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Public moral motivation during the COVID-19 pandemic: Analysis of posts on Chinese social media

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As COVID-19 struck worldwide, we were inspired by behavioral immune system theory and wondered whether there would be changes to public morality brought about by the pandemic. We tracked public reactions through posts on Chinese social media to analyze the dynamics of public moral motivation. Big data analysis shows that the impact of disaster upon moral motivation was context-sensitive. The level of the severity of the disaster played a leading role in variation of moral motivation. We found that disaster increased moral motivation only when the situation was severe, and such augmentation rapidly faded when the disaster was under control and recovery began. The sentiment of news shared during the pandemic played a regulating role, such that positive or encouraging news helped augment moral motivation only when the situation was severe. Finally, we found that the pandemic increased expressions of both agency and communion in a similar way to that of moral motivation.

Keywords
moral motivation; agency; communion; big data; COVID-19; pandemic; coronavirus; social media

By the beginning of February 2020, the coronavirus (COVID-19) pandemic had infected over 10.5 million people worldwide. Besides posing a great threat to physical health, the pandemic inevitably impacted on a wide array of psychological dimensions, such as individualism–collectivism, female sociosexuality, democratization, restriction of rights and civil liberties, and even uses of spices when cooking (Murray & Schaller, 2010). When disasters such as influenza pandemics strike, human nature is always manifested, especially morality (Murray et al., 2011; Van Leeuwen et al., 2012). When individuals' life security is threatened by disaster, the usual moral emphasis of concern for others confronts an unignorable self-interest focus. Scholars have shown that under the condition of pathogen prevalence, more emphasis is put on morality (Murray et al., 2011; Van Leeuwen et al., 2012), and citizens show greater sensitivity to moral violations (Murray et al., 2017). As witnesses of COVID-19, we wondered whether public morality would be promoted by the pandemic, and how the morality of the people would evolve dynamically during this time.

Moral behavior is driven by two fundamental motives, which are often conceptualized as being in tension (Frimer et al., 2011): *Agency* is the motive to promote the interests of the self, reflected as getting ahead, individuating, and advancing the self; whereas *communion* is the motive to promote the interests of others, with the theme of getting along and contributing to a social collective (Bakan, 1966; Frimer et al., 2012). As Bakan (1966) pointed out "The moral imperative is to try to mitigate agency with communion" (p. 14). Morality could be guided by a relatively high sense of other-oriented motive and a relatively low level of self-oriented motive, so that moral motivation could be represented as the ratio of communion to agency motives (Frimer et al., 2014; Zhang & Yu, 2018).

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From the perspective of the behavioral immune system, humans have evolved a range of cognitive, affective, and behavioral mechanisms to prevent infection risk when under threat from an infectious disease (Ackerman et al., 2018; Murray & Schaller, 2016; Schaller, 2011; Schaller & Park, 2011). Well-established findings show that people will turn to coping mechanisms such as in-group favoritism and out-group derogation to protect their social identity when perceiving a threat (Ackerman et al., 2018; Gaertner & Dovidio, 2000; Tajfel & Turner, 2001), which helps them to avoid exposure to unfamiliar targets that may bring pathogen dangers. For example, it has been found that the presence of an infectious disease makes citizens more conservative, with negative correlations observed for the two personality traits of extraversion and openness to experience (Murray & Schaller, 2010; Schaller & Murray, 2008). Historically, disease prevalence has been found to be positively correlated with collectivism and negatively correlated with individualism (Murray & Schaller, 2010). Beyond the field of study of disease, researchers of the disaster of the 9/11 terrorist attacks in 2001 also reported augmentation of social identity and homogeneity of others in the USA after that event (Esses et al., 2002; Olivas-Luján et al., 2004).

As noted above, communion represents a motive that is other- or group-oriented, and agency reflects a self-oriented motive (Frimer et al., 2012). Studies have shown that typical behavioral immune mechanisms lead to increases in in-group favoritism and collectivism. Therefore, an intuitive hypothesis that naturally follows is that the COVID-19 pandemic would strengthen the communion dimension (other- or group-oriented motive), weaken the agency dimension (self-oriented motive), and boost moral motivation.

Although the above theoretical inference is rational, the reality may not be so simple. We note here that the agency dimension (i.e., the self-oriented motive) also relates to dominance, mastery, and being in control (Pincus et al., 2010). Therefore, we decided to consider this issue from a different point of view. Sense of control is one of the basic psychological needs of human beings (Erikson, 1963). A series of consequences brought about by the pandemic, such as threat to life, fear of the unknown virus, and the disrupted daily routine through quarantine, made people lose their sense of control. According to compensatory control theory (Kay et al., 2009), when surrounded by the pandemic-induced disorder, people need to restore order and to regain a sense of control from the out-of-control status as compensation. One possible compensation channel is self-expression online through social media. Specifically, as regards agency, on the one hand, the threat to life and disrupted daily routine impair the individual's self-achievement and dominance in the real world. On the other hand, regarding compensation, to maintain their perceived sense of control, people may tend to use more self-oriented words to express themselves. These two opposite triggers impact the level of agency. The threat to life and disrupted daily routine decrease agency; thus, people may use compensatory expressions online to increase their agency. We reasoned that two such opposite propensities would generate a specific tension and lead to changes in the direction of agency during the pandemic, resulting in a counterintuitive increase in agency caused by the pandemic.

Similarly, with respect to communion, we anticipated that the psychological desire to connect or expressions made during connection with others would compensate for the enlarged social distance in the physical world during quarantine; thus, the other-oriented motive would increase. Of note, under these conditions we expected that agency and communion would show different levels of increase during the pandemic. Therefore, with a focus on behavioral immune system theory (Schaller, 2011; Schaller & Park, 2011), and also taking into account compensatory control theory (Kay et al., 2009), we formulated our hypothesis:
Hypothesis 1: The agency dimension will increase slightly during the COVID-19 pandemic as a result of compensation, rather than intuitively being weakened as predicted in behavioral immune theory. In comparison, the communion dimension will increase more significantly. Thus, deriving from both agency and communion dimensions, public moral motivation will be boosted by the pandemic.

To test the hypothesis and understand the dynamic evolution of moral motivation, we collected a large-scale corpus of text posted by Chinese people on social media sites during the COVID-19 pandemic. In this way

we could assess public reactions representing the linguistic expressions associated with the two motives. Big data, especially the large-scale human-generated comments on social media sites, offer an unprecedented opportunity to investigate morally relevant phenomena in the real world (Hoover et al., 2018). Our aim was to track the psychological process of the public during a lasting disaster and to offer insights into the issue through big data analytics. To the best of our knowledge, no empirical studies have previously been conducted to trace the dynamic impact of disaster on morality.

Method

Data Setup

We focused on the *People's Daily* (@人民日报), which is the largest Chinese official social media account on the Sina Weibo platform, to investigate public moral motivation during the COVID-19 pandemic. *People's Daily* tracks the most accurate news relating to COVID-19. The dataset we obtained included all the microblog posts on the *People's Daily* account and all the accessible comments located on these posts. This was done by crawling the Sina Weibo interface from 1 January 2020 to 7 April 2020, which comprised 6,935 posts and 1,722,044 comments, averaging 70.8 posts and 17,571.9 public comments per day. The credibility of *People's Daily* as the data source guarantees our experimental data are without fake news noise in respect to COVID-19. In addition, the posts before the pandemic did not relate to COVID-19 at all. As all the posts during the pandemic period (from 20 January 2020) related to COVID-19, we can conclude that our results during this period are convincing enough to reflect the impact of the pandemic, without any noisy impacts from other non-COVID-19 events or topics. Thus, the only variable before and during the pandemic period was COVID-19 and our dataset of public comments on the *People's Daily* site can be considered as an accurate sampling of the public reaction to this coronavirus.

According to the milestone events of the COVID-19 pandemic in China, together with the infected population numbers recorded by the Chinese Center for Disease Control and Prevention, which are shown as the red line in Figure 1, we distinguished four periods during the time covered in our analysis. As the Chinese government officially announced the outbreak of COVID-19 on January 20, we set the period from January 1–19, 2020 as *Predisaster*, denoting the period before the pandemic. We further divided the time during the pandemic into three fine-grained periods by calculating the daily increase in the ratio of infection (i.e., the proportion of the increase vs. the total infected on the previous day, illustrated as the dotted line in Figure 1), and we found that from February 21 the increase ratio notably dropped by two orders of magnitude. Taking February 20 as the pivot point, we set *During–Severe* as the period from January 20 to February 20, 2020, representing the period when the number of people in the population who were infected dramatically increased each day. *During–Moderate*, was specified as the period from February 21 to March 10, 2020, when the growth in the number of infected cases became moderate in China. Since all the emergency cabin hospitals serving the pandemic were closed nationwide by March 11, and the quarantine of Wuhan City, which was the most severely stricken city in China, ended on April 8, we set March 11 to April 7, 2020 as *During–Recovery*, the period when society gradually recovered from the pandemic.

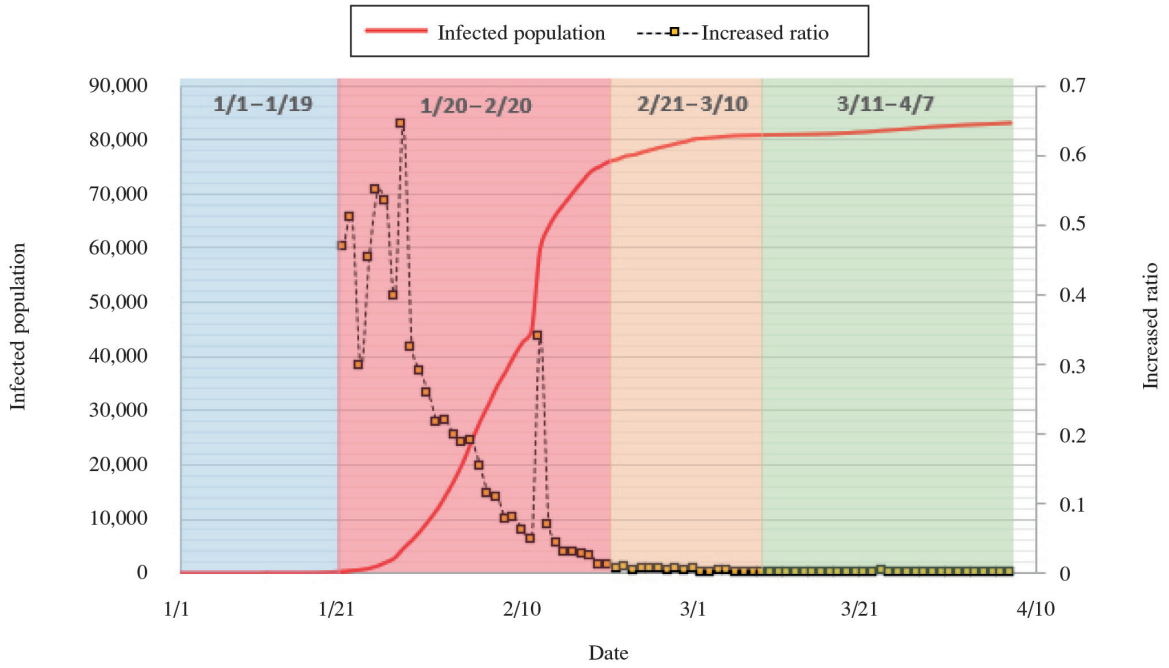


Figure 1. *Number of People in the Population Infected with COVID-19 as Recorded by the Chinese Center for Disease Control and Prevention*

Moral Motivation Representation

As word usage often reveals personal psychological functions (Tausczik & Pennebaker, 2010), the meaning of the term "moral motivation" was quantified by using the dictionary definition. The dictionary we used in our study was developed by Zhang and Yu (2018) in simplified Chinese. It comprises 690 agency words and 260 communion words, with Cronbach's alphas of .95 and .79, respectively, for these two types of word.

Taking the date (d) and the corresponding public comment set (CMT_d) on that date, we computed the agency and communion tendency of the public comments on that day, where A denotes use of agency and C denotes use of communion dictionary words. $Freq(A, d)$ represents the frequency of the agency words used in all the comments posted on that day.

$$Agency_d = Freq(A, d)|CMT_d|$$
$$Communion_d = Freq(C, d)/|CMT_d|$$

For the example in the comment text shown in Figure 2, one agency word and one communion word were detected, $Freq(A, d) = 1$, $Freq(C, d) = 1$ by simply counting the number of time the words were used, which is in line with the method used in previous research. However, when the linguistics are comprehensively understood, there should be two communion expressions, $Freq(C, d) = 2$. Thus, when calculating $Freq(A/C, d)$, instead of simply counting the frequency of use of communion and agency words, we went deeper to understand the semantics of agency/communion expressions in terms of whether they were used with negation words. The negation word dictionary we leveraged comes from the text analysis software program Linguistic Inquiry and Word Count (Tausczik & Pennebaker, 2010).

First, we utilized Chinese word-segmentation tools to segment the comment text into words and phrases. Then, we applied two general grammar rules: (a) an agency word modified by a negation word equals a communion word, and vice versa; and (b) two consecutive negation words express affirmation. We then calculated the *Freq*(*A/C, d*) as follows:

Step 1: Segment the sentences into clauses with punctuation marks.
Step 2: Reverse-scan each clause from the last word, to identify the negation–agency/negation–communion expressions or single agency/communion expressions, and then update *Freq*(*A/C, d*).
Step 3: Repeat Step 2 until the whole text is analyzed.

This semantic-based quantification method was adapted according to the agency/communion context from our previous work and has proved feasible (Zhao et al., 2016).

As illustrated in Figure 2, we segmented the text into two clauses. Using the above algorithm, we reverse-scanned each clause from the last word, took the agency/communion words together with the closest modifying negation words as the atomic semantic units, and obtained *Freq*(*C, d*) = 2, which coincides with human comprehension.

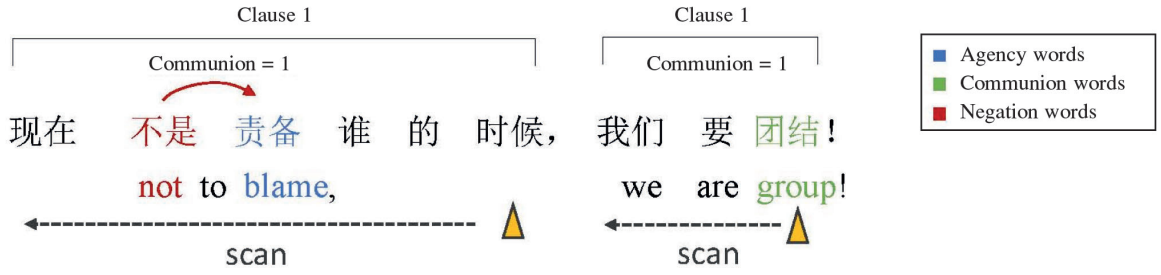


Figure 2. *Example of Semantic-Based Agency/Communion Words Frequency Calculation Method*

Finally, we represented moral motivation for the date (*d*) as

$$MM_d = Communion_d/Agency_d = Freq(C, d)/(Freq(A, d)$$

where a larger value of MM_d reveals a higher ratio of other-oriented motives, which reflects a higher moral motivation.

Results

General Analysis of Moral Motivation

Figure 3a shows that the tendency of moral motivation recorded from January 1 to April 7, 2020, was negatively correlated with the number of people infected as recorded by the Chinese Center for Disease Control and Prevention ($r = -.42$, $p < .001$). Figure 3b depicts the details of moral motivation in the four periods of the COVID-19 pandemic, where the gray circles (○) represent the outliers (i.e., values that fluctuated from the mean value by more than three times the standard deviation). The mean value of moral motivation in the During–Severe period ($M = .52$, $SD = .05$) increased by 8.61% compared with that of Predisaster period ($M = .48$, $SD = .08$). Statistically, there was a significant difference in the moral motivation level between the Predisaster and During–Severe periods, $t = -2.14$, $p < .05$, Cohen's $d = 0.59$.

Filtering out the outliers, we discovered that, compared with in the During–Severe period, moral motivation was significantly reduced in the During–Moderate period (M = .42, SD = .07), t = 6.01, p < .001, Cohen's d = 1.69, and the During–Recovery period (M = .46, SD = .04), t = 4.53, p < .001, Cohen's d = 1.17. The difference in moral motivation between the During–Recovery and Predisaster periods was nonsignificant, t = .72, p = .477.

In conclusion, we found that the impact of the COVID-19 pandemic on the public's moral motivation was quite context-sensitive. Our results show that moral motivation was promoted only when the situation was severe, and quickly reduced when the disaster was under control and recovery began occurring. Thus, the degree of severity of the disaster played a leading role in the variation in level of moral motivation, which supported our hypothesis.

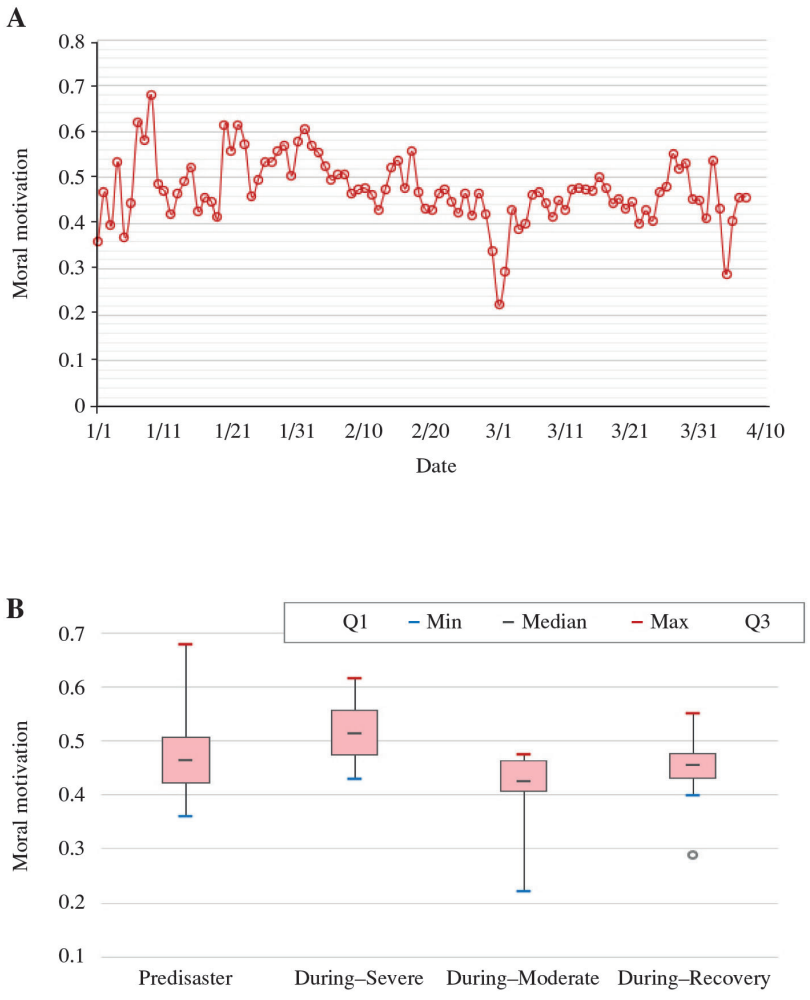


Figure 3. *Analysis of Moral Motivation From January 1 to April 7, 2020. (A) Illustrates the General Moral Motivation Tendency by Date; (B) Illustrates the Moral Motivation Statistics Across the Four Periods of the Pandemic*

Impact of Positive/Negative News on Moral Motivation

To gain a comprehensive understanding of the augmentation of moral motivation in the During–Severe period, we further selected comments in the posts that were accompanied by two typical hashtags. We chose *#Number of COVID-19 Cases Nationwide* as the negative tag that made the public panic. This tag tracked the up-to-date number of people who had been infected on each day. We chose *#Fighting Wuhan* as the positive tag. This tag conveyed warm social support for those who had been infected. In summary, on *People's Daily* there were 202 posts and 54,786 public comments under the negative tag, and 143 posts and 38,275 comments under the positive tag.

In Figure 4a the general tendency of moral motivation under both tags is shown and in Figure 4b the detailed data distribution is exhibited. The statistics show that moral motivation differed significantly, $t = -5.66$, $p < .001$, *Cohen's d* = 1.46, under the negative ($M = .42$, $SD = .19$) and positive tags ($M = .64$, $SD = .10$). These results further reveal the context-sensitivity of the impact of COVID-19 on public moral motivation. During the severe period of the pandemic, positive or encouraging news helped augment moral motivation, whereas negative or frustrating news reduced moral motivation.

We argue that our conclusion that moral motivation was promoted during the severe period of the disaster (see Figure 3b) is reliable because we checked all the posts in the During–Severe period, vertical comparison shows there were fewer positive (44%) than there were negative (56%) news posts, so that our results are not based on unbalanced or biased data, and our conclusions were not influenced by the numerous positive news posts. Horizontal comparison with other periods shows that almost all the news posts were positive in the During–Moderate/During–Recovery periods, but that moral motivation was significantly lower during these two periods than in the During–Severe period, and eventually fell back to the level of the Predisaster period. Further, in the During–Moderate and During–Recovery periods, when almost all the COVID-19 news posts were positive, the public moral motivation level reduced. This further shows that the degree of severity of the disaster played a leading role in the variation in the public's moral motivation, whereas the sentiment polarity of news (positive/negative) played only a regulating role.

Analysis of Agency/Communion Tendency

In unpacking moral motivation we also explored the impact of the COVID-19 pandemic on the two component dimensions of agency and communion. The general tendency of both dimensions from January 1 to April 7, 2020, are illustrated in Figure 5a. The two dimensions closely coincided, Pearson correlation coefficient (r) = .73, $p < .001$. Figures 5b and 5c show that disaster enhanced both agency and communion expressions in a parabola. When the situation was severe, there was a stronger increase, then this weakened as the disaster was becoming controlled. Compared with the Predisaster period ($M = .32$, $SD = .05$), the agency level increased on average by 48.97% in the During–Severe period ($M = .46$, $SD = .06$), $t = -8.93$, $p < .001$, Cohen's $d = 2.68$; During–Moderate period ($M = .58$, $SD = .27$), $t = -4.03$, $p < .001$, Cohen's $d = 1.31$; and During–Recovery period ($M = .41$, $SD = .05$), $t = -6.32$, $p < .001$, Cohen's $d = 1.90$. Similarly, compared with the Predisaster period ($M = .15$, $SD = .03$), the communion level increased by an average of 42.48% in the During–Severe period ($M = .24$, $SD = .04$), $t = -8.89$, $p < .001$, Cohen's $d = 2.68$; During–Moderate period ($M = .22$, $SD = .06$), $t = -4.94$, $p < .001$, Cohen's $d = 1.60$; and During–Recovery period ($M = .19$, $SD = .02$), $t = -4.86$, $p < .001$, Cohen's $d = 1.42$.

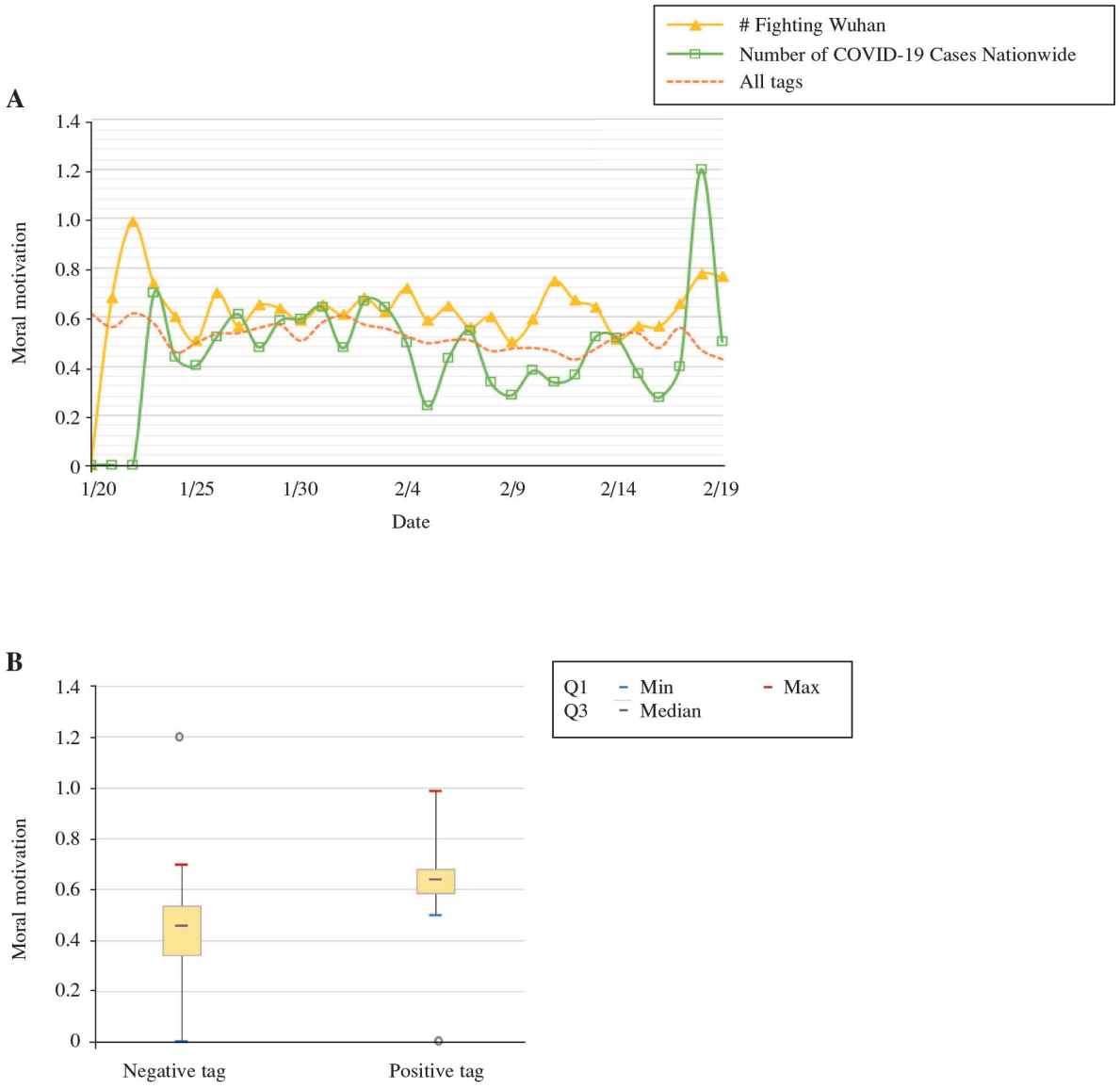
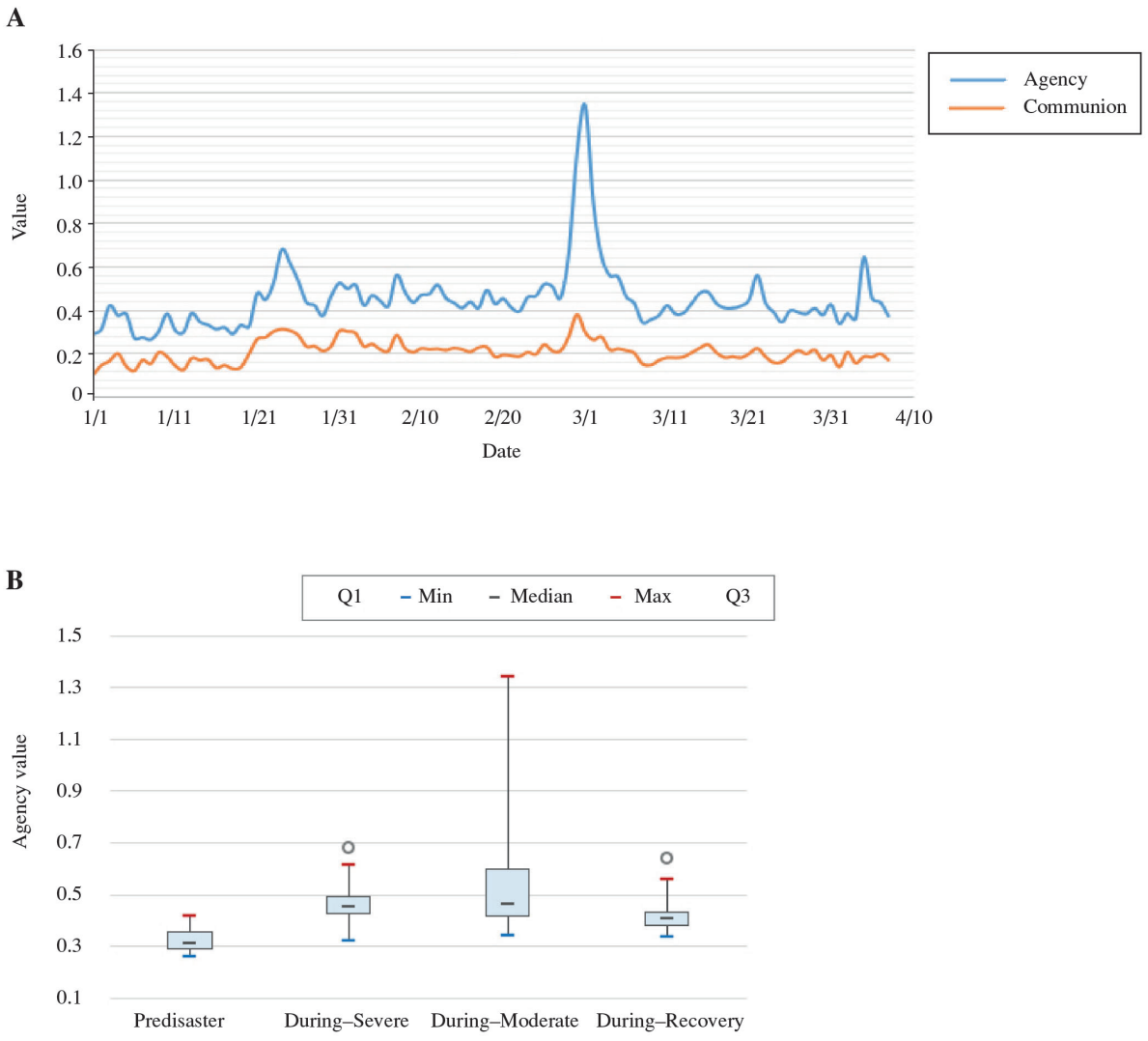


Figure 4. *Analysis of Moral Motivation by Negative/Positive Tags in the During–Severe Period of the Pandemic. (A) Comparison of the General Moral Motivation Tendency by Date; (B) Illustrates the Data Distribution by Tag*



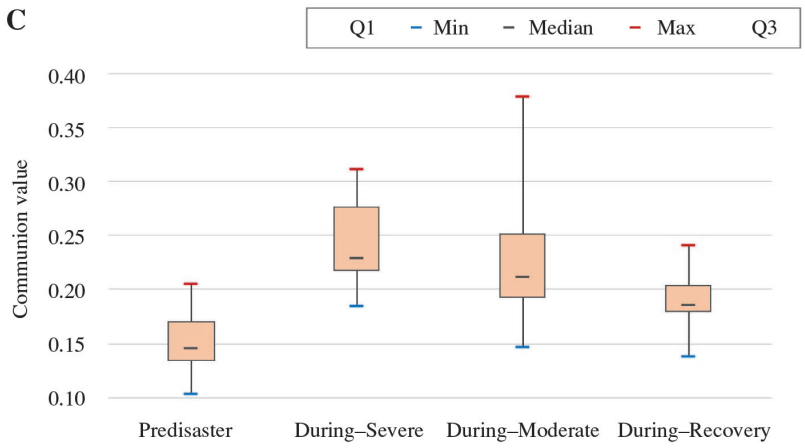


Figure 5. *Analysis of Tendency to Use Agency and Communion Expressions From January 1 to April 7, 2020. (A) Illustrates the General Tendency by Date; (B) Illustrates the Statistics for Change in Agency Expressions Over the Four Periods of the Pandemic; (C) Illustrates the Statistics for Change in Communion Expressions Over the Four Periods of the Pandemic*

Analysis of Outliers

As described, for each variable in each of the four periods, we considered the values that deviated from the mean value by more than three times the standard deviation as outliers, which are shown as the gray circles in Figures 3b, 4b, and 5b. We performed all the statistical analyses after filtering out the outliers to guarantee statistical efficiency. The outliers corresponded to events that were related to COVID-19 but that happened unpredictably. This may significantly bias the results. Thus, separate analysis is needed for the outliers.

As shown in Figures 3a and 5a, March 1 and April 4 represent two extreme points reached in reduction of moral motivation, along with dramatic increases in tendency to use agency expressions. We filtered these outliers to eliminate the noise from unpredicted external events. The extreme point on March 1 followed from the event that occurred 2 days earlier, on February 27, when the draft of *Regulations of the People's Republic of China on the Management of Permanent Residence of Foreigners* was released from the Ministry of Justice, with public opinions to be gathered until March 27. We looked at the comments on the date we identified, and found they were almost all about the draft. As suggested in behavioral immune system theory (Ackerman et al., 2018; Murray & Schaller, 2016; Schaller, 2011; Schaller, & Park, 2011), people inherently tend to reject outgroups (e.g., foreigners) more under conditions of pathogen dangers during a pandemic. Also around this date, there were some news items about foreigners rejecting quarantine and damaging pandemic prevention efforts in China society, which brought about more negative feelings toward foreigners. At the time that the draft came out, discussion on the permanent residence of foreigners in China and what benefits they would enjoy, made the Chinese public feel particularly that this was unfair as far as self-oriented interests were concerned. The perception of the Chinese public that they did not have control meant they then tried to compensate.

The extreme point on April 4 that was filtered as an outlier resulted from some overseas students returning to China who did not observe pandemic prevention regulations. We manually checked the comments on that date and found the extreme point was related to the return of these students. There was a peak in the discussion on these students having damaged the country's pandemic prevention performance.

For both these events, the news items involved outgroups who damaged China's pandemic prevention performance and public health security. The Chinese public perceived infection risk and unfairness for their own group through uncontrollability of an outgroup. As predicted in compensatory control theory (Kay et al., 2009), these perceptions provoked a greater emphasis on individual/in-group interest and consequently triggered an increase in posts with agency expressions, and a reduction in public moral motivation. Similarly, another small outlier of agency expressions occurred on January 24 (Figure 5a), which followed the Spring Festival Eve, when the strong contrast between New Year celebrations and the danger of the COVID-19 pathogen triggered a compensatory increase in posts with agency expressions. As the New Year is China's most ceremonious festival, people are always happy and relaxed while celebrating and enjoying the holiday. However, this year, because of COVID-19, people were afraid of infection and were living with this threat to their health rather than enjoying the festival; thus, their self-oriented motives were less well-controlled.

We did not extract a peak point on March 1 as a statistical outlier, because this occurred in the During–Moderate period. Because of the random evolution of the pandemic this period lasted only 19 days. Therefore, the deviation that depended on the sample values recorded day-by-day was not distinguishable. The statistical results were also vulnerable to external events. The persistent influence of the event brought about a reduction in moral motivation for a few days around March 1 (Figure 3a), such that the mean value fell. This also explains why moral motivation dropped significantly in the During–Moderate period, and was then even lower than that of the Predisaster period. Because of the potential bias occurring in the During–Moderate period, all the conclusions we have reported above as reliable relate to the other three periods.

Discussion

We applied big data analysis to posts on Chinese social media to investigate the impact of a disaster on public moral motivation. Focusing on the COVID-19 pandemic, we collected nearly 2 million tweets on Sina Weibo and carefully analyzed the dynamic changes in public moral motivation throughout four time periods of the pandemic. As we had predicted, the disaster increased moral motivation. We were also interested to find that the impact of the disaster on public moral motivation was context-sensitive.

Although social networking sites offer relatively credible semantics and opportunities for researchers to investigate morally relevant phenomena in the real world (Hoover et al., 2018), the data obtained also contain inevitable noise. To improve the validity of our big data collection approach and subsequent statistical analysis, we carefully employed a multifiltering framework and novel linguistic technique to ensure our experimental data were clean and the results convincing. We selected an official media account as our data source to avoid fake news noise in data collection, recorded only the COVID-19-related corpus during the pandemic to make the control groups valid, and filtered out outliers to avoid bias resulting from significant unpredictable events. When mapping the natural language-based text for quantitative moral motivation, we used a semantic-based moral-expression calculation instead of simply counting word frequency.

Contrasting with traditional theoretical assumptions, according to which agency and communion are two mutually exclusive dimensions (Frimer et al., 2012), our results show that the two dimensions resonated strongly during the pandemic. Although communion and agency expressions have different motives (self-oriented vs. group-oriented), their resonance is explicable, especially in a collectivistic culture such as that of China. First, as set out in our hypothesis, the compensation mechanism increases both self-oriented and group-oriented motives. Individuals used more self-oriented words online to compensate for impairments in self-achievements and dominance resulting from the threat to life and disrupted daily routine in the real world, and they used more group-oriented words relating to social connection to compensate for the greater social distance experienced during quarantine. Second, in Chinese culture the dialectics (Peng & Nisbett,

1999) emphasize that the real world is dynamic and full of contradictions, not cut-and-dried. The two sides of any contradiction are in an active harmony, opposite but connected, and the contradiction is meaningful only when investigated as a whole. Such contradiction–holism-based dialectics make opposites compatible when each is separately explored; thus, at least when analyzing Chinese data, two opposite motives could resonate. Third, although agency and communion motives shared a similar tendency, the detailed variation in amplitude of the two motives was totally different, and we compared the changes quantitatively to measure moral motivation.

Further, we found that news items relayed to the public during the pandemic played a regulating role, whereby positive or encouraging news helped augment public moral motivation only when the situation was severe, and negative or frustrating news damaged moral motivation. When we unpacked moral motivation into the two orthometric dimensions of agency and communion, we also found that the disaster boosted both agency and communion in a similar way to that of moral motivation, which supported our hypothesis inspired by compensatory control theory (Kay et al., 2009) that public moral motivation would be boosted by the pandemic, that the agency dimension would increase slightly as a result of compensation, rather than intuitively being weakened as predicted in behavioral immune theory, and that the communion dimension would increase more significantly.

In this study we have contributed to the literature on pandemic impacts and morality from both theoretical and methodological perspectives. Theoretically, from the data-driven perspective, in this empirical study we have validated behavioral immune system theory (Ackerman et al., 2018; Murray & Schaller, 2016; Schaller, 2011; Schaller & Park, 2011) in the COVID-19 context, and further combined the compensatory control mechanism to explain change in agency. Moreover, compared with previous work in which scholars have used a coarse-grained correlation between psychological dimensions and pandemic severity (Murray & Schaller, 2010; Schaller & Murray, 2008), we delved into finer grained details, tracked the moral dynamics day-by-day, and shed light on the relationship between moral motivation and the course of the pandemic, including the effect of pandemic severity, sentiment polarity of pandemic news, and agency/communion language motive components. Methodologically, instead of obtaining self-reported data after the event, an approach that has typically been adopted in previous research (Murray & Schaller, 2010; Schaller & Murray, 2008), we took full advantage of big data by tracking public reactions as they were updated using social media, which allowed us to keep pace with the pandemic as the situation evolved; thus, we have achieved high ecological validity. When traditional methods are used (Murray & Schaller, 2010; Schaller & Murray, 2008) such large-scale, real-time, dynamic tracing of public reaction to a pandemic cannot be accessed. To the best of our knowledge, our study is the first in which the impact of a disaster on public moral motivation has been investigated by performing big data analysis.

This study has some limitations. As there is no single study applicable to all groups, the conclusions from data obtained from social media may apply only to those netizens. For those who do not express themselves through the Internet, offline surveys or experiments are needed to gain access to their points of view. In addition, although we measured the moral motivation expressed in posts on social media and explored changes in this motivation during the COVID-19 pandemic, individual moral motivation does not necessarily lead to actual moral behavior. To conduct a comprehensive investigation of the impact of a disaster on morality from consciousness (moral motivation) to actions (moral behavior), both big data analysis and a conventional experimental paradigm should be combined.

There are still many interesting topics relating to the impact of a disaster on public moral motivation that are worth further investigation. As COVID-19 has become a worldwide pandemic, our next step is to conduct a cross-cultural comparison of moral motivation changes under the same disaster scenario, and to obtain insight into the inner psychological mechanism of why the severe phase of the pandemic increases morality.

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