COVID and Cognitive Warfare in Taiwan

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Abstract
In this study, we examine China’s cognitive warfare coordinated with military air operations during the COVID pandemic in Taiwan. In May 2021, Taiwan experienced its first novel coronavirus outbreak with up to 500 daily cases. The Chinese government launched a series of coordinated “cognitive warfare” campaigns targeting Taiwan in addition to the People’s Liberation Army (PLA) frequent air force incursions into Taiwan’s air zone. Meanwhile, through manipulation of the vaccine supply, China turned COVID vaccine into a political issue in Taiwan involving multiple players including pharmaceutical developers, tech giants, and local politicians. Combining multiple sources of data, we analyze the Chinese Government’s orchestrated cognitive and information warfare (IW) efforts targeted at influencing the Taiwan public’s trust in the Democratic Progressive Party (DPP) government as well as its home-developed vaccine. Identifying the patterns of influencing using cognitive and IW, we found China’s ultimate goal was to instill skepticism and confusion in Taiwan’s public about the President Tsai Ing-wen’s health policy and more generally undermine the creditability of the DPP government.

Keywords
COVID, vaccine policy, cognitive warfare, information warfare, ELM

Introduction
As of early 2022, more than 400 million people have been infected with the new Coronavirus with about six million lives lost. In the early stage of the pandemic, circa the first quarter of 2020, the United States and its allies alleged that China had to be held responsible for the global spread of the deadly virus, the Chinese government under Xi Jinping instead dodged that claim and launched a series of “cognitive warfare” in Taiwan, diverting the international attention from such accusations. In May 2021, as the number of infections with the new variant in Taiwan suddenly reached a new height, China’s cognitive warfare campaigns continued unabated.

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Akio Yaita (2021), the director of the Taipei branch of the Japanese media Sankei Shimbun, said the Chinese communist regime’s strategic goal of launching cognitive warfare against Taiwan during the pandemic was actually very clear. Besides accusing Taiwan of seeking independence while other countries are hand-tightened in dealing with pandemics at home, China is vigorously blocking Taiwan from acquiring vaccines from other countries and limiting the vaccine supply to Taiwan government to shape an image of the latter’s incompetence and unreliability. In addition, China actively spreads fake news to divide Taiwan’s population in an attempt to demoralize the public and undermine its confidence with the Democratic Progressive Party (DPP) government.

Taiwan’s National Security Agency (NSA) also charged China of launching a cognitive warfare against Taiwan. Taiwan’s Executive Yuan spokesperson Luo Bing-Cheng further confirms that in the new wave of COVID-19, the NSA has testified China’s orchestrated cognitive attacks on Taiwan through fake news and other means to fan skepticism and to tarnish the image of the government. The campaign emerged around 12–13 May, when the news of cluster infections of China Airlines crew members at Novotel Hotel began divulging.

It is worth noting that Taiwan’s Minister of Health and Welfare cum the commander of the Central Epidemic Command Center (CECC) Chen Shih-Chung revealed that Taipei purchased five million doses of Pfizer-BioNTech (BNT) COVID-19 vaccine from Germany as early as in December 2021. However, the company suddenly withdrew from the transaction at the last minute without justification. In an interview with the media, Chen warned that “external forces is intervening” and was cited as saying that “some people don’t want Taiwan to be too happy,” referring to potential Chinese interference (Chang, 2021).

Within hours of Chen’s comments to the media, the German company BNT immediately stated that its plan to provide vaccines to Taiwan remained unchanged. After the event, German legislator Ulrich Lechte confirmed that it was China’s intervention to prevent Taiwan from purchasing the German vaccine (Cheng, 2021).1

The 2021 outbreak of COVID-19 in Taiwan, as a prisoner of its past success, was taken by surprise. Vaccination rate was low and the government had not considered it necessary to keep sufficient doses of vaccines in stock given the practical non-existence of the virus in Taiwan until May that year. In retrospect, Beijing had already attempted to utilize vaccine accessibility as part of the cognitive warfare from the beginning. The demand for vaccines was not high due to the relatively low infection rate in Taiwan early on, thus such impact was not well attended.

Exploiting the new outbreak and panic in the public, China conducted another invisible campaign of cognitive warfare. On one hand, China claimed that it was willing to provide Taiwan vaccines to solve the problem, but privately was attempting all means to block vaccine delivery to Taiwan through the Shanghai-based company Fosun Pharmaceutical. Meanwhile, its propaganda wing continued to spread false information, jeopardizing the integrity of Taiwan government’s disease control agencies, and spreading general distrust of CECC’s policies.

China’s efforts include manipulating disinformation about “vaccines” to achieve its strategic goals. One such tactic targets denigrating the reputation of Taiwan’s locally developed vaccine Medigen (MVC) and deliberately exaggerating the side effects of the vaccines such as related deaths of unknown causes. These disinformation campaigns stirred skeptical sentiments among the public, causing apprehension about vaccines and ultimately weakening the country’s general immunity. Fabricated accusations such as charging senior government officials involved in profiteering vaccines similarly undermine the government’s efforts in handling the pandemic.

China’s campaigns against Taiwan take to the diplomatic front. For instance, Paraguayan Foreign Minister Euclides Acevedo addressed the media that Chinese vaccine manufacturers mentioned to him the cessation of diplomatic ties with Taiwan would be a precondition for vaccine donation. Paraguayan President Marito Abdo however publicly revoked that idea, claiming his
country “rejects the extortion of China’s vaccine diplomacy.” Jonathan Fritz, Deputy Assistant Secretary for Asia and the Pacific of the US State Department also warned that China’s vaccine diplomacy to squeeze out Taiwan’s diplomatic space will not stop, and it must not be taken lightly.

**What is cognitive warfare?**

Cognitive warfare, along with information warfare (IW), is a strategy designed to influence individuals or the public on how an issue, event, or situation is evaluated (Reding and Wells, 2022). What is different between IW and cognitive warfare is the primary use of information, misinformation, and disinformation for the former but cognitive warfare utilizes one or a combination of the previously mentioned to achieve social influencing in the cognitive domain. To that end, the operations will be **coordinated** to make the public “believe” the misinformation and/or disinformation with the aid of additional warfare tools. From military perspective, destabilization and influence in the target population are the fundamental goals of cognitive warfare. It is part of the larger concepts of gray zone or hybrid warfare conducted below the level of actual military engagement but could involve “intense political, economic, informational, and military competition more fervent in nature than normal steady-state diplomacy, yet short of conventional war” (Votel et al., 2016).

Cognitive warfare can be exploiting misinformation and/or disinformation to directly persuade the public **cognitively** into beliefs in a certain topic or indirectly introduce delusion or confusion despite evidence of the contrary (Guadagno and Guttieri, 2021). According to Institute of National Defense and Security Research Director Tzeng Yi-suo, cognitive warfare’s ultimate goal is “to control what’s between the ears. That is, your brain or how you think, which [Beijing] hopes leads to a change of behavior” (Huang, 2021). Taiwan military and security experts have investigated China and the People’s Liberation Army’s (PLA) cognitive warfare extensively. The COVID outbreak in 2021 provides an excellent case study for such war fronts combined with epidemiological data.

The term “cognitive warfare” often appears in studies of democratic countries under totalitarian attack. US Air Force General David L. Goldfein describes modern warfare as shifting from “traditional attrition warfare to cognitive warfare.” Neuroscientist James Giordano also points out that the “human brain” is a new battlefield in the 21st century. In other words, since the emergence of the term IW in the 1990s, “cognitive warfare” has become an all-inclusive term for non-kinetic warfare elements, including the United States’ “influence operation” and “information psychological warfare”; Russian’s “hybrid warfare” and “reflexive control”; China’s “united front work,” “three-warfare” and the concept of “brain-control” operation; and Taiwan’s usage of the “political warfare” to refer all the terminologies mentioned above. Although the names may differ, the common ground is the same, they all focus on how to win people’s hearts and minds on the mental battlefield.

In recent years, the Chinese Communist Party (CCP), whether maintaining domestic stability, wrestling internationally or employing united front work against Taiwan, has used social networks to disseminate fake news and even psychologically manipulate perceptions and attitudes for strategic advantages. This has attracted great attention from various countries. This study clarifies the connotation and development of the CCP’s cognitive warfare, analyzes the operational levels and strategies from real examples during the COVID-19 pandemic, and attempts to propose countermeasures to China’s vaccine cognitive warfare for Taiwan’s reference and response to the new type of warfare.

In military history, “to win without fighting” has always been respected by military strategists at home and abroad. Traditional battlefields are mainly conducted in physical space. With the continuous deepening of human understanding of war and the continuous evolution of technology, the current new type of warfare has gradually transformed from a kinetic warfare to a non-kinetic confrontation in the cyberspace and human brain. The CCP learned from the United States’
experiences in sponsoring the so-called “color revolutions” and Russia’s hybrid warfare against Crimea, and began to develop “cognitive warfare” of its own. It refers to the use of information to manipulate the cognitive function of the target audience in peacetime and in wartime as well.5

In 2014, the CCP first initiated the concept of “brain-control” operation, using the research results of inter-disciplinary approaches such as brain science, psychology, linguistics, communication theory, and information theory. From land control, sea control, air control to electromagnetic control and has now transformed into the brand-new cognitive domain of brain control, which is generally viewed as the next evolutionary phase of war. The Jamestown Foundation study indicates that cognitive warfare belongs to the category of psychological warfare in a broad sense. The CCP uses psychological warfare to shape and even control the enemy’s cognitive thinking and decision-making, thus psychological warfare has become important connotation of IW of China’s PLA.6

Oliver Backes and Andrew Swab define cognitive warfare as a strategy to change the thinking of the target object and its behavior. The two scholars provide a research approach to measure the actions of non-kinetic forces, using the framework of cognitive warfare to examine how did Russia weaponize information to persuade or confuse the people, change public opinion, widen social differences, and destroy or change the domestic political process of the targeted countries.7

The development of the CCP’s strategic vision in cognitive domain brought about by the rise of social media and the proposed brain-control strategy, actually came from the theoretical thinking of Western academic circles and think tanks especially the United States. These concepts include psychological operations, consciousness manipulation, strategic communication, war of ideas, and information war, which show that the CCP is trying to understand the operation of American cognitive thinking to remedy China’s own shortcomings. The soft-kill operations such as psychological warfare, public opinion warfare, and IW, in actuality are mutually reinforcing, make cognitive warfare a more effective tool in the modern psychological warfare.

For instance, China’s vaccine diplomacy highlighted the fact in the current globalized world pandemic diseases imposed a threat to political, economic, and social stability. Consequently, it is about winning of hearts and minds of people in poor countries by exporting vaccine, medical care, expertise, and personnel to help those who need the most.8

Vaccine diplomacy, a global charm offensive, is the typical example of China’s cognitive warfare that carries multiple possible attempts: deflecting anger and criticism over China’s early mishandling of the pandemic, and both strengthening and extending influence in Asia and beyond. “There is no doubt China is practicing vaccine diplomacy in an effort to repair its tarnished image,” said Huang Yanzhong, a senior fellow for global health at the Council on Foreign Relations.9 China may use its vaccine donations to advance its regional agenda, particularly on sensitive issues such as its claims in the South China Sea and military intimidations against Taiwan.

China’s Foreign Ministry spokesman Zhao Lijian made it clear in February 2021 that Chinese collaboration on issues such as global health is predicated on concessions by the international community. Obviously, it would further expose Taiwan to potential blackmail. Given Beijing’s incessant politicization of the pandemic and hostility toward Taiwan, it is hard to imagine that the CCP would not use the vaccine in some transactional fashion, with the obtention of the vaccine predicated on political concessions by Taipei, such as on the country’s status and “one China principle.”10

It is generally believed that Beijing’s vaccine diplomacy played a major role in Guyana’s decision in early February to revoke a prior agreement with Taipei to establish a Taiwan Office in Georgetown. Likewise, Chinese vaccine shipments to Turkey have been linked to a Chinese-Turkish extradition agreement that could send Uyghurs living in Turkey back to China (Chang, 2021).

Of course, it could also be possible as Financial Times states that China’s vaccine diplomacy is perceived as part of a broader public relations strategy, which is supposed to counteract negative perceptions of China as well as to present it as a responsible citizen of a global society. According
to Van Ham, having a bad reputation can be a serious impediment for a state that wished to play a significant role in the international arena. Therefore, image and the reputation became a significant element of states’ strategies.\textsuperscript{11} In a globalized world, oftentimes there is no time for in-depth analysis of information; therefore, perception of other states or nations are based mostly on stereotypes that shape opinions and influence the decision-making process to a much extent.\textsuperscript{12}

China applies the COVID-19 vaccine as an instrument to manipulate the information to its favor. These strategies can be further categorized into three areas. First of all, domestically China filters out all negative and unfavorable information regarding pandemic control. Only positive information and news reports would be allowed to circulate in line with the Standing Committee of the Political Bureau’s demand that all media “only tell the good story about China’s campaign against the pandemic.”\textsuperscript{13} To no one’s surprise, it emphasizes more important of the party guidelines to shape public opinion than the transparency of the much-needed pandemic information.

Second, internationally the CCP uses the distinguished public figures to manipulate the public opinions in China’s favor. For instance, the World Health Organization Secretary-General Tedros Adhanom Ghebreyesus was wittingly or unwittingly requested by China to endorse its own version of the COVID-19 narrative. The US former President Donald Trump, who paused funding and withdrew the United States from the UN agency, called the UN public health chief “a puppet of China.” However, the internationally reputable figure is very important and very influential for such strategy that helps convince the general public in all nations to believe in CCP’s propaganda and prevent the accusations and requests of reparations pointing to China.\textsuperscript{14}

Third, particularly to Taiwan, the PLA continues to flex its military muscles to intimidate the island state. These military gestures represent China’s reactions to and accusation of Taiwan’s seeking independence during the pandemic, justifying China’s moves not only to adopt military actions in response but also to divert the media coverage of the COVID origins from all other countries. China’s Sukhoi 30, J-10, Y-8, and anti-submarine aircraft were deployed in coordinated practices with various types of naval vessels to enter the airspace of Southwest Taiwan. In particular, joint exercises are held frequently in Taiwan’s air defense identification zone (ADIZ). These relevant military activities held by China often attracted more international media attention than other issue events occurred across the Taiwan Strait.

Coincidently whenever China is facing pressure and accusations of liabilities from the international society, it seems always coming in tandem with tension escalation across the Taiwan Strait. Best and Houng (2020) argue that

\begin{quote}
the pandemic has only served to sharpen tensions between China and Taiwan. Far from seizing the advent of COVID-19 to pursue rapprochement, leaders on both sides of the strait have retreated from cooperative efforts. Embarrassed by its initial mishandling of the outbreak and confident after its subsequent successes in bringing COVID-19 under control, Beijing increased its military activity in areas where it has territorial claims. In mid-March, the People’s Liberation Army (PLA) began a campaign of flying warplanes across the Taiwan Strait.\textsuperscript{15}
\end{quote}

Furthermore, Taiwan’s Institute for National Defense Strategy Research (INDSR) also points out that China has turned to “wolverine” or provocative cognitive warfare strategy after the COVID-19 pandemic. China employs the so-called “50-cent party” or Internet commentators paid by China’s United Front, to launch propaganda campaign on Western world’s social media such as YouTube, TikTok, and other Chinese social media platforms. To Taiwan, the CCP’s cognitive warfare goes an extra mile, which is in orchestrated efforts such as fake news in combination of the use of military intimidations. Such campaigns against Taiwan become daily practices after the advent of COVID-19.\textsuperscript{16}
The politics of vaccine

Relatively speaking, Taiwan enjoyed a generally early success of containing COVID-19. Unlike most countries, life in Taiwan went on as usual without much interruption in early stage of the pandemic. President Tsai Ing-Wen of DPP enjoyed high approval rating of up to 71.2% in 2020 to Beijing’s chagrin. Taiwan’s achievements in its COVID policy are at odds with Beijing’s narrative that China’s success in containing the virus—albeit only with draconian measures—demonstrates the supremacy of the “China model” compared with liberal democracies.

The sudden outbreak in May 2021 with the new COVID-19 variant with four to five hundred cases per day put the DPP government under duress. Tsai approval rating sank to the lowest approval rating of 43.2% in June 2021. This provides Beijing with an opportunity to push its agenda in favor of “political reunification” appeal using coordinated cognitive warfare.

Initially, China’s Taiwan Affairs Office (TAO) expressed its “goodwill” to Taiwan by offering to donate Chinese vaccines and starting off strategically vaccinating Taiwanese businessmen working and living in China, who highly applauded the program and efficacy of such vaccines (Chang, 2021). According to the CCP leader Wang Yang (Politburo Standing Committee member), the inoculation drive was aimed at encouraging Taiwanese residents in China to aid in the “reunification with the motherland.”

China’s political efforts using vaccines were three-thronged:

1. Delaying Taiwan’s procurement process.
2. The Taiwan government claimed that Beijing “intervened” the delivery of BNT vaccines Taiwan purchased early in 2021. The vaccines were manufactured in Germany but the sales and distribution rights were in the hand of the Shanghai-based Fosun Pharmaceutical Group. Chinese government denied all claims and TAO spokesperson Ma Xiaoguang faulted the DPP government for failing to acquire vaccines on a timely manner (Chang, 2021). Eventually, the Taiwan government allowed non-government companies and organized including Apple supplier Foxconn, chipmaker Taiwan Semiconductor Manufacturing Company (TSMC), and a Buddhist charity group to purchase and deliver the vaccine to Taiwan (Wang, 2021).
3. Employing military strategies to deter foreign donations.
4. Sugimoto and Yin in their recent article argue that if China comes to Taiwan’s aid before the United States and Japan, Beijing could propagandize that Japan and the United States are unreliable partners with neither the capabilities nor resolve to assist Taiwan in a timely fashion during a crisis. Beijing’s “goodwill,” therefore, could be interpreted as a strategy potentially designed to “reveal” how the United States and Japan’s commitments to Taiwan and its other Asian allies are simply empty words (Sugimoto and Yin, 2021).
5. In this sense, the delivery and donations of vaccines to Taiwan become key in the coordinated warfare efforts by the Chinese government, including those from donor countries particularly the United States and Japan. This study will investigate that China’s cognitive warfare include attempts to deter the United States and Japan’s aid to Taiwan by accusing Taiwan of seeking independence to further justify its military intimidations strategies: the more US and Japanese vaccine donations to Taiwan, the more frequently China will flex its military muscles against Taiwan.
6. Instilling distrust to public over Taiwan’s vaccine development.

Taiwan’s development of a homegrown vaccine is strategically important. Not only a locally developed and manufactured vaccine can have values beyond medical and public health purposes but also serve diplomatic and national defense purposes. Research and development of domestic vaccines are important for the biotechnology industry and a new direction Taiwan can develop
toward building international strategic cooperation. For China, this could mean losing leverage of its own vaccine as Taiwan could become vaccine-independent. Accordingly, we put the third focus of this study on China’s cognitive warfare promoting Chinese-made vaccines while disparaging the effectiveness of Taiwan’s Medigen: the more negative news attacking Medigen, the less likely people of Taiwan will support domestic vaccines and the DPP government. In summary, we examine China’s coordinated cognitive warfare in three directions:

1. Delaying Taiwan’s vaccine procurement process to inflict political damage on the DPP administration under Tsai;
2. Employing military intimidation strategies to deter foreign countries from coming to Taiwan’s aid;
3. Leverage the Chinese-made vaccines to promote its political unity agenda and instilling distrust in public over Taiwan’s vaccine developments.

**Data and methods**

While previous research employs data collected through unconventional methods (e.g. leaked 50cent gang’s emails) to provide evidence of China’s social media posts for propaganda (King et al., 2017), there is no systematic data collection method to acquire data establishing direct link of social media activities to cognitive warfare. For instance, one might suspect a post by 50-cent gang member but social influencing will not be achieved automatically. Cognitive theorists suggest the elaboration likelihood model (ELM) is a dual process model of persuasion based on the extent “how people vary in the amount of cognitive effort they put into processing persuasive appeals” (Guadagno and Guttieri, 2021). When motivated content consumer centrally processing messages, they focus on the quality of such content (e.g. a post or a message) before they are influenced. For those who peripherally consume media contents with little cognitive resources, they may be more likely to be influenced by the “quantity rather than quality of arguments or be swayed by the perceived credibility associated with the persuasive appeal rather than the veracity of its claims” (Guadagno and Guttieri, 2021: 178–179). In other words, quantity is more important that quality of the social media content for the general public only willing to spend little cognitive resources or effort to discern the validity or accuracy of online posts.

In this study, we focus on examining the quantity of posts and likes in social media data coupled with event analysis. We scrutinize the three arguments contended in the theoretical formulation by comparing the quantities of posts related to different COVID vaccines. To achieve that, we collect the following data to estimate a series of models in next section:

1. PLAAF incursions.
2. Presidential support (approval and disapproval).
3. COVID cases and death rates.
4. International vaccine donations to Taiwan.
5. Volume in social media (Twitter and Facebook).\(^{17}\)

**Findings**

The first argument suggests China’s cognitive warfare has a strategic goal to target at President Tsai’s approval ratings; the lower the approval ratings the more likely Tsai’s administration will be forced to the negotiate with China on acquiring vaccines.
Figure 1(a) and (b) illustrates the timing of the outbreak, presidential approval and disapproval ratings, along with PLA’s military actions in Taiwan.18

**PLA incursions and political support**

Starting April 2021, China escalated tension through dispatching warplanes into Taiwan’s ADIZ, driving Tsai’s approval ratings to down and disapproval up from May to July (see Figure 1). The timing coincided well with the new COVID variant outbreak in Taiwan. During this 3-month period from May to July, China seemed to relatively constrain itself from dispatching warplanes to near Taiwan as shown by the significant drop in frequency of air incursions. However, after July when the pandemic control was restored to secondary alert level, counterintuitively Tsai’s disapproval ratings actually rose to the “crossing point” above the approval level. We build a simple time series model to test if the PLA incursions “cause” any changes to the presidential approvals in Taiwan (see Table 1). Vector autoregression models running approval ratings against the counts of PLA aircrafts demonstrate that the presidential support follows an autoregressive process, which is related to previous records, instead of being correlated with or getting interrupted by the PLA aircraft incursions.19 This preliminary pattern of using military measures as leverage to influence approval ratings may warrant more empirical evidence with better measurement methods such as daily approval ratings or long period of data. Yet, as much as the data we can collect to date, we do not find any support that China’s military actions are in any way effective to sway the general support for the Taiwan president.

**International COVID support and coordinated warfare**

The second argument attempts to raise one of the possible explanations on why China suddenly increased its warplanes incursions into Taiwan’s airspace in September, 2021. As vaccine donation data suggest, more and more nations including Poland and Slovakia are joining the United States and Japan to donate COVID vaccines to Taiwan. Yet, these donations were greeted with increasing deployment of PLA aircrafts entering Taiwan ADIZ, particularly in September when Japan announced donation for the fourth time. On 7 September 2021, the number of aircrafts amounted to the record high 47 (see Figure 2). China considered these international vaccine donations to Taiwan as a signal of “using pandemic to plot independence.”20 In response, the PLA dispatched warplanes to protest Taiwan’s gaining support from other nations, on one hand, and continue to divert media attention, on the other. Meanwhile, crisis escalation can further divide Taiwan’s society arousing the fear of war. To China, increasing military presence over Taiwan Strait can also work as deterrence to countries like Japan and other eastern European countries such as Poland, Slovakia, and the Czech Republic against giving further support to Taiwan. In September 2021 alone, China has dispatched a total of 92 warplanes responding to each of these countries’ postures (see also Table 5 in Appendix 1 for detail of deployments). This apparently lends support to our second argument that the more vaccine donations from foreign countries to Taiwan, the more frequently China will flex its muscles to intimidate Taiwan and to deter supporting countries. To look closer to the empirical evidence, we combine the two variables of PLA incursions and international donations and build a multivariate model to be discussed in the later section on social media data analysis.

**Social media analysis: Twitter data**

The third argument of this study contends that China would not let Taiwan own domestic vaccines as a strategic card at hand. To that end, negative propaganda and disinformation campaigns were
Figure 1. (a) Vaccine donations, PLA incursions and Tsai approval, June 2020–September 2021 and (b) COVID cases and deaths, June 2020–September 2021.
employed to denigrate Taiwan’s locally developed MVC to make the public apprehend the shot. We take a small step to build a conceptualization framework in cognitive warfare and countermeasures. Figure 3 displays the volume of tweets on the four vaccines available in Taiwan, namely, MVC, BNT, AstraZeneca (AZ) and Moderna. Clearly, the locally developed vaccine became the target of “cognitive warfare,” which captured most conversations back and forth from different views. We do find efforts from pro-government accounts or key opinion leaders (KOLs) in defending Taiwan’s vaccine policy and locally developed products. That explains despite generally there is much volume on undermining DPP government’s vaccine and COVID efforts, lots of supporters also voice out to counter those attacks. The Twitter network plots are indicating MVC supporters as shown in Figures 3 and 4 are working to raise positive sentiments in social media, relaying the positive posts backing up MVC hundreds of times (one was 374 times).21 In other words, there are certain supporters in Taiwan retweeting favorably on Medigen as demonstrated in the regular blue spikes shown in Figure 4. Comparatively, AZ and Moderna posts are less frequent, sparsely organized and less supported or retweeted. Figures 3 and 4 also illustrate the network structure of MVC exchanges on Twitter. Clearly the higher volume traffic regarding the MVC testifies to the invisible “counter-warfare” online creating volume and rallying against suspicions of the Taiwan vaccine policy.

Table 1. PLA incursions and presidential support in Taiwan: vector autoregression (VAR) models.

| Equation                  | Coefficient | Std. err. | z       | P > z | [95% conf. interval] |
|---------------------------|-------------|-----------|---------|-------|----------------------|
| Approval                  |             |           |         |       |                      |
| L1. 0.516 0.222 2.320 0.020 0.080 0.951 |             |           |         |       |                      |
| L2. −0.018 0.255 −0.070 0.944 −0.518 0.482 |             |           |         |       |                      |
| L3. −0.049 0.219 −0.230 0.822 −0.478 0.380 |             |           |         |       |                      |
| Count of PLA aircrafts    |             |           |         |       |                      |
| L1. −0.008 0.038 −0.220 0.827 −0.082 0.066 |             |           |         |       |                      |
| L2. −0.020 0.035 −0.580 0.559 −0.089 0.048 |             |           |         |       |                      |
| L3. −0.017 0.040 −0.420 0.672 −0.096 0.062 |             |           |         |       |                      |
| _cons 29.502 12.520 2.360 0.018 4.964 54.040 |             |           |         |       |                      |
| Approve count             |             |           |         |       |                      |
| L1. −0.060 0.350 −0.170 0.863 −0.746 0.626 |             |           |         |       |                      |
| L2. −0.021 0.324 −0.070 0.947 −0.657 0.614 |             |           |         |       |                      |
| L3. 0.146 0.373 0.390 0.696 −0.056 0.878 |             |           |         |       |                      |
| _cons 218.410 116.167 1.880 0.060 −9.274 446.094 |             |           |         |       |                      |
| Sample: 2020 m9–2021 m9   | N = 13.000  |           |         |       |                      |
| Log likelihood −96.282    | AIC = 16.967 |             |         |       |                      |
| FPE 103,245.900           | HQIC = 16.841 |             |         |       |                      |
| Det(Sigma_ml) 9292.131    | SBIC = 17.575 |             |         |       |                      |

PLA: people’s liberation army; AIC: Akaike information criterion; RMSE: root mean square error; FPE: final prediction error; HQIC: Hannan-Quinn Information Criterion; SBIC: Schwarz’s Bayesian Information Criterion.
To further look into the actual virtual battle ground, we acquire additional Facebook data to investigate what’s behind the scene of the negative campaign about COVID vaccines.

**Social media data analysis: Facebook data**

We collect the main texts and comments related to vaccines from Facebook for analysis to examine the changes of sentiments in positive and negative voices of netizens over various vaccines. Despite that the “Made in Taiwan” Medigen or MVC vaccine came out much later than other foreign vaccines, it attracted the largest volume of conversation in Twitter as well as in Facebook.

A total of 150,000 doses of the Moderna vaccine came to Taiwan from 27 May to 30 May. The government vigorously promoted it, but the public believed that these doses are hardly a solution to the serious shortage problem in Taiwan. Events that prompt movement of public sentiments include:

- From 18 June to 22 June, the United States and Japan successively donated the Moderna vaccine, and the community’s voice also reached a peak. In addition to expressing gratitude to the United States and Japan, the public criticized the government for being unprepared to buy sufficient vaccines but only behaving like “begging its way” to obtain the vaccine.
- On 30 June, the first batch of Moderna vaccines was administered. During this period, the negative voices represented criticism of the government.

**Figure 2.** People’s Liberation Army (PLA) incursions to Taiwan’s air spaces after the arrival of vaccine donations.
Figure 3. Cognitive warfare in social media: comparisons of network exchange about vaccines on Twitter.

- There were consecutive peaks from 12 July to 15 September. The main discussions were focused on seeking solutions to the Moderna shortage problem. The government responded by encouraging the public to choose AZ and MVC vaccines as the second dose in lieu of Moderna, which was widely believed to have higher efficacy. More criticisms were on the different price tags of the vaccines. While MVC and AZ were free, citizens would have to pay for Moderna injection. The public believes that this is the government’s trick to limit the use of Moderna so more would choose the locally produced MVC and the more abundant AZ resulted from higher volume of donations from other countries.

Comparatively, MVC received much more attention than the other three imported vaccines, with almost double in number of posts compared with the first runner-up AstraZeneca. It also took highest volume of dislikes or negatives from users, two to three times than the rest (see Table 2). Why the Taiwanese are harsher to their own “MIT” (made in Taiwan) products. Explanations could
be multiple. Medigen was developed in collaboration with National Institute of Health in the United States but the clinical trial process and Emergency Use Authorization (EUA) approval from the Taiwanese government were reportedly expedited.

What’s behind the agnostics could be a more delicate mechanism. One would suspect identifying cyber troops or 50cents party by looking up external IP’s would directly expose the cyber- or cognitive warfare. While we do not have such direct evidence connecting the negative posts on social media to China’s cognitive warfare, we argue that any operations of this type would not be necessary to achieve the goal of social influencing. According to the ELM, people processing messages online may be more influenced by the quantity rather than quality of arguments or be likely swayed by the perceived credibility associated with the “persuasive appeal rather than the veracity of its claims” (Guadagno and Guttieri, 2021: 178). In other words, whether such claims are actually misinformation or even disinformation would not matter. Readers of the message care more about who posted the message than whether the claim in the message was actually accurate since such a process is only peripheral in the cognitive sense. In the case of the Facebook or social media data, the volume or influence could be produced by supporting, clicking the likes or forwarding the messages first posted by the opposition KOLs.

To demonstrate this, we acquire another dataset containing all negative posts about COVID vaccine on Facebook from May, 2021 to September 2021. Table 3 displays the KOL data with the
most liked, most read and most disliked statistics. Clearly, the appeals or criticisms about vaccine and its related policy were overwhelmingly originated from Kuomintang or blue camp KOLs and media (see Table 3). Among them, Taipei city councilor Lo Chih-chiang (spokesman for former president Ma Yingjeou) was the champion in getting most likes and most-read posts in the Facebook world, receiving over four million likes in his 129 posts. He is the most-read writer and for each post, the average number of likes is an astounding 35,000! The top 12 most popular accounts include mostly the media organizations in the blue camp, commentators, former KMT chairman Johnny Chiang and the other opposition party the Taiwan People’s Party. There is no direct evidence to demonstrate that these individuals or organizations coordinate with the CCP, United Front or the Beijing government to influence public opinion in Taiwan. The opposition party in a democracy with full freedom of speech will be the best channel for instilling distrust, skepticism, and confusion in the population, particularly with the general citizens in lack of cognitive resources to process highly technical information or those who are facing information overload. All it takes is
to build quantity or volume by viewing the post, clicking the like, and/or forwarding the post using easily accessible social media accounts. We have to raise the caveat that there is no direct evidence suggesting the anti-Medigen posts on Facebook and other social media are coordinated with or by the CCP. Nor do we suspect the opposition KOLs are in any way connected with China in a concerted effort in influencing public opinion against Taiwan’s home-developed vaccine. The platform of social media, however, provides a perfect channel for the opposition to raise the voice in challenging the governing party, which could also easily attract high volumes of likes and views via widespread circulation.\textsuperscript{23}

In the next step, we combine the Facebook data with PLA incursions to explore if the public opinion on social media has any correlation with China’s military interference. We aggregate the likes to the vaccine agnostics posts on Facebook to use as a proxy of public opposition to the government. Figure 5 displays the volume of likes with the number of aircrafts the PLA dispatched into the Taiwan ADIZ on a daily basis in the 3-month period following the May 2021 outbreak. The opposition outcry on social media mounted to the highest point in late May and early June, cumulating up to over 700,000 likes on the most popular social media in Taiwan. In about 10 days, that number lowered to about half a million but shortly the PLA sent a squadron of 29 warplanes over in a single day (15 June 2021). On Twitter, patriotic netizens flooded into the Ministry of National Defense account to show support, building support with 849 likes, which is about four times that of a regular day. On Facebook, there were not much movements among the vaccine skeptics. Actually, criticisms or challenges to government about vaccine policy began to taper off, leaving the volume down to lower than 100,000 beginning August. While that could be primarily driven by the COVID situation ameliorating in terms of infection cases and deaths, Taiwan citizens on the other end experienced new waves of threats from PLA air incursions. Warplanes came more often and the fleet became bigger. We estimate the PLA incursion data using a series of event count models given the nature of these military events. Event count models such as negative binomial, Poisson, and zero-inflated Poisson (ZIP) are good candidates for evaluating limited dependent variables such as military actions and conflicts (Hilbe, 2011; Long, 1997). In the case of PLA incursion, the data contain a certain proportion of zero’s and the non-zero case could range from one to any number without upper limit. On the right-hand side of the models, we include the volume of vaccine skeptics on Facebook and the vaccine donations from other supporting nations including Japan, the United States, and other European allies. We test the argument that cognitive warfare are coordinated operations with the military threat on one side and social influencing tools such as trolls, misinformation and disinformation on the other. If there is not any coordination, these variables should demonstrate zero connections.

We ran three event count models, and the results are shown in Table 4. Among them, negative binomial regression with mean dispersion is the better estimation compared with the Poisson and ZIP models.\textsuperscript{24} All models present quite consistent results of a statistically significant vaccine agnostics voice variable, indicating the negative relationship with PLA’s military actions. The donation variable is positive, suggesting it is possibly driving China’s protest by sending aircrafts. The relationship however is not consistently significant. In addition, the ZIP model using donation as the inflation variable indicates vaccine support from other nations may not immediately trigger PLA from no action (zero plane) to some deployment (non-zero). Yet, they are positively correlated (r=0.121). These event count models may not be fully parameterized due to lack of additional variables. However, the consistent and statistically significant results of social media volume could have important implications: as the pandemic cases and deaths in Taiwan seemed to get lower and the crisis apparently was relieved, criticisms on the government vaccine policy performance appeared to quiet down yet the PLA would pick up the pace of challenging the DPP government. This is a clear indication that the Chinese military efforts are well coordinated and in line with
China’s cognitive warfare efforts to influence Taiwan public instilling public distrust with government and the locally developed vaccine.

Conclusion

In this study, we examine China’s coordinated cognitive or IW and attempt to explain the mechanisms behind the operations during COVID outbreak in Taiwan. Given the overt nature of this psychological warfare, we may not be able to produce direct evidence to establish the causal links. Yet, observations of timing or temporal correlations of PLA incursions and voices raised in volume on social media found in this study provide important insights into understanding China’s intentions and plots over the political and international status of Taiwan. Our first argument about cognitive warfare and presidential approval was not fully supported, indicating the coordinated efforts were not effective in directly delivering impact on government support. Regarding international donations or support for Taiwan, China’s protests on all fronts (cognitive warfare and military threats) could raise some volume and possibly influence public opinion. If one of the goals of such warfare efforts is to discredit Taiwan’s homegrown vaccine, it was clearly well achieved just reading the final data. According to Taiwan Centers for Disease Control, as of July 2022, only about three million shots of MVC were administered, compared with about 60 million in total vaccinations. It is a merely 5%, indicating the general skepticism among Taiwan citizens on the vaccine developed and manufactured at their homeland.

To circumvent such warfare efforts, one critical policy prescription for the Taiwan government is to promote media literacy. Only if the public is capable of discerning disinformation will it be “inoculated for immunity.” This is the fundamental education for the public to counter the invisible cognitive warfare rampant in news and social media. The Achilles’ heel of the CCP’s
Table 4. PLA incursions and social media volume on vaccine: event count models.

| PLA incursions | (1) Poisson | (2) ZIP | (3) ZIP | (4) Negative binomial | (5) Negative binomial |
|----------------|-------------|--------|--------|-----------------------|----------------------|
| Facebook likes of vaccine skeptics | -3.89e–06*** (7.85e–07) | -2.87e–06*** (8.39e–07) |  | -3.23e–06** (1.33e–06) |  |
| Vaccine donations | 0.745*** (0.158) |  | -1.813 (1.390) | 0.590 (0.401) |  |
| Lnalpha |  | 0.715*** (0.210) |  |  |  |
| Constant | 0.681*** (0.122) | 1.201*** (0.126) | -0.199 (0.235) | 0.623** (0.263) |  |
| McFadden’s $R^2$ | 0.070 | 0.028 |  | 0.024 |  |
| AIC | 4.526 | 4.230 | 3.028 |  |  |
| BIC | -28.024 | -61.958 |  | -210.924 |  |
| Observations | 124 | 124 | 124 | 124 | 124 |

PLA: people’s liberation army; ZIP: zero-inflated Poisson; AIC: Akaike information criterion; BIC: Bayesian information criterion.

Standard errors in parentheses. ***p < 0.01; **p < 0.05; *p < 0.1.
Table 5. Taiwan MND 2021’s CCP incursion into Taiwan’s ADIZ and Timelin of vaccine donation.

| Date     | Donate nation | Administrative proceedings | Vaccine type | Warplane incursion into Taiwan’s ADIZ |
|----------|---------------|----------------------------|--------------|---------------------------------------|
| 5/28/21  | Japan         | 1st announcement           | AZ           | 5/28 Y-8 ASW 1                        |
|          |               |                            |              | 5/29 N/A                              |
|          |               |                            |              | 5/30 N/A                              |
|          |               |                            |              | 5/31 N/A                              |
|          |               |                            |              | 6/1 N/A                               |
|          |               |                            |              | 6/2 N/A                               |
|          |               |                            |              | 6/3 Y-8 EW 1                          |
| 6/4/21   | Japan         | 1st vaccine arrival        | AZ           | 6/4 KJ-500 1                          |
|          |               |                            |              | 6/5 N/A                               |
|          |               |                            |              | 6/6 N/A                               |
|          |               |                            |              | 6/7 N/A                               |
|          |               |                            |              | 6/8 N/A                               |
|          |               |                            |              | 6/9 N/A                               |
|          |               |                            |              | 6/10 N/A                              |
| 6/4/21   | USA           | 1st announcement           | N/A          | 6/4 KJ-500 1                          |
|          |               |                            |              | 6/5 N/A                               |
|          |               |                            |              | 6/6 N/A                               |
|          |               |                            |              | 6/7 N/A                               |
|          |               |                            |              | 6/8 N/A                               |
|          |               |                            |              | 6/9 N/A                               |
|          |               |                            |              | 6/10 N/A                              |
| 6/20/21  | USA           | 1st vaccine arrival        | Moderna      | 6/20 Y-8 ASW 1                        |
|          |               |                            |              | 6/21 N/A                              |
|          |               |                            |              | 6/22 N/A                              |
|          |               |                            |              | 6/23 N/A                              |
|          |               |                            |              | 6/24 N/A                              |
|          |               |                            |              | 6/25 N/A                              |
|          |               |                            |              | 6/26 Y-8 ASW 1                        |
| 6/22/21  | Lithuania     | 1st announcement           | AZ           | 6/22 N/A                              |
|          |               |                            |              | 6/23 N/A                              |
|          |               |                            |              | 6/24 N/A                              |
|          |               |                            |              | 6/25 N/A                              |
|          |               |                            |              | 6/26 Y-8 ASW 1                        |
|          |               |                            |              | 6/27 N/A                              |
|          |               |                            |              | 6/28 N/A                              |
| 6/25/21  | Japan         | 2nd announcement           | AZ           | 6/25 N/A                              |
|          |               |                            |              | 6/26 Y-8 ASW 1                        |
|          |               |                            |              | 6/27 N/A                              |
|          |               |                            |              | 6/28 N/A                              |
|          |               |                            |              | 6/29 N/A                              |
|          |               |                            |              | 6/30 N/A                              |
|          |               |                            |              | 7/1 N/A                               |
| 7/8/21   | Japan         | 2nd vaccine arrival        | AZ           | 7/8 Y-8 EW 1                          |
|          |               |                            |              | 7/9 N/A                               |
|          |               |                            |              | 7/10 N/A                              |
|          |               |                            |              | 7/11 N/A                              |
|          |               |                            |              | 7/12 N/A                              |
|          |               |                            |              | 7/13 Y-8 EW 1, Y-8 RECCE 1            |
|          |               |                            |              | 7/14 Y-8ASW 1                         |

(Continued)
### Table 5. (Continued)

| Date       | Donate nation | Administrative proceedings | Vaccine type | Warplane incursion into Taiwan’s ADIZ |
|------------|---------------|-----------------------------|--------------|---------------------------------------|
| 7/13/21    | Japan         | 3rd announcement            | AZ           | 7/13 Y-8 EW 1, Y-8 RECCE 1              |
|            |               |                              |              | 7/14 Y-8ASW 1                          |
|            |               |                              |              | 7/15 Y-8 ASW 1                          |
|            |               |                              |              | 7/16 N/A                               |
|            |               |                              |              | 7/17 N/A                               |
|            |               |                              |              | 7/18 N/A                               |
|            |               |                              |              | 7/19 N/A                               |
| 7/15/21    | Japan         | 3rd vaccine arrival          | AZ           | 7/15 Y-8ASW 1                          |
|            |               |                              |              | 7/16 N/A                               |
|            |               |                              |              | 7/17 N/A                               |
|            |               |                              |              | 7/18 N/A                               |
|            |               |                              |              | 7/19 N/A                               |
|            |               |                              |              | 7/20 N/A                               |
|            |               |                              |              | 7/21 Y-8ASW 1                          |
| 7/16/21    | Slovakia      | 1st announcement            | AZ           | 7/16 N/A                               |
|            |               |                              |              | 7/17 N/A                               |
|            |               |                              |              | 7/18 N/A                               |
|            |               |                              |              | 7/19 N/A                               |
|            |               |                              |              | 7/20 N/A                               |
|            |               |                              |              | 7/21 Y-8 ASW 1                          |
|            |               |                              |              | 7/ Y-8 ASW 1                            |
| 9/26/21    | Slovakia      | 1st vaccine arrival          | AZ           | 9/26 Y-8 RECCE 1                        |
|            |               |                              |              | 9/27 Y-8 EW 1, Y-9 EW 1, J-16 2, KJ-500 1, Y-8 ASW 1 |
|            |               |                              |              | 9/28 Y-8 EW 1, Y-8 ASW 1                |
|            |               |                              |              | 9/29 KJ-500 1, Y-8 ASW 1, J-16 4, J-10 4 |
| 7/16/21    | Czech         | 1st announcement            | Moderna      | 7/27 Y-8ASW 1                          |
|            |               |                              |              | 7/28 Y-8ASW 1                          |
|            |               |                              |              | 7/29 N/A                               |
|            |               |                              |              | 7/30 N/A                               |
|            |               |                              |              | 7/31 N/A                               |
|            |               |                              |              | 8/1 N/A                                |
|            |               |                              |              | 8/2 N/A                                |
| 7/31/21    | Lithuania     | 1st vaccine arrival          | AZ           | 7/31 N/A                               |
|            |               |                              |              | 8/1 N/A                                |
|            |               |                              |              | 8/2 N/A                                |
|            |               |                              |              | 8/3 N/A                                |
|            |               |                              |              | 8/4 N/A                                |
|            |               |                              |              | 8/5 N/A                                |
|            |               |                              |              | 8/6 N/A                                |
| 8/29/21    | Czech         | 1st vaccine arrival          | Moderna      | 8/29 Y-8 RECCE 1                        |
|            |               |                              |              | 8/30 Y-8 RECCE 1                        |
|            |               |                              |              | 8/31 N/A                               |
|            |               |                              |              | 9/1 Y-8 RECCE 1                         |
|            |               |                              |              | 9/2 N/A                                |
|            |               |                              |              | 9/3 Y-8 RECCE 1, Y-8 ASW 1 H-6K bomber 2 |
|            |               |                              |              | 9/4 JH -7 2, Y-8 ASW 2                  |
cognitive warfare is the safety concerns and low efficacy of the Chinese vaccines (Sinovac and Sinopharm) as most democratic countries in Europe and the United States have refused to endorse them. While this could be an advantage for Taiwan’s defense of cognitive warfare, this cannot be taken for granted when serious national security is concerned. More need be done to safeguard the young democracy on all fronts.

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Notes

1. See also Liberty Times (2021).
2. Bienvenue et al. (2019).
3. Gershaneck (2021).
4. Dotson (2019).
5. Rachael (2013).
6. Beauchamp-Mustafaga (2013).
7. Backes and Swab (2019).
8. Fauci (2007).
9. Roxburgh and Weerasekara (2020).
10. Cole (2021).
11. Van Ham (2010).
12. Anholt (2007).
13. People.cn (2020).
14. Molter and Diresta (2020).
15. Best and Houng (2020).
16. Hong and Lee (2020).
17. Raw data and programming files for processing and modeling the data are available at the corresponding author’s website at https://karlho.com/ under this article’s title (click at Data and Codes).
18. Presidential approval and disapproval rating data are drawn from Taiwanese Public Opinion Foundation (TPOF; https://www.tpof.org) surveys.
19. One caveat is the PLA incursion data are aggregated to fit in the model of presidential support, which is recorded monthly by the TPOF. This aggregation may have suppressed the daily variance in the time series model.
20. The phrase “using pandemic to plot independence” has been often cited by PRC Ministry of Foreign Affairs spokesperson Zhao Lijian and in Xinhua News Agency commentaries.
21. The post received the highest retweet and number of favorite was originally tweeted by a KOL who has 33k followers. Translated into English, the post reads

Thank you Professor Li Bingying for coming to the Hexinyue Club early in the morning to give a speech. Enlightening! Personal takeaway: 1 High-end (MVC) is a good thing, but it has been badmouthed by foreign influence. These garbage comments really suck. 2 Put on your mask and take whatever vaccine you have 3 There is a group of such excellent people in the command center in Taiwan helping everyone. You should feel very grateful and don’t be silly anymore.

22. Facebook data are provided by OPView, a company specialized in social media data.
23. Since we do not have detailed data of those who viewed and clicked likes to the posts, we cannot conclude the high volumes in these posts were from Chinese users representing the cognitive warfare efforts.
24. Rejection of lnalpha indicates Negative Binomial is better candidate than Poisson or ZIP as variance is significantly greater than the mean (see Long, 1997).

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Appendix 1

The Detailed analyses on Facebook data about vaccines in Taiwan are as follows:

We scrape the Facebook data using “vaccine and (MVC (Medigen)|domestic)” as the keyword, collecting a total of 2,186,813 related posts (see Figure 6(a)). Compared with other vaccines, this locally developed vaccine received much higher volume, including 203,967 positive emotions (green line) and 783,227 negative emotions (red line). In this public opinion observation interval, topics related to “domestic vaccines” are dominated by negative emotions. Data were extracted from different intervals, namely, 30 May–4 June (307,665), 8–13 June (298,160), 15 June (312,289), 19–21 July (105,513), 27–28 July (76,099), 16 August (26,235), 18 August (23,266), and 23–27 August (231,138) demonstrated spikes in May, June, and August.

Events during this period are worth mentioning:

- The first batch of Moderna vaccines arrived in Taiwan from 30 May to 4 June.
- While Taiwanese people are skeptical about domestic vaccines, from 8 June to 13 June, there have been much discussion about the unit price of domestic vaccines.
- On 15 June, the Philippines denied that it was exempted from the three-phase EUA emergency procedures for Taiwan’s vaccine.
- From 19 to 21 July, 16 August, 18 August, and 23 to 27 August, skepticism on social media emerged about MVC’s EUA review, doubting the protective power of Medigen, and its vaccination and post-treatment side-effects.

AstraZeneca. Using “vaccine and AZ” as the keyword to observe the volume of online voices, the total volume of related posts is 1,127,235, less than half those of MVC (see Figure 6(b)). These posts include 107,958 positive emotions (green line) and 399,057 negative emotions (red line).

While the topics related to “AZ vaccine” are mainly negative emotions, these are much smaller in volume compared with MVC. Data were extracted from different intervals, namely, 26–30 May (106,716 cases), 3–5 June (123,080 cases), 10–14 June (106,382 cases), 17 June (15,640 cases), 22 June (14,975), 25–26 June (46,568), 6 July (17,251), 8 July (13,999), and 13 July. On the 17 June (92,353 cases), 27 July (14,278 cases), 12 August (15,740 cases), and 5 September (13,590 cases), there were some clear spikes, probably triggered by events:

- The peak time is related to the issue of vaccine donations from Japan and Lithuania, except from 26 to 30 May, 17 June, 13 July, 17 July, 12 August.
- Mentioning the arrival of the Moderna vaccine in Taiwan.
- The case of sudden death from the AZ vaccine shot.
Figure 6. Comparative sentiments of different vaccines on Facebook (a) Medigen (Made in Taiwan), (b) AZ, (c) BioNTech (BNT), and (d) Moderna. Green: positive posts; red: negative post.
• The release of the mixed vaccine trial.
• The discussion of the relationship between AZ and sudden death, in the peak (3–5 June, 10 June), from 14 June, 22 June, 25–26 June, 6 July, 8 July, 27 July, and 5 September are to discuss.
• Japan, Lithuania donated me the vaccine and the arrival of self-purchased vaccines in Taiwan.

BioNTech. Using “vaccine and (BNT|Pfizer)” as the keyword, we collected 1,057,041 related posts, including 99,644 positive emotions (green line) and 386,720 negative emotions (red line) (see Figure 6(c)).

Like other vaccine related posts, the topics related to the “BNT vaccine” are mainly negative emotions. Data were extracted from different intervals, namely. 26 May–3 June (226,525), 13 June (20,395), 18 June (23,616), 11–15 July (164,544), 21 July (13,506 cases), and from 26 August to 2 September (155,544 cases).

From 26 May to 3 June, there were rumors that the BNT vaccine was a Chinese vaccine, prompting netizens’ skepticism and anger. On 13 June, another rumor was prevalent that President Tsai Ing-wen had administered the BNT vaccine, further making the BNT vaccine the subject of a political struggle. Negative sentiments were expressed on Facebook post, showing more disappointment with the political situation in Taiwan. The follow-up peaks are all related to the issue of vaccine donations by private organizations.

• On 18 June, the government expressed its opposition to the independent purchase of BNT vaccine by private organizations, and pointed out that the vaccine purchased by non-government organizations would not get full authorization, prompting a surge in negative voices. The public believed that the government rejected vaccines from NGO’s amid vaccine shortage, putting public health at high risk of infections and COVID deaths.
• From 11 to 15 July, there was a second peak in volume. The government accepted NGO’s purchase and donation of BNT vaccines. The public believed that the government’s move was nothing more than capitalizing on the vaccine donation.
• From 26 August to 2 September, the BNT vaccine purchased by private parties and NGO’s arrived in Taiwan. The public expressed their gratitude to these individuals and organizations while showing dissatisfaction with the government’s vaccine policy.

Moderna. Using “vaccine and Moderna” as the keyword to observe the online voice volume, we collected a total volume of 651,528 related posts, including 66,975 positive emotions and 202,795 negative emotions (see Figure 6(d)).

The “Moderna vaccine” posts were dominated by negative emotions. Data were extracted from different intervals, namely, 27–30 May (66,230), 18–22 June (111,541), 30 June (14,985), 12–17 July (60,641), 22 July (10,661), 25 July (10,557), 27 July (7700), 8–9 August (18,761), 15 August (8926), 30 August (7625), and 15 September (7442).