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COVID-19 and Sinophobia: Detecting Warning Signs of Radicalization on Twitter and Reddit

Matthew Costello, PhD,[1] Nishant Vishwamitra, PhD,[2] Song Liao, MA,[3] Long Cheng, PhD,[3] Feng Luo, PhD,[3] and Hongxin Hu, PhD[4]

Abstract

Hate crimes and hateful rhetoric targeting individuals of Asian descent have increased since the outbreak of COVID-19. These troubling trends have heightened concerns about the role of the Internet in facilitating radicalization. This article explores the existence of three warning signs of radicalization—fixation, group identification, and energy bursts—using data from Twitter and Reddit. Data were collected before and after the outbreak of COVID-19 to assess the role of the pandemic in affecting social media behavior. Using computational social science and Natural Language Processing techniques, we looked for signs of radicalization targeting China or Chinese individuals. Results show that fixation on the terms China and Chinese increased on Twitter and Reddit after the pandemic began. Moreover, tweets and posts containing either of these terms became more hateful, offensive, and negative after the outbreak. We also found evidence of individuals identifying more closely with a particular group, or adopting an ''us vs. them'' mentality, after the outbreak of COVID-19. These findings were especially prominent in subreddits catering to self-identified Republicans and Conservatives. Finally, we detected bursts of activity on Twitter and Reddit following the start of the pandemic. These warning signs suggest COVID-19 may have had a radicalizing effect on some social media users. This work is important because it not only shows the potential radicalizing effect of the pandemic, but also demonstrates the ability to detect warning signs of radicalization on social media. This is critical, as detecting warning signs of radicalization can potentially help curb hate-fueled violence.

Keywords: radicalization, warning signs, Sinophobia, social media, COVID-19, coronavirus

Introduction

Extremist violence is a growing menace throughout much of the world,[1] including the United States.[2] To wit, the Federal Bureau of Investigation reported 7,759 bias incidents in the United States in 2020, the highest total in 12 years.[3] Researchers, policymakers, and law enforcement agencies alike are acutely aware of this alarming trend and increasingly scrutinizing the role of the Internet in facilitating the adoption of radical worldviews[4] that hold the potential to fuel violence.[5,6] Online users are at risk of being radicalized through repeated exposure to extremist ideas and groups that encourage them to not only identify closely with the group and their ideals, but also demonstrate hostility or hatred toward particular out-groups.[7]

Given the threat of online radicalization, this study examines text on two prominent social media sites, Twitter and Reddit, to detect potential *warning signs* of radicalization during a 3-year period before and during the COVID-19 pandemic. We believe it is important to do so because two concurrent and seemingly intertwined trends have emerged in the wake of the COVID-19 outbreak—the proliferation of

[1]Department of Sociology, Anthropology and Criminal Justice, Clemson University, Clemson, South Carolina, USA.
[2]Department of Information Systems and Cyber Security, The University of Texas at San Antonio, San Antonio, Texas, USA.
[3]School of Computing, Clemson University, Clemson, South Carolina, USA.
[4]Department of Computer Science and Engineering, University at Buffalo, SUNY, Buffalo, New York, USA.

anti-Asian hate speech on social media sites[8] and physical and verbal assaults offline targeting individuals in the Asian American community.[9] Understanding the warning signs of online radicalization is critical because doing so holds the potential to curtail instances of hateful violence offline.

Pandemics and hate

The coronavirus disease was first detected in December 2019 in Wuhan, China, and by March 2020 the World Health Organization declared COVID-19 a pandemic. The effects of the pandemic have been sweeping and devastating, ranging from sickness and death, with >753 million cases and 6.81 million deaths worldwide during the first 3 years of the pandemic,[10] to financial ruin and mental anguish.[11,12] In addition, certain types of crimes—such as homicide and auto theft—increased as well as the pandemic unfolded.[13] Hate crimes also surged in the United States since the COVID-19 outbreak, with individuals of Asian descent, who some deem ''responsible'' for the spread of the disease, victimized by verbal and physical attacks at high rates.[14–16] From 2019 to 2020 hate crime victimization within the Asian American community rose by 76 percent,[17] and more than 9,000 anti-Asian hate incidents were self-reported between March 2020 and June 2021.[18] Hateful and offensive rhetoric targeting individuals of Asian descent has likewise proliferated on popular social media sites, such as Reddit[19] and Twitter.[20]

The recent growth of anti-Asian hate is indicative of a long history of negatively stereotyping Chinese people as *unclean* and prone to disease,[19,21] and more generally fits with a pattern of associating particular race/ethnic groups, especially immigrants, with outbreaks of disease.[22,23] Immigrant groups, for instance, have been blamed—and violently targeted—for spreading pestilence, cholera, polio, AIDS, SARS, H1N1, and Ebola, among other diseases.[24–26] Ginzburg[27] explains the pandemic-hate nexus with the assertion that outbreaks of disease cause both fear and hatred, leading individuals to look for scapegoats on whom to discharge these feelings. Race/ethnic minority groups, especially immigrants, are commonly scapegoated because they represent easily distinguishable outsider*s* who can be branded as dangerous and threatening interlopers.[25]

Online radicalization

Radicalization is a gradual process whereby extreme worldviews are normalized and internalized.[28] Experts disagree on the mechanisms that foster the adoption of radical views,[29] yet there is consensus that the Internet, especially social media, can facilitate the process.[4,30] This is because the Internet not only expose users to extremist ideas, but also fosters forums wherein such ideas are normalized, reinforced, and ultimately adopted and imitated.[31] Online echo chambers, or filter bubbles,[32] can manifest as likeminded individuals gravitate to virtual spaces and repetitively share similar ideas,[33,34] and the insular nature of filter bubbles allows for belief systems—even extreme or hateful belief systems—to seem both common and ubiquitous. Given the growing specter of online radicalization, it is critical to develop tools to recognize threats before they lead to violence.

Accurately detecting the threat posed by any one individual from a large population of potential threats is exceedingly difficult, however, and false-positive rates are high. One way to increase the accuracy of threat assessment is to examine the existence of *warning sings*,[35] or abrupt, often toxic changes in behavior that can signal someone is in the process of adopting—or has adopted—radical views. Indeed, extant work on threat assessment suggests that dynamic variables, such as warning signs, are better at predicting short-term violence relative to stable indicators, such as a history of violence.[36,37] This is precisely because a sudden change in behavior represents the possibility that a threat is accelerating or increasing.[35]

We look for three established warning signs of radicalization in this study, *fixation*, *group identification*, and *energy bursts*. Although these are not the only warning signs that someone's views might be moving from moderation to extremism, this study focuses on them because we believe they accurately capture the hallmarks of online radicalization: a sudden alteration in online activities, a compulsive, noxious focus on one topic, and the ostracism and denigration of a particular group.

The first warning sign, *fixation,* is a pathological preoccupation with someone or something.[38] It is typified by an increasing repetitive focus on a topic or increasingly strident opinions and growing negative sentiment toward the focus of fixation. We explore fixation by examining the frequency, degree of hatefulness and offensiveness, and sentiment of tweets and posts on Twitter and Reddit containing the terms ''China'' or ''Chinese.'' The second warning sign is *group identification*, described as the desire to be a ''pseudo-commando''[39,40] or adopt a ''warrior mentality,''[41] and identifying closely with a cause or other members of a cause. The tethering of one's identity to a particular cause or belief also involves the *othering* of those who hold opposing views. We look for signs of group identification by assessing the frequency of the terms *us, we, they,* and *them*[42] in tweets and posts containing the terms ''China'' or ''Chinese.'' The third warning sign, *energy bursts,* refers to sudden increases in the frequency or variety of activity.[43] We examine if the number of tweets or posts in the early stages of the pandemic show a sudden, dramatic increase as evidence of energy bursts.

In addition, we examine if the presence of warning signs of online radicalization varies by self-identified political party affiliation and political ideology. We do so because extant research shows that rightwing extremists presently dominate the domain of online hate[44,45] and perpetrate the majority of offline extremist violence.[46] We focus solely on Reddit for this portion of the analysis because it has specific subreddits dedicated to political affiliations and persuasions, attributes that are difficult to discern on Twitter.

Materials and Methods

Data collection

We collected textual data posted by social media users on Twitter and Reddit from January 1, 2019 to December 31, 2021 for this analysis. We consider January 1, 2020 as the date of the COVID-19 outbreak,[47] and data collected before that date represent social media user activity before the outset of the pandemic; subsequent data represents user activity after the outbreak.

Our objective was to collect random posts, so we did not initially use keywords to search for specific types of tweets. We used an open-source tool, snscrape[48] to collect 4,500

Table 1. Overview of the Twitter and Reddit Datasets

Social media type	*No. of tweets/ posts*	*No. of before outbreak*	*No. of after outbreak*
Twitter	4,917,880	1,641,244	3,276,636
Reddit			
Progressive	85,551	29,537	56,014
Conservative	105,704	35,178	70,526
Democrat	103,290	34,109	69,181
Republican	78,725	16,558	62,167

random, English language tweets every day from January 1, 2019 to December 31, 2021. We collected 4,917,880 tweets from Twitter; 1,641,244 were created before the COVID-19 outbreak and 3,276,636 tweets were made after the outbreak. We used the Pushshift.io[49] application programming interface to collect random posts directly from Reddit (i.e., using ''*'' as the search string). In addition to looking at Reddit as a whole, we also examined four subreddits: (a) Progressive, (b) Conservative, (c) Democrats, and (d) Republicans. We collected 373,270 total posts from Reddit; 85,551 from the Progressive subreddit, 105,704 from the Conservative subreddit, 103,290 from the Democrats subreddit, and 78,725 from the Republicans subreddit. Table 1 provides the summary of our data collection. This research was determined to be exempt from IRB approval.

Measures

Twitter and Reddit users predominantly communicate via text, so we used Natural Language Processing (NLP) techniques from previous works[42] and novel strategies introduced in this work to measure fixation, group identification, and energy bursts on these platforms.

Fixation. To measure fixation using NLP techniques, we considered ''China'' and ''Chinese'' as the objects of fixation. Because fixation involves increasingly strident opinions and negative characterizations of the object of fixation, we measured hatefulness, use of offensive language, and sentiment of tweets and posts containing the fixation terms. Hateful speech is language that expresses hatred toward a targeted group or intends to be derogatory, humiliating, or insulting.[50] Offensive language contains offensive words, but is not necessarily hate speech. We used an open source tool, HateSonar, to measure hateful and offensive tweets and posts, and Python NLTK sentiment analyzer[51] to measure sentiment. Both HateSonar and NLTK sentiment analyzer output a score in the range of 0 to 1 for hatefulness, offensiveness, and sentiment, where a greater value indicates more confidence. For each tweet and post in the Twitter and Reddit datasets, we first searched for samples that contained the fixation terms. We then ran HateSonar and NLTK sentiment analyzer for samples that contained these terms to capture the hatefulness, offensiveness, and sentiment of the samples.

Table 3. Comparison of Average Fixation (Welch's *T* statistic) Before and After COVID-19 Outbreak

Social media	*Fixation terms*	*Hate speech*	*Offensiveness*	*Sentiment*
Twitter	−1.904	1.050	−1.800	3.007*
Reddit (overall)	−1.810	−3.210*	−2.710*	0.880
Progressive	−0.250	−1.100	0.340	−0.100
Conservative	3.340*	−3.240*	−3.730**	1.570
Democrat	−0.82	−0.470	0.400	0.710
Republican	−3.080*	−2.340*	−2.030*	0.810

*$p < 0.05$; **$p < 0.01$.

Group identification. We focused on users identifying themselves as agents of the cause of spreading anti-China or anti-Chinese rhetoric to measure group identity. We did this because many social media users aligned themselves as pro-China or anti-China as rumors and false information regarding the source of the COVID-19 began circulating shortly after the outbreak of the disease.[52] We adopted the method suggested by Cohen and colleagues[53] and searched for first person plural identifiers (''us'' and ''we'') and third person plural identifiers (''them'' and ''they'') in each tweet and post. Grover and Mark[42] argues these identifiers act as effective proxies for measuring the degree to which in-group versus outgroup dynamics exist.

Energy bursts. Twitter and Reddit afford several activities to its users, the most fundamental being creating tweets and posts. Other activities such as likes, up- and downvotes, retweets and replies are applicable to already posted content. To measure energy bursts, we focused on the fundamental activity of posting tweets of posts. We measured the frequency of posting tweets and posts for each month to assess a sudden surge in activity on Twitter or Reddit.

Table 2. Linear Trends (R^2 and Beta) in Fixation in 2020

	Fixation terms		*Hate speech*		*Offensiveness*		*Sentiment*	
Social media	R^2	*Beta*	R^2	*Beta*	R^2	*Beta*	R^2	*Beta*
Twitter	0.226	−16.020	0.053	−6.09E-05	0.005	0.000	0.170	0.005
Reddit (overall)	0.034	−8.682	0.060	−0.001	0.050	0.001	0.747*	0.024
Progressive	0.011	−0.402	0.000	−0.002	0.070	−0.028	0.460	0.112
Conservative	0.054	−4.594	0.070	−0.001	0.001	0.000	0.360*	0.017
Democrat	0.005	−0.224	0.010	−0.002	0.169	0.005	0.068	0.022
Republican	0.003	−0.913	0.050	−0.002	0.040	0.002	0.340*	0.034

*$p < 0.05$.

Table 4. Pairwise Comparison of Month-on-Month Fixation Before and After COVID-19 Outbreak

	W-measure	
Social media	*2019–2020*	*2019–2021*
Twitter	4.0*	0.0*
Reddit (overall)	32.5	25.0
Progressive	37.0	24.0
Conservative	12.0*	9.0*
Democrat	31.0	18.0
Republican	28.5	31.0

*$p < 0.05$.

Data analysis

We analyzed tweets on Twitter and posts on Reddit in our datasets from three perspectives. First, we were interested in whether there was a trend of increased signs of radicalization associated with the COVID-19 pandemic. To study this, we examined linear trends in the potential radicalization for the entire period under investigation and then in the period after the outbreak based on linear modeling.[54] Second, we were interested in whether there was a significant overall increase in potential radicalization in the period after the outbreak relative to the period before the outbreak. To study this, we examined the average warning signs of radicalization in both periods based on Welch independent samples *t*-tests.[55] Third, we were interested in pairwise comparisons of warning signs of radicalization for each month before the outbreak with the corresponding months after the outbreak. We used the Wilcoxon signed test[55] to assess this. Finally, to assess energy bursts we analyzed the pace of Twitter and Reddit activity on a monthly basis.

Results

Fixation

We first computed fixation for all 3 years combined, then separately for each year from 2019 to 2021. Results are given in Tables 2 and 3. We found a significant linear increasing trend in the use of offensive words in tweets containing either the terms ''China'' or ''Chinese'' on Twitter ($R^2 = 0.118$, $p < 0.05$) and in posts on the Conservative subreddit ($R^2 = 0.118$, $p < 0.05$) for the combined period. We did not find significant linear trends in fixation in the year 2019 for either Twitter or Reddit when analyzing the years separately. In 2021 we observed a significant linear increasing trend in the usage of fixation terms on Twitter ($R^2 = 0.392$, $p < 0.05$), and for the year 2020 we found significant linear trends for negative sentiment on Reddit as a whole, as well as a significant linear increasing trend of negative sentiment in the Republican and Conservative subreddits.

Furthermore, we observed a significant difference in average negative sentiment in tweets containing either of the fixation terms on Twitter after the outbreak of COVID-19 relative to the prior period. A significant difference in both average hate speech and offensiveness was found on Reddit posts containing either of the fixation terms. We also observed a significant difference in the average proportion of fixation terms, hate speech, and offensiveness in posts containing fixation terms in the Republican and Conservative subreddits; in both subreddits, the use of fixation terms and hateful and offensive posts containing the fixation terms were significantly higher in the period following the outbreak.

Results of the month-on-month pairwise comparisons of fixation (e.g., January 2019 vs. January 2020 and January 2021, February 2019 vs. February 2020 and February 2021 and so on) between the periods before and after the outbreak are given in Table 4. We found a significant difference on Twitter for both comparisons between 2019–2020 and 2019–2021, and a significant pairwise difference in the Conservative subreddit. In all cases, the use of fixation terms increased in the months in subsequent years.

Group identification

Table 5 depicts linear trends in group identification. We observed a significant linear trend in group identification on Twitter, indicating an increase in the usage of ''us vs. them'' rhetoric from the period before the outbreak relative to the period after the outbreak. In addition, we observed two linear trends on Reddit—a significantly decreasing trend in group identification in the Democrat subreddit, and a significantly increasing trend in group identification in the Republican subreddit.

Next, we compared average group identification between the two periods of time. We observed a significant increase in the use of ''us vs. them'' rhetoric on Reddit after the outbreak. We also observed a significant decrease in group identification after the outbreak in the Democrat subreddit, and significant increases in the Republican and Conservative subreddits post-outbreak.

Results in Table 6 provide a significant pairwise difference in group identification on Twitter for the pairwise comparisons in both time periods. On Reddit, we observed a significant difference for the 2019–2021 period whereby group identification increased with time. Furthermore, we

Table 5. Linear Trends in Group Identification (*R*-squared, Beta) and Comparison of Average Group Identification (Welch's *T*) Before and After COVID-19 Outbreak

Social media	*Before outbreak*	*After outbreak*	R^2	*Beta*	T
Twitter	69,461	67,653	0.136*	–303.760	0.655
Reddit (overall)	7,475	7,986	0.000	–0.546	–2.333*
Progressive	1,245	1,239	0.101	–8.161	–0.368
Conservative	1,290	1,359	0.004	0.866	–2.045*
Democrat	1,892	1,368	0.639***	–24.536	6.304***
Republican	666	1,172	0.252*	19.984	–4.360***

*$p < 0.05$; ***$p < 0.001$.

Table 6. Pairwise Comparison of Month-on-Month Group Identification Before and After COVID-19 Outbreak

	W-measure	
Social media	*2019–2020*	*2019–2021*
Twitter	24.0	5.0*
Reddit overall	37.0	12.0*
Progressive	20.0	36.0
Conservative	8.0*	26.5
Democrat	5.0*	0.0*
Republican	37.0	34.0

*$p < 0.05$.

observed significant pairwise differences in the Democrat subreddit for both periods, with group identification decreasing, and in the Conservative subreddit in the 2019–2020 period when group identification increased. The differences by political party affiliation and ideology suggest a greater likelihood of adopting radical beliefs in the Republican and Conservative subreddits where signs of mobilization are present, relative to the Democrat subreddit.

Energy bursts

We focused on sharp, sudden rises in social media activity in a short time period to assess energy bursts. We plotted linear models of monthly tweets and posts made in 2020 on Twitter and Reddit, respectively, and examined acute rises in posting activity. Figure 1 provides the linear model for Reddit ($R^2 = 0.573$, $p < 0.05$). We observed a sharp rise in activity from the second period (February 2020) to the third period (March 2020) on both Twitter and Reddit, but the effect was only significant for Reddit. We likewise examined energy bursts in the four subreddits assessed in this article. The same burst of activity was observed from period 2 to period 3 in all four, although it was only statistically significant in the Progressive subreddit ($R^2 = 0.423$, $p < 0.05$), given in Figure 2. This rise in activity could indicate an energy burst preceding the peak of social media activity related to COVID-19. It is important to note, however, that energy bursts only denote increased activity, not the nature of the activity.

Taken together, our findings uncover the presence of warning signs of radicalization on both Twitter and Reddit. On Twitter, the usage of offensive language significantly increased over the period of analysis, and the sentiment of tweets containing either of the fixation terms, China or Chinese, became significantly more negative post-outbreak. Group identification on Twitter, however, significantly decreased post-outbreak.

On Reddit we uncovered a significant difference in hate speech and offensive language before and after the pandemic, whereby both increased post-outbreak. The use of offensive language significantly increased during the pandemic in the Conservative subreddit as well, whereas fixation terms, hate speech, and offensiveness increased in the Conservative and Republican subreddits post-outbreak. Finally, group identification significantly increased in the Republican subreddit during the pandemic, whereas significantly decreasing in the Democrat subreddit during this period.

Regarding energy bursts, we found some evidence of sudden, increased user activity. Namely significant bursts of social media activity were evidenced on Reddit overall from February to March 2020. Similarly, a burst of user activity was found in the Progressive subreddit during that same time period.

Study limitations

We believe this study makes a valuable contribution to the knowledge base on online radicalization; yet, it is not without limitations. First, we only analyzed three potential warning signs of radicalization. Prior work emphasizes their importance,[35,36] but there are other indicators of radicalization that future work could examine in relation to anti-Asian online hate and the pandemic. Second, the portion of this study examining Twitter focused on warning signs of radicalization in original tweets. Because we utilized text-analysis methods, we excluded retweets because the text in retweets is identical to the text in original tweets. Studying retweets could also be important, however, because they represent the potential for message amplification. Third, HateSonar and Python NLTK, commonly utilized tools for analyzing sentiment, have difficulty parsing the nuances of language. This can make it challenging to accurately autodetect some hateful or offensive speech because such language can be subject to social and cultural context. It is therefore likely that our estimates of hate and offensiveness are inflated, picking up text that is not actually hateful. Even so, this should not significantly affect our results because this inflation would be present in the periods both before and after the outbreak of COVID-19.

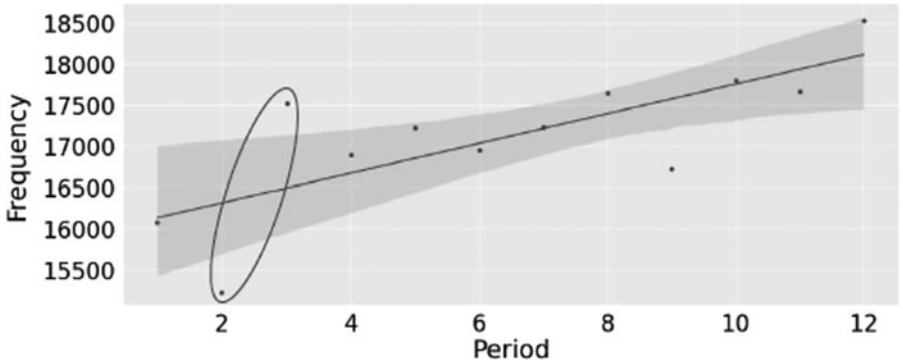

FIG. 1. Linear model for energy burst on Reddit in 2020.

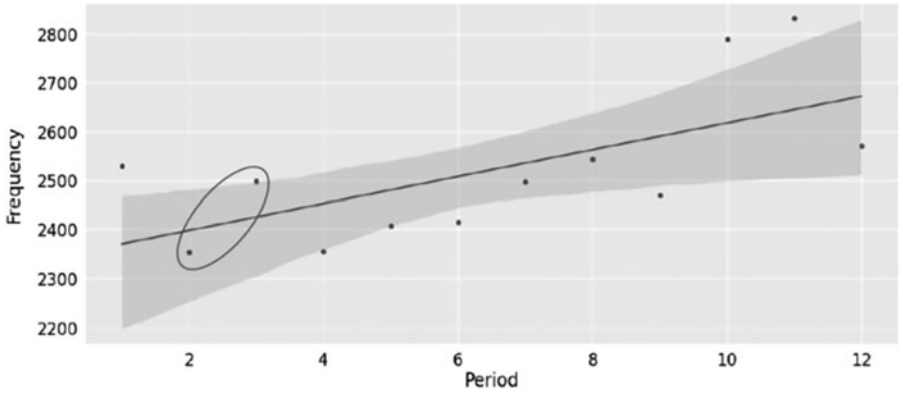

FIG. 2. Linear model for energy burst in progressive Subreddit in 2020.

Discussion and Conclusions

Online and offline anti-Asian hate has surged since the outbreak of COVID-19. These disturbing trends prompted us to explore the detection of warning signs of radicalization on Twitter and Reddit, two popular social media platforms. We found evidence that the pandemic potentially facilitated the radicalization of some social media users. Specifically, tweets containing the terms ''China'' or ''Chinese'' on Twitter became more negative after the pandemic began, and Reddit posts containing these terms became more offensive, hateful, and negative over time. Of note, we found differences in the subreddits we analyzed whereby posts were increasingly hateful, offensive, and negative in those catering to Republicans and conservatives, but not Democrats and progressives. This aligns with recent scholarship on rightwing extremism commonly targeting race/ethnic minority groups and immigrants online.[44,45]

Evidence of increasing group identification emerged on both Twitter and Reddit, including the Republican and conservative subreddits. Growing group identification can signal mobilization, as adopting an ''us vs. them'' outlook not only draws one closer to those with whom they identify, but simultaneously farther from those they do not. In turn, it is easier to ostracize, and even target, perceived outgroup members. Finally, we detected significant energy bursts, or flurries of social media activity, on Reddit, including the Progressive subreddit, shortly after the outbreak of COVID-19. These bursts of user activity are likely the result of events that transpired in March 2020, most notably a tweet by former President Trump calling COVID-19 the ''Chinese-Virus.''

In sum, our findings are, unfortunately, unsurprising. Asian American have long faced stigmatization and othering in the United States[14] and history is replete with examples of emergent diseases being met with the displacement of blame—usually onto race/ethnic minorities or immigrants—for the origin of the maladies. For instance, the outbreak of cholera in the 19th century, dubbed ''Irish disease,'' was blamed on newly arriving immigrants from Ireland, growing concern over the spread of tuberculosis were blamed on Jewish immigrants, and various European immigrant groups were targeted for purportedly causing outbreaks of yellow fever and polis.[25,56] In line with these and other past instances of scapegoating, we find evidence of growing Sinophobia on both Twitter and Reddit following the COVID-19 outbreak. This is concerning not only for those who are exposed to—or targeted by—such rancorous online content, but also because the expanse of Sinophobia online is likely linked to the rising tide of verbal and physical abuse targeting Asians offline.[57] We therefore believe it is imperative to continue exploring not only warning signs of online radicalization, but also avenues to circumvent the radicalization process.

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Address correspondence to:
Dr. Matthew Costello
Department of Sociology, Anthropology and Criminal Justice
Clemson University
130F Brackett Hall
Clemson, SC 29634
USA

E-mail: mjcoste@clemson.edu