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**Prevention is better than cure: Addressing anti-vaccine
conspiracy theories**

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Abstract

The current research tested if explicit anti-conspiracy arguments could be an effective method of addressing the potentially harmful effects of anti-vaccine conspiracy theories. In two studies, participants were presented with anti-conspiracy arguments either before, or after reading arguments in favor of popular conspiracy theories concerning vaccination. In both studies, anti-conspiracy arguments increased intentions to vaccinate a fictional child but only when presented *prior* to conspiracy theories. This effect was mediated by belief in anti-vaccine conspiracy theories and the perception that vaccines are dangerous. These findings suggest that people can be inoculated against the potentially harmful effects of anti-vaccine conspiracy theories, but that once they are established, the conspiracy theories may be difficult to correct.

Keywords: conspiracy theories; anti-vaccination; vaccination; persuasion; intentions; attitude inoculation; intervention

**Prevention is better than cure: Addressing anti-vaccine
conspiracy theories**

Despite the demonstrated importance of vaccination for population health and wellbeing, many people opt out of government-recommended vaccination schedules for their children. In some parts of the world, vaccination rates lie below the advised 95% uptake, leaving people at risk of serious, but preventable diseases (e.g., MMR, Health Protection Service, 2014). Whilst many factors undoubtedly influence people's decisions regarding vaccination, one potential obstacle may be *conspiracy theories* that are propagated by an active and prominent anti-vaccine movement. The present investigation examines the effects of anti-vaccine conspiracy theories on vaccination intentions, and attempts to introduce an intervention to attenuate the potential harmful effects of anti-vaccine conspiracy theories.

Conspiracy theories explain the ultimate causes of significant events as the secret actions of malevolent groups, who cover up information to suit their own interests (Brotherton, 2015; Cichocka, Marchlewska, & Golec de Zavala, 2016; Douglas & Sutton, 2008, 2011, 2015; Douglas, Sutton, Callan, Dawtry, & Harvey, 2016; Goertzel, 1994; McCauley & Jacques, 1979; Sutton & Douglas, 2014; van Prooijen & Jostmann, 2013; Uscinski & Parent, 2014; Wood, Douglas, & Sutton, 2012). For example, popular conspiracy theories allege that the 9/11 attacks were set up by the U.S. government to justify the war on terror, and that climate change is a hoax managed by climate scientists to secure research funding (Swami, Chamorro-Premuzic, & Furnham, 2010; Lewandowsky, Oberauer, & Gignac, 2013; Wood & Douglas, 2013, 2015). According to the most popular conspiracy theories associated with the issue of vaccination, data is faked and harmful side-effects of vaccines are hidden from the public to ensure that pharmaceutical companies and governments are able to make money (Kata, 2010; Offit, 2010). These conspiracy theories are popular. For example, Oliver and Wood (2014) asked American participants whether

they thought that doctors and governments were in favor of vaccination despite knowledge that vaccines cause autism. Twenty per cent agreed and 36% were undecided. Further, polls indicate that more than 20% of respondents endorse conspiracy theories that propose a link between childhood vaccines and autism (Public Policy Polling, 2013). In a similar way to climate change conspiracy theories (Lewandowsky et al., 2013), belief in anti-vaccine conspiracy theories is associated with mistrust in, and rejection of, scientific evidence.

Recent research suggests that belief in conspiracy theories may be associated with negative attitudes toward vaccination (Lewandowsky, et al., 2013). There is also evidence that belief in, and exposure to anti-vaccine conspiracy theories directly predicts people's intentions to vaccinate. Specifically, Jolley and Douglas (2014a) found that belief in anti-vaccine conspiracy theories predicted intentions to vaccinate a fictional child. Further, participants who were exposed to anti-vaccine conspiracy theories (vs. anti-conspiracy information and a control condition) were reluctant to vaccinate a fictional child. Anti-vaccine conspiracy theories therefore predict the extent to which people are willing, at least in principle, to engage with vaccination (see also Douglas & Leite, in press; Douglas, Sutton, Jolley, & Wood, 2015; Jolley & Douglas, 2014b for similar effects associated with politics, climate change, and conspiracy theories in the workplace).

If anti-vaccine conspiracy theories have the potential to negatively influence people's intentions to vaccinate, a challenge for scholars is therefore to consider if action needs to be taken to challenge them, and if so, what form this action should take. Existing efforts to improve vaccination intentions use expert sources to persuade people toward vaccination (Hopfer, 2012) and emphasise that vaccination is normative (Conroy, et al., 2009). Such persuasive methods have met with some success. The U.S state of Oregon also recently passed legislation that requires all parents or guardians who wish to claim an exemption from vaccination (that is not based on medical grounds), to receive education about the benefits

and risks of vaccination (Public Health Oregon, 2015). These methods however have not yet considered the role of conspiracy theories. Anti-vaccine conspiracy theories reflect suspicion and mistrust of scientific research, and can be used as an avenue to counteract evidence that vaccines are effective, safe and necessary (Kata, 2010). Suspicion and mistrust of vaccines may therefore be enhanced by conspiracy theories. Examining current efforts to improve vaccination intentions, whilst also taking into account the potential effects of conspiracy theories, is therefore an important challenge for researchers.

Sunstein and Vermeule (2009) made a number of suggestions to address the potential harms of conspiracy theories in general. One practical suggestion is to issue public anti-conspiracy arguments about specific conspiracy theories in order to arm people against the potential dangers of misinformation. Specifically, by responding to conspiratorial explanations for past events and current controversies, governments and health professionals may be able to address potentially harmful effects on people's attitudes and behaviors. However, Sunstein and Vermeule note that conspiracy theories may be extremely resistant to correction, and "contrary evidence can usually be shown to be a product of the conspiracy itself" (p. 210). It is therefore doubtful whether simply presenting anti-conspiracy arguments would be sufficient to influence conspiracy belief or behavioral intentions.

Banas and Miller (2013) directly tested this question, examining the effectiveness of two types of anti-conspiracy arguments. They asked participants to watch a 40-minute chapter from the 9/11 Truth Movement conspiracy theory film, *Loose Change: Final Cut*. Participants were then exposed to either a factual anti-conspiracy argument (e.g., that the film provided no evidence of explosives), or a logic-based anti-conspiracy argument (e.g., that the theory lacks parsimony). A control condition included no anti-conspiracy material. Afterwards, participants indicated their belief in the theory that the United States government participated in a conspiracy to carry out the 9/11 attacks. Results demonstrated that both

experimental conditions reduced belief in the 9/11 conspiracy theory relative to the control message. However, the fact-based message was more effective than the logic-based argument. The authors note this could be because “applying logic to a problem might be more challenging than understanding that the facts being presented are incorrect” (p. 199). Whatever exact mechanisms drive the effects, results suggest that fact-based anti-conspiracy arguments may be an effective tool to reduce belief in conspiracy theories.

Jolley and Douglas’s (2014a) research provides further support for this possibility. Specifically, exposure to anti-conspiracy arguments reduced belief in conspiracy theories relative to a control condition. However, less encouragingly, results also indicated that exposure to anti-conspiracy information did not improve *intentions* to vaccinate a fictional child relative to the control condition. Whilst it may be straightforward to influence belief in conspiracy theories by introducing factual arguments, this may have limited effectiveness on making people change their behaviors. As Jolley and Douglas (2014a) argued, “once the very idea of a conspiracy has been mentioned and taken root, even strong [anti-conspiracy] arguments may be unable to lead to behavioural action” (p. 8).

One way to strengthen the persuasiveness of anti-conspiracy arguments may be to present them *before* conspiracy theory material has been presented. If material presented first is relatively controversial, interesting, and familiar to the audience, this tends to produce a *primacy effect* (i.e., the first arguments presented have an advantage; e.g., Furnham, 1986; Rosnow, 1966; Rosnow & Robinson, 1967). If an audience starts with a high level of interest that decreases over time, it is more likely that they will be persuaded by arguments presented first (Gass & Seiter, 2010). Conspiracy theories are controversial and interesting by nature. They posit novel, often elaborate and unconventional explanations for events. Presenting anti-conspiracy arguments *before* people are exposed to conspiracy material may therefore inoculate them (e.g., McGuire & Papageorgis, 1961; Pfau & van Bockern, 1994) from any

potentially harmful consequences by providing a defence against the conspiracy theory. We tested this possibility in the current research.

In two studies, participants were given anti-conspiracy arguments concerning vaccination either before or after conspiracy arguments, or in the absence of each other. We examined the extent to which anti-conspiracy information improves vaccination intentions and the importance of presentation order. We also examined the potential mediating roles of anti-vaccine conspiracy beliefs and the perception that vaccines are dangerous. These studies present a first attempt to undermine the potentially negative consequences of anti-vaccine conspiracy theories that have been observed in previous research.

Study 1

Participants were asked to read one of five combinations of arguments: (1) conspiracy arguments only, (2) anti-conspiracy arguments only, (3) arguments refuting anti-vaccine conspiracy theories, followed by arguments in favor (anti-conspiracy/conspiracy), (4) arguments in favor of conspiracy theories, followed by arguments refuting them (conspiracy/anti-conspiracy), or (5) a control condition where participants were presented with no information. Participants were then asked to rate their belief in a series of anti-vaccine conspiracy theories and the extent to which they perceived vaccines to be dangerous. Finally, participants were presented with a scenario depicting a fictitious child. They were asked to imagine that they were faced with the decision to have this child vaccinated against a specific (made up) disease (see Jolley & Douglas, 2014a). They were then given some information about the disease and the vaccination and were asked to indicate their intention to have the child vaccinated.

To first demonstrate the potential dangers of anti-vaccine conspiracy theories and replicate previous research, we predicted that intentions to vaccinate would be reduced when people were exposed to anti-vaccine conspiracy theories (Jolley & Douglas, 2014a) (*H1*).

We also examined the mediating factor observed in previous research (the perception that vaccines are dangerous) and belief in anti-vaccine conspiracy theories (Jolley & Douglas, 2014a). In the current investigation however, we aimed to extend previous research by testing a serial mediation model. We predicted that exposure to anti-vaccine conspiracy theories would increase belief in anti-vaccine conspiracy theories, which may then *directly* lead to a heightened perception that vaccines are dangerous. In turn, this perception may reduce intentions to vaccinate a fictional child (*H2*). To test our intervention, we predicted that vaccination intentions would improve when anti-conspiracy arguments are presented before conspiracy theories (*H3*). We further predicted that this effect of the intervention would be explained by reduced belief in anti-vaccine conspiracy theories leading to the belief that vaccines are less dangerous, thus improving vaccination intentions (*H4*).

Method

Participants and design

Two hundred sixty seven participants (97 women and 170 men, $M_{\text{age}} = 31.73$, $SD = 9.93$) were recruited via Amazon's Mechanical Turk (MTurk™). Participants were residents of the U.S.A. and received 75 cents payment. At the end of the questionnaire, participants were asked if they devoted their full attention to the study and if there were any distractions. Participants who rated four and above (out of five, with five indicating no attention and many distractions) were removed from analyses. The final sample size was 260 (95 women and 165 men, $M_{\text{age}} = 31.90$, $SD = 9.96$). There were 55 participants in the conspiracy condition, 52 in the anti-conspiracy condition, 51 in the conspiracy/anti-conspiracy condition, 50 in the anti-conspiracy/conspiracy condition, and 52 in the control condition. One hundred thirty one (50.4%) were parents, who had an average of 1.16 ($SD = 0.46$) children, with the youngest being 3.47 ($SD = 1.37$) years old. The study was a single-factor between-subjects design

(conspiracy vs. anti-conspiracy vs. anti-conspiracy/ conspiracy vs. conspiracy/anti-conspiracy vs. control).

Materials and procedure

Participants indicated their informed consent before beginning the questionnaire. Next, they were randomly assigned to one of the five experimental conditions. The conspiracy and anti-conspiracy articles were identical in all conditions, which were taken from previous research (see supplementary materials in Jolley & Douglas 2014a: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0089177#s5>). Following previous research, the term ‘conspiracy theory’ was not mentioned in either of the articles (Douglas & Sutton, 2008). Extracts from the conspiracy and anti-conspiracy articles, respectively, are as follows:

“...further, there is a significant amount of evidence that vaccines can hurt more than they help. For example, by the year 2002, tens of thousands of reactions to vaccines, including deaths, were reported...”

“...further, there is little evidence to suggest that vaccines are harmful. The side effects are minimal and whilst millions of people have been immunised over the years, less than .005% have ever had an adverse reaction to a vaccine...”

We used the manipulation check measure from previous research (that asks participants to indicate their anti-vaccine conspiracy beliefs; Jolley & Douglas, 2014a) as a potential mediator variable. There were eleven statements (e.g., “Misrepresentation of the efficacy of vaccines is motivated by profit”, $1 = \text{strongly disagree}$, $7 = \text{strongly agree}$; $\alpha = .79$).

Participants then indicated the extent to which they felt that vaccines were dangerous (Betsch & Sachse, 2013; Jolley & Douglas, 2014a). There were eight statements (e.g., “Vaccines lead to allergies”, $1 = \text{strongly disagree}$, $7 = \text{strongly agree}$; $\alpha = .94$). Participants were then asked to imagine a scenario in which they were the parent of an infant (Sophie,

aged 8 months; Betsch & Sachse, 2013; Betsch, Renkewitz, & Haase, 2013; Jolley & Douglas, 2014a). They were informed that their doctor had provided them with information regarding the (fictitious) disease *dysomeria*, which may lead to serious consequences with symptoms such as fever and vomiting. After reading the scenario, participants indicated their intention to have the fictional child vaccinated (“If you had the opportunity to vaccinate your child (Sophie, aged 8 months) against dysomeria next week, what would you decide; 1 = *definitely not vaccinate*, 7 = *definitely vaccinate*). At the end of the study, participants were debriefed and informed that the information presented in the article was fictional. They were also pointed towards websites containing factual information about vaccines, vaccine efficacy and vaccine safety before being thanked and paid for their participation.

Results and discussion

Descriptive statistics are presented in Table 1. No results were affected by the participants’ parental status, nor their age or gender. These factors are not reported further.

Consequences of anti-vaccine conspiracy theories

Anti-vaccine conspiracy theories and vaccination intentions. To test *H1*, differences in vaccination intentions between the conspiracy, anti-conspiracy and control conditions were examined. There was a significant difference in vaccination intentions across conditions, $F(4, 255) = 5.00, p = .001, \eta^2 = .07$. Intentions were significantly lower in the conspiracy condition than the anti-conspiracy condition ($p < .001$) and the control condition ($p < .001$). Intentions were no different between the anti-conspiracy condition and control ($p = .718$). This replicates previous research (Jolley & Douglas, 2014a).

Belief in anti-vaccine conspiracy theories and perceived dangers of vaccines. To test *H2*, separate ANOVAs were first conducted between conspiracy, anti-conspiracy and control conditions as the independent variable, and mean scores on the two potential mediators (belief in anti-vaccine conspiracy theories and perceived vaccine dangers) as

dependent variables. There was a significant difference in belief in anti-vaccine conspiracy theories between conditions, $F(4, 255) = 9.46, p < .001, \eta^2 = .13$. Conspiracy belief was significantly higher in the conspiracy condition than the anti-conspiracy condition ($p < .001$) and the control condition ($p = .001$). Moreover, conspiracy belief was significantly lower in the anti-conspiracy than the control condition ($p = .017$). There was also a significant difference in belief in perceived dangers of vaccines between conditions, $F(4, 255) = 8.32, p < .001, \eta^2 = .12$. Participants in the conspiracy condition perceived vaccines to be more dangerous than those in the anti-conspiracy condition ($p < .001$) and the control ($p = .001$). The perception that vaccines are dangerous was also lower in the anti-conspiracy than the control condition ($p = .031$). Findings therefore replicate Jolley and Douglas (2014a).

Testing serial mediation. Building on Jolley and Douglas (2014a), each candidate mediator was examined in a test of serial mediation to explain the effect of the conspiracy condition on vaccination intentions ($H2$). This was carried out using Hayes' (2013) bootstrapping method for indirect effects, using PROCESS, Model 6 including two serial mediators with 5,000 bootstrapped resamples and a 95% confidence interval. This method allows us to test the 'direct effect' of conspiracy arguments on vaccination intentions, alongside the 'indirect effect' encompassing the effect of conspiracy arguments on vaccination intentions when each of the two mediators increase. This method also allows the 'indirect effect' of several mediators to be tested, specifically the effect of the conspiracy argument changing one mediator, which then *directly* leads to a change in the next.

The pro-conspiracy condition was coded as the representative condition and was compared to the anti-conspiracy condition (D1) and control (D2) separately. Results (see Figure 1) demonstrated that both mediation models were significant. Conspiracy arguments increased belief in anti-vaccine conspiracy theories, which directly increased belief in the

perceived dangers of vaccines, and subsequently reduced intentions to vaccinate a fictional child. This replicates and extends previous research (Jolley & Douglas, 2014a).

Addressing anti-vaccine conspiracy theories

Anti-vaccine conspiracy theories and vaccination intentions. We next examined the success of altering the order of the conspiracy and anti-conspiracy arguments as an avenue to improve vaccine uptake after being exposed to anti-vaccine conspiracy theories (*H3*). Vaccination intentions were improved when participants were presented with anti-conspiracy arguments *prior* to exposure to conspiracy theories ($p = .047$), but not when presented with anti-conspiracy arguments *after* exposure to conspiracy theories ($p = .263$), compared to conspiracy arguments. As predicted therefore, anti-conspiracy arguments presented *prior* to exposure to conspiracy theories improved vaccination intentions. However, conspiracy theories appear difficult to correct once established.

Belief in anti-vaccine conspiracy theories and perceived dangers of vaccines.

Next, the two mediators were examined in order to test effectiveness of the order of arguments in reducing these mediating factors. Belief in anti-vaccine conspiracy theories was lower when participants were presented with anti-conspiracy arguments *prior* to conspiracy arguments ($p = .006$), but not when presented with anti-conspiracy arguments *after* conspiracy arguments ($p = .211$), compared to conspiracy arguments. The perception that vaccines are dangerous was also lower when participants were presented with anti-conspiracy arguments *prior* to conspiracy arguments ($p = .003$), but not when presented with anti-conspiracy arguments *after* conspiracy arguments ($p = .171$), compared to conspiracy information only. Therefore, presenting anti-conspiracy arguments prior to conspiracy theories reduced belief in the conspiracy account and the perception that vaccines are dangerous. Once the conspiracy theory was established however, anti-conspiracy arguments did not successfully attenuate these beliefs and perceptions.

Testing serial mediation. We next tested whether the mediating factors explain the improvement in vaccination intentions when anti-conspiracy arguments were presented first (*H4*). The conspiracy condition was coded as the representative group and compared to conspiracy/anti-conspiracy and anti-conspiracy/conspiracy conditions. Results (see Figure 2) demonstrated that the mediation model between conspiracy and anti-conspiracy/conspiracy was significant (D1). In this case, exposure to anti-conspiracy arguments, then conspiracy arguments (in comparison to conspiracy arguments alone) reduced belief in anti-vaccine conspiracy theories, which then reduced perceptions that vaccines are dangerous, subsequently improving behavioral intentions. There was no significant mediation between conspiracy and pro-conspiracy/anti-conspiracy conditions (D2).

In summary, exposure to anti-vaccine conspiracy theories reduced vaccination intentions, an effect mediated by anti-vaccine conspiracy beliefs and perceptions that vaccines are dangerous. When anti-conspiracy arguments were presented *before* conspiracy theories, vaccination intentions improved relative to the conspiracy condition, and this effect was mediated by anti-vaccine conspiracy beliefs and the perception that vaccines are dangerous. However, when anti-conspiracy arguments were presented *after* conspiracy arguments, the intervention was less effective. This last finding supports Lewandowsky, Ecker, Seifert, Schwarz, and Cook's (2012) observation that misinformation may be "sticky" (p. 107). In particular, when people do not have the opportunity to prepare a defense to misinformation, the misinformation can be more persuasive. Our findings suggest, therefore, that prior exposure to correct information (i.e., 'inoculation') may be a successful way to address the effects of conspiracy theories in the controversial case of anti-vaccination.

Study 2

In Study 2, we aimed to replicate these findings, focusing solely on the inoculation effect observed in support of *H3* and *H4*. In recent years, the importance of replication has

been underscored (e.g., Giner-Sorolla, 2012; Reis & Lee, in press) and in the process of developing an intervention to address a significant social issue, replication is arguably at its most important. We therefore aimed to provide further evidence that inoculation may be a valuable tool to improve vaccination intentions. Participants were presented with anti-conspiracy information either before, or after information supporting anti-vaccine conspiracy theories. We predicted that anti-conspiracy information presented prior to conspiracy theories would improve vaccination intentions (*H3*) and that this effect would be mediated by anti-vaccine conspiracy beliefs and perceptions concerning vaccine dangers (*H4*).

Method

Participants and design

One hundred eighty participants (94 women, 84 men, 1 Transgendered/Other, $M_{\text{age}} = 33.76$, $SD = 11.76$) were recruited via Prolific Academic. Participants were residents of the U.S.A. and received one dollar as payment. At the end of the questionnaire, participants were asked the same attention check questions as in Study 1. Five participants failed and the final sample size was 175 (95 women, 79 men, 1 transgender/other, $M_{\text{age}} = 34.02$, $SD = 11.10$). There were 58 participants in the conspiracy condition, 64 in the anti-conspiracy/conspiracy condition, and 53 in the conspiracy/anti-conspiracy condition. Sixty four (36.6%) were parents, who had an average of 2.22 ($SD = 1.55$) children, with the youngest being 13.63 ($SD = 9.12$) years old. The study was a single-factor independent variable between-subjects design (conspiracy vs. anti-conspiracy/ conspiracy vs. conspiracy/anti-conspiracy).

Materials and Procedure

The materials and procedure were identical to Study 1 except for the removal of the anti-conspiracy and control conditions. Scales of belief in anti-vaccine conspiracy theories ($\alpha = .92$) and the perception that vaccines are dangerous ($\alpha = .94$) were reliable.

Results and discussion

Descriptive statistics are presented in Table 2. No results were affected by the participants' parental status, nor their age or gender. These factors are not reported further.

Anti-vaccine conspiracy theories and vaccination intentions. To again test *H3*, differences in vaccination intentions between the conspiracy and the two intervention conditions were examined. There was a significant difference in vaccination intentions across conditions, $F(2, 172) = 4.64, p = .011, \eta^2 = .05$. Vaccination intentions were improved when participants were presented with anti-conspiracy arguments *prior* to conspiracy theories ($p = .003$), but not when presented with anti-conspiracy arguments *after* conspiracy theories ($p = .164$), compared to the conspiracy condition. This replicates the results in Study 1 and provides further support for *H3*.

Belief in anti-vaccine conspiracy theories and perceived dangers of vaccines. To test potential mediators in support of *H4*, separate ANOVAs were first conducted between the conspiracy and two intervention conditions, and the mean scores on the two potential mediators (belief in anti-vaccine conspiracy theories and perceived vaccine dangers) were the dependent variables. Results revealed a significant difference in belief in anti-vaccine conspiracy theories between conditions, $F(2, 172) = 6.29, p = .002, \eta^2 = .07$. Belief was lower when participants were presented with anti-conspiracy arguments *prior* to conspiracy arguments ($p = .001$), but not when presented with anti-conspiracy arguments *after* conspiracy arguments ($p = .100$), compared to the conspiracy condition. There was also a significant difference in belief in perceived dangers of vaccines between conditions, $F(2, 172) = 4.64, p = .011, \eta^2 = .05$. Perceptions were lower when participants were presented with anti-conspiracy arguments *prior* to conspiracy arguments ($p = .008$), but not when presented with anti-conspiracy arguments *after* conspiracy arguments ($p = .460$), compared to the conspiracy condition.

Testing serial mediation. The same mediation procedure was followed as in Study 1, in order to provide further support for *H4*. Similarly therefore, the conspiracy condition was coded as the representative group and compared to anti-conspiracy/conspiracy (D1) and conspiracy/anti-conspiracy conditions (D2). The mediation model between conspiracy and anti-conspiracy/conspiracy (D1) was significant (see Figure 3). Exposure to anti-conspiracy arguments, then conspiracy arguments (in comparison to conspiracy arguments alone) reduced belief in anti-vaccine conspiracy theories, which then reduced perceptions that vaccines are dangerous, subsequently improving behavioral intentions. There was no significant mediation between conspiracy and conspiracy/anti-conspiracy conditions (D2).

In summary, as in Study 1, exposure to anti-conspiracy arguments *before* conspiracy theories reduced conspiracy belief, leading to a reduction in the belief that vaccines are dangerous, and improving vaccination intentions (*H3* and *H4*). Vaccination intentions were not improved when anti-conspiracy arguments were presented *after* conspiracy theories.

General discussion

The current research suggests that anti-vaccine conspiracy theories negatively influence vaccination intentions, but that these effects may be intervened upon with anti-conspiracy information presented *before* the conspiracy theories have been established. Once the conspiracy theories have been established however, anti-conspiracy information appears to be less effective. These results therefore suggest that combating the potentially negative consequences of anti-vaccine conspiracy theories may be achieved if people are exposed to accurate scientific information *before* the conspiracy theories.

Our work has replicated and extended previous research examining the role of anti-vaccine conspiracy theories on behavioral intention outcomes (Jolley & Douglas, 2014a). First, we have shown that exposure to pro-conspiracy information reduces peoples' intentions to vaccinate a fictional child, relative to an anti-conspiracy condition, or a control. We

extended this finding by testing a serial mediation model, and found that exposure to conspiracy theories increased belief in anti-vaccine conspiracy theories leading to an increase in the perception that vaccines are dangerous, which consequently reduced participants' intentions to vaccinate a fictional child.

Next, we systemically tested a technique to address conspiracy theories. Anti-conspiracy arguments were shown to improve vaccination intentions (when compared to the conspiracy only condition) if presented *prior* to conspiracy theories. This provides empirical evidence of the success of a technique to address conspiracy theories. We suggest that by presenting anti-conspiracy information first, this may in some way inoculate people from the potential harm of conspiracy theories. Previous research by McGuire and Papageorgis (1961) has demonstrated, for example, that providing people with a defense (i.e., refuting arguments) before hearing an attacking message provides a better defense than not being provided with any information at all. These refuting arguments presented in advance made people more resistant to persuasion. In our current investigation, we argue that providing anti-conspiracy arguments before conspiracy arguments offers people some kind of means of defense, making them more resistant to persuasion by conspiracy theories. We also found however, that anti-conspiracy information presented *after* conspiracy theories did not improve vaccination intentions. Lewandowsky, et al. (2012) refer to misinformation as being “sticky” and often resistant to correction (p. 107). Without being given the time to prepare a defense beforehand, the misinformation is potentially more persuasive than correct arguments. The current findings suggest similarly that once a conspiracy theory has become established, it may indeed ‘stick’ and become resistant to attempts at correction by accurate scientific information about vaccines.

Conspiracy theories are extremely easy to access through friends, acquaintances, and on the Internet (e.g., Coady, 2006). Also, conspiracy theories tend to surface very quickly

after an event has happened (e.g., Leman, 2007). For other types of conspiracy theories (e.g., when a celebrity dies or there is a major world disaster), it may therefore not be possible to present anti-conspiracy arguments *prior* to conspiracy theories. However, this intervention is more practical in the case of anti-vaccine conspiracy theories. For example, people may not come across anti-vaccine conspiracy theories very much until they have children. They may therefore be reasonably unaware of conspiracy theories that may influence their judgment until the judgment becomes immanent for them. However, we must also note that in the current research parental status did not appear to influence the results. It seems that once a person (parent or non-parent) is exposed to anti-vaccine conspiracy theories, counter-arguments alone are less effective in improving vaccination intentions.

Interventions therefore that focus on educating people *before* conspiracy theories have taken root may be effective in improving vaccination intentions. For others who have already taken on board anti-vaccine conspiracy theories, stronger interventions will likely be required to refute them. As mentioned earlier, the U.S. state of Oregon has recently passed legislation that requires parents or guardians to watch an education video before they are allowed a vaccination exemption. Such a technique may indeed improve vaccine uptake and time will tell if this is the case. However, our findings suggest that the success of such an intervention may depend on a person's prior exposure to conspiracy theories. If a person has not been exposed very much to anti-vaccine conspiracy theories, their vaccination intentions could be improved by such a technique. For those who have already taken on board the conspiracy theories however, merely providing factual information on vaccines may be less effective and stronger interventions may be required.

Previous research has shown for example that in some cases counter-arguments not only need to provide original opposing arguments, but also need to explicitly argue *against* each of the points included in the misinformation (Gass & Seiter, 2010). Researchers have

found that non-refutation counter-arguments (i.e., opposing arguments mentioned, but not arguing against the initial argument presented) are less effective than refutation counter-arguments (Allen, 1993, 1998; Allen, et al., 1990; O'Keefe, 1999). It is therefore reasonable to suggest that an anti-conspiracy argument that clearly argues *against* the conspiracy theory (as opposed to just presenting the anti-conspiracy information) may be more successful in attenuating the influence of conspiracy theories. An anti-conspiracy argument that directly refutes conspiracy theories could therefore be tested in future research as a means to combat the impact of conspiracy theories.

In a similar vein, another method may be to make the anti-conspiracy argument equally as interesting and controversial as the conspiracy theory account, alongside arguing *against* the conspiracy theory. For example, in the context of vaccines, more background could be provided surrounding Andrew Wakefield's 1998 article in *The Lancet*, how the research was discredited, and that the author is no longer permitted to practice medicine. For example, this may involve a discussion on Wakefield's undisclosed financial conflicts of interest, failed replications of Wakefield's findings, and his work ultimately being identified as an elaborate fraud. Providing more contextual details may make the anti-conspiracy arguments more interesting than just supplying the facts that refute the conspiracy argument.

In addition to making anti-conspiracy arguments more interesting, interventions may also use the technique of forewarning. Previous research has shown that combining refuting information with a warning about misinformation (i.e., that people tend to rely on misinformation even when it has been shown to be unreliable), enables participants to better resist misinformation than when refuting information is presented alone (Eakin, Schreiber & Sergent-Marshall, 2003). It is argued that this technique is successful because a forewarning enables recipients to more closely monitor incoming messages (Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012). In other words, being given a forewarning may induce a

temporary state of skepticism and prompt the recipient to become more vigilant, and they may therefore be more likely to suppress misinformation (Eakin et al., 2003; Lewandowsky et al., 2012). A similar warning approach may work to lessen the negative effects of conspiracy theories once they have been established.

Finally, as we mentioned in the introduction, interventions already exist that target anti-vaccine attitudes and behavior. For instance, interventions include using expert sources to make information appear more credible (Hopfer, 2012) or emphasizing that vaccination is normative behavior (Conroy et al., 2009). These interventions, although not directly targeted at conspiracy belief, may nevertheless contain strategies or techniques that reduce conspiracy belief. Future research could therefore address how current interventions may influence conspiracy belief as a route to attitude and behavior change. A further challenge for future research may also be to address how interventions that target conspiracy belief may be used in conjunction with existing interventions.

Some limitations of the current research should also be considered in future investigations. For example, the intervention tested in the current research was based on anti-vaccine conspiracy theories only and it is therefore not possible to conclude that all conspiracy theories may be resistant to correction. As mentioned previously, many conspiracy theories may emerge too quickly after an event to prevent pre-exposure to them, making inoculation almost impossible. It is also reasonable to propose that anti-vaccine conspiracy theories may be more persuasive than other types of conspiracy theories. Indeed, the conspiracy theory statements used in the present study discussed childhood vaccinations, which could be more emotionally laden than other conspiracy theories. Nonetheless, future research could examine the success of techniques for intervening upon other types of conspiracy theories, and especially perhaps climate change conspiracy theories for which

there is ample scientific evidence to draw upon (Douglas & Sutton, 2015; Lewandowsky et al., 2013).

Further, the mediators in the current investigation were not manipulated, and therefore we cannot rule out the possibility that a third variable may have affected both the mediators and the outcome. Future research could examine whether this makes a difference to the effectiveness of the intervention. Another factor to note is that the outcome measure used in the current investigation were based on intentions to vaccinate a fictional child. It is widely known however that intentions do not always lead to real behaviors (e.g., LaPiere, 1934; Sheeran, 2002). Although a challenging research endeavour, future research could therefore attempt to examine whether explicit anti-conspiracy arguments presented *prior* to conspiracy theories can improve actual vaccination behavior. Moreover, in the current investigation arguments were presented one after the other which is not necessarily reflective of how people receive information in everyday life. Future research could therefore examine the effectiveness of the current intervention with different time gaps between exposure to conspiracy and non-conspiracy information. This would also address any potential fatigue effects due to participants reading the information pages one after the other. Moreover, participants' prior knowledge concerning vaccination, and belief in anti-vaccine conspiracy theories, were not assessed in either of the current studies (with perhaps the exception of the control group in Study 1 to some degree). Future research could therefore examine whether existing knowledge about vaccination, and/or strength of prior belief in conspiracy theories influences the effectiveness of the intervention.

Future research could also attempt to enhance anti-conspiracy arguments by manipulating how they are presented to the reader. We know that certain sources are trusted more than others as a means to acquire information on a variety of topics. For example, people are more likely to seek information about vaccines via the Internet than through their

doctor (Downs, Bruine de Bruin, & Fischhoff, 2008). Varying the source of the counter-material could highlight which sources are therefore most trustworthy, and thus which are likely to have the most weight in making counter-arguments credible to the reader. Future research could also look into presenting anti-conspiracy material on other media platforms and measuring how the source of information may influence the impact of conspiracy theories on behavioral intentions. For example, anti-conspiracy text could be accompanied by images, or presented in a video or podcast format. Previous research has shown that anti-conspiracy arguments concerning the NASA moon landing accompanied by photographs reduced conspiracy beliefs below baseline (Swami, et al., 2012). Techniques such as this may be particularly applicable in developing education videos that aim to increase vaccine uptake.

Conclusion

Emerging research highlights the potential dangers of conspiracy theories. Conspiracy theories may not only stop people from engaging with important aspects of society, such as voting, engaging with their work, and vaccinating their children (Douglas & Leite, in press; Jolley & Douglas, 2014a, 2014b), but their effects may be difficult to alleviate. We found that whilst vaccination intentions could be improved when anti-conspiracy arguments were present *prior* to conspiracy theories, if they came afterwards, the intervention was unsuccessful. Once a conspiracy account has become established, it may be resistant to correction. Ongoing investigations are therefore needed to develop interventions designed for this type of persuasive communication.

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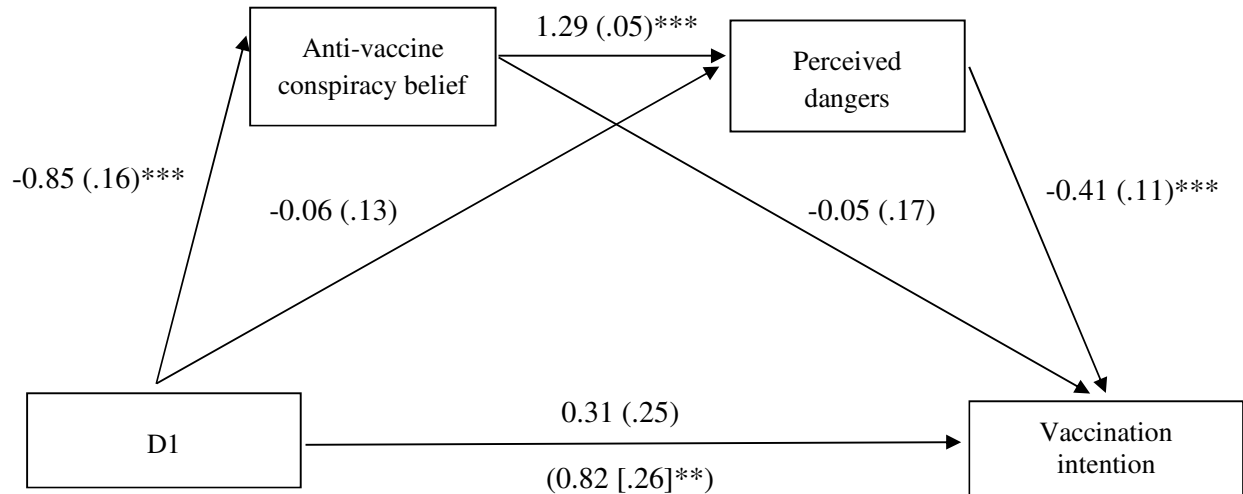
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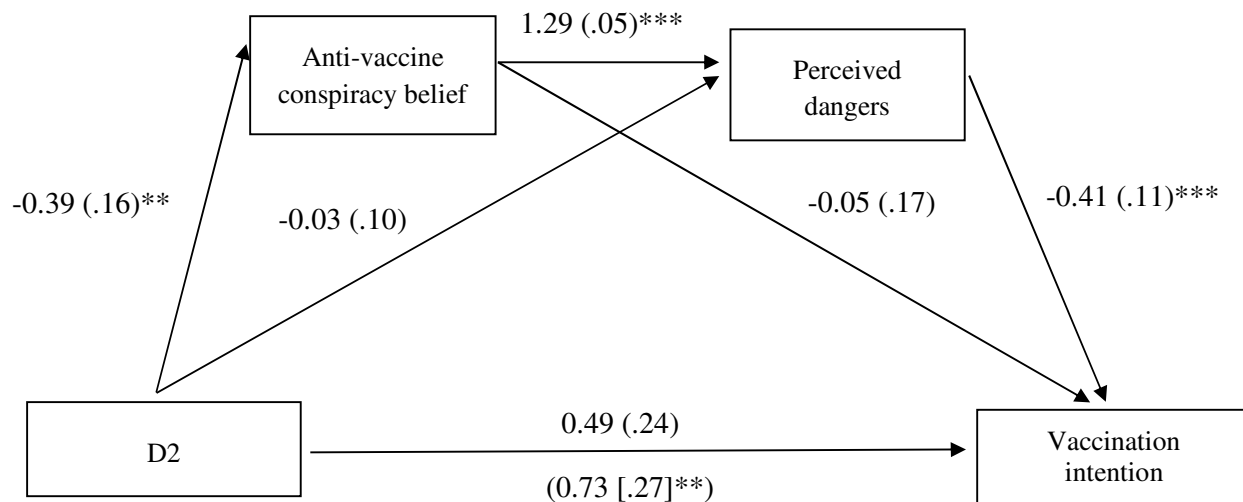
Table 1

Means and Standard Deviations across Conditions for Conspiracy Belief, Perceptions that Vaccines are Dangerous, and Intentions to Vaccinate in Study 1.

Condition	Means (SD)		
	Anti-vaccine conspiracy belief	Perceived dangers of vaccines	Intention to vaccinate
Conspiracy	4.47 (0.81)	4.50 (1.26)	4.42 (1.76)
Anti-conspiracy	3.38 (1.02)	2.92 (1.57)	5.60 (1.49)
Control	3.83 (1.12)	3.55 (1.62)	5.50 (1.21)
Anti-conspiracy/Conspiracy	3.94 (1.00)	3.63 (1.56)	5.04 (1.69)
Conspiracy/Anti-conspiracy	4.23 (0.91)	4.04 (1.45)	4.80 (1.77)



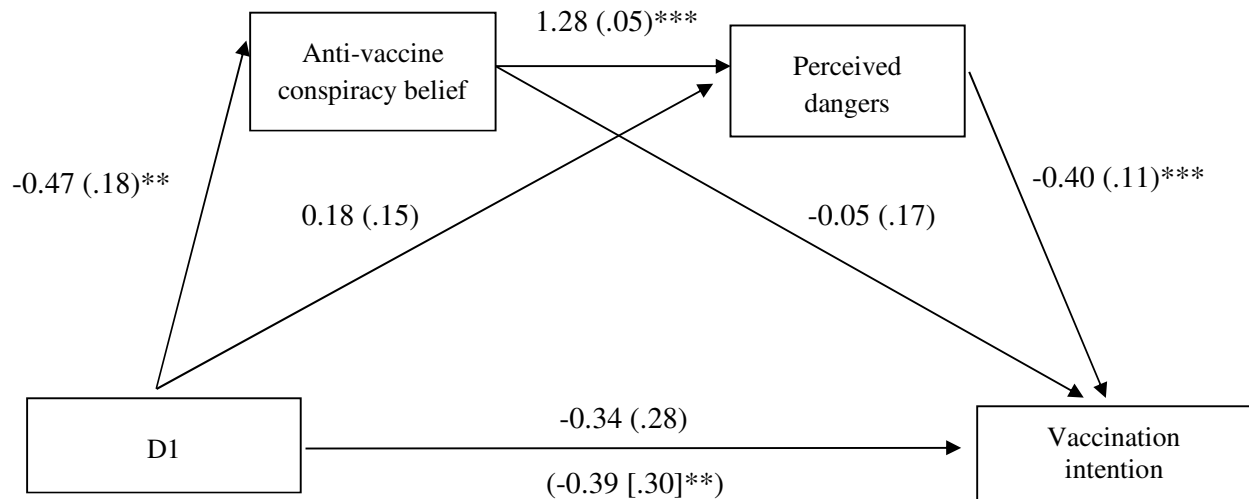
Point Estimate: 0.45 (SE: .16); Monte Carlo CI (95%): 0.1692 / 0.8031



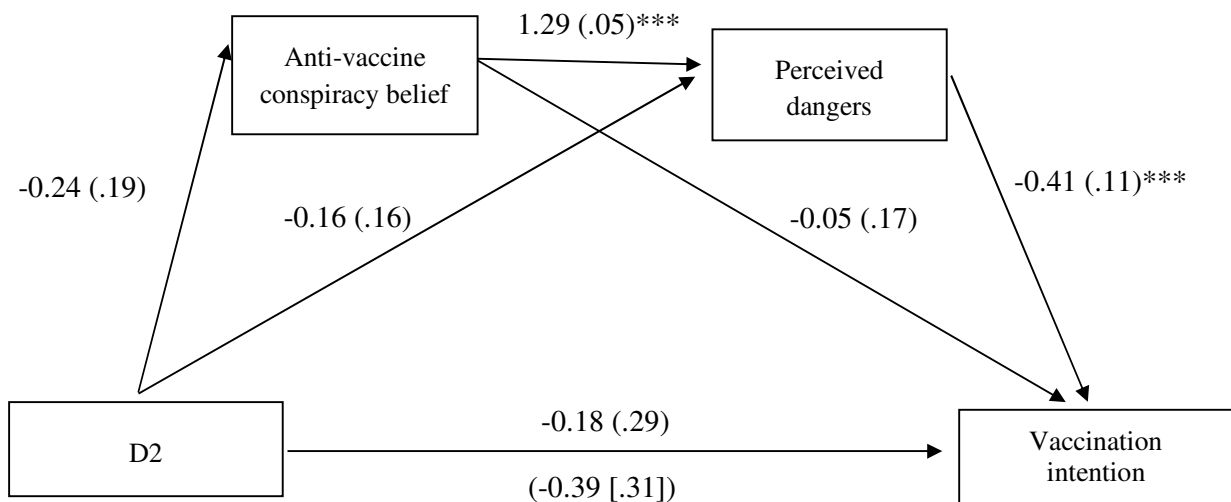
Point Estimate: 0.20 (SE: .11); Monte Carlo CI (95%): 0.0220 / 0.4521

Figure 1. A serial mediation test of conspiracy condition (D1, conspiracy versus anti-conspiracy, versus D2, conspiracy versus control) on vaccination intentions (DV) through belief in anti-vaccine conspiracy theories and the perception that vaccines are dangerous in Study 1 (MVs) (N = 260; 5000 bootstrap samples)

Note. First number represents b statistic and the second is the S.E. **p<.05, ***p<.001.



Point Estimate: -0.24 ($SE: .12$); Monte Carlo CI (95%): $-0.5175 / -0.0507$



Point Estimate: -0.12 ($SE: .09$); Monte Carlo CI (95%): $-0.3496 / 0.0421$

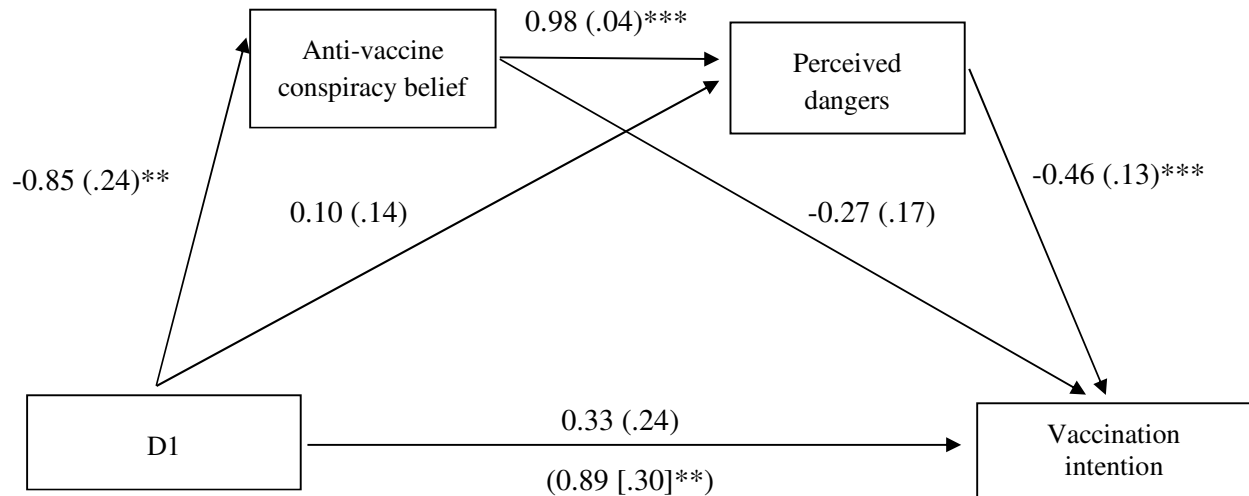
Figure 2. A serial mediation test of conspiracy condition (D1, conspiracy versus anti-conspiracy / conspiracy, versus D2, conspiracy versus conspiracy / anti-conspiracy) on vaccination intentions (DV) through belief in anti-vaccine conspiracy theories and perception that vaccines are dangerous in Study 1 (MVs) ($N = 260$; 5000 bootstrap samples)

Note. First number represents b statistic and the second is the $S.E.$ $^{**}p < .05$, $^{***}p < .001$.

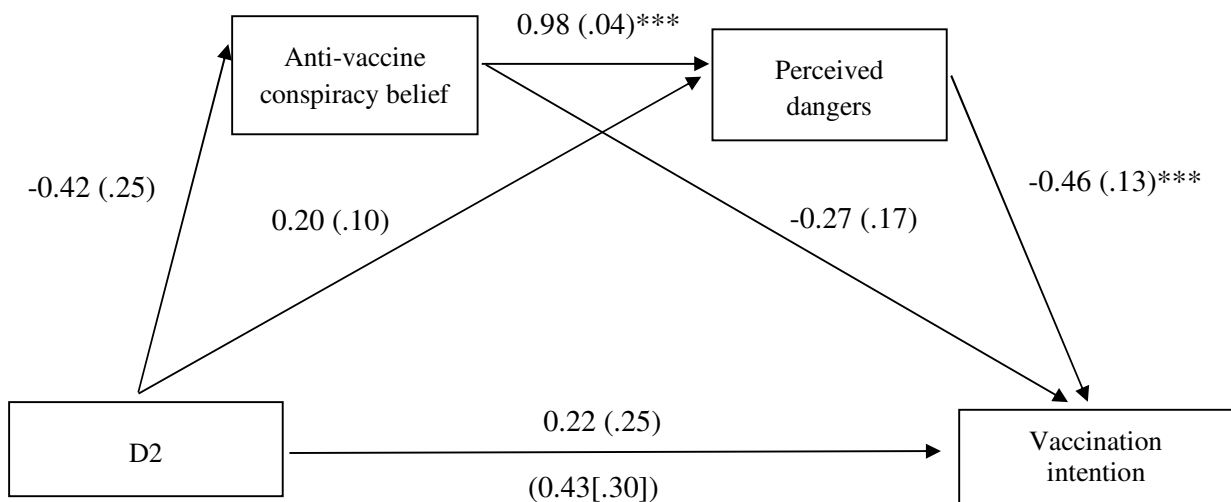
Table 2

Means and Standard Deviations across Conditions for Conspiracy Belief, Perceptions that Vaccines are Dangerous, and Intentions to Vaccinate in Study 2.

Condition	Means (SD)		
	Anti-vaccine conspiracy belief	Perceived dangers of vaccines	Intention to vaccinate
Conspiracy	3.61 (1.50)	3.28 (1.66)	5.16 (1.97)
Anti-conspiracy/Conspiracy	2.76 (1.23)	2.56 (1.48)	6.05 (1.20)
Conspiracy/Anti-conspiracy	3.19 (1.20)	3.08 (1.29)	5.58 (1.63)



Point Estimate: 0.38 (SE: .17); Monte Carlo CI (95%): 0.0932 / 0.7704



Point Estimate: 0.19 (SE: .14); Monte Carlo CI (95%): -0.0333 / 0.4963

Figure 3. A serial mediation test of conspiracy condition (D1, conspiracy versus anti-conspiracy / conspiracy, versus D2, conspiracy versus conspiracy / anti-conspiracy) on vaccination intentions (DV) through belief in anti-vaccine conspiracy theories and perception that vaccines are dangerous in Study 2 (MVs) ($N = 175$; 5000 bootstrap samples)

Note. First number represents b statistic and the second is the S.E. ** $p < .05$, *** $p < .001$.