

EFFECTS OF EXPOSURE TO ANTI-VACCINE CONSPIRACY VIDEOS ON VACCINATION INTENTION: AN EXPERIMENTAL STUDY

Research Project: Social Media & Business Analytics

Project term paper

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ABSTRACT

Anti-vaccine conspiracy theories have become pervasive across social media networks since the outbreak of the COVID-19 pandemic. The false and misleading conspiracy stories could not only cause intensive emotional responses, but also affect personal health decision such as that for vaccination, and further undermine the collective efforts to fight the pandemic. Using an experimental design, this study investigated the effects of exposure to video-based anti-vaccine conspiracy theory as well as on refutational messages on individual vaccination intention. Unlike the findings from the mainstream studies, our results revealed that neither kind of short-term exposure have significantly changed people's vaccination intention. However, the exposure to anti-vaccine conspiracy video did increase people's feeling of fear and anger. Our study sheds light on the impact of conspiracy theories on psychological well-being and offers insights into how conspiracy information could be related to vaccination intention in times of a global public health crisis.

Keywords

COVID-19, vaccination intention, anti-vaccine conspiracy theories/videos, refutational videos, social media, emotional effects, anger, fear, mediation, online survey experiment.

INTRODUCTION

As the COVID-19 pandemic sweeps across the world, so do various conspiracy theories flourish in the digital sphere. Among the myriad pandemic-related conspiracy theories, those pertaining to the COVID-19 vaccination have gained widespread traction as more and more countries embarked on the deployment of nationwide COVID-19 vaccines. The rapid proliferation of anti-vaccine conspiracy stories on social media does not only manifest the phenomenon of what the World Health Organization (WHO) labelled as “infodemic” (UNDGC, 2020), confusing the public judgement between facts and fiction. More severely, the broad circulation of this particular type of conspiracy messages can well intensify the anxieties and fear against vaccination among general population, slow down the vaccination process, and subsequently, reduce the effectiveness of public efforts to counter the pandemic (The Royal Society, 2020).

The potential underlying linkage between anti-vaccine conspiracy theories and vaccination uptake has clearly raised the alarm for national and international public health authorities. The WHO has lately called for national governments to develop specific strategic communication activities that promote vaccination and manage misinformation as an integrated approach towards a National Deployment and Vaccination Plan (WHO, 2021). Likewise, the European Union (EU) has launched a series of

campaigns to fight against disinformation as part of the COVID-19 responses¹, including identifying, debunking, and countering conspiracy theories that claim vaccines are intentionally used for social control (European Commission, n.d.). Yet apart from the assumption about possible (negative) association between anti-vaccine conspiracy theories and vaccination attitudes under the context of the ongoing pandemic, it remains unclear *whether* and *how* conspiracy theories against the COVID-19 vaccines actually affect people's vaccination intention through the lens of scientifically guided empirical studies. Even less is understood concerning if, at all, information that is deliberately disseminated to counter these conspiracy theories can affect people's attitudes towards vaccination in an opposite way. This is the gap the present study wants to bridge.

Despite the surge of individual investigations in the emergence of conspiracy theories and vaccine hesitancy over the past five to ten years in the field of public health and communication studies, those that look into the connection between these two phenomena remain limited. The COVID-19 pandemic is rapidly changing this blind spot in the scientific community as a new wave of research has been dedicated precisely to examining the linkage between anti-vaccine conspiracy theories and people's vaccine intention. This study aims to contribute to this growing research field.

Recent studies find that vaccine-related conspiracy theories are not only able to evoke heightened negative emotional reaction such as fear, anger, mistrust of authorities in the public; these emotions in turn could also negatively affect people's intention to vaccinate (Chou & Budenz, 2020; Oliver & Wood, 2014). Under the context of the COVID-19 pandemic, belief in vaccine-related conspiracy theories is reported to be related to the resistance to preventive behaviors including decreasing one's intention for vaccination (Freeman et al., 2020; Romer & Jamieson, 2020), while short-term exposure to refuting messages is associated with an increase in willingness to vaccinate (Featherstone & Zhang, 2020). Moreover, the negative effects of exposure to conspiracy information are further mediated by the emotion of anger. These studies offer some preliminary findings which conform the previous research that conspiracy theories against vaccination often present an obstacle to vaccine uptake among population, whereby negative emotions are playing the role of mediators (Jolley & Douglas, 2014; Shapiro et al., 2016; Tomljenovic et al., 2020).

Building on the abovementioned studies, the present paper employs an online experiment to further explore the effects of anti-vaccine conspiracy theories on vaccine intention, as well as on the emotional changes that may act as potential mediators. It focuses, however, on the specific format of conspiracy messages that has not yet been examined, namely the video-based conspiracy theories. In the digital world, conspiracy theories about COVID-19 vaccine are packed in both old and novel forms (Smith et al., 2020). Compared to the traditional, text-based conspiracy theories, their visualized counterparts often contain illustrative symbols and sensational narration and are playing an increasingly important role in social media platforms. We thereby set our research questions as the following:

1. *Whether and to which extent does the exposure to anti-vaccine conspiracy videos affect social media users' emotional changes (e.g., fear and anger), as well as intention for COVID-19 vaccination?*
 - 1a. *Whether the exposure to refuting videos has the opposite effects? and,*
2. *Do emotional changes (e.g., fear and anger) mediate the effect of exposure to conspiracy/refuting videos on intention for COVID-19 vaccination?*

¹ Definition of dis- and misinformation: both terms refer to information with false and misleading content. The distinction between the two lies primarily in the intention of their inventors/spreaders. While disinformation emphasizes the deliberateness of fabricating and sharing the information with malicious purpose to cause harm; there is no emphasize on the deliberateness of the creation and sharing of misinformation, i.e., those who share it may truly believe in the false and misleading content (UNESCO, 2018). Building upon these definitions, we place "anti-vaccine conspiracy theories" at the point where mis- and disinformation overlap. By doing so, we want to highlight that anti-vaccine conspiracy theories carry the shared feature of both terms – being false and misleading, while downplay the actual intention of their creator/spreader.

Overall, our study suggests that exposure to anti-vaccine conspiracy theories in the social media context does not directly affect the intention for COVID-19 vaccination. But it shows a weak positive effect on people's level of anger and fear. However, changes in these two emotions do not further contribute to one's vaccine uptake. In the next section, we present our conceptual framework after reviewing existing literature. Following that we introduce our research design, including the experiment setting and procedure, as well as the analytical approach. The main findings will be presented subsequently, followed by a reflective discussion. The paper concludes with implications of the findings, limitation of the present study, and recommendations for the future research.

THEORETICAL BACKGROUND

Vaccination intention and vaccine hesitancy

Prior to the outbreak of the COVID-19 pandemic, vaccine hesitancy – the reluctance (i.e. delay in acceptance) or refusal of vaccinate despite the availability of vaccines – was listed as one of the ten threats to global health (WHO, 2019). In fact, skepticism and opposition towards vaccination has existed ever since the first vaccines came into being in the 19th century (Dubé et al., 2015). Vaccine hesitancy can result in a series of negative consequences such as the failure to protect individuals from preventable diseases, as well as to achieve or sustain herd immunity of contagious diseases (Jacobson et al., 2015). For a public health crisis as dire as the current COVID-19 pandemic, a persistent high level of opposition towards the Covid-19 vaccines would challenge the collective efforts to protect the whole society.

Vaccination intention has thus been intensively monitored both nationally and globally as the COVID-19 pandemic evolves. Results from several cross-country surveys revealed that there is a great variation in citizens vaccination attitudes across countries (Lazarus et al., 2021), as well as over time (Hamburg Center for Health Economics, 2021). Overall, the majorities in most surveyed countries displayed a high willingness for vaccination, particularly since the end of 2020 when the first COVID-19 vaccines were made available (Imperial College London, 2021; Ipsos, 2021). However, the proportion of those who oppose vaccination and those who remain undecided still makes up a substantial amount in some part of the world. According to the Ipsos global vaccine attitude tracker, in Russia, France, Germany and Japan, over one third of the population refuse to get COVID-19 vaccination even if it is available in their countries. The time series data from Hamburg Center for Health Economics also indicate the same level of vaccine hesitancy in seven European countries.² The latest opinion poll conducted by the Imperial College London showed that 47% of the respondents would not want to get COVID-19 vaccines in the immediate future (within one week).³

The intention for COVID-19 vaccination also varies among sociodemographic groups within countries as shown in a number of national surveys. While age appears to be significantly associated with higher likelihood of being vaccinated for COVID-19 in the UK (Paul et al., 2021; Sherman et al., 2020), it goes into the opposite direction in France (Schwarzinger et al., 2021) and the US (Guidry et al., 2020), where younger population are more likely to accept being vaccinated. Many countries share similar effect of gender where males are more likely to accept the potential COVID-19 vaccine than female in Israel (Dror et al., 2020), France (Schwarzinger et al., 2021), the UK (Paul et al., 2021) and the US (Guidry et al., 2020; Kreps et al., 2020).

² The seven countries surveyed are Denmark, France, Germany, the Netherlands, Portugal, and the United Kingdom (n~7,000)

³ The opinion poll is based on samples from 15 countries (n~13,500) between November 2020 and mid-January 2021. Countries included are Australia, Canada, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Singapore, South Korea, Spain, Sweden, and the United Kingdom.

Apart from gauging vaccination intention and its distribution among different population groups, a substantial part of research on this issue have investigated factors (sometimes also called ‘predictors’ or ‘determinants’) that explain vaccine hesitancy. In their comprehensive review, Betsch et al. (2018) introduced a 5C-model that summarizes multiple influencing factors into five categories: confidence (trust in vaccine and public authorities), constraints (access and convenience to vaccination), complacency (perceived low threat and severity of vaccine-preventable diseases), calculation (decisions based on cost-benefits evaluation), and collective responsibility (normative effects). Many constructs of each 5C categories were reflected and examined in the recent studies on the COVID-19 vaccine hesitancy. Amongst others, the role of conspiracy theories was given particular attention, which we will now turn to.

Anti-vaccine conspiracy theories, media exposure, and the counteraction

Anti-vaccine conspiracy theories in the context of COVID-19 pandemic have multiple claims, yet they all carry similar features with conspiracy theories in general. The common ideas that underlie most COVID-19-related anti-vaccine conspiracy theories assert that vaccines are developed for the purpose of social or population control, be it human engineering, population tracking, or depopulation, and are propelled by a small group of hidden forces who withhold immense power behind the scenes (Smith et al., 2020). They offer an “explanation” for uncertain events that easily capture people’s emotive reactions than rational thinking (Grimes, 2020).

Conspiracy theories often exhibit varying degrees of skepticism towards their target subjects. Research beyond the vaccine-related context found that exposure to videos propagating government conspiracy theories led to cynicism and distrust toward the government (Kim & Cao, 2016). The similar pattern also applies to the vaccine-related context. According to the 5C-model, conspiracy belief is an integral component that measures general confidence among the public – both towards vaccines and towards public authorities that administer and regulate them (Betsch et al., 2018).

Different individual beliefs may influence individual responses. Erroneous conspiracy beliefs about the purposes and efficacy of vaccines could lead one to delay or refuse vaccination. Evidence from previous research indicates that not only does the preexisting belief in anti-vaccine conspiracy theories raise skepticism and result in higher vaccine hesitancy (Bogart et al., 2010; Oliver & Wood, 2014; Shapiro et al., 2016), mere short-term exposure to materials supporting the conspiracy ideas could also decrease personal as well as parental pro-vaccination attitudes (Dunn et al., 2015; Featherstone & Zhang, 2020; Jolley & Douglas, 2014). Recent studies on the impact of COVID-19 conspiracy theories on people’s health behavior further confirmed this line of findings. Results of several national surveys all point to the same direction: conspiracy belief was a significant predictor of vaccine hesitancy in France (Bertin et al., 2020), the US (Earnshaw et al., 2020; Romer & Jamieson, 2020) and the UK (Freeman et al., 2020). In the same vein, a cross-country survey, researchers found that the increase in susceptibility to COVID-19-related misinformation is significantly related to the decrease in willingness to get vaccinated against the virus in Ireland, the UK, the US, and Mexico (Roozenbeek et al., 2020).

Apart from the impact of anti-vaccine conspiracy theories *per se* on vaccine intention, the format through which they are disseminated is also worth noting. In the digital era, a great amount of mis- and disinformation is proliferated on social media networks. Many social media users have been directly or indirectly exposed to conspiracy theories against vaccination for preventable diseases. On and across social media platforms, conspiracy stories were presented in various formats such as texts, images, infographics, and videos, and circulated through users’ networks. The video-based conspiracy contents have gained increasing traction as many of them were imbued with melodramatic visualization and sound effects to capture the audience with intensified emotional bites (Smith et al., 2020). Media exposure of conspiracy theory videos was found to have both short-term and long-term effect in people’s conspiracy belief (Kim & Cao, 2016); it also decreases people’s willingness to

engage in pro-social activities (van der Linden, 2015). It can be argued that social media has become the common conduits of vaccine-related conspiracy theories in everyday life (Nowak et al., 2020), which in turn affects human behavior. Anti-vaccine activities and campaigns promulgated by human and nonhuman (i.e., trolls and bots) alike are pervasive on social networks such as Facebook and Twitter (Broniatowski et al., 2018; Broniatowski et al., 2020; Ortiz-Sánchez et al., 2020). Often fueled with falsified or fabricated information like conspiracy theories, the anti-vaccine movements aim to use the alluring simplicity of conspiracy stories to dissolve public confidence in vaccination against diseases such as measles, mumps, and influenza, and now moved to target at COVID-19 (Johnson et al., 2020). The circulation of anti-vaccine conspiracy theories is representative of infodemic (WHO, 2020), causing confusion and eroding public consensus on vaccination.

Following these findings, we concentrate on the video-based forms of anti-vaccine conspiracy theories in the context of COVID-19 pandemic and hypothesize our first hypothesis as the following:

H1. Exposure to anti-vaccine conspiracy videos decreases people's intention for vaccination among social media users compared to the control group.

Research has also looked into the effects of counteractions against the spread of conspiracy theories. One study discovered that the prevalence of echo chamber on social media realm has led debunking campaigns fail to reach communities whose users were mainly consumers of unsubstantiated contents such as conspiracy theories (Zollo et al., 2017). Others found that information framed with critical views towards conspiracy theories were found to be associated with lower tendency for subsequent conspiracy beliefs than those framed with supportive opinions (Swami et al., 2013). Some experimental studies offered preliminary evidence that preemptively exposing people with rational, cognitively focused communication strategies can reduce the effects of illogical and emotional charged conspiracy persuasion (Banas & Miller, 2013), and increase people's ability to spot misinformation techniques (Basol et al., 2020). Two experimental studies found short-term exposure to messages that refute vaccine conspiracy information increased people's attitudes towards vaccination (Featherstone & Zhang, 2020; Jolley & Douglas, 2017). Following this, we postulate the following hypothesis:

H2. Exposure to fact-checked videos that refute anti-vaccine conspiracy theories increases people's intention for vaccination among social media users compared to the control group.

The mediating role of emotions

Besides testing the direct effects of exposure to two types of COVID-19 vaccine-related videos on people's intention for vaccination, we also explore the effect of the exposure on people's emotional status, as well as the effect of different emotional level on attitudes towards vaccination. Given the emotive visual contents of conspiracy videos, it is vital to take into account the role of emotional changes triggered by the exposure to anti-vaccine conspiracy theories and its potential impacts on vaccine hesitancy.

A large body of studies have demonstrated the close link between vaccine-related conspiracy theories and emotions. Emotional appeals are one of the mostly used technics of anti-vaccine movements that frequently appear in conspiracy narratives (Kata, 2012). Unpleasant emotions towards vaccination were found to be associated with parental vaccine refusal. A seminal experimental work suggested anti-vaccine conspiracy theories could introduce undue suspicion among parents about vaccine safety, thus increase the feelings of powerlessness and disillusionment, which in turn decrease the willingness to vaccinate (Jolley & Douglas, 2014). This finding has been further confirmed by one recent online survey, which showed that the parental vaccine-related cognitions and behaviours were susceptible to direct effect of emotions towards vaccination that are not limited to fear, but also anger, disgust, anxiety, repulsiveness, and lack of relaxation and calmness (Tomljenovic et al., 2020). The mediating role of negative emotions are not only confined to parental vaccine attitudes. Evidence from an experimental study revealed that short-term exposure to both anti-vaccine conspiracy messages and

the refutational ones were found to triggered the emotion of anger and fear in the opposite direction, with the feeling of anger further mediating the effect of exposure on participants' own attitudes toward vaccination (Featherstone & Zhang, 2020).

For some, the renaissance of resistance towards vaccination against conquerable diseases in the context of COVID-19 pandemic is regarded as “the triumph of motive fictions over reality” (Grimes, 2020). Amongst others, most relevant to conspiracy theories are the feelings of fear and anger as they are characterized with the ability to scaremonger, provoke, and agitate public sentiment. One national online survey has shown that the direct consequences of COVID-19 anti-vaccine conspiracy theories on vaccine hesitancy is further mediated by the perceived threat – a sense of fear – that could be caused by the vaccines (Romer & Jamieson, 2020). A global sentiment monitor based on a large scale of Twitter database found that as the pandemic developed over time, public emotions has shifted strongly from fear towards anger (Lwin et al., 2020). The relations between emotionally charged anti-vaccine narratives embedded in conspiracy messages, negative sentiments such as fear and anger, as well as the subsequent vaccine intention deserve a close examination (Chou & Budenz, 2020). We therefore propose two more hypotheses as the following:

H3 Exposure to anti-vaccine conspiracy videos increases (a) fear and (b) anger among social media users, which in turn decreases their vaccination intention, as compared to the control group,

H4 Exposure to fact-checked videos that refute anti-vaccine conspiracy theories decreases (a) fear and (b) anger among social media users, which in turn increases their vaccination intention, as compared to the control group.

Based on the previous theoretical and empirical studies, we summarize our analytical framework in the following graph. The solid lines refer to the direct effect of exposure to two types of videos on vaccination intention (main model), whereas the dashed lines depict the indirect effect of the former on the latter, mediated through fear and anger (mediating model). The upper and the lower part of the graph illustrates the effect of exposure to anti-vaccine conspiracy videos and to the refutational videos respectively.

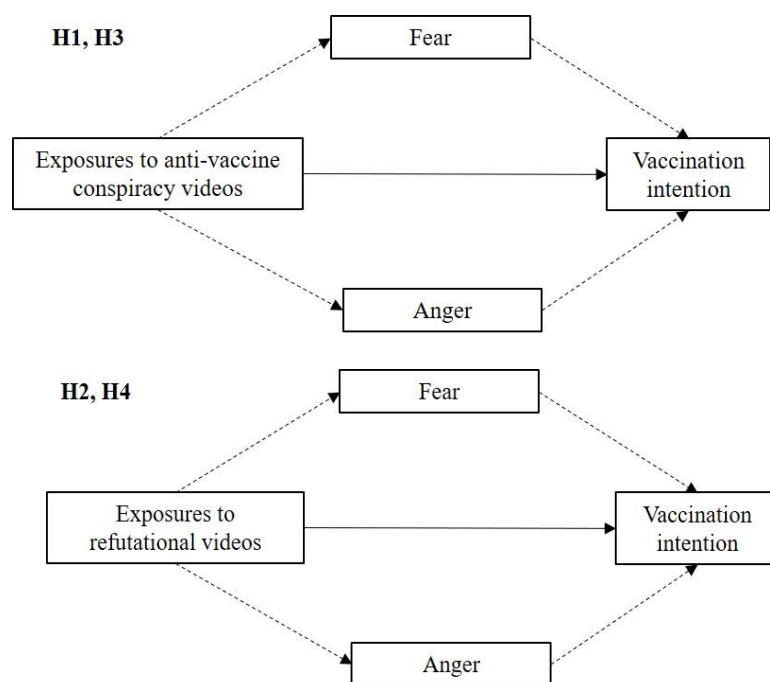


Figure 1. Analytical Framework

METHODOLOGY

Study design

Our study employed a web-based survey experiment design. This method has advantages over the lab-based experiment design for at least two reasons: first, as the COVID-19 pandemic is still ongoing, restrictions enforced by local and national authorities have not only substantially reduced individual mobility, but also increased the operational hurdles for practicing on-site experiments with a group of participants for research purposes. Secondly, setting the experiment online recreates a natural environment for participants as social media users without having to embark on an extra physical journey to the laboratory. Overall, conducting web-based experiment offers necessary health safety and convenience for both participants and the research team, while being able to stay close to the research objectives.

We designed our survey experiment with three different video conditions: one is the presentation of a video promoting anti-COVID-19-vaccine conspiracy theories, one with a video showing fact-checked and scientific-based materials that debunk the anti-vaccine conspiracy theories, and the third condition with a video with neutral content that serves as control condition. We collected and reviewed a group of anti-COVID-19-vaccine videos and refutational videos that have been circulating on the Internet since the outbreak of the COVID-19 pandemic. To ensure each of the video contains and triggers similar degree of emotionality by the audience, we conducted a systematic analysis of the narration style, the visual and sound effect and quality, and content complexity. In the end, we picked up two videos (one conspiracy video and one refutational video) with similar length that fulfil our selection criteria as the two key experiment treatments. We then added a third video whose content is irrelevant to COVID-19 pandemic and vaccination but meets the required degree of emotionality as the control element. [Table 1](#) summarized our experiment conditions and gives a brief account of the video content.

| Condition | Excerpt of video content |
|---|--|
| <i>Treatment 1</i> An anti-COVID-19-vaccine conspiracy video | COVID-19 vaccines serve as tools for human engineering by implanting microchip into human bodies... |
| <i>Treatment 2</i> A fact-checked video that refutes the anti-vaccine conspiracy theory | Millions of people have been immunized over the years and less than 0.005% had a disastrous reaction to a vaccine. Display of statistical evidence that shows getting vaccinated will help people overcome this disease and control the death rate of COVID-19. |
| <i>Control</i> A video with contents irrelevant to the COVID-19 pandemic and vaccines | Tipps for keeping fit with a balanced diet and sports... |

Table 1. Counterpoint of experimental contents across the three conditions

We programmed our survey questionnaire and integrated our experiment with a link that directs participants to a webpage that resembles a social network newsfeed with multiple posts whose contents are irrelevant to the COVID-19 pandemic and the vaccination. This was also to increase the internal validity of our experiment design. The posts in the newsfeed are either in the form of text, image, or infographics without external links. We inserted experiment stimuli into the newsfeed as *the one and the only* post with the video format.

The study was approved by the Chair of Business Informatics, Social Media, and Data Science at the University of Potsdam. All participants were provided with information on their personal data protection and were required to confirm their consent to it before participating in the study.

Participants and Procedures

In December 2020, we posted the invitation to our study on Facebook groups and sent it out to several mailing lists. Participants who successfully completed the study were allowed to take part in a lottery, in which five Amazon coupons equivalent to 10 Euro would be given to the winners randomly selected by our predesigned lottery program. Our online experiment started from December 7, 2020 till December 17, 2020. It is worth noting that at the time of our online study, many countries around the world were preparing the rollout of vaccines against COVID-19 and encouraging people to vaccinate to protect themselves and the society.

Since our target population is social media users, we set a pre-screening session that excludes those who are not a user of any kind of social media. Among 534 participants who gave consent to the data agreement to join the study, twenty-seven were excluded by the pre-screening session. Twelve participants were further excluded because they did not complete the entire study. Six more participants were excluded for not passing the manipulation check. In the end, we obtained a total sample of 489 respondents (a retention rate of 91.6%) for the data analysis.

Participants who passed the pre-screening were then directed to the first part of the survey consisting of demographic question items (e.g., age and gender) and one question item asking the intention for COVID-19 vaccination which serves as the pre-measure to control and identify the pre-existing vaccine intention among the participants. Upon finishing this part of the survey, a short instruction was displayed with a link that leads to the experiment setting, which is built on a newsfeed-like webpage. By clicking on the link, our participants were randomly assigned to three different experiment groups: the conspiracy group, the refuting group, and the control group, each with the same newsfeed background except for the post containing one of the three experiment stimuli. A floating bottom was placed on the right range of the webpage with the instruction to proceed the study and return to the survey interface once the participants finished browsing the content. Upon returning to the survey page, participants were asked to respond to the second part of the survey with questions that assess the magnitude of their feeling of fear and anger, as well as the intention for COVID-19 vaccination. To make sure that the participants received the intended treatments (i.e., having watched the videos and captured the main idea of it), we conducted a manipulation check with questions based on the content of the video treatments that they were assigned to (see Q1 and Q2, Part C in Appendix). [Figure 2](#) illustrates the main structure of the online survey procedure. For a complete version of the survey questionnaire, please refer to the Appendix.

| |
|--|
| <input type="checkbox"/> Demographic questions: age, gender <input type="checkbox"/> Pre-measure of vaccine intention <p>*****<i>Experiment setting</i>*****</p> <p><i>"Please spend some time browsing the content here, after doing so, please click the returning bottom on the right side of the page to continue the survey."</i></p> <p><i>Note: there is no time limit for your browsing activity.</i></p> <p>*****</p> <input type="checkbox"/> Level of fear (Ahorsu, 2020) (Cronbach's $\alpha = 79\%$) <input type="checkbox"/> Level of anger (Karim & Mendes, 2013) (Cronbach's $\alpha = 71\%$) <input type="checkbox"/> Post-measure of vaccine intention <input type="checkbox"/> Question for manipulation check |
|--|

Figure 2. Summary of online survey questionnaire

Measures of key variables

Vaccination intention was measured by one question item adopted from existing studies on vaccination intention (Betsch et al., 2018; Head et al., 2020; Paul et al., 2021). We adjusted the measures and formulated the question asking the extent to which one agrees with the following statement: “*If the COVID-19 vaccination is now available to me, I would like to get vaccinated within a week.*” The answer option takes on a seven-point Likert-type scale ranging from 1 = “*Strongly disagree*” to 7 = “*Strongly agree*”. The same question was posted twice: before and after the participants taking part in the experiment (i.e., exposing to the videos) as the score for pre-measure and the post-measure respectively.

Fear was measured by a five-point Likert-type scale composed by seven question items. We adopted the measurement for fear from Ahorsu et al.’s (2020) Fear of COVID-19 Scale (FCV-19S). Participants were asked to rate their agreement with each of the seven statement on a five-point scale (1 = “*Strongly disagree*” and 5 = “*Strongly agree*”).

Anger was measured by a five-point Likert-type scale composed by six question items adopted from the anger scale developed by Kassam and Mendes (2013) and tested by Featherstone and Zhang (2020). Likewise, participants were asked to rate their agreement with each of the six statement on a five-point scale (1 = “*Strongly disagree*” and 5 = “*Strongly agree*”).

For both *fear* and *anger*, the mean value was calculated by summing the individual scores and then dividing by the number of items. Both scales indicate acceptable reliability with Cronbach’s α of 79% and 71% for fear and anger respectively. [Table 2](#) summarizes the measurement of the key variables.

| Variable | Measurement |
|---|--|
| COVID-19 vaccination intention (<i>adopted from and adjusted on the basis of Betsch et al., 2018; Paul et al., 2020; Head et al. 2020</i>) | One item measuring the degree of agreement to the following statement with a 7-point Likert-type scale: (1) Strongly disagree ~ (7) Strongly agree “ <i>If the COVID-19 vaccination is now available to me, I would like to get vaccinated within a week.</i> ” |
| Fear (<i>adopted from and adjusted on the basis of Ahorsu et al. 2020</i>) | Seven items measuring the degree of agreement to the following statements with a 5-point Likert-type scale: (1) Strongly agree ~ (5) Strongly agree 1. <i>I am most afraid of Covid-19 vaccination</i> 2. <i>It makes me uncomfortable to think about Covid-19 vaccination</i> 3. <i>My hands become clammy when I think about Covid-19 vaccination</i> 4. <i>I am afraid of potential harms because of Covid-19 vaccination</i> 5. <i>When hear about news and stories about Covid-19 vaccination, I become nervous and anxious</i> 6. <i>I cannot sleep whenever I think about Covid-19 vaccination</i> 7. <i>My heart races or palpitates when I think about getting vaccinated</i> |

Anger
(Adopted from and adjusted based
on Kassam & Mendes, 2013;
Featherstone & Zhang, 2020)

Six items measuring the degree of agreement to the following
statements with a with 5-point Likert-type scale:

- (1) Strongly disagree ~ (5) Strongly agree
1. *I feel annoyed when I hear about Covid-19 vaccination*
 2. *It makes me frustrated to think about Covid-19 vaccination*
 3. *I feel angry after browsing the content just now*
 4. *I become aggressive when I think about Covid-19 vaccination campaign*
 5. *It makes me impatient to see the “truth” of Covid-19 vaccination*
 6. *I feel agitated when I hear about Covid-19 vaccination*

Table 2. Summary of measurement of key variables

Statistical analysis

Based on the eligible respondents ($n=489$), we performed our data analysis using R language as the main statistical analysis tool. To test the direct effects of the two treatments (“exposure to conspiracy video” and “exposure to the refutation video”), we conducted the analysis of covariance (ANCOVA). We regard this statistical method as a valid tool to explore whether any statistically significant difference existed in the outcome of vaccination intention, anger, and fear. We also want to compare the difference between pre-measure of vaccination intention (as the covariate) and post-measure of vaccination intention. Controlling for the covariate is an important step to ensure that the initial vaccination intention is not different among experiment groups. Accordingly, if there exist any different result of vaccination intention between either of the two treatment groups and the control group, it should be resulted from the treatment and not due to some left-over effect from the pre-measure. The other reason why we controlled for the covariate is to account for the variation of the post-measure means that comes from the variation of the pre-measure means.

With a significant result of ANCOVA, we would expect to conduct a post-hoc test where the difference between groups lies. Likewise, we would continue to test the indirect (mediated) effect by conducting the analysis using regression linear models as well as the analysis of variance (ANOVA). This is to see whether the effect of exposure to the conspiracy video and refuting video on vaccination intention, if presented, was mediated through the presence of anger and fear.

RESULT

Descriptive Statistics

The total sample ($n=489$) has a mean age of 31.4 ($SD=4.06$). In each of the experiment group, the mean age is around 31 with a slight variation. There is a similar amount of female (49.7%, $n=243$) and male (50.3%, $n=246$) respondents in the total sample. While the control group has a similar proportion of female and male participants as that of the total sample, there are more female (55.1%, $n=86$) in the group exposed to the anti-vaccine conspiracy video than male participants, and more male (55% $n=93$) in the group exposed to the fact-checked refuting video than female participants. [Table 3](#) presents the summary statistics including mean, median, and the range for the demographic characters, experiment treatments, and emotional scores for the total sample as well as for each of the experiment group.

| | Conspiracy (N = 156) | Control (N = 164) | Refuting (N = 169) | Total (N = 489) |
|---|-------------------------|----------------------|-----------------------|--------------------|
| Age | | | | |
| Mean (SD) | 31.5 (3.98) | 31.7 (4.36) | 31.1 (3.82) | 31.4 (4.06) |
| Median [Min, Max] | 31.0 [21.0, 42.0] | 31.0 [21.0, 43.0] | 31.0 [23.0, 40.0] | 31.0 [21.0, 43.0] |
| Gender | | | | |
| Female | 86 (55.1%) | 81 (49.4%) | 76 (45.0%) | 243 (49.7%) |
| Male | 70 (44.9%) | 83 (50.6%) | 93 (55.0%) | 246 (50.3%) |
| Vaccination intention (Pre-measure) | | | | |
| Mean (SD) | 4.27 (1.06) | 4.41 (0.828) | 4.43 (0.924) | 4.37 (0.939) |
| Median [Min, Max] | 4.00 [1.00, 7.00] | 4.00 [1.00, 7.00] | 5.00 [1.00, 7.00] | 4.00 [1.00, 7.00] |
| Vaccination intention (Post-measure) | | | | |
| Mean (SD) | 4.24 (1.15) | 4.35 (0.898) | 4.42 (1.02) | 4.34 (1.02) |
| Median [Min, Max] | 4.00 [1.00, 7.00] | 4.00 [1.00, 7.00] | 5.00 [1.00, 7.00] | 4.00 [1.00, 7.00] |
| Fear | | | | |
| Mean (SD) | 2.16 (0.470) | 2.06 (0.468) | 1.99 (0.406) | 2.07 (0.453) |
| Median [Min, Max] | 2.00 [1.00, 4.00] | 1.86 [1.00, 3.86] | 1.86 [1.14, 3.86] | 1.86 [1.00, 4.00] |
| Anger | | | | |
| Mean (SD) | 1.92 (0.455) | 1.83 (0.481) | 1.76 (0.394) | 1.83 (0.448) |
| Median [Min, Max] | 1.83 [1.00, 3.50] | 1.50 [1.00, 4.00] | 1.50 [1.00, 3.50] | 1.67 [1.00, 4.00] |

Table 3. Descriptive Statistics

We tried to see if the vaccination intention as both pre-measure and post-measure differs between age groups and genders. As displayed in [Figure 3.1-3.4](#), the general distribution of vaccination intention between those aged from 20 to 35 years old and those aged from 35 to 43 years old, as well as between female and male did not show a big difference across the ranks within each measure. For both age and gender groups, the majority of respondents hold a neutral or slightly positive intention for vaccination. Comparing the distribution of vaccination intention between pre- and post-measure, there is a slight decrease in willingness for vaccination intention among those aged over 35 years old, while a slight increase in willingness among the younger group. In terms of gender, there is a slight decrease for vaccination for both female and male, with a larger increase of male respondents than female.

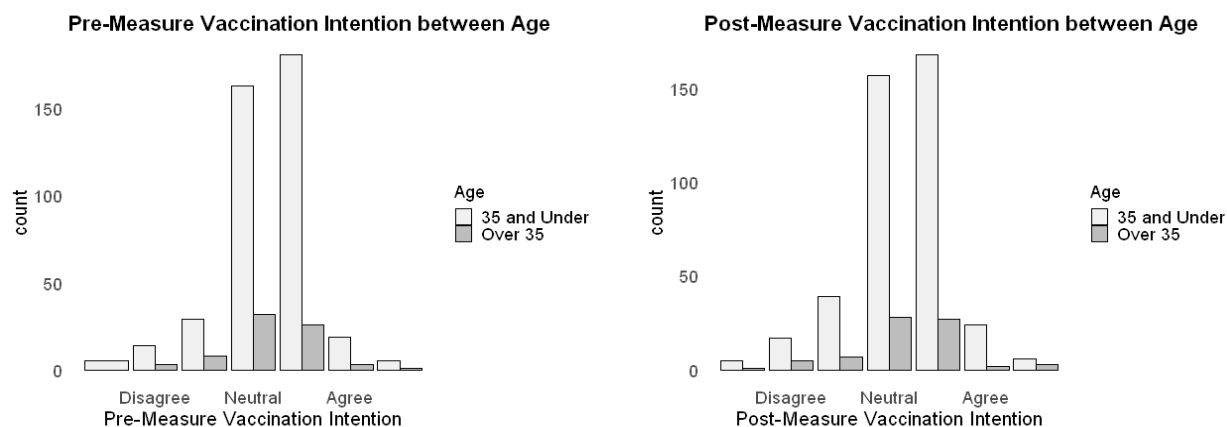


Figure 3.1 Vaccination intention (pre-measure) by age groups (left)

Figure 3.2 Vaccination intention (post-measure) by age groups (right)

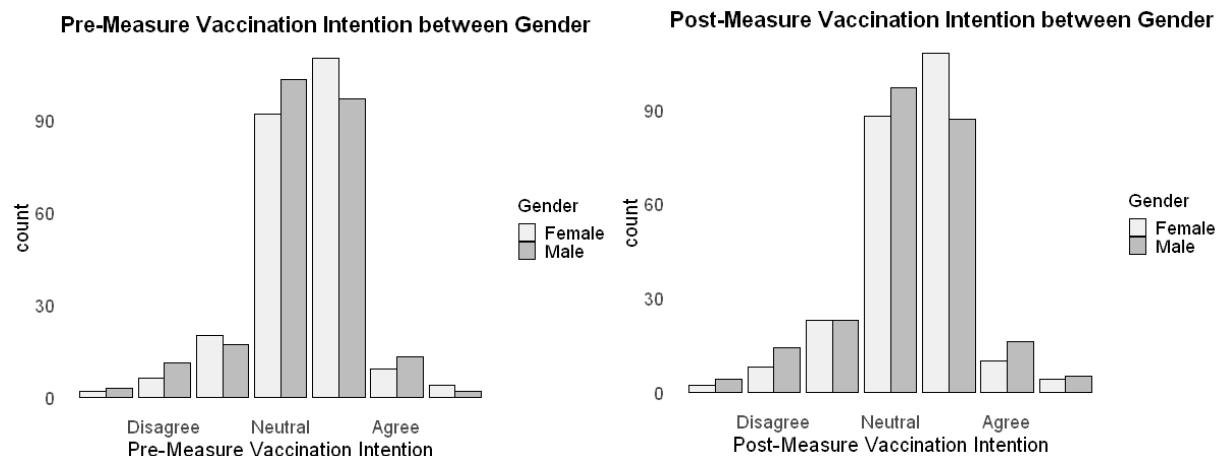


Figure 3.3 Vaccination intention (pre-measure) by gender (left)

Figure 3.4 Vaccination intention (post-measure) by gender (right)

Effects of exposure to two types of videos on vaccination intention

We present the mean values of vaccination intention before and after taking part in the experiment across three experiment conditions in [Figure 4](#). Across all groups, we observed a slight decrease in the mean values of vaccination intention. We continued with ANCOVA to examine the effects of two types of experiment stimuli on participants' vaccination intention as compared to that of the control condition, where we included the measurement of vaccination intention before the treatment (pre-measure) as a covariate to the effect.

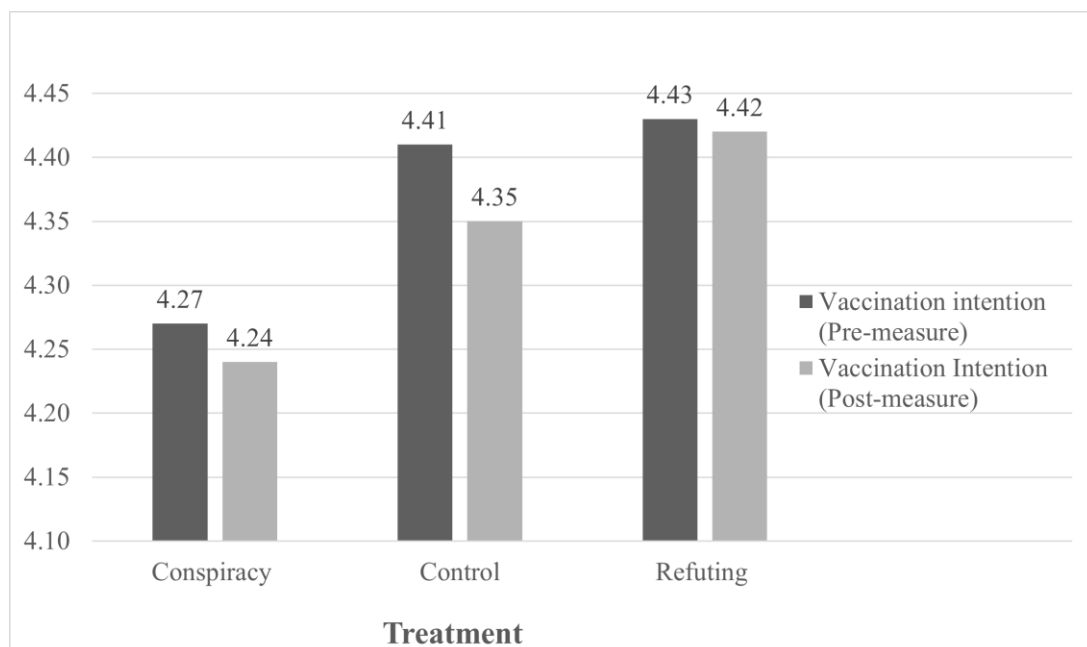


Figure 4. Comparison of means of vaccination intention as pre- and post-measure across groups

We ran a thorough assumption check prior to conducting the analysis of covariance. The results fulfill three of the five most common assumptions. First, we found that there was a linear relationship between the pre-measure and the post-measure for vaccination attitude in each experimental group. Specifically, $R^2 = 0.67, 0.75, 0.85$ corresponding to the group exposed to the conspiracy video, the

control group and the group exposed to the refuting video, respectively. Second, there was homogeneity of regression slopes as the interaction term was not statistically significant, where $F(2, 483) = 2.21$, $p = 0.11$. Third, the Levene's test to check the homogeneity of variances was not significant $p = 0.13$, which fulfills the assumption of homoscedasticity of residuals variance for all groups. On the other hand, two assumptions for ANCOVA were violated. With the significant result ($p = 0.000$) of Shapiro-Wilk test of normality on the model residuals, it violates the assumption of normal distribution of outcome variables. With 18 outliers in the data, it violates the assumption of no significant outliers.

Consequently, we decided to turn to the Quade's method,⁴ a nonparametric ANCOVA test based on ranks of independent variables to proceed the analysis. The conventional parametric ANCOVA test was utilized to control and compare the results of Quade's ANCOVA test.

As expected, the Quade's nonparametric ANCOVA showed that the difference across all three experiment conditions is not significant, where $F(2, 485) = 0.497$, $p = 0.609$, as compared to results according to parametric ANCOVA test, where $F(2, 485) = 0.403$, $p = 0.668$. The conventional ANCOVA procedures also produced the adjusted means of each experiment group controlling for the covariate. The values (see [Table 4.](#)) indicate that the treatment effects do not vary significantly among experiment groups.

| Treatment | Lower 95% Confidence Limits | Adjusted Means | Upper 95% Confidence Limits |
|----------------------|--------------------------------|-------------------|--------------------------------|
| Control Treatment | 4.237 | 4.315 | 4.394 |
| Conspiracy Treatment | 4.256 | 4.336 | 4.417 |
| Refuting Treatment | 4.288 | 4.366 | 4.443 |

Table 4. The adjusted means and confidence limits of vaccination intention

Nevertheless, there was a significant association between the attitude towards vaccination before and after the treatment, both containing p -values $< 2e-16$ in nonparametric and parametric tests (see [Table 5](#)). The scatter plot ([Figure 5](#)) also indicates that the pre-measure and post-measure of participants' intention for vaccination was highly correlated ($\beta = 0.945$, also indicated in [Table 5](#)).

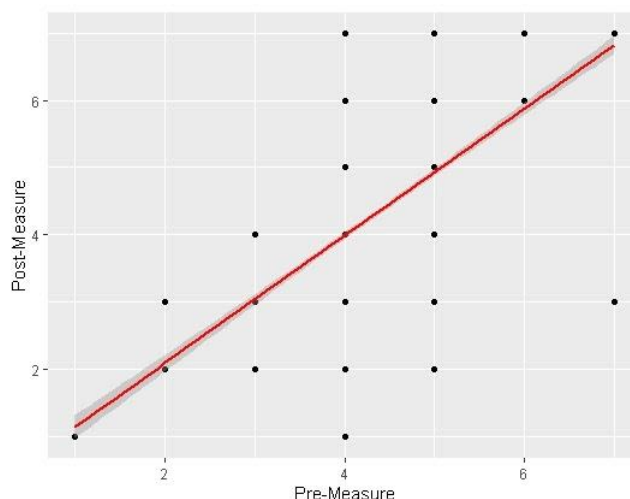


Figure 5. Correlation between pre-measure and post-measure of vaccination intention

⁴ Nonparametric covariance analysis (ANCOVA) methods are used when the assumptions of parametric ANCOVA are not met and/or the dependent variable has bivariate/ordinal scale. In the nonparametric ANCOVA methodology, Quade, Puri & Sen and McSweeney & Porter methods are known as Ranked ANCOVA methods.

| Coefficients: | Estimate | Std. Error | t-value | Pr(> t) |
|----------------------|----------|------------|---------|-------------|
| (Intercept) | 0.18292 | 0.11624 | 1.574 | 0.116. |
| pre_measure | 0.94475 | 0.02473 | 38.209 | < 2e-16 *** |
| Treatment Conspiracy | 0.02089 | 0.05732 | 0.364 | 0.716 |
| Treatment Refuting | 0.05010 | 0.05607 | 0.893 | 0.372 |

Residual standard error: 0.5115 on 485 degrees of freedom
Multiple R-squared: 0.752, Adjusted R-squared: 0.7504
F-Statistic: 409.2 on 3 and 485 DF, p-value: <2.2e-16

Table 5. Result of Analysis of Covariance

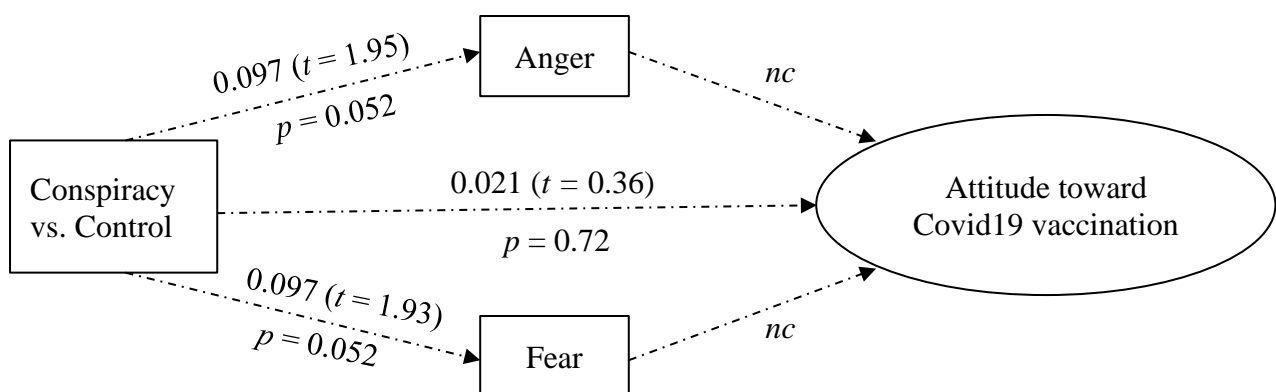
Considering pre-measure value as covariate, the refuting conspiracy video increased slightly the vaccination intention ($\beta = 0.05$, $p = 0.37$) more than the conspiracy video ($\beta = 0.021$, $p = 0.72$) compared to the control condition. Nevertheless, both cases derived non-significant effects of conditions on vaccination intention (see Figure 6.1 and 6.2). Thus, both H1 and H2 were not supported.

Mediating Effect

Since the direct effects of both experiment treatments are not significant, we did not continue with the analysis on the indirect effects, or what we usually call the mediating effects of the treatments.

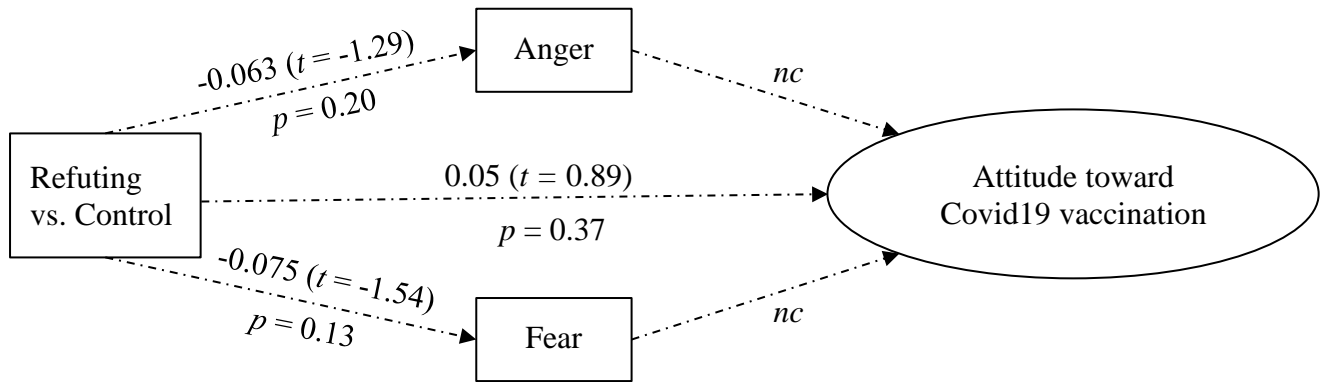
Effects of Treatment to Emotion

Even though the treatments did not produce significant effects toward vaccination intention, results according to ANOVA tests showed that there was a significant difference between those groups in fear level, $F(2, 486) = 5.998$, $p = 0.002$ and anger level, $F(2, 486) = 5.301$, $p = 0.005$. Fear level was higher in the conspiracy condition ($M = 2.16$, $SD = 0.470$) than the control condition ($M = 2.06$, $SD = 0.468$) and the refuting-conspiracy condition ($M = 1.99$, $SD = 0.406$). Similarly, anger level was higher in the conspiracy condition ($M = 1.92$, $SD = 0.455$) than the control condition ($M = 1.83$, $SD = 0.481$) and the refuting-conspiracy condition ($M = 1.99$, $SD = 0.394$).



Note. The unstandardized coefficients are shown; nc stands for not considering

Figure 6.1 Effects of conspiracy video on COVID-19 vaccination attitude, fear, and anger



Note. The unstandardized coefficients are shown; *nc* stands for not considering

Figure 6.2 Effects of refuting video on COVID-19 vaccination attitude, fear, and anger

Figure 6.1 and 6.2 showed the pathway of the mediation analysis. Conspiracy video slightly increased the anger ($\beta = 0.097$, $p = 0.052$) and fear ($\beta = 0.097$, $p = 0.052$) level in the case that the power of the test was reduced, and the significant level decreased to $\alpha = 0.1$. However, the fact-based refuting video treatment did not produce any significant effect on anger and fear level even when the significant level was adjusted to $\alpha = 0.1$. Thus, H3 (a-b) were partially supported while H4 (a-b) were not supported.

DISCUSSION

General Discussion

Overall, our findings suggest that exposure to video promoting anti-vaccine conspiracy theory and to video debunking such erroneous information does not change people's intention for vaccination against the COVID-19. At the first glance, these findings came as a surprise in two major aspects. First and foremost, the non-significant effect of exposure to anti-COVID-19-vaccine video stands in stark contrast to the results of the mainstream studies, which indicated a clear, negative link between the engagement with anti-vaccine conspiracy theories on the one hand, and people's vaccine intention on the other hand both in and beyond the context of COVID-19 pandemic (Bertin et al., 2020; Featherstone & Zhang, 2020; Freeman et al., 2020; Jolley & Douglas, 2014; Romer & Jamieson, 2020; Roozenbeek et al., 2020). Secondly, our findings also did not support the results of the majority of existing research on counteracting strategies targeted at the pervasive anti-vaccine conspiracy messages, which showed that fact-checked information used to debunk the conspiracy theories tended to increase people's vaccination intention (Banas & Miller, 2013; Basol et al., 2020; Featherstone & Zhang, 2020; Jolley & Douglas, 2017).

A main reason why our study produced somewhat rare results could be that we have mainly looked at the *short-term* effect of the video content (i.e., the spontaneous exposure to only one video embedded in the social media newsfeed) on people's vaccination attitudes, while many of the aforementioned studies have focused on the *long-term* effect of conspiracy theories (and the refutation information) on vaccination attitudes. That said, it does not necessarily lead to the conclusion that exposure to either type of video content has no effect on vaccination intention. A more nuanced interpretation could be that people's vaccination intention was more likely to be influenced by the *enduring* exposure to the video content than by the *immediate* exposure to it.

Another reason for the statistically nonsignificant results of our study could lie in the less direct experiment setting that emulates social media newsfeed. Our experiment stimuli were embedded in such background with other posts irrelevant to the COVID-19 and the vaccination. Admittedly, doing so can effectively avoid the problem of demand characteristics in our experimental study and through

manipulation check we can further ensure that participants did watch the video as we intended. However, we could not exclude the potential influence of the contents of other posts appeared on the newsfeed, which could have – in an unexpected way – exert influence on participants who perceived them to be more important or interesting by the time of experiment.

Given that our findings also indicate that the immediate exposure to anti-vaccine conspiracy video increased people's fear and anger level, this stands in line with the previous work emphasizing the negative impacts of conspiracy theories on psychological wellbeing (Chou & Budenz, 2020; Featherstone & Zhang, 2020; Jolley & Douglas, 2014; Romer & Jamieson, 2020). Our study offers further evidence of the disturbing effects of conspiracy contents for emotional stability and raises the alarm for government and relevant stakeholders to take infodemic on social media seriously. It points to the urgency of more intensive and strategic policy intervention to combat anti-vaccine conspiracy theories online from the government side, but also calls for more responsible measures taken by the internet companies themselves. Last but not least, for psychiatrists practicing therapies during the time of the pandemic, our findings shed light on the potential cause of symptomatic anxiety and irritation resulted from the immediate exposure to scaremongering and melodramatic conspiracy videos widespread online.

Limitation and recommendations for future research

Almost inevitably, our study also has several limitations that we want to address in this section.

Starting with our experiment treatment, as already mentioned in general discussion, the exposure to the two types of videos was only for a short period of time, which might not affect people's vaccine intention through immediate change of emotions. Future research needs to incorporate the two-stage randomized experimental design as done by Kim and Cao (2016).

As for the statistical analysis strategy, some assumptions were not fulfilled for using the parametric ANCOVA. To ensure a robust result, we also did nonparametric ANCOVA to control/compare the results, and the results were not different, in the sense that they were both not significant in treatment effects.

In terms of measurement, this study used the score of one statement to measure vaccination intention, this might compromise the accuracy in the measurement, since vaccination intentions were affected by other aspects that could not be recorded by only a single item. Future work analyzing vaccination intention could extend beyond our scale with reference to further elements that suit the research objectives. Measuring vaccination intention prior to exposing the participants to the treatment videos might have alerted these participants to the purpose of the study and, therefore, biased their responses. This was one trade-off for us to be able to control their pre-experiment vaccination intention to make sure they have the same level between groups.

Another problem of our study is related with the limited sample size. The fact that the vaccination intention was highest in the group exposed to refuting video and lowest in the conspiracy video group treatment even though the difference was not significant might give us a signal that the effect size was small. It was also shown by the effect of the treatment to participants' emotions when we reduced the significance level to $\alpha = 0.1$. Thus, a bigger sample size can be included in the experiment to increase the effect size, and therefore increasing the statistical power.

The participants were recruited from limited online channels and were exposed to the treatment manipulation that resembles a newsfeed setting of one particular social media platform. This means that the participants and the platforms might not be diverse since every social media platform has their own user demographics as well as unique functional designs. Increasing the diversification of participants' demographic background by taking into account a broader range of age, education, race, ethnicity is also another way to see different perspectives in the experiment. Future studies could be

conducted in a more diverse experiment setting that considers different characteristics of social media platforms.

CONCLUSION

Given the severity of the COVID-19 pandemic and the proliferation of mis- and disinformation containing anti-vaccine conspiracy theories on social media, understanding the effect of exposure to conspiracy video on people's intention for vaccination is of vital importance at the current stage for the success of the government's vaccination program. This study performed an online survey experiment with 489 participants randomly assigned into three experiment conditions, each being exposed either a video promoting the anti-vaccine conspiracy theory, a video that debunks the conspiracy theory, or a neutral video as control condition. By filling out a survey questionnaire prior and after taking part in the experiment, we collected a sample data that captures the vaccination intention, the emotional changes in terms of fear and anger, as well as basic demographic characters.

Our study found that short-term exposure to video-based anti-vaccine conspiracy theories leads to increased anger and fear level of the participants, as compared those expose to the video with irrelevant content. Even though we did not find any significant effect of both type of video treatment towards vaccination intention, the fact that the anger and fear levels increased under the condition of exposure to the conspiracy video suggested that participants were emotionally triggered in a negative direction. This might lead to future unknown actions. We conclude that promoting facts and benefits of vaccination, as well as intervening and controlling the spread of conspiracy theory are essential to prevent the change towards negative public perception towards the global efforts to end the COVID-19 pandemic.

APPENDIX

Survey Questionnaire

We are carrying out an experiment of COVID-19 vaccination, to see how people react to vaccination when it is available in the society. Thank you for taking the time to take part in our experiment and fill in this questionnaire; it should only take 15 minutes. Please submit your completed questionnaire via our Facebook homepage.

Part A:

Please answer the following questions before taking part in our experiment.

Q1: What is your gender?

- ☐ Female
- ☐ Male

Q2: Please select your date of birth: DD/MM/YY

Q3: Please indicate your level of agreement or disagreement with the following statement:

“If the COVID-19 vaccination is now available to me, I would like to get vaccinated within a week.”

- ☐ Strongly disagree
- ☐ Quite disagree
- ☐ Slightly disagree
- ☐ Neither disagree nor agree (neutral)
- ☐ Slightly agree
- ☐ Quite agree
- ☐ Strongly agree

Part B:

“Please spend some time browsing the content here, after doing so, please click the returning bottom on the right side of the page to continue the survey.”

Note: there is no time limit for your browsing activity.

Part C:

Please answer these following questions.

Q1: Your video number: (Manipulation check1)

Q2: Please describe shortly the content of the video you have finished watching recently: (Manipulation check 2)

.....

Q3: Please indicate your level of agreement or disagreement with the following statement:

“If the COVID-19 vaccination is now available to me, I would like to get vaccinated within a week.”

- ☐ Strongly disagree
- ☐ Quite disagree
- ☐ Slightly disagree
- ☐ Neither disagree nor agree (neutral)
- ☐ Slightly agree
- ☐ Quite agree

Q4: Why/Why not does it make you willing to get the vaccine?

.....

Q5: Please indicate your level of agreement or disagreement with each of these statements. Place an “X” mark in the number of your answer.

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly agree |
|--|--------------------------|-----------------|-----------------------------------|--------------|-----------------------|
| 1. I am not afraid of Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 2. It makes me uncomfortable to think about Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 3. My hands become clammy when I think about Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 4. I am afraid of potential harms because of Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 5. When hear about news and stories about Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 6. I cannot sleep whenever I think about Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 7. My heart races or palpitates when I think about getting vaccinated. | 1 | 2 | 3 | 4 | 5 |

| | Strongly disagree | Disagree | Neither disagree nor agree | Agree | Strongly agree |
|--|--------------------------|-----------------|-----------------------------------|--------------|-----------------------|
| 1. I feel annoyed when I hear about Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 2. It makes me frustrated to think about Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 3. I feel angry after browsing the content just now. | 1 | 2 | 3 | 4 | 5 |
| 4. I become aggressive when I think about Covid-19 vaccination campaign. | 1 | 2 | 3 | 4 | 5 |
| 5. It makes me impatient to see the “truth” of Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |
| 6. I feel agitated when I hear about Covid-19 vaccination. | 1 | 2 | 3 | 4 | 5 |

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