interesting to note that we do not observe negative sentiments associated with the large spikes in conversations accelerations.

Figure 13 depicts the negative second derivative of retweets and the sum of sentiment associated to the daily corpus of text created based on all the tweets of the day.
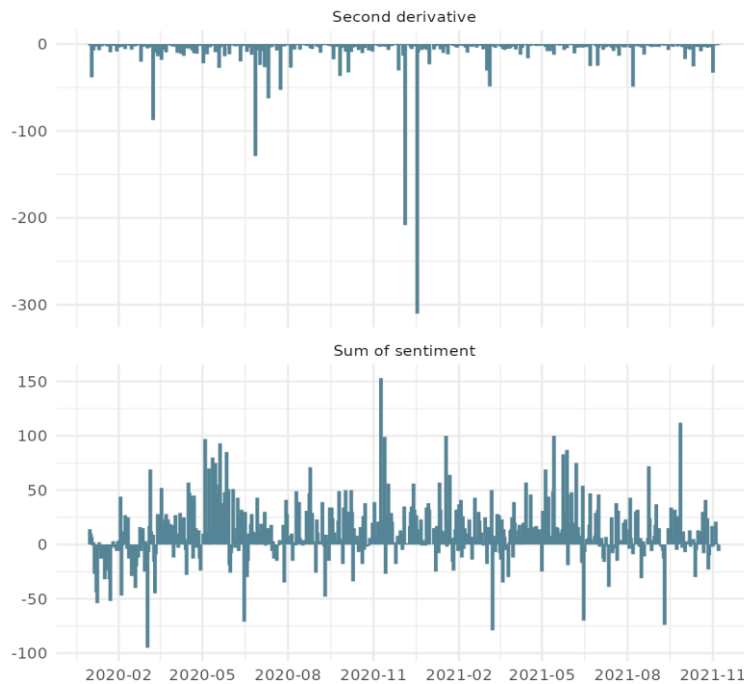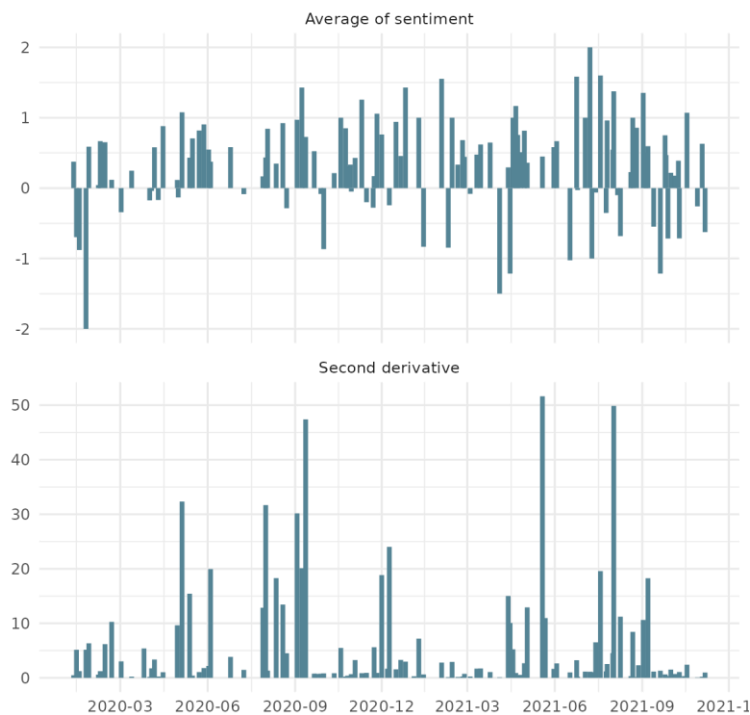
Figure 13. Negative second derivative of retweets and the sum of sentiment associated to the tweet per day

As a result, it is interesting to note that we can see some relationship between a deceleration of a conversation and prior negative sentiments of the conversation.

On the next figures, Figures 14 and 15, we want to have a look at the mean instead of the sum of the sentiments per day.

Figure 14. Positive second derivative of retweets and the mean of sentiment associated to the tweet per day

Most of the conversations that are picking up are in fact related to positive sentiments.

Figure 15. Negative second derivative of retweets and the mean of sentiment associated to the tweet per day
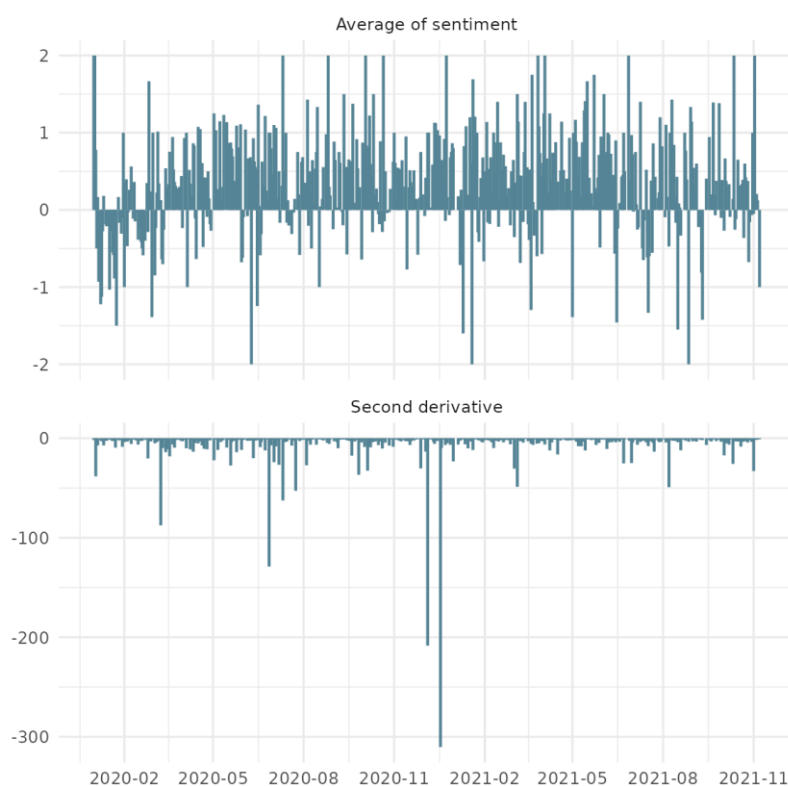
In conclusion, we can observe that the changes in pace of the conversations, being an acceleration or a deceleration, are mostly correlated to positive sentiments and rarely associated with negative sentiments. When it is about negative sentiments, they come prior to the deceleration of the conversation.

Those are interesting dimensions for the research avenue proposed here, which is about using quantitative indicators to measure legitimacy based on text-as-data from OSNs. Further research could be about some of the first results presented here, for instance, measuring the causality between negative sentiments and the deceleration of conversations and does it entail for legitimacy?

6. Conclusions

Millions of individuals connect on a regular basis using social media platforms such as Facebook and Twitter, and these platforms are getting increasingly popular. Because of the information and emotions that are expressed in them on a regular basis, daily social media micro-communications might have an impact on people's way of thinking.

Using Twitter as a case study, we determined if it was feasible to develop an empirical measure of legitimacy based on user feedback. We believe that our research will make it easier to understand human conversation dynamics about topics promoted by international organizations and displayed in online interactions because it will avoid the hassles and ethically questionable outcomes associated with previous experiments conducted on other social media sites.

As aforementioned, a legitimate account of power, according to Buchanan (2011), ought to take into consideration at least three aspects of the legitimacy term's application in political contexts: first, that agent justification (being justified in exercising political power) is necessary (though not sufficient) for legitimacy; second, that legitimacy implies authoritativeness (rule recipients should regard the institution's rules as providing content-independent reasons for acting); and third, that legitimacy implies equality (rule recipients should regard the institution's rules as providing content-independent reasons for acting).

We answer to the first two constraints by presenting a strategy based on text-as-data and OSNs. The third item is more in the hands of the World Health Organization or any other international bodies, and the lessons learned will be used to inform future policy.

The fact that our experiment is entirely observational means that we cannot rule out the possibility that it may have faults. For example, other talks outside of our sample may have an impact on the conversations in our sample, as well as the subjects pushed by WHO.

Furthermore, we believe that, as a result of its deployment, this protocol will open up new research opportunities in the field of political legitimacy. Initial research may be required to determine whether or if it is possible to widen the scope of the method's use to include tracking the growth of legitimacy in other international organizations as well. The International Olympic Committee, FIFA, and other organizations may become involved in sports in the future, and this protocol may be expanded to incorporate their activities in the future. Second, it is feasible that more studies will be conducted to improve the strategy by including new phases in the proposed method and by employing other ways to improve the present ones.

Conflict of Interests

 "The authors declare no conflict of interests".

Supplementary Material

Authors may submit supplementary files to be made available alongside their article. Supplementary material is available online only on the article's webpage (it is not published in the PDF of the article). Supplementary files are not copy-edited nor proofread by the Editorial Office, and it is the authors' responsibility to guarantee the scientific accuracy of these files.

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