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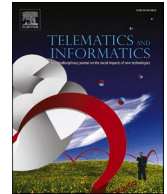
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The moderating effects of entertainers on public engagement through government activities in social media during the COVID-19

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ABSTRACT

Following the onset of COVID-19 pandemic, increasing the degree of public engagement is a crucial task for governments. This study investigated the moderating effects of entertainers on public engagement through government activities during COVID-19 pandemic. The government activities were publicized through the government's social media posts. The results showed a significant positive relationship between participation of entertainers and degree of public engagement through social media. Our findings indicated that inviting entertainers to participate could improve the effects of publicity and ease the emotional tension and anxiety among the public during a crisis. However, more attention should be paid to the choice of entertainers to maintain the legality and seriousness of government activities. These findings could help the government effectively communicate prevention policies and disseminate crisis information to the public, regardless of where they were physically located.

1. Introduction

Since December 2019, a new infectious disease called COVID-19 has quickly become a global threat. By 18 January 2021, there were more than 95 million cases of COVID-19 in the world, resulting in about two million deaths (Tsao et al., 2021). Public engagement is crucial for the government to understand the priorities and attention of the public in crises (Shah, 2019). In order to promote public engagement, governments in various countries have employed social media in crisis management, including China (Guo et al., 2021), the United States (Wang et al., 2021), the United Kingdom (Spielhofer, 2016), India (Jindal and Anand, 2020), Australia (Cameron et al., 2012), and Japan (Cho et al., 2013). In focusing on the COVID-19 pandemic in China, despite the effective measures for epidemic prevention carried out by the Chinese government (Kupferschmidt and Cohen, 2020), their strategies for official information and activities, in which entertainers participated, deserve attention. In particular, during the COVID-19 pandemic, many Chinese entertainers launched campaigns for the donation of medical equipment needed in the pandemic, and they showed their respect to medical staff through social media. Some of these online posts were reposted and commented on in government official accounts to expand their diffusion influence and accordingly help the medical staff who were fighting COVID-19. In addition, a few entertainers were invited by Chinese government departments to participate in official online or offline campaigns. For example, Wang Junkai, a young

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Chinese entertainer, was invited to visit and introduce the Supreme People's Procuratorate of China (SSP). The SPP then uploaded a video of its official account on Weibo, which received 15 million views in a few hours. Its hashtag received over 590 million hits. These behaviors attracted the public's attention, which resulted in considerable effects on propaganda during the COVID-19 pandemic. This phenomenon has led to the question of whether the participation of entertainers could be used as a moderating tool for improving public engagement through government activities during times of crisis.

Thus, this paper assesses how do entertainers moderate public engagement through government activities. In social media, the government activities were noticed by the public through *online official information*. In the present study, *online official information* (OOI) is defined as the information posted by the official government account on social media and reported news about government activities. Regarding the COVID-19 pandemic, OOI includes but is not limited to the notice of epidemic prevention policies, and publicity on progressive figures against the epidemic. During the COVID-19 pandemic, social media have played an important role in the generation, communication, dissemination, and consumption of information, which has attracted the attention of scholars (Tsao et al., 2021; Sesagiri Raamkumar et al., 2020; Wrycza and Maślankowski, 2020; Brailovskaia and Margraf, 2021; Rakshit, 2021). For instance, Tsao et al. conducted an excellent review to investigate studies on the use of social media during the COVID-19 pandemic (Tsao et al., 2021). Many studies have analyzed social media-based data to explore the public's attention to the COVID-19 (Ali et al., 2020; Hou et al., 2021; Zhao et al., 2020). For example, Hou and Hou (Jindal and Anand, 2020) and Zhao et al. (Cameron et al., 2012) performed topic modeling and sentiment analysis based on online posts collected from social media to perform a comprehensive study of public responses to COVID-19 in China. In addition, some previous studies have focused on misinformation related to COVID-19 on social media and its effects on epidemic prevention and public sentiment (Tasnim et al., 2020; Islam et al., 2020).

This study contributes to the literature on social media and emergency management. Theoretically, through researching the moderating effects of entertainers on public engagement through OOI, the current study provides important insights into the propagation mechanism of OOI on social media, and it responds to the call for a more comprehensive perspective on how to improve public engagement during emergencies (Ekström and Östman, 2015; Chen et al., 2020; Zhang et al., 2018). Moreover, its findings could enrich the literature on social media and crisis management. In practical terms, increasing public engagement has been the primary task of the government during the COVID-19 pandemic. The findings of this paper offer a possible strategy for enhancing public engagement in social media, which could assist the government in disseminating epidemic prevention policies and activities.

The rest of the paper is organized as follows. In Section 2, we review related works and develop the hypotheses. Section 3 describes the research design. Section 4 describes the empirical analysis and the results. Section 5 discusses the results and offers conclusions based on the outcome of the study.

2. Related works and development of hypotheses

2.1. Government social media and public engagement in crises

On social media, such as Twitter and Weibo, government agencies have created accounts to issue official information and obtain feedback from the public (Tang et al., 2021; Graham et al., 2015). Much evidence supports the crucial role of the government's social media accounts in social governance, especially during times of crisis (Chen et al., 2020), such as natural disasters, international conflicts, and global pandemics. In addition, timely communication between government agencies and the public is crucial in crisis management when increasing public engagement is the key problem (Zhang et al., 2018). However, strategies for promoting public-government collaboration and engagement on social media have rarely been employed or proposed by government agencies, which has limited the efficiency of social media in communicating information during crises.

Previous studies have focused on the factors that influence the degree of public engagement through government social media, such as sentiment (Tang et al., 2015), media richness (Chen et al., 2020; Rahim et al., 2019; Dubois et al., 2020), and content type (Rahim et al., 2019). Accordingly, they aimed to solve forecasting problems. However, few previous studies have employed moderating variables to further investigate the influential mechanisms. Chen et al. explored the moderating effects of media richness, dialogic loop, content type, and emotional valence in the public's engagement with OOI during the COVID-19 pandemic (Tang et al., 2015). Pioneering contributions have been made to the literature on public engagement and crisis management. We claim that it is of great significance to help the government expand the dissemination and sharing of OOI by developing more effective strategies based on the further analysis of moderating variables.

2.2. Opinion leaders on social media

Opinion leaders have been defined as the individuals in a social network who influence the opinions of others (Dubois et al., 2020). Related previous studies have focused on identifying opinion leaders on social media, as well as the effects of opinion leaders on opinion dynamics and information dissemination. Regarding the former, a few prior studies have proposed methods of detecting opinion leaders based on network topology (Li et al., 2019; Aghdam and Jafari Navimipour, 2016), text information (Li et al., 2013; Ma and Liu, 2014), and optimization algorithms (Jain and Katarya, 2019; Jain et al., 2020). These studies proposed many characteristics that may be used to identify opinion leaders. Regarding the latter, previous studies have yielded much evidence that supports the important role of opinion leaders in increasing public engagement and changing public attitudes on social media (Zhang et al., 2016; Xu et al., 2018; Walter and Brüggemann, 2020; Shi and Salmon, 2018). Xu et al. conducted a quantitative content analysis and found that different source attributes of opinion leaders had different influences on users' engagement in the public discourse (Zhang et al., 2016). However, there are multiple types of opinion leaders on social media, such as industry experts, business leaders, political elites,

famous entertainers, and highly active bloggers. Moreover, the influence of opinions on different topics was divergent. Thus, a deep analysis should be conducted to offer a more comprehensive perspective on the influence of opinion leaders on public engagement.

2.3. Entertainers on social media

In this study, “entertainer” refers to a person who entertains audiences and predominates in social media use. For instance, in July 2018, a “vaccine incident” occurred in China (Hu et al., 2020); which caught the attention of the public on social media. During this event, several famous Chinese female entertainers, such as Yao Chen and Tong Liya, posted messages expressing anger and resentment on Weibo and Chinese Twitter. These messages greatly increased the amount of public engagement during the event. In addition, a few days before the Gaza conflict in 2014, a photo of a Chinese movie star standing with Israeli diplomats became one of the most reposted images among all posts by the Israeli Embassy (Luqiu and Yang, 2020). Regarding the COVID-19 pandemic; a previous study observed that approximately 6.1% of COVID-19 related tweets on Twitter were written in a humorous tone (Kouzy et al., 2020).

Recent studies on issues related to the role of entertainers during crises have analyzed the relationship between entertainment and the dissemination of misinformation (Islam et al., 2020; Apuke and Omar, 2021; Yu and Oh, 2018). For instance, Islam et al. found that people who were driven by entertainment were more likely to share unverified information during the COVID-19 pandemic (Kouzy et al., 2020). They explained that posts related to entertainment could reduce fatigue, which reduced users’ concerns about the authenticity of information. However, compared with other factors that influence public engagement, such as user profile, content type, and sentiment, little attention has been paid to the role of entertainers, especially regarding issues related to government and its activities.

In addition, there is a need to delineate the differences between entertainers and influential users; much evidence has substantiated that the latter could enhance public engagement but little is known about the unique role of entertainers in influencing public participation (Zhang et al., 2016; Xu et al., 2018; Walter and Brüggemann, 2020; Shi and Salmon, 2018). In general, entertainers could be viewed as a subset of influential users. However, compared to other kinds of influential users, such as famous commentators, corporate executives, and university teachers, entertainers have two distinguishing characteristics. First, there are natural associations between entertainers and entertainment; messages posted by entertainers on social media, such as on government activities and response measures during the crisis, will inevitably involve entertainment elements despite these being serious topics. It is worth noting that the participation of entertainers could result in difficulties in discussing serious or sensitive topics with the public. In other words, although entertainment could increase public engagement, interpretation of serious issues through the lens of entertainment may distort the publicity purpose of the information. Second, compared to nonfans, fans of entertainers commonly pay more attention to the entertainers than the message itself, thus showing an emotional effect at play on social media. In this situation, if entertainers present irrational or “wrong” attitudes on serious or sensitive topics, their fans’ emotions could be easily amplified and become extreme. Antonetti et al. suggested that a small group of people with extreme emotions will rapidly evolve into a large group phenomenon through interactions in cyberspace (Antonetti et al., 2019) and Cyders and Smith stated that “under heightened emotional states, individuals are more inclined to engage in ill-considered or rash actions than at other times” (Cyders and Smith, 2008). This implies that extreme emotions are more likely to provoke cyber violence or even offline mass violence incidents, especially during a crisis such as COVID-19 pandemic when public emotions are at the height of tension. Thus, it is of significance to explore the impact of entertainers on public engagement.

2.4. Hypothesis development

2.4.1. Effects of government users on public engagement

We hypothesize that a positive relationship exists between the use of government social media accounts and the degree of public engagement in a given online post. The public engagement in a given post on social media could be measured by three features of popularity on Weibo: the number of reposts, the number of comments, and the number of likes. These three features are characteristic of all human interactions on social media (Almoqbel et al., 2019), and therefore represent the subjective will of users to share the post. In comparing them, some previous studies have investigated differences regarding Facebook (Kaur et al., 2019; Ekström and Östman, 2015; Obamiro, 2020; Kim and Yang, 2017). For instance, Kim and Yang (Kim and Yang, 2017) explained the differences among these three features from the perspective of communication. They suggested that there are three discrete levels of social media behavior: *consuming*; *contributing*, and *creating*. According to the cost of an action, they categorized *repost* as the highest level, *comment* as the intermediate level, and *like* as the lowest level. Based on previous studies and the characteristics of Weibo, we summarize the following:

1. *Like* refers to the easiest and quickest sharing behavior, which could reflect the positive feedback of readers on the given post.
2. *Comment* plays an important role in affecting readers’ attitudes toward discussions through sentiment tendency, and the number of comments could be used to measure the intensity of a given post. Thus, in addition to the number of comments, we also used the number of positive comments to represent the public support degree towards government statement.
3. Compared with *like* and *comment*, *repost* requires more cognitive effort. An increase in the number of reposts indicates a stronger conscious sense of agreement.

Based on the review of the relevant literature, the following hypotheses are proposed:

H1a: OOI receives more reposts on social media during a crisis compared with normal posts.

- H1b:** OOI receives more comments on social media during a crisis compared with normal posts.
- H1c:** OOI receives more positive comments on social media during a crisis compared with normal posts.
- H1d:** OOI receives more likes on social media during a crisis compared with normal posts.

2.4.2. *Effects of entertainers on public engagement in social media*

This study hypothesizes that the participation of entertainers performs an amplifier role in public engagement through government activities, which are measured by the OOI in social media. As we discussed in Section 2.3, some studies have shown that entertainers have the potential to attract more attention from the public in social media regarding particular topics or events. Specifically, previous studies found that classic social identity theory applies to the social media environment, and fans’ attitudes and behavioral intentions toward particular topics were greatly influenced by the users they followed (Leung and Tanford, 2016). Thus, the following hypotheses are proposed:

- H2a:** The participation of entertainers positively moderates the number of *reposts* of OOI on social media during a crisis.
- H2b:** The participation of entertainers positively moderates the number of *comments* of OOI on social media during a crisis.
- H2c:** The participation of entertainers positively moderates the number of positive *comments* of OOI on social media during a crisis.
- H2d:** The participation of entertainers positively moderates the number of *likes* of the OOI in social media during a crisis.

2.4.3. *Research model*

Fig. 1 displays our research model. In addition, we controlled for some characteristics of users and the sentimental tendency of posts, which have been shown to be related to the degree of the diffusion of posts on social media (Chen et al., 2020), in order to remove potential influences of other factors.

3. Research method

3.1. Data

The keywords used in the data collection were “COVID-19”, “coronavirus”, and “pneumonia”. Based on these keywords, we used Octopus (<https://www.bazhuayu.com>), a mature web crawler tool (Wang et al., 2019; Liu and Hu, 2019) to collect all online posts on Weibo from 1 March to 31 May 2020. Weibo is one of the largest social media platforms in China. To obtain the maximum number of relevant posts, we conducted our data collection process every day during the study period. The data included original, repost, and comment posts. For each post, we captured information on user ID, username, user description, number of followings, number of followers, number of posts, location, user labels, URL, posting time, content of the post, number of reposts, number of comments, and number of likes. We selected Weibo as the data source because many Chinese government agencies, news media providers, enterprises, organizations, and entertainers have created their own official accounts on this platform, which enabled us to explore issues concerning the relationship between government, entertainers, and information diffusion on social media. In addition, according to the 45th China Statistical Report on Internet Development, which was published by the China Internet Network Information Center (CNNIC), at the end of March 2020, the number of active Weibo users was 70 million, which was more than half of all Chinese netizens on average each month. In past years, Weibo has been widely used by many studies (Ma and Liu, 2014; Wang et al., 2019; Luo and Zhai, 2017; Han and Wang, 2019; Shan et al., 2019). Because the aim of this study was to investigate the moderating effects of entertainers on official information diffusion on social media, only the original posts were considered. In the data reprocessing, first, the SPSS 25.0 data cleaning function was employed to remove incomplete samples from the raw data. Posts that were not associated with the COVID-19 pandemic, such as advertisements, were manually removed based on their content. Finally, a total of 10,0789 original posts and their commenting data were obtained. Additionally, regular expression operations in R were carried out to delete noise contained in the collected data, which improved the efficiency of the textual analysis.

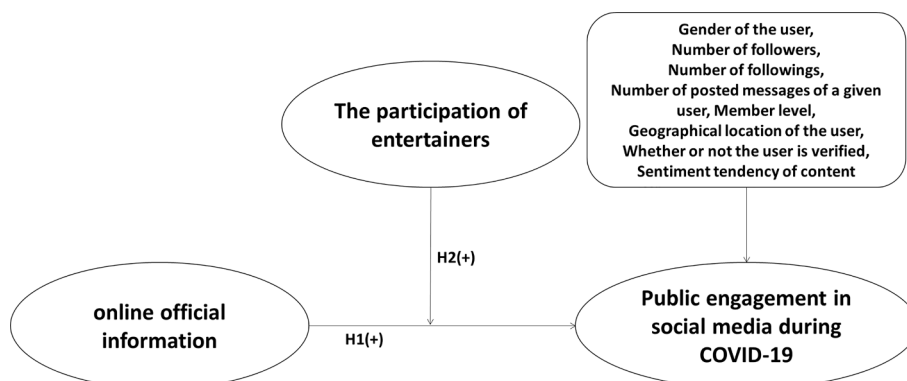


Fig. 1. Research model.

3.2. Variables

The independent variable in this study was the degree of public engagement of a given post, which was reflected by four indicators: *repost*, *comment*, *positive comment* and *like*. As we discussed in Section 2.4, these four measures have different implications in social media from the perspective of human behavior. For instance, *repost*, *comment*, and *like* were ranked from the highest to the lowest according to the cost of the action, and *positive comment* could reflect the support degree of the public towards government statement. Thus, to provide a comprehensive picture of the effects of the participation of entertainers in official information diffusion, these four measures were set as the independent variables used in the regression analysis. In specific, with respect to the sentiment tendency of comments, according to previous studies, machine learning algorithms have been commonly applied to analyze the content of social media data (Milusheva et al., 2021), especially those on a large scale. Sentiment analysis was described as follows: given a set $X = \{x_1, x_2, \dots, x_n\}$ with labels $= \{1, 2, \dots, y_n\}$. Sentiment analysis aims to obtain a classifier whose inputs are the feature representations of a document $x = \{1, 2, \dots, m\} \in X$ consisting of m words, and the output refers to the sentiment tendency of the document \times . In this study, we employed the long short-term memory model (LSTM), which is a special type of recurrent neural network (RNN) used in sentiment analysis. It has shown excellent performance in processing Chinese microblogging data (Wang et al., 2018; Shan et al., 2021; Yang et al., 2018). In general, a typical LSTM can be viewed as a gating structure that includes three gates: the forget gate, the input gate, and the output gate. These three gates protect and control the state of a memory cell in learning the long-distance dependency information in a given sentence. It should be noted that in this study, the word segmentation in the sentiment analysis was conducted using the R package of Jieba with the basic lexicon of *Sougou Pinyin*, which can be downloaded at <https://pinyin.sogou.com/>. The reason for using this lexicon instead of the one embedded in Jieba is that a greater number of words related to the COVID-19 pandemic are included in the former, such as novel coronavirus and covid. The use of this lexicon increased the accuracy of the segmentation results. In addition, Word2Vec, a word vector training tool launched by Google, was used for word embedding. In this study, the hidden size of each LSTM unit was set at 300, and the learning rate was set at 0.01 for optimization. We used a dataset containing 120,000 online posts collected from Weibo to train the model, half of which were labeled as positive and half of which were labeled as negative. These data are available at <https://qcsdn.com/q/a/49489.html>. We then used the obtained classifier to identify the sentiment tendency in our collected online posts and counted the number comments with positive tendency of each original post.

The dependent variable in this study was OOI, which was used to measure whether a given post was announced by a government official user on social media and reported government activities. First, we extracted the data that was posted by government official user based on the industrial category, an attribute of user profiles on Weibo. A total of 180 categories were identified in the collected data, 70 of which were related to the government (see the Appendix). Then, we manually extracted the data that reported news about government activities. This variable was considered a binary: 1 indicated those that were OOI, and 0 indicated those that were not.

The moderating variable in this study was the participation of entertainers, which was used to measure whether the contents of a given online post contained the name of the entertainer. In other words, we aimed to determine whether the participation of entertainers in government activities attracted more attention from the public. To achieve this goal, we assessed whether a given OOI posted by a government user on social media, which was used to promote a specific activity that was participated in by entertainers, had a greater degree of diffusion. This variable was based on the word segmentation results of each collected post using the R package *Jieba*, which has shown effective performance in processing the contents of Chinese social media data in many previous studies (Chen and Chen, 2019; Wang et al., 2021). In particular, for word segmentation, we used a lexicon containing 5,980 names of entertainers, which was provided by *Sougou Pinyin*. *Sougou Pinyin* is a widely used worldwide input method of Chinese characters. It allows users at all



Fig. 2. An example of user webpage on Weibo.

knowledge levels to learn or practice typing in Chinese. Its varied real-time updatable lexicons have mainly contributed to the success of this method. This lexicon can be accessed at <https://pinyin.sogou.com/dict/detail/index/15209>. The moderating variable was also a binary: 1 indicated those that contained one or more than one entertainer’s name, and 0 indicated those that did not contain an entertainer’s name.

Additional control variables were user’s characteristics, namely: gender, number of followers, number of followings, number of messages posted, member level, geographical location, whether the account was verified, and the sentiment tendency of a given post. The reasons for choosing these control variables are as follows. Gender, a basic demographic feature of social media users, was chosen as a control variable because previous studies showed that individual differences affected social media use (Chen et al., 2020). Tafesse and Wood studied the engagement strategy of influencer marketing on social media and found that follower count, followee count, and content volume influenced engagement behaviors (Tafesse and Wood, 2021). Thus, number of followers, number of followings, and number of messages posted were controlled for. In previous studies examining how to increase public engagement on social media during emergencies, users’ sentiment was commonly viewed as an important influencing factor (Chen et al., 2020; Ekström and Östman, 2015; Kim and Yang, 2017; Han and Wang, 2019). Therefore, the sentiment tendency of posts was controlled for in our model. User verification and member level were also included because they are highly correlated with user credibility, an effective predictor for information dissemination (Graham et al., 2015; Dubois et al., 2020; Aghdam and Jafari Navimipour, 2016). Finally, as the geographical locations of micro blog users are essential for event analysis on social media (Luo et al., 2020), we also considered it as a control variable. The first seven variables were obtained from the user’s webpage on Weibo (see Fig. 2) while sentiment tendency was calculated using the LSTM algorithm.

To test the overall performance of the results, three students were employed to manually check the accuracy of the sentiment classification of 5,000 online original posts and 5,000 commenting posts. Only those considered correct by all three students were classified in the correct group. The final accuracy rate of the 10,000 tested data annotations was 91.72%, which indicated an acceptable margin of error. Thus, the sentiment tendency results were highly reliable.

3.3. Models

We analyzed the data using a multiple-regression model with the maximum likelihood estimation method. The following regression models (formula (1)-(4)) were constructed based on our proposed hypotheses (Section 2.4). In the models, RP_i , CM_i , PCM_i , and LK_i , respectively, measured the number of reposts, comments, positive comments, and likes of the post i . Gov_i represented a binary variable: $Gov_i = 1$ if post i was OOI; otherwise, $Gov_i = 0$. Ent_i also represented a binary variable: $Ent_i = 1$ if the content of post i contained one or more names of entertainers; otherwise, $Ent_i = 0$. $Gov_i \times Ent_i$ was the interactive item, which indicated official information that contained content about entertainers. In other words, this official information was about a government activity that was participated by the entertainer. Gen_i represented the gender of the user who released post i , which equaled 1 when the user was labeled as male and 2 when the user was labeled as female. FW_i and FR_i , respectively, were the number of followings and followers of the user. $Post_i$ referred to the number of messages posted by a given user. $Loca_i$ was the geographical location of the user; $Veri_i$ was used to measure whether the user was verified; $MemL_i$ represented the member level of the user; and $Senti_i$ was used to measure the sentiment tendency of the content of post i . In $Loca_i$, we considered 36 provinces, autonomous regions, and municipalities in China. $Loca_i = 0$ if no location information was included on the user’s webpage. u_i was the error item.

$$RP_i = \beta_1 Gov_i + \beta_2 Gov_i \times Ent_i + \beta_3 Gen_i + \beta_4 FW_i + \beta_5 FR_i + \beta_6 Post_i + \beta_7 Loca_i + \beta_8 Veri_i + \beta_9 MemL_i + \beta_{10} Senti_i + \alpha + u_i \tag{1}$$

$$CM_i = \beta'_1 Gov_i + \beta'_2 Gov_i \times Ent_i + \beta'_3 Gen_i + \beta'_4 FW_i + \beta'_5 FR_i + \beta'_6 Post_i + \beta'_7 Loca_i + \beta'_8 Veri_i + \beta'_9 MemL_i + \beta'_{10} Senti_i + \alpha' + u'_i \tag{2}$$

Table 1
Descriptive Statistics of Variables.

	Minimum	Maximum	Mean	Std. Deviation
RP	1	558,826	135.27	2223.309
PCM	0	64,761	77.52	563.59
CM	0	78,306	155.44	958.006
LK	0	1,917,794	2298.60	21172.840
Gov	0	1	0.14	0.347
Ent	0	1	0.01	0.109
Gen	1	2	1.24	0.428
FW	0	20,000	1156.93	1385.589
FR	2	198,335,830	12069194.38	18047949.384
Post	0	411,580	68540.61	64294.498
Loca	0	36	5.24	9.531
Veri	0	2	1.49	0.651
MemL	0	7	5.11	2.454
Senti	0	2	1.3821	0.64544

$$PCM_i = \beta_1'' Gov_i + \beta_2'' Gov_i \times Ent_i + \beta_3'' Gen_i + \beta_4'' FW_i + \beta_5'' FR_i + \beta_6'' Post_i + \beta_7'' Loca_i + \beta_8'' Veri_i + \beta_9'' MemL_i + \beta_{10}'' Senti_i + \alpha'' + u_i'' \tag{3}$$

$$LK_i = \beta_1''' Gov_i + \beta_2''' Gov_i \times Ent_i + \beta_3''' Gen_i + \beta_4''' FW_i + \beta_5''' FR_i + \beta_6''' Post_i + \beta_7''' Loca_i + \beta_8''' Veri_i + \beta_9''' MemL_i + \beta_{10}''' Senti_i + \alpha''' + u_i''' \tag{4}$$

4. Empirical analysis and results

4.1. Descriptive statistics and correlations

Table 1 shows the descriptive statistics of the variables included in our proposed models. Our collected online posts varied greatly in the numbers of reposts, comments, positive comments, and likes, and our selected control variables, which allowed us to carry out the regression analysis. Specifically, of the total samples, 14,116 (14.01%) were posted by government official accounts, and 1,205 (1.2%) contained content related to entertainers. Table 2 shows the correlation matrix, in which the correlations of the variables were all below the threshold value of 0.8 (Tang et al., 2019). Thus, there was minimal concern regarding multicollinearity.

4.2. Regression results

The regression results of Model 1, Model 2, Model 3, and Model 4 are displayed in Table 3. Because the suggested cut-off for the corresponding VIF was 10.0 (Lahuerta-Otero and Cordero-Gutiérrez, 2016), we did not encounter values at this level, and multicollinearity problems were not detected in all four models. The results supported **H1a** at the 5% level (coefficient = 0.015, *p* value = 0.000) but rejected **H1b** (coefficient = 0.005, *p* value = 0.204), **H1c** (coefficient = 0.006, *p* value = 0.13), and **H1d** (coefficient = 0.003, *p* value = 0.373). In other words, during emergencies, OOI may not receive more comments and likes but may tend to have more reposts on social media. This finding indicated that a stronger conscious sense was aroused in readers by OOI related to the COVID-19 pandemic. Regarding comments and likes, as they will cost less cognitive effort compared with reposts, and many unofficial influential media and opinion leaders reposted or repeatedly posted OOI, the number of comments and likes received by official information posts were inevitably decreased.

Regarding the participation of entertainers, the findings showed that it positively moderated the relationship between OOI and the degree of public engagement, which supported **H2a**, **H2b**, **H2c**, and **H2d** at the 5% level: coefficient = 0.12 and *p* value = 0.000 in Model 1; coefficient = 0.118 and *p* value = 0.000 in Model 2; coefficient = 0.086 and *p* value = 0.000 in Model 4; coefficient = 0.023 and *p* value = 0.000 in Model 4. These results indicated that OOI with content related to entertainers would attract more attention from the public in emergencies, and they could yield greater propaganda effects than those in which entertainers did not participate. In particular, it is worth noting in Model 3 that the number of positive comments can be significantly increased by inviting entertainers to participate in government activities. Therefore, if user factors were held constant, the participation of entertainers would have the potential to improve public positive engagement in OOI on social media during emergencies. In terms of the COVID-19 pandemic, this result offers an effective tool for government departments to better propagate epidemic prevention policies and offline anti-epidemic activities on social media, as well as to better understand the core demands of the public in a crisis. In addition, as Postman stated, the participation of entertainers could decrease the degree of public fear, which is an essential task for the government during emergencies (Postman, 2006). These activities would help in fighting COVID-19.

Moreover, the following results were obtained for control variables:

1. No significant relationship was found between gender and public engagement which was consistent with previous studies (Zhang et al., 2018; Ye et al., 2017; Ferrara and Yang, 2015).
2. Regarding the number of followings, despite *repost*, a significant negative relationship with *comment*, *positive comment*, and *like* was identified. There was a significant positive relationship between number of followers and degree of public engagement. These two

Table 2
Relation Matrix between Variables

	1	2	3	4	5	6	7	8	9	10
1 Gov	1									
2 Ent	-0.015**	1								
3 Gen	-0.076**	0.008*	1							
4 FW	-0.106**	0.000	-0.032**	1						
5 FR	-0.197**	0.008*	-0.210**	0.120**	1					
6 Post	-0.125**	-0.004	-0.193**	0.156**	0.660**	1				
7 Loca	-0.222**	0.008**	0.157**	0.051**	-0.320**	-0.393**	1			
8 Veri	0.318**	-0.007*	-0.111**	0.001	0.198**	0.208**	0.393**	1		
9 MemL	-0.362**	0.017**	-0.074**	0.144**	0.354**	0.261**	-0.468**	-0.054**	1	
10 Senti	0.056**	0.001	-0.061**	0.009**	0.121**	0.153**	0.047**	0.145**	0.017**	1

** . Correlation is significant at the 0.01 level (2-tailed); * . Correlation is significant at the 0.05 level (2-tailed).

Table 3
Regression Results of the Models

	Model 1		Model 2		Model 3		Model 4		VIF
	Coefficient	P value	Coefficient	P value	Coefficient	P value	Coefficient	P value	
Gov	0.015	0.000	0.005	0.204	0.006	0.130	0.003	0.373	1.369
Gov × Ent	0.120	0.000	0.118	0.000	0.086	0.000	0.023	0.000	1.006
Gen	0.008	0.309	0.001	0.819	0.002	0.534	0.005	0.094	1.072
FW	-0.005	0.103	-0.021	0.000	-0.017	0.000	-0.014	0.000	1.052
FR	0.048	0.000	0.150	0.000	0.125	0.000	0.110	0.000	1.997
Post	-0.028	0.000	-0.054	0.000	-0.044	0.000	-0.014	0.001	1.966
Loca	0.001	0.897	-0.006	0.147	-0.005	0.174	-0.009	0.019	1.548
Veri	-0.007	0.043	-0.003	0.455	-0.003	0.467	-0.018	0.000	1.400
MemL	0.017	0.000	0.027	0.000	0.023	0.000	0.014	0.000	1.299
Senti	0.004	0.181	0.011	0.001	0.01	0.001	0.009	0.003	1.044

findings could be explained by the fact that most opinion leaders on social media have many followers and much fewer followings (Aghdam and Jafari Navimipour, 2016). Moreover, they attract more public attention than normal users.

- With respect to user credibility, there was no significant relationship between user verification and public engagement but a significant positive relationship between member level and public engagement was found. In other words, information posted by users with higher levels and who were more likely to be opinion leaders could receive more attention. This finding is similar to the second finding.
- Sentiment was an effective predictor of the number of comments (coefficient = 0.011 and *p* value = 0.001), positive comments (coefficient = 0.01 and *p* value = 0.001), and likes (coefficient = 0.009 and *p* value = 0.003) during the crisis at the 5% level. As we discussed in Section 2.4, *positive comment* and *like* both reflected the positive feedback of readers on a given post. Thus, the findings indicated that online posts with positive content attracted more attention on social media. This finding is in line with Ferrara and Yang (Ferrara and Yang, 2015) who explained it as the “positive bias” effect in social media. In other words, people are more inclined to share and favor positive content, especially during times of crisis.

We also conducted several robustness checks to assess the quality and validity of our results. First, we employed a smaller sample of 50,000 randomly selected online posts from the data to examine the moderating effects of the participation of entertainers on the improvement of public engagement through OOI. The results supported *H2a* (coefficient = 0.17 and *p* value = 0.000), *H2b* (coefficient = 0.095 and *p* value = 0.003), and *H2c* (coefficient = 0.077 and *p* value = 0.002), but rejected *H2d* (coefficient = 0.012 and *p* value = 0.084) at the 5% level. The main reason for the rejection of *H2d* was that some online posts that contained content about entertainers

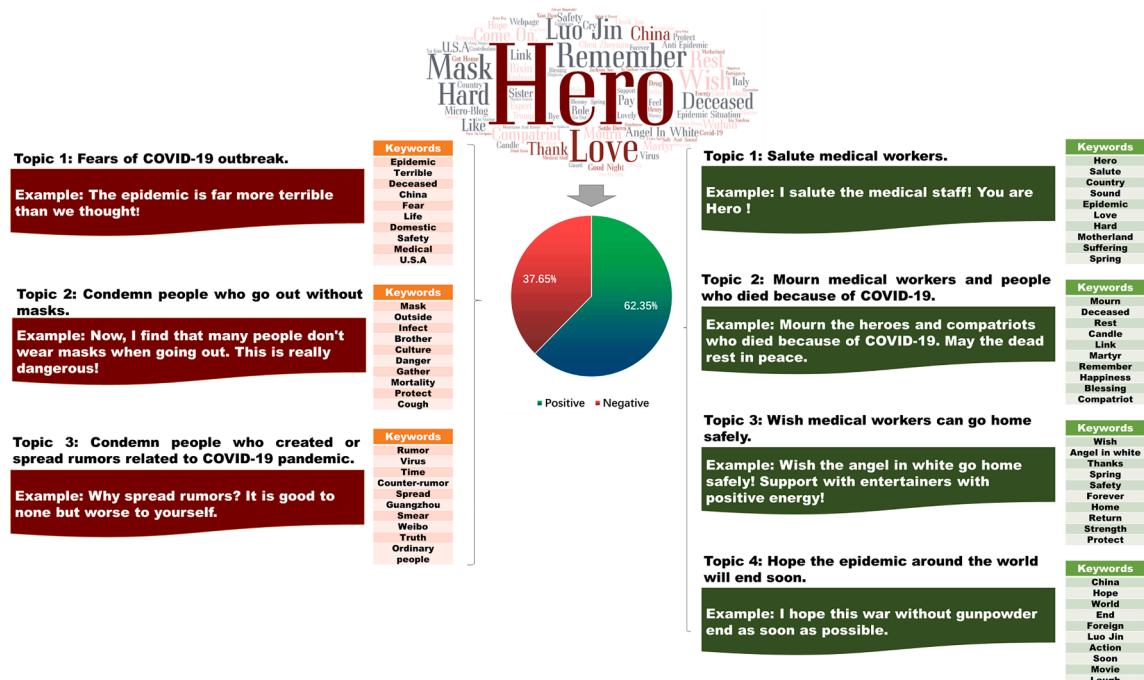


Fig. 3. Content analysis results of comments of OOI with contents related to the participation of entertainers in government activities.

were excluded from the random sample. However, the obtained coefficient regarding *like* was positive, which was in line with our findings. Second, we applied ordinary least squares (OLS) to analyze the relationships mentioned above. In all four cases, our results remained qualitatively unchanged.

4.3. Content analysis results

In order to understand the public's attitudes towards participation of entertainers in government activities, we carried out content analysis on comments responding to relevant online posts. First, Jieba with the basic lexicon of Sogou Pinyin was used for word segmentation. Then, term frequency-inverse document frequency (TF-IDF) method was used to determine important keywords. Third, the sentiment tendency of comments was calculated using the LSTM algorithm. Finally, topic clustering analysis on comments with positive sentiment and those with negative sentiment was conducted using the Latent Dirichlet Allocation (LDA) method. LDA is an unsupervised machine learning model which has performed well in extracting topics from Chinese social media data (Lian and Dong, 2021; Shan et al., 2021). In accordance with previous studies, k-dimensional topic smoothing parameter and k-dimensional word smoothing parameter were set as 0.1 and 0.01 respectively (Hao et al., 2017). In addition, The trial and error approach was employed to determine the number of topics.

Fig. 3 displays the content analysis results. We extracted the top 100 keywords according to the ranking results of the TF-IDF value. Keywords with high TF-IDF values include “hero”, “mask”, “love”, and “remember”. This finding showed that most people were concerned about medical workers. The proportion of positive and negative comments was 62.35% and 37.65% respectively. Three topics with negative tendency and four topics with positive tendency were extracted from the comments data. With respect to the topics with positive sentiment tendency, the following were obtained: “salute medical workers”, “mourn medical workers and people who died because of COVID-19”, “wish medical workers can go home safely”, and “hope the epidemic around the world will end soon”. For topics with negative sentiment tendency, “fears of COVID-19 outbreak”, “condemn people who go out without masks”, and “condemn people who created or spread rumors related to COVID-19 pandemic” were identified. Overall, we found that OOI with contents related to the participation of entertainers in government activities have positive effects on public attitudes toward the government's efforts in COVID-19 prevention and control. For example, Xinhua News Agency invited Chinese entertainers to record a music video titled “Because We Are Together” which showcased stories from the process of fighting the pandemic. Government users, such as the Central People's Broadcasting Station and the News for Reference, shared this music video on social media, which effectively propagated prevention and control policies and government offline anti-epidemic activities.

5. Discussions and conclusion

Improving public engagement would help the government enhance its understanding of the public's core demands and thus provide on point public services, especially during times of crisis. Social media, one of the most commonly used communication platforms by both citizens and governments around the world, has been effective in enhancing public engagement. Although previous studies have focused on how public engagement can be increased using social media (Zhang et al., 2018; Ye et al., 2017; del Mar Gálvez-Rodríguez et al., 2019), we still know little about the mechanisms that influence potential moderating factors (Guo et al., 2021; Chen et al., 2020).

Building on previous studies (Guo et al., 2021; Chen et al., 2020); this study focused on the moderating role of entertainers in increasing public engagement through OOI based on Weibo posts about COVID-19 pandemic. We aimed to find an effective way for the government to improve public engagement by disseminating official information about government activities on social media during a crisis. The findings indicated that while OOI did not receive large numbers of comments and likes, it tended to have more reposts on social media. Online posts with positive content attracted more attention during the crisis, which showed “positive bias” (Ferrara and Yang, 2015). Regarding the COVID-19 pandemic, the findings showed citizens were more sensitive to official online posts of good news (e.g., “The number of asymptomatic infected people has been cleared.”) than those conveying bad news (e.g., “A new case of COVID-19 was found in China.”)

With respect to the participation of entertainers, a significant positive relationship was found with the degree of public engagement, especially the positive ones, through OOI. Content analysis on OOI reporting the participation of entertainers in government activities further confirmed its positive effects on public engagement. These findings indicated that inviting entertainers to participate in government activities could increase the effectiveness of publicity and enable more citizens to be aware of prevention policies. Consistent with Postman (Postman, 2006) and Luqiu and Yang (Hu et al., 2020), we conclude that the power of entertainment is stronger during crisis than non-crisis times. During a crisis, entertainers could have a tremendous online influence on public opinion and human behavior and it could even be more effective than the government.

We recommend that publicity strategies could be developed to help the government increase public engagement with OOI, especially during emergencies such as the COVID-19 pandemic. Previous studies have suggested that entertainment conveys an expressive tone that has a positive effect. However, it may not be appropriate for OOI in most cases because there are significant differences between the tone of the information posted by the government and that of non-governmental agencies on both online and offline channels. For instance, during the COVID-19 pandemic, online posts generated by government official accounts were more serious and formal than those posted on Twitter by informal organizations and individuals (Kouzy et al., 2020).

Nonetheless, the findings indicate a better way for the government to increase public engagement through OOI during a crisis which is to strengthen the participation of entertainers in government official activities. Their inclusion not only could increase publicity, but could also ease emotional tension and anxiety among the public. However, there is a need to balance the degree of

participation. Specifically, the legality and seriousness of government publicity activities should be maintained during the entire process. If entertainment elements became too heavily involved in activities, the public may react negatively, leading to the opposite effect.

5.1. Theoretical implications of the study

First, this study identifies an important overlapping area in social media literature and crisis management literature, specifically the intersection between entertainment and governance. In addition, this study is one of the first to examine how government agencies could apply social media to improve public engagement during the COVID-19 pandemic. Our findings indicate that entertainers could be employed by the government to promote positive outcomes during crises.

Second, this study developed and validated a research model that considered the moderating effects of entertainers on public engagement through government activities during the COVID-19 pandemic. These findings could be applied in developing communication strategies for governments during other major emergencies such as natural disasters, accident disasters, and national security events. Therefore, our study contributes to the knowledge of network governance and crisis management.

Third, this study highlights the importance of selecting measures of public engagement in exploring moderating variables. Regarding social media, previous studies used the number of likes, reposts, and comments to represent the level of public engagement (Jiang and Beaudoin, 2016; Chen et al., 2020; Zhang et al., 2018). However, the inherent meanings of these measures differed from the perspective of citizens' attitudes and behaviors and did not always reflect public engagement. That is, it is valuable for scholars to examine the factors that influence public engagement. Therefore, the findings of this study enrich the research domain in the context of social media and crisis management issues.

5.2. Practical implications

From a global perspective, our findings have several practical implications for government practices in engaging citizens during crises. First, we have demonstrated that social media played an important role in the generation, communication, and dissemination of information during the COVID-19 pandemic. Thus, government agencies could consider creating official accounts on social media as soon as possible for timely release of crisis information, which could significantly improve public engagement in government activities. It is also helpful for countering misinformation on the social media (Brailovskaia and Margraf, 2021).

Second, government agencies could use social media to respond to public demands in a comprehensive and timely manner, through conducting content analyses on opinions at different stages of crisis. This also ensures effective two-way communication at key points of the crisis. Such measures would contribute to maintaining and strengthening the relationship between the government and the public.

Third, government agencies could consider the role of entertainers in enhancing public engagement. In this respect, the Chinese government has taken practical measures, such as inviting entertainers to be ambassadors of fundraising and participate in official publicity activities, which were highly effective in increasing the degree of public engagement. Therefore, other countries could consider leveraging on social media as well as the influence of entertainers to promote public engagement during the COVID-19 pandemic. However, it should be noted that the type of entertainers is an important point to consider; those with adverse records and reputations should be excluded, while those with positive attitudes and those who have engaged in activities in social development should be given priority.

5.3. Limitations of the study and future research directions

This study has several limitations which future studies could address. First, the effects of different types of entertainers on public engagement were not considered. In future studies, we will explore and identify an appropriate classification for types of entertainers. Second, the data was collected during one specific time period of the COVID-19 epidemic in China. However, we believe that the public's focus shifts in stages during crises which would require different strategies to improve public engagement. Thus, we will consider different periods of the COVID-19 pandemic in our data collection in future research. Lastly, other factors such as types of government departments and stages of crisis that influenced public engagement through OOI during a crisis also warrant further research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix:. 70 categories related to the government in user profile in Weibo

Category name	Category name
Government-Meteorology	Government-health hospital
Government-natural resources and resource planning	Government-public security criminal investigation economic investigation
Government-other agencies	Government-health blood donation
Government-natural resources and forestry grassland	Government-public security cyber police
Government-other agencies	Government-health commission
Government-housing construction	Government-public security other institutions
Government-agriculture rural	Government-Health-other institutions
Government-emergency management	Government-public security drug control
Government-Civil Affairs	Government-health emergency
Government-emergency fire	Government-public security traffic police
Government-technology	Government-statistics
Government-emergency forest fire	Government-Public Security Bureau
Government-Education	Government-Taiwan Affairs Office
Government-emergency earthquake	Government-public security anti cult
Government-transport post	Government-judicial administration
Government-publicity	Government-public security immigration
Government-transport railway	Government-culture and Tourism – Domestic Tourism Bureau
Government-civilization office	Government-Industry and information technology
Government-Transport – other agencies	Government-market supervision Drug Administration
Government-culture tourism culture management	Government-service center
Government-Transport – Transport Bureau	Government-market supervision market supervision
Government-culture, tourism and cultural security unit	Others-National Defense Commission
Government-transport aviation	Government-ecological environment
Government-culture, tourism and Library	Procuratorate
Government-transport Metro	Government-Foreign Affairs
Government-culture, tourism and other institutions	Court
Government-grassroots organizations	Government-foreign embassies and consulates
Party committee-other organizations	Party committee-political and Legal Affairs Committee
Government-customs	Government-Foreign-other institutions
Government-water	Government-Cultural Tourism Overseas Tourism Administration
Government-SASAC	Government-Commerce Bureau
Government-cultural tourism scenic spot	Supervision by Party committee Discipline Inspection Commission
Government-radio and television	Government-human social security
Government-cultural tourism Museum	Party committee
Government-public security administration	Newspaper-official newspaper

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