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Analysis of Quote Retweets for COVID-19 State of Emergency Related Tweets Posted from Prefectural Governors' Accounts in Japan

Keisuke Utsu¹, Natsumi Yagi¹, Airi Fukushima¹, Yuma Takemori¹, Atsushi Okazaki¹, and Osamu Uchida²

¹Dept. Communication and Network Eng., Sch. Information and Telecommunication Eng., Tokai University, Minato, Tokyo, Japan
utsu@utsuken.net

²Dept. Human and Information Science, Sch. Information Science and Technology, Tokai University, Hiratsuka, Kanagawa, Japan
o-uchida@tokai.ac.jp

Abstract. The novel coronavirus disease (COVID-19) pandemic has seriously affected countries all over the world. In Japan, a state of emergency has been declared several times in some prefectures. Information related to the spread of infection is provided to the public via central or local government websites and social media accounts. In particular, some prefectural governors have used Twitter accounts to provide information related to the pandemic, and this use of social media has been attracting attention. One of the advantages of Twitter is its ability to disseminate information instantly. In order to prevent the spread of infection, it is desirable to respond to changes in the situation and provide information in a timely manner. In this study, we focused on three Twitter accounts used by prefectural governors in Japan and aimed to clarify users' reactions to posts (tweets) related to the state of emergency posted from those accounts. We collected quote retweets for the top quote-retweeted tweets posted between January 1, 2020, and July 31, 2021, and classified them as either positive or negative.

Keywords: COVID-19, Social media, Twitter.

1 Introduction

The novel coronavirus disease (COVID-19) pandemic has seriously affected countries all over the world. In Japan, the number of infected people first began to increase in January 2020. States of emergency in this country are declared by the Prime Minister on a prefectural basis. On April 7, 2020, a state of emergency was declared for the first time in Japan. Since then, such declarations have been issued several times in some prefectures. The principal measures taken during these declared states of emergency have been requests to refrain from going out without good reason, encouragement of teleworking, shortening of business hours, and the closure of schools. The specific restrictions and requests implemented under each state of emergency varied depending

on the time period and the prefecture. In Japan, strict regulations such as lockdowns and curfews are not legally enforced.

In recent years, public institutions have begun to use Twitter to provide information proactively on daily matters and at times of disaster, and this use of social media has been attracting attention as a means of information sharing [1][2]. There is an increasing number of local governments opening official social media accounts to provide information to citizens. In response to the COVID-19 pandemic, it has been important to react immediately to changes in the situation and to provide information and requests to citizens in a timely manner. Twitter posts (tweets) related to the infection have been analyzed [3][4][5][6][7], and tweets related to the vaccination have been discussed [8][9]. Regarding the infection, statements made by world leaders and state governors at press conferences have been a particular focus of public attention. Tweets posted by world leaders and state governors have been discussed outside Japan [10][11][12][13]. In Japan, some prefectures have been disseminating information through their governors' Twitter accounts, and those tweets have attracted Twitter users' attention. However, there has been no major study that focuses on the analysis of tweets posted from the accounts of prefectural governors in Japan and the reactions of users to those tweets. Providing information from a governor's social media account is considered to make that information seem more highly credible because the governor's words can reach residents in an immediate and direct manner. It is necessary to discuss the effectiveness of this type of information dissemination.

The authors have already studied the Twitter accounts of prefectural governors who have made posts about the COVID-19 infection, and analyzed the top retweeted tweets [14]. In this study, we focus on the Twitter accounts of three governors: Mr. Hirofumi Yoshimura, the governor of Osaka prefecture, Ms. Yuriko Koike, the governor of the Tokyo metropolitan area, and Mr. Naomichi Suzuki, the governor of Hokkaido prefecture. This study aims to clarify the reactions of users to tweets related to the state of emergency in each region that were posted from those accounts. We collect quote retweets for the top quote-retweeted tweets posted between January 1, 2020, and July 31, 2021, and classify them as either positive or negative.

The rest of this paper is organized as follows: Section 2 introduces related studies. Section 3 shows the collection of tweets posted from the governor's account and presents an analysis of the quote retweets for the governor's top quote-retweeted tweets related to the state of emergency declared in his or her region. Section 4 summarizes this study.

2 Related studies

There have been many studies to analyze tweets related to the COVID-19 infection. Banda et al. [3] presented a large-scale curated dataset of tweets related to the infection. Xue et al. [4] examined COVID-19-related discussions, concerns, and sentiments using tweets. They concluded that "Real-time monitoring and assessment of Twitter discussions and concerns could provide useful data for public health emergency responses and planning."

In Japan, Yoshida [5] reviewed the state of social media during an early period of the pandemic, and introduced public datasets of social media data including those from outside Japan. Toriumi et al. [6] collected Japanese tweets containing words related to the infection and analyzed the use of emotive words in the tweets to analyze how people feel about the virus. The analysis results show that “The occurrence of a particular social event can change the emotions expressed on social media.” Yomoda [7] collected Japanese tweets containing words related to the infection during an early period of the pandemic and analyzed them using a quantitative text analysis technique. The analysis results show that “Concerns and stress related to coronavirus varied over a wide range of aspects, including fear of infection, stress due to restriction of daily behavior and recreational activities, concerns over government epidemiological measures and economic damage, and concerns arising from media information.”

COVID-19 vaccine-related tweets have also been discussed. Yousefinaghani et al. [8] identified public sentiments and opinions vis-à-vis the COVID-19 vaccines based on tweets. They concluded that “Understanding sentiments and opinions about vaccination using Twitter may help public health agencies to increase positive messaging and eliminate opposing messages in order to enhance vaccine uptake.” Lyu et al. [9] present a topic modeling, sentiment and emotion analysis of COVID-19 vaccine-related discussion on Twitter. They concluded that “Public COVID-19 vaccine-related discussion on Twitter was largely driven by major events about COVID-19 vaccines and mirrored active news topics in mainstream media.”

Tweets from world leaders and state governors have been a focus of attention, and have also been discussed outside Japan. Haman [10] examined how many leaders have used Twitter during the COVID-19 pandemic, in what way, and the impact they had on the public by using it. Haman stated that “The research implies that citizens are interested in being informed about emergencies through social networks and government officials should use them.” Rufai and Bunce [11] explored the role of Twitter as used by Group of Seven (G7) world leaders in response to COVID-19. They performed a context analysis to categorize tweets into appropriate themes and analyzed associated Twitter data. They conclude that “Twitter may represent a powerful tool for world leaders to rapidly communicate public health information to citizens, with a preference for tweets containing official government-based information sources.” Dwianto et al. [12] examined the responses of Joko Widodo’s and Donald Trump’s tweets regarding COVID-19 policies. According to the article, analysis results of responses to both presidents’ tweets reveal higher negative sentiments than positive ones. Qodir et al. [13] examined the official Twitter account for the governor of Jakarta, Indonesia, using a social network analysis method to examine communication patterns between the government and the public. This article concludes that the official account of the governor on social media is effective in a pandemic to assuage public panic and extend public trust in the government.

3 Analysis of Tweets

In this study, we focus on tweets posted from three accounts belonging to prefectural governors in Japan and analyze reactions of users to the tweets.

3.1 Governors' accounts to be analyzed

We focus on the following three accounts belonging to prefectural governors:

- Hirofumi Yoshimura, the governor of Osaka Prefecture, @hiroyoshimura, <https://twitter.com/hiroyoshimura>
- Yuriko Koike, the governor of the Tokyo metropolitan area, @ecoyuri, <https://twitter.com/ecoyuri>
- Naomichi Suzuki, the governor of Hokkaido Prefecture, @suzukinaomichi, <https://twitter.com/suzukinaomichi>

These governors' accounts posted relatively more tweets related to the infection than other governors' accounts. As of August 1, 2021, the Tokyo, Osaka and Hokkaido regions ranked first, second, and seventh, respectively, among the 47 prefectures in Japan, for the cumulative number of cases of COVID-19 infection [15]. For reference, Fig. 1 shows when states of emergency and intensive anti-virus measures (introduced in February 2021) were declared in the three relevant regions. In April 2020, a state of emergency was declared throughout Japan. In 2021, states of emergency had been declared three times by August 31, including in the Tokyo and Osaka regions.

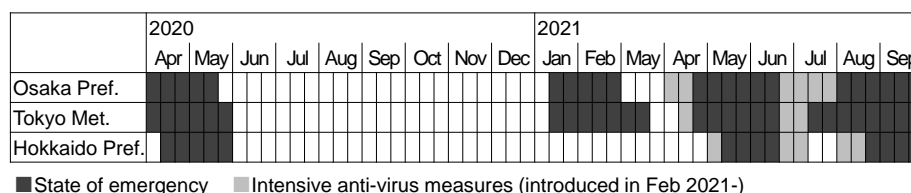


Fig. 1. Details of the states of emergency issued in the Osaka, Tokyo, and Hokkaido regions

3.1 Tweets collection

We collected tweets posted from the accounts of the three governors during the period from January 1, 2020, to July 31, 2021, using the Twitter API v2 [16]. The collection was conducted on August 1, 2021. For the account of Governor Koike, there were no tweets from June 21 to July 20, 2021. Tweets posted from this account during this period may have been deleted prior to our collection of them. Figures 2-4 show the number of tweets posted from each governor's account in the following categories (i) to (iii).

- Total tweets
- The original tweets including COVID-19 related words, which are Corona (コロナ), virus (ウイルス), infection (感染), vaccine (ワクチン), vaccination (接種),

test (検査), positive (i.e. of a test result) (陽性), sickbed (病床), severe illness (重症), mild illness (軽症), patient (患者), self-restraint (自粛), recuperation (療養), contact (接触), and emergency (緊急事態). These words were selected from among the words occurring most frequently in tweets posted from the governors' accounts that the authors considered to be related to COVID-19.

- (iii) The original tweets that included the word “emergency.” The reason we focus on the word “emergency” here is that this study intends to analyze tweets specifically related to declared “states of emergency (緊急事態宣言).”

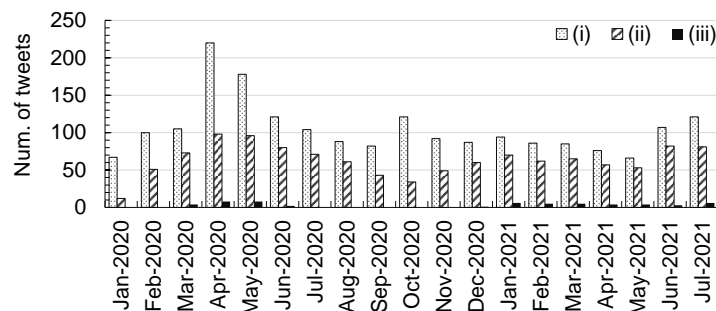


Fig. 2. The number of tweets posted per month from the account of Governor Yoshimura

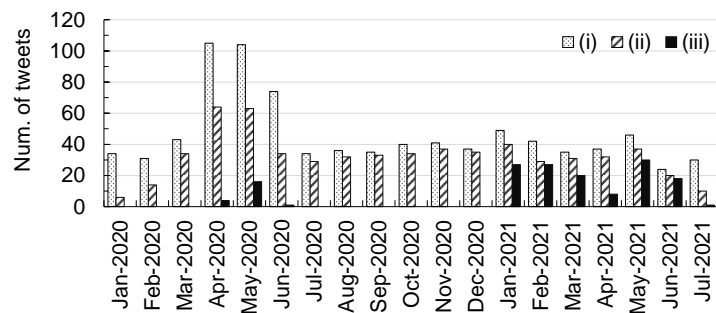


Fig. 3. The number of tweets posted per month from the account of Governor Koike

The content of the tweets in category (ii) included, for example, statements about the spread of infection (such as the number of infected people and PCR tests), statements about the declaration of a state of emergency, measures and responses to the spread of infection, statements about campaigns, requests for self-restraint, opinions and comments. Regarding the number of tweets in category (ii), the three governors commonly posted the largest number of tweets in April 2020. This may be due to the fact that a state of emergency was declared in their regions for the first time in that month, and as a result, they posted many tweets related to the infection. The tweets corresponding to

category (iii) were found mainly during the periods when a state of emergency had been declared.

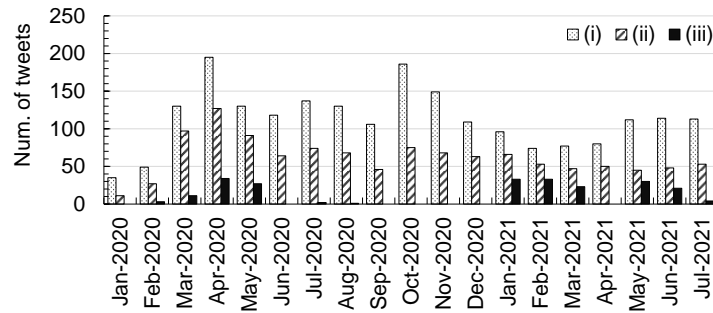


Fig. 4. The number of tweets posted per month from the account of Governor Suzuki

3.2 Analysis of quote retweets of governors' tweets

In order to analyze users' reactions to tweets posted from the governors' accounts relating to the states of emergency, we collected quote retweets for the top five quote-retweeted tweets in category (iii) in each year of 2020 (January 1-December 31) and 2021 (January 1-July 31) for each governor's account. Then we classified the quote retweets as either positive or negative. Although there is an alternative method of focusing on replies to examine a user's reaction, we focus on quote retweets because they are more likely to aid the spread of information. Figures 5-7 show the number of quote retweets for the tweets in category (iii) for each governor's account. In the figures, the top five quote-retweeted tweets in each year of 2020 and 2021 are indicated by balloons as T01 to T30. Tables 1-3 show the contents of the original tweet, its ID, the date and time of posting, and the number of retweets (RTs) and quote retweets (QRTs) it received.

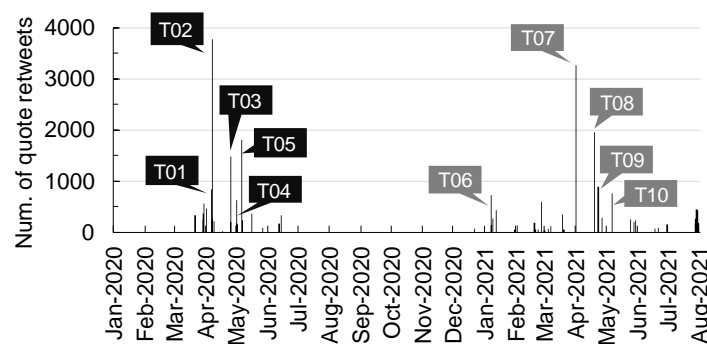


Fig. 5. The number of quote retweets for each tweet posted from the account of Governor Yoshimura

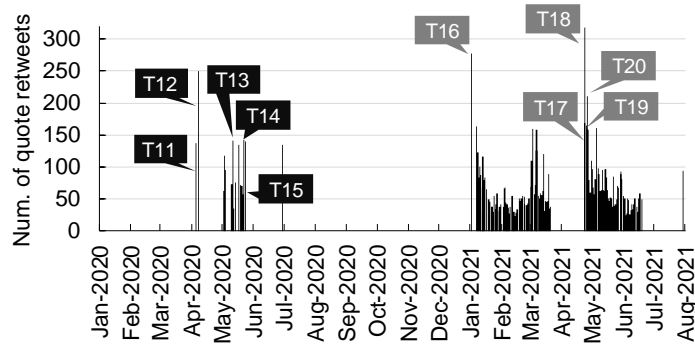


Fig. 6. The number of quote retweets for each tweet posted from the account of Governor Koike

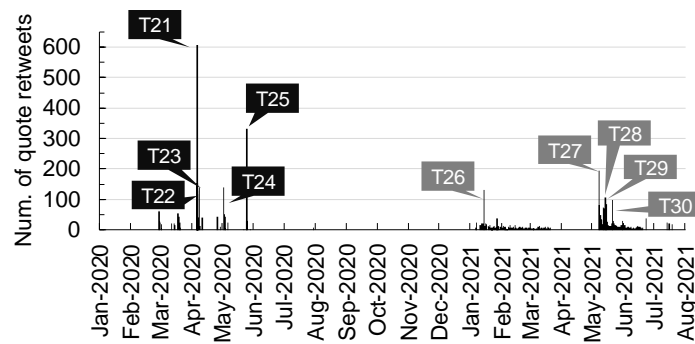


Fig. 7. The number of quote retweets for each tweet posted from the account of Governor Suzuki

Table 1. Top quote-retweeted tweets for Governor Yoshimura: T01-T10

Contents	
Tweet ID, Date/Time, Retweets (RTs), Quote retweets (QRTs)	
T01	● Messages for people including a request to refrain from panic-buying foods and goods ID: 1247022999993077760, Date/Time: 13:47, Apr 6, 2020, RTs: 19.2k, QRTs: 836
T02	● Video message from the governor related to a state of emergency ID: 1247517477468114951, Date/Time: 22:31, Apr 7, 2020, RTs: 43.7k, QRTs: 3,771
T03	● Opinions including a request for pachinko parlors to restrict admission ID: 1253963991337955329, Date/Time: 17:28, Apr 25, 2020, RTs: 10.1k, QRTs: 1,477
T04	● Opinions related to measures for preventing a medical collapse ID: 1256204571770142722, Date/Time: 21:51, May 1, 2020, RTs: 4.8k, QRTs: 628
T05	● Message for the Minister in charge of Economic Revitalization in Japan ID: 1258026380601655297, Date/Time: 22:30, May 6, 2020, RTs: 8.1k, QRTs: 1,809
T06	● Reporting the number of new cases ● Information that the governor was considering requesting the declaration of a state of emergency ID: 1347118393388724225, Date/Time: 18:50, Jan 7, 2021, RTs: 2.4k, QRTs: 724
T07	● Comment for TV news

	ID: 1377631360051863554, Date/Time: 23:38, Apr 1, 2021, RTs: 1.6k, QRTs: 3,277
T08	● Information that the governor requested that the central government declare a state of emergency ID: 1384006532048723978, Date/Time: 13:50, Apr 19, 2021, RTs: 4.9k, QRTs: 1,959
T09	● Video message from the governor related to a state of emergency ID: 1385560154079334404, Date/Time: 20:44, Apr 23, 2021, RTs: 3.1k, QRTs: 894
T10	● A video message from the governor related to the extension of a state of emergency ID: 1390648829410648065, Date/Time: 21:44, May 7, 2021, RTs: 2.4k, QRTs: 767

Table 2. Top quote-retweeted tweets for Governor Koike: T11-T20

	Contents
	Tweet ID, Date/Time, Retweets (RTs), Quote retweets (QRTs)
T11	● Information that the governor requested that the central government declare a state of emergency. ID: 1246787821282582528, Date/Time: 22:12, Apr 5, 2020, RTs: 1.8k, QRTs: 137
T12	● Request for people to refrain from going out due to the declaration of a state of emergency ID: 1247523431546884096, Date/Time: 22:55, Apr 7, 2020, RTs: 3.4k, QRTs: 250
T13	● The number of new cases ● Information about an extension of a state of emergency ID: 1259826644228820992, Date/Time: 21:44, May 11, 2020, RTs: 1.1k, QRTs: 141
T14	● Information about easing the business suspension request ID: 1263823455436210176, Date/Time: 22:26, May 22, 2020, RTs: 0.7k, QRTs: 142
T15	● Information that the central government will discuss lifting a state of emergency ID: 1264540976279810049, Date/Time: 21:57, May 24, 2020, RTs: 1.4k, QRTs: 140
T16	● The number of severe cases, deaths, and new cases ● Information that the governor requested that the Minister in charge of Economic Revitalization declare a state of emergency ID: 1345335212645912576, Date/Time: 20:44, Jan 2, 2021, RTs: 0.7k, QRTs: 278
T17	● The number of severe cases, deaths, and new cases ● Video message to appeal for a reduction in the flow of people during vacation ID: 1385614660435537924, Date/Time: 0:20, Apr 24, 2021, RTs: 0.3k, QRTs: 168
T18	● The number of severe cases, deaths, and new cases ID: 1385950210627563524, Date/Time: 22:34, Apr 24, 2021, RTs: 0.4k, QRTs: 318
T19	● Encouragement of the use of paid vacation ● The number of severe cases, deaths, and new cases ID: 1386301142125072384, Date/Time: 21:48, Apr 25, 2021, RTs: 0.2k, QRTs: 164
T20	● The number of severe cases, deaths, and new cases ● Request for people to refrain from trips crossing prefectural borders ID: 1386668587847327748, Date/Time: 22:08, May 26, 2021, RTs: 0.2k, QRTs: 211

Table 3. Top quote-retweeted tweets for Governor Suzuki: T21-T30

	Content
	Tweet ID, Date/Time, Retweets (RTs), Quote retweets (QRTs)
T21	● Opinion for a news item regarding a declaration of a state of emergency in Hokkaido ID: 1246962933952688128, Date/Time: 9:48, Apr 6, 2020, RTs: 3.2k, QRTs: 308
T22	● Opinion for a news item regarding a declaration of a state of emergency in Hokkaido Prefecture ID: 1247045561158488065, Date/Time: 15:16, Apr 6, 2020, RTs: 1.5k, QRTs: 153
T23	● Request for people to cooperate to prevent the spread of infection ID: 1247694817343098881, Date/Time: 10:16, Apr 8, 2020, RTs: 2.6k, QRTs: 138
T24	● Information about sending notification by e-mail when the central government extends the period of a state of emergency ID: 1256469795148451845, Date/Time: 15:25, May 2, 2020, RTs: 1.7k, QRTs: 139
T25	● Information about lifting a state of emergency ● Request for people to refrain from going out and making trips to Sapporo, and a request for business suspension ID: 1264784711122972673, Date/Time: 14:05, May 25, 2020, RTs: 4.4k, QRTs: 333

T26	● Criticism of the national government strategy ID: 1349711663730069506, Date/Time: 22:35, Jan 14, 2021, RTs: 1.0k, QRTs: 132
T27	● Denial of misinformation in the news ID: 1390995004802232323, Date/Time: 20:40, May 8, 2021, RTs: 1.1k, QRTs: 193
T28	● Message related to a declaration of a state of emergency ID: 1393202065136963585, Date/Time: 22:50, May 14, 2021, RTs: 0.7k, QRTs: 107
T29	● Message related to a declaration of a state of emergency ID: 1393558413582479360, Date/Time: 22:26, May 15, 2021, RTs: 0.4k, QRTs: 85
T30	● Request to refrain from contact with other people and going out ID: 1395704237573562376, Date/Time: 20:33, May 21, 2021, RTs: 0.3k, QRTs: 97

We collected the quote retweets for each tweet of T01 -T30 using the Twitter API v2 [16], and selected the tweets to be analyzed using the following procedure:

1. For Governor Yoshimura, we focused on the quote retweets that were posted within 24 hours of the governor's original tweet being posted. As for Governors Koike and Suzuki, we focused on the quote retweets that were posted within 120 hours of the governors' original tweets being posted, because the number of quote retweets for Governor Koike's and Governor Suzuki's tweets is smaller than that for Governor Yoshimura's tweets.
2. If there were multiple quote retweets by one account, we focused only on the first quote retweet.
3. If there were more than 100 quote retweets satisfying (1) and (2), 100 of them were selected randomly; if there were less than 100, all of them were selected.

The quote retweets selected by the above procedure were classified by three of the authors involved in this paper into one of the following categories:

- (P) Positive content (such as an approving or encouraging message)
- (N) Negative content (such as an opposing or critical message)
- (E) Neither (P) nor (N): Not a comment on the governor's tweet, or unknown.

Then, classifications made by two or more of the authors were taken as the discriminated result for the quote retweet. If the classifications made by all three authors differed among (P), (N), or (E), the result was taken to be (E).

Figures 8-10 show the classification results for each of the quote retweets of T01-10, T11-T20, and T21-30, respectively. In the figures, the numbers of classified quote retweets are shown in brackets. The proportion of (E) classifications is larger than that of (P) and (N) for many tweets, however the details of the tweets classified as (E) will be discussed in a future paper. In the following, we discuss the quote retweets classified as (P) and (N).

The discussion of the quote retweets for the tweets posted from Governor Yoshimura's account is as follows. Comparing tweets in 2020 (T01 -T05) with those in 2021 (T06-T10), those in 2020 showed a large proportion of positive content, while those in 2021 showed a large proportion of negative content. It seems that, in Osaka Prefecture, with a state of emergency declared for the second and third times in 2021, there were more quote retweets indicating dissatisfaction with the governor's pandemic response posted in 2021 than in 2020. The tweet with the largest percentage of positive content was T02 (P: 62%), and the tweet with the largest percentage of negative content was

T09 (N: 53%). Both of those tweets are about a video message from the governor related to a state of emergency. Table 4 shows the original texts and English translations of T02 and T09.

The discussion of the quote retweets for the tweets posted from Governor Koike's account is as follows. Comparing tweets in 2020 (T11-T15) with those in 2021 (T16-T20), those in 2020 showed a large proportion of positive content, while those in 2021 showed a large proportion of negative content. This trend is similar to that for Governor Yoshimura's tweets. It seems that, in the Tokyo metropolitan area, with a state of emergency declared for the second and third times in 2021, there were more quote tweets indicating dissatisfaction with the governor's pandemic response posted in 2021 than in 2020. The tweet with the largest positive content was T12 (P: 28%), which requested people to refrain from going out due to the declaration of a state of emergency. The tweet with the largest negative content was T17 (N: 58%), which contained information on the number of severe cases, deaths, and new cases. The tweet quoted a tweet with a video message requesting a reduction in the flow of people during vacation. Table 5 shows the original texts and English summaries of T12 and T17.

The discussion of the quote retweets for the tweets posted from Governor Suzuki's account is as follows. Comparing the tweets in 2020 (T21-T25) with those in 2021 (T26-T30), the differences in the time trends were not as great as those for the accounts of Governors Yoshimura and Koike. Unlike the Osaka and Tokyo regions, a state of emergency had not been declared again in Hokkaido Prefecture in the period up to July 31, 2021, and thus it seems that the percentage of negative quote retweets of tweets from Governor Suzuki's account did not increase as it did in the case of tweets from the other two governors' accounts. The tweet with the largest percentage of positive content was T26 (P: 39%), which featured criticism of the national government strategy. Although there were two tweets with almost the same percentage of negative content, which were T29 and T30 (N: 29%), of those two tweets the one which had the smallest percentage of positive content was T30. The tweet was about refraining from contact with other people and called for people to refrain from going out. Table 6 shows the original texts and English summaries of T26 and T30.

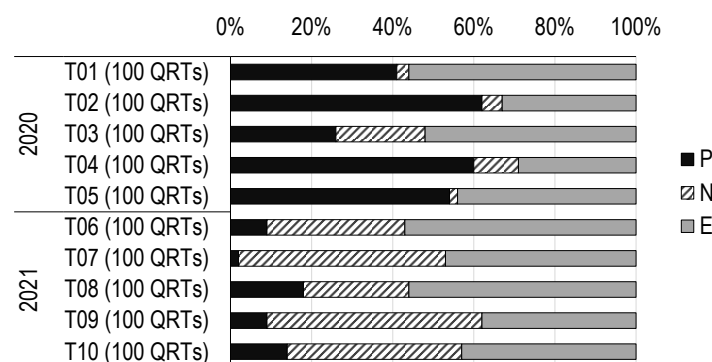


Fig. 8. Classification result of quote retweets for T01-T10 posted from the account of Governor Yoshimura

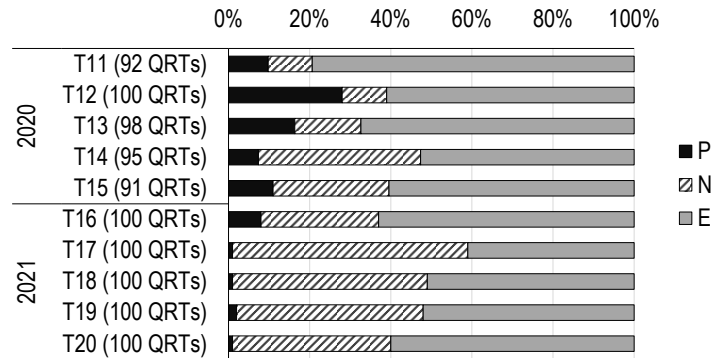


Fig. 9. Classification result of quote retweets for T11-T20 posted from the account of Governor Koike

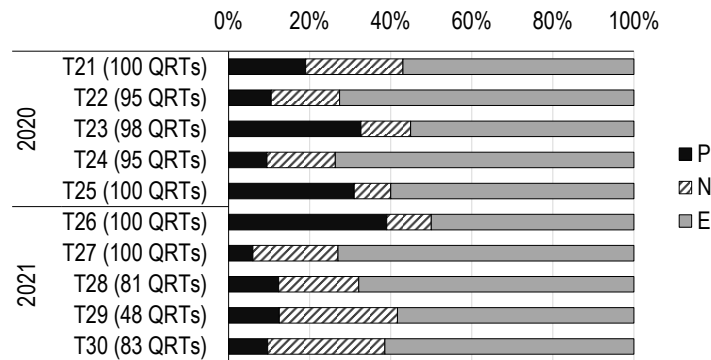


Fig. 10. Classification result of quote retweets for T21-T30 posted from the account of Governor Suzuki

Table 4. Original texts and their English translations for T02 and T09 posted from the account of Governor Yoshimura

	Original Japanese text	English translation
T02	本日、緊急事態宣言が出されました。僕から皆様へのメッセージです。 https://*** (A video of the governor's message was embedded.)	Today, a state of emergency has been declared. This is a message for you.
T09	本日、緊急事態宣言が決定されたことに関し、僕からのメッセージです。なんとかこの危機を乗り越える為、ご協力をお願い申し上げます。 https://*** (A video of the governor's message was embedded.)	This is a message for you regarding the decision to declare a state of emergency today. I would like to ask for your cooperation in overcoming this crisis.

Table 5. Original texts and their English summary for T12 and T17 posted from the account of Governor Koike

	Original Japanese text	English summary
T12	<p>本日の緊急事態宣言発令を受け、都は緊急事態措置として、都民の皆様へ『徹底的な外出自粛』を要請します。大目的は、【都民の皆様を守る】こと。人と人の接触を避けることが最大の対応策です。自分を、大切な人を守るため、皆様の行動変容がカギです。一丸となって、この難局を乗り越えましょう https://*** (<i>Two images regarding requests made of citizens were embedded.</i>)</p>	<p>In response to today's declaration of a state of emergency, the metropolitan government requests all residents of Tokyo to refrain from going out. The objective is to protect the lives of the people. The best way to deal with this threat is to avoid contact with people. <i>The tweet also includes a message of encouragement for citizens to overcome the crisis.</i></p>
T17	<p>「緊急事態宣言発出決定」 新型コロナウイルスの23日の重症者52人。検査件数3日間移動平均10091件。お亡くなりになられた5名の方のご冥福を心よりお祈り致します。新規感染者759人。7日間平均対前週比128.7% 都民、事業者の皆様にはご協力を頂いてきました。人流を抑えるため力を結集しましょう。 https://*** (<i>A video of a message from the governor was embedded.</i>)</p>	<p>[Decision taken to declare a state of emergency] 52 people were severely ill with COVID-19 on the 23rd. The three-day moving average for the number of tests administered was 10091. We sincerely pray for the souls of the five people who passed away. The number of newly-infected people was 759. The seven-day average of new cases was 128.7% compared to the previous week. <i>The tweet also includes a request to reduce the flow of people.</i></p>

Table 6. Original texts and their English summary for T26 and T30 posted from the account of Governor Suzuki

	Original Japanese text	English summary
T26	<p>緊急事態宣言の対象地域になる、ならないで、国からお金がもらえる、もらえないと違いが出てくるのはおかしい。感染拡大の影響は全国幅広く及んでいる。感染を抑えるために全国が一丸となり、取り組んでいるなか、分断を生むような対策については、再考いただきたい。 https://*** (<i>A news article was embedded.</i>)</p>	<p>It is not appropriate that there would be a difference in whether or not the prefecture can receive financial support from the government based on whether the prefecture is under a declared state of emergency or not.</p>
T30	<p>【緊急事態宣言メッセージ】市中での感染が広がり、感染経路の不明な事例も多いなど、誰もが、どこでも感染する可能性があります。人と人との接触を徹底的に抑えてください。特に週末は、外出を控えてください。道民の皆様のご協力をお願いします。 https://*** (<i>A video of a message from the governor was embedded.</i>)</p>	<p>[Message regarding the state of emergency] The infection is spreading throughout the city. There are many cases where the route of infection is unknown. Anyone can be infected. Please reduce your contact with other people and avoid going out, especially on weekends.</p>

4 Conclusions

This study aimed to clarify the reactions of users to tweets relating to COVID-19 states of emergency posted by three governors in Japan: Hirofumi Yoshimura, the governor of Osaka prefecture, Yuriko Koike, the governor of the Tokyo metropolitan area, and Naomichi Suzuki, the governor of Hokkaido prefecture.

We collected quote retweets for the top quote-retweeted tweets posted from each of these accounts between January 1, 2020, and July 31, 2021, and classified the quote retweets as either positive or negative. In particular, Governor Yoshimura's tweet posted during a state of emergency in Osaka prefecture in 2020 received a large proportion of positive quote retweets. However, for both Governors Yoshimura and Koike, the percentage of negative quote retweets for his or her 2021 tweets was larger than that for his or her 2020 tweets. This suggests that negative content may account for a large percentage of quote retweets when a state of emergency is declared again in the future. For Governor Suzuki, the variation in the classification of quote retweets of tweets posted in 2020 and of those posted in 2021 was not as large as for Governors Yoshimura and Koike.

Some limitations exist in this study. Firstly, for many tweets, the proportion of those classified as neither positive nor negative was larger than that of those classified as clearly positive or negative, and thus the details of the tweets classified as neither positive nor negative will be discussed in a future paper. Secondly, the number of quote retweets examined was limited. We plan to analyze a larger number of tweets using a sentiment analysis service based on natural language processing in a forthcoming paper.

It is expected that cases of COVID-19 infection will continue and that the governors' accounts will continue to post COVID-19-related information. Therefore, we will continue to collect and analyze the governors' tweets and user responses to them.

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