

Exposing misinformation structures about the “COVID-19 vaccine infertility” myth: An empirical study on Japanese Twitter

INTRODUCTION AND MAIN FOCUS

Misinformation interferes with people's decisions based on sound health information, especially during the COVID-19 pandemic (WHO, 2020). In recent years, studies have proved that such misinformation originated only by a few accounts but rapidly, profoundly, and effectively spread through social media (e.g. Vosoughi, 2018). To cultivate accurate health information, debunking misinformation has been attempted, including fact-checking or disseminating "correct" scientific information by public organizations (Kraus et al. 2020). However, the "belief persistence" of those people entrapped in the echo chamber is difficult to resolve, and the effectiveness of countermeasures toward misinformation is yet to be studied (Chan et al., 2017).

In this study, we investigated whether the existence of an echo-chamber would affect the structure of echo chambers per se in social media. More specifically, this study consists of two steps: In the first step, we gathered and analyzed Twitter data on the topic of the "COVID-19 vaccine causes infertility." The results showed that only 29 accounts were disseminating the hoax, but followers were vigorously disseminating them. At this point, this preliminary result was frequently quoted and reported by the Japanese mass media and social media, including Twitter (Nikkei, 2021). Therefore, we continued to investigate how the argument structure about vaccine infertility in Twitter changed after our results were widely known to the public. We expected that the results of this research would provide us with the perspective of taming misinformation for better health communication in this hybrid media environment.

DATA AND METHODS

Twitter data was collected by the authors using an API. About 420,000 cases were collected between January 1, 2021, and August 31, 2021, which included the keywords "vaccine" and "infertility." The retweet network and hyperlinks included in each tweet were analyzed using Python programs. A total of 50,000 cases were randomly sampled to visualize the retweet network structure.

RESULTS

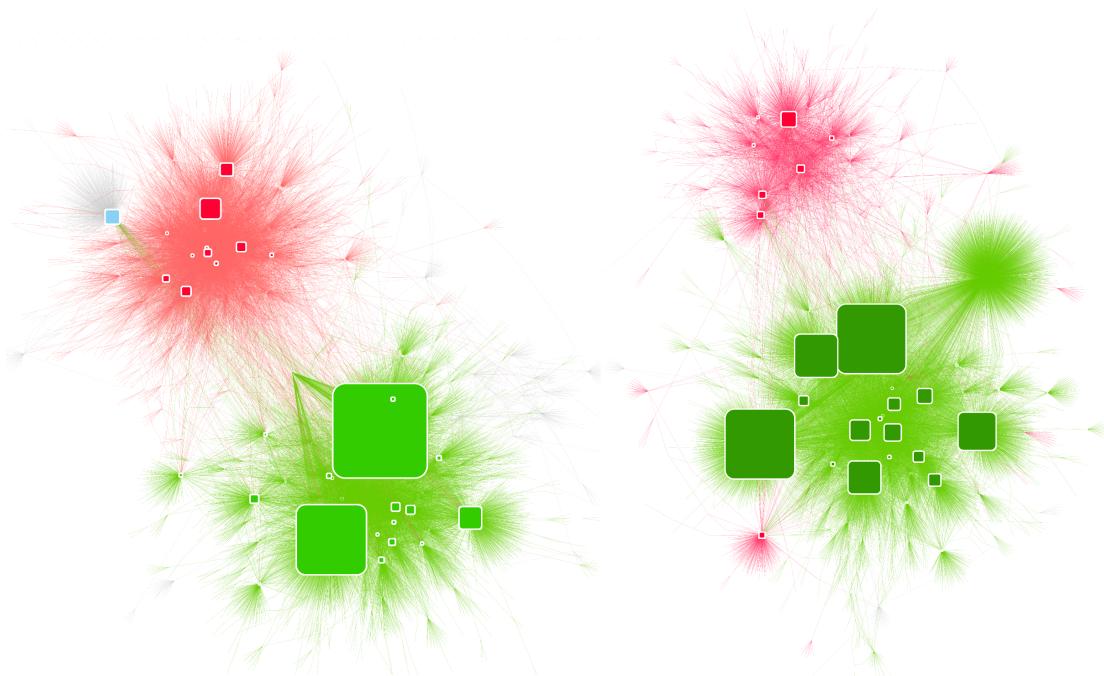
The retweet network analysis depicted two large clusters: that of the vaccine-hesitants (VHs) and that of its counterpart, the debunkers (DBs), in which many doctors and scientists were involved (Fig. 1). Table 1 shows examples of actual tweets that each cluster insists on mutually exclusive opinions, proving that each cluster could be called an echo chamber. The number of users in each cluster was calculated (Fig. 2). Comparing before and after the media coverage of our preliminary result (Fig. 2A), the percentage of DBs increased (+16.9 %), and VHs decreased (-15.6 %). The 25,037 users found in both before/after data were defined as "core users." Focusing on these core users (Fig. 2B), the ratio of DBs and VHs was almost unchanged (+0.9 % and -1.5%, respectively). In other words, there was no significant change in the activity of core users in either cluster. Furthermore, we investigated the number of users who changed their attitudes within each cluster. After the article was published, 2.1% of DBs and 9.2% of users of VHs changed to another partisanship.

DISCUSSION

Based on our analysis, to some extent, the articles that insinuate “You are being instigated by some agitators” confirmed to have some debunking effects that scientists would expect. However, it could also be argued that VHs are not significantly affected because opinion leaders' activities remain intact. Moreover, it must be stated that the echo chambers of the VHs and DBs are structurally equivalent. This indicates the need for further study that the science news increases uncertainty, such as a report of vaccine side effects, would have a reverse effect observed in this study. The effects of debunking and fact-checking do not solve everything on their own, but we have to continue to struggle for a better communication environment.

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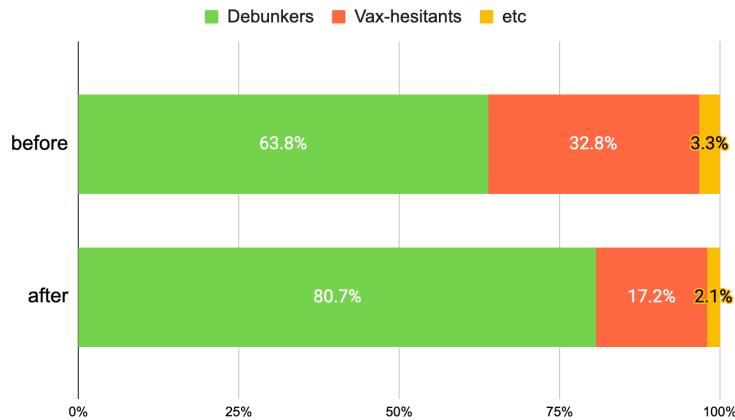
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- [Omitted for anonymity]



[Figure 1] Retweet network of Japanese tweets about misinformation on the link between vaccines and infertility.

Transition of the network structure before (left) and after (right) our findings were reported on mass media.

A



B

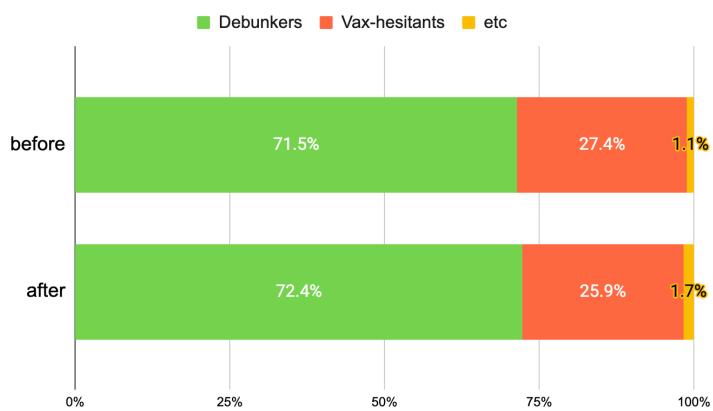
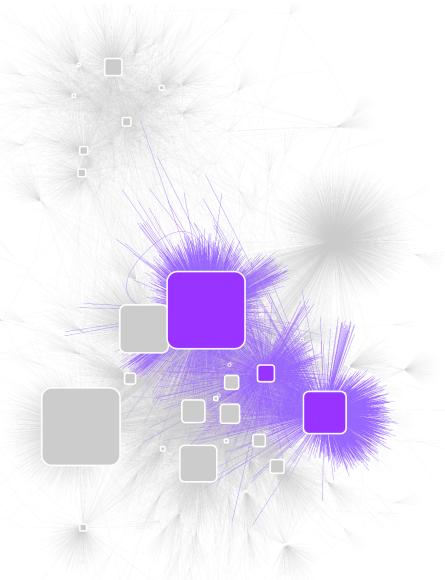


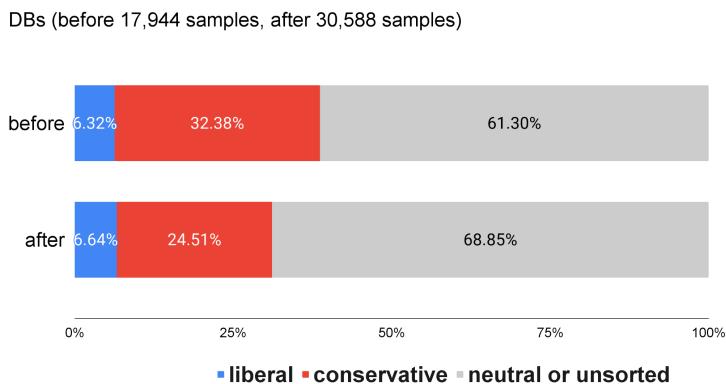
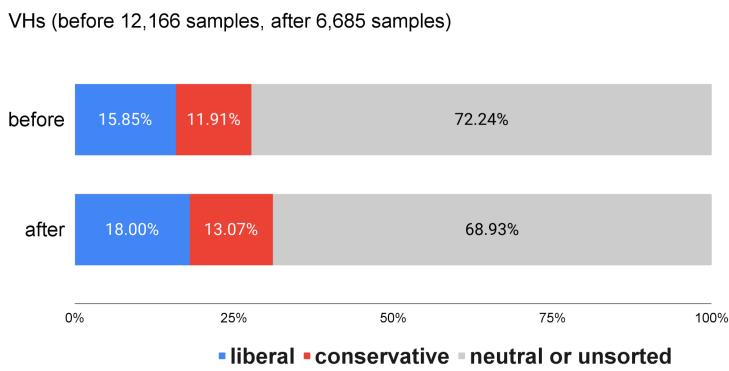
Figure 2 Changes in number of users per cluster

Figure 2 shows the trajectories in the number of users per cluster before and after the article was published (A) and changes in the number of core users for each cluster before and after the article was published (B).



[Figure 3] Range that the article propagated in the retweet network

Figure 3 shows the extent to which our article propagated on the retweet network. The article spread intensively in the lower DB cluster and hardly spread in the upper VH cluster.

A**B**

[Figure 4] Comparison of political stances of users in DB (4A) and VH (4B) clusters

Finally, we investigated the political stances of the users within each cluster (Figure 4). To this end, we referred to Yoshida et al. (2021), who investigated the political stance of Japanese Twitter users, and through this, users of our datasets were classified as liberal, conservative, and natural or unsorted. Regardless of whether the article was reported or not, in the case of DBs, the number of conservation was much higher than that of liberals (Figure 4A), and in the case of VHs, the number of conservation exceeded that of liberals (Figure 4B).

Table 1. Three most popular retweets in each cluster

Rank	Cluster of vax-hesitants (red)	Rank	Cluster of debunkers (green)
1	Today, my daughter is going to have a miscarriage of her dead child in her stomach. (...) A week after she was vaccinated against the corona, the baby died in her stomach. (...)	1	The Ministry of Health, Labor and Welfare has officially issued statements saying, "Vaccination does not increase deaths," "Vaccination does not increase miscarriage," and "Rumors are spreading on SNS and leaflets that people are dying." (...)
2	It is almost certain that mass vaccination can lead to infertility. Examining the official document, on page 16 of the following official document, "The main tissues where radioactivity was found outside the administration site are the liver, spleen, adrenal gland, and ovary, and the highest value is 8 to 48 hours after administration."	2	Regarding vaccines currently inoculated in Japan, we have not learned that the number of deaths from any disease will increase due to vaccination. Overseas surveys also show that miscarriages have not increased among vaccinated people.
3	USA: 6,985 deaths after vaccination of new corona, 6,899 fatal injuries, 10,400 thrombosis and stroke, 775 miscarriages, 411,931 adverse events CDC updates data (as of June 25, 2021)	3	There were about 110,000 posts on Twitter that vaccines lead to infertility in the seven months from January. Half of them, more than 50,000, started with only 29 account posts.