ABSTRACT

Title of Dissertation:	PSYCHOLOGICAL INOCULATION AGAINST VACCINE MISINFORMATION: WHY AND WHEN IT WORKS
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Vaccine misinformation has posed a significant threat to public health. Drawing upon inoculation theory, this dissertation investigates whether exposure to an inoculation message – a message that forewarns and refutes potential persuasive attacks – can confer resistance to misinformation about COVID-19 vaccines. Based on two online experiments, this research seeks to answer four overarching questions: Can exposure to an inoculation message reduce susceptibility to misinformation? Through which mechanisms does inoculation message confer resistance to misinformation? Does the effect of inoculation messages vary among initially informed, uninformed, and misinformed individuals? How do partisan source cues (in-group vs. out-group) impact the effectiveness of inoculation messages among politically affiliated individuals?

Study 1 investigated the effectiveness, mechanisms, and recipient factors related to inoculation messages. A two-condition (inoculation vs. control) between-subject experiment was conducted (N = 659). Results indicated that exposure to an inoculation message effectively reduced individuals' susceptibility to misinformation. Inoculation message not only counteracted

beliefs in misinformation but also protected positive attitudes and intentions toward COVID-19 vaccination. Moreover, perceived ease of counterarguing and anger were identified as significant mediators underlying the persuasive effects of the inoculation message, while counterarguing was not a significant mediator. Furthermore, the effectiveness of inoculation message remained consistent among initially informed, uninformed, or misinformed groups, suggesting that inoculation message offers both prophylactic and therapeutic effects.

Study 2 examined how partisan source cues impacted inoculation message effectiveness. A 2 (in-group vs. out-group inoculation) X 2 (in-group vs. out-group misinformation) between-subject online experiment was conducted among politically affiliated individuals (N = 448). Results showed no main or interaction effects of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation on persuasive outcomes, suggesting that the efficacy of inoculation messages in conferring resistance to misinformation did not differ based on whether the inoculation or misinformation messages came from an in-group or out-group source. Additionally, party identification strength moderated the impact of in-group (vs. out-group) inoculation on beliefs in COVID-19 vaccine misinformation and COVID-19 vaccination attitudes. Surprisingly, the advantage of in-group inoculation over out-group inoculation was stronger among individuals with lower levels of party identification. Moreover, out-group inoculation appeared to be more persuasive than in-group inoculation among individuals with extremely strong political identification.

This dissertation offers several theoretical and practical implications for health communication research and practice. First, this research contributes to inoculation theory by examining two alternative mechanisms – perceived ease of counterarguing and anger – underlying inoculation message effects. The findings underscore the importance of considering

cognitive, meta-cognitive, and affective routes that underlie resistance to persuasion. Additionally, this research expands the scope of inoculation theory by demonstrating its effectiveness among initially informed, uninformed, and misinformed individuals. These results suggest that inoculation messages can be useful beyond the traditional scope of cultural truisms, offering both prophylactic and therapeutic effects. Furthermore, the study challenges the conventional assumption that messages from in-group sources are more persuasive than those from out-group sources, indicating that political groups should work together to address vaccine hesitancy. Overall, this dissertation supports the use of inoculation messages as an effective tool in counteracting misinformation and promoting vaccination acceptance.

PSYCHOLOGICAL INOCULATION AGAINST VACCINE MISINFORMATION: WHY AND WHEN IT WORKS

by

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Chapter 1: Introduction

People seek trustworthy information when making crucial health decisions, such as whether to receive a vaccine. However, discerning reliable information has become increasingly challenging in the age of infodemic, characterized by an overabundance of information – some accurate and some not (World Health Organization, 2021). Misinformation, despite its lack of scientific evidence, often gains traction because it fulfills people's need for certainty and provides a sense of control (Marchlewska et al., 2018). Misinformation has posed a significant threat to public health (Office of the Surgeon General, 2021). Vaccine misinformation, in particular, is putting many lives at risk by eroding vaccine confidence and impeding community immunity (Lazarus et al., 2021).

Online platforms, particularly social media, have become hotbeds for vaccine misinformation. In recent years, numerous studies have evidenced the prevalence of vaccine misinformation across various platforms, including Facebook (Jamison et al., 2020), Instagram (Massey et al., 2020), Twitter (Kornides et al., 2022), TikTok (Basch et al., 2021), and YouTube (H. Li et al., 2022). The COVID-19 pandemic has further exacerbated the spread of misinformation. For example, more than 250,000 TikTok videos about COVID-19 vaccines have been identified as misinformation (Hsu, 2023), and about 10.7% of YouTube's most-viewed videos about COVID-19 vaccines have been found to contain misinformation (H. Li et al., 2022). As a result, exposure to and beliefs in vaccine misinformation are common. For example, a study found that 57.6% of full-time working professionals reported encountering COVID-19 vaccine misinformation (S. K. Lee et al., 2022), while a national poll (Lopes et al., 2021) found that 54% of American adults either believed in some misinformation about COVID-19 vaccines or were

unsure about its accuracy. As the COVID-19 pandemic persists, misinformation surrounding the virus and vaccines continues to jeopardize public health.

Vaccine misinformation has become an increasing concern, particularly during the COVID-19 pandemic. In 2019, World Health Organization [WHO] identified vaccine hesitancy as one of the top threats to global health (WHO, 2019). Empirical evidence has revealed a clear link between vaccine misinformation and vaccine hesitancy, with exposure to vaccine misinformation resulting in less favorable vaccination attitudes (Chen et al., 2020; Featherstone & Zhang, 2020) and decreased vaccination intentions (Chia et al., 2021; Neely et al., 2022). Moreover, a systematic about health misinformation (Y. Wang et al., 2022b) suggests that misinformation can have detrimental consequences on both individual and society levels. Beliefs in and exposure to health misinformation tend to decrease individuals' willingness to engage in healthy behaviors, trigger negative emotions, heighten stigma perceptions, undermine trust in experts and institutions, and fuel the spread of health misinformation (Y. Wang et al., 2022b). The prevalence of vaccine misinformation and its potential harmful impacts underscore the urgent need to develop effective interventions that counteract vaccine misinformation and foster vaccine confidence.

Inoculation messages have shown potential to confer resistance to misinformation. Considered as “the grandparent theory of resistance to attitude change” (Eagly & Chaiken, 1993, p. 561), inoculation theory posited that exposing individuals to weakened arguments against an attitude they hold can confer resistance to future attitudinal attacks (Compton & Pfau, 2005; McGuire, 1964). The underlying rationale is that forewarning people that their existing beliefs or attitudes might be attacked will generate threat, which motivates them to counterargue against the attack message and result in less attitude change (McGuire, 1964). Emerging evidence

suggests that inoculating publics against misinformation leads to lower perceived credibility of misinformation (e.g., Cook et al., 2017), reduced misperceptions (e.g., Vraga et al. 2019), increased confidence in individuals' ability to spot misinformation (Roozenbeek, van der Linden, et al., 2022), and lower willingness to share misinformation with others (Basol et al., 2021). These findings highlight the potential of inoculation messages as a pre-bunking strategy to counter misinformation.

Despite the growing interest in inoculation messages, there are two inquiries surrounding inoculation theory that are not fully answered: What are the mechanisms underlying inoculation message effects? And for whom do inoculation messages work? Studies have found that inoculation message effects cannot be fully explained by threat and counterarguing (e.g., Compton & Ivanov, 2013; Pfau et al., 2001), calling for more studies to explore alternative mechanisms underlying inoculation message effects.

There are two limitations associated with inoculation theory. First, the theory presumes that resistance to persuasion is an effortful cognitive process dependent on extensive thinking (Wegener et al., 2004). However, research has shown that resistance can be achieved through both cognitive and affective routes (Compton & Pfau, 2005), especially via anger (Fransen et al., 2015; Pfau et al., 2001). Second, inoculation theory emphasizes the number of counterarguments that inoculated individuals generate but neglects individuals' subjective experiences when generating these counterarguments. Counterarguing can backfire when individuals perceive their efforts as unsuccessful (Rucker & Petty, 2004) or view the information as difficult to refute (Ahluwalia, 2000), even if they generate a great number of counterarguments (Tormala et al., 2002). Thoughts can impact judgements through two distinct routes: the number of thoughts retrieved and the ease with which those thoughts come to mind (Schwarz et al., 1991). Building

upon the feelings-as-information theory (Schwarz, 2012), this dissertation posits that exposure to inoculation messages will improve individuals' ability to refute misinformation by not only increasing the number of counterarguments they generate but also by improving their perceived ease of counterarguing against the misinformation. Therefore, the first objective of this dissertation is to extend inoculation theory by examining the affective (i.e., anger) and meta-cognitive (i.e., perceived ease of counterarguing) mechanisms underlying the effects of inoculation messages.

Another underexplored area in inoculation research pertains to the question of whether inoculation messages can provide resistance to attack messages, irrespective of individuals' initial beliefs or attitudes. Early inoculation studies viewed inoculation as a strategy to protect individuals' existing positions and to develop resistance against attacks contradicting their beliefs (McGuire & Papageorgis, 1962). The underlying assumption of inoculation theory is that recipients should already hold an established belief or attitude consistent with the advocated position of the inoculation message (Compton, 2020). In other words, inoculation messages against misinformation are designed for people who initially hold accurate beliefs, rather than those who are initially misinformed. However, empirical evidence has shown that inoculation can effectively promote individuals' beliefs toward the advocated direction of the inoculation message, regardless of their pre-existing beliefs (e.g., Ivanov et al., 2017; Wood, 2007). To further investigate the boundary conditions of inoculation message effectiveness, the second objective of this dissertation is to examine whether the effectiveness of inoculation messages against misinformation varies among initially informed, uninformed, and misinformed individuals.

While some evidence supports the overall effectiveness of inoculation messages across different groups of people, less is known about whether the underlying mechanisms of inoculation message remain consistent for individuals with varying pre-existing beliefs. Wood (2007) found that for people who initially disagreed with the advocated position of the inoculation message, inoculation messages effectively protected their attitudes from becoming more negative; however, this effect did not operate through counterarguing. Similarly, Compton (2020) posited that for individuals with neutral or opposing initial attitudes toward the advocated position of inoculation message, the attack message does not pose a threat to their initial attitude and is, therefore, unlikely to trigger counterarguing. Despite these insights, empirical evidence addressing this issue remains limited.

I argue that for individuals who are initially informed or uninformed, the inoculation message will make them aware that their existing positions can be threatened, which in turn elicits anger, motivates them to engage in counterarguing, and confers resistance to the misinformation message. However, for initially misinformed individuals, the misinformation message aligns with their initial positions. Therefore, they may not necessarily engage in greater counterarguing against misinformation. Instead, they may tend to engage in reverse counterarguing (i.e., argue for the misinformation) to defend their initial positions. However, the weight-of-evidence nature of the inoculation messages would make initially misinformed individuals find it easier to counterargue against the misinformation while more challenging to argue for the misinformation. It is through the ease they experience in generating counterarguments and the difficulty they experience in engaging in reverse counterarguing that lead to their resistance to the misinformation message. The third objective of this dissertation,

therefore, is to examine whether the underlying mechanisms of inoculation effects differ among initially informed, uninformed, and misinformed individuals.

The operation of inoculation messages largely relies on evidence-based persuasion, which rests on the assumption that people hold misperceptions due to a lack of knowledge about relevant facts (Sturgis & Allum, 2004). However, a growing body of research suggests that evidence-based persuasion often fails when the public is motivated to reject science (e.g., Hornsey, 2020; Hornsey & Fielding, 2017; Rynes et al., 2018). In many situations, people hold misperceptions not because they lack access to factual information, but because they are driven by a motivation to defend their existing beliefs and group identities (Nyhan, 2021). With the increasing political polarization on health and scientific issues, maintaining beliefs that align with one's political identity could be a higher priority than achieving accuracy, which motivates individuals to process information in a biased way (Van Bavel & Pereira, 2018).

The era of infodemic has arisen within a broader societal context marked by increasing political polarization (Lewandowsky et al., 2017). The mixed findings regarding the effectiveness of misinformation correction interventions imply that combating misinformation involves more than simply providing factual information (Wang, 2021). To effectively counter misinformation, corrective interventions must be rooted in a deep understanding of the relationship between message sources and audience characteristics. Research has shown that debunking messages are more persuasive when attributed to in-group partisan sources (e.g., Benegal & Scruggs, 2018; Clayton et al., 2019; Li & Wagner, 2020). However, countering misinformation also becomes more challenging when misinformation comes from in-group partisan sources (Blom, 2021). Therefore, the fourth objective of this dissertation is to examine whether inoculation message effectiveness varies based on the source (i.e., in-group vs. out-

group) associated with the inoculation message, the source (i.e., in-group vs. out-group) associated with the misinformation message, and the strength of individuals' party identification.

Taken together, this dissertation seeks to apply inoculation theory in the context of combatting COVID-19 vaccine misinformation, extend inoculation theory by examining the affective mechanism and the meta-cognitive mechanism underlying the inoculation message effects, explore the boundary conditions of inoculation effects by examining the role of individuals' pre-existing beliefs, and examine whether the relative effectiveness of inoculation messages varies depending on the source cues associated with inoculation messages and misinformation.

Chapter 2: Vaccine Misinformation

Defining Vaccine Misinformation

Although the field of health misinformation is rapidly growing, there is still no shared agreement on what health misinformation is. A scoping review (Y. Wang et al., 2022a) found that there were more than 30 distinct definitions of misinformation in the health misinformation literature. Scholars defined misinformation from different perspectives. Some definitions emphasize the intention of the messenger. For example, Centers for Disease Control and Prevention [CDC] (2021) defined misinformation as "false information shared by people who do not intend to mislead others" (n.p.), indicating that misinformation should be differentiated from disinformation, which they defined as "false information deliberately created and disseminated with malicious intent" (n.p.). Other definitions addressed the criteria to differentiate misinformation from facts. For instance, Tan et al. (2015) used expert consensus as the benchmark, proposing that facts or misinformation should be distinguished based on "what is considered to be correct or incorrect by expert consensus contemporaneous with the time period of this study" (p. 675). Bode et al. (2020) proposed using the best available evidence as the criterion, defining misinformation as "objectively incorrect information, as determined by the best available evidence and expertise on the subject" (p. 3). The lack of consensus on the definition of misinformation poses challenges in measuring the prevalence of misinformation, assessing its impact, and designing effective interventions to counter it.

Wang and colleagues (2022a) argued that the definition of health misinformation should be guided by three principles. First, health misinformation should be defined based on the message's intrinsic features rather than source intention. Although some definitions (e.g., CDC, n.p.) distinguish misinformation from disinformation based on the sender's intent to deceive and

consider them as mutually exclusive, it is challenging to determine the messenger's intention in practice. Moreover, false information could have harmful impacts regardless of whether it is intentionally disseminated. Therefore, it is better to consider disinformation as a subtype of misinformation and define misinformation solely based on its intrinsic features (O'Keefe, 2003).

Second, the benchmarks for assessing misinformation should include both expert consensus and the best available evidence at the time (Y. Wang et al., 2022a). In emerging or contentious health issues, expert consensus is not always available. In those cases, scholars may refer to the best available evidence to distinguish misinformation from facts. The hierarchy of evidence pyramid (Brownson et al., 2009; D. Evans, 2003; Murad et al., 2016) provides helpful guidelines for determining evidence quality, suggesting that systematic reviews and meta-analyses of randomized controlled trials should be ranked as the highest quality of evidence, followed by randomized controlled trials, cohort studies, case-control studies, cross-sectional studies, case reports, and expert opinions. Scholars should refer to available evidence at the highest level in the evidence pyramid when evaluating misinformation.

Third, misinformation should be considered as an umbrella term that includes false claims, unsubstantiated claims, and inaccurate claims (Y. Wang et al., 2022a). The current health misinformation scholarship debates the scope of misinformation. Some scholars focus solely on false claims, defining misinformation as "unintentionally false information" (Al Khaja et al., 2018, p. 345) or "objectively incorrect information" (Bode et al., 2020, p. 3). Other scholars adopt broader definitions that include inaccurate claims, defining misinformation as "false or misleading information" (Duplaga 2020, p. 2) or "false or inaccurate information"(Southwell et al., 2019, p. 282). Another group of definitions of misinformation includes unsubstantiated claims. For example, Chou et al. (2018) defined health misinformation as "a health-related claim

of fact that is currently false due to lack of scientific evidence" (p. 2417). Wang et al. (2022a) advocated for a broad definition of health misinformation because unverified and inaccurate health claims are prevalent in the real world and can have harmful impacts on individuals' health decisions. Therefore, to fully understand the phenomenon of misinformation, a definition of misinformation should encompass all forms of misinformation (i.e., false claims, unsubstantiated claims, inaccurate claims) that individuals may encounter in the information environment.

In response to the three key points of debate about health misinformation definitions, Wang et al. (2022) proposed a comprehensive definition of health misinformation: "a health-related claim of fact that is currently false due to its contradiction to expert consensus and/or best available evidence at the time, inaccurate due to its use of incomplete evidence, or unsubstantiated due to a lack of evidence" (p. 10). According to this definition, health misinformation is considered as an umbrella term that consists of false claims, inaccurate claims, and unsubstantiated claims, regardless of the information source's intention to deceive, the recipients' perception of the information, and the actual impact of this information.

Vaccine misinformation is a subtype of health misinformation, and like other forms of health misinformation, it is prevalent both online and offline. Vaccine misinformation can take many forms, including false claims (e.g., "MMR vaccine causes autism," CDC, 2022a, n.p.), inaccurate claims ("Better hygiene and sanitation are actually responsible for decreased infections, not vaccines," PublicHealth.org, 2022, n.p.), and unsubstantiated claims ("COVID-19 vaccines will affect my fertility," CDC, 2022b, n.p.). Therefore, in this dissertation, I define vaccine misinformation as "a claim of fact about vaccines that is currently false due to its contradiction to expert consensus and/or best available evidence at the time, inaccurate due to its use of incomplete evidence, or unsubstantiated due to a lack of evidence."

Prevalence of Vaccine Misinformation

Many reviews have suggested that vaccine misinformation is prevalent online, especially on social media platforms (Nan et al., 2021; Suarez-Lledo & Alvarez-Galvez, 2021; S. Zhao et al., 2023). A recent report indicated that over 70% of Americans encountered health-related misinformation, with 82% of those individuals citing social media as the source of misinformation (Pola, 2022). In a study focusing on full-time working professionals, 57.6% of participants reported exposure to COVID-19 vaccine misinformation (S. K. Lee et al., 2022). Consequently, beliefs in vaccine misinformation are very common in the United States. For example, a national poll conducted in April 2021 found that 54% of American adults either believed in some misinformation about COVID-19 vaccines or were unsure of the information's accuracy (Lopes et al., 2021). A systematic review (Suarez-Lledo & Alvarez-Galvez, 2021) revealed that previous studies have documented a wide range of beliefs in COVID-19 vaccine misinformation among the general public, from 2.5% to 55.4%. The high prevalence of vaccine misinformation and the widespread beliefs in it underscore the urgent need to better understand this phenomenon and develop effective interventions to address it.

Over the past decade, a growing body of literature has demonstrated the prevalence of vaccine misinformation across various social media platforms. For instance, a study about vaccine-related advertising on Facebook (Jamison et al., 2020) found that nearly half of the advertisements (47%) were anti-vaccine, which questioned vaccine safety by citing vaccine-related injuries (e.g., "Healthy 14 week old infant gets 8 vaccines and dies within 24 hours," p. 8) or expressing doubts about vaccine testing (e.g., "Flu shot bombshell: vaccine safety testing never done…" p. 7). Similarly, a study of HPV vaccine-related posts on Instagram (Massey et al., 2020) found that 44.1% of them were against HPV vaccines. Typical strategies of the anti-

vaccine posts included providing unsubstantiated claims (e.g., “vaccines cause SIDS”), citing conspiracy theories (e.g., “vaccine manufacturers and FDA caught hiding risks of HPV vaccines”), falsely claiming that vaccines are not effective, and mentioning vaccine-related injuries (Massey et al., 2020, Appendix). A number of studies have shown that vaccine misinformation is common on Twitter, with about one-fourth of tweets concerning the COVID-19 vaccines (22.29%, Wang & Chen, 2022) and the HPV vaccines (24%, Kornides et al., 2022) containing misinformation. Moreover, vaccine misinformation also circulates on video-based social media platforms. For example, half of TikTok’s COVID-19 vaccine videos (Basch et al., 2021) and 11% of the top viewed YouTube videos about COVID-19 vaccines (H. Li et al., 2022) discouraged people from getting vaccinated.

Vaccine misinformation not only proliferates online but also tends to receive more social media engagement compared to factual information. Studies have shown that articles with anti-vaccine headlines received more shares, likes, and comments on Facebook compared to those with pro-vaccine headlines (Xu & Guo, 2018). Similarly, YouTube videos that discouraged HPV vaccines were found to receive more likes than videos that promoted HPV vaccines or discussed both pros and cons of HPV vaccines (Briones et al., 2012). Likewise, Facebook posts that promoted influenza vaccines were more shared and liked than anti-vaccine posts (Gandhi et al., 2020). In fact, the advantage of misinformation over facts in terms of virality is not limited to vaccine misinformation. Several studies about misinformation in other health contexts, such as the Zika virus (Sommariva et al., 2018), psoriasis (Qi et al., 2016), the COVID-19 pandemic (Y. Zhang et al., 2021), and misinformation in general (Vosoughi et al., 2018), have also shown that misinformation receives more engagement, involves more users in its diffusion, and spreads more widely and faster than scientific information.

Why is misinformation so prevalent and viral? Southwell and Thorson (2015) posited that three factors collectively contribute to the prevalence of misinformation. Firstly, human brain has a tendency to process information in a biased way that confirms existing beliefs, making it challenging to debunk misinformation once individuals have accepted it. Secondly, in democratic countries, regulatory structures are often reactive, focusing on post-hoc detection of misinformation rather than prevention. Finally, misinformation often evokes strong emotions, causing it to spread faster and wider compared to corrective messages.

Empirical evidence supports these claims. Individuals with stronger beliefs in misinformation (Guo et al., 2023) and more extreme ideologies (Hopp et al., 2020) are more likely to share misinformation on social media. Moreover, algorithmic filter bubbles on social media platforms can expose individuals with initial misperceptions to additional misinformation, which may further amplify the spread of misinformation (Rhodes, 2021; Scheufele & Krause, 2019). Although social media platforms have initiated actions to remove vaccine misinformation (Milmo, 2021; Strozewski, 2021), emerging evidence indicates that anti-vaccine messages are not taken off social media platforms in a timely manner (e.g., Ginossar et al., 2022) and anti-vaccine messages continue to propagate even after platform-led interventions (Gruzd et al., 2023). Additionally, misinformation is often narrative-based and emotionally arousing (Nan et al., 2021). For example, messages expressing vaccine hesitancy use more words associated with sadness, fear, and anger compared to pro-vaccine messages (Y. Wang & Chen, 2022; Xu & Guo, 2018). People are more likely to share emotionally arousing messages than emotionally neutral ones, as it helps them connect with others and make sense of events (Maitlis & Sonenshein, 2010). In summary, human cognitive bias, inadequate media regulation, and the intrinsic message features of misinformation all contribute to the prevalence of vaccine misinformation.

While vaccine misinformation is widespread across various platforms, scholars are particularly concerned about its proliferation on social media (Nan et al., 2021; Suarez-Lledo & Alvarez-Galvez, 2021; S. Zhao et al., 2023). Social media has been criticized for amplifying the prevalence of misinformation due to several factors. First, as user-generated content platform, social media lacks a gatekeeping function and allows non-experts to create and disseminate information (Chou et al., 2020; Jang et al., 2019). As a result, misinformation can be easily generated and circulated, particularly when promoted by unauthorized accounts such as social bots and trolls (Broniatowski et al., 2018). Second, the networking function of social media facilitates the promotion of misinformation through users' viral sharing, magnifying the scope and speed of its diffusion (Del Vicario et al., 2016). Third, social media is characterized by fragmented and isolated communities, where individuals tend to seek and consume information from like-minded individuals, reducing the likelihood of encountering ideologically incongruent opinions (Liang, 2018). Furthermore, social media algorithms reinforce this trend by filtering information that aligns with individuals' pre-existing beliefs (Lewandowsky et al., 2017). As a result, individuals with initial misperceptions are less likely to encounter corrective messages. These features of social media make it challenging to overcome the impact of misinformation and correct misperceptions in today's information landscape.

Impact of Vaccine Misinformation

Health misinformation has posed a serious threat to public health (Office of the Surgeon General, 2021). Concerns about the surge of health misinformation rest on the assumption that misinformation has detrimental public health consequences (Nan et al., 2021). Emerging evidence has revealed the harmful impact of health misinformation at both individual and society levels. As a recent systematic review (Y. Wang et al., 2022b) shown, beliefs in and exposure to

health misinformation generally reduce individuals' attitudes and intentions to engage in healthy behaviors, induce negative affect, increase stigma perceptions, undermine trust in experts and institutions, and fuel the spread of health misinformation. A meta-analysis (Walter & Tukachinsky, 2020) indicated the continued influence of misinformation, suggesting that misinformation continues to impact people's beliefs even when it is debunked by a corrective message. This is because misinformation could exert lingering impacts on people's memory and inferential reasoning after it has been retracted (Ecker et al., 2015). The persistence of misinformation's impact makes its threat to public health particularly concerning.

Beliefs in vaccine misinformation have become a major obstacle to achieving community immunity (Lazarus et al., 2021). In 2019, WHO identified vaccine hesitancy as one of the top threats to global health (WHO, 2019). Many people who refuse vaccines cite vaccine misinformation as the reason that drives their hesitancy. For example, Zimmerman et al. (2023) conducted interviews with US participants regarding their attitudes toward COVID-19 vaccines. They found that participants often cited misinformation (e.g., "The vaccine contains aborted baby cells"; "'Bill Gates tracking implants [in the vaccination]") as the reason for not getting the COVID-19 vaccine (p. 141). Empirical studies provide additional support for the detrimental impact of beliefs in vaccine misinformation. For example, in a study about MMR vaccination, Jolley and Douglas (2014) found a negative relationship between anti-vaccine conspiracy beliefs and MMR vaccination intentions, and the relationship was mediated by perceived dangers of vaccines, feelings of powerlessness, and mistrust in authorities. The harmful impact of beliefs in vaccine misinformation is especially evident during the COVID-19 pandemic. For instance, a series of studies have consistently found that people with stronger beliefs in COVID-19 vaccine

misinformation reported lower intentions to get a COVID-19 vaccine (Bitar et al., 2021; Earnshaw et al., 2020; Enders et al., 2020; Romer & Jamieson, 2020; Teovanović et al., 2021).

Does merely being exposed to vaccine misinformation increase vaccine hesitancy? Empirical evidence largely supports this claim. Several studies have indicated that people who reported greater exposure to vaccine misinformation were less willing to get vaccinated. For example, Neely et al. (2022) compared the level of exposure to COVID-19 vaccine misinformation among vaccinated and unvaccinated individuals and found a significant difference: 73.8% of participants who reported no exposure to misinformation were vaccinated, whereas only 62.9% of those who reported seeing at least one misinformation about COVID-19 vaccines were vaccinated. Chia et al. (2021) examined COVID-19 vaccine acceptance among elderly people in Hong Kong and found that participants who reported more frequent exposure to misinformation about COVID-19 vaccines were less likely to get vaccinated. In a longitudinal study about child immunization rates in Italy, Carrieri et al. (2019) found that child immunization rates significantly declined in 2012, when the vaccine misinformation claiming a link between MMR vaccines and autism was widely spread.

Experimental studies have provided additional support for the causal link between exposure to vaccine misinformation and vaccine hesitancy. Featherstone and Zhang (2020) conducted an experiment to examine the impact of exposure to MMR-related vaccine misinformation on people's attitudes toward MMR vaccination. They found that both conspiracy misinformation ("Pharmaceutical companies have hidden the relation between the two by covering up cases in which children were diagnosed with autism following MMR vaccinations") and uncertainty misinformation ("Scientists are not sure about the relation between the two even

by studying cases in which children were diagnosed with autism following MMR vaccinations") lowered people's vaccination attitudes, which was mediated by anger (p. 4).

Exposure to vaccine misinformation has also been linked to lower vaccination intentions. Through a pretest-posttest experiment, Loomba et al. (2021) found that fewer people reported that they would definitely get a COVID-19 vaccine after being exposed to COVID-19 vaccine misinformation. Moreover, exposure to COVID-19 vaccine misinformation (vs. factual misinformation) decreased vaccination intentions among people who initially reported strong intentions to get a vaccine (Loomba et al., 2021). In another experimental study, Calo et al. (2021) found that parents who received misinformation about HPV vaccines were less likely to vaccinate their children against HPV than those who read a factual message about HPV vaccines. Similarly, Chen et al. (2020) examined the impact of vaccine misinformation exposure on Chinese young adults' vaccine acceptance and found that exposure to conspiracy theories about HPV vaccines (vs. irrelevant message) resulted in less favorable attitudes and lower intentions to get the HPV vaccine.

Taken together, these findings suggest that vaccine misinformation poses a significant barrier to vaccine acceptance and herd immunity. Beliefs in and exposure to vaccine misinformation tend to reduce favorable attitudes toward vaccination, decrease vaccination intentions, and undermine potential uptake. Given the detrimental impact of vaccine misinformation, it is important to develop timely and effective interventions to combat it.

Correcting Vaccine Misinformation

The growing prevalence of misinformation has prompted scholars to investigate effective interventions to mitigate its impact. One approach focuses on developing education-based interventions to reduce misperceptions. Instead of directly refuting misinformation, this approach

aims to bolster individuals' ability to identify and counter misinformation. For example, Hindin et al. (2004) developed a media literacy nutrition education curriculum to help parents evaluate the accuracy of food advertisements on television. Hindin and colleagues found that participants who took this educational program reported greater self-confidence in their ability to distinguish between truth and false claims in food advertisements. Similarly, Kalichman et al. (2006) designed an online support group to promote individuals' information evaluation skills. Participants in the intervention group demonstrated improved health information evaluation skills and were more likely to discuss online health information with their health care providers, thereby reducing their vulnerability to health misinformation. In another study about news literacy intervention, Tully et al. (2020) designed news literacy messages on social media that improve individuals' understanding of news production, context, and consumption. They found that people who were exposed to these news literacy messages reported less perceived credibility of misinformation about the flu vaccine. Overall, these interventions address misinformation by improving the individuals' ability to assess information credibility.

Another approach to intervention directly addresses misinformation by exposing the public to corrective messages. These messages refute misinformation by clarifying the fallacies in misinformation and/or by providing alternative explanations of a myth. Corrective messages discussed in previous studies can be categorized into three major types. The first type is *factual elaboration messages*. This type of messages does not directly refute the misinformation; instead, it combats misinformation by reinforcing the correct information (van der Meer & Jin, 2020). The second type is *direct rebuttal messages*. Messages in this type directly refute misinformation by declaring its falsity, including both simply rebuttal messages that do not contain detailed arguments and detailed rebuttal messages that provide factual information to

explain why the misinformation should not be trusted (Vraga & Bode, 2017). The third type is *narrative corrections,* which debunk misinformation by telling personal experiences and stories (Ecker et al., 2020; Huang & Wang, 2022; J. Lee, 2020).

Corrective messages can take various formats. Previous studies have examined the effectiveness of corrective messages in a format of fact-checking (Carey et al., 2022; Garrett et al., 2013; Young et al., 2018), corrective advertising (e.g., Aikin et al., 2015, 2017), algorithmic corrections such as the Facebook's related news recommendation function (e.g., Bode & Vraga, 2015, 2018; Huang & Wang, 2022), and social corrections such as corrective comments and posts (e.g., Bode & Vraga, 2018). Typical debiasing strategies used in corrective messages include providing alternative explanations of the myth (e.g., van der Meer & Jin, 2020), using expert sources (e.g., Buczel et al., 2022; Pluviano et al., 2022; Vraga & Bode, 2017), providing weight-of-evidence information (e.g., Dixon, 2016), citing statistical evidence (Song et al., 2022), and emphasizing scientific consensus (e.g., Benegal & Scruggs, 2018) and social consensus (e.g., Kumar & Geethakumari, 2014).

Although a wealth of studies has addressed the importance of providing corrections to combat misinformation, findings were mixed regarding the effectiveness of corrective messages in reducing misperceptions. Some studies suggest that corrective messages can counteract the influence of misinformation. For example, Zhang et al. (2021) found that people exposed to fact-checking labels on vaccine misinformation had more positive vaccine attitudes than those in a misinformation control group. In another study about tobacco misinformation, Sangalang et al. (2019) found that exposure to narrative corrective messages reduced individuals' misperceptions about tobacco products and lowered their intentions to use natural tobacco products compared to a no-correction condition. Vraga and Bode (2021) found that exposure to a corrective graphic on

social media can reduce individuals' misperceptions about using hot bath as a prevention strategy of COVID-19, with correction effects persisting even one week after exposure. Ecker et al. (2023) found that presenting participants with vaccine myths and contrasting them with facts significantly reduced participants' belief that the MMR vaccine causes autism. A meta-analysis by Walter and Murphy (2018) revealed that corrective messages have a moderate effect on reducing misperceptions. Another meta-analysis specifically focused on health misinformation correction (Walter, Brooks, et al., 2021) found that interventions that correct health misinformation are effective in protecting people's attitudes, intentions, and behaviors from being attacked by misinformation. Health misinformation corrections are especially effective when participants are involved with the health topic, the misinformation is distributed by news organizations (vs. peers), and the corrective message is attributed to an expert (vs. non-expert) source (Walter, Brooks, et al., 2021).

However, a separate group of studies found that the correction of misinformation can be ineffective and may even trigger a backfire effect, wherein exposure to a corrective message increases beliefs in the misinformation being addressed (Swire-Thompson et al., 2022). For example, Smith et al. (2011) found that while corrective messages reduced individuals' misperceptions about smoking immediately, the correction effect diminished and returned back to the baseline level within one week. In another study concerning COVID-19 vaccine misinformation, Schmid and Betsch (2022) found that exposure to corrective messages, compared to a control group, temporarily lowered participants' perceived credibility of the misinformation. However, among people with higher religiosity, corrections backfired after two months, as those people perceived misinformation as more credible than the control group (Schmid & Betsch, 2022). Pluviano et al. (2019) examined effects of corrective messages that

employ a myth vs. fact format and found that parentes exposed to a corrective message about vaccines reported stronger vaccine misperceptions compared to the control group. Similarly, Peter and Koch (2016) found that corrective messages that first presented a myth and then presented a debunking claim backfired, with the backfire effect intensifying after five days. Nyhan and Reifler (2010) also found a backfire effect of corrective intervention. Through a series of experiments on correcting political misperceptions, they found that the effectiveness of corrective messages depends on audiences' pre-existing values; people who had an inconsistent worldview with the corrective messages were likely to engage in defensive processing of the message and subsequently report higher misperceptions after exposure to the corrective message. Despite these findings, it should be noted that evidence on the backfire effect of corrective messages is still limited.

The failure of correction can be attributed to three factors. Firstly, when misinformation is repeatedly presented, individuals perceive it as more accurate due to the increased fluency of the misinformation (Berinsky, 2017). Therefore, repeating misinformation in corrective messages can reinforce its influence (Berinsky, 2017). Secondly, misinformation has a continued influence. Once misinformation has been integrated, it can be challenging for recipients to retrieve and update their memory, even after being exposed to corrective messages (Lewandowsky et al., 2012). Finally, when corrective messages contradict individuals' pre-existing attitudes and ideologies, motivated reasoning can come into play, leading people to evaluate corrective messages negatively (Nyhan & Reifler, 2010).

Conflicting findings in previous studies suggest that debunking misinformation requires more than simply providing factual information. Effective correction of misperception relies not only on detailed factual content in corrective messages but also on a deep understanding of

message designs, timing of correction, and audiences' characteristics. Given the difficulty of debunking misinformation, recent studies suggest that prewarning people about the misinformation may be a more effective approach to counteract its influence compared to post hoc corrections (Lewandowsky et al., 2012; Lewandowsky & van der Linden, 2021; Roozenbeek, van der Linden, et al., 2020). The present dissertation aims to examine the effectiveness of inoculation, a prewarning strategy, as an intervention to mitigate the negative impact of misinformation.

Chapter3: Inoculation Theory

Key Concepts and Applications of Inoculation Theory

Inoculation theory is considered the "grandparent theory of resistance to attitude change" (Eagly & Chaiken, 1993, p. 561). Originally developed by McGuire (1961), inoculation theory uses a biological analogy to describe an approach of promoting individuals' resistance to persuasive messages (Banas & Rains, 2010). McGuire (1964) posited that individuals can be inoculated against persuasion in a similar way as they can be inoculated against viruses. In the medical setting, injecting weakened viruses into a person can cause the body to produce antibodies and confer resistance to future virus attacks (McGuire, 1964). Similarly, exposing individuals to weakened arguments against an attitude they hold can confer resistance to future attitude attacks (Compton & Pfau, 2005; McGuire, 1964).

Components of Inoculation Message

Inoculation messages contain two core elements: forewarning and refutational preemption (Banas & Richards, 2017). The forewarning component explicitly instructs individuals that their attitudes or beliefs may be vulnerable to future attacks (Ivanov, 2017). Forewarning statements can trigger perceived threat, which motivates individuals to counterargue against the attack message, thereby weakening its persuasive impact (Compton & Pfau, 2005; McGuire & Papageorgis, 1962). Refutational preemption "provides specific content that receivers can employ to strengthen attitudes against subsequent change" (Pfau et al., 1997, p. 188). It typically involves mentioning the weakened arguments of the attack message and then explicitly refuting them (McGuire & Papageorgis, 1962b). Inoculation messages, which provide two sides of arguments, were found to be more effective in conferring resistance to attitude attacks than one-sided supportive messages that only provide attitude bolstering information

(Banas & Rains, 2010; Dillingham & Ivanov, 2017; Ivanov et al., 2009, 2017). McGuire and Papageorgis (1962) argued that supportive messages may make individuals overconfident in the strength of their beliefs, making them more vulnerable to attack messages. In contrast, the two-sided message feature of inoculation messages provides the opposing point of view, which confers more resistance by building up defense-provoking threat and triggering more counterarguing (McGuire & Papageorgis, 1962).

Mechanism of Inoculation Message

Threat and counterarguing are central components underlying the influence of inoculation (McGuire & Papageorgis, 1962). McGuire (1964) proposed that the forewarning component of the inoculation messages generates a sense of threat, which motivates defense processing of the attack message, often in a form of counterarguing. In McGuire's inoculation theory, threat is considered as a primitive construct, which is often assumed without any direct measurement or tested as manipulation check (Banas & Richards, 2017). Early inoculation research defined threat as realization of attitudinal vulnerability, assuming that receivers needed to feel threatened to trigger defense motivation and build resistance (Compton & Pfau, 2005). However, a meta-analysis of research on inoculation theory found no significant relationship between perceived threat and resistance (Banas & Rains, 2010). More recent inoculation research argues that the threat component in inoculation theory should be viewed as the motivation to defend one's attitudes, rather than an emotional state associated with attitudinal vulnerability (Banas & Richards, 2017; Richards & Banas, 2018). This perspective posits that it is the motivational function of threat, rather than the apprehension-inducing function of threat, that drives recipients to counterargue against the opposing attitudinal position and fosters resistance (Richards & Banas, 2018).

Counterarguing can be defined as "a thought process that can inhibit agreement with an advocated position" (Rucker & Petty, 2004, p. 1). It embodies how individuals strengthen attitudes: by generating counterarguments and refutations (Ivanov et al., 2017; Pfau et al., 2006). Counterarguing makes individuals more certain about their attitudes (Tormala & Petty, 2002) and makes counterarguments more accessible in their minds (Graf et al., 1978). As a result, individuals are less likely to change their attitudes when exposed to counter-attitudinal messages. Empirical studies have found that people who received inoculation messages exhibited greater counterarguing and less attitude change in response to attack messages compared to those who did not (e.g., Parker et al., 2016). Through threat and counterarguing, inoculation can help recipients build resistance toward attitude attacks over time (Pfau et al., 2004).

Researchers have employed various methods to measure counterarguing. The most widely used method is the thought listing technique, which is originally proposed by Brock (1967). This method involves asking participants to list all the thoughts that come to mind when they read a persuasive message, and then coding and computing the valence of these thoughts to generate a counterarguing score. However, there is no general agreement on how to code the thoughts or to compute the overall counterarguing score. Early studies computed counterarguing scores by simply counting the number of generated counterarguments (e.g., Benoit, 1991). Eagly and Chaiken (1993) critiqued this approach, arguing that it did not account for the different weights participants might give to their thoughts. Later studies incorporated the variable of perceived strength of the thought into the calculation, multiplying each listed thought by its perceived strength rating, with thoughts congruent with the attack message coded as negative values and thoughts against the attack message given positive scores (e.g., Pfau et al., 2001; Wood, 2007). Another approach used the same computing equation but had the valence of each

thought rated by participants (e.g., Miller et al., 2013). Eagly and Chaiken (1993) argued that the thought listing technique requires considerable participation efforts, therefore might not accurately reflect the counterarguing process. Other methods used measure counterarguing include the recognition check-off procedure (Pfau et al., 2004, 2005) and a single-item scale (Miller et al., 2013). In summary, there is no consensus on the best approach for measuring counterarguing. While the thought listing technique has been widely used, an increasing number of studies are turning to alternative methods, such as self-report scales, that require less participation efforts.

Application of Inoculation Theory

Over the past five decades, inoculation theory has been widely applied in various contexts. Empirical evidence has supported that inoculation can effectively protect individuals' positive attitudes toward a brand (S. Kim, 2013), a political candidate (Pfau & Burgoon, 1988), and health behaviors (Compton et al., 2016; Iles et al., 2021) from being undermined by persuasive messages. A meta-analysis (Banas & Rains, 2010) found that inoculation message confers more resistance than no-message control ($d = 0.43$) and supportive message ($d = 0.22$), confirming the overall effectiveness of inoculation in preventing attitude change. Moreover, the resistance to persuasion conferred by inoculation messages can withstand multiple attacks (Ivanov et al., 2009) and can generalize beyond the arguments refuted in inoculation messages (Banas & Rains, 2010).

More recently, several studies have applied inoculation theory to understand whether inoculation messages can confer resistance to misinformation. For example, Vraga et al. (2019) examined the effects of inoculation on counteracting the influence of misinformation about climate change, gun control, and HPV vaccination. They found that both logic-based and humor-

based inoculation messages can reduce misperceptions about HPV vaccination compared to a misinformation-only control; however, the effects were not significant in the gun control and climate change contexts. Similarly, Cook et al. (2017) conducted a study on inoculating against climate change misinformation and found that inoculation messages can reduce the negative impact of misinformation on individuals' trust in scientists and perceived scientific consensus. This experiment was replicated by Schmid-Petri and Bürger (2022) among German participants, and no significant effect of inoculation messages on people's climate-related attitudes was found, however. Maertens et al. (2020) tested the long-term effects of inoculation messages and found that inoculated participants rated misinformation as less reliable compared to non-inoculated participants and the effect persisted for five weeks. Through six experiments and one field study, Roozenbeek et al. (2022) found that inoculating people about the common techniques used by misinformation can improve their confidence in spotting misinformation and lower their likelihood of sharing misinformation. These findings highlight the potential of inoculation messages as a technique to reduce people's susceptibility to misinformation. Despite the growing interest in inoculation theory as a strategy for countering misinformation, there is still a lack of research exploring the effects of inoculation messages in the context of health misinformation. Particularly, there is a need for further investigation into the psychological mechanisms underlying inoculation message effects.

Alternative Mechanisms underlying Inoculation Effects

A growing body of research suggests that the effects of inoculation messages cannot be fully explained by threat and counterarguing, calling for more studies to explore alternative mechanisms underlying inoculation effects. For example, Papageorgis and McGuire (1961) found that inoculation can effectively prevent attitude change; however, inoculated subjects did

not report more counterarguing compared to their respective control. Similarly, Pfau et al. (2001) found that after controlling for the mediation role of threat and counterarguing, inoculation still had a direct impact on subsequent resistance, suggesting that there may be unexplained elements in the process of resistance.

The Need for Understanding Alternative Mechanisms

The original model of inoculation theory has two limitations that need to be addressed. First, this model assumes that resistance to persuasion is an effortful cognitive process that relies on extensive thinking (Wegener et al., 2004). However, research indicates that resistance to persuasion can be achieved through both cognitive and affective routes (Compton & Pfau, 2005). Message-elicited emotions, particularly anger, plays an important role in bolstering resistance to persuasion (Pfau et al., 2001). In addition, individuals differ in their motivations and abilities to engage in effortful thinking and processing of a message. The Elaboration Likelihood Model (Petty & Cacioppo, 1986) proposes dual processes underlying attitude changes. Under high elaboration conditions, people engage in relatively extensive issue-relevant thinking, and persuasion outcomes mainly depend on the valence of their thoughts. In contrast, under low elaboration conditions, persuasion mainly exerts influence through mental shortcuts (i.e., heuristics). Scholars argue that, akin to the dual processes of attitude change, there should also be dual processes underlying resistance to attitude change: a thoughtful resistance process that operates through counterarguing, and a non-thoughtful process that operates through heuristics (Wegener et al., 2004). These perspectives highlight the need to include a component that captures the heuristic process of resistance.

The second limitation of the inoculation theory model is its sole focus on the number of counterarguments generated by inoculated individuals while ignoring their experience of

generating those counterarguments. Scholars argue that thoughts can influence judgements though two different routes: the number of thoughts retrieved and the ease with which those thoughts come to mind (Schwarz et al., 1991). Petty et al. (2004) proposed a model of attempted resistance, which suggests that individuals may experience reduced confidence in their initial attitudes when they found it difficult to counterargue or when their counterarguments appear to be of low quality. Empirical studies have shown that counterarguing can backfire when individuals believe that their counterarguing is unsuccessful (Rucker & Petty, 2004) or when they perceive the information as difficult to refute (Ahluwalia, 2000). Counterarguing does not always lead to resistance. The outcome of counterarguing largely relies on whether individuals feel that their counterarguing is successful, which depends on their ability to counterargue, perceived quality of the generated counterarguments, and their confidence in those counterarguments (Rucker & Petty, 2004). Therefore, it is important to consider the role of individuals' subjective experiences of counterarguing underlying inoculation message effects. To fill these gaps, the current dissertation extends inoculation theory by incorporating variables that reflect individuals' metacognitive experiences (i.e., perceived ease of counterarguing) and affective resistance (i.e., anger).

Perceived Ease of Counterarguing as An Alternative Mechanism

Recent studies have argued that there are two processes of elaboration underlying persuasion: a cognitive elaboration process in which recipients reflect on the content of their thought, and a metacognitive elaboration process in which recipients reflect on their subjective experiences that occurred while being exposed to the message (Walter & Cohen, 2019). Metacognition refers to "people's thoughts about their thoughts, or their awareness of their own cognitive states and processes" (Tormala & Petty, 2004, p.428). Individuals are influenced not

only by the content of their thoughts but also by the accompanied subjective experience of ease, or fluency, with which those thoughts come to mind (Walter et al., 2020; Walter & Cohen, 2019; Weingarten & Hutchinson, 2018).

Feelings-as-information theory (Schwarz, 2012) conceptualizes the role of subjective experiences in judgement. Schwarz (2012) proposed that individuals attend to their subjective feelings, such as moods, emotions, bodily sensations, and metacognitive experiences, as sources of information when forming judgements. Feelings, as a highly accessible source of information, will exert more influences on individuals' judgements when they have low processing capacity or motivation (Schwarz, 2012). Feelings-as-information theory builds upon Schwarz and Clore (1983)'s mood-as-information model, in which Schwarz and Clore found that people use their momentary affective states as information when making judgements. Later, Schwarz (2012) proposed that the model could be applied to other types of feelings, such as metacognitive experiences of ease or difficulty.

There are two types of metacognitive expriences of ease: accessibility experience and processing fluency (Schwarz, 2012). *Accessibility expeirnece* refers to "the ease or difficulty with which information can be brought to mind" (Schwarz, 2012, p. 16). It focuses on the subjective experiences of information retrieval and thought generation. *Processing fluency* refers to the ease or difficulty of processing external information (Schwarz, 2012). It focuses on the subjectvie experiences of information processing. Since the underlying assumption of the current project is that inoculation messages can enhance individuals' motivation and ability to generate counterarguments, the metacognitive experience I focus on is the accessibility experience of ease.

The discussion about the role of accessibility experiences of ease on judgements can be traced back several decades. Tversky and Kahneman (1973) proposed *the availability heuristics,* which suggested that people make judgments about the likelihood of an event based on how easily the instance comes to mind. Grounded in the availability heuristics, Schwarz et al. (1991) further proposed *the ease of retrieval effect*, suggesting that people rely on their experienced ease of retrieval as a source of information when forming judgments. In their experiment, Schwarz and colleagues asked participants to recall either six examples (i.e., easy-to-retrieve condition) or 12 examples (i.e., difficult-to-retrieve condition) of situations in which they engaged in assertive or unassertive behaviors. Results of this experiment found that people who were asked to generate 12 examples found it more difficult to generate the requested number of assertive behaviors and rated themselves as less assertive compared to those who were asked to generate six examples, despite the fact that they generated more total examples. Schwarz and colleagues concluded that people not only rely on the content of recalled thoughts but also the subjective experience of the recall process when forming judgements.

Early studies about ease of retrieval effects proposed that it operates through availability heuristics (e.g., Reber et al., 1998; Schwarz et al., 1991; Wänke et al., 1995; Winkielman et al., 1998). These studies argued that when individuals feel it is difficult to generate favorable arguments for a position, they may assume that those arguments are few in number and, as a result, question the supported position. Conversely, the experience of ease in generating supportive arguments indicates that many supportive arguments exist, and the position is worthy of support.

Later research suggested that the ease of retrieval effect exerts influences through multiple mechanisms. In one experiment, Wänke and Bless (2000) found that there was an ease-

of-retrieval effect when individuals were under high accuracy motivation but not when they were under low accuracy motivation. Wänke and Bless argued that there should be dual processes underlying ease-of-retrieval effects, one of which operated through systematic processing. Similarly, Tormala et al. (2002) found that the ease of retrieval effect was more pronounced when participants were under high rather than low elaboration conditions. Tormala and colleagues explained that individuals who engaged in extensive issue-relevant thinking were also attentive to their subjectvie feelings about their thoughts. Under these conditions, greater ease-of-retrieval led to more thought confidence, and ultimately, produced more thought-congruent attitudes. Petty et al. (2007) proposed that there are multiple mechanisms underlying ease-of-retrieval effects: it exerts influence via availability heuristic when individuals' elaboration is low and operates by enhancing thought confidence when individuals are under high level of elaborations.

Ease of retrieval has been found to influence a variety of judgments, including explicit and implicit attitudes (Gawronski & Bodenhausen, 2006; Walter & Cohen, 2019), attitude certainty (Tormala et al., 2002; Walter et al., 2020), perceived disease severity (Clear et al., 2021), stereotype (Vázquez et al., 2017), and risk assessment (Grayson & Schwarz, 1999). Moreover, studies have shown that the subjective experience of ease in generating cognition can override the number of cognitions generated under specific conditions (Tormala et al., 2007). For example, Tormala et al. (2002) found that individuals' subjective ease of generating supportive thoughts about a policy leads to positive attitudes toward the policy; however, the perceived number of supportive thoughts did not significantly influence attitudes.

In this dissertation, I propose that perceived ease of counterarguing can serve as an alternative mechanism underlying the effects of inoculation messages. When individuals are

exposed to inoculation messages against misinformation, the refutational preemption component can provide recipients with counterarguments against misinformation, thereby enhancing their ability to refute it. Additionally, inoculation can enhance the accessibility of inoculation-advocated attitudes from memory (Pfau et al., 2003) and boost individuals' confidence in their ability to counterargue (Clear et al., 2021). Therefore, inoculated subjects will feel it is easier to generate counterarguments against misinformation compared to those who are not inoculated.

Anger as An Alternative Mechanism

Early inoculation theory assumed that the resistance process to is highly cognitive. However, an increasing number of studies have argued that resistance could also operate through affective means, particularly through anger (Compton et al., 2022; Compton & Pfau, 2005; Fransen et al., 2015; Pfau et al., 2001). For instance, Dillard and Shen (2005) found that individuals' motivation to reject a persuasive message – *reactance* – is best operationalized as an intertwined process of negative cognition (i.e., counterarguing) and anger. Walter et al. (2021) found that message-eliciting anger led to more perceived freedom threat, less message elaboration, and less favorable attitudes toward message-advocated opinions.

Anger can be defined as "a syndrome of relatively specific feelings, cognitions, and physiological reactions linked associatively with an urge to injure some target" (Berkowitz & Harmon-Jones, 2004, p.108). As one of the basic human emotions (Williams, 2017), anger arises when "individuals perceive an offense to themselves or their reference group caused by an external, blameworthy agent" (Arpan & Nabi, 2011, p. 7). Anger signals an undesirable situation that needs to be addressed and motivates individuals to regain control of the situation by changing their relationship with the environment (Nabi, 1999). In persuasive communication, anger can be elicited when individuals perceive a message as manipulative, injustice, or work

against one's best interests (Walter et al., 2019). Driven by anger, individuals tend to restore goal attainment by derogating or rejecting the message, leading to greater resistance to persuasion (M. M. Turner, 2007).

Anger influences attitude change through multiple routes. Slovic et al. (2002) proposed the affect heuristic theory, arguing that affect serves as a heuristic in influencing individuals' judgments and decision-making. Affect-as-information theory (Clore et al., 2001), conversely, addressed the cognitive functions of emotions and argued that emotions provide an embodied source of information about objects. Drawing upon the Elaboration Likelihood Model (Petty & Cacioppo, 1986), Nabi (1999) argued that negative emotions, including anger, mainly influence persuasive outcomes by impacting audiences' motivation to process the message. Findings were mixed regarding the influence of anger on information processing styles, however. While some studies found that anger drives individuals to engage in peripheral processing and rely more on heuristics cues (Bodenhausen et al., 1994; Walter, Demetriades, et al., 2021), another collection of studies found that anger leads to increased message elaboration and information seeking (Griffin et al., 2008).

Emerging evidence suggests that exposure to inoculation messages can lead to increased anger toward the attack message. For example, Ivanov et al. (2020) found that inoculated individuals expressed greater anger in response to a counter-attitudinal attack message regarding the First Amendment than uninoculated individuals. Similarly, Pfau et al. (2009) studied inoculation message effects in the context of gun control and marijuana legislation and found that exposure to inoculation messages elicited greater anger toward the counter-attitudinal attack message compared to the non-inoculation control group. Likewise, Iles et al. (2021) found that

exposure to the inoculation message against breast cancer screening misinformation led to greater anger at the misinformation message.

Despite the growing evidence, most of the current inoculation research examines anger as an outcome of inoculation exposure; little is known about whether anger works as an underlying mechanism mediating the influence of inoculation exposure on individuals' beliefs and attitudes. Pfau et al. (2001) examined the effects of three types of inoculation messages: cognitive inoculation, affective-anger inoculation, and affective-happiness inoculation. They found that inoculation-elicited anger was negatively associated with attitudes toward the attack message across the three inoculation conditions; however, only affective-anger inoculation led to greater anger compared to the control condition. Their findings support the potential of anger as a mediator that underly inoculation effects, provided that the inoculation message elicited a great amount of anger. More recently, Featherstone and Zhang (2020) found that exposure to refutational messages about MMR vaccination misinformation led to greater anger compared to exposure to misinformation, which further increased pro-vaccination attitudes. Although Featherstone and Zhang's study focused on post-hoc correction instead of pre-bunking, I argue that anger will play a similar role in inoculation messages. I propose that individuals who are inoculated against misinformation will express greater anger at the misinformation, which subsequently reduces misperceptions.

The Impact of Recipient Characteristics on Inoculation Effectiveness

Persuasive messages can produce different effects under different conditions (O'Keefe, 2004). The effectiveness of a correction intervention may vary depending on who is the source and who is the recipient (Wang, 2021). While studies in inoculation messages are growing, most of the current literature focuses on the overall effectiveness of the inoculation technique; limited

studies have examined the relative effectiveness of inoculation messages depending on recipient and source characteristics.

The Informed, Uninformed, and Misinformed

The Motivated Reasoning Theory proposed that individuals tend to process information in relation to what they already believe (Kuru et al., 2017). People often evaluate information that is congruent with their pre-existing beliefs favorably whereas evaluate information incongruent with their pre-existing beliefs unfavorably (Kobayashi, 2016). Consequently, persuasion often fails when the persuasive message contradicts individuals' pre-existing beliefs and attitudes (Druckman & Bolsen, 2011). For example, Ecker et al. (2014) found that people continued to believe in misinformation that was consistent with their pre-existing beliefs even when provided with corrected information. However, other studies have found that the tendency to confirm ones' pre-existing beliefs and attitudes can be counteracted, especially when the counter-attitudinal message provides rigorous arguments. For example, Ahluwalia (2000) found that even defense-motivated recipients were likely to accept counter-attitudinal information if it was perceived as difficult to refute or counterargue. Other message framing techniques, such as communicating scientific consensus (Dixon, 2016) and self-affirmation (Carnahan et al., 2018), have also been found to increase the effectiveness of persuasion among counter-attitudinal populations.

In the context of misinformation correction, mixed findings have emerged regarding whether correction effectiveness varies based on individuals' initial beliefs. Some studies have found that correction interventions fail when individuals' initial beliefs are aligned with the misinformation. For example, Chan et al. (2017) conducted a meta-analysis and found that debunking messages were less effective when audiences generated reasons in support of their

initial misperception. Similarly, in the context of political misinformation, Nyhan and Reifler (2010) found that corrections backfired among the targeted ideological group, as conservatives who received a corrective message stating that Iraq did not have weapon of mass destruction were more likely to believe the political misinformation. Nyhan and Reifler argued that people were likely to engage in defensive processing of a corrective message if it is inconsistent with their pre-existing beliefs, resulting in increased misperceptions.

Conversely, other studies have found that corrections are equally or even more effective among those who are initially misinformed. For instance, Ecker et al. (2014) found that messages that debunked racial misinformation were equally effective among people in the high- and low-prejudice groups. Vraga and Bode (2017) examined the effects of four types of corrective messages in reducing misperceptions about Zika virus, and they found that three corrective messages (user-only correction, CDC plus user correction, user plus CDC correction) were more effective in reducing misperceptions among people with higher initial Zika misperceptions. However, the correction effectiveness did not differ across individuals' initial misperceptions when the corrective message was from CDC-only (Vraga & Bode, 2017). Moreover, Vraga et al. (2019) found that misinformation corrective messages were equally effective in conferring resistance to misinformation about climate change and gun control among people with different levels of initial misperceptions; however, exposure to logic-based corrections led to lower perceived misinformation credibility among those with initial misperceptions yet backfired among those initially agreed with scientific consensus. Mixed findings on the role of initial misperceptions in correction effectiveness may be attributable to varying issue topics. More studies are needed before a conclusion can be drawn.

The early misinformation literature mainly focuses on the binary distinction between informed and misinformed individuals. More recent studies argue that individuals can be classified into three groups: the informed, the misinformed, and the uninformed (Li & Wagner, 2020b; Scheufele & Krause, 2019; van Kessel et al., 2021). *Informed publics* refer to individuals who possess accurate factual beliefs on a given claim (Kuklinski et al., 2000; van Kessel et al., 2021). *Misinformed publics* are individuals who believe in inaccurate, incorrect, or counterfactual claims (Scheufele & Krause, 2019; van Kessel et al., 2021). *Uninformed publics* refer to individuals who have no factual beliefs about a claim (Kuklinski et al., 2000), often indicated by responding "I don't know" when answering a factual question (Li & Wagner, 2020). Unlike the informed and misinformed, the uninformed publics have neither correct nor incorrect beliefs (van Kessel et al., 2021). They are people who have not formed a belief due to a lack of knowledge (van Kessel et al., 2021) or are currently uncertain about the answer due to conflicting information exposure (Nagler et al., 2019; Nagler & LoRusso, 2017).

There is a need to distinguish the uninformed and the misinformed. First, uninformed publics are aware of their lack of knowledge on an issue, whereas misinformed publics believe they possess knowledge but hold inaccurate beliefs (van Kessel et al., 2021). Therefore, misinformed publics are less motivated to update their beliefs compared to uninformed publics, making it more difficult to debunk misinformation among those initially misinformed (Kuklinski et al., 2000; Scheufele & Krause, 2019). Second, emerging evidence suggests that the public is often uninformed rather than misinformed on health (e.g., Mallon et al., 2021) and political (e.g., Li & Wagner, 2020) claims. Distinguishing between the two types of publics could foster our understanding of correction effectiveness among different types of publics and inform the design of tailored corrective messages.

In conclusion, there is a clear conceptual distinction between informed, uninformed, and misinformed individuals. I argue that the objective of inoculation messages should be threefold: inform the uninformed publics, change the beliefs of misinformed publics, and prevent the beliefs of informed publics from being changed.

Pre-Exiting Beliefs and Inoculation Effectiveness

Early studies on inoculation theory considered inoculation as a strategy for protecting individuals' existing positions and to developing resistance to attacks against their beliefs (McGuire & Papageorgis, 1962). McGuire's work of inoculation theory exclusively focused on *cultural truisms*, which McGuire defined as "beliefs that are so widely shared within the person's social milieu that [the person] would not have heard them attacked, and indeed, would doubt that an attack was possible" (1964, p. 201). The underlying assumption of inoculation theory is that recipients should already hold an established belief or attitude that is consistent with the advocated position of the inoculation message (Compton, 2020). In other words, like inoculations in medical settings that protect healthy subjects from virus attacks, inoculations in persuasion settings protect "healthy" individuals who are not already infected by harmful beliefs (Compton & Pfau, 2005). Under this assumption, early inoculation studies were mainly based on non-controversial issues (Banas & Rains, 2010) and only tested effects of inoculation on subjects with initial supportive attitudes towards the content of inoculation messages (M. L. M. Wood, 2007). However, more recent scholarship has critiqued this approach for limiting the applicability of inoculation theory in real-world settings (Compton, 2020; M. L. M. Wood, 2007). Messages from media, especially social media, can reach unintended audiences, for whom the message could have boomerang effects (Cho & Salmon, 2007). Therefore, it is important to

investigate how individuals with different pre-existing attitudes process, evaluate, and are influenced by inoculation messages.

Compton (2020) theorized that there are two types of inoculation: prophylactic and therapeutic. *Prophylactic inoculation* is administered to those who are in a desired state, meaning that they have an initial attitude/belief that is consistent with the advocacy of the inoculation message. Prophylactic inoculation serves as a preventative treatment, preventing individuals' beliefs from being persuaded. In contrast, *therapeutic inoculation* is administered to those without a desired, existing position in place. Therapeutic inoculation works as a persuasive message, persuading individuals to change their beliefs toward the advocated position. Compton argued that both types of inoculation can contribute to conferring resistance to persuasion, although they may have different mechanisms.

Empirical studies have shown that inoculation can effectively promote individuals' beliefs toward the advocated direction of the inoculation message, regardless of their pre-existing beliefs (Ivanov et al., 2017; M. L. M. Wood, 2007). For example, M. L. M. Wood (2007) examined the effects of inoculation messages on consumers' acceptance of agricultural biotechnology and whether the impacts differed based on individuals' pre-existing attitudes. The results showed that initially supportive, neutral, and opposed subjects exposed to the inoculation message all reported significantly more positive attitudes toward agricultural biotechnology following an attack message than their non-inoculation controls (M. L. M. Wood, 2007). M. L. M. Wood argued that inoculation message can make initially opposed or neutral subjects aware of the vulnerability of their pre-existing beliefs and led them to re-evaluate their initial positions. Similarly, in another study about tourist destination reputation, Ivanov et al. (2017) found that among people with initial neutral and opposing attitudes toward the inoculation-advocated

position, inoculation message could change their attitudes toward the message-advocated direction and "protect these attitudinal gains from attack-message-induced slippage." (p. 105). These studies highlight the potential of inoculation messages to benefit individuals beyond those who initially agree with the advocated position of the inoculation message.

Despite the emerging evidence, there have been limited studies conducted in a misinformation context. It is unclear whether inoculation messages can equally confer resistance to misinformation among those who are initially informed, uninformed, and misinformed. The current dissertation seeks to fill this gap. Based on the reviewed evidence, I propose that exposure to the inoculation message will confer resistance to misinformation, regardless of individuals' initial beliefs in misinformation.

Pre-Exiting Beliefs and Inoculation Mechanisms

Although previous studies have shown that inoculation effects can generate beyond those who initially support the advocated position of the inoculation message (Ivanov et al., 2017; M. L. M. Wood, 2007), it remains unclear whether the underlying mechanism of inoculation is the same for people with different pre-existing beliefs. Compton (2020) argued that the pre-existing beliefs do not impact the inoculation efficacy; however, the underlying mechanism for inoculating those already affected by harmful beliefs is different from the traditional route: counterarguing. As Compton suggested, for subjects with a neutral or opposed initial attitude toward the advocated position of inoculation message, the attack message may not be threatening to their initial attitude and, therefore, may not trigger counterarguing.

Similarly, M. L. M. Wood (2007)'s study found that although inoculation can prevent initially opposed subjects (i.e., people with initially opposing beliefs and attitude toward the inoculation-advocated position) from forming more negative attitudes, it does not lead to more

counterarguing against the attack message among initially opposed subjects. Instead, M. L. M. Wood found that initially opposed subjects engaged in "reverse counterarguing" (p. 361), which involves generating counterarguments against the position advocated in the inoculation message. Difficulty in generating counterarguments has been found to increase individuals' support for the advocated position. For example, Rucker and Petty (2004) found that individuals who failed to counterargue against a message became more favorable toward the message compared to those who did not engage in counterarguing, and they held that positive attitude with higher certainty. Similarly, in a study on physician-assisted suicide, Walter and Cohen (2019) found that when individuals found it difficult to generate counterarguments against physician-assisted suicide, they became more supportive of physician-assisted suicide.

I argue that for people with initially supportive (i.e., the informed) or neutral beliefs (i.e., the unformed) toward the advocated position of the inoculation message, the forewarning component of the inoculation message makes them aware that their existing positions can be threatened, which further elicits anger, motivates them to engage in counterarguing, and confers resistance to the misinformation message. However, for people with initially opposing beliefs toward the advocated position of the inoculation message (i.e., the misinformed), the misinformation message is consistent with their positions and thus the forewarning component may not pose a strong threat to their existing positions. Therefore, inoculation may not necessarily trigger counterarguing against the misinformation among people with initial misperceptions. Instead, initially opposed subjects may engage in reverse counterarguing, generating supportive arguments for the misinformation message while generating counterarguments for the inoculation messages. However, exposure to inoculation messages would make it easier to generate counterarguments against the misinformation whereas more

difficult to generate counterarguments against the inoculation messages. It is through the difficulty they experience in generating counterarguments that leads to their resistance to the misinformation message. Therefore, this dissertation seeks to explore whether the underlying mechanism of inoculation effects differ among initially informed, misinformed, and uninformed individuals.

Impact of Source Characteristics on Inoculation Effectiveness

"Belonging is stronger than facts" (Fisher, 2021, n.p.). The evidence-based persuasion approach rests on the assumption that people believe in misinformation because they lack knowledge about relevant facts (Sturgis & Allum, 2004). However, a growing body of evidence suggests that misperceptions may not arise from a lack of access to factual information, but rather from individuals' distrust in scientists (Goldenberg, 2016) and their motivations to defend one's existing belief and group identity (Nyhan, 2021; van der Linden, 2022). Individuals conform to social influence to achieve their goals of affiliation and maintain a positive self-concept (Cialdini & Goldstein, 2004). As a result, maintaining beliefs that are aligned with one's group identity could be a higher priority than achieving accuracy in many situations (Van Bavel & Pereira, 2018). The era of infodemic has emerged alongside declining trust in scientists, increasing political polarization, and a fragmented media landscape (Lewandowsky et al., 2017). As such, successful misinformation interventions should be considered within a broader political and societal context (Lewandowsky et al., 2017).

Partisan Identities and Judgments

Social identity theory (Tajfel & Turner, 2001; Turner & Oakes, 1986) posited that people get a sense of who they are based on their group memberships. People categorize themselves as belonging to various groups, such as gender, nationality, or professional groups. When group

membership is salient, individuals approach others as members of their own group (i.e., in-groups) and members of the other group (i.e., out-groups) (Hornsey, 2008). Alongside self-categorization, people constantly compare the value of their in-groups and out-groups to determine the worth of their group memberships (Trepte & Loy, 2017). One's group memberships, together with their group evaluations, form their social identity and impact their self-esteem (Trepte & Loy, 2017). People tend to favor their in-group over the out-group to maintain a positive self-evaluation and boost self-esteem (Hornsey et al., 2002). Self-categorization theory (Turner, 1999), as an extension of social identity theory, distinguishes between personal and social identity. Self-categorization theory assumes that social and personal identity are not the poles of a continuum but could both impact one's judgment and behavior. Cues, such as media exposure, can remind people of their membership in certain groups (Mastro, 2003; Trepte & Loy, 2017). Groups are cognitively represented as prototypes – "a fuzzy set of attributes (perceptions, attitudes, feelings, and behaviors) that are related to one another in a meaningful way" (Hogg, 2018, p. 119). When a certain social identity becomes salient, one's self perception is dominated by their social identity and people tend to depersonalize both in-group and out-group members; in other words, people come to view themselves and others "less as individuals and more as interchangeable exemplars of the group prototype"(Hornsey, 2008, p. 208). According to the social identity perspective, people tend to adopt the norms and values of their groups, through which they obtain a sense of pride, stability, and meaning (Korte, 2007; Prost et al., 2023).

Partisan identities, as one type of social identities, satisfy individuals' basic needs such as belonging, distinctiveness, and access to power and guidance (Hornsey et al., 2002). When the net value of these gratifications outweighs accuracy goals, they may motivate individuals to

process information in a biased way that ignores truth (Van Bavel & Pereira, 2018). The effort to examine persuasive outcomes of partisan sources rests on the premise that that people's political group memberships influence their health and science decisions. Empirical evidence has largely supported this assumption. In the US, public opinions about scientific issues have been widely divided along partisan lines (Jiang et al., 2021). Democrats and Democrat-leaners report stronger trust in scientists compared to Republicans and Republican-leaners (Funk et al., 2020; Hamilton, 2015; Motta, 2021). Partisan differences over trust in scientists became wider during the COVID-19 pandemic. According to a survey conducted by Pew Research Center (Kennedy et al., 2022), about half (44%) of Democrats and Democratic-leaning independents expressed a great deal of confidence in medical scientists to act in the public's best interests, whereas only 15% of Republicans and Republican leaners believed so. Partisan differences in the proportion of people who expressed at least a fair amount of trust in medical scientists have grown from 3% in 2016 to 24% in 2021 (Kennedy et al., 2022).

Alongside the partisan differences in trust in scientists, there is a political divide in vaccine acceptance and misinformation susceptibility. Compared to Democrats, Republicans were found to report lower likelihood to get a COVID-19 vaccine (Golos et al., 2022) and stronger COVID-19 vaccine hesitancy (Khubchandani et al., 2021). According to a Pew Research Survey conducted in August 2021 (Funk & Gramlich, 2021), 86% of Democrats and Democrat leaners had received at least one dose of COVID-19 vaccine, whereases the vaccination rate was 26% lower among Republicans and Republican leaners (60%). Emerging evidence suggests that pro-vaccine messages have lower persuasive effects among Republicans than Democrats. For example, Golos et al. (2022) found that scientific messages advocating for COVID-19 vaccines significantly increased Democrats' intentions to get vaccinated but had no

significant effect on Independent or Republicans. Moreover, Republicans were found to be more susceptible to misinformation than Democrats (Golos et al., 2022). Freiling et al. (2023) found that Republicans were more likely to believe and share COVID-19 misinformation than Democrats. In a systematic review on health misinformation susceptibility, Nan et al. (2022) found that six out of eight studies revealed a positive relationship between being Republicans and beliefs in health misinformation. With growing political polarization, correcting misperceptions becomes even more difficult (Scheufele & Krause, 2019), as individuals tend to seek information from like-minded sources (e.g., Spohr, 2017; Wang & Song, 2020) and are motivated to derogate information from ideologically incongruent sources (e.g., Li & Wagner, 2020; Osmundsen et al., 2021).

Individuals' political group memberships have also been found to shape their media consumptions and media evaluations. In the US, Republications and Democrats have shown preferences for different media outlets. A 2020 poll by Pew Research Center (Grieco, 2020) suggested that 93% of Republican and Republican leaners identified Fox News as their major source for political news, whereas only 6% of Democrats and Democrat-leaners said so. Conversely, 95% of Democrats and Democrat leaners named MSNBC as their major political news source, whereas only 5% of Republican and Republican-leaners said so (Grieco, 2020). Moreover, Republicans perceived more media bias from CNN than Democrats, while Democrats perceived more bias from Fox News than Republicans (Glynn & Huge, 2014). Stroud et al. (2014) proposed that individuals have in-group and out-group orientations toward media outlets in a way similar to their self-categorizations in group settings. They found that liberal Democrats perceived in-group media sources (e.g., CNN, MSNBC) as more diverse and perceived our-group sources (e.g., Fox, Rush Limbaugh) as more homogeneous, whereases conservative

Republicans had the opposite conclusions. Taken together, these findings suggest that partisan individuals perceive their partisan in-group sources more favorably than out-group sources.

Partisan Source Cues and Persuasion Effectiveness

When it comes to persuasion, source matters. A meta-analysis conducted by Wilson and Sherrell (1993) revealed that source manipulations account for an average of 9% of variance in persuasion effects. Persuasive messages tend to be more effective when conveyed by an in-group partisan source rather than an out-group partisan source (e.g., De Benedictis-Kessner et al., 2019; Li & Wagner, 2020; Lu & Lee, 2019). The persuasive effects of partisan source cues can be explained from various perspectives. According to the elaboration likelihood model (R. Petty & Cacioppo, 1986), partisan source cues could serve as a peripheral cue (i.e., a mental shortcut) and activate the credibility heuristic (e.g., "if my party holds this position, it must be the right one") (Van Bavel & Pereira, 2018, p. 8). Additionally, Kahan (2017b) proposed the theory of identity-protective cognition, which suggests that individuals tend to defend the opinions of their cultural groups rather than to seek the truth. Partisan source cues can activate people's Democratic-Republican identifications and lead them to take different value positions (Goren et al., 2009). As such, partisan source cues can direct people to engage in identity-protective reasoning, motivating individuals to process information in a way that reaffirm their party group's ideas, values, or positions (Boyer et al., 2020; Kahan, 2017a). Consequently, people are more susceptible to misinformation when it is identity-affirming (Kahan, 2017b). From the social identity perspective, people are more resistant to a persuasive message when it is associated with an out-group (vs. in-group) source. According to the intergroup sensitivity effect (Hornsey & Esposo, 2009), people tend to react more negatively to criticism from out-group members than from in-group members. This is because out-group criticisms evoke more negative sentiments,

result in a worse evaluation of the speaker's personality, and are perceived as less constructive and legitimate than in-group criticisms (Hornsey et al., 2002). Regardless of the rationale, these perspectives indicate that party cues can direct individuals to adjust their views to align with those of their party, ultimately affecting the persuasiveness of a message (Brader et al., 2013).

Empirical studies have found that persuasive effects can be enhanced with the presence of an in-group source whereas diminished with an out-group source. For example, Bolsen et al. (2019) found that when an environmental threat was linked to a Republican party leader, Republicans reported greater beliefs that climate change as an environmental threat and were less likely to believe that climate change is a hoax. However, when the same message was attributed to a Democratic party leader, the message backfired among Republicans, as they were more convinced that climate change is a hoax. Similarly, Pink et al. (2021) found that unvaccinated Republicans were more likely to have favorable attitudes toward COVID-19 vaccines when the pro-vaccine messages were endorsed by Republican elites, but less likely to have favorable attitudes when the same message was endorsed by Democratic elites. Furthermore, when processing information from an out-group source, partisan individuals perceived the media coverage of an issue to be more biased against their personally held views than it actually is (Hart et al., 2015). For example, Kim (2016) studied the impact of partisan sources on audiences' bias perceptions of controversial news with South Korea participants. They found that individuals perceived the news article as less biased when it was attributed to an in-group partisan source than an out-group source, regardless of whether the article was congruent with their pre-existing beliefs. Similarly, Reid (2012) found that individuals perceived neutral political news as in-group favoring when attributed to an in-group source whereas as hostile when linked to an out-group source. In another experiment, Reid (2012) found that when

exposed to an attack message on Democrats, Democrat participants perceived the message as less bias when it was attributed to a Democrat source, but as more bias when it was attributed to a Republican source.

Despite the growing interests in studying the effects of partisan source cues on persuasion effectiveness, evidence remains limited in the context of inoculation messages. Some findings have emerged concerning misinformation debunking messages, suggesting that corrective messages are more persuasive when attributed to in-group sources (e.g., Benegal & Scruggs, 2018; Clayton et al., 2019; Li & Wagner, 2020) while misinformation is also perceived as more credible when linked to in-group sources (e.g., Blom, 2021). For instance, Li and Wagner (2020) asked participants to evaluate the truthfulness of several statements selected from fact-checking websites. The experimental group was told that these statements were made by Trump, while the control group was not given information about the source. The study found that when these statements were attributed to Trump, Trump voters were more likely to evaluate these statements as true whereas non-Trump voters were less likely to rate them as true. In another study on correcting misperceptions in climate change, Benegal and Scruggs (2018) found that Republicans reported greater agreement with scientific consensus on climate change when exposed to a corrective message from a Republican source, but did not no significant belief changes when the corrective message came from a Democrat. Blom (2021) found that false headlines about illegal immigrants were perceived as more believable by right-leaning participants when attributed to Fox News, while left-leaning participants considered them more credible when attributed to CNN. Moreover, recent evidence suggests that people are more susceptible to misinformation when it is associated with a politically congruent source, even when the misinformation concerns a nonpolitical issue (Traberg & van der Linden, 2022). This is

because individuals perceive politically congruent sources as more credible, leading them to evaluate (mis)information from their trusted source as more accurate (Traberg & van der Linden, 2022).

Taken together, these findings suggest that partisan source cues impact individuals' message evaluations, judgments, and ultimately, persuasive effectiveness of the message. Correcting misinformation with an in-group source can facilitate corrective effectiveness. However, it can be more challenging to correct misinformation when it also comes from an in-group source. To further explore the role of partisan source cues in inoculation message effects, this dissertation seeks to examine whether the effectiveness of inoculation messages depend on the partisan sources of both the inoculation message and the misinformation attack.

The Moderating Role of Party Identification Strength

People are not equally influenced by their group memberships. According to the social identity approach, the degree to which group memberships impact individuals' perceptions, emotions, and actions is determined by their levels of in-group identification (Leach et al., 2008). Ingroup identification refers to "the degree to which the ingroup is included in the self" (Tropp & Wright, 2001, p. 586). One's identification with a group can manifest as perceptions of similarity with the in-group prototype (self-definition) and positive feeling about their in-group membership (self-investment) (Leach et al., 2008). People with higher in-group identification are more likely to view themselves as part of the group, feel similar to group members, and conform to in-group norms compared to those with lower in-group identification (Tropp & Wright, 2001). Relatedly, political party identification refers to "an internalized sense of party membership" (Huddy et al., 2015, p. 4). Individuals with stronger identification with their political party are more likely to experience negative emotions and defend their political party in the face of group

threat (Huddy et al., 2015). For example, In the US, highly identified Republicans and Democrats were found to report stronger support for their own party than less identified partisans (J. K. Brown & Hohman, 2022).

Emerging evidence suggests that individuals' media perceptions and message responses are influenced not only by their party affiliation but also by the strength of their party identification. For example, Hartmann and Tanis (2013) conducted a study on the abortion debate and found that ingroup identification moderated the hostile media effect. Both pro-choice and pro-life partisans perceived a newspaper article about abortion as less favorable toward their respective group, but only when their level of ingroup identification was high. Similarly, Castro et al. (2021) found that strong partisans perceived news media as more hostile than weak partisans. Azrout and de Vreese (2018) studied the 2009 European Parliament elections and found that the persuasive effects of partisan source cues depended on individuals' party identification. Individuals with stronger party identification were more likely to be influenced by a cue from their party than those with weaker party identification. Similarly, Sechrist and Young (2011) found that consensus messages were more persuasive among people with stronger ingroup identification, although this study was not conducted in a partisan context.

While many studies have emphasized the crucial role of partisan identification strength in shaping persuasive outcomes, most of these studies examined partisan identification strength as a covariate (Brick et al., 2017; Nelson & Garst, 2005). There is a lack of research that investigates whether individuals' partisan identification strength moderates the effects of partisan source cues on persuasive outcomes. Therefore, this dissertation aims to address this gap by exploring whether the persuasive effects of in-group (vs. out-group) partisan source cues are moderated by individuals' party identification strength. Specifically, I propose that individuals

with stronger party identification are more susceptible to the influence of partisan source cues than those with weaker party identification.

Chapter 4: Present Research

Context of Inquiry: COVID-19 Vaccines

Since the first cases of COVID-19 were reported in December 2019, the virus has rapidly spread to nearly every country and territory around the world. Over the past three years, COVID-19 has infected millions of people and caused widespread illness and death. As of January 9, 2023, the number of COVID-19 cases worldwide had reached about 669 million, and over 6.7 million people had lost their lives to the disease (Elflein, 2023). In the United States, COVID-19 has become the deadliest pandemic in history (Wilkes, 2021). The devastating impact of COVID-19 and the evolving nature of the virus underline the necessity of ongoing preventative measures.

Vaccination is one of the most crucial steps in achieving herd immunity against COVID-19 and long-term pandemic control (CDC, 2022b). In September 2022, the FDA authorized the bivalent booster shots (also known as the "updated booster") from Moderna and Pfizer-BioNTech, which protect against both the original virus and the omicron variant that cause COVID-19 (U.S. Food and Drug Administration, 2023). Although the majority (81%) of US residents had received at least one dose of COVID-19 vaccine as of January 2023 (Our World in Data, 2023), recent reports indicate that people are reluctant to continue get a COVID-19 booster. According to a national survey conducted in November 2022, 19% of US participants claimed that they were unwilling to get a bivalent booster (Schulman et al., 2022). As of January 27, 2023, only 15.5% of US population had received the bivalent booster dose (CDC, 2023a). People aged 65 and older, who are most vulnerable to the virus, have shown declining interest in COVID-19 boosters (Span, 2022). Although 94.2% of people 65 and older were fully vaccinated, only 40.1% had received the bivalent booster by the end of January 2023 (CDC, 2023a). Given

that the virus that causes COVID-19 is constantly evolving, and that people's immunity wanes over time, it is important to understand how to maintain the public's trust in vaccines and avoid future surges in new cases.

COVID-19 vaccine misinformation has become a major obstacle to building vaccine confidence and achieving community immunity (Lazarus et al., 2021). Since the beginning of the pandemic, misinformation about COVID-19 vaccines has rapidly spread online. For example, a content analysis study found that about 10.7% of YouTube's most-viewed videos about COVID-19 vaccines contained misinformation (H. Li et al., 2022). On Twitter, 22.3% of the tweets about COVID-19 vaccines expressed hesitancy toward the vaccine (Y. Wang & Chen, 2022). On TikTok, more than 250,000 videos have been identified as misinformation and removed from the platform (Hsu, 2023). Regarding online articles, a study found that 55.4% contained misinformation about COVID-19 vaccines, such as false claims about COVID-19 vaccine safety efficacy (e.g., "COVID-19 vaccines will cause autism") and conspiracy theories (e.g., "COVID vaccines will be used for population control")(Lurie et al., 2022, p. 3). As COVID-19 continues to spread, misinformation about the virus and the vaccine also evolves, continuing to undermine the public's vaccine acceptance.

Exposure to vaccine misinformation can have a detrimental impact on public health. A systematic review on the impact of health misinformation suggests that misinformation exposure is in general associated with stronger beliefs in misinformation, less favorable health attitudes, and lower intentions to engage in health behaviors (Y. Wang et al., 2022b). In terms of COVID-19 vaccine hesitancy, another systematic review suggests that vaccine misperceptions, concern of side effects, and mistrust in the government and pharmaceutical companies collectively drive low acceptance rate of the COVID-19 boosters in the US (Shah & Coiado, 2023). With empirical

evidence, Loomba et al. (2021) conducted an experiment and found that exposure to COVID-19 vaccine misinformation led to a decline in COVID-19 vaccination intentions. These findings highlight the detrimental impact of vaccine misinformation on vaccine acceptance. Therefore, it is important to design effective interventions to help the public resist vaccine misinformation.

Inoculation messages have shown potential to help people resist misinformation. Previous studies have found that people who were inoculated against misinformation reported less perceived reliability of misinformation (Maertens, Roozenbeek, et al., 2020), stronger confidence in their ability to spot misinformation (Roozenbeek, van der Linden, et al., 2022), and lower willingness to share misinformation with others (Basol et al., 2021). In the context of COVID-19 vaccination, emerging evidence indicates the effectiveness of inoculation message as a technique to combat vaccine misinformation and boost vaccine acceptance. For example, Ramirez et al. (2022) found that advertising with psychological inoculation against COVID-19 vaccine misinformation received more positive responses on Facebook than CDC ads that simply encourage vaccination. Through an experiment among elderly participants, Vivion et al. (2022) found that people who were inoculated against misinformation expressed stronger intentions to receive the COVID-19 vaccine compared to those who only received the misinformation. Despite the growing number of studies, empirical evidence on the effectiveness of inoculation messages in combating COVID-19 vaccine misinformation is still limited. Moreover, little is known about the role of recipient characteristics and message sources in moderating inoculation message effectiveness (Traberg et al., 2022). Therefore, grounded in the context of COVID-19 vaccine misinformation, this dissertation seeks to fill these gaps. Through two online experiments, I seek to understand the potential of inoculation messages in boosting resistance to

misinformation about COVID-19 vaccines and investigate whether individuals' initial misperceptions and message sources moderate inoculation effectiveness.

Research Questions and Hypothesis

The main goal of this dissertation is to examine the effectiveness of inoculation messages in building resistance to misinformation in the context of COVID-19 vaccine communication. Specifically, I aim to explore the impact of inoculation message in conferring resistance to misinformation (H1), identify the underlying mechanisms of inoculation message effects (H2-H5), and examine whether the effectiveness of inoculation exposure is conditional on recipients' initial beliefs in misinformation (RQ1, RQ2), partisan sources of the inoculation and misinformation messages (H6-H8, RQ3, RQ4), and individuals' party identification strength (H9-11). The following hypotheses and research questions are formulated to achieve these objectives.

Effects of Inoculation Message

According to the inoculation theory (McGuire, 1961), people can be immunized against persuasion in the same way that they can be immunized against viruses. Just as injecting weak viruses into a person can provide protection from future virus attacks, exposing people to weak arguments against an attitude they hold can foster immunity against future persuasion. This is because inoculation messages can induce defense motivation and trigger counterarguing against the persuasive attempt (McGuire & Papageorgis, 1962).

A wealth of empirical studies have provided support for inoculation theory, suggesting that exposure to inoculation messages can prevent attitude change across various contexts (e.g., Banas & Rains, 2010; Braddock, 2022; Compton et al., 2016; Kim, 2013; Pfau & Burgoon, 1988). Recent research has highlighted the potential of inoculation messages as a "prebunking"

strategy (Roozenbeek & van der Linden, 2022, p. 572) for addressing health misinformation. By forewarning people about how they may be misinformed, inoculation messages can reduce individuals' susceptibility to health misinformation. For example, inoculated individuals have reported lower beliefs in health misinformation (e.g., Maertens et al., 2020), more favorable health attitudes (e.g., Iles et al., 2021), and stronger intentions to engage in health behaviors (Vivion et al., 2022) than than those who were not inoculated, after being exposed to health misinformation.

Given the theory and empirical evidence pointing to the effectiveness of inoculation message in reducing susceptibility to misinformation. I propose that exposure to an inoculation message can confer resistance to COVID-19 vaccine misinformation, as indicated by five dependent variables (i.e., belief in COVID-19 vaccine misinformation, COVID-19 vaccination attitudes, COVID-19 vaccination intentions for self, COVID-19 vaccination intentions for child, and COVID-19 vaccination recommendation intentions). Therefore, the following hypothesis is proposed:

> **H1:** Exposure to an inoculation message (vs. no-message control) will lead to weaker beliefs in COVID-19 misinformation (H1a), more favorable attitudes toward COVID-19 vaccines (H1b), stronger intentions to vaccinate oneself (H1c) and one's child (H1d) against COVID-19, and stronger intentions to recommend COVID-19 vaccines to others (H1e).

Mechanisms of Inoculation Message Effects

The inoculation theory suggests that inoculation messages confer resistance to persuasion through triggering counterarguing. However, an increasing number of studies have suggested that effects of inoculation message cannot be fully explained by counterarguing and call for more

research exploring the underlying mechanisms of inoculation messages (e.g., Compton & Ivanov, 2013; Pfau et al., 2001).

As mentioned in Chapter 3, I argue that there are two limitations of the original model of inoculation theory. First, it assumed that resistance to persuasion is an effortful cognitive process, while neglecting the heuristic and affective processes. Second, this model focuses on the number of counterarguments that inoculated individuals generated, without considering their subjective experiences of generating those counterarguments. To address these gaps, the current dissertation extends inoculation theory by examining mediators that capture individuals' metacognitive experiences (i.e., perceived ease of counterarguing) and affective responses (i.e., anger) when resisting persuasion. I propose that:

H2: Inoculated individuals will engage in greater counterarguing against the misinformation compared to uninoculated individuals.

H3: Inoculated individuals will report higher perceived ease of counterarguing against the misinformation compared to uninoculated individuals.

H4: Inoculated individuals will report greater anger towards the misinformation compared to uninoculated individuals.

H5: Counterarguing (H5a), perceived ease of counterarguing (H5b), and anger (H5c) will mediate the influence of inoculation message (vs. control) on each of the five dependent variables (belief in misinformation, attitudes toward vaccines, vaccination intentions for self, vaccination intentions for child, vaccine recommendation intentions).

Recipient Effects: The Role of Pre-Existing Beliefs

Early inoculation studies considered inoculation as a strategy for protecting individuals' existing positions and developing resistance to attacks against their beliefs (McGuire &

Papageorgis, 1962a). More recently, Compton (2020) theorized that there are two types of inoculation: *prophylactic inoculation*, which is administered to those who are in a desired state (i.e., have an initial attitude/belief that is consistent with the advocacy of the inoculation message); and *therapeutic inoculation*, which is administered to those without a desired, existing position in place. Compton argued that prophylactic inoculation serves as a preventative treatment, preventing individuals' beliefs from being persuaded; conversely, therapeutic inoculation works as a persuasive message, persuading individuals to change their beliefs toward the advocated position. Compton argued that the two types of inoculation, although they might have different mechanisms, both can contribute to conferring resistance to persuasion. A growing number of studies suggests that inoculation effects can generate beyond those who initially support the advocated position of the inoculation message (e.g., Ivanov et al., 2017; M. L. M. Wood, 2007). Empirical evidence on whether inoculation messages can equally confer resistance to misinformation among those initially misinformed, uninformed, and misinformed is still limited, however. Moreover, it is unclear whether the underlying mechanism of inoculation is the same for people with different pre-existing beliefs. Therefore, the current dissertation seeks to examine whether individuals' initial beliefs in COVID-19 vaccine misinformation moderate the direct and indirect effects of inoculation messages on the five persuasive outcomes. The following research questions are proffered:

Conditional Effect

RQ1: Will the effects of inoculation message (vs. control) on the five dependent variables differ among initially misinformed, uninformed, and informed individuals?

Conditional Indirect Effect

RQ2: Will the indirect effects of inoculation message (vs. control) through counterarguing, perceived ease of counterarguing, and anger on the five dependent variables differ among initially misinformed, uninformed, and informed individuals?

Source Effects: The Role of Partisan Source Cues

Drawing upon the social identity perspective, studies suggest that people tend to evaluate in-group sources favorably while are more negative towards out-group sources (Glynn & Huge, 2014; Li & Wagner, 2020; Osmundsen et al., 2021). As such, persuasive messages are often more effective when conveyed by an in-group partisan source compared to an out-group partisan source (e.g., De Benedictis-Kessner et al., 2019; Li & Wagner, 2020; Lu & Lee, 2019). This is because in-group source cues can activate credibility heuristics (Van Bavel & Pereira, 2018), direct people to engage in identity-protective cognition (Kahan, 2017b), and are considered as more constructive and legitimate than out-group sources (Hornsey et al., 2002). While source has long been considered as an important factor in persuasion, it remains less clear about how source cues impact the persuasiveness of misinformation and corrective messages. The inoculation scholarship has called for more research examining how source cues moderate inoculation effectiveness (Traberg & van der Linden, 2022). Given previous findings, I argue that inoculation messages should be more effective when conveyed by an in-group (vs. out-group) partisan source. However, people will also become more susceptible to misinformation when it is conveyed by an in-group (vs. out-group) partisan source, thereby diminishing the effectiveness of inoculation messages. Therefore, the following hypotheses are proposed:

Effects of In-group (vs. Out-group) Partisan Source Cues

H6: Exposure to an in-group (vs. out-group) inoculation message will lead to weaker beliefs in COVID-19 misinformation (H6a), more favorable attitudes toward COVID-19

vaccines (H6b), stronger intentions to vaccinate oneself (H6c) and one's child (H6d) against COVID-19, and stronger intentions to recommend COVID-19 vaccines to others (H6e).

H7: Exposure to an in-group (vs. out-group) misinformation will lead to stronger beliefs in COVID-19 misinformation (H7a), less favorable attitudes toward COVID-19 vaccines (H7b), weaker intentions to vaccinate oneself (H7c) and one's child (H7d) against COVID-19, and weaker intentions to recommend COVID-19 vaccines to others (H7e).

H8: There is a two-way interaction between in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation on the five dependent variables. Specifically, the persuasive effect of in-group (vs. out-group) inoculation is weaker when the misinformation is conveyed by an in-group (vs. out-group) source.

Mechanisms of Partisan Source Effects

Furthermore, I seek to examine whether the positive impact of in-group (vs. out-group) inoculation message and the negative impact of in-group (vs. out-group) misinformation on the five persuasive outcomes are mediated by the three proposed mediators. Therefore, I ask:

RQ3: Do counterarguing, perceived ease of counterarguing, and anger mediate the effects of in-group (vs. out-group) inoculation on the five dependent variables?

RQ4: Do counterarguing, perceived ease of counterarguing, and anger mediate the effects of in-group (vs. out-group) misinformation on the five dependent variables?

The Moderating Role of Party Identification Strength

Finally, emerging evidence suggests that individuals' media perceptions and message responses are influenced not only by their party affiliation but also by the strength of their party identification (e.g., Azrout & de Vreese, 2018; Hartmann & Tanis, 2013; Sechrist & Young,

2011). Those with stronger party identification are more susceptible to cues from their party (e.g., Azrout & de Vreese, 2018). Therefore, I propose:

H9: There is a two-way interaction between in-group (vs. out-group) inoculation and party identification strength on the five dependent variables. Specifically, the positive effect of in-group (vs. out-group) inoculation in conferring resistance to misinformation will be stronger among people with stronger party identification strength.

H10: There is a two-way interaction between in-group (vs. out-group) misinformation and party identification strength on the five dependent variables. Specifically, the negative impact of in-group (vs. out-group) misinformation will be stronger among people with stronger party identification strength.

H11: There is a three-way interaction among in-group (vs. out-group) inoculation, in-group (vs. out-group) misinformation, and individuals' party identification strength on the five dependent variables. Specifically, the positive effect of in-group (vs. out-group) inoculation in conferring resistance to out-group (vs. in-group) misinformation will be stronger among people with stronger party identification strength.

Chapter 5: Pilot Test

Before conducting the main experiments, two questions remained: (1) Is the inoculation message easily comprehensible for lay audiences? (2) Which source can best represent in-group and out-group sources for Republicans and Democrats, respectively? To address these questions, I conducted a pilot test to gather feedback on the inoculation message design, select the message source for the in-group (vs. out-group) source manipulation, and evaluate the reliability of the COVID-19 vaccine misinformation belief scale.

Method

Procedure

An online survey was conducted with participants recruited from Amazon's Mechanical Turk (MTurk) on December 15, 2022. Eligible participants were MTurk workers who were 18 years or older, currently living in the United States, and had at least 50 previously approved tasks on MTurk with a task approval rate of over 95%. Qualified participants who agreed to participate were offered $1 for completing the 10-minute study.

The survey consisted of several sections. Participants first answered questions about their trust in sources, and beliefs about COVID-19 vaccine misinformation. They then read two messages designed for Study 1, including a public service announcement (PSA) that conveyed an inoculation message against COVID-19 vaccine misinformation and a Reddit misinformation message about COVID-19 vaccines. Participants were then asked to provide feedback on their perceptions of the two messages. Next, participants were randomly assigned to read an inoculation tweet against COVID-19 vaccine misinformation from either MSNBC or FOX News, followed by a misinformation tweet simulated as from either a Republican or a Democrat. These messages are designed for study 2 to examine the persuasive effects of partisan sources.

Participants provided feedback on their comprehension of the inoculation messages and answered questions about their perceptions toward these messages. Finally, participants were asked to provide demographic information.

Participants

A total of 82 eligible participants were recruited for the pilot study. Participants reported an average age of 38.43 (*SD* = 13.7). Of the participants, 56.1% were male (*n* = 46) and 43.9% were females (*n* = 36). No participants identified as another sex. Regarding ethnicity, 23.2% of participants (*n* = 19) identified as Hispanic, Latino, or Spanish, while 76.8% (*n* = 63) did not. Most participants self-identified as White (84.1%, *n* = 69), followed by Black or African American (8.5%, *n* = 7), Asian (4.9%, *n* = 4), and American Indian or Alaska Native (2.4%, *n* = 2). No participants identified as Native Hawaiian, multi-racial, or other racial background. In terms of education level, 8.5% of participants (*n* = 7) had a high school education, 13.4% (*n* = 11) had some college, 54.9% (*n* = 45) were college graduates, and 23.2% (*n* = 19) were postgraduates. No participants reported having less than a high school education. For annual household income, 6.1% of participants (*n* = 5) reported an income of $10,000 to $14,999, 3.7% participants (*n* = 3) reported $15,000-$19,999, 11% participants (*n* = 9) reported $20,000-$34,999, 26.8% participants (*n* = 22) reported $35,000-$49,999, 31.7% participants (*n* = 26) reported $50,000 to $74,999, 14.6% participants (*n* = 12) reported $75,000-$99,999, and 6.1% participants (*n* = 5) reported $100,000-$199,999. No participants had an annual household income of $0-$9,999 or $200,000 or more. In terms of political affiliation, 47.6% of participants identified as Republicans (*n* = 39), 41.5% identified as Democrats (*n* = 34), 9.8% identified as Independents (*n* = 9), and 1.2% identified as other party affiliation (*n* = 1). A summary of the sample characteristics is provided in Table 1.

Measurement

Trust in Source. To determine whether Republicans and Democrats had different levels of trust in partisan sources, I measured participants' trust in information about COVID-19 from five sources: (1) MSNBC; (2) CNN; (3) FOX; (4) Republicans; and (5) Democrats. Participants were asked to rate to what extent they trusted information from each source on a seven-point scale (1 = *Do not trust at all*, 7 = *Completely trust*).

Belief in COVID-19 Vaccine Misinformation. Participants rated their perceived truthfulness of four false statements about COVID-19 vaccines: 1) "COVID-19 vaccines are not effective at all;" 2) "COVID-19 vaccines cannot protect against COVID-19 variants at all;" 3) "Vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID-19;" and 4) "Natural immunity provides better protection than vaccine-induced immunity to Covid-19." These statements have been identified by authoritative health organizations as false and represent common misperceptions about COVID-19 vaccines (CDC, 2021a, 2022b, 2023b). Responses were recorded on a five-point Likert scale (1 = *Definitely false*, 2 = *Probably false*, 3 = *I don't know*, 4 = *Probably true*, 5 = *Definitely true*). The similar five-point scale has been used in other misinformation studies (Freiling et al., 2023; Furnham & Hughes, 2014; Hall Jamieson & Albarracín, 2020), with a higher score reflects stronger beliefs in misinformation. The scale demonstrated good reliability (α = .92, M = 3.36, SD = 1.24).

Message Comprehension. Message comprehension assessed how easily understandable the message was to participants. Participants indicated their comprehension of the inoculation message on a seven-point scale (1 = *Strongly disagree*, 7 = *Strongly agree*) with three items: 1) "The message was easy to read;" 2) "The message was easy to

understand;" and 3) "The message was difficult to understand (reverse coded)." The three items were averaged to form an index for message comprehension (PSA inoculation message: α = .76, *M* = 5.73, *SD* = 0.97; Twitter inoculation message: α = .77, *M* = 5.73, *SD* = 0.91).

Qualitative Feedback. Qualitative feedback was collected from participants to obtain their thoughts about the message. Participants were asked to respond to a single open-ended question: "Please write down any thoughts you have about the message you just read. Please pay attention to the words and ideas in the message and tell us what you think could be done to make it easier to understand."

Results

Manipulation Check

O'Keefe (2003) posited that when investigating the impact of message variations on persuasive outcomes, there is no need to check the manipulation of message variations by assessing participant perceptions. This is because the differences in message variations are not dependent on participant perceptions. Rather, researchers are suggested to directly compare the effect of different message conditions on persuasive outcomes (O'Keefe, 2003). Accordingly, there is no need to check participants' perceptions of the variation between an inoculation message and a no-message control in this dissertation. This approach aligns with previous studies on inoculation message effects (e.g., Cook et al., 2017; Schmid-Petri & Bürger, 2022) and source effects (J. Li & Wagner, 2020a; S. Lu & Zhong, 2022; Nadarevic et al., 2020; Swire et al., 2017), which also did not include a manipulation check.

In-group vs. Out-group Manipulation. As this dissertation focuses on in-group versus out-group sources rather than a comparison between specific sources, a manipulation check was conducted to investigate whether Democrats and Republicans differ in their trust towards

different partisan sources. Results from independent sample t-tests suggest that Republicans reported significantly stronger trust in COVID-19 information from FOX (M = 5.46, SD = 1.47, $t(71) = 2.19$, $p = .03$) and Republicans (M = 5.46, SD = 1.57, $t(71) = 2.67$, $p = .009$) than Democrats did (FOX: M = 4.56, SD = 2.05; Republicans: M = 4.26, SD = 2.23). Conversely, Democrats reported significantly stronger trust in COVID-19 information from MSNBC (M = 5.59, SD = 1.08, $t(71) = -2.69$, $p = .009$) and Democrats (M = 5.85, SD = 1.18, $t(71) = -2.42$, $p = .02$) than Republicans (MSNBC: M = 4.74, SD = 1.53; Democrats: M = 4.92, SD = 1.95) did. Moreover, Democrats (M = 5.32, SD = 1.12) reported stronger trust information from CNN than Republicans did (M = 5.10, SD = 1.57), but the difference was not statistically significant ($t(71) = -0.68$, $p = .50$). Therefore, MSNBC and Democrats are considered as in-group sources for Democrats, while FOX and Republicans are considered as in-group sources for Republicans. These four sources will be used as source manipulations in study 2.

Message and Source Recall. Some studies have utilized participants' reflection on the message content as a form of manipulation check (e.g., Lee, 2019; Mayrhofer et al., 2020). Although the differences in message variations exist objectively and do not depend on participants' perceptions (O'Keefe, 2003), assessing whether participants can accurately recall the content and source of the message can help evaluate the ease of processing the manipulation. If most participants fail to notice message variations, any observed message effects could be due to random error. For this reason, participants in this study were asked to recall the content and source of the message after exposure to the stimuli.

Results suggest that 12 participants did not correctly recall the content of the messages designed for study 1, with 5 participants (6.1%) incorrectly reporting that the inoculation PSA suggested COVID-19 vaccines are not effective, and 7 participants (8.5%) incorrectly

recalling that the Reddit misinformation message suggested that COVID-19 vaccines are effective. Similarly, 14 responses incorrectly recalled the content of the messages designed for study 2, with 8 responses (9.8%) incorrectly perceiving the inoculation tweet as a message suggesting that COVID-19 vaccines are not effective, and 6 (7.3%) responses suggesting that the misinformation tweet showed that COVID-19 vaccines are effective. Furthermore, when recalling the partisan source of the stimuli, 13 participants (15.9%) did not correctly report the source of the inoculation message (FOX or MSNBC) and 7 participants (8.5%) incorrectly report the source of the misinformation message (Republican or Democrat).

The rate of incorrect responses is comparable to previous studies. For instance, in a study on misinformation correction, Lee (2019) found that 12.6% participants recruited from MTurk did not correctly recall exposure to corrective information, and 7% of participants incorrectly recalled the content of misinformation that they were exposed to. Mayrhofer et al. (2020) also used message recall as a manipulation check and set an 80.6% correct response rate as a threshold for effective manipulation. Based on these standards, the present study's results suggest that participants understood the content of the messages, and most were able to correctly identify the source of the messages.

The incorrect responses may be due to a lack of attention among participants. Therefore, to enhance participants' attention to the stimuli in the main studies, two measures will be implemented in main studies. First, the eligibility requirement for participants will be increased from a 95% approval rate to a 98% approval rate. Additionally, participants in the main studies will be required to spend at least one minute on the stimuli to ensure that they pay reasonable attention to the messages.

Message Comprehension

On average, participants spent approximately 2 minutes on the inoculation message presented in PSA format (designed for study 1), 1.5 minutes on the misinformation message presented in Reddit format (designed for study 2), 2 minutes on the inoculation tweet (designed for study 2), and 1.3 minutes on the misinformation tweet (designed for study 2).

Participants rated the inoculation messages as easy to comprehend, both for the PSA inoculation message (M = 5.73, SD = 0.97) and the Twitter inoculation message (M = 5.73, SD = 0.91). Regarding the qualitative feedback, the majority of participants found the messages easy to comprehend, with comments such as "very informative about COVID vaccine;" "clear direct messaging;" "the message was very clear;" "I feel everything was explained well enough;" "their words are easy to understand and give very useful information for our society." Another collection of comments did not provide any specific thoughts, mentioning "no thoughts." Some participants provided negative feedback about the messages, expressing doubts about the effectiveness of COVID-19 vaccines. For instance, one participant commented that "Those shots are to hurt people and COVID-19 isn't even a real disease!" while another participant claimed that "We now know we have been lied to about the vaccines, and that they are not as safe, or effective as they claim to be." These comments show that pro-vaccine persuasive messages might not be effective for people with strong initial misperceptions. One participant noted that "the word bivalent makes it hard to understand as I'm not familiar with the word." To address this, the main studies will provide additional background information about bivalent boosters.

Belief in COVID-19 Vaccine Misinformation

Participants reported moderate to high levels of beliefs in COVID-19 vaccine misinformation. Nearly half of participants believed that COVID-19 vaccines are not effective at all (48.8%), including 19.5% who believed this statement is definitely true. Additionally, over half of participants believed that COVID-19 vaccines cannot protect against COVID-19 variants at all (56.1%), vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID-19 (59.7%), and natural immunity provides better protection than vaccine-induced immunity to Covid-19 (59.3%). The prevalence of beliefs in COVID-19 vaccine misinformation is reported in Table 2.

To assess the dimensionality of the scale, an exploratory factor analysis was conducted using principal axis factoring. The results indicated that the four items loaded on one factor (eigenvalue = 3.26, explained variance = 81.51%), suggesting that the four items measured the same underlying construct. Since one purpose of study 1 is to examine whether the inoculation effects differ among initially uninformed, informed, and misinformed individuals, participants' beliefs in COVID-19 vaccine misinformation needed to be assessed in both the pre-test and post-test. However, using the same scale in both tests may introduce a testing effect, which could threaten the experiment's internal validity (Campbell & Stanley, 1967). This is because participants may become familiar with the questions after completing pre-test, which can affect their memory and performance on the post-test, and potentially confound the treatment effect (Campbell & Stanley, 1967).

To avoid the potential impact of repeated testing effects on the validity of the experiment, scholars have recommended using alternative measures in the pre-test and post-test (Shadish et al., 2001). This approach has been employed in previous studies (e.g., Greitemeyer, 2023). To

implement this recommendation, one item from the four-item scale, "COVID-19 vaccines are not effective at all," will be used as a pre-test item in the main study to assess participants' initial beliefs in COVID-19 vaccine misinformation. The remaining three items will be averaged to create an index used in the post-test to assess participants' beliefs in COVID-19 vaccine misinformation after exposure to the treatment. The three-item scale also demonstrated strong reliability (α = .90, M = 3.43, SD = 1.24) in the pilot test, and the principal axis factor analysis indicated that the three items loaded onto one factor (eigenvalue = 2.513, explained variance = 83.77%).

Discussion

The purpose of the pilot study is to prepare the message stimuli for the main studies. Results indicated that the message stimuli were easy to comprehend. However, about 6.1% to 15% participants incorrectly recalled the content or the source of the manipulation, suggesting that some participants may not have paid careful attention to the stimuli. To address this, several measures will be implemented in the main studies. First, eligibility requirements for participants in the main studies will be increased to from 50 previously approved tasks with a 95% approval rate to 100 previously approved tasks with a 98% approval rate. Moreover, in the main studies participants will be required to spend at least one minute on the stimuli page before moving to the post-test questions. Furthermore, the main studies will provide additional background information about the bivalent booster to enhance participants' understanding of the context.

Results also showed significant differences in trust among Republicans and Democrats for four partisan sources (MSNBC, FOX, Republicans, Democrats). Specifically, Republicans demonstrated greater trust in information about COVID-19 from FOX and Republican sources, while expressing weaker trust in information from MSNBC and Democrat sources when

compared to Democrats. Therefore, in the main studies, FOX and Republican sources will be used as in-group sources for Republicans, and MSNBC and Democrat sources will be used as in-group sources for Democrats in Study 2.

Participants in the pilot study showed moderate to high levels of belief in COVID-19 vaccine misinformation, highlighting the need for addressing COVID-19 vaccine misinformation even in the post-pandemic stage. A four-item scale was developed to measure beliefs in COVID-19 vaccine misinformation, which demonstrated strong reliability and loaded onto one factor in principal axis factor analysis. To avoid the threat of testing effect on the internal validity of the treatment, scholars have suggested using alternative measures in the pre-test and post-test (Shadish et al., 2001). Therefore, one item from the four-item scale, "COVID-19 vaccines are not effective at all," was used as a pre-test item in the main study to assess participants' initial beliefs in COVID-19 vaccine misinformation, and the remaining three items in the scale will be averaged to form an index for beliefs in COVID-19 vaccine misinformation to assess participants' post-treatment misperceptions.

Chapter 6: Study 1

The primary objective of study 1 is to investigate the effectiveness and mechanisms of inoculation message in conferring resistance to COVID-19 vaccine misinformation. The study has three main objectives. First, this study aims to examine whether exposure to an inoculation message can mitigate the impact of misinformation, as compared to a no-message control (H1). Second, this study seeks to examine the mechanisms underlying inoculation message effects (H2-H5). Finally, this study aims to explore whether the effectiveness (RQ1) and mechanisms (RQ2) of inoculation message effects differ among individuals who are initially misinformed, uninformed, and informed. Figure 1 provides a conceptual map of the study.

Method

Procedure

An online experiment was conducted using a between-subjects design with two conditions: inoculation and no-message control. Participants were recruited on January 6, 2023, from Amazon's Mechanical Turk (MTurk), an online labor system run by Amazon.com. Although M-Turk samples tend to overrepresent younger, White, and male participants in the United States (Nadler et al., 2021), they are often used in social scientific research because they are considered more representative of an average adult sample than college student samples (Burnham et al., 2018). Eligible participants were MTurk workers who were 18 years or older, currently living in the United States, and had previously completed at least 100 tasks on MTurk with a task approval rate of over 98%. Qualified participants who agreed to participate were offered $1 for completing the 10-minute study.

The experiment was conducted in three steps. First, all the participants received background information about the bivalent COVID-19 booster and answered questions about their initial beliefs in misinformation about COVID-19 vaccines.

Next, all participants were randomly assigned to either the control or the inoculation condition. In the *control* condition, participants did not receive any message. In the *inoculation* condition, participants were presented with an inoculation message in a form of public service announcement (PSA) poster, which is attributed to CDC. The inoculation message began with a forewarning paragraph stating that there is misinformation stating that COVID-19 vaccines are ineffective at protecting against COVID-19 variants at all and that getting immunity naturally is safer than getting it from a vaccine. The remaining paragraphs in the inoculation message refuted the misinformation statement by providing scientific evidence. The myth represents a common misperception about COVID-19 vaccines (CDC, 2023b; Spencer, 2022), and the refuting arguments were selected from websites from CDC (CDC, 2021). Participants assigned to the inoculation condition were instructed to spend at least one minute on the stimuli page, after which they were asked to answer questions about their perceptions of the inoculation message.

Finally, all participants were presented with a misinformation message about COVID-19 vaccines. The message was simulated as a post from a Reddit forum and contained five comments stating that COVID-19 vaccines are not effective. To increase the ecological validity of the study and uphold ethical considerations, comments in the misinformation message was adopted from real-world messages that circulate on Reddit. Usernames in the post were created by the researcher. Participants were required to spend at least one minute reading the misinformation messages before the continue button would appear. After reading the misinformation message, participants answered post-test questions, including questions on

counterarguing against the misinformation message, perceived ease of counterarguing, anger, post-test beliefs in misinformation about COVID-19 vaccines, COVID-19 vaccination attitudes and intentions, COVID-19 vaccination recommendations, and demographic questions. At the end of the survey, participants were informed of the study's purpose, explained that the comments in the Reddit post were misinformation, and provided with hyperlinks to more scientific information about COVID-19 vaccine effectiveness.

Participants

A power analysis was conducted using G-Power (Faul et al., 2009), based on a Cohen's d effect size of 0.43, which was drawn from a previous meta-analysis on inoculation message effects (Banas & Rains, 2010). The analysis showed that a sample size of 172 is needed to achieve a statistical power of 0.8 at an alpha level of 0.05 when detecting the main effect of inoculation message. A total of 701 eligible participants participated in study 1. Responses that were incomplete (n = 17) or failed the message recall check (n = 25) were removed from analysis. Therefore, the final sample consisted of 659 responses.

Participants reported an average age of 40.03 (SD = 14.22). Of the participants, 59.2% were male (n = 390), 40.8% were female (n = 269), and no participants identified as another gender. In terms of ethnicity, 17.8% of participants (n = 117) identified as Hispanic, Latino, or Spanish, while 82.2% (n = 542) did not. Most participants self-identified as White (89.7%, n = 591), followed by Asian (4.6%, n = 30), Black or African American (3.8%, n = 25), other races (0.9%, n = 6), American Indian or Alaska Native (0.8%, n = 5), and multi-racial background (0.3%, n = 2), with no participants identified as Native Hawaiian or Pacific Islander. In terms of education level, 0.3% of participants (n = 2) had less than a high school education, 8.5% (n = 56) had a high school education, 12.7% (n = 84) had some college, 63.7% (n = 420) were college

graduates, and 14.7% (*n* = 97) were postgraduates. For annual household income, 1.4% of participants (*n* = 9) reported an income of $0-$9,999, 3.8% of participants (*n* = 25) reported an income of $10,000 to $14,999, 3.8% of participants (*n* = 25) reported $15,000-$19,999, 13.5% participants (*n* = 89) reported $20,000-$34,999, 33.7% participants (*n* = 222) reported $35,000-$49,999, 26.1% participants (*n* = 172) reported $50,000 to $74,999, 13.1% participants (*n* = 86) reported $75,000-$99,999, 4.2% participants (*n* = 28) reported $100,000-$199,999, and 0.5% participants (*n* = 3) reported $200,000 or more. In terms of political affiliation, 29.4% of participants identified as Republicans (*n* = 194), 55.4% identified as Democrats (*n* = 365), 14.9% identified as Independents (*n* = 98), and 0.3% identified as other party affiliation (*n* = 2).

Compared to the 2021 US Census data, participants in this study were slightly younger (median age = 37 vs. 38.8), had a lower proportion of female participants (40.8% vs. 50.5%), a higher proportion of white participants (89.7% vs. 61.2%), and a slightly lower proportion of Hispanic, Latino, or Spanish participants (17.8% vs. 18.8%). The sample was more educated (91.2% vs. 53.5% had some college or higher) and reported lower annual household income (43.9% vs. 63.6% had an annual household income of $50,000 or more) (United States Census Bureau, 2022). Additionally, the sample consisted of fewer Republicans (29.4% vs. 43%) and slightly more Democrats (55.4% vs. 46%) compared to the general American public (Jones, 2022). Table 3 provides a summary of the sample characteristics.

Measurement

Manipulation Check

Message Recall. Study 1 sets out to examine the effects of message variations (inoculation vs. no-message control) on persuasive outcomes. As the differences in message variations were not contingent on participant perceptions, a manipulation check was not needed

(O'Keefe, 2003). Nonetheless, to confirm that participants accurately comprehend the stimuli, two questions regarding the content of the messages were included in the survey. First, after being exposed to the inoculation message, participants were asked to choose one option that best fits with the message content: 1) "the message suggests that COVID-19 vaccines are effective;" or 2) "the message suggests that COVID-19 vaccines are not effective." Similarly, after being exposed to the misinformation message, participants were asked to choose one option that best fits with the message content: 1) "comment on the Reddit post suggests that COVID-19 vaccines are effective;" or 2) "comment on the Reddit post suggests that COVID-19 vaccines are not effective."

Moderator

Initial Beliefs in COVID-19 Vaccine Misinformation. To assess participants' initial misperceptions about COVID-19 vaccines, a single item was used based on the findings from the pilot test. Participants rated their perception of the claim "COVID-19 vaccines are not effective at all" on a five-point scale (1 = *Definitely false*, 2 = *Probably false*, 3 = *I don't know*, 4 = *Probably true*, 5 = *Definitely true*). Participants who chose "definitely false" or "probably false" were coded as *informed individuals*. Participants who chose "I don't know" were coded as *uninformed individuals*. Participants who chose "definitely true" or "probably true" were coded as *misinformed individuals*. This coding procedure is consistent with previous studies (e.g., Ivanov et al., 2017; Vraga & Bode, 2017; M. L. M. Wood, 2007) that group participants into three categories based on their initial misperceptions. The final sample included 44% informed individuals (n = 290), 10.93% uninformed individuals (n = 72), and 45.07% misinformed individuals (n = 297).

Mediators

Counterarguing. Counterarguing against misinformation was measured using a quantitative self-assessment item adopted from Richards and Banas (2018). Participants were asked to select the option that best reflected how they responded in their mind to the arguments presented in the Reddit post (i.e., the misinformation attack) on a seven-point scale (I thought of: 1 = A *lot of* arguments *support* those viewpoints; 2 = *Several* arguments *support* those viewpoints; 3 = At *least one* argument *supports* those viewpoints; 4 = Arguments *both for and against* those viewpoints; 5 = *At least one* argument *against* those viewpoints; 6 = *Several* arguments *against* those viewpoints; 7 = A *lot of* arguments *against* those viewpoints). This measure has been increasingly adopted by inoculation research (e.g., Barbati et al., 2021; R. Li, 2021; Niederdeppe et al., 2015; Parker et al., 2016, 2020). Participants reported moderate to high levels of counterarguing against the misinformation attack (M = 4.33, SD = 1.76).

Perceived Ease of Counterarguing. To assess participants' perceived ease of counterarguing against the misinformation, two items adapted from Tormala and Petty (2004) were used: 1) "overall, how easy/difficult was it for you to come up with arguments that refute the viewpoints in the Reddit post?" and 2) "overall, how easy/difficult was it for you to come up with arguments that support the viewpoints in the Reddit post? (Reverse coded)" Participants rated the items on a seven-point scale (1 = *Very difficult*, 7= *Very easy*). The two items were averaged to form an index for perceived ease of counterarguing against misinformation ($Spearman\text{-}Brown$ = .98, M = 5.22, SD = 1.44). Results from the principal axis factor analysis suggested that the two items loaded on one factor (eigenvalue = 1.73, explained variance = 86.54%).

Anger. Four items adopted from Dillard and Shen (2005) measured anger on a seven-point scale (1 = *None of this feeling*, 7 = *A great deal of this feeling*): "While viewing the Reddit

post, to what extent do you feel: 1) irritated, 2) angry, 3) annoyed, 4) aggravated?" The four items were averaged to form an index for anger toward the misinformation message (α = .94, *M* = 4.42, *SD* = 1.72). Results from the principal axis factor analysis suggested that the four items loaded on one factor (eigenvalue = 3.42, explained variance = 85.38%).

Outcome Variables

Beliefs in COVID-19 Vaccine Misinformation. Participants rated their perceptions about three claims on a five-point Likert scale (1 = *Definitely false*, 2 = *Probably false*, 3 = *I don't know*, 4 = *Probably true*, 5 = *Definitely true*): 1) COVID-19 vaccines cannot protect against COVID-19 variants at all; 2) vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID; 3) Natural immunity provides better protection than vaccine-induced immunity to Covid-19. These statements have been identified by authoritative health organizations as false and represent common misperceptions about COVID-19 vaccines (CDC, 2021a, 2022b, 2023b). The similar five-point scale has been used in other studies on misinformation (Furnham & Hughes, 2014; Hall Jamieson & Albarracín, 2020), with higher scores indicating stronger beliefs in misinformation. The scale demonstrated good reliability (α = .84, *M* = 3.20, *SD* = 1.11). Results from the principal axis factor analysis suggested that the three items loaded on one factor (eigenvalue = 2.27, explained variance = 75.65%). Different scales were used in the pre-test and post-test to assess participants' beliefs in COVID-19 vaccine misinformation, which helps to minimize the potential impact of repeated testing effects on the experiment's validity (Shadish et al., 2001),

Attitude toward COVID-19 Vaccination. Participants answered four semantic differential items on a seven-point scale adapted from Guidry et al. (2021): "Getting a COVID-19 vaccine is: 1) *Foolish-Wise*, 2) *Harmful-Beneficial*, 3) *Worthless-Valuable*, and 4) *Bad-*

Good." The scale demonstrated strong reliability (α = .90, *M* = 5.63, *SD* = 1.21). Results from the principal axis factor analysis suggested that the four items loaded on one factor (eigenvalue = 3.11, explained variance = 77.77%).

COVID-19 Vaccination Intention for Self. Participants were first asked to report their COVID-19 vaccination status by choosing one of four options: 1) "I am fully vaccinated and have received the updated bivalent booster;" 2) "I am fully vaccinated and have received the original booster;" 3) "I have received at least one dose of vaccine but have not received any booster shot;" or 4) "I have not received any COVID-19 vaccine." Of the participants, 51% (n = 336) reported being fully vaccinated and had received the updated bivalent booster, 42.7% (n = 281) had not received the updated bivalent booster (31.9% received the original booster and 10.8% did not receive any booster), and 6.4% (n = 42) had not received any COVID-19 vaccine.

Next, participants indicated their future COVID-19 vaccination intentions. Specifically, those who were fully vaccinated and had received the updated bivalent booster were asked, "How likely would you take another booster shot of COVID-19 vaccine when it is recommended to you?" Participants who received the original booster or no booster shot were asked, "How likely would you take an updated booster shot of COVID-19 vaccine when you are eligible?" Participants who had not received any dose of COVID-19 vaccine were asked, "How likely would you take a COVID-19 vaccine?" Participants rated the item on a seven-point scale (1 = *Very unlikely*, 7= *Very likely*). These responses were combined into one item to indicate participants' future COVID-19 vaccination intention, with higher scores indicating stronger vaccination intentions (*M* = 5.24, *SD* = 1.51).

COVID-19 Vaccination Intention for Child. Participants' intention to vaccinate their child against COVID-19 was assessed with the following item asking: "If you have a child (or

imagine that you have a child) who is eligible to a COVID-19 bivalent booster, how likely would you have your child take a COVID-19 bivalent booster?" Responses were indicated on an eight-point scale (1 = *Very unlikely,* 7= *Very likely,* 8 = *Not applicable, my child has already taken the COVID-19 bivalent booster*). A total of 2.3% participants (*n* = 15) chose "8" and indicated that their child has already taken the COVID-19 bivalent booster, and those responses were recoded as "7" for analysis. Therefore, the recoded scale was a seven-point Likert scale, with higher scores indicating stronger intentions to vaccinate one's child against COVID-19 (*M* = 5.36, *SD* = 1.51).

COVID-19 Vaccination Recommendation. Participants indicated their intentions to recommend COVID-19 vaccines to hesitant others on a seven-point scale (1 = *Very unlikely*, 7= *Very likely*) with three items: "How likely would you recommend COVID-19 vaccination 1) to your family, friends, or colleague who are hesitant about getting a COVID-19 vaccine? 2) to parents who are hesitant about getting their children vaccinated against COVID-19? 3) to a stranger online who asks about whether it is necessary to get a COVID-19 vaccine?" The three items were averaged to form an index for COVID-19 vaccine recommendation (α = .89, *M* = 5.13, *SD* = 1.36). Results from the principal axis factor analysis suggested that the three items loaded on one factor (eigenvalue = 2.47, explained variance = 82.44%).

Control Variables

Demographic Variables. Demographic variables were included as covariates, including age, sex (male, female, other), ethnicity (Hispanic, non-Hispanic), race (White, Black or African American, Asian, Native Hawaiian or Pacific Islander, two or more races, other), education (less than high school, high school graduate, some college, college graduate, post-graduate), income ($0-$9,999, $10,000 to $14,999, $15,000-$19,999, $20,000-$34,999, $35,000-$49,999, $50,000

to $74,999, $75,000-$99,999, $100,000-$199,999, $200,000 or more), and political party affiliation (Republican, Independent, Democrat, other).

Age, education, and income were analyzed as continuous variables. Since no participants identified as "other" sex, sex was coded as female (vs. male). Ethnicity was coded as Hispanic (vs. non-Hispanic), with "Hispanic" representing participants who are of Hispanic, Latino, or Spanish origin, and "non-Hispanic" representing people who are not of Hispanic, Latino, or Spanish origin. Race was recoded as White (vs. other), with the "other" category representing all other racial backgrounds other than White. Political party affiliation was dummy coded into two categorical variables, including Democrat (vs. Republican) and other (vs. Republican). Specifically, the "other" category includes independents and people who identified as neither Democrats, Republicans, nor independents.

Analytical Approach

Randomization Check. To check the success of randomization, I examined whether there were any significant differences between the treatment group and the control group in terms of sample characteristics. I used the chi-square test to examine categorical outcomes and the independent sample t-test to examine continuous outcomes. Results showed no significant differences between the two groups in terms of age ($t(657) = -.70$, $p = .48$), sex ($x(1)^2 = .04$, $p = .87$), ethnicity ($x(1)^2 = .81$, $p = .42$), race ($x(5)^2 = 5.14$, $p = .40$), education ($t(657) = -.16$, $p = .88$), income ($t(657) = .50$, $p = .62$), political party affiliation ($x(3)^2 = 4.24$, $p = .24$), and groups of initial misperception ($x(2)^2 = .59$, $p = .74$). Additionally, the two groups were comparable in size (inoculation group: $n = 330$; control group: $n = 329$). These results suggest that the randomization process was successful, and any subsequent difference between the treatment and control groups on the post-test questions can be attributed to the treatment effect.

Manipulation Check. According to O'Keefe (2003), when examining the impact of message variations on persuasive outcomes, a manipulation check is unnecessary as the differences of message variations are not dependent on participant perceptions. Consistent with previous studies on inoculation message effects (e.g., Biddlestone et al., 2023; Cook et al., 2017; Schmid-Petri & Bürger, 2022), this study does not include a manipulation check of participants' perceptions of the variation between an inoculation message and a no-message control.

Instead, this study utilized participants' reflection on the message content as a form of manipulation check, which has also been used in previous studies (e.g., Lee, 2019; Mayrhofer et al., 2020). Results indicated that 2.73% of participants incorrectly recalled the inoculation message as suggesting that COVID-19 vaccines are not effective, while 2.43% incorrectly reported that the misinformation message stated that COVID-19 vaccines are effective. These rates of incorrect responses are lower than those found in previous studies with M-Turk participants. For example, Lee (2019) found 7% to 12.6% participants did not correctly recall the content of experimental stimuli. These incorrect responses may be due to participants' lack of attention to the stimuli and therefore were removed from final analysis.

Statistical Analysis. First, I conducted a series of regression analyses to examine the main effects of inoculation message (vs. control) on the five persuasive outcomes (H1) and three mediators (H2-H4). Second, I conducted a series of mediation analyses via PROCESS Model 4 (Hayes, 2017) to examine the mechanisms underlying inoculation message effects on the five persuasive outcomes (H5). Third, five moderation models were performed via PROCESS Model 1 (Hayes, 2017) to examine whether the effects of inoculation message (vs. control) on the five dependent variables differs among initially informed, uninformed, and misinformed participants (RQ1). The moderator was dummy coded into two categorical variables (uninformed vs.

informed; misinformed vs. informed). Finally, a series of moderated mediation models were performed via PROCESS Model 8 (Hayes, 2017) to examine the conditional indirect effects of inoculation messages on the five dependent variables based on participants' initial misperceptions about COVID-19 vaccines (RQ2). Similarly, the moderator was dummy coded into two categorical variables (uninformed vs. informed; misinformed vs. informed). Demographic variables were included as control variables in each model.

The regression analyses were performed using R Studio by the dplyr package (Wickham et al., 2023). Model assumptions were checked before performing the analyses. The regression models fulfilled the assumptions of linearity, homoscedasticity, normality, and independence. Moderation, mediation and moderated mediation analyses were constructed using PROCESS models via SPSS. PROCESS is a regression-based path analysis modeling tool that has been widely used in social sciences for estimating direct, indirect, and conditional effects (Hayes, 2017). In this study, PROCESS models were constructed based on 5,000 bootstrap samples. Correlations among key variables are reported in Table 4. Observed mean and standard deviations of the treatment groups and control group on key variables are reported in Table 5.

Results

Main Effects of Inoculation Message (H1)

The first hypothesis predicted that exposure to an inoculation message (vs. a no-message control) will confer resistance to misinformation, as indicated by weaker beliefs in COVID-19 misinformation (H1a), more favorable attitude toward COVID-19 vaccines (H1b), stronger intentions to vaccinate oneself (H1c) and one's child (H1d) against COVID-19, and stronger intentions to recommend COVID-19 vaccines to others (H1e). Five regression analyses were constructed. The demographic variables and the experimental treatment as a whole explained

about 4.1% to 7.9% of the variance in the five dependent variables. Inoculation alone explained about 0.6% to 2% of the variance in the five dependent variables. Results are summarized in Table 6 and Figure 2.

Beliefs in COVID-19 Misinformation. Results indicated that exposure to an inoculation message significantly lowered participants' beliefs in COVID-19 vaccine misinformation, compared to the no-message control group (b = -.31, SE = .08, p < .001). Specifically, the inoculation group reported moderate beliefs in COVID-19 vaccine misinformation (M = 3.06, SD = 1.07), while the control group reported moderate to high levels of beliefs in COVID-19 vaccine misinformation (M = 3.34, SD = 1.14). Therefore, H1a was supported.

Attitude toward COVID-19 Vaccines. Inoculation (vs. control) was a significant positive predictor of participants' attitudes toward COVID-19 vaccines (b = .20, SE = .09, p = .03). Specifically, participants in the inoculation message group (M = 5.72, SD = 1.09) expressed more favorable attitudes toward COVID-19 vaccines compared to the no-message control group (M = 5.53, SD = 1.32). Therefore, H1b was supported.

COVID-19 Vaccination Intention for Self. Exposure to an inoculation message (vs. a no-message control) led to stronger intentions to get oneself vaccinated against COVID-19 (b = .26, SE = .12, p = .03). Both groups expressed moderate to high levels of COVID-19 vaccination intention (Inoculation: M = 5.35, SD = 1.41; Control: M = 5.12, SD = 1.59). H1c was supported.

COVID-19 Vaccination Intention for Child. Exposure to an inoculation message (vs. no-message control) led to stronger intention to have one's child vaccinated against COVID-19 (b = .26, SE = .12, p = .03). Both groups reported moderate to high levels of intentions to get

their child vaccinated against COVID-19 (Inoculation: $M = 5.48$, $SD = 1.45$; Control: $M = 5.24$, $SD = 1.56$). H1d was supported.

COVID-19 Vaccination Recommendation. Inoculation (vs. control) significantly predicted participants' COVID-19 vaccination recommendation intentions ($b = .21$, $SE = .10$, $p = .04$). Specifically, inoculated participants expressed stronger intentions to recommend COVID-19 vaccines to hesitant others ($M = 5.24$, $SD = 1.28$) compared to those in the control group $M = 5.01$, $SD = 1.42$). Therefore, H1e was supported.

Covariates. Additionally, results indicated that older people expressed stronger beliefs in COVID-19 vaccine misinformation ($b = .01$, $SE = .003$, $p = .04$). Participants who identified as Hispanic, Latino, and/or Spanish origin reported stronger beliefs in COVID-19 vaccine misinformation ($b = .69$, $SE = .12$, $p < .001$), but also expressed more favorable attitudes toward COVID-19 vaccines ($b = .34$, $SE = .13$, $p = .01$) and stronger intentions to recommend COVID-19 vaccination to others ($b = .64$, $SE = .15$, $p < .001$) compared to non-Hispanic participants. White participants expressed greater beliefs in COVID-19 vaccine misinformation than individuals with other racial backgrounds ($b = .50$, $SE = .14$, $p < .001$). Participants with higher education levels reported more favorable attitudes toward COVID-19 vaccines ($b = .14$, $SE = .06$, $p = .02$), were more likely to get a COVID-19 vaccine for themselves ($b = .26$, $SE = .12$, $p = .03$) and their child ($b = .18$, $SE = .08$, $p = .03$), and were more likely to recommend COVID-19 vaccine to hesitant others ($b = .15$, $SE = .07$, $p = .04$). Finally, individuals who identified as independent or with other political party affiliations held lower beliefs in COVID-19 vaccine misinformation compared to Republican ($b = -.27$, $SE = .13$, $p = .04$).

Mechanisms of Inoculation Message Effects (H2-H5)

The second through fifth hypotheses predicted that inoculated individuals would engage in greater counterarguing against misinformation (H2), perceived counterarguing against misinformation as easier (H3), and feel greater anger towards misinformation (H4) compared to uninoculated individuals. Moreover, counterarguing (H5a), perceived ease of counterarguing (H5b), and anger (H5c) will mediate the influence of inoculation message (vs. control) on each of the five dependent variables. Results from regression analyses indicated that the whole model explained a significant portion of variance in perceived ease of counterarguing (R^2 = 4%, p = .02) and anger (R^2 = 6.3%, p = .03), but did not significantly explain the variance in counterarguing (R^2 = 2%, p = .91). Inoculation itself significantly explained 0.9% of the variance in perceived ease of counterarguing and explained 0.8% of the variance in anger. Table 7 presents a summary of regression analysis results.

Counterarguing. After controlling for demographics, there was no significant difference between the inoculation group (M = 4.32, SD = 1.79) and the control group (M = 4.33, SD = 1.73) in terms of counterarguing against misinformation (b = -.04, SE = .14, p = .77). Therefore, H2 was not supported.

Perceived Ease of Counterarguing. Inoculation (vs. control) was a significant positive predictor of perceived ease of counterarguing against misinformation (b = .23, SE = .10, p = .02). Specifically, participants exposed to an inoculation message (M = 5.33, SD = 1.12) perceived greater ease of counterarguing against misinformation compared to the control group (M = 5.10, SD = 1.33). Therefore, H3 was supported.

Anger. Inoculation (vs. control) was a significant positive predictor of anger towards misinformation (b = .27, SE = .13, p = .04). Specifically, participants exposed to an inoculation

message (M = 4.57, SD = 1.66) expressed greater anger towards misinformation compared to the control group (M = 4.27, SD = 1.77). Therefore, H4 was supported.

Mediation Analyses. Five parallel mediation models were constructed to examine whether counterarguing, perceived ease of counterarguing, and anger mediated the effects of inoculation message (vs. control) on the five persuasive outcomes. Demographic variables were included as control variables. Results were analyzed based on PROCESS Model 4 with 5,000 bootstrap samples. Table 8 presents a summary of results of the mediation analyses.

Results indicated that counterarguing against misinformation was not a significant mediator in the relationship between inoculation message (vs. control) on any of the five outcomes, including beliefs in COVID-19 vaccine misinformation (b = -.002, 95% CI = [-.021, .013]), COVID-19 vaccination attitude (b = -.002, 95% CI = [-.019, .012]), COVID-19 vaccination intention for self (b = .001, 95% CI = [-.011, .009]), COVID-19 vaccination for child (b = -.001, 95% CI = [-.017, .011]), COVID-19 vaccination recommendation (b = -.004, 95% CI = [-.032, .019]). Therefore, H5a was not supported.

The indirect effects of inoculation message (vs. control) through perceived ease of counterarguing against misinformation on all five persuasive outcomes were significant, including beliefs in COVID-19 vaccine misinformation (b = -.039, 95% CI = [-.082, -.006], p < .05), COVID-19 vaccination attitude (b =.106, 95% CI = [.017, .203], p < .05), COVID-19 vaccination intention for self (b = .127, 95% CI = [.023, .243], p < .05) and for child (b = .122, 95% CI = [.027, .230], p < .05), and COVID-19 vaccination recommendation (b = .103, 95% CI = [.021, .200], p < .05). Therefore, H5b was supported.

Anger was a significant mediator in four of the five relationships. Specifically, anger significantly mediated the impact of inoculation message (vs. control) on COVID-19 vaccination

attitude (b = .024, 95% CI = [.001, .056], p < .05), COVID-19 vaccination intention for self (b = .032, 95% CI = [.001, .076], p < .05) and for child (b = .027, 95% CI = [.001, .066], p < .05), and COVID-19 vaccination recommendation (b = .053, 95% CI = [.003, .109], p < .05). However, anger was not a significant mediator between the impact of inoculation message (vs. control) on beliefs in COVID-19 vaccine misinformation (b = -.003, 95% CI = [-.022, .015]). Therefore, H5c was largely supported.

The Moderating Role of Individuals' Pre-Existing Beliefs in Misinformation (RQ1-RQ2)

The first research question asked whether the effects of inoculation message (vs. control) on the five dependent variables differ among initially misinformed, uninformed, and informed individuals. The second research question asked whether indirect effects of inoculation effects through counterarguing, perceived ease of counterarguing, and anger on the five dependent variables differ among initially misinformed, uninformed, and informed individuals.

Conditional Effects. To address the first research question, a series of moderation analyses were conducted using PROCESS Model 1. The moderator was dummy coded into two categorical variables: uninformed vs. informed individuals, and misinformed vs. informed individuals. Demographic variables were included as control variables. See Table 9 and Figure 3 for a summary of results.

Results of the highest order unconditional interaction tests indicated that the interaction terms as a whole did not significantly explain the variance in the five dependent variables (beliefs in COVID-19 vaccine misinformation: ΔR^2= 0.15%, p = .45; COVID-19 vaccination attitude: ΔR^2= 0.12%, p = .63; COVID-19 vaccination intention for self: ΔR^2= 0.08%, p = .77; COVID-19 vaccination for child: ΔR^2= 0.06%, p = .82; COVID-19 vaccination recommendation: ΔR^2= 0.15%, p = .59).

None of the interaction terms were significant, indicating that the effects of inoculation messages in conferring resistance to misinformation did not differ significantly among initially informed, uninformed, and misinformed individuals. Specifically, the experimental condition (inoculation vs. control) did not significantly interact with initially uninformed (vs. informed) groups in terms of the five dependent variables (beliefs in COVID-19 vaccine misinformation: b = .12, SE = .23, p = .61; COVID-19 vaccination attitude: b = .28, SE = .30, p = .35; COVID-19 vaccination intention for self: b = -.11, SE = .39, p = .78; COVID-19 vaccination intention for child: b = -.12, SE = .39, p = .76; COVID-19 vaccination recommendation: b = .12, SE = .35, p = .72). Similarly, the persuasive effects of inoculation message (vs. control) did not differ significantly between initially misinformation (vs. informed) groups (beliefs in COVID-19 vaccine misinformation: b = -.14, SE = .14, p = .34; COVID-19 vaccination attitude: b = .08, SE = .19, p = .65; COVID-19 vaccination intention for self: b = .13, SE = .24, p = .58; COVID-19 vaccination intention for child: b = .10, SE = .24, p = .67; COVID-19 vaccination recommendation: b = .23, SE = .22, p = .30).

Conditional Indirect effect. To examine whether the indirect effects of inoculation message (vs. control) differ among initially informed, uninformed, and misinformed publics, a series of moderated mediation analyses were conducted via PROCESS Model 8. Demographic variables were included as control variables. PROCESS used index of moderated mediation (IMM) to quantify the differences in indirect effects across the levels of the moderator (Hayes, 2015). See Table 10 and Figure 4 for a summary of results.

Results from moderated mediation analyses indicated that there were no significant differences in the conditional indirect effects among initially informed, uninformed, and misinformed publics. Specifically, the indirect effects of inoculation message (vs. control)

through the three mediators on beliefs in COVID-19 vaccine misinformation (Counterarguing: $IMM_{Counterarguing}$ = .005, IMM_{ease} = .029, IMM_{anger} = .009), COVID-19 vaccination attitude ($IMM_{Counterarguing}$ = .013; IMM_{ease} = -.114; IMM_{anger} = -.026), COVID-19 vaccination intention for self ($IMM_{Counterarguing}$ = .003; IMM_{ease} = -.140; IMM_{anger} = -.032) and for child ($IMM_{Counterarguing}$ = .008; IMM_{ease} = -.133; IMM_{anger} = -.027), and COVID-19 vaccination recommendation ($IMM_{Counterarguing}$ = .019; IMM_{ease} = -.115; IMM_{anger} = -.051) were not statistically significant among initially uninformed publics and informed individuals.

Similarly, none of the indirect effects were significantly different among misinformed and informed publics on the five persuasive outcomes, including beliefs in COVID-19 vaccine misinformation ($IMM_{Counterarguing}$ = -.007; IMM_{ease} = .011; IMM_{anger} = .008), COVID-19 vaccination attitude ($IMM_{Counterarguing}$ = -.021, IMM_{ease} = -.046; IMM_{anger} = -.025), COVID-19 vaccination intention for self ($IMM_{Counterarguing}$ = -.005; IMM_{ease} = -.056; IMM_{anger} = -.031) and for child ($IMM_{Counterarguing}$ = -.012; IMM_{ease} = -.053; IMM_{anger} = -.025), and COVID-19 vaccination recommendation ($IMM_{Counterarguing}$ = -.030; IMM_{ease} = -.046 IMM_{anger} = -.049)

Summary of Findings

In summary, results of study 1 indicated that inoculation message was effective in conferring resistance to misinformation about the COVID-19 vaccines. Participants who received the inoculation message before being exposed to misinformation about the COVID-19 vaccine expressed lower beliefs in COVID-19 vaccine misinformation, more favorable attitudes toward COVID-19 vaccination, stronger intentions to vaccinate themselves and their child, and stronger intentions to recommend COVID-19 vaccines to hesitant others compared to those who received no message.

The impact of the inoculation message (vs. control) on all five dependent outcomes were mediated by perceived ease of counterarguing. Anger significantly mediated the impact of the inoculation message (vs. control) on four outcomes, including COVID-19 vaccination attitude, COVID-19 vaccination intentions for self and for child, and COVID-19 recommendation intention. However, it did not significantly mediate the impact of inoculation message (vs. control) on beliefs in COVID-19 vaccine misinformation. Counterarguing was not a significant mediator.

Moreover, participants' initial misperception status – whether informed, uninformed, or misinformed – did not significantly moderate the direct or indirect effects of inoculation messages on the five persuasive outcomes. These findings suggest that the efficacy and mechanisms of inoculation messages in conferring resistance to misinformation do not differ significantly among initially informed, uninformed, and misinformed publics.

Discussion

Study 1 sets out to investigate the effectiveness and mechanisms of inoculation message in conferring resistance to COVID-19 vaccine misinformation. Through a two-condition (inoculation vs. control) between-subject experiment, this study examines whether exposure to an inoculation message can mitigate the impact of misinformation on individuals' beliefs, attitudes, and intentions toward COVID-19 vaccination. Additionally, this study extends inoculation theory by exploring the potential mediating role of perceived ease of counterarguing and anger. Finally, this study investigates whether the efficacy of inoculation message varies across initially informed, uninformed, and misinformed individuals.

First, results of study 1 indicate that exposure to an inoculation message significantly reduced individuals' susceptibility to COVID-19 vaccine misinformation, compared to a no-

message control condition. Participants who received an inoculation message prior to exposure to misinformation about COVID-19 vaccines reported lower beliefs in COVID-19 vaccine misinformation, more favorable attitudes toward COVID-19 vaccines, stronger intentions to vaccinate themselves and their children, and stronger intentions to recommend COVID-19 vaccines to hesitant others, compared to those who directly read the misinformation message. These findings are consistent with previous research, which suggests that exposure to inoculation messages can effectively reduce susceptibility to COVID-19 vaccine misinformation (Ramirez et al., 2022; Vivion et al., 2022). In fact, previous studies have shown that inoculation message can confer resistance to misinformation across a variety of issues, including climate change (Cook et al., 2017), gun control (Vraga et al., 2019), the COVID-19 pandemic (Bertolotti & Catellani, 2023), and organization reputation (Boman, 2023). Furthermore, a meta-analysis (Banas & Rains, 2010) suggested that inoculation messages, in general, conferred more resistance to persuasion than no-message control and supportive messages. Taken together, these findings, along with the current study, highlight the potential of inoculation messages to counteract the detrimental impact of misinformation.

How do inoculation messages help people resist misinformation? The conventional model of inoculation theory suggests that inoculation messages bolster resistance to persuasion by enhancing individuals' ability to generate counterarguments (Banas, 2020; Compton, 2013; Pfau & Burgoon, 1988). However, this study did not find a significant mediating role of counterarguing in the relationship between inoculation message exposure and the five persuasive outcomes. People exposed to the inoculation message reported similar levels of counterarguing against misinformation as those who did not receive the inoculation message. This finding suggests that exposure to an inoculation message against COVID-19 vaccine misinformation did

not improve individuals' ability to generate more counterarguments when encountering the misinformation message. Although this finding contradicts the proposition of inoculation theory, it is consistent with some previous studies. For example, Papageorgis and McGuire 's (1961) early study on the effect of inoculation messages in protecting people's attitudes about health prevention behaviors found that inoculated individuals generated a similar number of counterarguments against persuasive messages that discouraged health prevention behaviors compared to those who did not receive the inoculation message. In another study about protecting people's attitude about agricultural biotechnology, M. L. M. Wood (2007) found that exposure to an inoculation message enhanced counterarguing output among individuals with initially supportive and neutral attitudes, but the difference did not reach statistical significance at the traditional threshold of 0.05. Similarly, Ivanov et al. (2022) found that while inoculation message can effectively change attitudes among individuals with initially neutral or opposed attitudes toward the position advocated in the message, they did not significantly increase counterarguing among these audiences.

The inconsistent findings regarding the role of counterarguing in inoculation message effects could be attributed to varying issue contexts, target audiences, and methods of measuring counterarguing. For example, most early inoculation studies focused on cultural truisms (i.e., widely accepted beliefs that people shared without question) (Compton, 2013). Whether exposure to inoculation messages can boost counterarguing in contentious issues where people have varying pre-existing beliefs remains understudied. Furthermore, studies have employed different approaches to measure counterarguing, which may impact the results. For instance, the thought-listing technique (Brock, 1967) requires more cognitive effort, while self-reported scales (Miller et al., 2013) demand less cognitive effort. Participants may exert more cognitive effort in

generating counterarguments when a thought-listing technique is used to measure counterarguing. In contrast, they might be less engaged in counterarguing when simply asked to rate the extent of counterarguments generated. Another crucial factor to consider is that this study was conducted in the post-pandemic stage, when the public may feel fatigued by COVID-19 messaging. Research has shown that message fatigue is linked to heuristic processing (Hwang et al., 2022). Therefore, it is possible that the message fatigue people experienced in the context of COVID-19 vaccine messaging made them less willing to engage in counterarguing, which relies on extensive thinking.

An increasing number of studies have called for exploring alternative mechanisms underlying inoculation message effects (Banas, 2020; Compton & Pfau, 2005; Pfau et al., 2003). In response to this call, the current study expands the conventional model of inoculation theory by examining the potential mediating role of two mediators: perceived ease of counterarguing, which reflects individuals' metacognitive experiences in generating counterarguments, and anger, which represents affective resistance. Results suggest that perceived ease of counterarguing against misinformation significantly mediated the impact of inoculation message (vs. control) on all five persuasive outcomes. Specifically, exposure to an inoculation message made people feel it was easier to counterargue against misinformation about COVID-19 vaccines, which further led to lower misperceptions, more favorable attitudes toward COVID-19 vaccines, and greater intentions to get vaccinated, vaccinate one's child, and recommend COVID-19 vaccines to others. These findings align with the feelings-as-information theory (Schwarz, 2012), which emphasizes the critical role of subjective experiences in judgment. When people feel it is easy to generate counterarguments against a position, they tend to assume that many counterarguments exist and the position is worth questioning (Schwarz et al., 1991).

The experience of ease in generating (counter)arguments also leads to increased thought confidence and subsequently produces stronger thought-congruent attitudes (Tormala et al., 2002). The significant mediating role of perceived ease of counterarguing suggests that the efficacy of inoculation messages in conferring resistance to misinformation can, at least in part, be attributed to making people feel that they can easily refute misinformation.

Anger significantly mediated the impact of exposure to inoculation message on four of out of five persuasive outcomes. Compared to the control group, exposure to an inoculation message elicited greater levels of anger against misinformation, which further led to more favorable attitudes toward COVID-19 vaccines, stronger intentions to vaccinate oneself and one's child, and stronger intentions to recommend COVID-19 vaccines to others. These findings are consistent with previous studies, which suggest that inoculation message elicits anger against the attack message (Iles et al., 2021; Ivanov et al., 2020; Pfau et al., 2009) and that anger against a persuasive message leads to greater resistance to persuasion (Featherstone & Zhang, 2020; Pfau et al., 2001).

However, anger did not mediate the impact of inoculation message (vs. control) on beliefs in COVID-19 vaccine misinformation. A possible reason is that affect may play a more important role in influencing attitudes and intentions than changing beliefs, which relies more on cognitive processes (Baron, 2000). While inoculated individuals may experience anger toward misinformation, it may not necessarily lead to a change in beliefs in specific misinformation statements. Nevertheless, it should be noted that the current study measures beliefs in claims about vaccine effectiveness. Anger may play a more important role in influencing beliefs in other forms of misinformation, such as conspiracy theories, which are more emotionally laden (Van Prooijen et al., 2022). Moreover, the inoculation message in this experimental treatment is

cognitive inoculation. Scholars have categorized two types of inoculation appeals: affect-based appeals, which use anecdotes and affect-laden refutations, and cognitively-based appeals, which use rational, evidence-based arguments (Compton & Pfau, 2008; Lee, 1997). While cognitive inoculation confers resistance to persuasion mainly through threat and counterarguing, affective inoculation relies more on elicited emotional responses (Pfau et al., 2001). It is possible that affective inoculation might trigger higher levels of anger, which is strong enough to change misperceptions. Overall, these findings highlight the important role of anger underlying the effects of inoculation messages in reducing the impact of misinformation on people's attitudes and behavioral intentions. However, further studies are needed to determine whether anger elicited by inoculation messages can lower misperceptions.

Finally, results indicate that participants' initial beliefs in COVID-19 vaccine misinformation did not significantly moderate the direct or indirect effects of inoculation messages (vs. control) on the five persuasive outcomes. These findings suggest that exposure to an inoculation message can provide resistance to misinformation, regardless of whether the recipient was initially informed, uninformed, or misinformed. While early inoculation message scholarship focused on cultural truisms, recent research has theorized that inoculation message offers both prophylactic and therapeutic effects (Compton, 2020; Compton et al., 2021). Prophylactic inoculation prevents individuals with desired beliefs from being persuaded, while therapeutic inoculation works as a persuasive message, persuading individuals with undesired beliefs to change their beliefs toward the advocated position (Compton, 2020). Findings in this study, combined with previous research (Amazeen et al., 2022; Ivanov et al., 2017; M. L. M. Wood, 2007), provide empirical support for the therapeutic effect of inoculation message and

suggest that the efficacy of inoculation message in conferring resistance to persuasion can extend beyond the traditional scope of inoculation theory – cultural truisms.

In conclusion, the results of this study suggest that exposure to an inoculation message can effectively foster resistance to misinformation about COVID-19 vaccines. Inoculation message not only counteracts beliefs in misinformation but also protects positive attitude and intentions regarding COVID-19 vaccination. Why does it work? Its effectiveness can be attributed to the fact that the inoculation message makes recipients feel it is easier to refute misinformation and evokes greater levels of anger toward misinformation. Furthermore, the impact and mechanisms of inoculation messages remain consistent across individuals who are initially informed, uninformed, or misinformed, signifying that inoculation message possess both prophylactic and therapeutic effects.

Chapter 7: Study 2

The primary objective of study 2 is to investigate how partisan sources impact the effectiveness of inoculation messages in conferring resistance to misinformation among politically affiliated individuals. The study has three main objectives. First, this study seeks to examine whether inoculation becomes more effective when the inoculation message is attributed to an in-group (vs. out-group) partisan source, and when the misinformation comes from an out-group (vs.) in-group partisan source (H6-H8). Second, this study aims to investigate the mechanisms underlying the relative persuasiveness of in-group (vs. out-group) sources (RQ3, RQ4). Finally, this study aims to explore whether the impact of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation become stronger among individuals with stronger party identification (H9-11). Figure 5 provides a conceptual map of the study.

Method

Procedure

A 2 (in-group inoculation vs. out-group inoculation) X 2 (in-group misinformation vs. out-group misinformation) between-subject online experiment was conducted. Participants were recruited on January 25, 2023, from Prolific, an online crowdsourcing platform for research. Prolific has been frequently used in social experimental research and is recommended as an addition to MTurk (Palan & Schitter, 2018). Studies have found that participants from Prolific are more diverse and provide higher-quality data than those recruited through MTurk (Peer et al., 2017). As such, Prolific was employed for study 2 to obtain a more diverse participant pool, while also leveraging on its capacity to pre-screen participants based on their political party affiliations. Eligible participants were Prolific workers who were 18 years or older, currently living in the United States, and self-identified as either a Democrat or a Republican. To ensure

balanced representation, a quota was set to recruit equal numbers of Democrats and Republicans. Qualified participants who agreed to participate were offered $2 for completing the 10-minute study.

The experiment consisted of three steps. First, all participants received background information about the bivalent COVID-19 booster and answered pre-test questions about their trust in various partisan sources.

Next, participants were randomly assigned to read an inoculation message, which was presented as a tweet from either MSNBC or FOX. The inoculation tweet began with a forewarning paragraph stating that there is misinformation stating that COVID-19 vaccines are ineffective at protecting against COVID-19 variants at all and that getting immunity naturally is safer than getting it from a vaccine. In the MSNBC-inoculation message, the tweet contained two comments from MSNBC that refuted the misinformation statement by providing scientific evidence, including a quote from a Democrat official. In FOX-inoculation message, the tweet also contained two comments that refuted the misinformation, including a quote from a Republican official. The arguments in the inoculation messages were all sourced from health organization websites (CDC, 2021). The *in-group versus out-group* status is determined based on whether the participant's political identification aligned with the source. Based on findings from the pilot test, MSNBC is considered as an in-group source for Democrats and an out-group source for Republicans, while FOX is considered as an in-group source for Republicans and an out-group source for Democrats. To ensure that participants had sufficient exposure to the inoculation message, they were required to spend at least one minute reading the inoculation message before the continue button appeared.

Finally, participants were randomly assigned to read one misinformation message about COVID-19 vaccines, simulated as a tweet either from a Democrat or a Republican twitter user. The misinformation messages stated that COVID-19 vaccines are not effective in protecting against COVID-19. For Republicans, the misinformation tweeted by a Republican user is considered an in-group message, while it is considered an out-group message for Democrats. Conversely, for Democrats, the misinformation tweeted by a Democrat user is considered an in-group message, while it is considered an out-group message for Republicans. The content of the misinformation message was taken from actual messages circulating on social media. The name used as the source in the misinformation messages, "Hunter Wilson", was created by the researcher and has been validated as a gender-neutral name in previous research (S. C. Kim et al., 2021). Participants were required to spend at least one minute on the misinformation message before the continue button appeared. After reading the misinformation message, participants answered post-test questions, including questions on counterarguing against the misinformation message, perceived ease of counterarguing, anger, post-test beliefs in misinformation about COVID-19 vaccines, COVID-19 vaccination attitudes and intentions, COVID-19 vaccination recommendations, and demographic information. At the end of the survey, participants were informed of the study's purpose, explained that the second tweet represented misinformation, and provided with hyperlinks to more scientific information about COVID-19 vaccine effectiveness.

Participants

A power analysis was conducted using G-Power (Faul et al., 2009), based on a Cohen's d effect size of 0.63, which was derived from a previous meta-analysis on source manipulations in persuasion research (Wilson & Sherrell, 1993). The analysis indicated that a minimum sample size of 41 in each cell is required to achieve a statistical power of 0.8 at an alpha level of 0.05

when detecting the main effect of each source comparison. As this study has four cells, a sample size of 164 is necessary to detect the main effects of partisan source cues. A total of 451 eligible participants took part in study 2. Responses that failed to accurately recall the message source (*n* = 3) were removed from analysis. No responses were incomplete. Therefore, the final sample comprised 448 responses.

The participants' ages ranged from 18 to 77, with an average age of 40.41 years. Of the participants, 48.4% were male (*n* = 217), 50.7% were female (*n* = 227), and 0.9% identified as other gender (*n* = 4). Regarding ethnicity, 8.9% of participants (*n* = 40) identified as Hispanic, Latino, or Spanish, while 91.1% (*n* = 408) did not. The majority of participants self-identified as White (77.7%, *n* = 348), followed by Asian (10.3%, *n* = 46), Black or African American (6.7%, *n* = 30), multi-racial background (3.8%, *n* = 17), other races (0.9%, *n* = 4), American Indian or Alaska Native (0.7%, *n* = 3), and no participants identified as Native Hawaiian or Pacific Islander. In terms of education, 0.4% of participants (*n* = 2) had less than a high school education, 15.8% (*n* = 71) had a high school education, 25.9% (*n* = 116) had some college, 44.9% (*n* = 201) were college graduates, and 12.9% (*n* = 58) were postgraduates. For annual household income, 3.6% of participants (*n* = 16) reported an income of $0-$9,999, 4.7% of participants (*n* = 21) reported an income of $10,000 to $14,999, 4.7% of participants (*n* = 21) reported $15,000-$19,999, 12.1% participants (*n* = 54) reported $20,000-$34,999, 12.3% participants (*n* = 55) reported $35,000-$49,999, 23.7% participants (*n* = 106) reported $50,000 to $74,999, 16.5% participants (*n* = 74) reported $75,000-$99,999, 18.1% participants (*n* = 81) reported $100,000-$199,999, and 4.5% participants (*n* = 20) reported $200,000 or more. The sample was divided evenly between Republicans (49.3%, *n* = 223) and Democrats (50.2%, *n* = 225).

Compared to the 2021 US Census data, participants in this study were slightly younger (median age = 37 vs. 38.8), had a similar proportion of female participants (50.7% vs. 50.5%), a higher proportion of white participants (77.7% vs. 61.2%), and a lower proportion of Hispanic, Latino, or Spanish participants (8.9% vs. 18.8%). The sample was more educated (83.8% vs. 53.5% had some college or higher) and reported a similar annual household income (62.8% vs. 63.6% had an annual household income of $50,000 or more) (United States Census Bureau, 2022). Additionally, because this study focused on politically affiliated individuals, the sample consisted of slightly more Republicans (49.8% vs. 43%) and Democrats (50.2% vs. 46%) compared to the general American public (Jones, 2022). Table 11 provides a summary of the sample characteristics.

Measurement

Manipulation Check

Trust in Partisan Sources. To determine whether Republicans and Democrats had different levels of trust in various partisan sources, participants were asked to rate their level of trust in information about COVID-19 from four sources: (1) MSNBC; (2) FOX; (3) Republicans; and (4) Democrats. Responses were indicated on a seven-point scale (1 = *Do not trust at all*, 7 = *Completely trust*).

Source Recall. To check whether participants paid attention to the source of the stimuli, they were asked to recall the source of the message. After being exposed to the inoculation message, participants were asked to indicate the source of the tweet as either (1) MSNBC or (2) FOX. Similarly, following exposure to the misinformation message, participants were asked to indicate the source of the message as a Twitter user who self-identifies either a (1) Democrat, or (2) Republican.

Moderator

Party Identification Strength. Party identification strength was assessed using four items adapted from Huddy et al. (2015) and rated on a four-point scale. Specifically, Democrats answered four questions that asked: (1) "How important is being a Democrat to you?" (1 = *Not important at all*, 2 = *Not very important*; 3 = *Very important*; 4 = *Extremely important*); (2) "How well does the term Democrat describe you?" (1 = *Not at all*; 2 = *Not very well*; 3 = *Very well*; 4 = *Extremely well*); (3) "When talking about Democrat, how often do you use "we" instead of "they"?" (1 = *Never*; 2 = *Rare*; 3 = *Sometimes*; 4 = *Most of the time*); and (4) "To what extent do you think of yourself as being a Democrat?" (1 = *Not at all*; 2 = *Very little*; 3 = *Somewhat*; 4 = *A great deal*). Republicans answered the same set of questions regarding their identification as Republicans. The four items were averaged to form an index for party identification strength, with higher scores indicating stronger in-group party identification. The scale demonstrated good reliability (α = .85, M = 2.70, SD = 0.69), and results from the principal axis factor analysis suggested that the four items loaded on one factor (eigenvalue = 2.82, explained variance = 70.56%). In addition, Republicans (M = 2.67, SD = 0.70) and Democrats (M = 2.74, SD = 0.68) did not differ significantly in terms of their party identification strength (t (446) = -1.18, p = .24).

Mediators

Counterarguing. Counterarguing against misinformation was measured using a quantitative self-assessment item adopted from Richards and Banas (2018). Participants were asked to select the option that best reflected how they responded in their mind to the viewpoints presented in tweet from Hunter (i.e., the misinformation attack) on a seven-point scale (I thought of: 1 = A *lot of* arguments *support* those viewpoints; 2 = *Several* arguments *support* those

viewpoints; 3 = At *least one* argument *supports* those viewpoints; 4 = Arguments *both for and against* those viewpoints; 5 = *At least one* argument *against* those viewpoints; 6 = *Several* arguments *against* those viewpoints; 7 = A *lot of* arguments *against* those viewpoints). This measure has been increasingly adopted by inoculation research (e.g., Barbati et al., 2021; Li, 2021; Niederdeppe et al., 2015; Parker et al., 2020). Participants reported moderate to high levels of counterarguing against the misinformation attack (M = 4.58, SD = 2.03).

Perceived Ease of Counterarguing. Two items adapted from Tormala and Petty (2004) were used to assess participants' perceived ease of counterarguing against the misinformation,: 1) "overall, how easy/difficult was it for you to come up with arguments that refute the viewpoints in the tweet from Hunter?" and 2) "overall, how easy/difficult was it for you to come up with arguments that support the viewpoints in the tweet from Hunter? (Reverse coded)" Participants rated the items on a seven-point scale (1 = *Very difficult*, 7= *Very easy*). The two items were averaged to form an index for perceived ease of counterarguing against misinformation (*Spearman-Brown* = .99, M = 4.57, SD = 1.78). Results from the principal axis factor analysis suggested that the two items loaded on one factor (eigenvalue = 1.69, explained variance = 84.25%).

Anger. Four items adopted from Dillard and Shen (2005) measured anger on a seven-point scale (1 = *None of this feeling*, 7 = *A great deal of this feeling*): "While viewing the tweet from Hunter, to what extent do you feel: 1) irritated, 2) angry, 3) annoyed, 4) aggravated?" The four items were averaged to form an index for anger toward the misinformation message (α = .96, M = 3.45, SD = 2.07). Results from the principal axis factor analysis suggested that the four items loaded on one factor (eigenvalue = 3.57, explained variance = 89.24%).

Outcome Variables

Beliefs in COVID-19 Vaccine Misinformation. Participants rated their perceptions about three claims on a five-point Likert scale (1 = *Definitely false*, 2 = *Probably false*, 3 = *I don't know*, 4 = *Probably true*, 5 = *Definitely true*): 1) COVID-19 vaccines cannot protect against COVID-19 variants at all; 2) vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID; 3) Natural immunity provides better protection than vaccine-induced immunity to Covid-19. The scale demonstrated good reliability (α = .83, *M* = 2.46, *SD* = 1.24). Results from the principal axis factor analysis suggested that the three items loaded on one factor (eigenvalue = 2.25, explained variance = 74.89%).

Attitude toward COVID-19 Vaccination. Participants answered four semantic differential items on a seven-point scale adapted from Guidry et al. (2021): "Getting a COVID-19 vaccine is: 1) *Foolish-Wise*, 2) *Harmful-Beneficial*, 3) *Worthless-Valuable*, and 4) *Bad-Good*." The scale demonstrated strong reliability (α = .99, *M* = 5.14, *SD* = 2.08). Results from the principal axis factor analysis suggested that the four items loaded on one factor (eigenvalue = 3.85, explained variance = 96.28%).

COVID-19 Vaccination Intention for Self. Participants were first asked to report their COVID-19 vaccination status by choosing one of four options: 1) "I am fully vaccinated and have received the updated bivalent booster;" 2) "I am fully vaccinated and have received the original booster;" 3) "I have received at least one dose of vaccine but have not received any booster shot;" or 4) "I have not received any COVID-19 vaccine." Of the participants, 30.1% (n = 135) reported being fully vaccinated and had received the updated bivalent booster, 48% (n = 215) had not received the updated bivalent booster (24.1% received the original booster and 23.9% did not receive any booster), and 21.9% (n = 98) had not received any COVID-19 vaccine.

Next, participants indicated their future COVID-19 vaccination intentions. Specifically, those who were fully vaccinated and had received the updated bivalent booster were asked, "How likely would you take another booster shot of COVID-19 vaccine when it is recommended to you?" Participants who received the original booster or no booster shot were asked, "How likely would you take an updated booster shot of COVID-19 vaccine when you are eligible?" Participants who had not received any dose of COVID-19 vaccine were asked, "How likely would you take a COVID-19 vaccine?" Participants rated the item on a seven-point scale (1 = *Very unlikely*, 7= *Very likely*). These responses were combined into one item to indicate participants' future COVID-19 vaccination intention, with higher scores indicating stronger vaccination intentions (M = 4.21, SD = 2.44).

COVID-19 Vaccination Intention for Child. Participants' intention to vaccinate their child against COVID-19 was assessed with the following item asking: "If you have a child (or imagine that you have a child) who is eligible to a COVID-19 bivalent booster, how likely would you have your child take a COVID-19 bivalent booster?" Responses were indicated on an eight-point scale (1 = *Very unlikely*, 7= *Very likely,* 8 = *Not applicable, my child has already taken the COVID-19 bivalent booster*). A total of 4% participants (n = 18) chose "8" and indicated that their child has already taken the COVID-19 bivalent booster, and those responses were recoded as "7" for analysis. Therefore, the recoded scale was a seven-point Likert scale, with higher scores indicating stronger intentions to vaccinate one's child against COVID-19 (M = 4.35, SD = 2.50).

COVID-19 Vaccination Recommendation. Participants indicated their intentions to recommend COVID-19 vaccines to hesitant others on a seven-point scale (1 = *Very unlikely*, 7= *Very likely*) with three items: "How likely would you recommend COVID-19 vaccination 1) to

your family, friends, or colleague who are hesitant about getting a COVID-19 vaccine? 2) to parents who are hesitant about getting their children vaccinated against COVID-19? 3) to a stranger online who asks about whether it is necessary to get a COVID-19 vaccine?" The three items were averaged to form an index for COVID-19 vaccine recommendation (α = .96, M = 4.18, SD = 2.26). Results from the principal axis factor analysis suggested that the three items loaded on one factor (eigenvalue = 2.80, explained variance = 93.27%).

Control Variables

Demographic Variables. Demographic variables were included as covariates, including age, sex (male, female, other), ethnicity (Hispanic, non-Hispanic), race (White, Black or African American, Asian, Native Hawaiian or Pacific Islander, two or more races, other), education (less than high school, high school graduate, some college, college graduate, post-graduate), income ($0-$9,999, $10,000 to $14,999, $15,000-$19,999, $20,000-$34,999, $35,000-$49,999, $50,000 to $74,999, $75,000-$99,999, $100,000-$199,999, $200,000 or more), and political party affiliation (Republican, Democrat).

Age, education, and income were analyzed as continuous variables. Due to the limited number of participants who identified as a sex other than male or female, sex was recoded as female and other (vs. male), with female and other combined into a single category and male treated as the reference group. Ethnicity was coded as Hispanic (vs. non-Hispanic), where "Hispanic" referred to participants of Hispanic, Latino, or Spanish origin, and "non-Hispanic" referred to those not identifying with these origins. Race was recoded as White (vs. other), with the "other" category representing all other racial backgrounds other than White. Political party affiliation was coded as Republican (vs. Democrat), with Democrat serving as the reference group.

Analytical Approach

Randomization Check. Participants were randomly assigned to read an inoculation message from either FOX (n = 223) or MSNBC (n = 225), followed by a misinformation message either from a Republican (n = 224) or a Democrat (n = 224). To check the success of randomization, I examined whether there were any significant differences between the four experimental groups in terms of sample characteristics. Chi-square test was employed to examine categorical outcomes and one-way analysis of variance (ANOVA) was employed to examine continuous outcomes. Results showed no significant differences between the four groups in terms of age (F(3, 447) = 1.07, p = .36), sex ($x(6)^2$ = 4.81, p = .57), ethnicity ($x(3)^2$ = 2.66, p = .45), race ($x(15)^2$ = 8.39, p = .91), education (F(3, 447) = 0.68, p = .57), income (F(3, 447) = 0.59, p = .62), political party affiliation ($x(3)^2$ = 0.73, p = .87), and party identification strength (F(3, 447) = 0.76, p = .52).These results suggest that the randomization process was successful. The experimental conditions were recoded as four conditions: in-group inoculation with in-group misinformation (n = 121), in-group inoculation with out-group misinformation (n = 107), out-group inoculation with in-group misinformation (n = 104), and out-group inoculation with out-group misinformation (n = 116). The recoded four groups also showed no significant difference in terms of sample characteristics. Figure 6 depicts the randomization procedure.

Manipulation Check. Three participants failed to correctly recall the source of the messages and therefore were excluded from analyses. Moreover, to check the success of manipulation on in-group (vs. out-group) partisan sources, a series of independent sample t-test were conducted to examine whether Democrats and Republicans differ in their trust towards different partisan sources. Results revealed that Republicans reported significantly stronger trust in COVID-19 information from FOX (M = 3.60, SD = 1.77) and a Republican source (M = 4.06,

SD = 1.58) than Democrats did (FOX: *M* = 1.67, *SD* = 1.11, *t*(446) = 13.84, *p* < .001; Republican: *M* = 1.73, *SD* = 1.05, *t*(446) = 18.61, *p* < .001). Conversely, Democrats reported significantly stronger trust in COVID-19 information from MSNBC (*M* = 4.43, *SD* = 1.57) and a Democratic source (*M* = 4.84, *SD* = 1.36) than Republicans did (MSNBC: *M* = 2.36, *SD* = 1.66, *t*(446) = -13.54, *p* < .001; Democrat: *M* =2.33, *SD* = 1.37, *t*(446) = -19.47, *p* < .001).

Moreover, paired-sample t-tests showed that Republicans reported significantly stronger trust in COVID-19 information from FOX compared to MSNBC (*t*(222) = 9.19, *p* < .001) and stronger trust in COVID-19 information from Republican compared to that from Democrats (*t*(222) = 14.47, *p* < .001). Conversely, Democrats expressed significantly stronger trust in COVID-19 information from MSNBC compared to FOX (*t*(224) = 21.99, *p* < .001) and stronger trust in COVID-19 information from Democrat compared to that from Republican (*t*(224) = -27.89, *p* < .001). These findings provide reasonable evidence to justify using MSNBC/Democrat as in-group sources and FOX/Republican as out-group sources for Democrats, while using FOX/Republican as in-group sources and MSNBC/Democrat as out-group sources for Republicans.

Statistical Analysis. First, I conducted a series of regression analyses to examine the main effects of in-group (vs. out-group) inoculation (H6), the main effect of in-group (vs. out-group) misinformation (H7), and the interaction effect of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation (H8) on the five dependent variables. Next, I performed a series of mediation analyses using PROCESS model 4 (Hayes, 2017) to examine whether the effects of in-group (vs. out-group) inoculation (RQ3) and in-group (vs. out-group) misinformation (RQ4) on the five dependent variables were mediated by three proposed mediators: counterarguing, perceived ease of counterarguing, anger. Finally, a series of

regression analyses were performed to explore the moderating role of party identification strength in impacting partisan source effects. Specifically, I examined whether were a two-way interaction between in-group (vs. out-group) inoculation and party identification strength (H9), a two-way interaction between in-group (vs. out-group) misinformation and party identification strength (H10), and a three-way interaction among in-group (vs. out-group) inoculation, in-group (vs. out-group) misinformation, and individuals' party identification strength on the five dependent variables (H11). The moderator, party identification strength, was mean-centered when included in the regression analyses. Demographic variables were included as control variables in each model.

The regression analyses were performed using R Studio by the dplyr package (Wickham et al., 2023). Model assumptions were checked before performing the analyses. The regression models fulfilled the assumptions of linearity, homoscedasticity, normality, independence, and showed no significant multicollinearity among the predictors. In this study, PROCESS models were constructed based on 5,000 bootstrap samples. Correlations among key variables are reported in Table 12. Observed mean and standard deviations of the experimental groups on key variables are reported in Table 13 and Figure 7.

Results

Main Effects of In-group (vs. Out-group) Inoculation (H6)

The sixth hypothesis predicted that inoculation message from an in-group (vs. out-group) source would confer stronger resistance to misinformation, as indicated by weaker beliefs in COVID-19 misinformation (H6a), more favorable attitude toward COVID-19 vaccines (H6b), stronger intentions to vaccinate oneself (H6c) and one's child (H6d) against COVID-19, and stronger intentions to recommend COVID-19 vaccines to others (H6e). Five regression analyses

were constructed, with demographic variables and misinformation sources included as control variables in each model.

Results (see Table 14, Model 1) showed that in-group (vs. out-group) inoculation had no significant impact on participants' beliefs in COVID-19 misinformation (b = -.04, SE = .10, p = .71), attitude toward COVID-19 vaccines (b = -. 09, SE = .17, p = .58), intentions to vaccinate themselves (b =. 06, SE = .19, p = .76) and their child (b = -.03, SE = .19, p = .86), and intentions to recommend COVID-19 vaccines to others (b = -.08, SE = .18, p = .64) after controlling for demographic and misinformation source variables. These findings indicate that the inoculation message from an in-group source did not significantly differ from an out-group inoculation in terms of its ability to foster resistance to misinformation. Therefore, H6 was not supported.

Main Effects of In-group (vs. Out-group) Misinformation (H7)

The seventh hypothesis predicted that exposure to an in-group (vs. out-group) misinformation would lead to stronger beliefs in COVID-19 misinformation (H7a), less favorable attitudes toward COVID-19 vaccines (H7b), weaker intentions to vaccinate oneself (H7c) and one's child (H7d) against COVID-19, and weaker intentions to recommend COVID-19 vaccines to others (H7e).

Results from regression analyses (see Table 14, Model 1) indicated that in-group (vs. out-group) misinformation had no significant impact on participants' beliefs in COVID-19 misinformation (b = .09, SE = .10, p = .38), attitude toward COVID-19 vaccines (b = -. 07, SE = .17, p = .69), intentions to vaccinate themselves (b = -.07, SE = .19, p = .71) and their child (b = -.07, SE = .19, p = .73), and intentions to recommend COVID-19 vaccines to others (b = -.18, SE = .18, p = .33). These findings indicate that, after controlling for demographic and inoculation

source variables, the persuasive impact of misinformation from an in-group source did not significantly differ from that of an out-group misinformation. Therefore, H7 was not supported.

The Interaction Effects of In-group (vs. Out-group) Inoculation and In-group (vs. Out-group) Misinformation (H8)

The eighth hypothesis predicted that there is a two-way interaction between in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation on the five dependent variables. Specifically, the persuasive effect of in-group (vs. out-group) inoculation is weaker when the misinformation is conveyed by an in-group (vs. out-group) source. Five regression models were performed (see Table 14, Model2).

Results showed no significant two-way interaction between in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation on the five dependent variables, including COVID-19 misinformation (b = -.05, SE = .19, p = .81), attitude toward COVID-19 vaccines (b = -. 26, SE = .34, p = .46), intentions to vaccinate themselves (b = .18, SE = .38, p = .63) and their child (b = -.01, SE = .38, p = .98), and intentions to recommend COVID-19 vaccines to others (b = .14, SE = .36, p = .70). Therefore, H8 was not supported. Figure 8 presents the effects of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation on the five dependent variables.

Subgroup Analysis. Additionally, I conducted a series of subgroup analyses to investigate the impact of in-group (vs. out-group) inoculation message and in-group (vs. out-group) misinformation message on the five dependent variables among Republicans and Democrats separately. Results from regression analyses showed that neither in-group (vs. out-group) inoculation nor in-group (vs. out-group) misinformation had a significant main effect on the five dependent measures for both Republicans and Democrats. Moreover, no significant

interaction effects were found between the in-group (vs. out-group) inoculation messages and in-group (vs. out-group) misinformation messages on the five dependent measures for both Republicans and Democrats. Overall, these findings provide additional support for rejecting H6, H7, and H8. Results of subgroup analyses are summarized in Table 15.

Covariates. Several demographic variables emerged as significant predictors of the dependent measures in the regression models. Specifically, older participants expressed stronger intentions to get a COVID-19 vaccine (b = .01, SE = .01, p = .04). In comparison to males, females and individuals identifying with other sex reported stronger beliefs in COVID-19 vaccine misinformation (b = .21, SE = .10, p = .04). Participants with higher education levels indicated stronger intentions to get a COVID-19 vaccine themselves (b = .24, SE = .11, p = .03) and their child (b = .22, SE = .11, p = .04). Compared to Republicans, Democrats reported lower beliefs in COVID-19 vaccine misinformation (b = -1.46, SE = .10, p < .001), more favorable attitudes toward COVID-19 vaccines (b = 2.16, SE = .19, p < .001), stronger intentions to vaccinate themselves (b = 2.79, SE = .21, p < .001) and their children (b = 2.99, SE = .21, p < .001), and stronger intentions to recommend COVID-19 vaccines to hesitant individuals (b = 2.61, SE = .19, p < .001). Among Democrats, White individuals expressed lower beliefs in COVID-19 vaccine misinformation (b = -.30, SE = .12, p = .02) and more favorable attitudes towards COVID-19 vaccines (b = .47, SE = .21, p = .03) compared to Democrats from other racial backgrounds. Conversely, White Republicans reported lower intentions to receive a COVID-19 vaccine compared to Republicans from other racial backgrounds (b = -1.24, SE = .45, p = .01).

Mechanisms of In-group (vs. Out-group) Source Effects (RQ3-RQ4)

The third and fourth research question asked whether counterarguing, perceived ease of counterarguing, and anger would mediate the effects of in-group (vs. out-group) inoculation (RQ3) and in-group (vs. out-group) misinformation (RQ4) on the five dependent variables. According to Hayes (2009), an independent variable can exert indirect effects through a third variable, even in the absence of an association between the independent variable and the dependent variable (Hayes, 2009). As such, researchers are advised to "not require a significant total effect before proceeding with tests of indirect effects" (Hayes, 2009, p. 414). In line with this recommendation, although there were no significant main effects of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation on the five dependent variables, I proceeded to analyze the indirect effects of in-group (vs. out-group) source cues on the five dependent variables through counterarguing, perceived ease of counterarguing, and anger. I first conducted three regression analyses to examine whether in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation significantly impacted the three variables. Next, I performed a series of mediation analyses using PROCESS Model 4 to probe significance of the indirect effects. Results are presented in Table 16 and Table 17.

Counterarguing. Regression analysis results indicated that participants reported lower counterarguing against misinformation from an in-group source compared to an out-group source (b = -.34, SE = .16, p = .03). Moreover, mediation analyses revealed significant indirect effects of in-group (vs. out-group) misinformation on the five dependent variables, including beliefs in COVID-19 vaccine misinformation (b = .050, 95%CI = [.003, .108]), attitude toward COVID-19 vaccines (b = -.09, 95%CI = [-.207, -.009]), COVID-19 vaccination intention for oneself (b =

-.085, 95%CI = [-.198, -.007]) and for one's child (b = -.093, 95%CI = [-.215, -.008]), and intentions to recommend COVID-19 vaccines to others (b = -.095, 95%CI = [-.211, -.008]).

In contrast, there was no significant difference in counterarguing between in-group and out-group inoculation (b = .02, SE = .16, p = .92). Moreover, the indirect effects of in-group (vs. out-group) inoculation on the five dependent variables through counterarguing were also not significant (see Table 17).

Perceived ease of counterarguing. In-group (vs. out-group) inoculation (b = -.10, SE = .14, p = .49) and in-group (vs. out-group) misinformation (b = -.21, SE = .14, p = .15) were not significant predictors of perceived ease of counterarguing. Moreover, none of the indirect effects of in-group (vs. out-group) inoculation or in-group (vs. out-group) misinformation on the five dependent variables through perceived ease of counterarguing was significant (see Table 17).

Anger. In-group (vs. out-group) inoculation (b = .05, SE = .17, p = .75) and in-group (vs. out-group) misinformation (b = -.21, SE = .17, p = .21) did not significantly predict anger. Moreover, none of the indirect effects of in-group (vs. out-group) inoculation or in-group (vs. out-group) misinformation on the five dependent variables through anger was significant (see Table 17).

Covariates. Party affiliation emerged as a significant predictor of counterarguing, perceived ease of counterarguing, and anger. Compared to Republicans, Democrats expressed greater counterarguing against misinformation (b = 2.27, SE = .17, p < .001), perceived counterarguing against misinformation as easier (b = 1.91, SE = .15, p < .001), and reported stronger anger toward the misinformation message (b = 2.26, SE = .18, p < .001).

The Moderating Role of Party Identification Strength (H9-H11)

Finally, hypothesis nine through eleven proposed that the positive impact of in-group (vs. out-group) inoculation (H9) and the negative impact of in-group (vs. out-group) misinformation (H10) on the five dependent measures would be stronger among people with stronger party identification strength. Moreover, hypothesis 11 proposed that the positive effect of in-group (vs. out-group) inoculation in conferring resistance to out-group (vs. in-group) misinformation would be stronger among people with stronger party identification strength. A series of regression analyses were performed to examine the three hypotheses. Results are summarized in Table 18.

Two-way Interaction between In-group (vs. Out-group) Inoculation and Party Identification Strength. Results showed that party identification strength significantly moderated the impact of in-group (vs. out-group) inoculation on beliefs in COVID-19 vaccine misinformation (b = .48, SE = .20, p = .02) and attitude toward COVID-19 vaccines (b = -.81, SE = .36, p = .02). However, the direction of the interaction is the opposite with the proposed direction. Results from Johnson-Neyman analysis indicated that in-group (vs. out-group) inoculation led to significantly lower beliefs in COVID-19 vaccine misinformation among individuals with low and moderate party identification strength (i.e., individuals who scored 2.20 or lower on a four-point scale), whereas it led to significantly greater beliefs in COVID-19 vaccine misinformation among individuals with strong party identification (i.e., individuals who scored 3.67 or higher on a four-point scale). In addition, in-group (vs. out-group) inoculation led to significantly more favorable attitudes toward COVID-19 vaccines among individuals with low and moderate party identification strength (i.e., individuals who scored 1.52 or lower on a four-point scale), whereas it led to significantly lower COVID-19 vaccination attitude among individuals with strong party identification (i.e., individuals who scored 3.28 or higher on a four-

point scale). These findings suggest that in-group inoculation was more effective than out-group inoculation among politically individuals with low level of party identification, while it could be less effective than out-group inoculation among politically individuals with extremely strong party identification. Results are summarized in Table 19, Figure 9, and Figure 10.

Moreover, the interaction effect of in-group (vs. out-group) inoculation and party identification strength was not significant in predicting participants' intentions to get a COVID-19 vaccine (b = -.77, SE = .39, p = .05), intentions to vaccinate their child against COVID-19 (b = -.55, SE = .40, p = .17), and intentions to recommend COVID-19 vaccines to others (b = -.38, SE = .40, p = .31). Therefore, H9 was not supported.

Two-way Interaction between In-group (vs. Out-group) Misinformation and Party Identification Strength. Results from regression analyses indicated that there was no significant interaction between in-group (vs. out-group) misinformation and party identification strength on beliefs in COVID-19 vaccine misinformation (b = .17, SE = .20, p = .41), COVID-19 vaccination attitude (b = -.53, SE = .36, p = .14), COVID-19 vaccination intention for oneself (b = -.06, SE = .39, p = .88) and for one's child (b = -.29, SE = .40, p = .48), and COVID-19 vaccination recommendation (b = .24, SE = .37, p = .51). Therefore, H10 was not supported.

Three-way Interaction among In-group (vs. Out-group) Inoculation, In-group (vs. Out-group) Misinformation, and Party Identification Strength. Results indicated that the three-way interaction among in-group (vs. out-group) inoculation, in-group (vs. out-group) misinformation, and party identification strength were not significant in predicting beliefs in COVID-19 vaccine misinformation (b = -.19, SE = .28, p = .49), COVID-19 vaccination attitude (b = .36, SE = .50, p = .47), COVID-19 vaccination intention for oneself (b = .01, SE = .55, p = .98) and for one's child (b = .53, SE = .57, p = .35), and COVID-19 vaccination

recommendation (b = -.28, SE = .52, p = .59). Therefore, H11 was not supported. Results of three-way interactions are presented in Figure 11.

Summary of Findings

In summary, results in study 2 showed no main or interaction effects of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation on the five persuasive outcomes. This suggests that the efficacy of inoculation messages in conferring resistance to misinformation did not differ based on whether the messages came from an in-group or out-group source.

Politically affiliated individuals expressed greater counterarguing against misinformation when it was attributed to an out-group source compared to an in-group source, which further led to lower beliefs in COVID-19 vaccine misinformation, more favorable COVID-19 vaccination attitudes, and stronger intentions to get vaccinated, vaccinate one's child, and recommend COVID-19 vaccines to others. Despite this, the main effects of in-group (vs. out-group) misinformation on the five dependent measures were not significant, suggesting that there may be unexplored mediators that negate the indirect effects of in-group (vs. out-group) misinformation through counterarguing.

Contrary to the hypothesis, the positive impact of in-group (vs. out-group) inoculation in conferring resistance to misinformation was more effective among individuals with lower levels of party identification. For those with extremely strong political identification, out-group inoculation appeared to be more persuasive than in-group inoculation in lowering beliefs in COVID-19 vaccine misinformation and promoting positive COVID-19 vaccination attitudes. Party identification did not moderate the persuasive impact of in-group (vs. out-group)

misinformation or the interaction effect of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation.

Discussion

Study 2 sets out to examine how partisan sources impacts the effectiveness of inoculation messages in conferring resistance to misinformation among politically affiliated individuals (Republicans and Democrats). Through a 2 (in-group vs. out-group inoculation) X 2 (in-group vs. out-group misinformation) between-subject online experiment, this study investigates whether the efficacy of inoculation messages varies depending on the source (in-group vs. out-group) associated with the inoculation message, the source (in-group vs. out-group) associated with the misinformation message, and individuals' party identification strength.

First, this study found that although Republicans and Democrats trusted their in-group sources more than out-group sources, partisan sources did not significantly impact the effectiveness of inoculation messages. Specifically, neither in-group (vs. out-group) inoculation nor in-group (vs. out-group) misinformation had significant main effects or interaction effects on the five persuasive outcomes. These findings suggest that the efficacy of inoculation messages in conferring resistance to COVID-19 vaccine misinformation remained consistent, regardless of whether the messages originated from an in-group or out-group source. Inoculation messages from an in-group source did not show a discernible advantage over those from an out-group source. Additionally, misinformation was not more challenging to correct when attributed to an in-group source compared to an out-group source.

These findings contradict previous research (Bandel et al., 2022; Bolsen et al., 2019; Cohen, 2003; Pink et al., 2021) that suggests messages are more persuasive when attributed to an in-group partisan source as opposed to an out-group partisan source. However, recent studies

have also reported similar results to our study, indicating that in-group (vs. out-group) partisan source cues have no significant impact on message persuasiveness during the COVID-19 pandemic. For example, Lu and Zhong (2022) found that individuals who were exposed to a misinformation corrective message about COVID-19 vaccines from in-group media perceived the message as more credible than those exposed to out-group media, but the difference was not statistically significant. Freiling et al. (2023)'s findings are partially consistent with the current study. They examined the influence of partisan sources (MSNBC vs. FOX) on individuals' perceptions of various COVID-19-related messages (fact-checking message, misinformation, accurate information). Their findings suggested that source congruency had a significant impact on individuals' acceptance of fact-checking messages, but not on beliefs in misinformation or accurate information. Politically affiliated individuals were more likely to believe in fact-checking messages from ideologically congruent sources, but they reported similar beliefs regardless of whether the misinformation or accurate information was attributed to an ideologically congruent or incongruent source. Additionally, studies have found that corrective messages attributed to political figures were not effective in impacting COVID-19 vaccination perceptions. For example, R. M. Wood et al. (2023) found that debunking messages from healthcare professionals effectively lowered participants' perceived risks of COVID-19 vaccines, whereas debunking messages attributed to political authorities had no significant impact. The authors suggested that this disparity may arise because statements made by healthcare professionals carry more credibility than those made by political figures, particularly in the context of a highly politicized pandemic.

The mixed findings on the effects of source congruency might be attributed to differences in the topic issues, assessed outcomes, and manipulations. First, previous studies that found

significant partisan source effects mainly focused on widely politically divided issues, such as climate change (Bolsen et al., 2019) and gun control (Bandel et al., 2022). A report conducted by Pew Research Center revealed that Republicans and Democrats reported an average 57-point gap in attitudes toward gun control policies and 48-point difference on climate change (Nadeem, 2019). While reports also indicated a clear partisan difference regarding COVID-19 vaccination, the partisan gap appears to be narrower. For example, Republicans and Democrats reported a 26-point difference in the percentage of individuals who have received at least one dose of COVID-19 vaccine (Nadeem, 2022), and no gap was observed between Biden and Trump counties in the percentage of fully vaccinated individuals with booster doses (Kates et al., 2022). It is possible that the impact of partisan sources is more prominent in social issues that involve a stronger political divide. Moreover, when individuals are highly involved in an issue, they tend to focus on the message content itself rather than relying on source cues when evaluating the message, as suggested by the elaboration likelihood model (R. E. Petty & Cacioppo, 1984). Therefore, people's strong involvement in the issue of COVID-19 vaccination issue might lead them to elaborate on the messages extensively and be less influenced by the message sources. Furthermore, the inconsistency in findings could be attributed to differences in the assessed outcomes. Some studies that found significant partisan source effects assessed outcomes that indicate perceived message persuasiveness, such as perceived message accuracy (Traberg & van der Linden, 2022), perceived message credibility (Blom, 2021; J. Li & Wagner, 2020a), and perceived message bias (Hart et al., 2015; M. Kim, 2016; Reid, 2012). However, the current study assessed participants' behavioral beliefs, attitudes, and intentions, which indicate the actual persuasiveness of messages. Additionally, politically affiliated individuals might have varied degree of trust in different in-group and out-group sources. This study manipulated in-group (vs.

out-group) inoculation using two media source (MSNBC, FOX) and manipulated in-group (vs. out-group) misinformation using two politically affiliated individuals (a Republican or Democratic Twitter user). It is possible that the source congruency effect may be more prominent when the message is attributed to partisan sources that politically affiliated individuals have a stronger identification with, such as co-partisan elites (Pink et al., 2021) or co-partisan political leaders (Bolsen et al., 2019; Golos et al., 2022; J. Li & Wagner, 2020a).

In-group (vs. out-group) misinformation had significant indirect effects on the five persuasive outcomes through counterarguing. Specifically, politically affiliated individuals expressed lower counterarguing against misinformation when it was attributed to an in-group source compared to an out-group source. The lowered counterarguing, in turn, led to stronger beliefs in COVID-19 vaccine misinformation, less favorable COVID-19 vaccination attitudes, and lower intentions to get vaccinated, vaccinate one's child, and recommend COVID-19 vaccines to others. These findings suggest that politically affiliated individuals were less likely to actively resist misinformation when it originated from an in-group source as opposed to an out-group source. However, it is important to note that there was no significant main effect of in-group (vs. out-group) misinformation on the five persuasive outcomes. This finding suggests that in-group misinformation is not more persuasive than out-group misinformation, despite triggering less counterarguing. It implies that there may be other mediators at play that negate the indirect effects of in-group (vs. out-group) misinformation through counterarguing.

A possible explanation is that in-group misinformation elicits stronger source derogation than out-group misinformation. Scholars have theorized that source derogation could be an alternative mechanism underlying inoculation message effects, proposing that exposure to an inoculation message will not only trigger more issue-specific counterarguments but also

refutations of the source's credibility (Compton, 2013). The black sheep effect (Marques et al., 1988) suggests that individuals tend to evaluate their in-group members more extremely than out-group members, either favorably or unfavorably. When individuals perceive a target's behavior as violating the normative standard of the group membership category and the group membership is relevant to the perceiver's own social identity, they tend to evaluate the target more unfavorably if it is an in-group member than out-group member (Marques et al., 1988). The is because a negative in-group member represents a threat to group identity and rejecting the negative in-group member helps protect the positive distinctiveness of the in-group as a whole (Branscombe et al., 1993; Marques et al., 1988). Studies have also found that exposure to weak arguments from an in-group source resulted in negative evaluations about the source (Budesheim et al., 1996; Mackie et al., 1990). Therefore, it is likely that individuals engage in stronger source derogation toward an in-group source that spreads misinformation than an out-group source, through which they achieve group-oriented goals such as protecting positive group image and enforcing important group norms (Packer et al., 2021). Empirical studies on the role of source derogation underlying inoculation message effects are still limited, however. Future studies are needed to explore how source derogation, along with other variables such as counterarguing, mediate the impact of in-group (vs. out-group) source cues.

Furthermore, this study examined the moderating role of party identification strength. Party identification did not moderate the persuasive impact of in-group (vs. out-group) misinformation or the interaction effect of in-group (vs. out-group) inoculation and in-group (vs. out-group) misinformation. These findings are consistent with previous studies. For example, Freiling et al. (2023) conducted a study about COVID-19 misinformation and found that the extremity of political ideology did not moderate the impact of partisan source congruency on

individuals' beliefs in misinformation, accurate information, or fact-checks. Their findings indicate that the impact of congruent (vs. incongruent) partisan sources on people's beliefs in the message was consistent across individuals with different levels of political ideology extremity. Similarly, Ardèvol-Abreu (2022) found that there was no significant interaction between fake news exposure and party identification strength on perceived media bias.

Contrary to predictions, the positive impact of in-group (vs. out-group) inoculation in lowering beliefs in COVID-19 vaccine misinformation and promoting positive attitudes toward COVID-19 vaccines was more effective among individuals with lower levels of party identification. For those with extremely strong political identification, out-group inoculation appeared to be more persuasive than in-group inoculation. One possible explanation is that individuals with lower levels of party identification are more likely to engage in heuristic processing of messages from partisan sources and, therefore, are more influenced by heuristic cues such as source credibility (Sniderman et al., 1991). Conversely, individuals with extremely strong party identification might be more motivated to process messages from partisan media sources deeply and more influenced by message arguments. In such case, an out-group inoculation message might outweigh an in-group inoculation message because people tend to trust communicators who expressed positions contrary to their assumed beliefs (Cohen, 2003; Kahan et al., 2010). Another plausible explanation is that individuals who identify as extreme Democrats exhibit stronger confirmation of their positions when exposed to an inoculation message from an unexpected source such as FOX. Moreover, due to the black sheep effect (Marques et al., 1988), extreme Republicans may view their in-group sources more unfavorably than out-group sources when those sources deliver a pro-vaccine persuasive message that contradicts their positions.

It should be noted that this finding contradicts previous studies in similar settings. For example, Sylvester et al. (2023) found that receiving a pro-vaccine message from an in-group partisan source significantly improved COVID-19 vaccination intentions among Republicans and Democrats with moderate party identification but not among those who identified as strong or weak partisans. The difference between their findings and the current study might be due to differences in the timing of data collection or comparison groups used (within-group vs. between-group comparison). Nonetheless, empirical evidence on the moderating role of party identification strength in source effects in the context of vaccination is still limited. Further research is needed to draw a conclusive answer on the role of party identification strength in impacting partisan source effects.

Moreover, results in this study indicated a clear political divide in public perceptions about COVID-19 vaccination. Compared to Democrats, Republicans expressed stronger beliefs in COVID-19 vaccine misinformation, less favorable attitudes toward COVID-19 vaccines, and lower intentions to get a COVID-19 vaccine, vaccinated their children, and recommend COVID-19 vaccines to others. The partisan divide on COVID-19 vaccination has continued to widen (Kates et al., 2022). A recent report conducted by KFF indicated that 41% of Democrats has received a bivalent COVID-19 booster by March 2023, whereas only 11% of Republicans had done so (Sparks et al., 2023). The increasing political polarization on COVID-19 vaccination can be attributed to several factors, including different levels of trust in scientists (J. H. Evans & Hargittai, 2020), various cultural worldviews (Y. Wang et al., 2023), and polarized new media coverage on vaccine safety and effectiveness (Kates et al., 2022). To bridge the partisan divide on vaccination acceptance, it is essential to continue promoting accurate information about

COVID-19 vaccines, building trust in the scientific community, and conducting targeted outreach to vaccine-hesitant communities.

In conclusion, the study did not find a significant impact of partisan source cues on inoculation message effectiveness. Overall, the effectiveness of inoculation message in conferring resistance to misinformation about COVID-19 vaccines does not depend on whether the inoculation message or the misinformation message comes from an in-group partisan source or an out-group partisan source. Among individuals with lower party identification, in-group inoculation is more persuasive than out-group inoculation. Surprisingly, out-group inoculation appears to be more persuasive than in-group inoculation among individuals with extremely strong party identification. This suggests that inoculation messages from an unexpected source may have unique persuasive advantages when reaching individuals with extreme ideologies.

Chapter 8: General Discussion

Vaccine hesitancy continues to pose a threat to public health and hampers preparations future pandemics (Edwards, 2022). Drawing upon and extending inoculation theory (McGuire, 1964), this dissertation investigates whether exposure to an inoculation message – a message that forewarns and refutes potential persuasive attacks – can confer resistance to misinformation about COVID-19 vaccines. Based on two online experiments, I seek to answer four overarching questions: Can exposure to an inoculation message reduce susceptibility to misinformation? Through which mechanisms does inoculation message confer resistance to misinformation? Does the effect of inoculation messages vary among initially informed, uninformed, and misinformed individuals? How do partisan source cues (in-group vs. out-group) impact the effectiveness of inoculation messages among politically affiliated individuals?

Study 1 conducted a two-condition, between-subject experiment, comparing the inoculation condition to a no-message control condition. Results indicated that exposure to an inoculation message effectively reduced individuals' susceptibility to misinformation. Inoculated participants reported lower beliefs in COVID-19 vaccine misinformation, more favorable attitudes toward COVID-19 vaccines, stronger intentions to vaccinate themselves and their children, and stronger intentions to recommend COVID-19 vaccines to hesitant others, compared to those who did not receive the inoculation message. These findings highlight the potential of inoculation messages to counteract the detrimental impact of vaccine misinformation, even at the post-pandemic stage.

Extending inoculation theory, study 1 examined three potential mediators underlying the persuasive effects of inoculation message: counterarguing (the cognitive path), perceived ease of counterarguing (the meta-cognitive path), and anger (the affective path). Results revealed

perceived ease of counterarguing and anger as important mediators between exposure to inoculation message and persuasive outcomes, whereas counterarguing did not appear to be a significant mediator. These findings suggest that exposure to an inoculation message can foster resistance to misinformation by making people feel it is easier to refute misinformation and by evoking anger toward it.

Moreover, study 1 indicated that the effectiveness of inoculation message in conferring resistance to misinformation remained consistent among initially informed, uninformed, and misinformed individuals. These findings suggest that the efficacy of inoculation message in conferring resistance to persuasion can extend beyond the traditional scope of inoculation theory – cultural truisms (i.e., widely accepted beliefs that people shared without question). These findings also provide empirical support for Compton (2020)'s theory, suggesting that inoculation message possess both prophylactic and therapeutic effects.

Study 2 examined how partisan source cues impacted inoculation message effectiveness. The study conducted an online experiment among politically affiliated individuals who self-identified as Republicans or Democrats, using a between-subject design with two factors: in-group vs. out-group inoculation, and in-group vs. out-group misinformation. Results indicated that, despite both Republicans and Democrats expressing stronger trust in their in-group sources than out-group sources, partisan sources overall did not significantly impact inoculation effectiveness. Inoculation messages from an in-group source did not show a discernible advantage over those from an out-group source. Additionally, misinformation from an in-group source was not more challenging to correct compared to that from an out-group source.

Party identification strength moderated the impact of in-group (vs. out-group) inoculation on beliefs in COVID-19 vaccine misinformation and COVID-19 vaccination attitudes.

Surprisingly, the advantage of in-group inoculation over out-group inoculation appears to be stronger among individuals with lower levels of party identification. In contrast, out-group inoculation appears to be more persuasive among those with extremely strong party identification. Overall, the study suggests that the effectiveness of inoculation messages in conferring resistance to misinformation does not depend on whether the inoculation message or misinformation message comes from an in-group or out-group source. However, inoculation messages from an unexpected source may be especially effective for reaching individuals with extreme ideologies.

Taken together, this dissertation offers several key takeaways. First, inoculation message works. It not only prevents beliefs in misinformation but also protect positive attitudes and intentions toward COVID-19 vaccination. Second, inoculation message confers resistance to misinformation by making recipients feel it is easier to refute misinformation and eliciting anger against misinformation. Third, inoculation message offers both prophylactic and therapeutic effects. It can foster resistance to persuasion regardless of individuals' initial beliefs. Finally, the efficacy of inoculation messages in reducing misinformation susceptibility does not vary depend on whether the inoculation message or misinformation message comes from an in-group or out-group source. Collectively, these findings provide significant implications for health communication research and practice.

Theoretical Implications

This research provides several theoretical implications. First, it demonstrates that inoculation theory can be effectively applied to the context of vaccine hesitancy. Although inoculation theory has long been considered as the "grandparent theory of resistance to attitude change" (Eagly & Chaiken, 1993, p. 561), there is still a lack of research exploring the effects of

inoculation messages in combating vaccine misinformation. By confirming the effectiveness of inoculation messages in reducing susceptibility to COVID-19 vaccine misinformation, this study extends the application of inoculation theory to addressing vaccine hesitancy, a severe public health challenge.

Second, this research offers new insights into the mechanisms through which inoculation messages build resistance to misinformation. Inoculation theory posited that inoculation message confers resistance to persuasion because it elicits greater counterarguing against the attack message (McGuire & Papageorgis, 1962). This study expands inoculation theory by examining two alternative mechanisms: perceived ease of counterarguing and anger. By identifying the significant mediating role of perceived ease of counterarguing and anger underlying the inoculation message effects, this research provides valuable insights into the cognitive, meta-cognitive, and affective processes involved in inoculation message effects. The conventional model of inoculation theory assumes that resistance to persuasion is an effortful cognitive process that relies on extensive thinking (Wegener et al., 2004). This study, in contrast, highlights the importance of considering the meta-cognitive and affective paths underlying resistance to persuasion. Contradictory to predictions, this study did not find counterarguing as a significant mediator underlying inoculation message effect. It is possible that the message fatigue people experienced about COVID-19 vaccine messages drives them to engage in heuristic processing and become less willing to engage in counterarguing. Taken together, the findings suggest that, similar to dual processes of attitude change (R. Petty & Cacioppo, 1986), there could be dual processes of resistance to attitude change: a thoughtful resistance process that operates through cognition (e.g., counterarguing) and a non-thoughtful process that operates

through heuristics such as meta-cognition (e.g., perceived ease of counterarguing) and affect (e.g., anger).

Third, this research expands the scope of inoculation theory by demonstrating its efficacy among initially informed, uninformed, and misinformed individuals. Traditional inoculation scholarship focused on cultural truisms (i.e., widely accepted beliefs that people shared without question), assuming that recipients should already hold an established belief or attitude that is consistent with the advocated position of the inoculation message (McGuire, 1964). However, this approach has been critiqued for limiting the applicability of inoculation theory in real-world settings (Compton, 2020; M. L. M. Wood, 2007). Compton (2020) theorized that there are two types of inoculation: prophylactic and therapeutic. Prophylactic inoculation serves as a preventative treatment, preventing individuals with desired beliefs from being persuaded. In contrast, therapeutic inoculation is administered to those without a desired, existing position in place. Therapeutic inoculation works as a persuasive message, persuading individuals with undesired beliefs to change their beliefs toward the advocated position. The current research provides empirical support for Compton (2020)'s theory, suggesting that the applicability of inoculation theory can extend beyond the traditional scope of cultural truisms and provide both prophylactic and therapeutic effects.

Finally, this dissertation advances our understanding of the role of source effects in inoculation messaging. Despite the clear political divide on COVID-19 vaccine acceptance, the effectiveness of inoculation messages in conferring resistance to misinformation does not significantly vary based on whether the inoculation message or misinformation comes from an in-group or out-group partisan source. These findings challenge the assumption that messages from in-group sources are more persuasive than those from out-group sources. Moreover, this

research adds to the literature on the moderating role of party identification strength in partisan source effects. Contrary to expectations, the relative advantage of in-group (vs. out-group) inoculation in conferring resistance to misinformation was more effective among individuals with lower levels of party identification. Furthermore, out-group inoculation appears to be more persuasive than in-group inoculation among those with extreme party identification, suggesting that unexpected sources can have unique persuasive advantages. These findings highlight the complex interplay between party identification and partisan source effects in the context of COVID-19 vaccination.

Practical Implications

Developing effective interventions against vaccine misinformation is crucial for addressing vaccine hesitancy and fostering vaccine hesitancy. Findings in this dissertation have several practical implications for health communication professionals and educators.

First, this study suggests that inoculation messages can effectively reduce susceptibility to COVID-19 vaccine misinformation and promote COVID-19 vaccine acceptance, even in the post-pandemic stage when people have experienced some degree of message fatigue. Inoculation messages, in various forms such as text-based, video-based, and game-based, have been found to be effective in addressing misinformation (Maertens et al., 2023). Health communication practitioners can incorporate inoculation messages into their campaigns to continue counteracting vaccine misinformation and promoting vaccine uptake.

Moreover, the results also have implications for targeting different segments of the public. Inoculation message appears to be effective among individuals with various initial beliefs in misinformation. Therefore, public health campaigns should consider using inoculation messages to reach a wide range of audiences, regardless of their initial stances on vaccination.

Furthermore, this research highlights the urgent need for interventions targeting vaccine-hesitant communities, particularly among Republicans. This study did not find a significant advantage of in-group partisan sources over out-group sources in promoting vaccine acceptance, implying that content might be more important than messengers in the context of COVID-19 vaccination at the post-pandemic stage. To bridge the political divide on vaccine hesitancy, interventions that tailored to individuals' psychological predispositions underlying vaccine hesitancy, such as moral foundations (Nan, Wang, Thier, et al., 2022) and cultural worldviews (Y. Wang et al., 2023), need to be developed and evaluated for effectiveness.

Finally, inoculation messages remain effective regardless of the partisan source. This finding encourages collaboration between different political groups in addressing vaccine hesitancy. Health communicators and policymakers may not solely rely on in-group sources to deliver inoculation messages. While trusted sources remain important, promoting vaccine acceptance through unexpected sources, such as out-group members, may be a promising strategy for reaching individuals with extreme political identification.

Limitations

This research has several limitations. First, participants in this study were recruited from online platforms (M-Turk and Prolific), which are not nationally representative. Compared to the general U.S. public (United States Census Bureau, 2022), participants in the two studies were younger, more educated, and contained a lower proportion of racial and ethnic minority groups. In addition, Republicans were underrepresented in study 1. Previous studies have revealed that individuals' demographic characteristics such as age, education, and race are important predictors that impact individuals' susceptibility to misinformation (Nan, Wang, & Thier, 2022). Therefore, findings in this research should be interpreted with caution when generalized to the

general U.S, public. Moreover, this research only sampled participants from the U.S. Populations from different countries may have varying levels of political polarization (Pennycook et al., 2022), trust in experts (Algan et al., 2021; Rozek et al., 2021), beliefs in misinformation (Roozenbeek, Schneider, et al., 2020), and vaccine hesitancy (Wagner et al., 2019). Therefore, it is unclear whether the findings can be generalized to other populations, countries, or cultural contexts.

Second, the scalability of interventions may vary based on the specific medium in which they are implemented (Biddlestone et al., 2023). Participants in this study were presented with text-based inoculation. Especially, the experimental stimuli in study 1 contain a fairly large amount of information. Therefore, while effective, it is unclear whether this technique may be effective when implemented in other mediums such as short videos, television advertisements, and images that may favor concise information over detailed information. Relatedly, this research simulated misinformation message as a Reddit post (study1) and a tweet (study 2). The extent to which inoculation messages can counteract the impact of misinformation delivered in other mediums such as Instagram and Tik-Tok remains unclear.

Third, this research employed a single-message design. With a single-message design in the experiment, the apparent relationship between the manipulation and the dependent variable might be the result of an interaction with other, unknown message factors (Thorson et al., 2012). In other words, it is possible that the detected effect of inoculation message is confounded with other message features that are concurrently manipulated, such as the usage of a graph. Additionally, since this study only examined the effect of exposure to a single inoculation message and a single misinformation message, it remains clear whether the findings hold true in

conditions when individuals were repeatedly exposed to inoculation messages, exposed to multiple misinformation attacks, or exposed to a wide array of information sources.

Fourth, this study only assessed the immediate effects of inoculation message. To what extent inoculation messages can persist remains unclear. Moreover, participants were exposed to misinformation immediately after exposure to the inoculation message. Therefore, these findings might not apply to conditions when there is a delay between inoculation message exposure and misinformation exposure. A meta-analysis on inoculation theory (Banas & Rains, 2010) has revealed a curvilinear relationship between time delay on resistance, suggesting that inoculation messages are more effective when there is a moderate delay between inoculation treatment and subsequent attack than shorter or longer delays. Therefore, it is unclear how the findings would translate to real-world scenarios where individuals are exposed to a complex combination of accurate and inaccurate information, with varying time delays.

Finally, the survey was conducted in January 2023, when most people had already received at least one shot of COVID-19 vaccine (CDC, 2023a) and were experiencing message fatigue regarding the pandemic (Hwang et al., 2022). While the findings provide insights for promoting ongoing preventative measures, their applicability to other contexts, such as the early stages of a health crisis, remains unclear. It should be noted that the efficacy of corrective messaging against vaccine misinformation could be dynamic, shifting as public perceptions of vaccines evolve over time. For example, an earlier study by Pluviano et al. (2017) found that corrective messages in a myth-fact format backfired and reinforced vaccine misperceptions. However, a replication study conducted in 2021 (Ecker et al., 2023) found no evidence of this backfire effect, as the corrective message effectively reduced participants' vaccine misperceptions. The authors posited that a possible explanation for this discrepancy could be that

people became less skeptical about childhood vaccines in 2021 compared to 2016, thus rendering corrective messages more effective (Ecker et al., 2023). Therefore, future studies that employ a longitudinal design are needed to understand the changing landscape of vaccine misinformation and to determine the optimal timing for implementing corrective interventions.

Future Research Directions

Several potential avenues for future research can further our understanding of inoculation message effects. First, more research is needed to examine the relative persuasiveness of different forms of inoculation message. There are two difference types of inoculation message that address misinformation: issue-based and technique-based inoculations. Issue-based inoculations focus on forewarning and refuting specific misleading arguments about an issue, while technique-based inoculation concentrate on revealing the strategies that misinformation often relies on to deceive the public (Roozenbeek, Traberg, et al., 2022). This dissertation solely examines issue-based inoculation. It would be valuable to explore whether the effects and mechanisms of technique-based inoculation differ from those of issue-based inoculation. Moreover, inoculation messages may utilize difference types of evidence. In this research, the inoculation message presented statistical evidence. Emerging evidence suggests that narrative correction can reduce conspiracy beliefs about government malfeasance (Biddlestone et al., 2023) and appears to be more effective in reducing misperceptions than corrective messages based on factual evidence (Kropf et al., 2023). Further studies are needed to examine whether inoculation message effects vary depending on the type of evidence employed.

Future research can replicate our findings using various presentation modes. Previous studies have found that presentation mode significantly impacts individuals' responses to persuasive messages. For example, infographics led to greater issue-relevant thinking compared

to text-only messages (Lazard & Atkinson, 2015), and image-only corrections enhanced message believability of corrective messages compared to text-only correction and text-plus-image correction (Song et al., 2022). Moreover, it remains unclear whether corrections employing multimodal approaches are more effective than a traditional text-based approach (Johnson et al., 2022). Therefore, future studies may replicate experiments from this dissertation using different presentation modes and explore the most effective mode for communicating inoculation messages. Relatedly, additionally research is needed to examine whether inoculation messages can effectively counteract misinformation delivered in other formats, such as deepfake videos (Heley et al., 2022) and out-of-context visual misinformation (Fazio, 2020; Qian et al., 2023).

In the similar vein, an important direction for future research is to examine whether the effectiveness of inoculation message varies across different forms of misinformation. An increasing number of studies have highlighted the need to differentiate between various forms of misinformation, as they may have varying impacts (Enders et al., 2020; Southwell et al., 2022; Y. Wang et al., 2022b; X. Zhao & Tsang, 2023). For example, X. Zhao and Tsang (2023) conducted a study on COVID-19 vaccine misinformation and found that people perceived misused misinformation as less false than fabricated misinformation. Moreover, they found that misinformation accompanied by narrative evidence was perceived as less false compared to that supported by statistical evidence. In another study on COVID-19 misinformation, Enders et al. (2020) distinguished between conspiracy theories and general health misinformation. They found that conspiracy theories (e.g., “Bill Gates is behind the coronavirus pandemic.” P. 3) received more support than misinformation about dangerous health practices (e.g., “putting disinfectant into your body can prevent or cure COVID-19.” p.3). Furthermore, emerging evidence indicates that the valence of misinformation significantly impacts the efficacy of corrective interventions.

For example, Huijstee et al. (2022) found that corrective messages could effectively mitigate the impact of positive misinformation (e.g., a story about the hospital winning an award for having the highest COVID-19 recovery rates in Western Europe) but not negative misinformation (e.g., a story about the hospital having the highest COVID-19 mortality rates of Western Europe). As such, it is important for future research to investigate whether inoculation messages have varied effectiveness when addressing health misinformation with different valence, evidence types, and levels of falsity.

It is worth exploring whether emerging communication technologies, such as AI chatbots, gaming platforms, and virtual reality systems, can enhance the delivery of inoculation messages. Research has suggested that chatbots can be effective tools in inoculating people against misinformation, as they can identify fallacious arguments and deliver persuasive messaging through dialogue (Musi et al., 2023). Moreover, emerging evidence suggests that fact-checking is more effective when delivered through chatbots compared to traditional webpages (X. Zhao et al., 2023). Although gamified inoculation interventions are gaining traction, their efficacy remains inconclusive. While some studies suggest that gamified inoculation is more effective than non-gamified version of the same intervention in improving individuals' news veracity discernment (Modirrousta-Galian et al., 2023), other research indicates that it does not improve individuals' ability to distinguish between true and fake news (Matchanova et al., 2023; Modirrousta-Galian & Higham, 2023). Recent research has raised concerns that the immersive features of virtual reality systems may foster false beliefs (J. G. Brown et al., 2023). Nonetheless, few studies have investigated whether the capabilities of these virtual reality systems can also contribute to the acceptance of factual messages. Therefore, further research is needed to

determine the potential of emerging communication technologies in addressing misinformation and promoting fact acceptance.

Effective intervention against misinformation relies not only on well-crafted message design but also on appropriate message dissemination. However, the question of how many doses of inoculation or debunking messages are needed to effectively reduce misperceptions remains largely unexplored. Some studies have shown that repeatedly informing people about the benefits of vaccination can reduce COVID-19 vaccination hesitancy, whereas a single message emphasizing vaccine benefits may be insufficient (Burger et al., 2022). Similarly, Morgan and Cappella (2023) found that repeated exposure to factual statements about tobacco was linked to stronger subjective truth. It should be noted, however, that repeated exposure to persuasive messages might lead to message fatigue (So et al., 2017), which could further undermine health behaviors (Ball & Wozniak, 2021; S. Kim & So, 2018; So, 2022). Therefore, additional research is needed to determine the optimal frequency for disseminating inoculation messages to effectively communicate facts to the public.

Future research is also needed to determine the efficacy of inoculation messages in conferring resistance to repeated exposure to misinformation. Although Ivanov et al. (2009) found that exposure to an inoculation message can protect established attitudes against multiple persuasive attacks, the existing empirical evidence for this inquiry remains limited. Mourali and Drake (2022) found that debunking misinformation about public masking during COVID-19 enhanced individuals' attitudes and intentions toward masking. However, the positive effect diminished when participants encountered a second wave of misinformation. More concerning, the detrimental impact of the second misinformation message could not be mitigated by subsequent exposure to further debunking messages. This is because exposure to multiple

corrective and misinformation messages made individuals less likely to believe in the existence of an objective truth concerning the issue (Mourali & Drake, 2022). The information landscape is often rife with a mix of contradictory information, some accurate and some not, rather than a simple linear progression from misinformation to corrections. As such, it is crucial for future research to delve deeper into how the complex interplay between misinformation and corrective interventions impacts individuals' perceptions of truth.

It would be valuable to further explore the role of affect in inoculation message effects. Studies have shown that exposure to inoculation can elicit a number of emotions. For example, Ivanov et al. (2020) found that compared to non-inoculated individuals, those who received an inoculation message experienced greater levels of anger, fear, sadness, surprise, and lower levels of happiness after encountering the attack message. Moreover, other discrete emotions, such as happiness (Pfau et al., 2001) and guilt (Compton & Pfau, 2008), also appear to impact resistance to persuasion. Future research can advance our understanding of how inoculation messages elicit distinct emotions, and how these emotions impact resistance to persuasion. Additionally, emerging evidence suggests that negative emotions could be a double-edged sword in misinformation correction. For example, Freiling et al. (2023) found that anxiety during the COVID-19 pandemic not only amplified susceptibility to misinformation, but also made people more open to accurate information. This finding highlights the need for further research to delve into a more nuanced understanding of the role emotions play in both the consumption and correction of misinformation. For example, future study can examine whether anger against misinformation lowers beliefs in misinformation while simultaneously undermining beliefs in accurate information.

More studies are needed to examine whether the moderating role of individuals' initial misperceptions in impacting inoculation message effectiveness varies across different contexts. While the current study found that inoculation message remains effective among initially informed, uninformed, and misinformed individuals, previous findings appear to be mixed. Some studies found that corrective intervention addressing misinformation about COVID-19 vaccines were more effective among those with less initial vaccine hesitancy (Amazeen et al., 2022; Johnson et al., 2022). In contrast, another collection of studies found that interventions addressing COVID-19 vaccine misinformation were more effective among initially misinformed individuals (Carey et al., 2022). Additionally, similar to our findings, some studies indicated that the effectiveness of inoculation message (vs. one-side message) in promoting COVID-19 vaccination attitudes did not differ among those with initial neutral and opposed attitudes about COVID-19 vaccines (Brinson, 2022). The inconsistency of findings might be attributed to the different timings of data collection and the different control groups being compared. Further research is needed to advance our understanding of whether inoculation messages consistently possess therapeutic effects across different populations and issue contexts.

Future research can extend the current research to other cultural contexts. Scholars have called for more cross-cultural comparative research on messaging related to contentious health and science issues (Carey et al., 2022). Emerging evidence suggests that there are cross-national differences in people's perceptions of misinformation. For example, van der Meer et al. (2022) found that individuals from the UK reported lower levels of third-person perception of misinformation compared to those from the Netherlands. This difference could be attributed to the fact that UK citizens have lower trust in news sources, and the information environment in the UK is more polarized than in the Netherlands (van der Meer et al., 2022). Moreover, the

effectiveness of correction messages also appears to vary across samples from different nations. For example, R. M. Wood et al. (2023) found that exposure to a debunking message against COVID-19 vaccine misinformation effectively decreased perceived risks of COVID-19 vaccines among UK respondents. However, the same intervention had no significant impact among US respondents (R. M. Wood et al., 2023). Therefore, more cross-cultural comparison studies are needed to examine whether inoculation message effects vary across populations from different cultural backgrounds.

Conclusion

In conclusion, this dissertation demonstrates the efficacy of inoculation messages in reducing susceptibility to COVID-19 vaccine misinformation. Findings indicate that inoculation messages not only counteract beliefs in misinformation but also foster positive attitudes and intentions toward COVID-19 vaccination. This research extends inoculation theory by examining alternative mechanisms – perceived ease of counterarguing and anger – underlying inoculation message effects. Findings underscore the need to consider cognitive, meta-cognitive, and affective routes involved in resistance to persuasion. The study also reveals the consistent effectiveness of inoculation messages among initially informed, uninformed, and misinformed individuals, suggesting inoculation message offers both prophylactic and therapeutic effects. Moreover, the research demonstrates that the efficacy of inoculation messages is not contingent upon the partisan sources linked to the inoculation or misinformation messages, encouraging collaboration across political groups to address vaccine hesitancy. These findings support inoculation messages as an effective tool in counteracting misinformation and fostering vaccination acceptance.

Appendix A: Tables

Table 1

Pilot Test Sample Characteristics (N = 82)

Variable	Categories	Number	Percent (%)
Age	*M* = 38. 43, *SD* = 13. 70, *Range* = [20, 74]		
Sex	Male	46	56.1
	Female	36	43.9
	Other	0	0
Ethnicity	Hispanic	19	23.2
	Non-Hispanic	63	76.8
Race	White	69	84.1
	Black or African American	7	8.5
	American Indian or Alaska Native	2	2.4
	Asian	4	4.9
	Native Hawaiian or Pacific Islander	0	0
	Two or more races	0	0
	Other	0	0
Education	Less than high school	0	0
	High school graduate	7	8.5
	Some college	11	13.4
	College graduate	45	54.9
	Post-graduate	19	23.2
Income	$0-$9,999	0	0
	$10,000 to $14,999	5	6.1
	$15,000-$19,999	3	3.7
	$20,000-$34,999	9	11
	$35,000-$49,999	22	26.8
	$50,000 to $74,999	26	31.7
	$75,000-$99,999	12	14.6
	$100,000-$199,999	5	6.1
	$200,000 or more	0	0
Political party affiliation	Republican	39	47.6
	Independent	8	9.8
	Democrat	34	41.5
	Other	1	1.2

Table 2

Beliefs in COVID-19 Vaccine Misinformation (Pilot Test)

Misinformation Statements	Responses				
	Definitely false	Probably false	I don't know	Probably true	Definitely true
COVID-19 vaccines are not effective at all.	17 (20.7%)	11 (13.4%)	14 (17.1%)	24 (29.3%)	16 (19.5%)
COVID-19 vaccines cannot protect against COVID-19 variants at all.	12 (14.6%)	10 (12.2%)	14 (17.1%)	32 (39%)	14 (17.1%)
Vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID-19.	12 (14.6%)	8 (9.8%)	13 (15.9%)	26 (31.7%)	23 (28%)
Natural immunity provides better protection than vaccine-induced immunity to Covid-19.	12 (14.6%)	6 (7.3%)	17 (20.7%)	23 (28%)	24 (29.3%)

Table 3

Study 1Sample Characteristics (N = 659)

Variable	Categories	Number	Percent (%)
Age	*M* = 40.03, *SD* = 14.22, *Range* = [18, 78]		
Sex	Male	390	59.2
	Female	269	40.8
	Other	0	0
Ethnicity	Hispanic	117	17.8
	Non-Hispanic	542	82.2
Race	White	591	89.7
	Black or African American	25	3.8
	American Indian or Alaska Native	5	0.8
	Asian	30	4.6
	Native Hawaiian or Pacific Islander	0	0
	Two or more races	2	0.3
	Other	6	0.9
Education	Less than high school	2	0.3
	High school graduate	56	8.5
	Some college	84	12.7
	College graduate	420	63.7
	Post-graduate	97	14.7
Income	$0-$9,999	9	1.4
	$10,000 to $14,999	25	3.8
	$15,000-$19,999	25	3.8
	$20,000-$34,999	89	13.5
	$35,000-$49,999	222	33.7
	$50,000 to $74,999	172	26.1
	$75,000-$99,999	86	13.1
	$100,000-$199,999	28	4.2
	$200,000 or more	3	0.5
Political party affiliation	Republican	194	29.4
	Independent	98	14.9
	Democrat	365	55.4
	Other	2	0.3

Table 4

Descriptive Statistics and Correlation Matrix for Key Variables (Study 1)

	M	*SD*	1	2	3	4	5	6	7	8	9	10
1	-	-										
2	-	-	.02 [-.06, .10]									
3	-	-	.03 [-.05, .10]	-.32** [-.38, -.25]								
4	4.33	1.76	-.00 [-.08, .07]	-.04 [-.11, .04]	.09* [.02, .17]							
5	5.22	1.24	.09* [.02, .17]	-.08* [-.16, -.00]	-.03 [-.11, .04]	.32** [.24, .38]						
6	4.42	1.72	.09* [.01, .16]	-.04 [-.12, .03]	.08* [.00, .15]	.23** [.15, .30]	.40** [.33, .46]					
7	3.20	1.11	-.13** [-.20, -.05]	.07 [-.01, .14]	.55** [.49, .60]	.05 [-.02, .13]	-.16** [-.24, -.09]	-.03 [-.10, .05]				
8	5.63	1.21	.08* [.00, .15]	-.12** [-.20, -.05]	-.19** [-.26, -.12]	.24** [.17, .31]	.57** [.52, .62]	.34** [.27, .41]	-.28** [-.34, -.20]			
9	5.24	1.51	.08* [.00, .15]	-.09* [-.17, -.02]	-.09* [-.17, -.02]	.17** [.10, .24]	.52** [.46, .57]	.32** [.25, .39]	-.18** [-.25, -.10]	.65** [.61, .69]		
10	5.36	1.51	.08* [.01, .16]	-.14** [-.21, -.06]	-.05 [-.12, .03]	.19** [.12, .27]	.50** [.44, .56]	.30** [.23, .37]	-.17** [-.24, -.09]	.60** [.54, .64]	.75** [.71, .78]	
11	5.13	1.36	.08* [.01, .16]	-.11** [-.19, -.04]	.02 [-.06, .09]	.30** [.23, .37]	.55** [.50, .60]	.45** [.39, .51]	-.06 [-.13, .02]	.65** [.60, .69]	.67** [.63, .71]	.61** [.56, .66]

Note. 1 = Inoculation (vs. Control). 2 = Uninformed (vs. Informed) individuals. 3 = Misinformed (vs. Informed) individuals. 4 = Counterarguing. 5 = Perceived ease of counterarguing. 6 = Anger. 7 = Belief in COVID-19 vaccine misinformation. 8 = COVID-19 vaccination attitude. 9 = COVID-19 Vaccination intention for self. 10 = COVID-19 vaccination intention for child. 11 = COVID-19 vaccination recommendation. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$.

Table 5.1

Summary of Means and SD of Key variable by Experimental Groups in Study 1

	Control Group (n = 329)		Inoculation Group (n = 330)	
Dependent Variables	M	SD	M	SD
Beliefs in COVID-19 Vaccine Misinformation	3.34	1.14	3.06	1.07
COVID-19 Vaccination Attitude	5.53	1.32	5.72	1.09
COVID-19 Vaccination Intention for Self	5.12	1.59	5.35	1.41
COVID-19 Vaccination Intention for Child	5.24	1.56	5.48	1.45
COVID-19 Vaccination Recommendation	5.01	1.42	5.24	1.28
Mediators				
Counterarguing	4.33	1.73	4.32	1.79
Perceived Ease of Counterarguing	5.10	1.33	5.33	1.12
Anger	4.27	1.77	4.57	1.66

Note. M and *SD* represent mean and standard deviation, respectively.

Table 5.2

Summary of Means and SD of Key variable by Initial Misperception Groups in Study 1

	Conditions	Informed (n = 290)		Uninformed (n = 72)		Misinformed (n = 297)	
Dependent Variables		M	SD	M	SD	M	SD
Beliefs in COVID-19	Control	2.59	1.12	3.53	0.61	4.08	0.63
Vaccine Misinformation	Inoculation	2.32	1.01	3.32	0.67	3.67	0.75
COVID-19 Vaccination	Control	5.93	1.03	5.01	1.19	5.23	1.49
Attitude	Inoculation	6.06	1.03	5.38	0.93	5.50	1.11
COVID-19 Vaccination	Control	5.41	1.40	4.82	1.31	4.88	1.78
Intention for Self	Inoculation	5.59	1.37	4.84	1.31	5.27	1.44
COVID-19 Vaccination	Control	5.49	1.38	4.74	1.48	5.09	1.72
Intention for Child	Inoculation	5.71	1.40	4.79	1.60	5.46	1.41
COVID-19 Vaccination	Control	5.16	1.28	4.61	1.18	4.96	1.59
Recommendation	Inoculation	5.26	1.42	4.75	1.25	5.33	1.12
Mediators							
Counterarguing	Control	4.13	1.91	3.97	1.17	4.63	1.61
	Inoculation	4.25	1.94	4.29	1.51	4.39	1.71
Perceived Ease of	Control	5.19	1.22	4.91	1.22	5.06	1.47
Counterarguing	Inoculation	5.49	1.09	4.95	1.13	5.28	1.13
Anger	Control	4.12	1.81	4.15	1.36	4.46	1.80
	Inoculation	4.55	1.76	4.25	1.58	4.67	1.58

Note. M and *SD* represent mean and standard deviation, respectively.

Table 6

Effect of Inoculation Message on Five Persuasive Outcomes

	DV1: Beliefs in COVID-19 Vaccine misinformation			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	2.66 ***	0.30		<.001
Age	0.01 *	0.003	0.07	0.04
Female (vs. Male)	-0.05	0.09	-0.02	0.57
Hispanic (vs. Non-Hispanic)	0.69 ***	0.12	0.24	<.001
White (vs. Other)	0.50 ***	0.14	0.14	<.001
Education	0.04	0.06	0.03	0.50
Income	-0.02	0.03	-0.02	0.58
Democrat (vs. Republican)	-0.18	0.10	-0.08	0.08
Other (vs. Republican)	-0.27 *	0.13	-0.09	0.04
Inoculation	-0.31 ***	0.08	-0.14	<.001
	ΔR^2 = .020***, R^2 = .093***			
	DV2: COVID-19 Vaccination Attitude			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	4.62 ***	0.33		<.001
Age	-0.03	0.003	-0.03	0.39
Female (vs. Male)	0.07	0.10	0.03	0.47
Hispanic (vs. Non-Hispanic)	0.34 **	0.13	0.11	0.01
White (vs. Other)	-0.21	0.16	-0.05	0.19
Education	0.14 *	0.06	0.09	0.02
Income	0.05	0.03	0.05	0.17
Democrat (vs. Republican)	0.55 ***	0.11	0.22	<.001
Other (vs. Republican)	0.12	0.15	0.03	0.42
Inoculation	0.20 *	0.09	0.08	0.03
	ΔR^2 = .007*, R^2 = .079***			
	DV3: COVID-19 Vaccination Intention for Self			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	4.00 ***	0.41		<.001
Age	-0.01	0.004	-0.06	0.15
Female (vs. Male)	0.15	0.12	0.05	0.20
Hispanic (vs. Non-Hispanic)	0.18	0.16	0.05	0.27
White (vs. Other)	-0.17	0.20	-0.03	0.40
Education	0.26 **	0.08	0.13	0.001
Income	0.07	0.04	0.07	0.09
Democrat (vs. Republican)	0.16	0.14	0.05	0.27
Other (vs. Republican)	-0.35	0.18	-0.08	0.06
Inoculation	0.26 *	0.12	0.09	0.03
	ΔR^2 = .007*, R^2 = .059***			

	DV4: COVID-19 Vaccination Intention for Child			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	4.59 ***	0.41		<.001
Age	-0.004	0.004	-0.04	0.31
Female (vs. Male)	0.03	0.12	0.01	0.77
Hispanic (vs. Non-Hispanic)	0.30	0.17	0.07	0.08
White (vs. Other)	-0.27	0.20	-0.05	0.18
Education	0.18 *	0.08	0.09	0.03
Income	0.03	0.04	0.03	0.51
Democrat (vs. Republican)	0.30 *	0.14	0.10	0.04
Other (vs. Republican)	-0.08	0.19	-0.02	0.65
Inoculation	0.26 *	0.12	0.09	0.03
	ΔR^2 = .008*, R^2 = .041**			

	DV5: COVID-19 Vaccination Recommendation			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	4.06 ***	0.37		<.001
Age	-0.001	0.004	-0.01	0.81
Female (vs. Male)	0.05	0.11	0.02	0.61
Hispanic (vs. Non-Hispanic)	0.64 ***	0.15	0.18	<.001
White (vs. Other)	0.14	0.18	0.03	0.43
Education	0.15 *	0.07	0.08	0.04
Income	0.01	0.04	0.01	0.80
Democrat (vs. Republican)	0.26 *	0.13	0.10	0.04
Other (vs. Republican)	-0.18	0.17	-0.05	0.27
Inoculation	0.21 *	0.10	0.08	0.04
	ΔR^2 = .006*, R^2 = .056***			

Note. A significant *b*-weight indicates the beta-weight is also significant. *b* represents unstandardized regression weights. *beta* indicates the standardized regression weights. *SE* represents standard error. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively. Inoculation represents the experimental treatment (inoculation message vs. no message-control). ΔR^2 represents R-square increase due to experimental treatment. *indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$.

Table 7

Effect of Inoculation Message on Three Mediators

	M1: Counterarguing			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	4.14 ***	0.49		<.001
Age	<.001	0.005	<.001	0.96
Female (vs. Male)	-0.24	0.14	-0.07	0.10
Hispanic (vs. Non-Hispanic)	0.54 **	0.19	0.12	0.006
White (vs. Other)	0.32	0.24	0.06	0.18
Education	-0.002	0.09	<.001	0.99
Income	-0.001	0.05	<.001	0.98
Democrat (vs. Republican)	-0.09	0.17	-0.02	0.60
Other (vs. Republican)	-0.03	0.22	-0.01	0.88
Inoculation	-0.04	0.14	-0.01	0.77
	$\Delta R^2 < .01$, $R^2 = .020$			
	M2: Perceived Ease of Counterarguing			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	4.25 ***	0.34		<.001
Age	0.003	0.003	0.03	0.38
Female (vs. Male)	-0.06	0.10	-0.03	0.52
Hispanic (vs. Non-Hispanic)	0.36 **	0.14	0.11	0.009
White (vs. Other)	-0.13	0.16	-0.03	0.43
Education	0.10	0.07	0.06	0.12
Income	0.04	0.03	0.05	0.21
Democrat (vs. Republican)	0.30 *	0.12	0.12	0.01
Other (vs. Republican)	0.17	0.15	0.05	0.26
Inoculation	0.23 *	0.10	0.09	0.02
	$\Delta R^2 = .009$*, $R^2 = .040$**			
	M3: Anger			
Predictor	*b*	*SE*	*beta*	*p*
(Intercept)	2.70 ***	0.47		<.001
Age	0.005	0.004	0.04	0.29
Female (vs. Male)	-0.20	0.14	-0.06	0.14
Hispanic (vs. Non-Hispanic)	0.87 ***	0.19	0.19	<.001
White (vs. Other)	0.24	0.23	0.04	0.29
Education	0.26 **	0.09	0.12	.003
Income	0.02	0.05	0.02	0.66
Democrat (vs. Republican)	-0.01	0.16	-0.00	0.97
Other (vs. Republican)	-0.13	0.21	-0.03	0.52
Inoculation	0.27 *	0.13	0.08	0.04
	$\Delta R^2 = .008$*, $R^2 = .063$**			

Note. ΔR^2 represents R-square increase due to experimental treatment. *indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$.

Table 8

Mediation Models of Inoculation Message Effects on Five Persuasive Outcomes

	DV1: Beliefs in COVID-19 Vaccine misinformation		
	Estimate	*SE*	95% CI
Direct Effect	-.270*	.083	[-.432, -.108]
Indirect Effect			
M1: Counterarguing	-.002	.008	[-.021, .013]
M2: Perceived ease of counterarguing	-.039*	.019	[-.082, -.006]
M3: Anger	-.003	.009	[-.022, .015]
	DV2: COVID-19 Vaccination Attitude		
	Estimate	*SE*	95% CI
Direct Effect	.075	.076	[-.073, .224]
Indirect Effect			
M1: Counterarguing	-.002	.008	[-.019, .012]
M2: Perceived ease of counterarguing	.106*	.047	[.017, .203]
M3: Anger	.024*	.014	[.001, .056]
	DV3: COVID-19 Vaccination Intention for Self		
	Estimate	*SE*	95% CI
Direct Effect	.094	.099	[-.100, .289]
Indirect Effect			
M1: Counterarguing	.001	.004	[-.011, .009]
M2: Perceived ease of counterarguing	.127*	.056	[.023, .243]
M3: Anger	.032*	.019	[.001, .076]
	DV4: COVID-19 Vaccination Intention for Child		
	Estimate	*SE*	95% CI
Direct Effect	.112	.102	[-.088, .313]
Indirect Effect			
M1: Counterarguing	-.001	.007	[-.017, .011]
M2: Perceived ease of counterarguing	.122*	.052	[.027, .230]
M3: Anger	.027*	.017	[.001, .066]
	DV4: COVID-19 Vaccination Recommendation		
	Estimate	*SE*	95% CI
Direct Effect	.061	.084	[-.103, .225]
Indirect Effect			
M1: Counterarguing	-.004	.013	[-.032, .019]
M2: Perceived ease of counterarguing	.103*	.046	[.021, .200]
M3: Anger	.053*	.027	[.003, .109]

Note. Coefficients represent unstandardized indirect effects. 95% CIs are 95% confidence intervals based on 5,000 bootstrap samples. *denotes significance based on 95% bootstrap CI.

Table 9

The Moderating Role of Initial Misperception Groups (Informed, Uninformed, Misinformed) on the Persuasive Effects of Inoculation Message

Predictors	Dependent Variables				
	Beliefs in Misinformation	Vaccination Attitude	Vaccination Intention for self	Vaccination Intention for child	Vaccination Recommendation
(Intercept)	2.22 ***	4.88 ***	4.19 ***	4.77 ***	4.22 ***
Age	-0.001	-0.001	-0.005	-0.004	-0.001
Female (vs. Male)	-0.03	0.07	0.14	0.02	0.04
Hispanic (vs. non-Hispanic)	0.43 ***	0.45 ***	0.24	0.33 *	0.65 ***
White (vs. Other)	0.14	-0.05	-0.06	-0.18	0.18
Education	0.06	0.13 *	0.24 **	0.16 *	0.13
Income	0.00	0.04	0.07	0.03	0.02
Democrat (vs. Republican)	-0.02	0.49 ***	0.12	0.28	0.26 *
Other (vs. Republican)	-0.23 *	0.10	-0.36 *	-0.10	-0.19
Inoculation	-0.29 **	0.15	0.22	0.24	0.11
Uninformed (vs. Informed)	0.89 ***	-0.94 ***	-0.61 *	-0.76 **	-0.60 *
Misinformed (vs. Informed)	1.44 ***	-0.62 ***	-0.42 *	-0.31	-0.19
Inoculation* Uninformed	0.12	0.28	-0.11	-0.12	0.12
Inoculation* Misinformed	-0.14	0.08	0.13	0.10	0.23
ΔR^2	0.001	0.001	0.001	0.001	0.001
R^2	0.41***	0.14***	0.08***	0.07***	0.07***

Note. Coefficients represent unstandardized indirect effects. Inoculation represents the experimental treatment (inoculation message vs. no message-control). Initial misperception groups are dummy-coded, with the informed group as the reference group. ΔR^2 represents R-Square increase due to interaction terms. *indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$.

Table 10

Conditional Indirect Effects of Inoculation Message on Five Persuasive Outcomes

	DV1: Beliefs in COVID-19 Vaccine misinformation			
	W Level	Estimate	*SE*	95%CI
M1: Counterarguing	W1: IMM = .005, *SE* = .012, 95%CI = [-.019, .037]			
	W2: IMM = -.007, *SE* = .012, 95%CI = [-.036, .012]			
	Informed	.002	.007	[-.012, .019]
	Uninformed	.007	.012	[-.014, .035]
	Misinformed	-.006	.008	[-.026, .007]
M2: Perceived Ease of Counterarguing	W1: IMM = .029, *SE* = .038, 95%CI = [-.382, .114]			
	W2: IMM = .011, *SE* = .023, 95%CI= [-.036, .056]			
	Informed	-.034*	.018	[-.074, -.005]
	Uninformed	-.006	.034	[-.074, .068]
	Misinformed	-.023	.019	[-.067, .008]
M3: Anger	W1: IMM = .009, *SE* = .017, 95%CI = [-.024, .050]			
	W2: IMM = .008, *SE* = .013, 95%CI = [-.014, .037]			
	Informed	-.014	.013	[-.042, .007]
	Uninformed	-.005	.015	[-.039, .022]
	Misinformed	-.006	.009	[-.027, .008]
	DV2: COVID-19 Vaccination Attitude			
	W Level	Estimate	SE	95%CI
M1: Counterarguing	W1: IMM = .013, *SE* = .027, 95%CI = [-.039, .071]			
	W2: IMM = -.021, *SE* = .021, 95%CI = [-.067, .016]			
	Informed	.005	.015	[-.024, .039]
	Uninformed	.019	.023	[-.023, .069]
	Misinformed	-.016	.014	[-.046, .009]
M2: Perceived Ease of Counterarguing	W1: IMM = -.114, *SE* = .143, 95%CI = [-.400, .170]			
	W2: IMM = -.046, *SE* = .088, 95%CI = [-.220, .126]			
	Informed	.136*	.061	[.021, .262]
	Uninformed	.022	.131	[-.233, .291]
	Misinformed	.090	.066	[-.032, .231]
M3: Anger	W1: IMM = -.026, *SE* = .042, 95%CI = [-.117, .058]			
	W2: IMM = -.025, *SE* = .030, 95%CI = [-.088, .031]			
	Informed	.041	.025	[-.001, .097]
	Uninformed	.015	.036	[-.056, .090]
	Misinformed	.016	.020	[-.022, .060]
	DV3: COVID-19 Vaccination Intention for Self			
	W Level	Estimate	SE	95%CI

M1: Counterarguing	W1: IMM = .003, *SE* = .014, 95%CI = [-.026, .035]			
	W2: IMM = -.005, *SE* = .013, 95%CI = [-.035, .021]			
	Informed	.001	.008	[-.015, .019]
	Uninformed	.004	.013	[-.020, .035]
	Misinformed	-.003	.009	[-.026, .014]
M2: Perceived Ease of Counterarguing	W1: IMM = -.140, *SE* = .176, 95%CI =[-.483, .212]			
	W2: IMM = -.056, *SE* = .108, 95%CI = [-.270, .152]			
	Informed	.167*	.076	[.024, .323]
	Uninformed	.027	.160	[-.293, .355]
	Misinformed	.111	.081	[-.040, .277]
M3: Anger	W1: IMM = -.032, *SE* = .053, 95%CI = [-.145, .070]			
	W2: IMM = -.031, *SE* = .038, 95%CI = [-.111, .041]			
	Informed	.051	.031	[-.003, .123]
	Uninformed	.019	.044	[-.069, .112]
	Misinformed	.021	.025	[-.026, .077]

	DV4: COVID-19 Vaccination Intention for Child			
	W Level	Estimate	SE	95%CI
M1: Counterarguing	W1: IMM = .008, *SE* = .021, 95%CI = [-.029, .058]			
	W2: IMM = -.012, *SE* = .017, 95%CI = [-.055, .016]			
	Informed	.003	.011	[-.019, .029]
	Uninformed	.011	.019	[-.020, .056]
	Misinformed	-.009	.012	[-.039, .010]
M2: Perceived Ease of Counterarguing	W1: IMM = -.133, *SE* = .164, 95%CI= [-.460, .186]			
	W2: IMM = -.053, *SE* = .101, 95%CI= [-.261, .145]			
	Informed	.159*	.071	[.025, .303]
	Uninformed	.026	.151	[-.265, .327]
	Misinformed	.106	.077	[-.043, .261]
M3: Anger	W1: IMM = -.027, *SE* = .045, 95%CI = [-.126, .053]			
	W2: IMM = -.025, *SE* = .032, 95%CI = [-.099, .031]			
	Informed	.042	.028	[-.001, .108]
	Uninformed	.016	.037	[-.056, .093]
	Misinformed	.017	.021	[-.023, .063]

	DV5: COVID-19 Vaccination Recommendation			
	W Level	Estimate	SE	95%CI
M1: Counterarguing	W1: IMM = .019, *SE* = .038, 95%CI = [-.053, .101]			
	W2: IMM = -.030, *SE* =.028, 95%CI = [-.091, .023]			
	Informed	.008	.021	[-.034, .051]
	Uninformed	.027	.032	[-.032, .095]
	Misinformed	-.022	.019	[-.064, .011]
	W1: IMM = -.115, *SE* = .144, 95%CI = [-.405, .164]			

M2: Perceived	W2: IMM = -.046, *SE* = .090, 95%CI = [-.224, .128]			
Ease of	Informed	.137*	.062	[.024, .268]
Counterarguing	Uninformed	.022	.131	[-.233, .283]
	Misinformed	.091	.068	[-.037, .231]
M3: Anger	W1: IMM = -.051, *SE* =.080, 95%CI = [-.214, .108]			
	W2: IMM = -.049, *SE* = .056, 95%CI = [-.160, .060]			
	Informed	.081	.044	[-.001, .173]
	Uninformed	.030	.068	[-.100, .170]
	Misinformed	.032	.037	[-.038, .108]

Note. W1 represents uninformed (vs. informed) groups. W2 represents misinformed (vs. informed) groups. IMM refers to the index of moderated mediation. Coefficients represent unstandardized indirect effects drawn from PROCESS model 8. 95% CIs are 95% confidence intervals based on 5,000 bootstrap samples.

Table 11

Study 2 Sample Characteristics (N = 448)

Variable	Categories	Number	Percent (%)
Age	*M* = 40.41, *SD* = 14.77, *Range* = [18, 77]		
Sex	Male	217	48.4
	Female	227	50.7
	Other	4	0.9
Ethnicity	Hispanic	40	8.9
	Non-Hispanic	408	91.1
Race	White	348	77.7
	Black or African American	30	6.7
	American Indian or Alaska Native	3	0.7
	Asian	46	10.3
	Native Hawaiian or Pacific Islander	0	0
	Two or more races	17	3.8
	Other	4	0.9
Education	Less than high school	2	0.4
	High school graduate	71	15.8
	Some college	116	25.9
	College graduate	201	44.9
	Post-graduate	58	12.9
Income	$0-$9,999	16	3.6
	$10,000 to $14,999	21	4.7
	$15,000-$19,999	21	4.7
	$20,000-$34,999	54	12.1
	$35,000-$49,999	55	12.3
	$50,000 to $74,999	106	23.7
	$75,000-$99,999	74	16.5
	$100,000-$199,999	81	18.1
	$200,000 or more	20	4.5
Political party affiliation	Republican	223	49.8
	Democrat	225	50.2

Table 12

Descriptive Statistics and Correlation Matrix for Key Variables (Study 2)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11
1	-	-											
2	-	-	.06 [-.03, .15]										
3	-	-	-.00 [-.09, .09]	-.00 [-.10, .09]									
4	2.70	0.69	-.00 [-.10, .09]	-.03 [-.13, .06]	.06 [-.04, .15]								
5	4.58	2.03	-.00 [-.09, .09]	-.08 [-.17, .01]	.55** [.49, .61]	.06 [-.04, .15]							
6	4.57	1.78	-.03 [-.12, .06]	-.06 [-.15, .03]	.54** [.47, .60]	.06 [-.03, .16]	.83** [.80, .86]						
7	3.45	2.07	.01 [-.09, .10]	-.06 [-.15, .04]	.53** [.46, .60]	.19** [.10, .28]	.66** [.61, .71]	.68** [.63, .73]					
8	2.46	1.24	-.00 [-.10, .09]	.04 [-.05, .13]	-.57** [-.63, -.50]	-.07 [-.16, .02]	-.76** [-.80, -.72]	-.80** [-.83, -.76]	-.66** [-.71, -.60]				
9	5.14	2.08	-.03 [-.12, .06]	-.02 [-.12, .07]	.50** [.43, .57]	.02 [-.07, .11]	.73** [.68, .77]	.76** [.72, .79]	.62** [.56, .67]	-.79** [-.82, -.75]			
10	4.21	2.44	-.00 [-.09, .09]	-.04 [-.13, .06]	.56** [.49, .62]	.15** [.06, .24]	.72** [.67, .76]	.76** [.72, .80]	.66** [.60, .71]	-.77** [-.81, -.73]	.77** [.72, .80]		
11	4.35	2.50	-.01 [-.10, .08]	-.03 [-.12, .06]	.58** [.52, .64]	.10* [.01, .19]	.73** [.69, .77]	.77** [.73, .81]	.63** [.57, .68]	-.78** [-.81, -.74]	.77** [.73, .81]	.91** [.89, .92]	
12	4.18	2.26	-.03 [-.12, .06]	-.05 [-.14, .04]	.56** [.49, .62]	.11* [.01, .20]	.73** [.69, .77]	.76** [.72, .80]	.65** [.59, .70]	-.78** [-.82, -.75]	.79** [.75, .82]	.84** [.81, .87]	.83** [.80, .86]

Note. 1 = In-group (vs. out-group) inoculation. 2 = In-group (vs. out-group) misinformation. 3 = Party affiliation (Democrat vs. Republican). 4 = Party identification strength. 5 = Counterarguing. 6 = Perceived ease of counterarguing. 7 = Anger. 8 = Belief in COVID-19 vaccine misinformation. 9 = COVID-19 vaccination attitude. 10 = COVID-19 Vaccination intention for self. 11 = COVID-19 vaccination intention for child. 12 = Vaccination recommendation. *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. * indicates $p < .05$. ** indicates $p < .01$.

Table 13

Summary of Means and SD of Key variable by Experimental Groups and Party Affiliation

	Conditions		Party Affiliation			
	Inoculation Source	Misinformation Source	Republican (n = 223)		Democrat (n = 225)	
			M	*SD*	*M*	*SD*
Dependent Variables						
Beliefs in COVID-19 Vaccine Misinformation	FOX	Republican	3.22	1.17	1.76	0.93
	MSNBC	Republican	3.26	1.04	1.68	0.71
	FOX	Democrat	3.15	1.27	1.80	0.83
	MSNBC	Democrat	3.05	1.20	1.80	0.91
COVID-19 Vaccination Attitude	FOX	Republican	3.92	2.14	6.12	1.52
	MSNBC	Republican	4.14	2.00	6.30	1.26
	FOX	Democrat	4.06	2.18	6.33	1.31
	MSNBC	Democrat	4.28	2.15	5.99	1.61
COVID-19 Vaccination Intention for Self	FOX	Republican	2.79	2.03	5.62	1.84
	MSNBC	Republican	2.74	2.09	5.70	1.75
	FOX	Democrat	2.80	2.26	5.43	2.12
	MSNBC	Democrat	3.05	2.27	5.51	1.91
COVID-19 Vaccination Intention for Child	FOX	Republican	2.79	2.10	5.98	1.76
	MSNBC	Republican	2.92	2.20	5.80	1.62
	FOX	Democrat	2.96	2.35	5.70	2.03
	MSNBC	Democrat	2.88	2.22	5.69	1.98
COVID-19 Vaccination Recommendation	FOX	Republican	2.80	1.79	5.73	1.67
	MSNBC	Republican	2.81	1.90	5.45	1.64
	FOX	Democrat	2.94	2.19	5.38	1.88
	MSNBC	Democrat	3.09	2.15	5.19	1.75
Mediators						
Counterarguing	FOX	Republican	3.15	1.81	5.91	1.44
	MSNBC	Republican	3.46	1.75	5.91	1.32
	FOX	Democrat	3.75	2.06	5.52	1.50
	MSNBC	Democrat	3.52	2.01	5.46	1.49
Perceived Ease of Counterarguing	FOX	Republican	3.38	1.47	5.75	1.53
	MSNBC	Republican	3.68	1.52	5.63	1.28
	FOX	Democrat	3.63	1.67	5.40	1.36
	MSNBC	Democrat	3.76	1.80	5.30	1.35
Anger	FOX	Republican	2.45	1.71	4.71	1.90
	MSNBC	Republican	2.00	1.50	4.70	1.88
	FOX	Democrat	2.26	1.55	4.41	2.00
	MSNBC	Democrat	2.60	1.80	4.38	1.65

Note. FOX (inoculation) x Republican (misinformation) (n = 118). MSNBC (inoculation) x Republican (misinformation) (n = 106). FOX (inoculation) x Democrat (misinformation) (n = 105). MSNBC (inoculation) x Democrat (misinformation) (n = 119).

Table 14

Effect of Experimental Conditions on Five Persuasive Outcomes

	DV1: Beliefs in COVID-19 Vaccine misinformation			
	Model1		Model2	
Predictor	*b*	*SE*	*b*	*SE*
(Intercept)	3.62 ***	0.29	3.61 ***	0.29
Age	0.002	0.003	0.002	0.003
Female and Other (vs. Male)	0.21 *	0.10	0.21 *	0.10
Hispanic (vs. Non-Hispanic)	-0.09	0.17	-0.09	0.17
White (vs. Other)	-0.12	0.12	-0.12	0.12
Education	-0.07	0.06	-0.07	0.06
Income	-0.05	0.03	-0.05	0.03
Democrat (vs. Republican)	-1.46 ***	0.10	-1.46 ***	0.10
Ingroup Inoculation	-0.04	0.10	-0.01	0.14
Ingroup Misinformation	0.09	0.10	0.11	0.14
Ingroup Inoculation* Ingroup Misinformation			-0.05	0.19
R^2	0.35***		0.35***	
	DV2: COVID-19 Vaccination Attitude			
	Model1		Model2	
Predictor	*b*	*SE*	*b*	*SE*
(Intercept)	3.41 ***	0.51	3.34 ***	0.52
Age	0.001	0.01	0.001	0.01
Female and Other (vs. Male)	-0.12	0.18	-0.11	0.18
Hispanic (vs. Non-Hispanic)	0.13	0.30	0.13	0.30
White (vs. Other)	0.12	0.22	0.12	0.22
Education	0.04	0.10	0.04	0.10
Income	0.09	0.05	0.09	0.05
Democrat (vs. Republican)	2.16 ***	0.19	2.16 ***	0.19
Ingroup Inoculation	-0.09	0.17	0.03	0.24
Ingroup Misinformation	-0.07	0.17	0.06	0.24
Ingroup Inoculation* Ingroup Misinformation			-0.26	0.34
R^2	0.26***		0.26***	
	DV3: COVID-19 Vaccination Intention for Self			
	Model1		Model2	
Predictor	*b*	*SE*	*b*	*SE*
(Intercept)	1.46 *	0.56	1.51 **	0.57
Age	0.01 *	0.01	0.01 *	0.01
Female and Other (vs. Male)	-0.32	0.20	-0.32	0.20
Hispanic (vs. Non-Hispanic)	0.01	0.34	0.02	0.34
White (vs. Other)	-0.37	0.24	-0.37	0.24
Education	0.24 *	0.11	0.24 *	0.11
Income	0.07	0.05	0.07	0.05

Democrat (vs. Republican)	2.79 ***	0.21	2.79 ***	0.21
Ingroup Inoculation	0.06	0.19	-0.03	0.27
Ingroup Misinformation	-0.07	0.19	-0.16	0.27
Ingroup Inoculation* Ingroup Misinformation			0.18	0.38
R^2	0.34***		0.34***	
	DV4: COVID-19 Vaccination Intention for Child			
	Model1		Model2	
Predictor	*b*	*SE*	*b*	*SE*
(Intercept)	1.91 ***	0.57	1.91 **	0.58
Age	0.004	0.01	0.004	0.01
Female and Other (vs. Male)	-0.34	0.20	-0.34	0.20
Hispanic (vs. Non-Hispanic)	-0.21	0.34	-0.21	0.34
White (vs. Other)	-0.00	0.24	-0.00	0.24
Education	0.22 *	0.11	0.22 *	0.11
Income	0.04	0.05	0.04	0.05
Democrat (vs. Republican)	2.99 ***	0.21	2.99 ***	0.21
Ingroup Inoculation	-0.03	0.19	-0.03	0.27
Ingroup Misinformation	-0.07	0.19	-0.06	0.27
Ingroup Inoculation* Ingroup Misinformation			-0.01	0.38
R^2	0.36***		0.36***	
	DV5: COVID-19 Vaccination Recommendation			
	Model1		Model2	
Predictor	*b*	*SE*	*b*	*SE*
(Intercept)	2.20 ***	0.53	2.24 ***	0.54
Age	0.01	0.01	0.01	0.01
Female and Other (vs. Male)	-0.21	0.18	-0.22	0.18
Hispanic (vs. Non-Hispanic)	0.01	0.31	0.02	0.31
White (vs. Other)	-0.09	0.23	-0.10	0.23
Education	0.07	0.10	0.07	0.10
Income	0.07	0.05	0.07	0.05
Democrat (vs. Republican)	2.61 ***	0.19	2.62 ***	0.19
Ingroup Inoculation	-0.08	0.18	-0.15	0.25
Ingroup Misinformation	-0.18	0.18	-0.24	0.25
Ingroup Inoculation* Ingroup Misinformation			0.14	0.36
R^2	0.33***		0.33***	

Note. Ingroup inoculation represents in-group (vs. out-group inoculation). Ingroup misinformation represents in-group (vs. out-group) misinformation. *b* represents unstandardized regression weights. *SE* represents standard error. *indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$.

Table 15

Subgroup Analysis of Treatment Effects on Five Persuasive Outcomes

	DV1: Beliefs in COVID-19 Vaccine misinformation			
	Republican		Democrat	
Predictor	Model1	Model2	Model1	Model2
(Intercept)	3.57 ***	3.51 ***	2.07 ***	2.10 ***
Age	-0.00	-0.00	0.01	0.01
Female and Other (vs. Male)	0.27	0.28	0.17	0.17
Hispanic (vs. Non-Hispanic)	-0.36	-0.37	0.20	0.20
White (vs. Other)	0.15	0.17	-0.30 *	-0.30 *
Education	-0.03	-0.03	-0.10	-0.11
Income	-0.07	-0.07	-0.03	-0.03
Ingroup Inoculation	-0.05	0.05	-0.04	-0.10
Ingroup Misinformation	0.11	0.21	0.07	0.02
Ingroup Inoculation* Ingroup Misinformation		-0.21		0.11
R^2	0.04	0.04	0.07*	0.07*

	DV2: COVID-19 Vaccination Attitude			
	Republican		Democrat	
Predictor	Model1	Model2	Model1	Model2
(Intercept)	3.32 ***	3.34 ***	5.80 ***	5.65 ***
Age	0.01	0.01	-0.01	-0.01
Female and Other (vs. Male)	-0.31	-0.31	0.01	0.02
Hispanic (vs. Non-Hispanic)	0.27	0.27	-0.03	-0.04
White (vs. Other)	-0.43	-0.43	0.47 *	0.48 *
Education	-0.03	-0.03	0.09	0.11
Income	0.14	0.14	0.04	0.03
Ingroup Inoculation	-0.11	-0.14	0.02	0.30
Ingroup Misinformation	-0.11	-0.14	-0.01	0.28
Ingroup Inoculation* Ingroup Misinformation		0.06		-0.58
R^2	0.04	0.04	0.04	0.05

	DV3: COVID-19 Vaccination Intention for Self			
	Republican		Democrat	
Predictor	Model1	Model2	Model1	Model2
(Intercept)	1.87 *	2.01 *	4.25 ***	4.24 ***
Age	0.02 *	0.02 *	0.01	0.01
Female and Other (vs. Male)	-0.45	-0.47	-0.18	-0.18
Hispanic (vs. Non-Hispanic)	-0.09	-0.08	0.04	0.04
White (vs. Other)	-1.24 **	-1.27 **	0.08	0.08
Education	0.22	0.21	0.25	0.25
Income	0.09	0.09	0.04	0.04

Ingroup Inoculation	0.05	-0.17	0.14	0.15
Ingroup Misinformation	-0.06	-0.28	-0.05	-0.04
Ingroup Inoculation* Ingroup Misinformation		0.44		-0.02
R^2	0.09**	0.09**	0.03	0.03

	DV4: COVID-19 Vaccination Intention for Child			
	Republican		Democrat	
Predictor	Model1	Model2	Model1	Model2
(Intercept)	2.65 **	2.62 **	4.47 ***	4.49 ***
Age	0.01	0.01	-0.00	-0.00
Female and Other (vs. Male)	-0.42	-0.42	-0.26	-0.26
Hispanic (vs. Non-Hispanic)	-0.34	-0.34	-0.17	-0.16
White (vs. Other)	-0.81	-0.81	0.40	0.39
Education	0.11	0.11	0.36 *	0.36 *
Income	0.04	0.04	0.03	0.03
Ingroup Inoculation	0.03	0.07	-0.07	-0.11
Ingroup Misinformation	-0.02	0.03	-0.09	-0.13
Ingroup Inoculation* Ingroup Misinformation		-0.10		0.09
R^2	0.04	0.04	0.05	0.05

	DV5: COVID-19 Vaccination Recommendation			
	Republican		Democrat	
Predictor	Model1	Model2	Model1	Model2
(Intercept)	2.25 **	2.32 **	4.79 ***	4.80 ***
Age	0.02	0.02	-0.00	-0.00
Female and Other (vs. Male)	-0.38	-0.39	-0.10	-0.10
Hispanic (vs. Non-Hispanic)	0.07	0.07	-0.10	-0.10
White (vs. Other)	-0.58	-0.60	0.19	0.19
Education	-0.03	-0.03	0.18	0.17
Income	0.12	0.12	0.03	0.03
Ingroup Inoculation	0.07	-0.04	-0.18	-0.21
Ingroup Misinformation	-0.13	-0.24	-0.21	-0.23
Ingroup Inoculation* Ingroup Misinformation		0.23		0.05
R^2 =	0.04	0.04	0.02	0.02

Note. Ingroup inoculation represents in-group (vs. out-group inoculation). Ingroup misinformation represents in-group (vs. out-group) misinformation. Coefficient represents unstandardized regression weights. *indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$.

Table 16

Effect of Experimental Conditions on Three Mediators

	Counterarguing		Perceived Ease of counterarguing		Anger	
Predictor	*b*	*SE*	*b*	*SE*	*b*	*SE*
(Intercept)	3.54 ***	0.48	3.66 ***	0.42	1.33 **	0.49
Age	-0.01	0.01	-0.01	0.01	0.00	0.01
Female and Other (vs. Male)	-0.24	0.16	-0.24	0.15	0.01	0.17
Hispanic (vs. Non-Hispanic)	-0.05	0.28	-0.06	0.25	-0.34	0.29
White (vs. Other)	0.12	0.20	0.00	0.18	0.18	0.21
Education	0.03	0.09	0.07	0.08	0.12	0.10
Income	0.05	0.04	0.05	0.04	0.08	0.05
Democrat (vs. Republican)	2.27 ***	0.17	1.91 ***	0.15	2.26 ***	0.18
Ingroup Inoculation	0.02	0.16	-0.10	0.14	0.05	0.17
Ingroup Misinformation	-0.34 *	0.16	-0.21	0.14	-0.21	0.17
R^2	0.32***		0.31***		0.30***	

Note. Ingroup inoculation represents in-group (vs. out-group inoculation). Ingroup misinformation represents in-group (vs. out-group) misinformation. *b* represents unstandardized regression weights. *SE* represents standard error. *indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$.

Table 17.1

Mediation Models of In-group (vs. Out-group) Inoculation Effects on Persuasive Outcomes

	DV1: Beliefs in COVID-19 Vaccine misinformation		
	Estimate	*SE*	95% CI
Direct Effect	-.060	.066	[-.190, .069]
Indirect Effect			
M1: Counterarguing	-.002	.024	[-.051, .047]
M2: Perceived ease of counterarguing	.030	.044	[-.055, .120]
M3: Anger	-.004	.013	[-.031, .022]
	DV2: COVID-19 Vaccination Attitude		
	Estimate	*SE*	95% CI
Direct Effect	-.055	.124	[-.298, .189]
Indirect Effect			
M1: Counterarguing	.004	.046	[-.086, .102]
M2: Perceived ease of counterarguing	-.050	.075	[-.212, .091]
M3: Anger	.006	.021	[-.036, .049]
	DV3: COVID-19 Vaccination Intention for Self		
	Estimate	*SE*	95% CI
Direct Effect	.099	.138	[-.171, .370]
Indirect Effect			
M1: Counterarguing	.004	.041	[-.084, .083]
M2: Perceived ease of counterarguing	-.055	.080	[-.214, .101]
M3: Anger	.011	.035	[-.061, .079]
	DV4: COVID-19 Vaccination Intention for Child		
	Estimate	*SE*	95% CI
Direct Effect	.015	.141	[-.261, .291]
Indirect Effect			
M1: Counterarguing	.004	.046	[-.089, .096]
M2: Perceived ease of counterarguing	-.059	.087	[-.238, .108]
M3: Anger	.006	.022	[-.037, .052]
	DV4: COVID-19 Vaccination Recommendation		
	Estimate	*SE*	95% CI
Direct Effect	-.049	.130	[-.304, .205]
Indirect Effect			
M1: Counterarguing	.004	.048	[-.084, .109]
M2: Perceived ease of counterarguing	-.048	.071	[-.197, .091]
M3: Anger	.009	.030	[-.049, .070]

Note. Coefficients represent unstandardized indirect effects. 95% CIs are 95% confidence intervals based on 5,000 bootstrap samples. *denotes significance based on 95% bootstrap CI.

Table 17.2

Mediation Models of In-group (vs. Out-group) Misinformation Effects on Persuasive Outcomes

	DV1: Beliefs in COVID-19 Vaccine misinformation		
	Estimate	*SE*	95% CI
Direct Effect	-.043	.066	[-.174, .087]
Indirect Effect			
M1: Counterarguing	.050*	.027	[.003, .108]
M2: Perceived ease of counterarguing	.064	.044	[-.020, .155]
M3: Anger	.015	.013	[-.008, .045]
	DV2: COVID-19 Vaccination Attitude		
	Estimate	*SE*	95% CI
Direct Effect	.152	.125	[-.093, .397]
Indirect Effect			
M1: Counterarguing	-.092*	.051	[-.207, -.009]
M2: Perceived ease of counterarguing	-.105	.074	[-.254, .034]
M3: Anger	-.024	.022	[-.075, .013]
	DV3: COVID-19 Vaccination Intention for Self		
	Estimate	*SE*	95% CI
Direct Effect	.169	.138	[-.103, .441]
Indirect Effect			
M1: Counterarguing	-.085*	.050	[-.198, -.007]
M2: Perceived ease of counterarguing	-.114	.078	[-.271, .034]
M3: Anger	-.041	.035	[-.117, .022]
	DV4: COVID-19 Vaccination Intention for Child		
	Estimate	*SE*	95% CI
Direct Effect	.172	.141	[-.106, .449]
Indirect Effect			
M1: Counterarguing	-.093*	.053	[-.215, -.008]
M2: Perceived ease of counterarguing	-.124	.085	[-.293, .042]
M3: Anger	-.023	.023	[-.079, .013]
	DV4: COVID-19 Vaccination Recommendation		
	Estimate	*SE*	95% CI
Direct Effect	.052	.130	[-.204, .308]
Indirect Effect			
M1: Counterarguing	-.095*	.052	[-.211, -.008]
M2: Perceived ease of counterarguing	-.099	.070	[-.244, .029]
M3: Anger	-.034	.030	[-.099, .016]

Note. Coefficients represent unstandardized indirect effects. 95% CIs are 95% confidence intervals based on 5,000 bootstrap samples. *denotes significance based on 95% bootstrap CI.

Table 18

The Interaction Effect of Experimental Conditions and Party Identification Strength on Five Persuasive Outcomes

	Dependent Variables				
	Beliefs in Misinformation	Vaccination Attitude	Vaccination Intention for self	Vaccination Intention for child	Vaccination Recommendation
(Intercept)	3.66 ***	3.19 ***	1.49 **	1.88 **	2.25 ***
Age	0.00	0.00	0.01	0.00	0.01
Female and Other (vs. Male)	0.22 *	-0.12	-0.34	-0.36	-0.23
Hispanic (vs. Non-Hispanic)	-0.14	0.21	0.14	-0.14	0.09
White (vs. Other)	-0.13	0.14	-0.36	0.00	-0.08
Education	-0.07	0.05	0.25 *	0.23 *	0.08
Income	-0.05 *	0.09	0.07	0.05	0.08
Democrat (vs. Republican)	-1.48 ***	2.22 ***	2.77 ***	2.98 ***	2.59 ***
Ingroup Inoculation	-0.03	0.06	0.02	0.00	-0.13
Ingroup Misinformation	0.08	0.10	-0.08	-0.02	-0.19
Party Identification Strength	-0.36 **	0.56 *	0.85 **	0.55 *	0.40
Ingroup Inoculation* Ingroup Misinformation	-0.02	-0.28	0.10	-0.05	0.08
Ingroup Inoculation* Party Identification Strength	0.48 *	-0.81 *	-0.77	-0.55	-0.38
Ingroup Misinformation* Party Identification Strength	0.17	-0.53	-0.06	-0.29	0.24
Ingroup Inoculation* Ingroup Misinformation* Party Identification Strength	-0.19	0.36	0.01	0.53	-0.28
R^2	0.36***	0.28***	0.37***	0.37***	0.34***

Note. Ingroup inoculation represents in-group (vs. out-group inoculation). Ingroup misinformation represents in-group (vs. out-group) misinformation. Party identification strength is centered by mean. Coefficient represents unstandardized regression weights. *indicates $p < .05$. ** indicates $p < .01$. *** indicates $p < .001$.

Table 19.1

Conditional Effect of In-group (vs. Out-group) Inoculation on Beliefs in COVID-19 Vaccine Misinformation

	DV: Beliefs in COVID-19 Vaccine Misinformation			
Simple Slopes Analysis	*b*	*SE*	*t*	*p*
Party Identification Strength				
Low (Mean -1 SD)	-0.31*	0.14	-2.24	0.03
Moderate (Mean)	-0.04	0.10	-0.45	0.65
High (Mean +1 SD)	0.22	0.14	1.61	0.11
Johnson-Neyman Analysis				
The slope of in-group (vs. out-group) inoculation is significant at p <.05 level when party identification strength is outside the interval [2.20, 3.67]				

Note. The range of observed values of party identification strength is [1,4.]. Low level of party identification is represented by Mean -1 SD (2.02), moderate party identification is represented by mean (2.7), high party identification is represented by mean +1 SD (3.39).

Table 19.2

Conditional Effect of In-group (vs. Out-group) Inoculation on COVID-19 Vaccination Attitude

	DV: COVID-19 Vaccination Attitude			
Simple Slopes Analysis	*b*	*SE*	*t*	*p*
Party Identification Strength				
Low (Mean -1 SD)	0.36	0.24	1.47	0.14
Moderate (Mean)	-0.07	0.17	-0.43	0.66
High (Mean +1 SD)	-0.51*	0.24	-2.10	0.04
Johnson-Neyman Analysis				
The slope of in-group (vs. out-group) inoculation is significant at p <.05 level when party identification strength is outside the interval [1.52, 3.28]				

Note. The range of observed values of party identification strength is [1,4.]. Low level of party identification is represented by Mean -1 SD (2.02), moderate party identification is represented by mean (2.7), high party identification is represented by mean +1 SD (3.39).

Appendix B: Figures

Figure 1

Conceptual Map (Study 1)

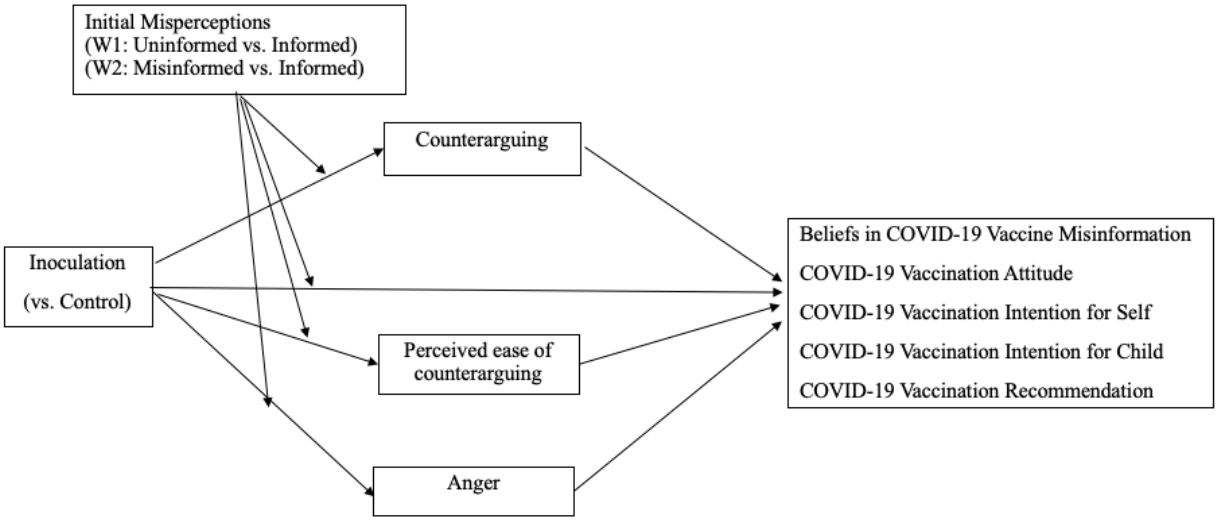
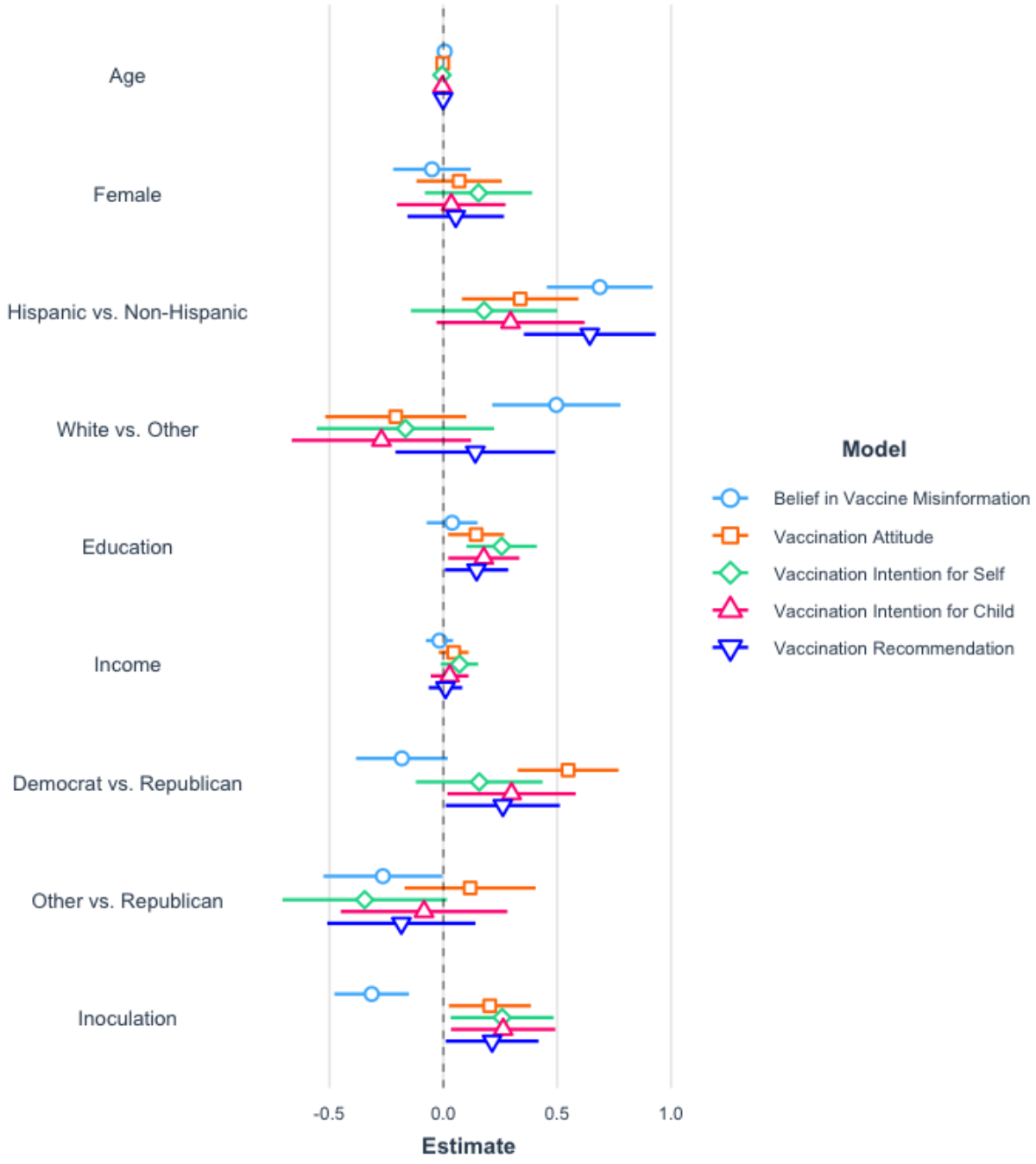


Figure 2

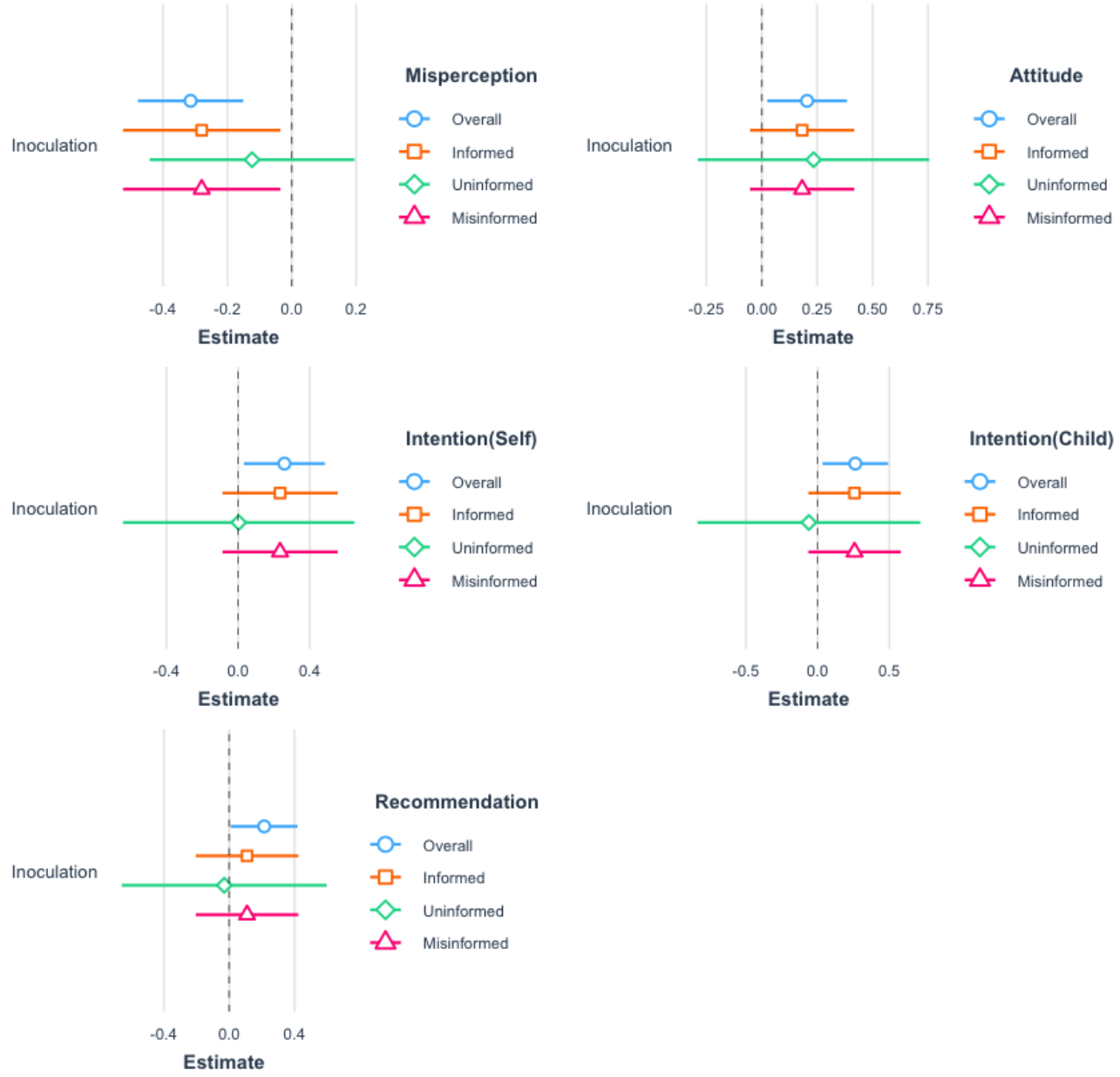
Predicting Persuasive Outcomes about COVID-19 Vaccination



Note. Estimates in the dot-and-whisker plot represent unstandardized regression coefficients and 95% confidence intervals. Inoculation represents the experimental group (inoculation vs. control).

Figure 3

Effect of Inoculation Message on Five Persuasive Outcomes



Note. Estimates in the dot-and-whisker plot represent unstandardized regression coefficients and 95% confidence intervals. Covariates in the models include age, sex (female vs. male), ethnicity (Hispanic vs. non-Hispanic), race (White vs. other), education, income, political affiliation (Democrat vs. Republican, other vs. Republican). Misperception represents beliefs in COVID-19 vaccine misinformation. Attitude represents COVID-19 vaccination attitude. Intention (Self) represents COVID-19 vaccination intention for self. Intention (Child) represents COVID-19 vaccination intention for child. Recommendation represents COVID-19 vaccination recommendation.

Figure 4.1

Moderated Mediation Model Predicting Beliefs in COVID-19 Vaccine Misinformation

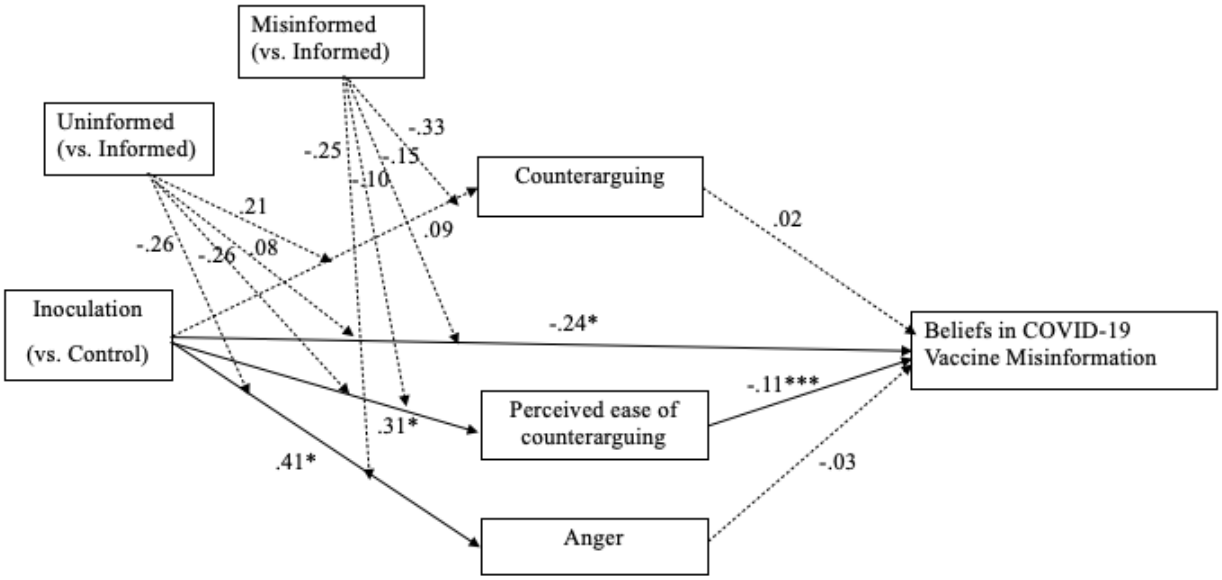


Figure 4.2

Moderated Mediation Model Predicting COVID-19 Vaccination Attitude

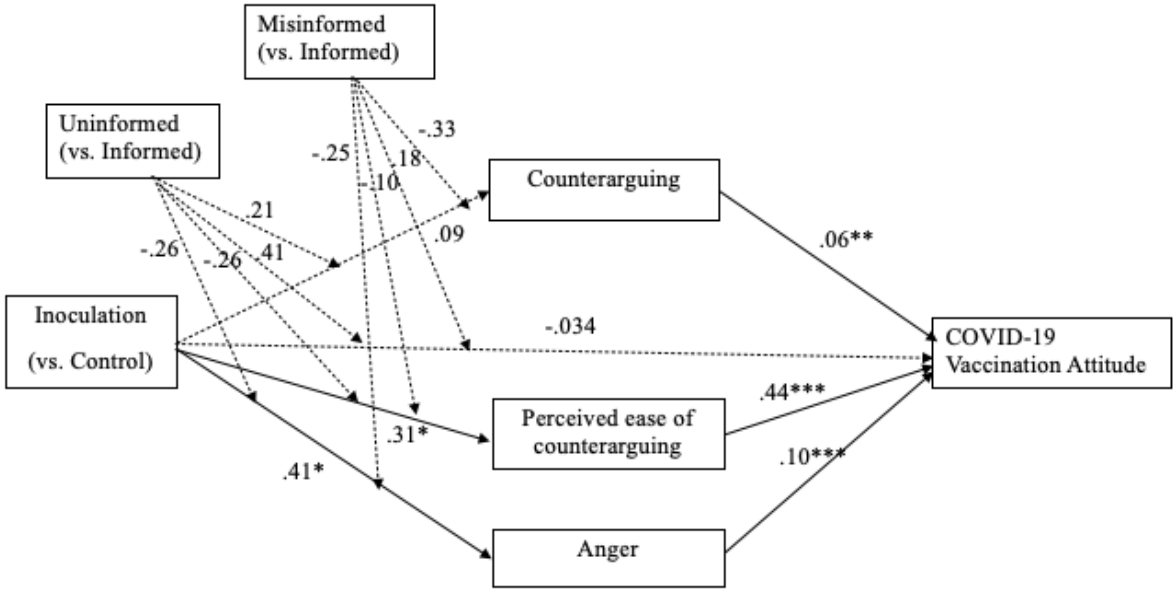


Figure 4.3

Moderated Mediation Model Predicting COVID-19 Vaccination Intention for Self

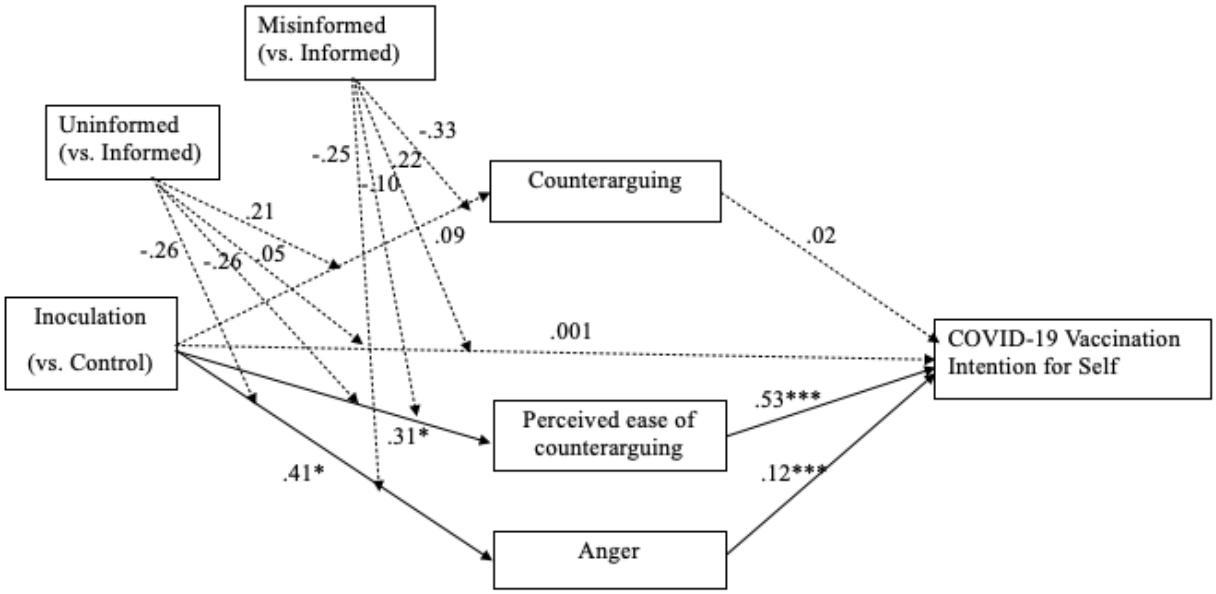


Figure 4.4

Moderated Mediation Model Predicting COVID-19 Vaccination Intention for Child

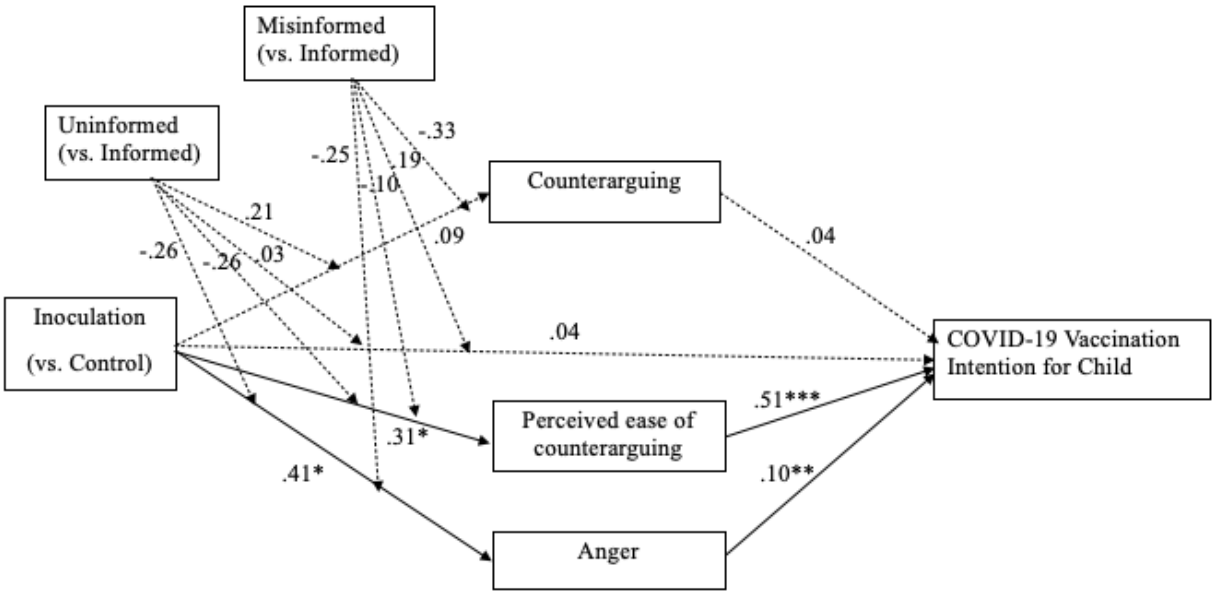


Figure 4.5

Moderated Mediation Model Predicting COVID-19 Vaccination Recommendation

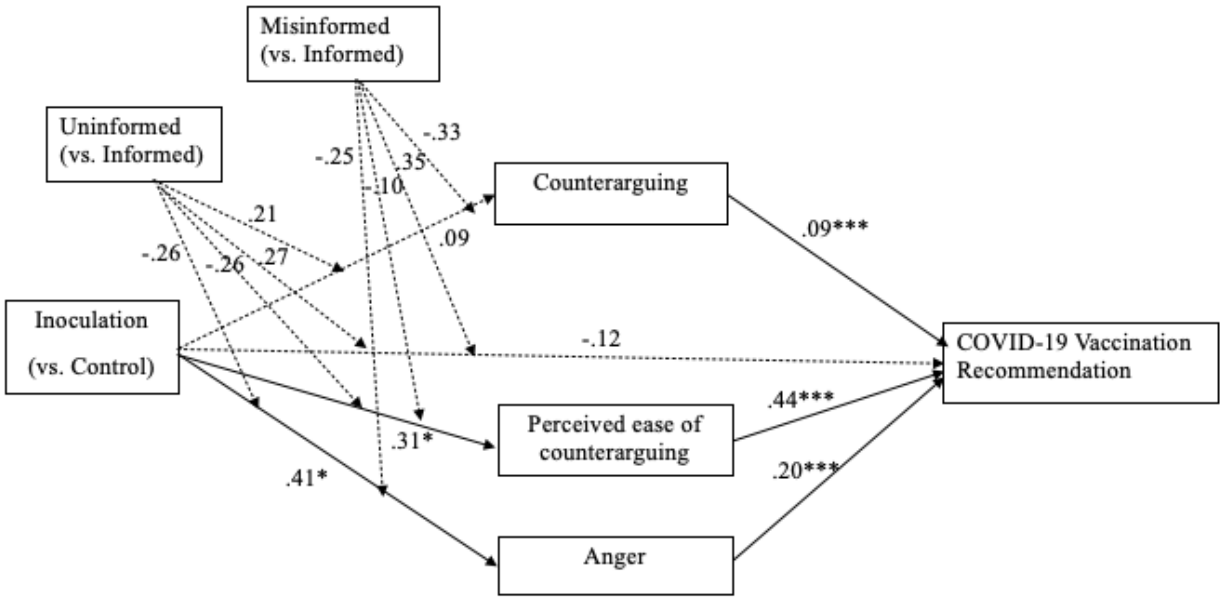


Figure 5

Conceptual Map (Study 2)

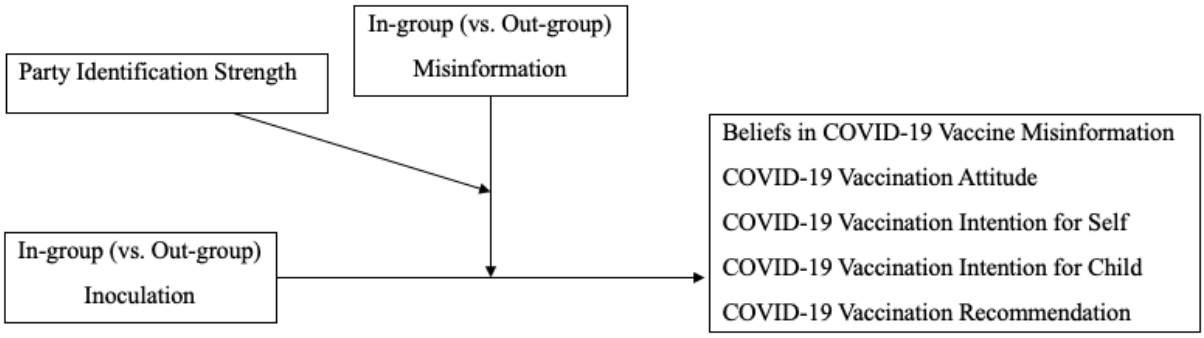


Figure 6

Experiment Randomization Procedure (Study 2)

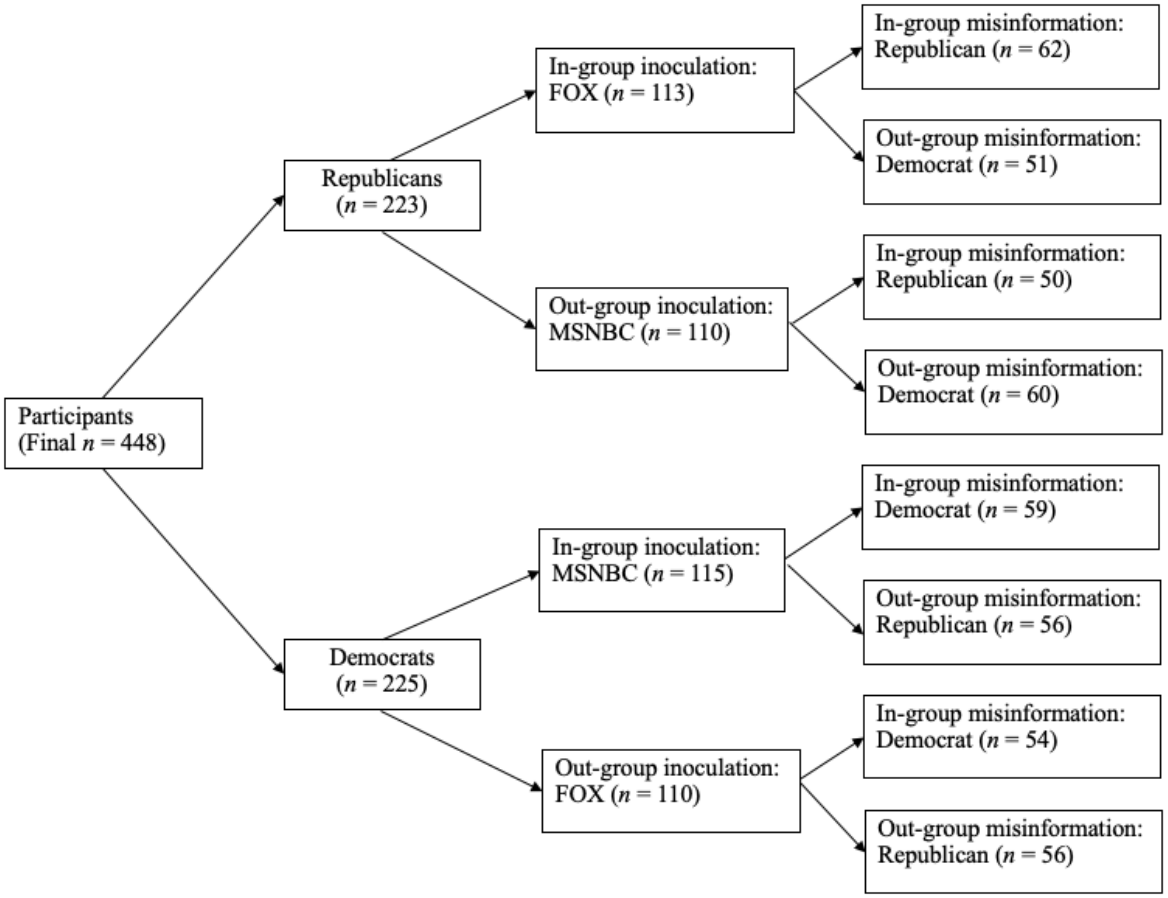


Figure 7

Mean Scores of Experimental Conditions on Five Persuasive Outcomes

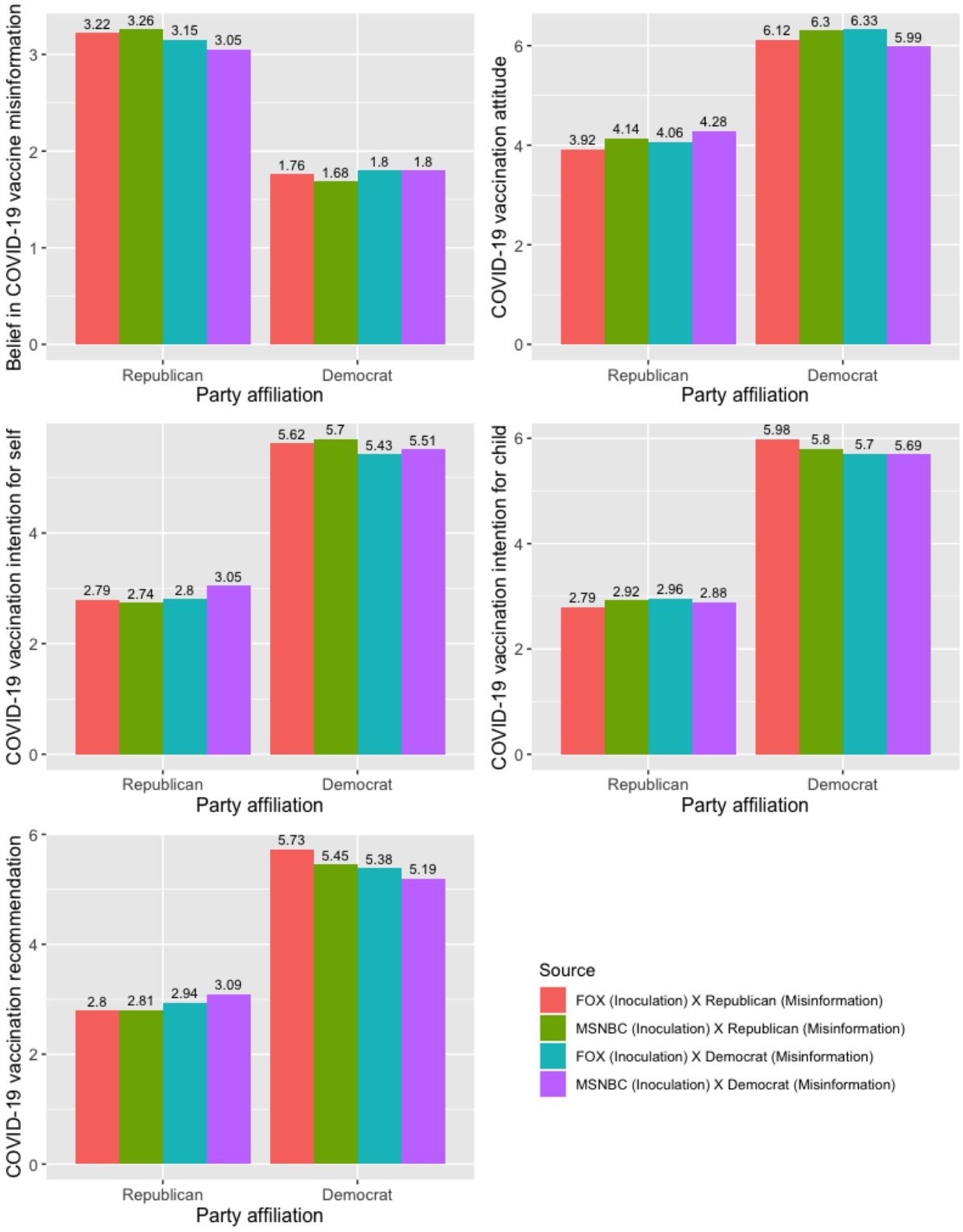
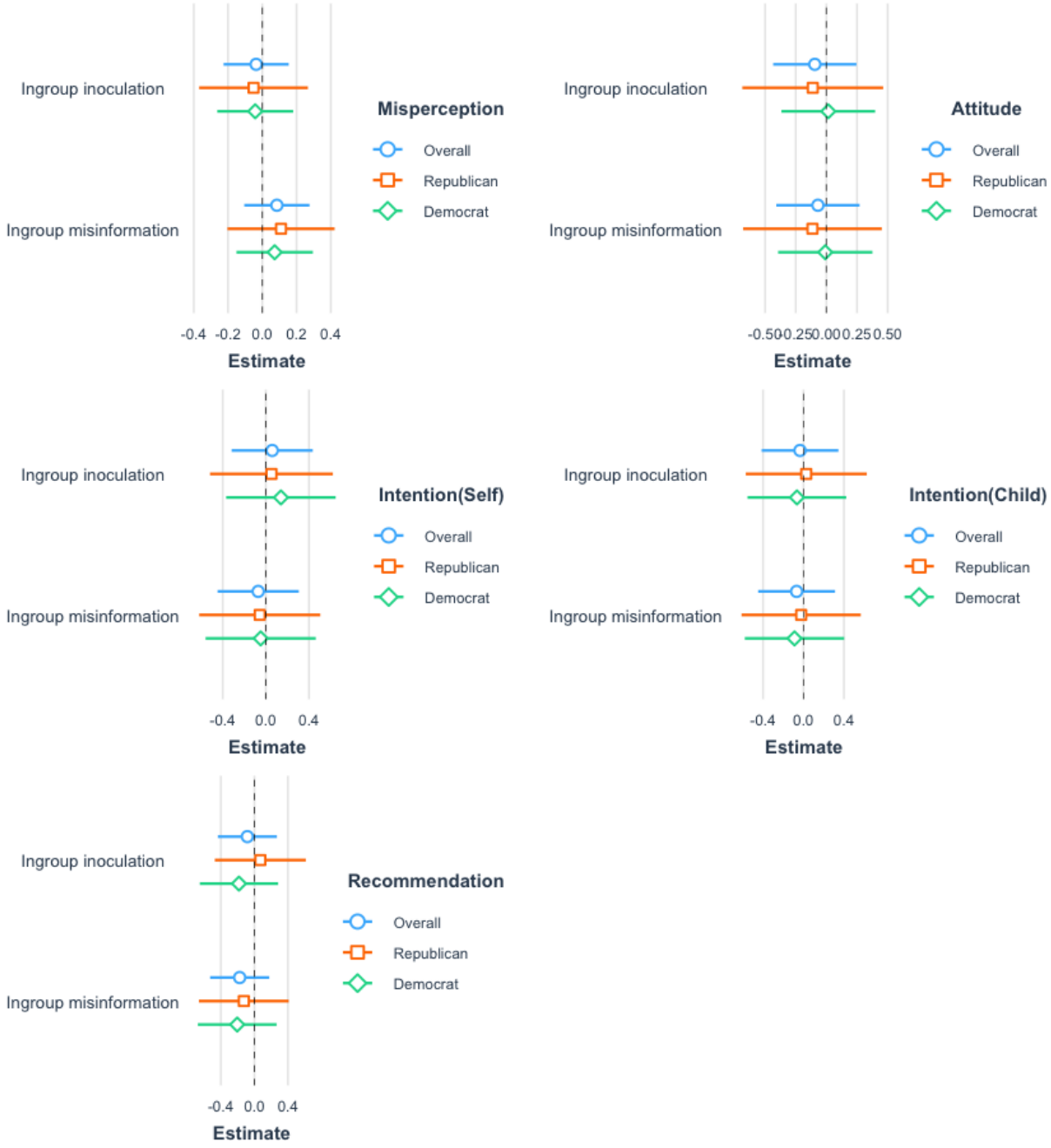


Figure 8

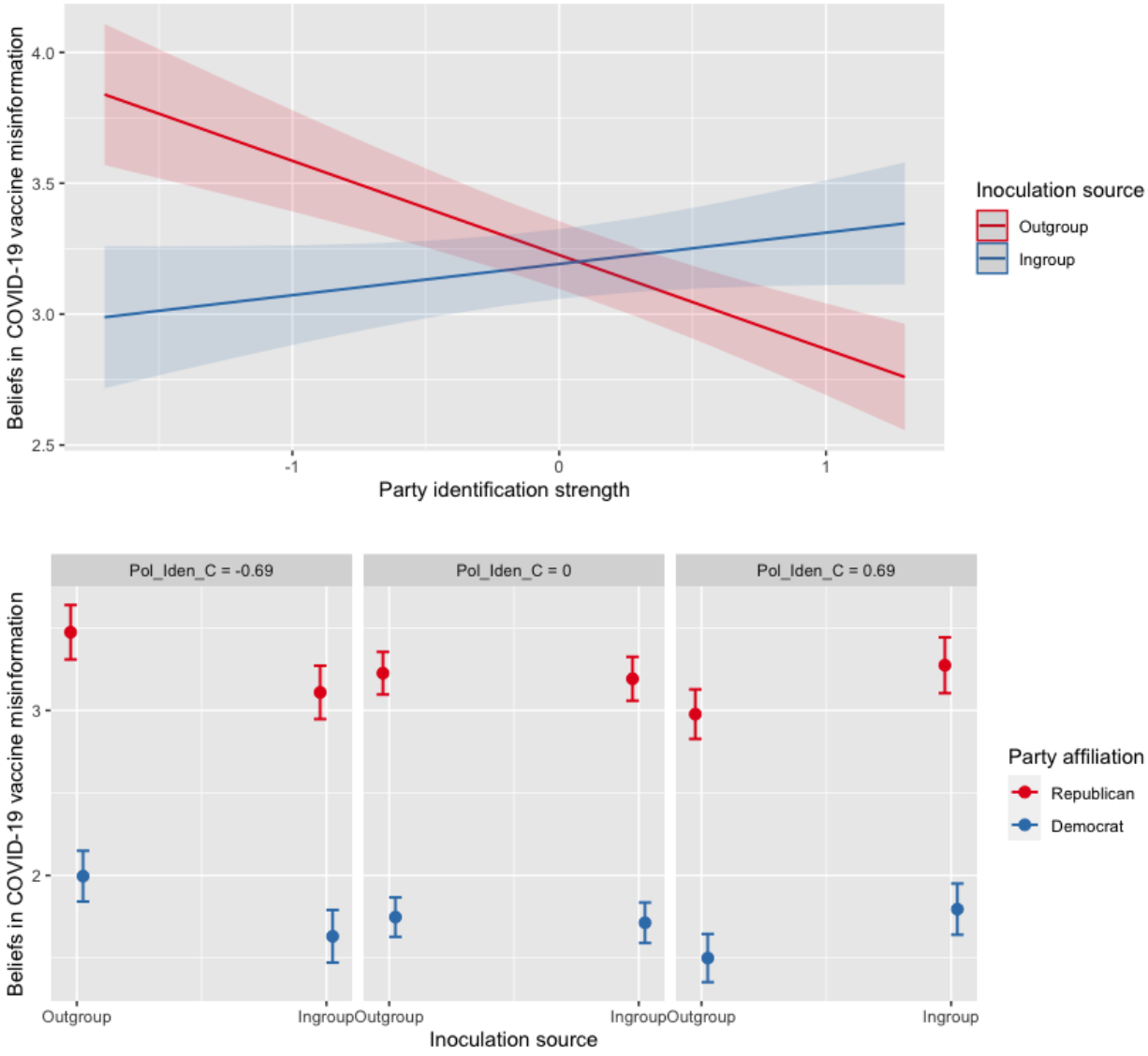
Effects of In-group (vs. Out-group) Sources on Five Persuasive Outcomes



Note. Estimates in the dot-and-whisker plot represent unstandardized regression coefficients and 95% confidence intervals. Misperception represents beliefs in COVID-19 vaccine misinformation. Attitude represents COVID-19 vaccination attitude. Intention (Self) represents COVID-19 vaccination intention for self. Intention (Child) represents COVID-19 vaccination intention for child. Recommendation represents COVID-19 vaccination recommendation.

Figure 9a

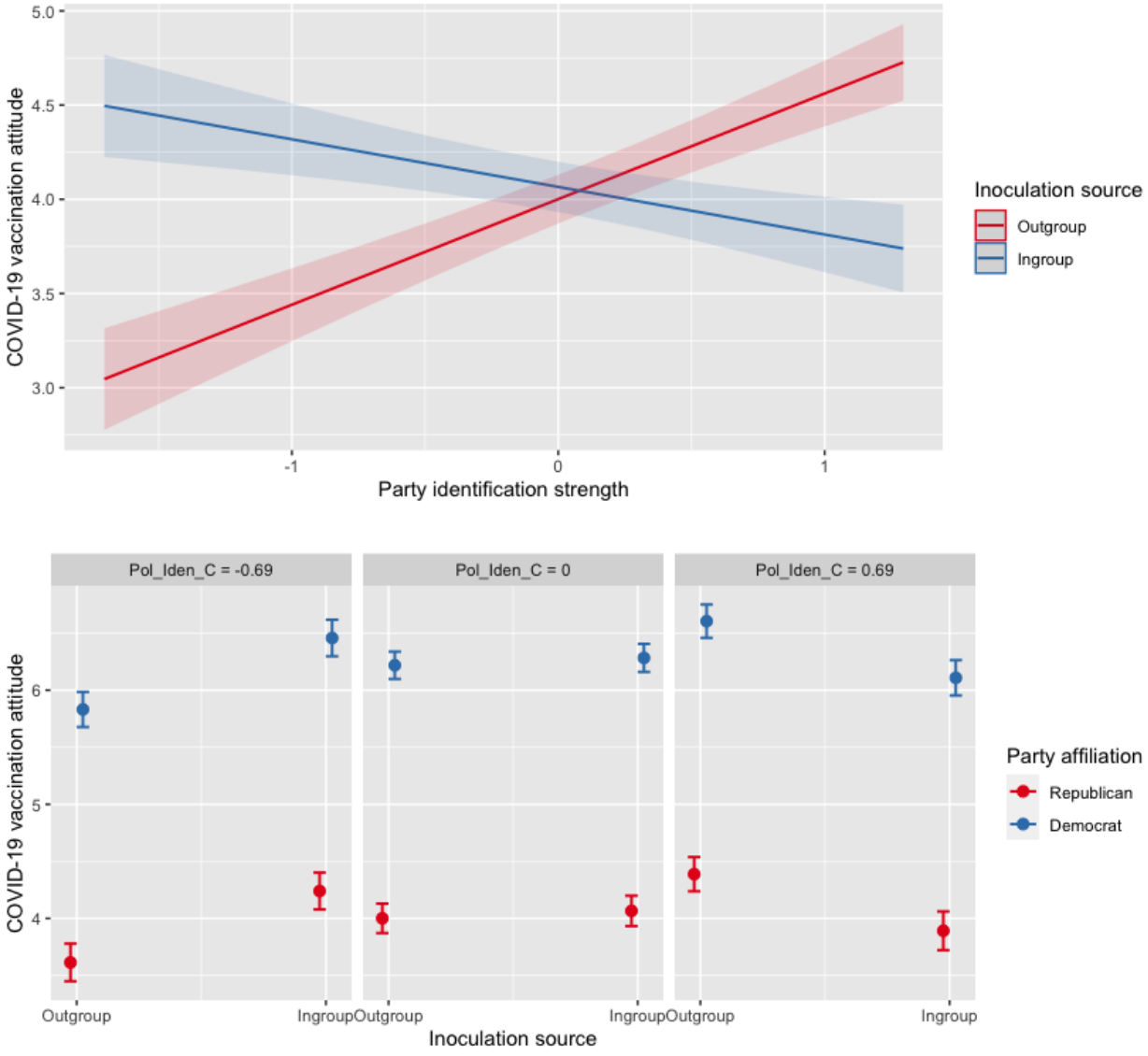
Two-way Interaction of Inoculation Source and Party Identification Strength on Beliefs in COVID-19 Vaccine Misinformation



Note. Pol_Iden_C represents the mean-centered variable: party identification strength. A value of 0 for Pol_Iden_C represents the mean of party identification strength. A value of -0.69 for Pol_Iden_C represents one standard deviation below the mean of party identification strength, and a value of 0.69 represents one standard deviation above the mean of party identification strength.

Figure 9b

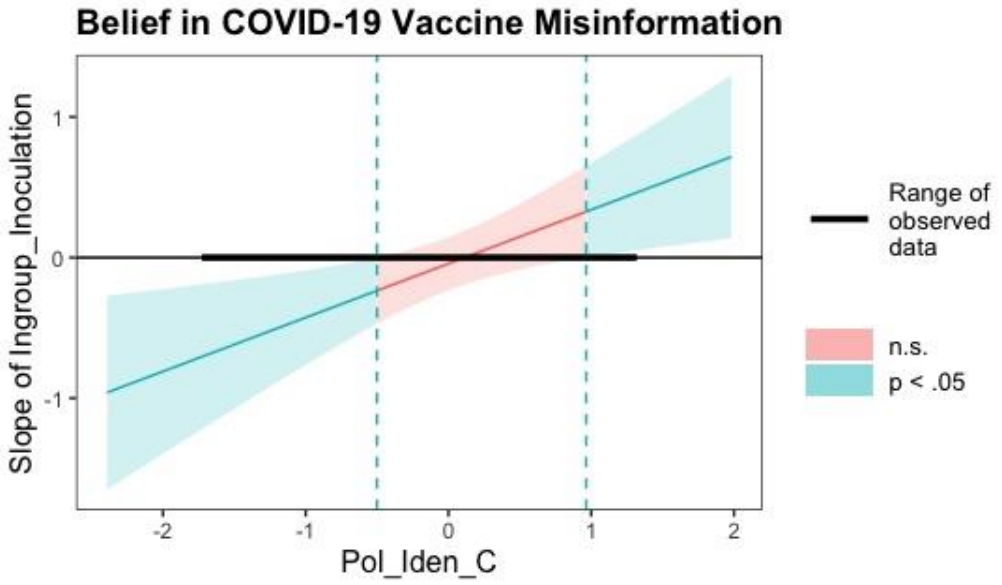
Two-way Interaction of Inoculation Source and Party Identification Strength on COVID-19 Vaccination Attitude



Note. Pol_Iden_C represents the mean-centered variable: party identification strength. A value of 0 for Pol_Iden_C represents the mean of party identification strength. A value of -0.69 for Pol_Iden_C represents one standard deviation below the mean of party identification strength, and a value of 0.69 represents one standard deviation above the mean of party identification strength.

Figure 10a

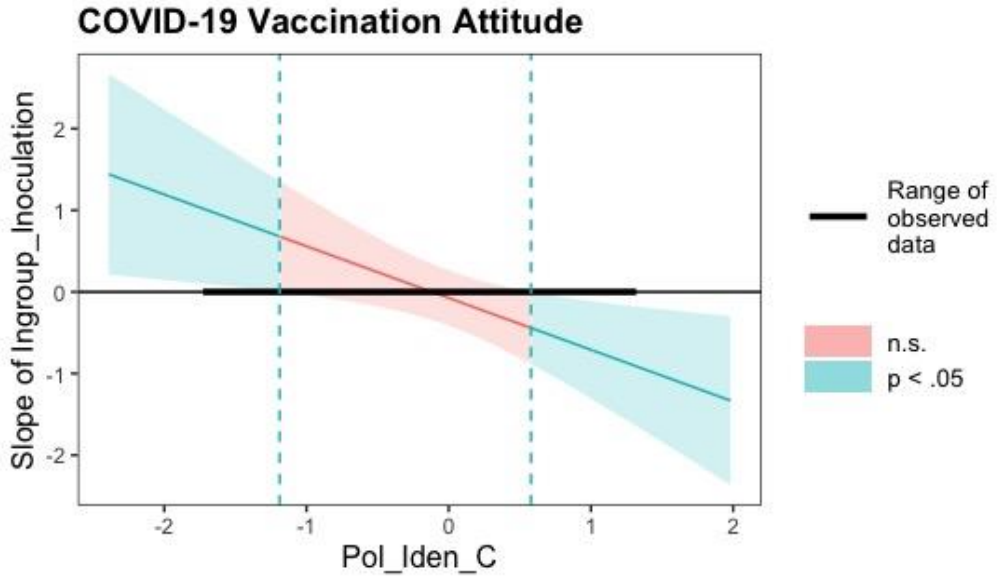
Johnson-Neyman Plot of Interaction Effect of Inoculation Source and Party Identification Strength on Beliefs in COVID-19 Vaccine Misinformation



Note. Pol_Iden_C represents the mean-centered variable: party identification strength.

Figure 10b

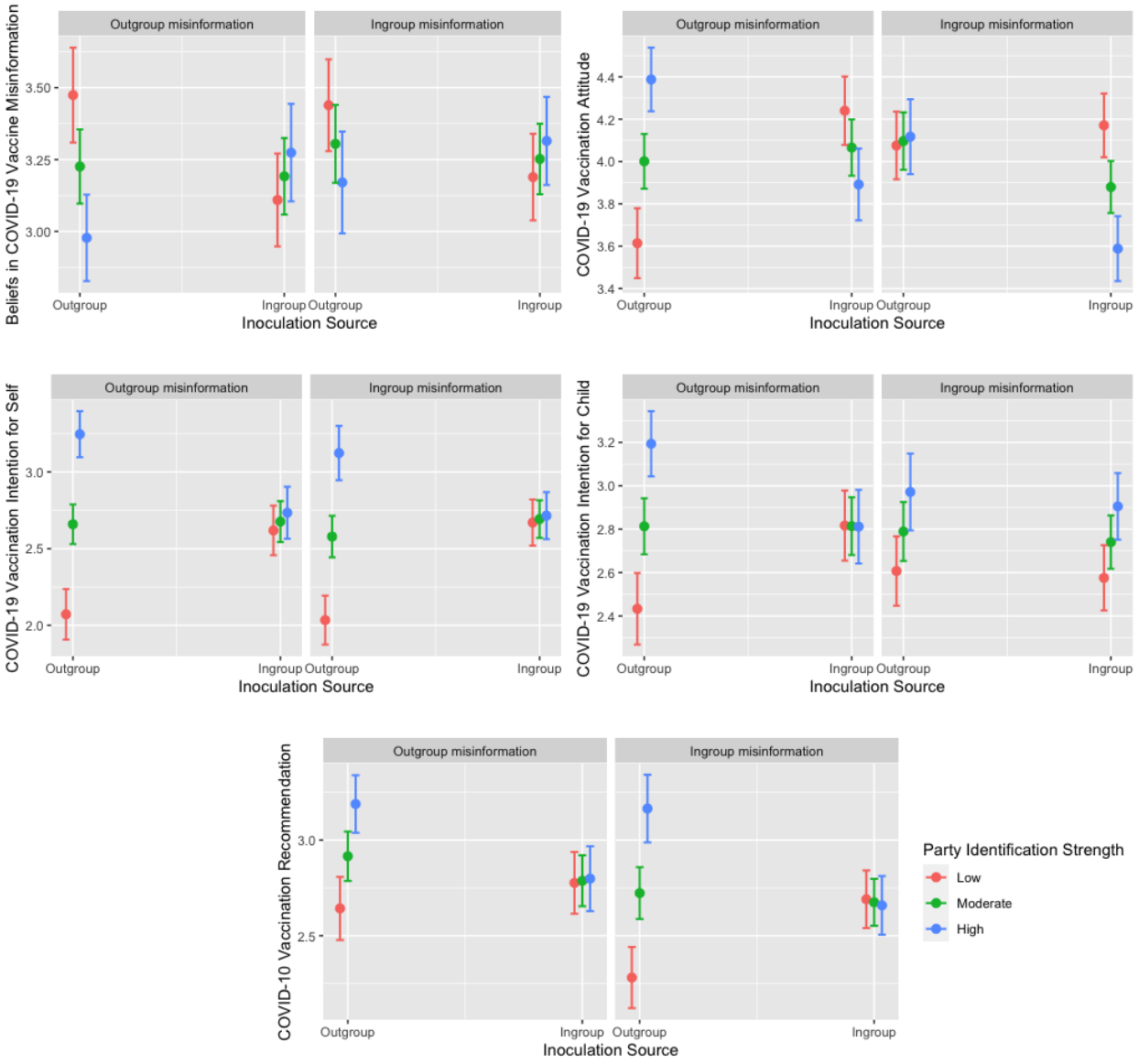
Johnson-Neyman Plot of Interaction Effect of Inoculation Source and Party Identification Strength on COVID-19 Vaccination Attitude



Note. Pol_Iden_C represents the mean-centered variable: party identification strength.

Figure 11.

Three-way Interaction among Inoculation Source, Misinformation Source, and Party Identification Strength on Five Persuasive Outcomes



Appendix C: Experimental Stimuli

Figure C1

Inoculation Message in Experiment 1

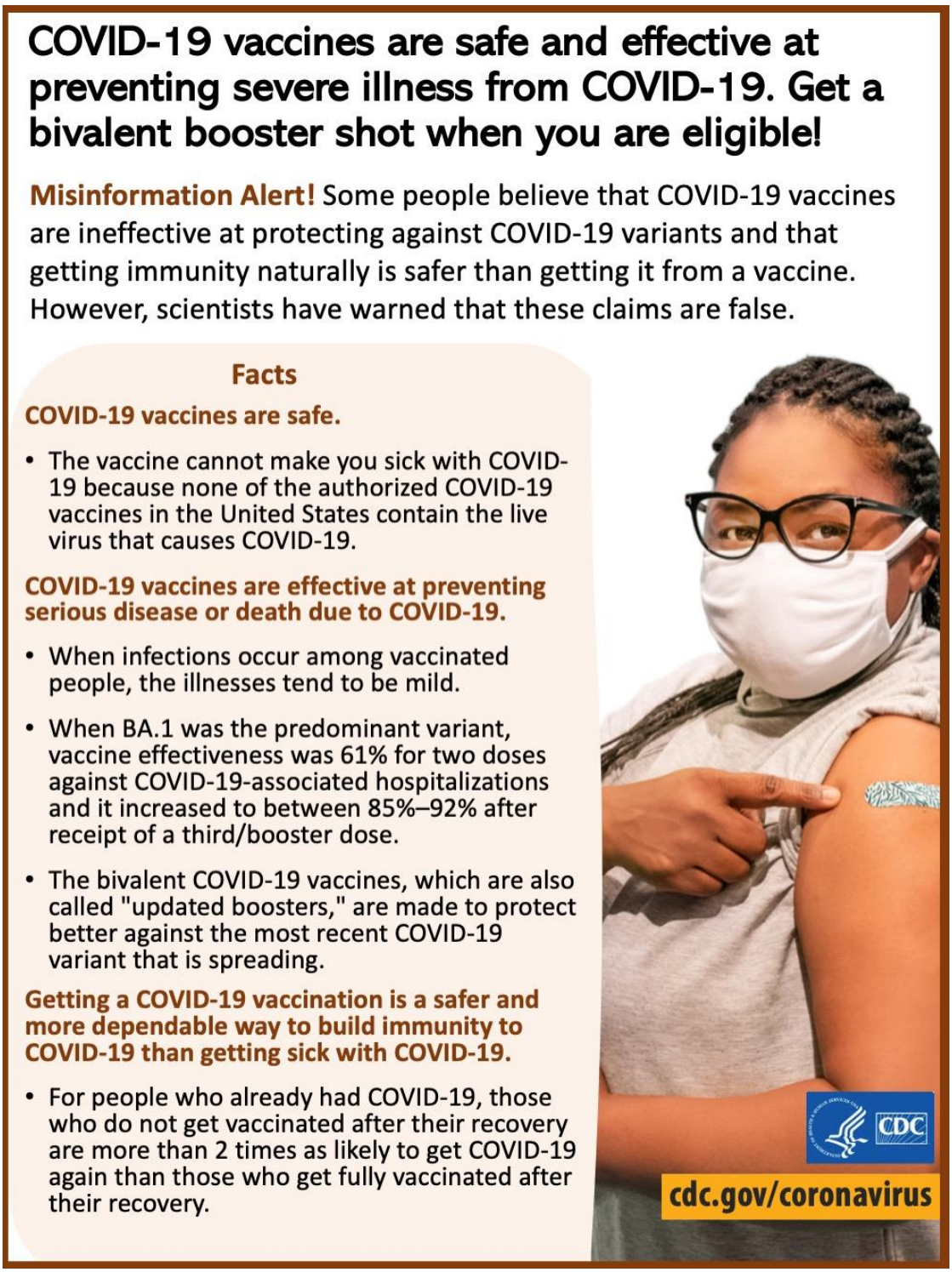


Figure C2

Misinformation Message in Experiment 1

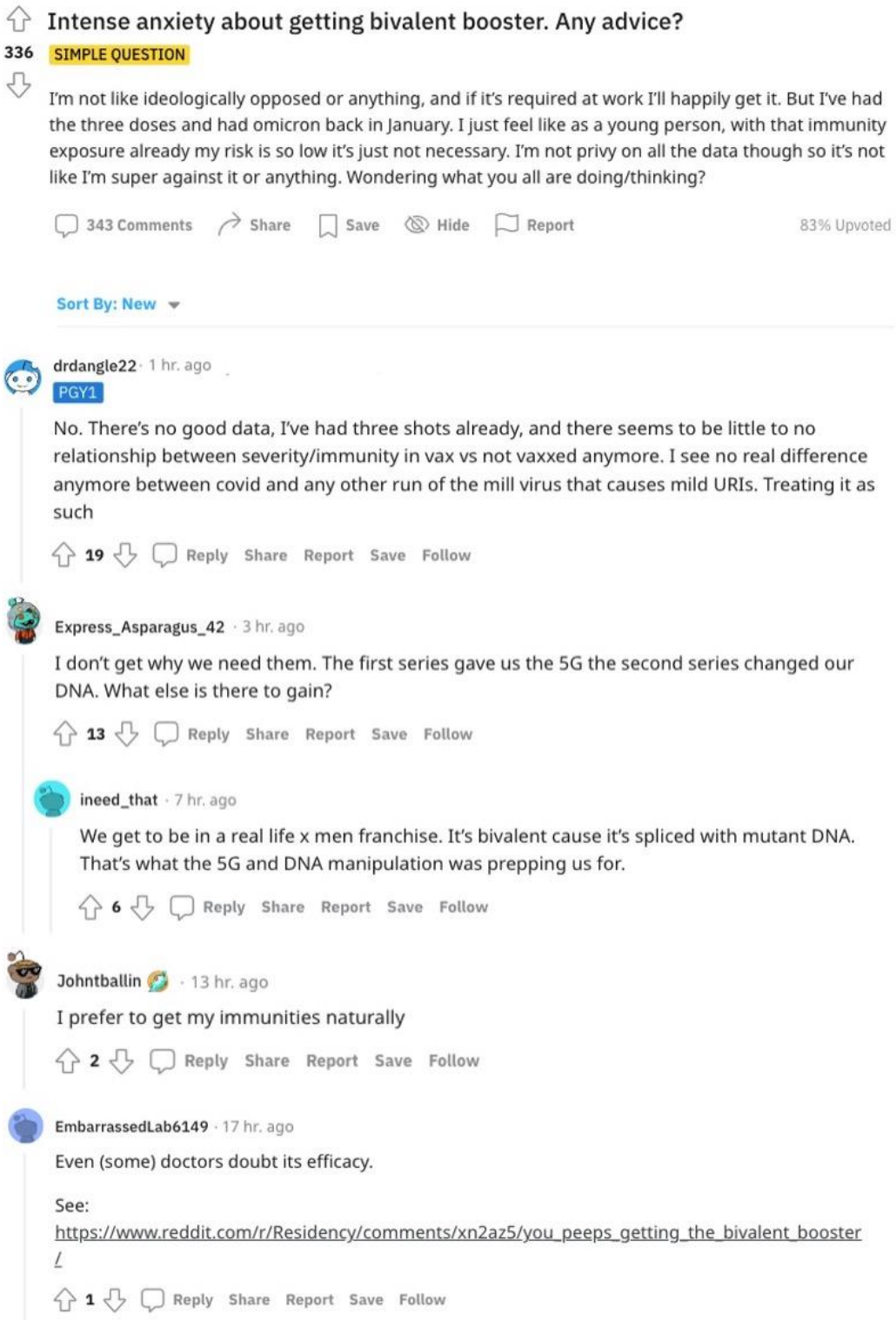


Figure C3

Inoculation Message in Experiment 2 (FOX)

Figure C4

Inoculation Message in Experiment 2 (MSNBC)

Figure C5

Misinformation Message in Experiment 2 (Republican)

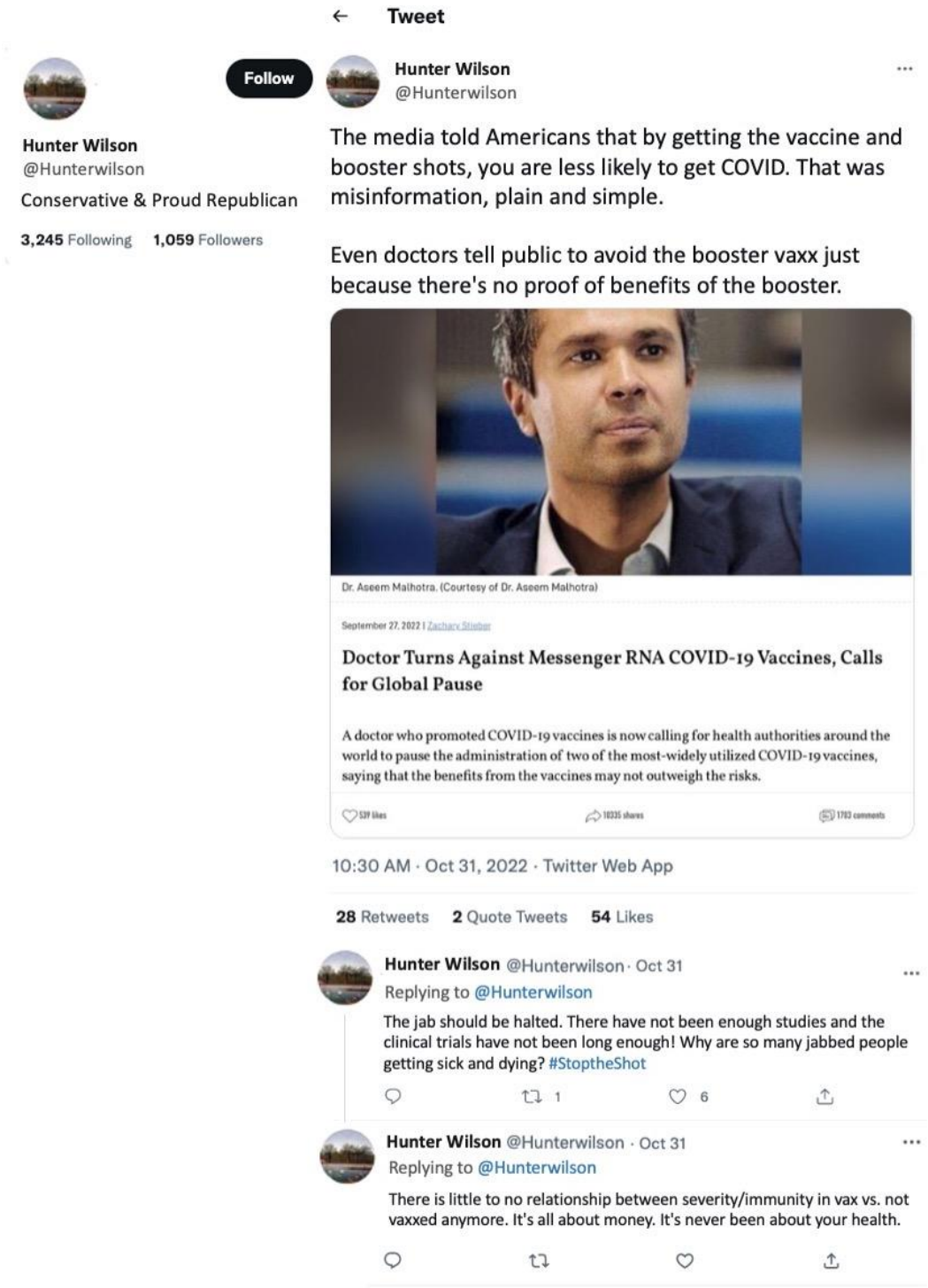
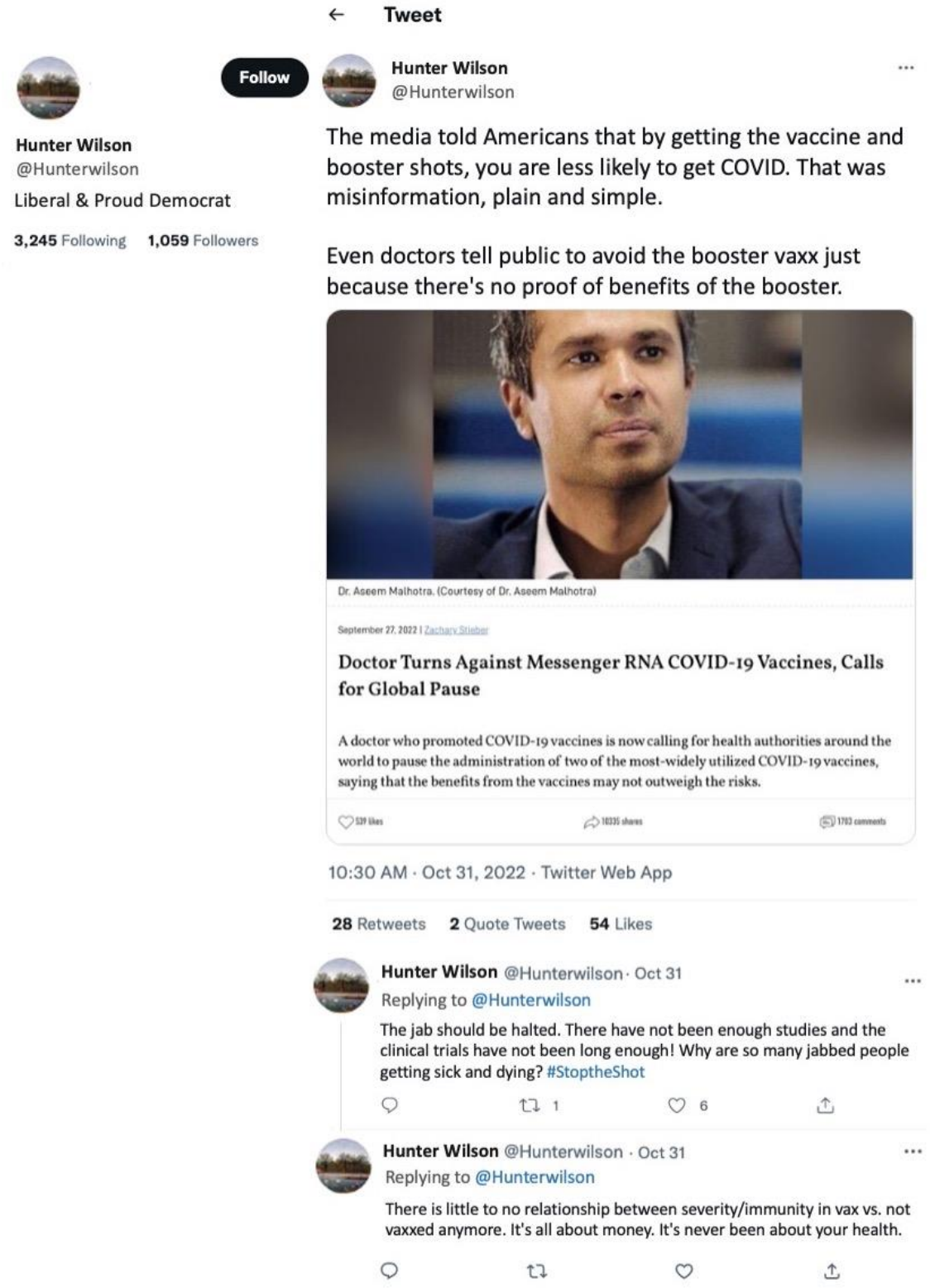


Figure C6

Misinformation Message in Experiment 2 (Democrat)



Appendix D: The Questionnaire for Pilot Test

[Consent Form]

[Trust in source]

1. **How much do you trust information about COVID-19 from the following sources?**

Do not trust at all [1]	[2]	[3]	[4]	[5]	[6]	Completely trust [7]

(1) MSNBC
(2) CNN
(3) FOX
(4) Republicans
(5) Democrats

[Pre-existing beliefs in COVID-19 vaccine misinformation]

2. **Some people are hesitant about the effectiveness of COVID-19 vaccines, including the boosters. Below are some claims about COVID-19 vaccines, please read each claim and indicate whether you believe it is true or false.**

Definitely false	Probably false	I don't know	Probably true	Definitely true
[1]	[2]	[3]	[4]	[5]

(1) COVID-19 vaccines are not effective at all.
(2) COVID-19 vaccines cannot protect against COVID-19 variants at all.
(3) Vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID-19.
(4) Natural immunity provides better protection than vaccine-induced immunity to COVID -19.

STIMULI EXPOSURE

[DISPLAY: inoculation message for study1]

Next, we would like to invite you to read a public service announcement (PSA). Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message.

[Manipulation check]

3. **Thinking back to the PSA you just read, choose one option that best reflects the message content:**
   (1) The message suggests that COVID-19 vaccines are effective.
   (2) The message suggests that COVID-19 vaccines are not effective.

[Message comprehension]

4. **Please indicate how strongly you agree or disagree with the following statements:**

Strongly disagree [1]	[2]	[3]	[4]	[5]	[6]	Strongly agree [7]

(1) The message was easy to read.
(2) The message was easy to understand.
(3) The message was difficult to understand.

5. Qualitative feedback
Please write down any thoughts you have about the message you just read. Please pay attention to the words and ideas in the message and tell us what you think could be done to make it easier to understand.

_____

Next, we would like to invite you to read a post from Reddit. Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message.

[DISPLAY: The misinformation message for study 1]

[Manipulation check]

6. Thinking back to the Reddit post you just read, choose one option that best reflects the message content:
(1) The Reddit post suggests that COVID-19 vaccines are effective.
(2) The Reddit post suggests that COVID-19 vaccines are not effective.

[DISPLAY: The inoculation message for study 2. Randomly assign an inoculation message from MSNBC/FOX]

Next, we would like to invite you to read a Twitter message from MSNBC/FOX. Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message.

[Manipulation check]

7. Thinking back to the tweet you just read, choose one option that best reflects the message content:
(1) The tweet suggests that COVID-19 vaccines are effective.
(2) The tweet suggests that COVID-19 vaccines are not effective.

8. **Thinking back to the tweet you just read, it comes from:**
(1) MSNBC
(2) FOX

[Message comprehension]

9. Please indicate how strongly you agree or disagree with the following statements:

Strongly disagree [1]	[2]	[3]	[4]	[5]	[6]	Strongly agree [7]

(4) The message was easy to read.
(5) The message was easy to understand.
(6) The article was difficult to understand.

10. Qualitative feedback
Please write down any thoughts you have about the message you just read. Please pay attention to the words and ideas in the message and tell us what you think could be done to make it easier to understand.

_____

Next, we would like to invite you to read a post from a Twitter user: Hunter Wilson. Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message.

[DISPLAY: The misinformation message for study 2. Randomly assign a Twitter post from a Democrat/Republican user]

[Manipulation check]

11. Thinking back to the tweet from Hunter, choose one option that best reflects the message content:
(1) The tweet suggests that COVID-19 vaccines are effective.
(2) The tweet suggests that COVID-19 vaccines are not effective.

12. Thinking back to the tweet you just read, it comes from a Twitter user who self-identifies as:
(1) A Democrat
(2) A Republican

[Demographic variables]

13. How old are you?

14. What's your sex?
(1) Male
(2) Female
(3) Other

15. Are you of Hispanic, Latino, or Spanish origin?
(1) Yes, I am of Hispanic, Latino, or Spanish origin.
(2) No, I am not of Hispanic, Latino, or Spanish origin.

16. Which of the following best describes your racial background?
(1) White
(2) Black or African American
(3) American Indian or Alaska Native
(4) Asian

(5) Native Hawaiian or Pacific Islander
(6) Two or more races
(7) Other

17. What is the highest level of school you completed?
(1) Less than high school
(2) High school graduate
(3) Some college
(4) College graduate
(5) Post-graduate

18. What's your household annual income?
(1) $0-$9,999
(2) $10,000 to $14,999
(3) $15,000-$19,999
(4) $20,000-$34,999
(5) $35,000-$49,999
(6) $50,000 to $74,999
(7) $75,000-$99,999
(8) $100,000-$199,999
(9) $200,000 or more

19. **How would you describe your political party affiliation?**
(1) Republican
(2) Independent
(3) Democrat
(4) Other

[Debrief]

Thank you for participating in this study. Please note that the four messages you just read were created by the researcher for the purpose of this study. We apologize for any deception involved in the survey. Please contact the researcher if you wish to withdraw your data. We are planning to conduct a study that examines whether scientific messages about COVID-19 vaccines can reduce the impact of COVID-19 vaccine misinformation. The purpose of the current survey is to collect feedback on message design. The public service announcement and the tweet from MSNBC/FOX were created based on information from the CDC about COVID-19 vaccines. The Reddit message and the tweet from Hunter Wilson were developed based on actual social media posts. The name of the Twitter user Hunter Wilson is created by the researcher.

According to scientists, COVID-19 vaccines are effective in preventing severe illness and death from COVID-19, and getting vaccinated provides better protection than natural immunity. For reliable information about COVID-19 and COVID-19 vaccines, please visit the CDC website (https://www.cdc.gov/coronavirus/2019-ncov/index.html).

Questions about this study should be addressed to the researcher, Yuan Wang (yuanwang@umd.edu), at the University of Maryland-College Park.

Appendix E: The Questionnaire for Study 1

[Consent Form]

PRE-TEST MEASURES

[Background]

In August, the Food and Drug Administration authorized the updated COVID-19 boosters, which are called bivalent vaccines because they are tailored to protect against Omicron subvariants now circulating as well as the original version of the virus. Since December 2022, The Centers for Disease Control and Prevention recommends one updated (bivalent) booster dose: (1) for everyone aged 5 years and older if it has been at least 2 months since their last dose; and (2) for children aged 6 months–4 years who completed the Moderna primary series and if it has been at least 2 months since their last dose.

Next, you will answer several questions regarding your opinions about COVID-19 vaccines, including the boosters.

[Pre-existing beliefs in COVID-19 vaccine misinformation]

1. **Please read the following claim and indicate whether you believe it is true or false: COVID-19 vaccines are not effective at all.**
   (1) Definitely false
   (2) Probably false
   (3) I don't know
   (4) Probably true
   (5) Definitely true

INOCULATION EXPOSURE

[DISPLAY: Randomly assign 1] an inoculation message or 2) a no message control condition]

Next, we would like to invite you to read a public service announcement (PSA). Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message.

[Manipulation check]

2. **Thinking back to the PSA you just read, choose one option that best reflects the message content:**
   (3) The message suggests that COVID-19 vaccines are effective.
   (4) The message suggests that COVID-19 vaccines are not effective.

MISINFORMATION EXPOSURE

Next, we would like to invite you to read a post from Reddit. Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message.

[DISPLAY: The misinformation message]

[Manipulation check]

3. **Thinking back to the Reddit post you just read, choose one option that best reflects the message content:**
   (3) Comments on the Reddit post argue that COVID-19 vaccines are effective.
   (4) Comments on the Reddit post argue that COVID-19 vaccines are not effective.

[Counterarguing]

4. **Thinking back to the viewpoints in the Reddit post, which option below best reflects your opinions?** I thought of:
   (1) A *lot of* arguments support those viewpoints.
   (2) *Several* arguments support those viewpoints.
   (3) At *least one* argument supports those viewpoints.
   (4) Arguments both for and against those viewpoints.
   (5) *At least one* argument against those viewpoints.
   (6) Several arguments against those viewpoints.
   (7) A *lot of* arguments against those viewpoints.

[Perceived ease of counterarguing]

5. **Overall, how easy/difficult was it for you to come up with arguments that *refute* the viewpoints in the Reddit post?**

Very difficult [1]	[2]	[3]	[4]	[5]	[6]	Very easy [7]

6. **Overall, how easy/difficult was it for you to come up with arguments that *support* the viewpoints in the Reddit post?**

Very difficult [1]	[2]	[3]	[4]	[5]	[6]	Very easy [7]

[Anger]

7. **While viewing the Reddit post, to what extent do you feel:**
   (1 = none of this feeling, 7 = a great deal of this feeling)
   (1) Irritated
   (2) Angry
   (3) Annoyed
   (4) Aggravated

[Beliefs in misinformation about COVID-19 vaccines]

8. **Some people are hesitant about the effectiveness of COVID-19 vaccines. Below are some claims about COVID-19 vaccines, please read each claim and indicate whether you believe it is true or false.**

Probably false	Definitely false	I don't know	Probably true	Definitely true
[1]	[2]	[3]	[4]	[5]

(1) COVID-19 vaccines cannot protect against COVID-19 variants at all.
(2) Vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID-19.
(3) Natural immunity provides better protection than vaccine-induced immunity to COVID-19.

[Attitude toward COVID-19 vaccines]

9. In your opinion, getting a COVID-19 vaccine is:

Foolish [1]	[2]	[3]	[4]	[5]	[6]	Wise [7]
Harmful [1]	[2]	[3]	[4]	[5]	[6]	Beneficial [7]
Worthless [1]	[2]	[3]	[4]	[5]	[6]	Valuable [7]
Bad [1]	[2]	[3]	[4]	[5]	[6]	Good [7]

[Vaccination status]

10. Have you received any COVID-19 vaccine? Choose the option that best fits with your situation.
(1) Yes, I am fully vaccinated and have received the updated bivalent booster.
(2) Yes, I am fully vaccinated and have received the original booster.
(3) Yes, I have received at least one dose of vaccine but have not received any booster shot.
(4) No, I have not received any COVID-19 vaccine.

[Vaccination intentions]

11. How likely would you take a COVID-19 vaccine [display if [4] is chosen in Q10**]/ take an updated booster shot of COVID-19 vaccine when you are eligible** [display if [2/3] is chosen in Q10/**take another booster shot of COVID-19 vaccine when it is recommended to you** [display if [1] is chosen in Q10]**?**
(1) Very unlikely
(2) Unlikely
(3) Somewhat unlikely
(4) Hard to say
(5) Somewhat likely
(6) Likely
(7) Very likely

[Vaccination intentions for kids]

12. If you have a child (or imagine that you have a child) who is eligible to a COVID-19 bivalent booster, how likely would you have your child take a COVID-19 bivalent booster?

(1) Very unlikely
(2) Unlikely
(3) Somewhat unlikely
(4) Hard to say
(5) Somewhat likely
(6) Likely
(7) Very likely
(8) Not applicable (my child has taken the updated COVID-19 booster)

[COVID-19 Vaccine Recommendations]

13. How likely would you recommend COVID-19 vaccination (including the boosters) to the following groups of people?

Very unlikely	Unlikely	Somewhat unlikely	Hard to say	Somewhat likely	Likely	Very likely
[1]	[2]	[3]	[4]	[5]	[6]	[7]

(1) Your family, friends, or colleague who are hesitant about getting a COVID-19 vaccine.
(2) Parents who are hesitant about getting their children vaccinated against COVID-19.
(3) A stranger online who asks about whether it is necessary to get a COVID-19 vaccine.

[Demographic variables]

14. How old are you?

_____

15. What's your sex?

(1) Male
(2) Female
(3) Other

16. Are you of Hispanic, Latino, or Spanish origin?

(1) Yes, I am of Hispanic, Latino, or Spanish origin.
(2) No, I am not of Hispanic, Latino, or Spanish origin.

17. Which of the following best describes your racial background?

(1) White
(2) Black or African American
(3) American Indian or Alaska Native
(4) Asian
(5) Native Hawaiian or Pacific Islander

(6) Two or more races
(7) Other

18. What is the highest level of school you completed?
(1) Less than high school
(2) High school graduate
(3) Some college
(4) College graduate
(5) Post-graduate

19. What's your household annual income?
(1) $0-$9,999
(2) $10,000 to $14,999
(3) $15,000-$19,999
(4) $20,000-$34,999
(5) $35,000-$49,999
(6) $50,000 to $74,999
(7) $75,000-$99,999
(8) $100,000-$199,999
(9) $200,000 or more

20. **How would you describe your political party affiliation?**
(1) Republican
(2) Independent
(3) Democrat
(4) Other

[Debrief]

Thank you for participating in this study. Please note that the public service announcement and the Reddit post you just read were both created by the researcher. We apologize for any deception involved in the survey. Please contact the researcher if you wish to withdraw your data. We created the two messages to examine whether exposing people to scientific messages about COVID-19 vaccines can reduce the impact of COVID-19 vaccine misinformation. The public service announcement was drafted based on COVID-19 vaccine information provided by CDC. The reddit message was drafted based on actual reddit posts. If you were not exposed to a public service announcement, you were assigned to the control group and did not receive the vaccine-related scientific message.

According to scientists, COVID-19 vaccines are effective in preventing severe illness and death from COVID-19, and getting vaccinated provides better protection than natural immunity. For reliable information about COVID-19 and COVID-19 vaccines, please visit the CDC website (https://www.cdc.gov/coronavirus/2019-ncov/index.html).

Questions about this study should be addressed to the researcher, Yuan Wang (yuanwang@umd.edu), at the University of Maryland-College Park.

Appendix F: The Questionnaire for Study 2

[Consent Form]

PRE-TEST MEASURES

[Party affiliation]

1. **How would you describe your political party affiliation?**
   (1) Republican
   (2) Democrat

[Party identification strength]

2. **Please answer the following questions about your identity:**
   [Display questions about Republican if [1] is chosen in Q1 and Display questions about Democrats if [2] is chosen in Q1]

Items	[1]	[2]	[3]	[4]
(1) How important is being a Democrat/Republican to you?	Not important at all	Not very important	Very important	Extremely important
(2) How well does the term Democrat/Republican describe you?	Not at all	Not very well	Very well	Extremely well
(3) When talking about Democrat/Republican, how often do you use "we" instead of "they"?	Never	Rare	Sometimes	Most of the time
(4) To what extent do you think of yourself as being a Democrat/Republican?	Not at all	Very little	Somewhat	A great deal

[Trust in source]

3. **How much do you trust information about COVID-19 from the following sources?**

Do not trust at all [1]	[2]	[3]	[4]	[5]	[6]	Completely trust [7]

(1) MSNBC
(2) FOX
(3) Republicans
(4) Democrats

[Background]

In August, the Food and Drug Administration authorized the updated COVID-19 boosters, which are called bivalent vaccines because they are tailored to protect against Omicron subvariants now circulating as well as the original version of the virus. Since

December 2022, The Centers for Disease Control and Prevention recommends one updated (bivalent) booster dose: (1) for everyone aged 5 years and older if it has been at least 2 months since their last dose; and (2) for children aged 6 months–4 years who completed the Moderna primary series and if it has been at least 2 months since their last dose.

Next, you will answer several questions regarding your opinions about COVID-19 vaccines, including the boosters.

INOCULATION EXPOSURE

[DISPLAY: Randomly assign 1] an inoculation message from MSNBC, 2) an inoculation message from FOX]

Next, we would like to invite you to read a Twitter message from MSNBC/FOX. Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message.

[Manipulation check]

4. **Thinking back to the tweet you just read, it comes from:**
   (1) MSNBC
   (2) FOX

MISINFORMATION EXPOSURE

[DISPLAY: Randomly assign 1] a Republican-sourced misinformation, 2) a Democrat-sourced misinformation]

Next, we would like to invite you to read a post from a Twitter user - Hunter Wilson. Please view the message for at least one minute before moving on to the following page to answer a few questions about your reactions to the message from Hunter.

[DISPLAY: The misinformation message]

[Manipulation check]

5. **Thinking back to the tweet from Hunter, it comes from a Twitter user who self-identifies as:**
   (1) A Democrat
   (2) A Republican

[Counterarguing]

6. **Thinking back to the viewpoints in the tweet from Hunter, which option below best reflects your opinions?** I thought of:
   (1) A *lot of* arguments support those viewpoints.
   (2) *Several* arguments support those viewpoints.
   (3) At *least one* argument supports those viewpoints.

(4) Arguments both for and against those viewpoints.
(5) *At least one* argument against those viewpoints.
(6) Several arguments against those viewpoints.
(7) A *lot of* arguments against those viewpoints.

[Perceived ease of counterarguing]

7. **Overall, how easy/difficult was it for you to come up with arguments that *refute* the viewpoints in the tweet from Hunter?**

Very difficult [1]	[2]	[3]	[4]	[5]	[6]	Very easy [7]

8. **Overall, how easy/difficult was it for you to come up with arguments that *support* the viewpoints in the tweet from Hunter?**

Very difficult [1]	[2]	[3]	[4]	[5]	[6]	Very easy [7]

[Anger]

9. **While viewing the tweet from Hunter, to what extent do you feel:**
(1 = none of this feeling, 7 = a great deal of this feeling)
(1) Irritated
(2) Angry
(3) Annoyed
(4) Aggravated

[Beliefs in COVID-19 vaccine misinformation]

10. **Some people are hesitant about the effectiveness of COVID-19 vaccines. Below are some claims about COVID-19 vaccines, please read each claim and indicate whether you believe it is true or false.**

Probably false	Definitely false	Neither true nor false	Probably true	Definitely true
[1]	[2]	[3]	[4]	[5]

(1) COVID-19 vaccines cannot protect against COVID-19 variants at all.
(2) Vaccinated individuals and unvaccinated individuals are equally likely to get sick from COVID-19.
(3) Natural immunity provides better protection than vaccine-induced immunity to COVID -19.

[Attitude toward COVID-19 vaccines]

11. **In your opinion, getting a COVID-19 vaccine is:**

Foolish [1]	[2]	[3]	[4]	[5]	[6]	Wise [7]

Harmful [1]	[2]	[3]	[4]	[5]	[6]	Beneficial [7]
Worthless [1]	[2]	[3]	[4]	[5]	[6]	Valuable [7]
Bad [1]	[2]	[3]	[4]	[5]	[6]	Good [7]

[Vaccination status]

12. Have you received any COVID-19 vaccine?

(1) Yes, I am fully vaccinated and have received the updated bivalent booster.
(2) Yes, I am fully vaccinated and have received the original booster.
(3) Yes, I have received at least one dose of vaccine but have not received any booster shot.
(4) No, I have not received any COVID-19 vaccine.

[Vaccination intentions]

13. How likely would you take a COVID-19 vaccine [display if [4] is chosen in Q11**]/ take an updated booster shot of COVID-19 vaccine when you are eligible** [display if [2/3] is chosen in Q11] **take another booster shot of COVID-19 vaccine when it is recommended to you** [display if [1] is chosen in Q11]**??**

(1) Very unlikely
(2) Unlikely
(3) Somewhat unlikely
(4) Hard to say
(5) Somewhat likely
(6) Likely
(7) Very likely

[Vaccination intentions for kids]

14. If you have a child (or imagining you have a child) who is eligible to a COVID-19 bivalent booster, how likely would you have your child take a COVID-19 bivalent booster?

(1) Very unlikely
(2) Unlikely
(3) Somewhat unlikely
(4) Hard to say
(5) Somewhat likely
(6) Likely
(7) Very likely
(8) Not applicable (my child has taken the updated COVID-19 booster)

[COVID-19 Vaccine Recommendations]

15. How likely would you recommend COVID-19 vaccination to the following groups of people?

Very unlikely	Unlikely	Somewhat unlikely	Hard to say	Somewhat likely	Likely	Very likely
[1]	[2]	[3]	[4]	[5]	[6]	[7]

(1) Your family, friends, or colleague who are hesitant about getting a COVID-19 vaccine.
(2) Parents who are hesitant about getting their children vaccinated against COVID-19.
(3) A stranger online who asks about whether it is necessary to get a COVID-19 vaccine.

[Demographic variables]

16. How old are you?

_____

17. What's your sex?

(1) Male
(2) Female
(3) Other

18. Are you of Hispanic, Latino, or Spanish origin?

(1) Yes, I am of Hispanic, Latino, or Spanish origin.
(2) No, I am not of Hispanic, Latino, or Spanish origin.

19. Which of the following best describes your racial background?

(1) White
(2) Black or African American
(3) American Indian or Alaska Native
(4) Asian
(5) Native Hawaiian or Pacific Islander
(6) Two or more races
(7) Other

20. What is the highest level of school you completed?

(1) Less than high school
(2) High school graduate
(3) Some college
(4) College graduate
(5) Post-graduate

21. What's your household annual income?

(1) $0-$9,999
(2) $10,000 to $14,999
(3) $15,000-$19,999
(4) $20,000-$34,999
(5) $35,000-$49,999
(6) $50,000 to $74,999
(7) $75,000-$99,999
(8) $100,000-$199,999
(9) $200,000 or more

[Debrief]

Thank you for participating in this study. Please note that the Twitter messages you just read were both created by the researcher. We apologize for any deception involved in the survey. Please contact the researcher if you wish to withdraw your data. We created the Twitter messages to examine whether exposing people to scientific messages about COVID-19 vaccines can reduce the impact of COVID-19 vaccine misinformation and how messages sources can impact message persuasiveness. The tweet from MSNBC/FOX was drafted based on COVID-19 vaccine information provided by CDC. The tweet from Hunter Wilson was drafted based on actual social media posts. The name of the Twitter user (Hunter Wilson) was created by the researcher.

According to scientists, COVID-19 vaccines are effective in preventing severe illness and death from COVID-19, and getting vaccinated provides better protection than natural immunity. For reliable information about COVID-19 and COVID-19 vaccines, please visit the CDC website (https://www.cdc.gov/coronavirus/2019-ncov/index.html).

Questions about this study should be addressed to the researcher, Yuan Wang (yuanwang@umd.edu), at the University of Maryland-College Park.

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