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## Effects of inoculation against a disinformation campaign: A case study of disinformation over Japan's release of Fukushima treated water

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# **[Working Paper] Effects of inoculation against a disinformation campaign: A case study of disinformation over Japan's release of Fukushima treated water**

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## **Abstract**

This study examines whether news media can effectively counter a disinformation campaign. It uses disinformation against the release of treated water from the Fukushima nuclear power plant in Japan as a case study from the perspective of media studies. Based on psychological inoculation theory and multivariate statistical analysis of survey data collected in Feb 2024, it is found that warnings about a disinformation attack from the news media can reduce people's beliefs in actual disinformation. However, the results also reveal that news media reports on debunked disinformation can have the opposite effect unless they also educate people with tropes used in the debunked disinformation.

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## Introduction

Coordinated online disinformation campaigns have become a clear and present threat to democracies (The Conversation, 2023). Research has shown that, by exploiting social media algorithms, organised online disinformation campaigns can manipulate public opinion and even destabilise society (Lewandowsky et al., 2023; Nagasako, 2020). Currently, most attention on the impact of disinformation campaigns has focused on the West because of the saliency of events like the alleged Russian interference in the 2016 US presidential elections (Bose, 2020). However, in recent years, it appears that democracies in Asia are no exception to this threat (Mainichi Japan, 2023; Nagasako, 2020).

In the summer of 2023, Japan became the target of a disinformation campaign aiming to drive negative public opinion against its government's controversial decision to release the ALPS treated water from the Fukushima Daiichi nuclear power plant into the Pacific Ocean<sup>2</sup>. In the weeks before and after the first release of the treated water on 24 August 2023, in parallel with strong diplomatic protests mainly by the Chinese government, waves of disinformation about the treated water flooded the internet (Cai, 2023; Davidson, 2023). Reports from different organisations in the UK (Hariharan, n.d.), Canada (Government of Canada, 2023), Australia (Zhang, 2023), and Taiwan (Lin & Yu, 2023) have pointed out that the disinformation and diplomatic protests against the treated

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<sup>2</sup> ALPS = Advanced Liquid Processing System. For details about the release, refer to the official website of the International Atomic Energy Agency (IAEA)

<https://www.iaea.org/topics/response/fukushima-daiichi-nuclear-accident/fukushima-daiichi-alps-treated-water-discharge>

water during this period appeared to be coordinated between Chinese state media and pro-China influencers.

In response, the Japanese government refuted the claims diplomatically as well as made special efforts domestically to counter the disinformation and disseminate its corrective information on mass and social media (Miki, 2023; Uechi, 2023). During this period, almost all major Japanese news media outlets made special programmes and reports to debunk the disinformation and warn the public against disinformation about the treated water. In particular, during the weeks before and after the beginning of the first release on 24 Aug 2023, all national television stations broadcast special reports about disinformation against the treated water in their prime-time news and current affairs programmes.

While the disinformation has caused some commotion in neighbouring countries, in particular in China and Korea (Hall & Zhang, 2023), most people in Japan seemed to have remained calm. According to public opinion polls carried out by NHK (the public broadcaster) before the release in Aug 2023 (NHK News Web, 2023b) and after the release in Sep 2023 (NHK News Web, 2023a), the approval rates on the government's decision to release the treated water had increased from 53% to 66%, despite the general approval rates of the Kishida Cabinet were hitting record lows.

As of now, most of the discussion of the issue has been centring on the geopolitics between the East and the West (Rich & Liu, 2023; Siow, 2013; Suzuki & Kainuma, 2023). This study takes a different angle on this issue from the perspective of media studies, media literacy, and social psychology. Specifically, drawing from psychological inoculation theory (van der Linden, 2023), its main research question is to examine whether news media can counter a disinformation campaign.

## 2 Literature Review

### *2.1 Disinformation campaigns*

Disinformation can be defined as false, fabricated, or manipulated content that is created and spread intentionally to deceive and mislead people (Council of Europe, 2017). It has long been part of human history, what makes it significant in today's context is that the internet, in particular social media, has allowed disinformation to travel faster and reach deeper than ever before. Studies have found that the creation of 'echo chambers' and 'filter bubbles' by social media algorithms has significantly reduced the cost of disinformation campaigns. In particular, by exploiting these algorithms and people's psychological biases, malicious actors can now deceive the public and manipulate their opinion by micro-targeting individuals with disinformation that aligns with their prejudices (NHK News Web, 2018; van der Linden, 2023).

When disinformation is created and dissemination in a coordinated way to achieve specific political purposes, it is referred to as a disinformation campaign or coordinated disinformation attack (Nagasako, 2020). From a national security level, it is defined by the European Union Agency for Cybersecurity as Foreign Manipulation and Interference (FIMI), which is:

a mostly non-illegal pattern of behaviour that threatens or has the potential to negatively impact values, procedures and political processes. Such activity is manipulative in character, conducted in an intentional and coordinated manner. Actors of such activity can be state or non-state actors, including their proxies inside and outside of their own territory (European Union Agency for Cybersecurity, 2022, p. 26).

Examples of major recent events influenced by disinformation campaigns in recent years include the 2016 Brexit Referendum in the UK, the 2016 US Presidential elections, the 2021 January 6 US Capital attack, and anti-vaccine movements during the COVID-19 pandemic (Lewandowsky et al., 2023; Wilson & Wiysonge, 2020).

## ***2.2 Psychological Inoculation Theory***

Much research has been devoted to counter disinformation. Recent studies have found that one of the most promising tactics stems from psychological inoculation theory (van der Linden, 2023).

The theory suggests that, similar to vaccinating against viruses, people can be also psychologically inoculated against disinformation. The concept was proposed by McGuire in the US in the 1960s during the Cold War (McGuire & Papageorgis, 1962). Drawing from an analogy of biomedical inoculations, the core idea of psychological inoculation is that people will be more psychologically resilient against persuasion attacks if they are pre-exposed to weakened versions of the impending persuasions (Traberg et al., 2022).

Recent models of psychological inoculation consist of different combinations of the following three elements (Compton, 2012, 2021; Lewandowsky & van der Linden, 2021; van der Linden, 2023; van der Linden & Roozenbeek, 2020):

- 1) Warn: Forewarnings of an impending disinformation attack to raise awareness and motivate resistance. These warnings are usually direct messages that explicitly forewarn people of threats from specific actors who are attempting to mislead the public for specific goals. They are also usually the first part of the

psychological inoculation process as threat is the most direct way to catch people's attention and raise awareness.

- 2) Prebunk: Preemptive refutation using debunked or weakened versions of disinformation to elicit attitudinal responses and build motivation to defend against actual disinformation. Both as a follow-up or independent of the forewarnings, people are presented with refutational preemptions. These preemptions are usually debunked versions of actual or hypothetical disinformation aiming to raise people's awareness of what they may come across in the near future. They implicitly increase people's alertness and, subsequently, resistance against actual disinformation.
- 3) Educate: Equip people with the knowledge to identify disinformation in real life by showing different persuasive tropes used in the debunked or weakened versions of disinformation. According to (Roozenbeek et al., 2022), most disinformation uses similar tropes to mislead people, such as 1) using emotionally charged words to evoke negative emotions; 2) using incoherent arguments; 3) presenting false dichotomies; 4) scapegoating others; and 5) engaging in ad hominem attacks. Therefore, if people can learn to identify these tropes from the debunked disinformation, they will be more capable of spotting actual disinformation in real life, just like having antibodies against a virus. The explaining of disinformation tropes (Educate) is usually presented as part of the refutational preemptions.

Studies on psychological inoculation have shown positive results in increasing people's resistance against disinformation in different areas, from health, politics, to commerce. For instance, studies by (Schmid-Petri & Burger, 2022; van der Linden et al.,

2017) demonstrated how pre-emptively inoculating people against disinformation about climate change can effectively increase their resistance to real-world climate change disinformation on social media.

That being said, just like biomedical vaccines, psychological inoculations also have limitations and side effects. For instance, not everyone is equally receptive to the threats in the warning messages. When the content of the warning messages contradicts the worldviews or beliefs of the recipients, they may reject or ignore the messages. Studies have found that in some cases, the threats can even lead to backlashes like source derogation and irritation (Compton, 2021).

Another concern of presenting people with weakened or debunked versions of disinformation is that it unavoidably will bring the disinformation topics into public discourses, which may cause some people to over- or under-react to disinformation (Compton, 2021). Moreover, it is a challenge to get people to pay attention to the inoculation messages in today's media-saturated society, in which people's attention is limited. Besides, in reality, it is difficult to predict when people will come across the actual disinformation. Even if people have learned the tropes from the inoculation messages, by the time they come across the actual disinformation, they may have forgotten them. Moreover, people may be exposed to actual disinformation before they receive the inoculation messages (van der Linden, 2023).

### **3 Research Question**

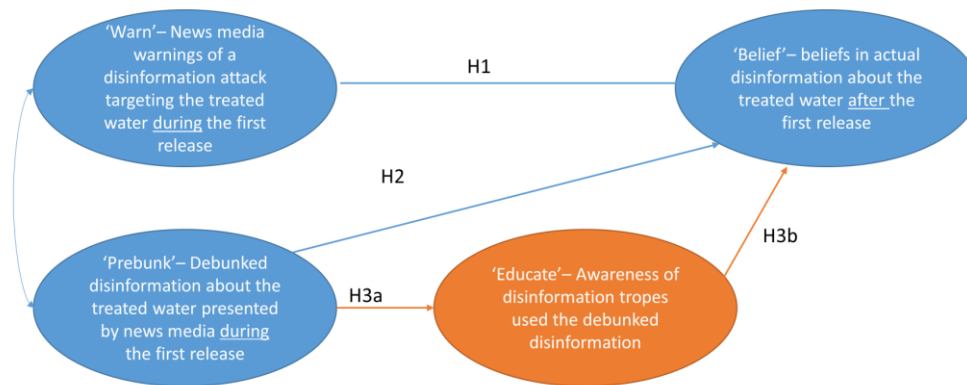
The main research question is to find out whether news media can counter a disinformation campaign. Based on the psychological inoculation theory, in the case of the disinformation campaign against the release of the treated water, it is assumed that:



Japanese news media reports on disinformation related to the treated water that were broadcast or published during or before the first release (28 Aug - 11 Sep 2023 REF) would increase people's resistant to actual disinformation about the treated that appeared afterward. As illustrated in Figure 1, it is hypothesised that:

- H1: Warnings of a disinformation attack (Warn) presented by the news media reduce beliefs in the actual disinformation (Belief)
- H2: Debunked disinformation presented by the news media (Prebunk) reduces beliefs in the actual disinformation (Belief)
- H3a: Debunked disinformation presented by news media (Prebunk) increases awareness of tropes used in the debunked disinformation (Educate)
- H3b: Awareness of tropes used the debunked disinformation (Educate) reduces beliefs in the actual disinformation (Belief)

Theoretical model



Social demographic: Age, Gender, Education, Parenthood, Residing area  
 Media usage: Mass media, Social media, Internet news sites, Liberal media trust, Conservative media trust  
 Personal opinion: Government trust, Evaluation (government decision to release the treated water), Concerns (the treated water), Feeling towards China

Figure 1 Theoretical framework

## 4 Data and Method

Data were collected from a questionnaire survey conducted between 20 and 22 Feb 2024, a week before the 4th release of the treated water (NHK News Web, 2024). As shown by the Google Trends of the search keyword ‘treated water’ (処理水 in Japanese) in Figure 2, people’s overall attention on this topic dropped significantly after the first release (24 Aug-11 Sep 2023). During the periods of the second release (5-23 Oct 2023) and the third release (2-20 Nov 2023), the levels of attention were minimal in comparison. Therefore, it could be assumed that responses collected during the survey period would not be significantly influenced by the saliency of the issue.



Figure 2 Goggle Trends Source: (Google Trends, n.d.,)

The survey was administered by Macromill, a professional survey company that maintained an opt-in survey panel of more than 1 million users across Japan. Respondents were selected from the survey company’s panel using a quota sampling emulating the age,

gender, and residing area distributions of the 2022 population data (e-Stat, 2023). In total, responses from 1,034 adults between 20 to 69 years old were collected.

The average age of the sample population was 45.83. 50.4% were men and 49.6% were women. 44.9% resided in Eastern Japan and 55.1% resided in Western Japan. 60.7% were married and 39.3% were single. 51.6% were parents and 48.4% had no children. 45.1% had a tertiary degree.

#### ***4.2.1 Questionnaire design***

In the survey, respondents were asked questions in the following orders:

1. Actual disinformation (Belief): Respondents were presented with screenshots of four selected pieces of disinformation about the treated water (Table 1) that appeared on social media after the beginning first release (24 Aug). Then they were asked whether they believed each one of them was true or not on a five-point scale (1=Not at all to 5 =Very much). All four pieces of disinformation were verified by fact-checking organisations as false or misleading.

*Table 1 Actual disinformation (Belief)*

	Source	Date	Claim (summarised and translated into English by the authors)	Debunked by
FN1	X	23/9/23	(With no evidence) - even though the treated water released so far was tested to be safe, the real 'poisonous' water will be released next year.	Japan Fact-check Center <sup>3</sup>

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<sup>3</sup> <https://www.factcheckcenter.jp/fact-check/nuclear/highly-radioactive-contaminated-water-release-next-year-false/>

FN2	X	27/08/23	(Misquoted a TV (TBS) report) - the ALPS system only removed 60% of the tritium	Japan Fact-check Center <sup>4</sup>
FN3	X	05/09/23	(Based on an old news report – before the first release) - fish caught in the area was tested with high radioactive readings	Huffing Post Japan <sup>5</sup>
FN4	X	05/09/23	(Based on a link to a Chinese SNS) – Russian experts suggested using hydrogen bombs to stop Japan’s release of ‘nuclear’ water	Information Environment Research Center <sup>6</sup>

2. Warning messages (Warn): Respondents were presented with headlines of nine selected news media reports on disinformation and negative reactions from China against Japan’s release of the treated water that were published before or during the first release (24 Aug-11 Sep 2024). Then they were asked whether they had seen similar reports on a five-point scale (1=Never to 5=Frequently).

*Table 2 Warning messages (Warn)*

	Source	Date	Headline topics (summarised and translated into English by the authors)
WN1	NHK <sup>7</sup>	24/08/2023	The Ministry of Foreign Affairs of Japan is strengthening countermeasures against disinformation targeting the treated water

<sup>4</sup> <https://www.factcheckcenter.jp/fact-check/nuclear/alps-strontium-radioactive-materials-60-percent-not-removed-sea-discharge-false/>

<sup>5</sup> [https://www.huffingtonpost.jp/entry/factcheck-fukushimasuzuki\\_jp\\_64f7b3dae4b039d8665217d2](https://www.huffingtonpost.jp/entry/factcheck-fukushimasuzuki_jp_64f7b3dae4b039d8665217d2)

<sup>6</sup> [https://iorg.tw/\\_en/da/50#h2-9](https://iorg.tw/_en/da/50#h2-9)

<sup>7</sup> <https://www3.nhk.or.jp/news/html/20230824/k10014172021000.html>

WN2	TBS <sup>8</sup>	31/08/2023	A member of the House of Representatives requests stronger countermeasures against ‘information war’ from countries like China.
WN3	NTV <sup>9</sup>	04/07/2023	Reactions in China against Japan’s ‘polluted water’ – malicious disinformation and boycotting of Japanese goods.
WN4	ANN <sup>10</sup>	31/08/2023	Disinformation spreading on Chinese SNS such as ‘black water at Fukushima’ and ‘mutated fish.’
WN5	NHK <sup>11</sup>	28/08/2023	Disinformation about the treated water and the boycotting of Japanese cosmetics.
WN6	NTV <sup>12</sup>	08/08/2023	Reactions on Japan’s release of the treated water. A combination of banning ‘Japanese fish’ and fake news.
WN7	ANN <sup>13</sup>	31/08/2023	Real anti-Japan sentiments from Chinese visitors ‘no problem,’ ‘scary.’
WN8	NTV <sup>14</sup>	25/08/2023	Full ban of Japanese seafood by China amidst test reports showing the treated water was safe.
WN9	NTV <sup>15</sup>	26/08/2023	Tension in China on Japan’s release of the treated water is affecting Japan.

3. Preemptive refutation (Prebunk): Respondents were presented with screenshots and excerpts of four selected news media reports that debunked disinformation related to the treated water that were broadcast or published before or during the first release (24 Aug-11 Sep 2024). Then they were asked

<sup>8</sup> <https://newsdig.tbs.co.jp/articles/-/634260?display=1&mwplay=1%201/4>

<sup>9</sup> <https://news.ntv.co.jp/category/society/0feb24a75978488895a055c419080d62>

<sup>10</sup> [https://news.tv-asahi.co.jp/news\\_international/articles/000313825.html](https://news.tv-asahi.co.jp/news_international/articles/000313825.html)

<sup>11</sup> <https://www3.nhk.or.jp/news/html/20230828/k10014176331000.html> 1/14

<sup>12</sup> <https://news.ntv.co.jp/category/international/790d2bbf460f4f2287ae60a9917341a9>

<sup>13</sup> [https://news.tv-asahi.co.jp/news\\_society/articles/000313885.html](https://news.tv-asahi.co.jp/news_society/articles/000313885.html)

<sup>14</sup> <https://news.ntv.co.jp/category/society/a7a7bdeab61d4ca0bd59cb108f7843b4>

<sup>15</sup> <https://news.ntv.co.jp/category/international/136a0c2c64704dd0a172c9c6290b239a>

whether they had seen similar reports on a five-point scale (1=Never to 5= Frequently).

*Table 3 Preemptive refutations (Prebunk)*

	Source	Date	Topics (summarised and translated into English by the authors)
EX1	ANN <sup>16</sup>	31/08/23	Debunked disinformation about the treated water that was circulated on Chinese SNS
EX2	NHK <sup>17</sup>	28/08/23	Debunked disinformation about the treated water that spread from Chinese SNS to Japanese SNS
EX3	FNN <sup>18</sup>	04/09/23	Debunked a piece of defamatory disinformation targeting the Japanese Prime Minister over his decision to release the treated water that was circulated on Chinese SNS
EX4	NHK <sup>19</sup>	23/07/23	Debunked a piece of defamatory disinformation targeting the Japanese government and IAEA (International Atomic Energy Agency) that was circulated on Korean and Chinese SNS

4. Disinformation tropes (Educated): Respondents were asked whether they thought the debunked disinformation presented in the four news media report excerpts (EX1 to EX4) was trying to incite negative emotions like anger and fear on a five-point scale (TP1 to TP4) (1=Not at all to 5=Very much).
5. Media usage and personal opinion: Respondents were also asked about their:
  - 1) trust in the Japanese government in general; 2) opinion towards the government's handling of the release of the treated water; 3) concerns over

<sup>16</sup> [https://news.tv-asahi.co.jp/news\\_international/articles/000313825.html](https://news.tv-asahi.co.jp/news_international/articles/000313825.html)

<sup>17</sup> <https://www3.nhk.or.jp/news/html/20230828/k10014176331000.html>

<sup>18</sup> <https://www.fnn.jp/articles/-/581000>

<sup>19</sup> <https://www3.nhk.or.jp/news/html/20230723/k10014139611000.html>

the release; 4) opinion towards China. In addition, they were also asked about their 5) media usage and 6) trust in liberal and conservative news outlets.

Finally, at the end of the survey, respondents were presented with a debriefing statement explaining all the disinformation presented in the survey was verified as false or misleading by fact-checking organisations.

## 5 Results

First, descriptive results (Table 4) show that the levels of belief in the four selected disinformation about the treated water were quite low. The means of the levels of belief of all four pieces were below the mid-point (three). In fact, not only the levels of belief in the disinformation. The levels of awareness of most of the warning and debunked disinformation messages presented by the news media were also below the mid-point. These findings are in line with the Google Trends shown in Figure 1 implying that in general people's attention on the treated water was quite low during the time the survey was conducted.

*Table 4 Descriptive results*

Belief (Beliefs in actual disinformation 1~5)	Mean	SD
FN1	2.29	1.08
FN2	2.35	1.07
FN3	2.31	1.09
FN4	2.02	1.04
Cronbach's Alpha = 0.856		
Warn (awareness of warnings of disinformation 1~5)	Mean	SD
WN1	2.57	1.15
WN2	2.31	1.09
WN3	3.17	1.28

WN4	2.37	1.20
WN5	2.49	1.21
WN6	2.92	1.25
WN7	2.80	1.23
WN8	2.98	1.32
WN9	2.46	1.25
Cronbach's Alpha = 0.896	2.67	1.22
Prebunk (awareness of debunked disinformation 1~5)	Mean	SD
EX1	2.44	1.23
EX2	2.28	1.16
EX3	2.26	1.25
EX4	2.32	1.16
Cronbach's Alpha = 0.791		
Educate (Awareness Tropes)	Mean	SD
TP1	3.52	1.16
TP2	3.40	1.19
TP3	3.29	1.21
TP4	3.33	1.12
Cronbach's Alpha = 0.872		

### ***5.1 Hypothesis testing***

The hypotheses were tested in two separate SEM models. H1 and H2, the inoculation effects of warnings (Warn) and preemptive refutation (Prebunk) on beliefs in disinformation (Belief), were tested with the full sample set (n=1034). As for H3a and H3b, the inoculation effect of educating people with tropes used in disinformation (Educate) through the debunked disinformation (Prebunk), it is assumed only people who were exposed to the debunked disinformation by the news media would fit this criterion. Therefore, H3a and H3b were tested with a subset of the sample (n=221) who reported 4 (sometimes) or 5 (frequently) to questions regarding the awareness of the debunked disinformation presented by the new media.



## 5.2 H1 warnings and H2 preemptive refutation

H1 was supported according to the results (Figure 3). As predicted by the psychological inoculation theory, exposure to news media warnings of a disinformation attack (Warn) reduced beliefs (Belief) in actual disinformation (Standardised  $\beta = -0.152^{***}$ ). As for H2, however, was rejected according to the results. Interestingly, contrary to the theory, instead of reducing beliefs in actual disinformation, exposure to debunked disinformation presented by the news media actually increased beliefs in actual disinformation (Standardised  $\beta = 0.341^{***}$ ).

As for the control variables, the following variables were found to be significantly and positively related to beliefs in the actual disinformation: age (younger), education (lower), parenthood, trust in liberal news outlets, distrust in government, negative evaluation of the government's handling of the release, and concerns about the release of the treated water.

SEM Model 1

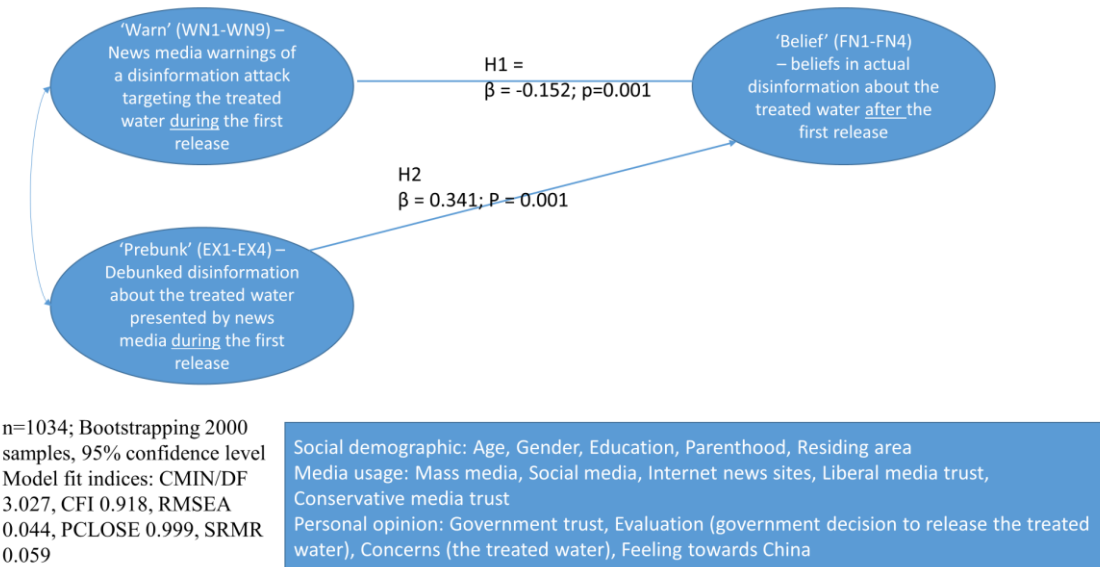


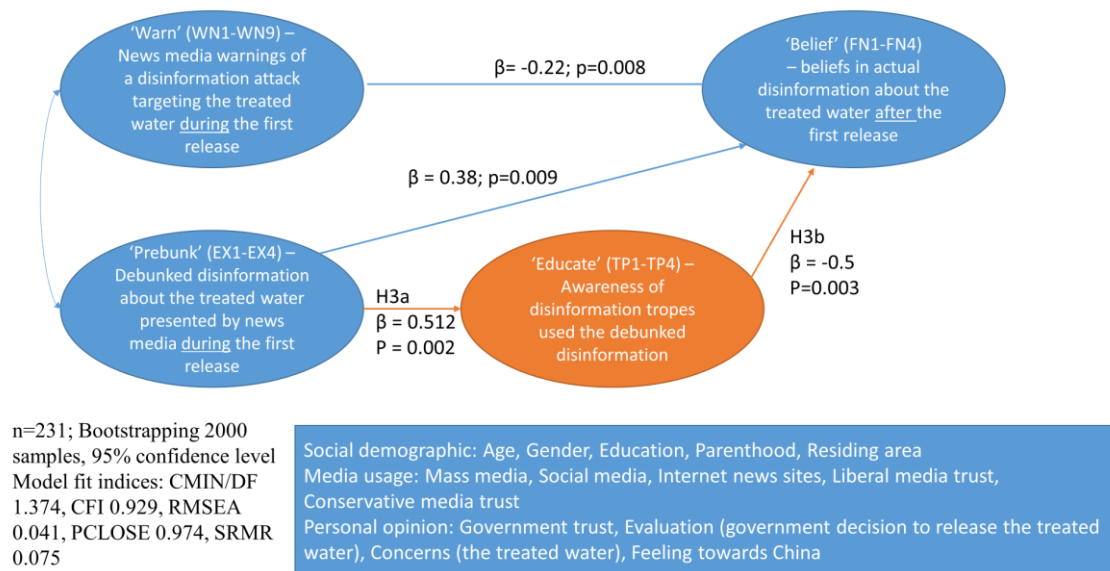
Figure 3 SEM Model 1 (H1 and H2)

### ***H3a and H3b Disinformation tropes***

The results of H3a and H3b are shown in Figure 4. Both of them were supported. First, H3a shows that exposure to debunked disinformation presented by the news media (Prebunk) increased people's awareness of tropes used in the debunked disinformation (Educate). Second, H3b shows that consistent with the inoculation theory, knowledge of disinformation tropes (Educate) reduced beliefs in actual disinformation (Belief).

Moreover, it is worth noting that the polarities of the effects between 'Warn' and 'Belief' and between 'Prebunk' and 'Belief' of SEM model 2 were the same as that of SEM model 1. In other words, these effects were consistent for both the full sample group (n=1034) and the subset (n=231) which were exposed to the debunked disinformation presented by the news media.

SEM Model 2



*Figure 4 SEM Model 2 (H3a and H3b)*

## **6 Discussion and conclusion**

The aim of this study is to examine whether news media can counter a disinformation

campaign. Based on the psychological inoculation theory and using the case of disinformation against Japan's release of the treated water in August 2023, it is hypothesised that news media reports on disinformation about the treated water before or during the first release would reduce beliefs in actual disinformation that appeared afterward.

First, the results show that news media warnings of an impending disinformation attack were effective in increasing people's resistance to actual disinformation about the treated water as the theory predicted (H1). However, the results also highlight a potential risk of the over-reporting of disinformation by news media. This is because the results show that, contrary to the inoculation theory, exposure to debunked disinformation presented by the news media actually increased people's beliefs in the actual disinformation (H2). One plausible reason for this is that, as explained in section 2.2, by presenting debunked disinformation, the media has to bring the topic into the public realm. In other words, the debunked disinformation presented by the news media might have primed some individuals who are not aware of the disinformation or are already concerned about the topic to pay more attention when they come across the actual disinformation.

That being said, the results also reveal a potential solution to this shortcoming. It is found that people who were both exposed to the debunked disinformation reported by the news media and were aware of the tropes used were much less receptive to the actual disinformation (H3a and H3b). This finding implies that in order for news media to counter disinformation effectively, on top of just presenting the debunked versions of the disinformation, the content must be clearly and carefully constructed to highlight the tropes used in a way that can capture people's attention.

Finally, this study has several limitations that readers should be reminded of. First is the temporal relation between the selected news media reports and actual disinformation. This is because, in today's media environment, many news reports, including the ones used in this study, are available on the internet even after they were broadcast on TV. Therefore, we cannot rule out the possibility that some respondents might have come across the reports after they were exposed to the disinformation. Second, as the data were collected from a self-reported questionnaire survey, self-reporting bias is evitable, especially on this relatively sensitive topic.

Nonetheless, the results are largely in line with the theory and they empirically demonstrate that news media can play a key role in countering a disinformation campaign. Moving forward, our next steps are to examine the mediation effect of 'Educate' on 'Prebunk' and 'Belief,' as well as the interaction effect between 'Warn' and 'Prebunk.' Moreover, further literature review is also necessary to develop a deeper understanding of the negative effect of 'Prebunk' on 'Belief.'

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