



## Case Report

Using two-sided messages to facilitate misinformation correction for strongly held beliefs<sup>☆</sup>Mengran Xu<sup>a,\*</sup>, Richard E. Petty<sup>b</sup><sup>a</sup> School of Management, Fudan University<sup>b</sup> Department of Psychology, The Ohio State University

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## ABSTRACT

In the U.S. and around the world, the dissemination of misinformation has become a widespread issue, and efforts to correct it have faced significant challenges. Prior research on influencing strong attitudes has shown that using two-sided (vs. one-sided) messages can be more effective in producing attitude change. Although there is a long history of research examining two-sided persuasive messages, this has never been examined in the context of misinformation correction. Rather, misinformation correction messages are invariably one-sided. Across two studies ( $N = 869$ ), we extend the outcome observed in the persuasion domain to the context of debunking misinformation. Study 1, focused on a widespread but incorrect political belief regarding the 2020 U.S. election, and a preregistered Study 2, examined the correction of misinformation regarding a health belief (i.e., FDA withholding cancer treatment). Both studies demonstrated that a two-sided (vs. one-sided) correction message became more effective as the strength of individuals' belief in the misinformation increased. People's openness to the two-sided correction message was driven by their enhanced appreciation of the source acknowledging their view and the source's credibility. This openness, in turn, was associated with more favorable beliefs in the correct information. Taken together, these findings demonstrate the effectiveness of using two-sided messages as a strategic tool for combating misinformation among those whose beliefs in the misinformation are strong.

In today's digital age, the proliferation of misinformation — information without a factual basis — has emerged as a critical societal challenge with profound implications for public health, politics, and social cohesion (Wardle & Derakhshan, 2017; West & Bergstrom, 2021). For example, a recent review by the World Health Organization (WHO, 2022) showed that incorrect understanding of health information increased vaccine hesitancy and delayed the provision of health care. Similarly, fabricated news has intensified political polarization as evidenced by its role in recent U.S. presidential elections, where it reinforced echo chambers and deepened societal divisions (Bovet & Makse, 2019). In response, researchers have sought to identify drivers that contribute to its acceptance (Axt et al., 2020) and to develop effective corrections (Lewandowsky et al., 2012). Yet, despite extensive research, the conditions under which individuals reliably correct mistaken beliefs remain poorly understood, highlighting the need for further investigation.

## 1. Efforts to Correct Misinformation

Although much research has examined the origins of misinformation (Lewandowsky et al., 2012), who is most susceptible to it (e.g., the elderly, Brashier & Schacter, 2020), which variables increase its acceptance (e.g., presentation by ingroup sources; Traberg et al., 2024), and how it can spread inadvertently or with intent (Kozyreva et al., 2020), the present work is focused on the *correction* of mistaken beliefs. One clear finding is that simply retracting a piece of misinformation does not necessarily remove its influence (Ecker et al., 2011). This is because cognitive biases such as motivated reasoning (Kunda, 1990) and reactance (Brehm, 1981) can cause people to cling to misinformation even when presented with corrections. Despite these challenges, researchers have devoted considerable effort to investigating effective ways to correct misinformation. Notably, research on misinformation correction has examined many of the same source, message, context, and recipient variables that have dominated the general literature on persuasion

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(Hovland et al., 1953) which focuses on ways to change any belief (Petty, 2024).

One of the most widely studied source variables is credibility. A recent review identified nearly 100 studies that examined the impact of this variable alone in the misinformation context (Mang et al., 2024). Correction studies targeting the context have found that multiple repetitions of correction messages can be helpful in reducing misinformation impact, though not eliminating it (Ecker et al., 2011). With respect to recipient factors, affirming a person's core values (Nyhan & Reifler, 2011) can facilitate receptivity to corrections.

Prior misinformation correction efforts have less frequently focused on aspects of the debunking message itself, with some exceptions, such as people preferring simple correction explanations over complex ones (Chater & Vitányi, 2003; Lombrozo, 2006). More recently, researchers leveraged large language models to provide correction messages that directly target individuals' conspiracy theory beliefs (Costello et al., 2024). This personalized persuasion method (cf., Petty et al., 2025) has shown both short-term and long-term beneficial effects, though it remains unclear which specific aspects of the AI-generated messages contributed to their effectiveness. To add to the literature on effective correction messages, the current research focuses on testing what might appear to be a highly counter-intuitive strategy that involves validating why someone might believe in the misinformation. This technique, explained next, is based on recent persuasion research comparing the effectiveness of one-versus two-sided messages for people who vary in their belief strength (Xu & Petty, 2022, 2024).

## 2. Using Two-sided Messages to Influence Strong Beliefs

The exploration of when and why two-sided messages can be more effective than one-sided communications have a long history (see O'Keefe, 1999). Xu and Petty (2022, 2024) recently demonstrated that two-sided messages, which acknowledge some validity to arguments on both sides of an issue while still advocating for one-side, become increasingly more effective than one-sided communications as the strength of the challenged attitude increases. Stronger beliefs are generally more resistant to change and more consequential in guiding corresponding behaviors (Krosnick & Petty, 1985). The strength of a belief is indexed by factors such as the certainty with which it is held and how closely it is linked to a person's identity (Luttrell & Sawicki, 2020). For misinformation correction, it would be particularly valuable to find ways to soften people's strongly held incorrect beliefs as most persuasion techniques are more effective on weak ones (Petty et al., 2023).

Changing strongly held beliefs is facilitated by first increasing recipients' openness to opposing viewpoints (Hussein & Tormala, 2021). This approach mirrors the transtheoretical model of change in psychotherapy, where contemplation—actively considering shifting—precedes actual behavioral or attitudinal change (Norcross et al., 2011). While we recognize that openness and change are separable (Minson & Chen, 2022; Santoro et al., 2025), research demonstrates that two-sided messages promote attitude change both directly and indirectly through enhanced openness (Xu & Petty, 2022, 2024). We therefore propose that openness can serve as a critical precursor to successful misinformation correction.

To explain why two-sided messages are particularly effective in encouraging openness for those with strong beliefs, consider a source who is presenting a two-sided correction message. In such a message, the brief but genuine acknowledgement of the audience's side signals that the source is open to the recipient's viewpoint (Hussein & Tormala, 2021), which the recipient would appreciate. Based on the principle of reciprocity, the source's openness would motivate recipients to reciprocate by being open to the source's beliefs (Cialdini & Goldstein, 2004). Specifically, when a communicator acknowledges a recipient's viewpoint, this fosters a sense of appreciation. This appreciation then prompts a desire to reciprocate, leading to more openness to the

source's position. Furthermore, the acknowledgement of one's view is especially appreciated by recipients who hold strong beliefs because acknowledging deeply cherished views constitutes a more meaningful "favor" that can motivate greater reciprocation. Importantly, reciprocity has not only been effective as a mechanism in the compliance literature (Cialdini & Goldstein, 2004), but has also proven effective in persuasion situations (Cialdini et al., 1992), suggesting its plausibility in the misinformation correction context.

Although there is a long history of research examining two-sided messages, to our knowledge such message have never been examined with respect to misinformation correction. Rather, misinformation correction messages are invariably one-sided. We argue that when it comes to debunking misinformation, two vs. one-sided correction messages could be especially effective for those who strongly believe in the misinformation. In addition to fostering appreciation and reciprocity, two- vs. one-sided communications can make the source seem more credible (Kamins & Marks, 1987). This notion comes from attribution theory (Jones & Davis, 1965; Kelley, 1973). When message recipients encounter a one-sided message, they often attribute the claims to the source's desire to benefit from the position in some way (i.e., some bias; Eagly et al., 1981). However, when people encounter a two-sided message, they are less likely to attribute the claim to bias and instead infer that the claim and the source making it are credible (Wallace et al., 2024). Furthermore, it is reasonable to assume that people who hold strong positions tend to value source credibility more. Thus, this inference could be especially important to those with strong beliefs.

Given both the reciprocity and credibility mechanisms, we predicted that two-sided communications will be more effective than one-sided ones in encouraging openness to misinformation correction, especially for those whose beliefs in the misinformation are strong. This effect is expected to be driven by: (1) recipients' appreciation of the acknowledgement of their perspective, motivating reciprocity, and (2) their enhanced perception of source credibility from two- over one-sided messages.

## 3. Research Overview

This research had three goals. First, we examined whether the relative effectiveness of two- over one-sided messages for people with strong attitudes could be extended to the misinformation correction context. Second, we explored the potential mechanisms for this outcome. Finally, we examined the generalizability and broader applicability of using two-sided messages as a strategic tool for combating misinformation among those whose beliefs in the misinformation are strong. Study 1 focused on correcting political misinformation and Study 2 (preregistered) on health misinformation. Given the similarity in study designs and the consistent pattern of results, we describe the study materials separately for each study as they examined different misinformation. However, for efficiency, we report the results of both studies together as a single, multi-study investigation, including Study as a factor.<sup>1</sup>

## 4. Method: Combined

### 4.1. Study 1

U.S. residents who subscribed to the incorrect belief that the U.S. 2020 Presidential election was rigged were recruited. Then, participants were provided with either a one- or a two-sided correction message, arguing that there was no evidence for systematic voter fraud. We examined whether two-sided messages were more effective than one-

<sup>1</sup> All study measures, manipulations, and participant exclusions are reported in the manuscript. All data and analysis scripts are available here: [https://osf.io/ck48z/?view\\_only=92dbf0cd2f2b471f992ee65c65e9cd6b](https://osf.io/ck48z/?view_only=92dbf0cd2f2b471f992ee65c65e9cd6b)

sided ones in producing openness to the correction, especially for those with strong beliefs in the misinformation.

#### 4.2. Participants

We recruited 395 Amazon Mechanical Turk (MTurk) workers who received a payment of \$0.70.<sup>2</sup>

##### 4.2.1. Procedure

At the beginning of the study (conducted in May 2024), participants responded to three statements describing some common incorrect beliefs (e.g., “there is significant disagreement among climate scientists that humans are causing global warming”). Among them, we embedded our core item about voter fraud in the 2020 U.S. Presidential election. Participants rated the extent to which they believed in each statement and only those who subscribed to the belief that the 2020 Presidential election outcome was fraudulent – rated 4 and above on a 6-point scale anchored at 1 (*not at all*) and 6 (*extremely*) – were invited to the study. Given the scale anchors, a rating of 4 implied at least moderate agreement with the mistaken belief.

Following this assessment, participants rated the strength of that belief on several scales. Then, participants were randomly presented with either the one- or two-sided correction message. Each message explained that there is no evidence for systematic voter fraud in the 2020 U.S. Presidential election. After reading the message, participants responded to the measures of openness to the other side and provided their beliefs about the 2020 election results being rigged. Next, they answered questions assessing their appreciation of the position taken in the message and perceived source credibility. Lastly, they completed the manipulation check for message sidedness and demographic questions.

##### 4.2.2. Independent Variables

**Pre-Correction Beliefs.** Participants indicated the extent to which they believed that “the 2020 Presidential election in the U.S. was a fraud and that Donald Trump was the actual winner of the election” on a 6-point scale anchored at 1 (*not at all*) and 6 (*extremely*).

**Belief Strength.** Participants rated how certain, correct, important, self-defining, and a reflection of their core moral beliefs and convictions their belief regarding the 2020 US Presidential election results was on 7-point scales anchored at 1 (*not at all*) and 7 (*extremely*) ( $\alpha = 0.87$ ). These are common items to assess attitude and belief strength (Krosnick, 1988; Petrocelli et al., 2007; Petty & Krosnick, 1985; Skitka & Morgan, 2014; Zunick et al., 2017). The items were averaged to create a belief strength index (cf., Xu & Petty, 2024).<sup>3</sup>

**Message Sidedness.** Both messages argued that there was no evidence for systematic voter fraud in the 2020 Presidential election. In the *one-sided condition*, the message stated that researchers using statistical reasoning and original data analysis found no evidence for systematic voter fraud. Also, the author debunked the myth that the

Dominion Voting Systems switched votes from Trump to Biden. The author concluded that there was no evidence of fraud and all lawsuits challenging the results were lost after hearings in court.

In the *two-sided condition*, the author presented the same set of correction arguments as in the one-sided version. Then the author briefly acknowledged that a reasonable percentage of Americans still believe the election was fraudulent because there was clear evidence that some fraud occurred. However, this fraud was on both sides, occurs in nearly all elections, and did not affect the election outcome. The author also acknowledged that Trump is a charismatic political figure and continues to have a powerful influence among his supporters. Regardless, the author drew the same conclusion as in the one-sided condition (see the online supplement for the full messages).

##### 4.2.3. Dependent Variables

**Openness.** Four items assessed how open participants were to the debunking message. Participants rated how likely they were to: (1) share the article they read with friends, (2) want to read another article taking the same position as the one they just read, (3) how much they appreciated the position taken in the message, and (4) recognized the merit of the arguments provided for the writer's position. Responses were made on 7-point scales anchored at 1 (*extremely unlikely*) and 7 (*extremely likely*). The four items were adapted from prior work (Chen et al., 2010; Minson & Chen, 2022) and used previously (e.g., Xu & Petty, 2022, 2024). The items appeared in a randomized order. Given high reliability ( $\alpha = 0.94$ ), the items were averaged to form the openness measure.

**Post-Correction Beliefs.** Participants responded to “There was no evidence for voter fraud in the 2020 US Presidential election that would have changed the results” on two 7-point semantic differential scales (disagree–agree; unfavorable–favorable;  $r = 0.96$ ). The average of these two items served as the post-correction belief measure. Higher scores indicate more agreement with the correction.

**Perceived Appreciation.** Two items (“Please rate the extent to which you were pleasantly surprised by the arguments provided in the message/the author has acknowledged your side in the message”; 1–*not at all* and 7–*extremely*) were averaged to assess perceived appreciation of the correction message ( $r = 0.82$ ). These items were adapted from prior work (Hare, 2003; Ward et al., 2008) and used previously (Xu & Petty, 2022, 2024).

**Source Credibility.** Participants rated the extent to which they thought that the journalist was a credible source (1–*not at all*; 7–*extremely*). See Table 1 for all pairwise correlations.

**Manipulation Check.** Participants rated the information they received on a 7-point scale anchored at 1 (*presented only one-sided information*) and 7 (*presented information from both sides*).<sup>4</sup>

#### 4.3. Study 2

In Study 1, we examined a misconception (election fraud) that is believed mostly by U.S. Republicans. In Study 2 we aimed to explore the generalizability of using two-sided messages as a tool for combating misinformation using a misconception that is also endorsed by Democrats. We conducted a survey to find a suitable belief. Of seven topics examined, a belief regarding the Food and Drug Administration (FDA) suppressing cancer cures was the most suitable. Republicans and Democrats endorsed this misinformation to a similar degree on a 7-point scale anchored at 1 (*not at all*) and 7 (*extremely*);  $M_{Republican} = 3.79$ ,  $SD = 2.02$ ;  $M_{Democrat} = 3.26$ ,  $SD = 2.18$ ),  $t(199) = 1.74$ ,  $p = .08$ , partial  $\eta^2 = 0.015$ .<sup>5</sup> Furthermore, this false belief is in a different domain (public health) than the topic from Study 1 (politics). Study 2 was pre-

<sup>2</sup> Given there was no information about what effect size to expect for this new context of misinformation correction, a small effect was assumed, ( $f^2 = 0.03$ ; Cohen, 1988) for the predicted interaction between belief strength and message sidedness on openness to change. Using G\*Power, 208 participants are needed to have 80 % power to detect a significant two-way interaction. Given the criticism of G\*Power for underestimating the sample size needed for interaction effects (Correll et al., 2020), we nearly doubled the total number of participants suggested by G\*Power. We also conducted a sensitivity power analysis. Under the standard criteria (i.e.,  $\alpha = 0.05$  and 80 % power) and given the final sample size recruited, the minimum effect size that could be obtained is partial  $\eta^2 = 0.02$ .

<sup>3</sup> We conducted an exploratory factor analysis using the maximum likelihood method with Direct Oblimin rotation. A scree test showed a single clear factor above the break in the data line, justifying our decision to use the composite index.

<sup>4</sup> The manipulation check used in both studies worked as expected (see online supplement for details).

<sup>5</sup> Details of this survey are in the online supplement.

**Table 1**

Matrix of the bivariate correlations between the variables used in regression models in Study 1.

	Pre-correction beliefs	Belief strength	Openness	Post-correction beliefs	Perceived appreciation
Pre-correction beliefs	–	–	–	–	–
Belief strength	0.39**	–	–	–	–
Openness	–0.08	–0.01	–	–	–
Post-correction beliefs	–0.11*	–0.04	0.78**	–	–
Perceived appreciation	–0.11*	–0.01	0.86**	0.68**	–
Source credibility	–0.10*	0.004	0.86**	0.78**	0.83**

Note: \*\* denotes significance at the 0.01 level; \* denotes significance at the 0.05 level.

registered: <https://aspredicted.org/pwqj-tz8g.pdf>. Given that Study 2 adopted the same basic procedures as Study 1, we only describe the materials that differed.

#### 4.4. Participants

This study, conducted in August 2024, recruited 474 MTurk workers who were paid \$0.70.<sup>6</sup>

##### 4.4.1. Procedure

Study 2 followed the same procedure as Study 1.

##### 4.4.2. Independent Variables

**Pre-Correction Beliefs.** Participants first indicated the extent to which they believed that “the Food and Drug Administration (FDA) is conspiring with Big Pharma to suppress approval of some cures for cancer” on a 6-point scale anchored at 1 (*not at all*) and 6 (*extremely*). As in Study 1, only those who subscribed to the focal belief at a moderate level (i.e., rated 4 and above) were invited to participate.

**Belief Strength.** The same set of items used in Study 1 were employed ( $\alpha = 0.89$ ). The items were averaged to create an overall belief strength index.<sup>7</sup>

**Message Sidedness.** Both messages argued that there was no evidence that the FDA is conspiring with Big Pharma to suppress cures for cancer. In the *one-sided condition*, the author stated that it is more financially advantageous for “Big Pharma” and the FDA to keep cancer patients alive if effective cancer cures were available. Beyond capitalistic motivations, it is also difficult to coordinate such a convoluted scheme and not everyone involved in cancer research would benefit from keeping a cure secret. The author concluded that there is no evi-

<sup>6</sup> Based on the effect size obtained in Study 1 for the interaction between belief strength and message sidedness on openness, using G\*Power, 395 participants are needed to have 80 % power to detect a significant two-way interaction. In our preregistration, we stated that we would recruit 400 participants. In anticipation of incomplete data entries, we recruited more than the targeted number in hope of getting at least 400 usable data points. In addition to the a priori power analysis, we conducted a sensitivity power analysis. Under the standard criteria (i.e.,  $\alpha = 0.05$  and 80 % power) and given the final sample size recruited, the minimum effect size that could be obtained is partial  $\eta^2 = 0.017$ .

<sup>7</sup> As in Study 1, we conducted an exploratory factor analysis using the maximum likelihood method with Direct Oblimin rotation. A scree test showed a single clear factor above the break in the data line, justifying our decision to use the composite index. Additionally, when using the belief certainty item alone, the preregistered indicator, very similar results were obtained (see online supplement for the results of Study 2 alone as well as the combined analyses using only belief certainty).

dence to suggest that Big Pharma and the FDA are conspiring to suppress cures for cancer.

In the *two-sided condition*, the author first presented the same set of arguments as those in the one-sided version. Then the author briefly acknowledged why a reasonable percentage of Americans would believe the misinformation. The author stated that it is likely true that by suppressing certain cures, big Pharma can make more money from their most expensive treatments. Additionally, the author claimed it is understandable that people are frustrated by the lack of cures for many forms of cancer and wish to believe that some cure might exist. Regardless, the author drew the same conclusion as in the one-sided condition (see the online supplement for the full messages).

##### 4.4.3. Dependent Variables

**Openness.** The same four items used in Study 1 were employed ( $\alpha = 0.87$ ) and averaged to form the key dependent measure.

**Post-Correction Beliefs.** Participants responded to “There is no evidence suggesting that the FDA is conspiring with Big Pharma to suppress certain cures for cancer” on the same two 7-point semantic differential scales used in Study 1 ( $r = 0.90$ ). The average of these two items served as the post-correction belief measure. Higher scores indicate more agreement with the correction.

**Perceived Appreciation.** The same two items used in Study 1 were employed ( $r = 0.74$ ) and averaged to form the perceived appreciation measure.

**Source Credibility.** The same item used in Study 1 was included. See Table 2 for all pairwise correlations.

**Manipulation Check.** The same item was used as in Study 1.

#### 4.5. Results: Combined Analyses

Given the very similar methods and consistent pattern of results when the studies are analyzed separately (see the online supplement for details), for efficiency we report the results of both studies together as a single, multi-study investigation.

#### 4.6. Regression Analyses

##### 4.6.1. Openness

A hierarchical multiple linear regression model was used to examine the effect of belief strength and message sidedness on participants' openness to the correction article. In the model, the belief strength and message sidedness variables along with the two-way interaction were used as independent variables, the openness measure served as the dependent variable, and the pre-correction belief measure served as the covariate.<sup>8</sup> The belief strength and message sidedness variables were entered into the model in the first step and the interaction between belief strength and message sidedness was entered in the second.

There was a significant two-way interaction between belief strength and message sidedness,  $B = 0.35$ ,  $t(864) = 3.90$ ,  $p < .001$ , 95 % CI: [0.17, 0.52], partial  $\eta^2 = 0.017$  (see Fig. 1, top left panel). For the two-sided message, the more strongly participants held their beliefs toward the respective misconception, the more they were open to the correction,  $B = 0.26$ ,  $t(864) = 3.99$ ,  $p < .001$ , 95 % CI: [0.13, 0.39], partial  $\eta^2 = 0.018$ . However, for the one-sided message, the effect was in the opposite direction, though not significant,  $B = -0.08$ ,  $t(864) = -1.30$ ,  $p = .19$ , partial  $\eta^2 = 0.002$ . A floodlight analysis using the Johnson-Neyman technique (Spiller et al., 2013) indicated that for those who scored 4.85 and above on the belief strength measure (58.11 % of the sample), the two-sided message was significantly more

<sup>8</sup> Persuasion research often uses pre-message attitudes as a covariate to highlight post-message beliefs that go beyond initial beliefs. However, the key effects reported remained the same when the pre-correction belief measure is not used as a covariate (see online supplement for details).

**Table 2**

Matrix of the bivariate correlations between the variables used in regression models in Study 2.

	Pre-correction beliefs	Belief certainty	Openness	Post-correction beliefs	Perceived appreciation
Pre-correction beliefs	–	–	–	–	–
Belief certainty	0.36**	–	–	–	–
Openness	–0.01	–0.004	–	–	–
Post-correction beliefs	–0.12*	–0.16*	0.65**	–	–
Perceived appreciation	–0.05	0.02	0.78**	0.58**	–
Source credibility	–0.07	–0.06	0.80**	0.64**	0.79**

Note: \*\* denotes significance at the 0.01 level; \* denotes significance at the 0.05 level.

effective than the one-sided message. Among participants who scored 2.99 and below (6.33 % of the sample), the effect was in the opposite direction. We further examined whether the two-way interaction between belief strength and message sidedness was further moderated by Study. The three-way interaction was not significant,  $B = -0.17$ ,  $t(860) = -0.97$ ,  $p = .33$ , partial  $\eta^2 = 0.001$ .<sup>9</sup>

#### 4.6.2. Post-Correction Beliefs

The same hierarchical multiple linear regression analysis conducted on openness was conducted on post-correction beliefs. This resulted in an interaction in the same form as openness,  $B = 0.26$ ,  $t(864) = 2.53$ ,  $p = .012$ , 95 % CI: [0.06, 0.47], partial  $\eta^2 = 0.007$  (see Fig. 1, top right panel). For the one-sided message, there was a significant negative effect of belief strength on post-correction beliefs,  $B = -0.21$ ,  $t(864) = -2.76$ ,  $p = .006$ , 95 % CI: [-0.36, -0.06], partial  $\eta^2 = 0.009$ , consistent with prior literature showing that higher strength of a belief makes influence less likely (Rucker et al., 2014). However, for the two-sided message, the effect was in the positive direction, though not significant,  $B = 0.05$ ,  $t(864) = 0.71$ ,  $p = .48$ , partial  $\eta^2 = 0.0006$ . A floodlight analysis indicated that for those who scored 5.44 and above on the belief strength measure (40.39 % of the sample), reading the two-sided correction message induced significantly greater belief in the position argued by the message than for the one-sided message. Among participants for those who scored 1.43 and below (0.92 % of the sample), the effect was in the opposite direction.

#### 4.6.3. Perceived Appreciation

The same hierarchical multiple linear regression was conducted on reported appreciation. The two-way interaction between belief strength and message sidedness was in the predicted direction and significant,  $B = 0.36$ ,  $t(864) = 4.02$ ,  $p < .001$ , 95 % CI: [0.18, 0.53], partial  $\eta^2 = 0.018$  (see Fig. 1, bottom left panel). When receiving a two-sided message, there was a significant positive effect of belief strength on appreciation,  $effect = 0.32$ ,  $t(864) = 4.85$ ,  $p < .001$ , 95 % CI: [0.19, 0.45], partial  $\eta^2 = 0.03$ . However, with a one-sided message, the direction was opposite,  $B = -0.04$ ,  $t(864) = -0.59$ ,  $p = .55$ , partial  $\eta^2 = 0.004$ . A floodlight analysis indicated that for those who scored 4.09 and above on the belief strength measure (78.71 % of the sample), there was significantly more appreciation after reading a two- than one-sided message. Among participants for those who scored 1.45 and below (0.92 % of the sample), the effect was opposite.

#### 4.6.4. Source Credibility

The same hierarchical multiple linear regression was conducted on source credibility. The two-way interaction between belief strength and message sidedness was in the predicted direction and significant,  $B = 0.34$ ,  $t(864) = 3.50$ ,  $p < .001$ , 95 % CI: [0.15, 0.53], partial  $\eta^2 = 0.014$  (see Fig. 1 bottom, right panel). For the two-sided message, there was a significant positive effect of belief strength on source credibility,  $effect = 0.25$ ,  $t(864) = 3.44$ ,  $p < .001$ , 95 % CI: [0.11, 0.39], partial  $\eta^2 = 0.014$ . For the one-sided message, the direction was opposite,  $B = -0.09$ ,  $t(390) = -1.30$ ,  $p = .19$ , partial  $\eta^2 = 0.002$ . A floodlight analysis indicated that for those who scored 4.70 and above on the belief strength measure (64.10 % of the sample), source credibility was significantly higher after reading a two-sided (vs. one-sided) message. Among participants who scored 2.23 and below (3.22 % of the sample), the effect was in the opposite direction.

For an additional comparison across the results of the two studies individually and combined, we conducted a mega-analysis (McShane & Böckenholt, 2017) and summarized the regression results for all dependent measures using forest plots (see Fig. 2). In sum, the studies showed very consistent results,  $r = 0.12$ ,  $SE = 0.01$ ,  $z\text{-value} = 9.70$ ,  $p < .001$ , 95 % CI: [0.09, 0.14].

#### 4.7. Mediation

##### 4.7.1. Moderated Parallel Mediation

PROCESS macro model 8 (Hayes, 2017) was used to look at the hypothesized mediation of openness through appreciation and credibility (see Fig. 3). There was a significant moderated mediation path through perceived appreciation,  $effect = 0.15$ , 95 % bootstrapping CI: [0.07, 0.24] and through source credibility,  $effect = 0.15$ , 95 % bootstrapping CI: [0.06, 0.24]. In the two-sided condition, perceived appreciation ( $effect = 0.14$ , 95 % bootstrapping CI: [0.08, 0.20]) and source credibility ( $effect = 0.11$ , 95 % bootstrapping CI: [0.04, 0.18]) significantly mediated the relationship between belief strength and openness. In the one-sided condition, both indirect effects through perceived appreciation and source credibility were not significant ( $effect = -0.02$ , 95 % bootstrapping CI: [-0.08, 0.04] and  $effect = -0.04$ , 95 % bootstrapping CI: [-0.10, 0.02] respectively).<sup>10</sup>

##### 4.7.2. Moderated Serial Mediation

Having shown that openness was mediated by perceived appreciation and source credibility, we examined whether post-correction beliefs about the misinformation were mediated serially by these two mediators and openness. This model did not preexist in PROCESS, so we self-defined this model (see Fig. 4). There was a significant serial moderated mediation path through perceived appreciation and openness,  $effect = 0.08$ , 95 % bootstrapping CI: [0.04, 0.14], and through source credibility and openness,  $effect = 0.08$ , 95 % bootstrapping CI: [0.03, 0.14]. In the two-sided condition, the indirect effect through perceived appreciation and openness was significant,  $effect = 0.07$ , 95 % bootstrapping CI: [0.04, 0.12], as was the indirect effect through source credibility and openness,  $effect = 0.06$ , 95 % bootstrapping CI: [0.02, 0.10]. However, in the one-sided condition, the indirect effect through perceived appreciation and openness was not significant,  $effect = -0.009$ , 95 % bootstrapping CI: [-0.04, 0.02], nor was the indirect effect through source credibility and openness,  $effect = -0.02$ , 95 % bootstrapping CI: [-0.06, 0.01]. This suggested that the increased appreciation of the message and source credibility were associated with more openness toward the issue among those with strong beliefs after viewing a two-sided (vs. one-sided) correction message and plausibly led to post-correction beliefs more consistent with the misinformation correction message.

<sup>9</sup> We also ran this analysis for the other dependent measures and none of the three-way interactions were significant ( $ps > 0.39$ ).

<sup>10</sup> We also tested for serial mediation models and both orders of the two mediators work (see online supplement).

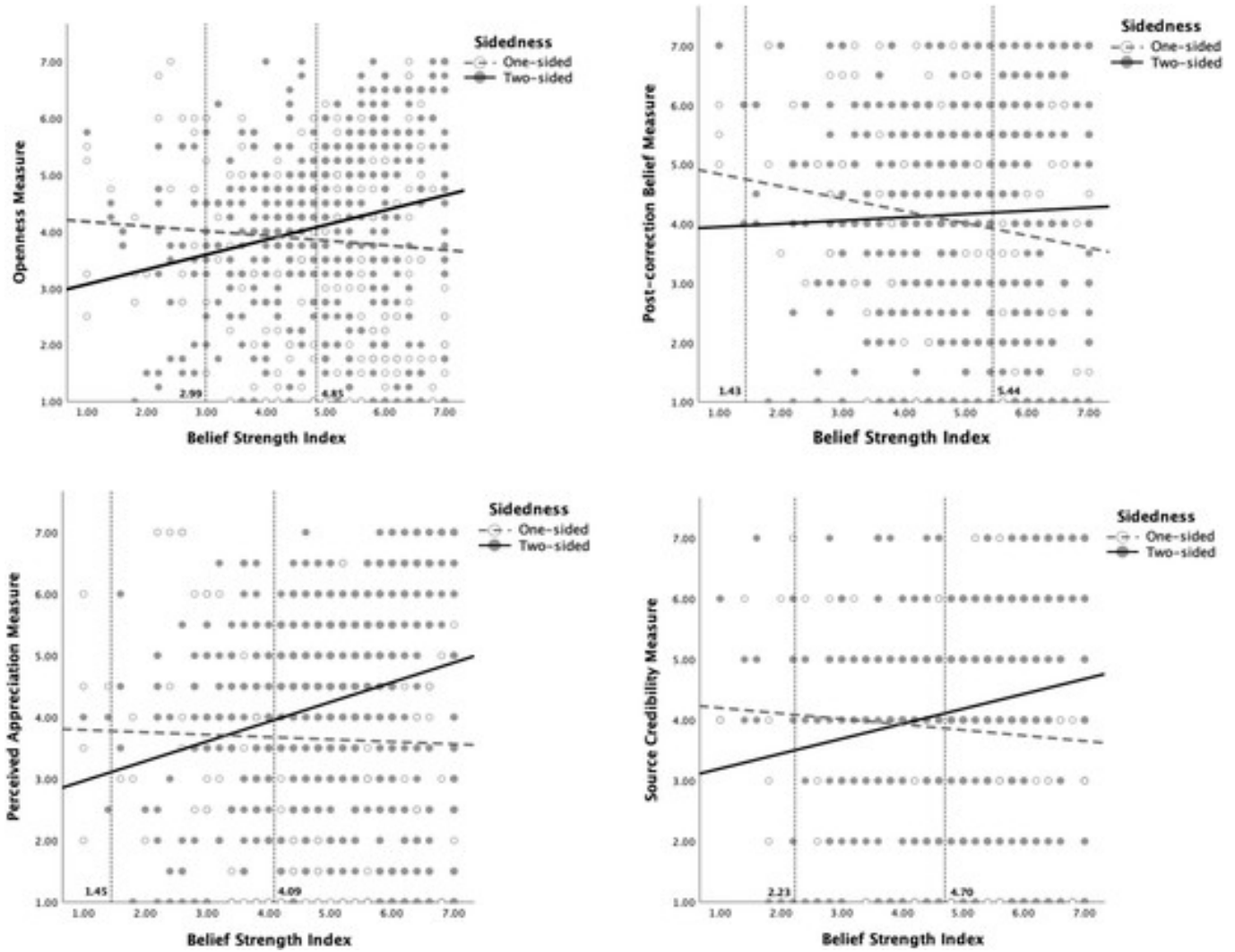


Fig. 1. Combined analysis: The interaction between belief strength and message sidedness on openness, post-correction beliefs, perceived appreciation, and source credibility.

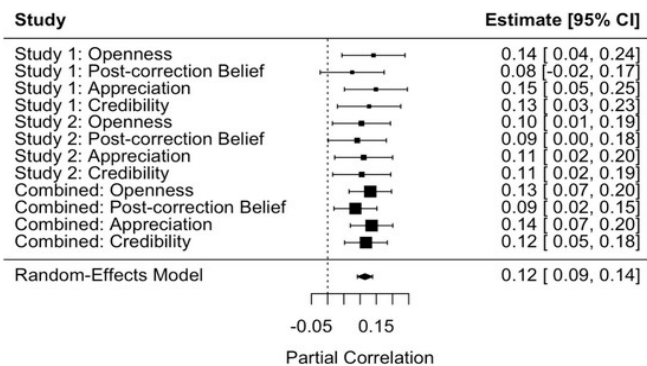
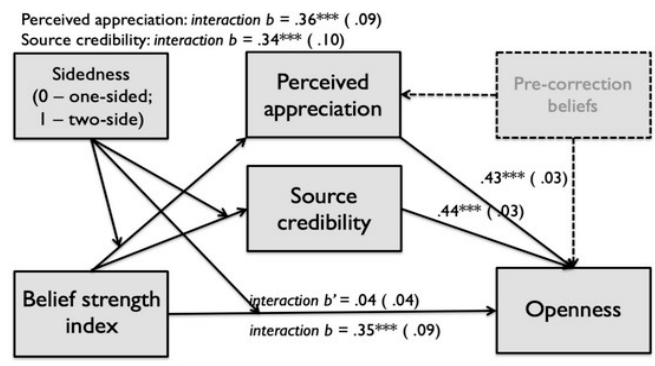


Fig. 2. Forest Plots Summarizing Regression Results.

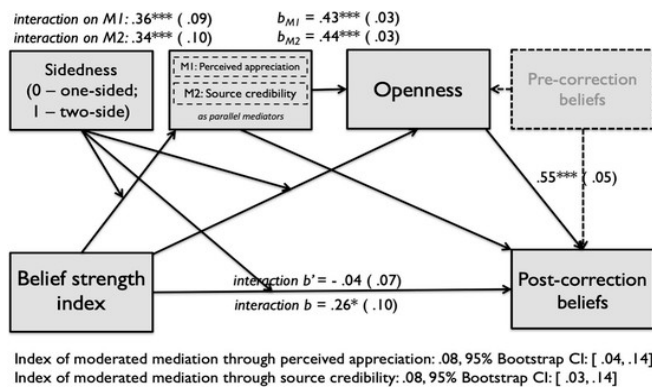


Index of mediation effect through perceived appreciation: .15, 95% Bootstrap CI: [.07, .24]  
 Index of mediation effect through source credibility: .15, 95% Bootstrap CI: [.06, .24]

5. General Discussion

In light of challenges posed by the proliferation of misinformation, researchers are working to develop effective correction strategies (Chan & Albarracín, 2023; Prike & Ecker, 2023). The current research builds

Fig. 3. Combined Analysis: Moderated Mediation Model.  
 Note: \*\*\* Denotes  $p < .001$ ; standard error reported in parentheses.



**Fig. 4.** Combined Analysis: Moderated Serial Mediation Models through Perceived Appreciation and Source Credibility as Parallel Mediators and Openness. Note: \*\*\* Denotes  $p < .001$ ; \* Denotes  $p < .05$ ; standard error reported in parentheses.

on past persuasion work demonstrating an advantageous impact of two-sided over one-sided messages in producing attitude change for individuals with strong beliefs. In two experiments, one preregistered, we found that prior persuasion findings on message sidedness were relevant to debunking misinformation (Walter & Tukachinsky, 2020). In particular, instead of only examining the typical one-sided correction message, we employed two-sided messages in which the correction information is accompanied by an acknowledgement of why someone might believe in the misinformation. Across two different incorrect beliefs, unlike the one-sided messages that tended to lose effectiveness as belief strength was increased, the two-sided correction messages gained effectiveness in enhancing openness to misinformation correction and also in adopting beliefs more in line with the correction message. Additionally, the resulting openness to two-sided correction messages was driven by the recipients' appreciation of the source's acknowledgement of their viewpoint and in the source's perceived credibility. This enhanced openness, in turn, was associated with more favorable beliefs in the correct information.

### 5.1. Theoretical Contribution

Past research on misinformation correction has systematically investigated the source, the recipient, and the context of correction information (Prike & Ecker, 2023). Fewer efforts have shed light on how to construct successful correction messages, although some work has supported using relatively simple and personalized communications (Costello et al., 2024). The current work contributes to the misinformation correction literature by identifying message sidedness as a relevant factor when constructing correction messages. This complements existing strategies of misinformation correction (Prike & Ecker, 2023) and extends the understanding of how to influence individuals with strong beliefs (Xu & Petty, 2022, 2024).

The current work supports a surprising conclusion: when debunking misinformation, acknowledging why some people believe that the misinformation is true can render individuals with relatively strong beliefs more receptive to the correction than simply debunking the misinformation. For those with weaker beliefs, the traditional one-sided message tends to be better. Importantly, the enhanced openness is linked to the downstream consequence of seeing the accurate belief more favorably. Although there is considerable research in the traditional persuasion context that examines two-sided messages (Eisend, 2007), the effectiveness of these communications has never been examined in the context of misinformation correction.

Furthermore, building on prior research on using two-sided messages to soften strongly held attitudes (Xu & Petty, 2022, 2024), the cur-

rent work extended and refined these prior studies in several ways. First, it identified enhanced source credibility as a key mediator along with perceived appreciation in the context of misinformation correction. Second, although Xu and Petty's original work examined two-sided messages as a tool for softening strongly held attitudes in persuasion contexts, the current studies extend this framework to the correction of strongly held misbeliefs in the domain of factual misinformation. There is currently some debate as to whether factual and opinion-based beliefs are subject to the same psychological processes (cf., Petty, 2024; Riesthuis & Woods, 2023), and the current research adds to the evidence that they definitely can be. Last, the current work demonstrated the prior framework's versatility while offering plausible practical benefits for misinformation intervention strategies.

### 5.2. Limitations and Future Directions

Even though we assessed participants' political affiliation along with their endorsement of various myths in a preliminary survey, in both studies we did not assess political affiliation. Nonetheless, it is reasonable to assume that given the content of the misinformation belief used in Study 1 (election fraud), the majority of the sample would be Republicans/Conservatives. Regarding Study 2, however (given the survey data), it is reasonable to assume that the sample would include a similar proportion of each political party/ideology.

In addition, although when combining data from both studies, we demonstrated both direct and indirect effects of our independent variables on post-correction beliefs, it would be interesting to explore how long the correction endures by adopting a longitudinal design to assess the sustained effect of the two-sided correction messages. Furthermore, it is important to specify exactly what needs to be included in two-sided messages for them to be maximally effective. For example, is merely acknowledging why someone might believe in misinformation without detailing those validities sufficient? What if the two-sided correction message said that there are extremely good reasons to believe in the misinformation? Would this reinforce the misbelief or elicit more appreciation? Lastly, past literature has not examined whether correction techniques work differently depending on whether the misinformation stems from a deliberate intent to deceive or not and that could be another interesting question for future research.

### Open Practices

All manuscript data and material reported in the current paper is available here: [https://osf.io/ck48z/?view\\_only=92dbf0cd2f2b471f992ee65c65e9cd6b](https://osf.io/ck48z/?view_only=92dbf0cd2f2b471f992ee65c65e9cd6b). Study 2 reported in the current paper is a preregistered study (<https://aspredicted.org/pwj-tz8g.pdf>).

### CRedit authorship contribution statement

**Mengran Xu:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Richard Petty:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization.

### Declaration of Competing Interest

The authors have no conflicts of interest.

### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jesp.2025.104807>.

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