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What If Unmotivated Is More Dangerous? The Motivation-Contingent Effectiveness of Misinformation Correction on Social Media

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This study examines the effect of misinformation correction on social media, contingent on the motivational factors heightened by social media when users are strongly opinionated. A 2 (uncertainty: low vs. high) × 2 (risk: low vs. high) × 2 (personal relevance: low vs. high) × 2 (attitudinal congruence with correction: incongruent vs. congruent) pretest and posttest factorial online experiment of 973 U.S. participants was conducted to examine the effectiveness of correction while controlling for misinformation source credibility. Findings suggest that correction is effective in decreasing social media users' perceived credibility and sharing intention toward misinformation even when they are polarized on the issue of the misinformation. Interestingly, while this study confirms previous literature that users are biased toward proattitudinal correction sources than counterattitudinal ones, misinformation correction is also significantly more effective in decreasing perceived credibility and sharing intention when users are motivated by the personal relevance, uncertainty, and risks associated with the misinformation.

Keywords: misinformation, correction, motivation, message credibility, information sharing

Misinformation, broadly defined as unintentionally spread false information whose "factual matters are not supported by clear evidence and expert opinion" (Nyhan & Reifler, 2010, p. 35), is perhaps the most pressing challenge we face on social media. As we brace for the rise of a posttruth era (Lewandowsky, Ecker, & Cook, 2017), wherein "'alternative facts' replace actual facts, and feelings have more weight than

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evidence" (The MIT Press, 2018, para. 1), it is not surprising to see a rising discussion about the role of motivation in the misinformation literature.

Meta-analyses suggest that the effectiveness of correction hinges upon factors like misinformation topic (e.g., politics vs. health), misinformation distributor (e.g., peers vs. organizations), time of debunking (e.g., rebuttals or forewarnings), correction source (e.g., experts vs. laymen), quality of refutation messages (e.g., coherence), and the match between audiences' worldviews and the rebuttal messages (e.g., Chan, Jones, Hall Jamieson, & Albarracín, 2017; Walter & Murphy, 2018). If we agree that misinformation correction is a form of persuasion (Bordia, DiFonzo, Haines, & Chaseling, 2005), then motivation is clearly behind many factors listed above given its role in information processing and decision making in classic persuasion literature (Petty, Tormala, Hawkins, & Wegener, 2001) and specifically to misinformation spread in this posttruth era (e.g., Chen, Sin, Theng, & Lee, 2015).

Social media have fundamentally amplified user motivations when they interact with information through maximizing users' ego involvement with and vested interest in the content. On the one hand, pervasive content personalization and customization make sure the content revolves around users, including their identities, preferences, and views. The seamless content tailoring significantly boosts users' confidence in their opinions, however extreme they might be, by creating a "false consensus" (Schulz, Wirth, & Müller, 2020, p. 201) and "echo chambers" with like-minded others (Colleoni, Rozza, & Arvidsson, 2014). On the other hand, social media significantly intensify emotions as algorithms constantly push polarizing, sensational content (Berger & Milkman, 2013) for greater user engagement (e.g., likes, comments, views)—the central metric for revenues. Misinformation on social media tends to contain overwhelmingly negative sentiments (Zollo et al., 2015), such as anxiety, a negatively valenced emotion that has long been discussed as a notable predictor of misinformation spread when high uncertainty and risks make users deeply vested in misinformation (Bordia et al., 2005) during crises and controversies (Van der Meer & Jin, 2020).

Current literature mostly focuses on motivation as a driving force behind the spread of misinformation (Chadwick & Vaccari, 2019), with only a few exceptions that argued otherwise (e.g., Pennycook & Rand, 2019). Yet, it remains unclear how different motivations impact misinformation mitigation when users are already likely strongly opinionated on social media. This study examines the effectiveness of correction on users' perceived message credibility and sharing intention—two key predictors of the spread of misinformation—when the misinformation involves users' vested interest (i.e., uncertainty, risks, and personal relevance) and ego (i.e., motivated reasoning; Ecker, Swire, & Lewandowsky, 2014). This motivational approach will reveal a nuanced understanding of the contingencies for effective misinformation correction on polarizing issues on social media.

Theoretical Background

Misinformation and Correction

Despite being an elusive concept, misinformation is undeniably one of the fastest-growing areas in social media research. From the folklore scholarships that focus on gossip, hearsay, hoax, and rumors during World War II to the most recent rise of fake news after the 2016 election, we have awoken to a

misinformation plague on social media (Ha, Andreu Perez, & Ray, 2019). While some scholars consider misinformation as any false information either deliberately or accidentally shared (Southwell, Thorson, & Sheble, 2018), others argue for a distinction between unwittingly spread false information (misinformation) and intentionally fabricated misleading information (disinformation; Hjorth & Adler-Nissen, 2019). Different approaches, such as algorithmic detection (e.g., Conroy, Rubin, & Chen, 2015) and social correction (Bode & Vraga, 2015), have been proposed to mitigate misinformation. Social media companies like Facebook and Twitter have also geared up to rectify misinformation using features to alert users to content disputes (Allcott, Gentzkow, & Yu, 2019). Yet, these flagging systems have produced mixed outcomes (Lyons, 2018).

Despite the doubt cast on the efficacy of misinformation correction (see Ecker et al., 2014; Lewandowsky, Ecker, Seifert, Schwarz, & Cook, 2012 for a review), meta-analytic evidence suggests that correction is still an effective remedy to curtail misinformation (Chan et al., 2017; Walter & Murphy, 2018). One debunking strategy is to rate the truthfulness of information presented as commonly seen in many fact-checking websites that marks a piece of (mis)information in a varying degree of its falsity from, for example, "false, mostly false, and half true," to "accurate" (Shin & Thorson, 2017). Some recommend the simple denial/dispute strategy that directly flags the presented information as misleading (e.g., Ecker, Lewandowsky, & Tang, 2010). Others embrace a more elaborative approach, arguing that refuting misinformation with contextual evidence and plausible alternative accounts is more effective (Ecker et al., 2014). The simple dispute strategy is the most commonly used on social media (Allcott et al., 2019), and empirical research confirms the effect of this strategy on reducing (albeit not eliminating) misinformation (Ecker et al., 2010). Hence, it is expected that correction will still make an impact on users' perceptions and intention of misinformation:

H1: Correction will be effective in reducing users' perceived message credibility (H1a) and sharing intention (H1b) of misinformation on social media.

Motivational Contingencies for Misinformation Correction

What stands at the heart of the controversies over misinformation correction is that people share information even when they know it may be erroneous (Chen et al., 2015), for human cognitions are often intertwined with various motivations that will bias the way we process and act on information (Bordia & DiFonzo, 2004, 2005). The growing literature on the failure or even a backfire effect of misinformation correction (e.g., Lewandowsky et al., 2012; Nyhan & Reifler, 2010) has centered around a particular type of motivation, *ego involvement*, referring to when individuals' identities, ideologies, or worldviews are deeply implicated in the (mis)information, thereby biased to confirm their perceptions (Berinsky, 2017; Petty, Briñol, & Tormala, 2002).

Users can also be motivated by *vested interest* (i.e., personal involvement with the [mis]information; Crano & Prislin, 1995), including personal influence (e.g., Chen et al., 2015), anxiety reduction (e.g., Weeks, 2015), risk aversion (e.g., Bordia & DiFonzo, 2002), and information seeking (e.g., Bordia & DiFonzo, 2004). Although scholars call for more attention to the role of motivation in misinformation spread on social media, no studies to the best of our knowledge have tested how vested interest and ego

involvement may impact the effectiveness of correction when users are undermotivated and thereby likely to engage in automatic processing as cognitive misers on social media (e.g., Pennycook & Rand, 2019).

Vested Interest

In reviewing vested interest in motivating attitudes and behaviors, Adame (2020) summarized six key variables in the vested interest theory, of which stake, certainty, and salience are made particularly prominent by social media, for users are constantly targeted with sensational content with high uncertainty (i.e., certainty), risks (i.e., stake), and personal relevance (i.e., salience) for the sake of greater user engagement.

Uncertainty

The state of feeling uncertain because of scarce verified information (Ashill & Jobber, 2010) could promote misinformation spread (Bordia & DiFonzo, 2004). Misinformation will "arise in situations where cognitive regions especially relevant to immediate behavior are largely unstructured" (Festinger et al., 1948, p. 484). Sense of control is the cornerstone of human autonomy (Deci & Ryan, 1995), and the lack thereof puts one's positive self in jeopardy. Sharing misinformation, hence, serves as "a trial-and-error problem-solving process in which individuals keep referring to the group until a concrete, acceptable shared conception on which to coordinate actions and develop new collective patterns emerges" (Rosnow, 1988, p. 16).

Bordia and DiFonzo's (2004) content analysis of 13 Internet rumors confirmed that about 60% of these rumor-spreading posts contained sensemaking statements for determining the veracity of the rumor. Likewise, Huang, Starbird, Orand, Stanek, and Pedersen (2015) found misinformation spread as a consequence of individuals collectively making sense out of incomplete information after the 2013 Boston Marathon Bombings. When motivated to reduce uncertainty, users might temporarily hold their judgment on the presented (mis)information for the sake of social sensemaking (Bordia & DiFonzo, 2005). The effect of correction on perceived message credibility and sharing intention, hence, may be discounted by an increasing level of uncertainty:

H2: The effectiveness of correction on perceived message credibility (H2a) and sharing intention (H2b) will decrease when users incur higher levels of uncertainty on social media.

Risk

From an evolutionary perspective, risk aversion is our profound self-protecting motivation. When facing incomplete information with grave ramifications, individuals will suffer an intensifying feeling of anxiety and will try to reduce it. In reviewing the social psychology of rumor spreading, Bordia and DiFonzo (2002) stated that misinformation needed to spark concern to be a social phenomenon. This explains why misinformation on social media often flies on pivotal topics like natural disasters and societal crises (Ha et al., 2019).

A classic example of misinformation on social media is the false statement that vaccines cause autism. This misinformation, despite being repeatedly refuted by public health officials, has always held a strong grip on public attention because of the alleged high risks to children (Ecker et al., 2014). Likewise, misinformation tends to gain momentum in crises as people are scared and anxious about looming consequences (Jin, Van der Meer, Lee, & Lu, 2020). Sharing misinformation may help relieve anxiety, especially when risk is coupled with uncertainty. As Allport and Postman (1947) stated in their basic law of rumor, "the amount of rumor in circulation will vary with the importance of the subject to the individuals concerned times the ambiguity of the evidence pertaining to the topic at issue" (p. 34). Motivated to seek more information to minimize risks, users may be more vulnerable to misinformation in spite of correction. Thus, we predict:

H3: The effectiveness of correction on perceived message credibility (H3a) and sharing intention (H3b) will decrease when users perceive more risks associated with the misinformation on social media.

Personal Relevance

Social media have unprecedentedly increased the personal relevance of content to users that could be a significant motive for misinformation spread (Bordia & DiFonzo, 2004). Analyzing over 20,000 Tweets, Oh, Agrawal, and Rao (2013) confirmed that misinformation was positively correlated with personal relevance. Sharing personally relevant misinformation can be driven by the desire for new social connections with like-minded people or strengthening the existing relationships with whom we identify (Chen et al., 2015; Rafaeli & Ariel, 2008).

Sharing, however, could also be driven by the need for status-seeking as users push their personal agenda to others. In Wikipedia, individuals enhance their influence over others in the community by sharing their knowledge (Rafaeli & Ariel, 2008). Specific to misinformation sharing, Chen et al. (2015) found that respondents clearly listed the feeling of "being influential" as one of the reasons why they chose to share misinformation even when it had already been flagged. Therefore, it can be argued that the more users perceive misinformation as personally relevant, the more susceptible they are to it.

H4: The effectiveness of correction on perceived message credibility (H4a) and sharing intention (H4b) will decrease when misinformation is more personally relevant on social media.

Ego Involvement

The echo chambers on social media with like-minded others (Colleoni et al., 2014) constantly create false consensuses for users (Schulz et al., 2020), inflating their beliefs in their own views. Thought confidence as metacognition plays a huge role in persuasion (Petty & Briñol, 2008). When evaluating information (including corrective messages) on issues one is highly confident of one's opinions, users are more motivated to use themselves as the reference to avoid cognitive dissonance from making inconsistent decisions (Festinger, 1957).

Attitudinal Congruence with Correction

One major reason why misinformation correction fails to effectively persuade users is when the views represented by the correction run counter to those of users engaged in motivated reasoning (Walter & Murphy, 2018). Of course, not every evaluation of attitudinal (in)congruence with corrective information is made out of intentional, effortful deliberations because of our limited cognitive capacity on social media (Lang, 2009). Under a fast, automatic mode of information processing, users are more prone to various cognitive shortcuts driven by heuristic cues (Chaiken, 1980).

One important cue at play in this fast decision-forming process is the correction source (Ecker et al., 2014). Social distance theory (see Magee & Smith, 2013, for a review) states that people are inherently biased to favor in-group members and discredit out-group ones. Research has revealed that users selectively shared fact-checking messages to support their own political candidate and to discredit the opposing candidate (Shin & Thorson, 2017). This in-group bias explains why researchers proposed social correction as a better alternative to algorithmic correction (Bode & Vraga, 2015). As such, it is expected that users are more receptive to correction from proattitudinal sources than from counterattitudinal ones.

H5: The effectiveness of correction on perceived message credibility (H5a) and sharing intention (H5b) will increase when users receive correction from proattitudinal sources than from counterattitudinal sources on social media.

The above-discussed motives could work in combination as human beings' decision-making processes are often subject to multiple motivations. Therefore, some combination of these motivating factors is likely to impact how correction can persuade.

H6: The effectiveness of correction on perceived message credibility (H6a) and sharing intention (H6b) will vary as a function of interactions of uncertainty, anxiety, personal relevance, and attitudinal congruence with correction on social media.

Method

Controlling for different message sources, this study employed a 2 (uncertainty: low vs. high) x 2 (risk: low vs. high) x 2 (personal relevance: low vs. high) x 2 (attitudinal congruence with correction: congruent vs. incongruent) pretest and posttest factorial online experiment of 973 participants to examine the effectiveness of correction on social media users' perceived credibility and sharing intention toward misinformation. The first three variables—uncertainty, risk, and personal relevance—were manipulated in the eight versions of the news randomly shown to the participants. The last variable (attitudinal congruence) was manipulated by two versions of corrective messages (proattitudinal or counterattitudinal) depending on participants' preexisting attitudes toward gene-editing technology.

It is important to acknowledge the notable role of misinformation source as social media users increasingly rely on heuristic cues for fast decision making (Tormala, Briñol, & Petty, 2006). Therefore, it is

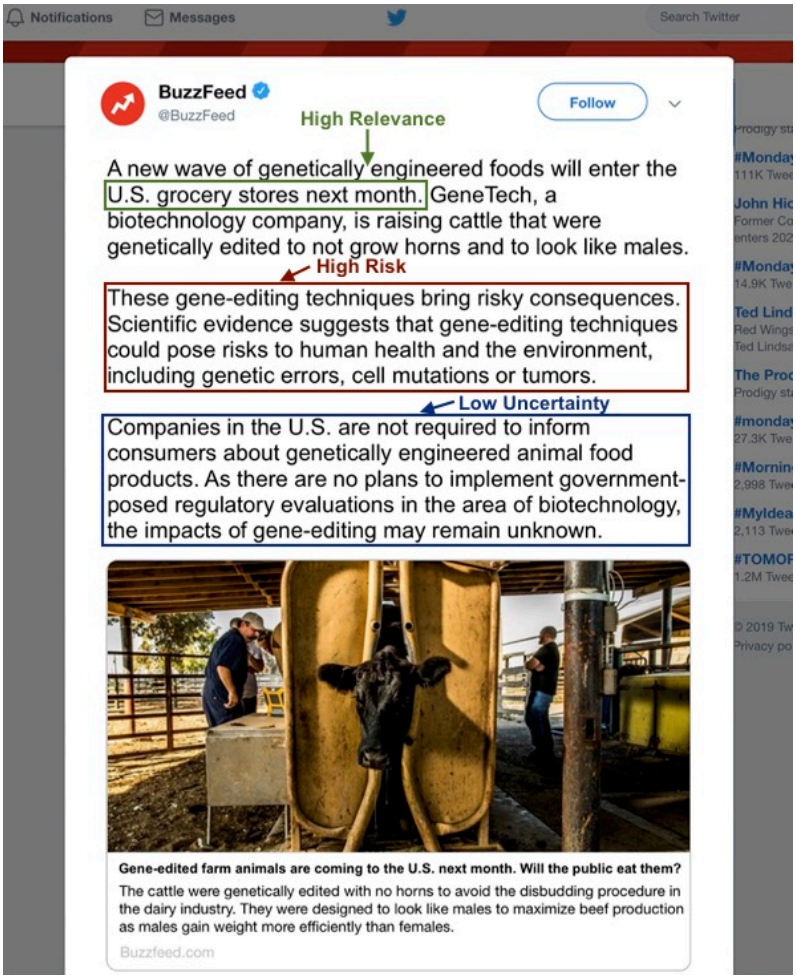
an imperative undertaking to control for this noticeable factor while examining the effect of misinformation correction on users' perceived credibility and sharing intention.

Stimulus Material

Social Media Misinformation

Participants were shown a screenshot of a piece of manipulated Twitter news. The news was modified from a real story about gene-edited cattle that appeared in *The Washington Post* (Johnson, 2018) about how a fictitious biotechnology company, GeneTech, was raising gene-edited cattle and the potential impact of gene-edited farm animal food on consumers' health and the environment. We intentionally chose this topic at the intersection of science and health because previous literature has suggested that these topics tend to be controversial and riddled with misinformation (Ha et al., 2019).

The construction of the stimuli was informed by previous literature about the manipulation of personal relevance (Allport & Postman, 1947), risk (Pezzo & Beckstead, 2006), and uncertainty (Ashill & Jobber, 2010; see Figure 1 for the manipulations of the variables). To maximize the ecological validity of the stimulus material and rule out the influence of message source, we varied the news source to be *Buzzfeed* or *The New York Times* (NYT). While their credibility may not necessarily be perceived as previous literature suggested given the increasing political polarization (e.g., Wu et al., 2016), they are different modes of news media in terms of their history, modality (e.g., print + online vs. exclusively online), target audiences, and so on. In total, 16 versions of the news were designed, and participants were randomly assigned to read one version.


Notifications
Messages
Search Twitter
BuzzFeed
@BuzzFeed
Follow
High Relevance
A new wave of genetically engineered foods will enter the U.S. grocery stores next month. GeneTech, a biotechnology company, is raising cattle that were genetically edited to not grow horns and to look like males.
High Risk
These gene-editing techniques bring risky consequences. Scientific evidence suggests that gene-editing techniques could pose risks to human health and the environment, including genetic errors, cell mutations or tumors.
Low Uncertainty
Companies in the U.S. are not required to inform consumers about genetically engineered animal food products. As there are no plans to implement government-posed regulatory evaluations in the area of biotechnology, the impacts of gene-editing may remain unknown.
Gene-edited farm animals are coming to the U.S. next month. Will the public eat them?
The cattle were genetically edited with no horns to avoid the disbudding procedure in the dairy industry. They were designed to look like males to maximize beef production as males gain weight more efficiently than females.
Buzzfeed.com

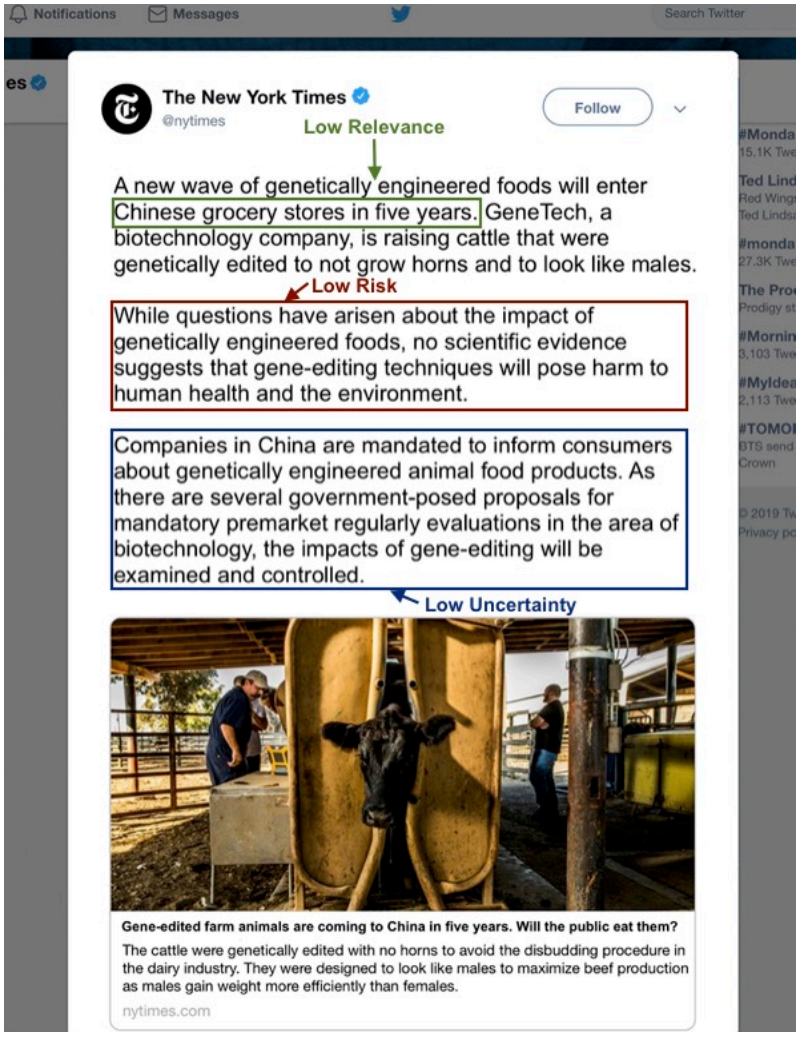


Figure 1. Twitter news with high personal relevance, high anxiety, and high uncertainty on BuzzFeed and with low personal relevance, low anxiety, and low uncertainty on NYT.

Corrective Information

After reading the Twitter news, two versions of the correction to the news were created that mimicked how major social media companies flag and correct suspicious posts (Lyons, 2018). Participants were randomly assigned to view one version where the accuracy of the news they just read had been disputed by either pro–gene-editing or anti–gene-editing organizations (see Figure 2).

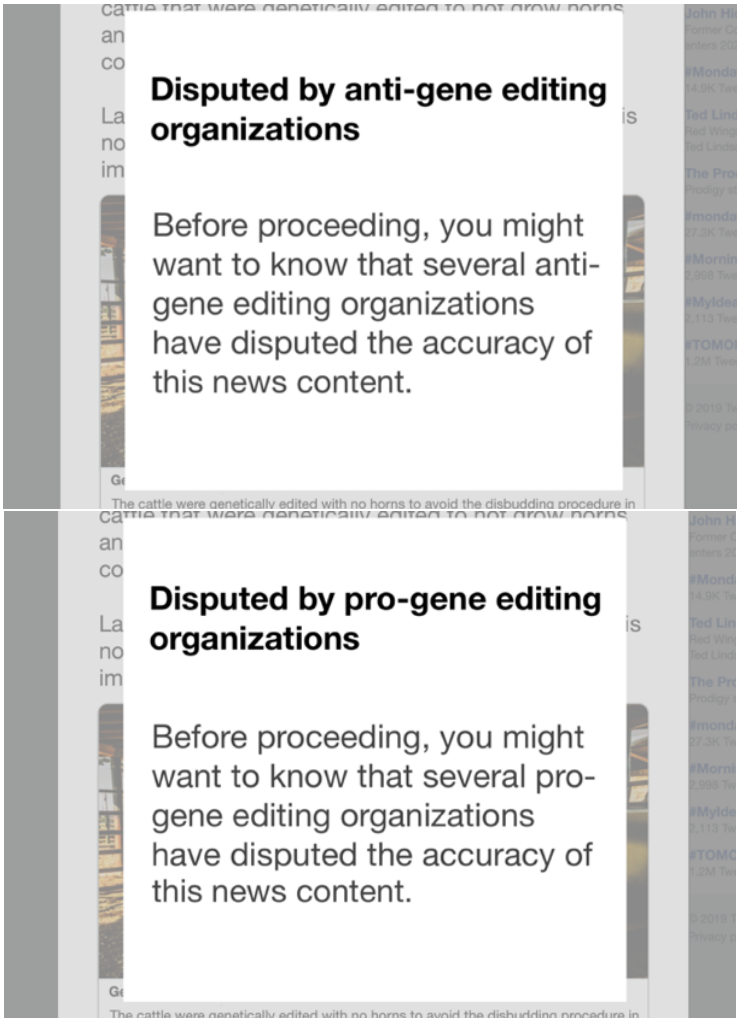


Figure 2. Two versions of the correction messages.

Pretest

As previous research has noted the importance of belief in misinformation (Pezzo & Beckstead, 2006), a pretest (N = 291) was conducted on *Amazon Mechanical Turk* master workers to check the quality of the stimuli. Three items borrowed from Yale (2013) were used to measure the plausibility of the Twitter news and the correction messages (see Appendix A). Results suggested that perceived believability of the news (M = 5.13, SD = 1.37, Cronbach's α = .91) and the correction messages were both satisfactory (M = 5.25, SD = 1.16, Cronbach's α = .90). We intentionally checked the believability of the news and the correction in the pretest to avoid triggering participants' suspicion of the research purpose in the main study.

Procedure

The main experiment was conducted online through a *Qualtrics* panel. Participants who spent less than seven minutes (roughly two-thirds of the median time) were automatically terminated and removed from the sample. In addition, four attention-check items were added to the questionnaire. Participants who failed the attention-check questions were removed from the sample as well. The exclusion was consistent across all randomizations. Among participants who spent at least seven minutes on the survey, none of them failed the attention-check questions. A Qualtrics link was sent to participants, which directed them to the questionnaire. Upon indicating their consent, participants read a brief description of gene-editing technology. They were asked to answer questions about demographics and their preexisting attitudes toward gene editing. Next, participants were randomly assigned to one of the 16 versions of the news that varied by uncertainty, risk, personal relevance, and message source credibility. Afterward, all participants completed the same questionnaire, including the manipulation-check questions, perceived credibility of the news, and their intention to share the news.

Participants then randomly received one correction message either from pro– or anti–gene-editing organizations. To avoid prompting participants' suspicion of the research purpose, we did not directly check the manipulation of the correction. Participants were instead asked to acknowledge that they saw the message by checking the option "Okay, I got it" displayed underneath the message. They were subsequently asked to rate the perceived credibility of the news and their intention to share it again. Upon completing the study, all participants were debriefed and thanked for their participation.

Participants

Per the IRB requirements, participants aged at least 18 years old were recruited for this study on a voluntary basis through *Qualtrics Panel*. The current sample was a quota sample managed to closely mirror the U.S. population's gender and age distribution according to the U.S. Census. Among the participants who completed the study (N = 1,080), 48.98% (N_{male} = 529) were male, 50.74% (N_{female} = 548) were female, and 0.28% (N_{other} = 3) identified as other. The average participant age was 45.89 (SD = 16.88).

As we are interested in examining the effectiveness of correction when users hold strong opinions and are highly confident in their views, we filtered responses according to participants' preexisting attitudes toward gene-editing technology using three items adapted from Bredahl's (2001) scale on attitudes toward genetically modified food. Participants were asked to rate gene-editing technology on a 7-point semantic differential scale on items like "applying gene-editing technology in food production is extremely bad — extremely good" (Cronbach's α = .94, M = 3.56, SD = 1.75). We followed the recommendation of Pestana and Gageiro (2003) on categorizing interval-level variables into three segments: pro-gene editing (n = 548), anti-gene editing (n = 425), and neutral (n = 107).[2] Participants with neutral opinions on gene editing were excluded, setting the final sample size to be 973.

[2] The procedure suggests that for relatively normally distributed data with no outliers, the two cut-off values can be obtained through mean ± standard deviation* 0.25. In our case, the cut off values were mean (3.58)

Independent Variables

The manipulated independent variables *uncertainty*, *risk*, and *personal relevance*, and the control variable *message source* were as described in the procedure section above. The manipulated independent variables also include *attitudinal congruence with correction*. Appendix A reported all the items used to measure the key variables.

Attitudinal Congruence with Correction

This variable was operationalized through manipulating the match or unmatch between users' preexisting attitudes on gene editing and the orientations of the correction sources. That is, if anyone from the 548 pro–gene-editing participants received a correction from pro–gene-editing organizations or anyone from the 425 anti–gene-editing participants received a correction from anti–gene-editing organizations, then it was dummy coded as 1 = congruent; otherwise, it was 0 = incongruent.

Dependent Variables

Perceived Message Credibility

Perceived message credibility of the Twitter news was measured using 10 items borrowed from Appelman and Sundar (2016), Cronbach's α = 0.93, M = 4.62, SD = 1.19 for precorrection; Cronbach's α = 0.95, M = 4.18, SD = 1.30 for postcorrection (Appendix A).

Effectiveness of Correction on Perceived Message Credibility

As correction is supposed to reduce the perceived credibility of misinformation, its effectiveness was, therefore, measured by the difference between one's post- and precorrection scores (M = .44, SD = 1.09).

Information Sharing Intention.

Information sharing intention was measured using five items adapted from DiStaso, Vafeiadis, and Amaral (2014), Cronbach's α = 0.87, M = 3.95, SD = 1.62 for precorrection; Cronbach's α = 0.90, M = 3.65, SD = 1.69 for postcorrection (Appendix A).

Effectiveness of Correction on Information Sharing Intention.

As with perceived message credibility, the effect of correction was measured by the difference between participants' postcorrection scores and their precorrection scores (M = .31, SD = 1.16).

[±] standard deviation (1.75) * 0.25 = 3.14, 4.02. Therefore, participants with categorized as strongly against (1 through 3.14), pro (4.02 through 7), and neutral (3.14-4.02) on gene editing.

Results

Manipulation Checks

Uncertainty

We used eight items adapted from Ashill and Jobber (2010) to measure uncertainty (see Appendix A), Cronbach's α = .91, *M* = 4.26, *SD* = 1.56. An independent-sample *t*-test revealed that the manipulation was successful. Participants in the high uncertainty condition reported significantly greater levels of uncertainty (*M* = 4.37, *SD* = 1.62) than those in the low uncertainty condition (*M* = 4.15, *SD* = 1.49), $t(971) = -2.20$, $p < .05$.

Risk

Three items adapted from Klerck and Sweeney (2007) were used to measure perceived risks associated with genetically modified foods (see Appendix A), Cronbach's α = .78, *M* = 5.21, *SD* = 1.42). Another independent-sample *t*-test revealed that the manipulation of risk was successful, such that participants assigned to the high risks condition perceived significantly greater risks (*M* = 5.20, *SD* = 1.31) than those in the low risks condition (*M* = 4.74, *SD* = 1.41), $t(971) = -5.27$, $p < .001$.

Personal Relevance

Three items adapted from Darley and Lim (1991) were employed to check the manipulation of personal relevance (see Appendix A), Cronbach's α = .89, *M* = 5.10, *SD* = 1.50). An independent-sample *t*-test revealed that the manipulation of personal relevance was successful. Participants in the high personal relevance condition rated the news as significantly more relevant to them (*M* = 5.26, *SD* = 1.44) than those assigned to the low relevance condition (*M* = 4.91, *SD* = 1.55), $t(971) = -3.61$, $p < .001$.

Message Source

To ensure that participants noticed the source of the presented news, we designed a question to ask, "The news I just saw was posted by_____." Participants would choose the message source to be (1) *Buzzfeed*, (2) NYT, or (3) Other. A Chi-square test suggested that significantly larger percentages of participants (86.62%, *N* = 466 for *Buzzfeed* condition, and 87.36%, *N* = 380 for NYT condition) correctly identified the news source than those who couldn't (12.64%, *N* = 55 for *Buzzfeed* condition, and 13.38%, *N* = 72 for NYT condition), $\chi^2(1, N = 973) = 529.3$, $p < .001$, $V^* = .74$.

Main Results

Two paired-sample *t*-tests demonstrated that exposing to correction overall significantly decreased perceived message credibility, *M* = 4.62, *SD* = 1.19 for precorrection and *M* = 4.18, *SD* = 1.30 for postcorrection, $t(972) = 12.48$, $p < .001$, and sharing intention, *M* = 3.96, *SD* = 1.65 for precorrection and *M* = 3.65, *SD* = 1.70 for postcorrection, $t(972) = 8.28$, $p < .001$, providing support for H1a and H1b.

Statistically controlling message source as a covariate, a 2 (uncertainty: low vs. high) x 2 (risk: low vs. high) x 2 (personal relevance: low vs. high) x 2 (attitudinal congruency with correction: incongruent vs. congruent) multivariate analysis of covariance (MANCOVA) was conducted to examine the impact of correction on perceived message credibility and information sharing intention. The multivariate analysis revealed a significant main effect for risk, Wilks' $\Lambda = .99$, $F(2, 955) = 5.39$, $p < .01$, partial $\eta^2 = .01$. A significant Personal Relevance X Risk interaction was also obtained in the multivariate analysis, Wilks's $\Lambda = .99$, $F(2, 955) = 6.47$, $p < .01$, partial $\eta^2 = .01$. Another significant Uncertainty X Attitudinal Congruence with Correction interaction also emerged from this multivariate analysis, Wilks's $\Lambda = .99$, $F(2, 955) = 3.81$, $p < .05$, partial $\eta^2 = .01$. In addition, this analysis also found a significant Personal Relevance X Uncertainty X Attitudinal Congruence with Correction interaction, Wilks's $\Lambda = .99$, $F(2, 955) = 3.48$, $p < .05$, partial $\eta^2 = .01$. The main effects of relevance, Wilks's $\Lambda = 1.00$, $F(2, 955) = .19$, $p = .83$, partial $\eta^2 = .00$, attitudinal congruence, Wilks's $\Lambda = 1.00$, $F(2, 955) = .44$, $p = .65$, partial $\eta^2 = .00$, and uncertainty, Wilks's $\Lambda = 1.00$, $F(2, 955) = .33$, $p = .72$, partial $\eta^2 = .00$, were not significant.

Effect of Correction on Message Credibility

In the univariate analysis, a significant main effect for risk emerged for the effect of correction on perceived message credibility. Contrary to what H3a predicts, while participants' perceived credibility decreased in both low- and high-risk conditions after receiving the correction, perceived credibility of the Twitter news decreased significantly more in the high-risk conditions ($n = 488$, $M = .33$, $SE = .05$) than in the low-risk conditions ($n = 485$, $M = .54$, $SE = .05$), $F(1, 956) = 9.18$, $p < .01$, partial $\eta^2 = .01$.

However, the significant main effect of risk should be interpreted in light of a significant Personal Relevance X Risk interaction that was also obtained in the univariate analysis, $F(1, 956) = 10.71$, $p < .01$, partial $\eta^2 = .01$. As Figure 3 shows, when the Twitter news was only tangential to participants, the correction was significantly more effective in decreasing perceived credibility of this news when participants saw many risks of the gene-editing technology from the news ($n = 232$, $M = .64$, $SE = .07$) than when the risks were low ($n = 230$, $M = .20$, $SE = .07$), $p < .001$. In contrast, when the Twitter news appeared to be highly relevant to participants, decrease in participants' perceived credibility of the news became invariant regardless of risk levels associated with genetically modified animal food ($n = 256$, $M = .44$, $SE = .07$ for the high risks condition, $n = 255$, $M = .46$, $SE = .07$ for low-risk condition, $p = .86$).

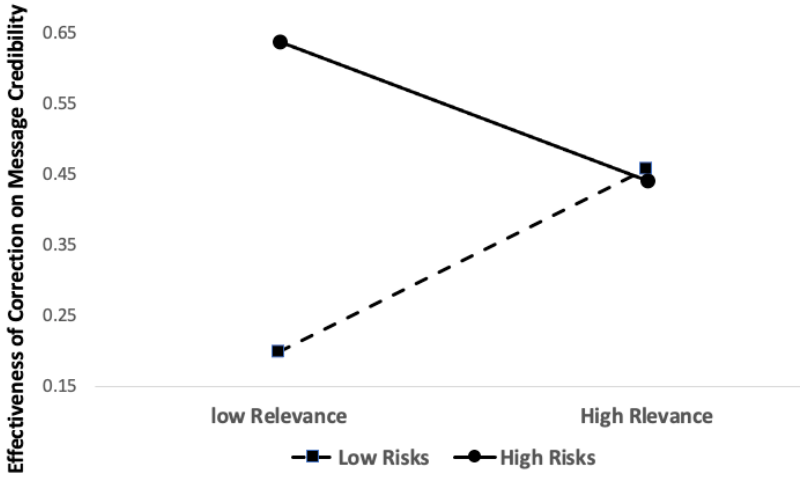


Figure 3. Effect of correction on decreasing perceived message credibility: Risk X personal relevance interaction.

Note. A higher mean means a greater decrease, hence, greater effectiveness of the correction.

Another Uncertainty X Attitudinal Congruence with Correction interaction was also obtained, $F(1, 956) = 7.34$, $p < .01$, partial $\eta^2 = .01$. When the Twitter news provoked little uncertainty, reduction in participants' perceived credibility of the news stayed invariant regardless of if the correction came from organizations with congruent ($n = 244$, $M = .49$, $SE = .07$) or incongruent views on gene editing ($n = 242$, $M = .33$, $SE = .07$), $p = .12$. However, when participants perceived high uncertainty from the news, their perceived credibility decreased significantly more when they received the correction from organizations with the same attitudes ($n = 239$, $M = .57$, $SE = .07$) than from the ones with opposing attitudes ($n = 248$, $M = .35$, $SE = .07$) on gene editing, $p < .05$ (see Figure 4). Hence, H3a was disconfirmed, H5a was partially supported, H6a was supported, and H2a and H4a were not supported.

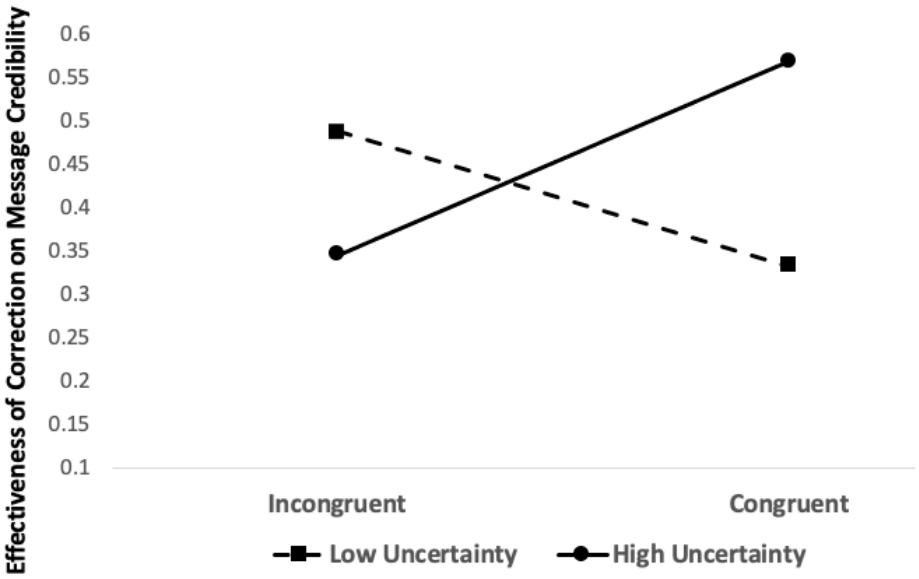


Figure 4. Effect of correction on decreasing perceived message credibility: Uncertainty X attitudinal congruence with correction interaction.

Note. A higher mean means a greater decrease, hence, greater effectiveness of the correction.

Effect of Correction on Information Sharing Intention

A significant main effect for risk was also obtained in the univariate analysis on the effectiveness of correction on information sharing intention, $F(1, 956) = 3.92$, $p < .05$, partial $\eta^2 = .00$. Similar to perceived message credibility, correction overall was significantly more effective in decreasing the intention to share the Twitter news for participants in the high-risk conditions ($n = 485$, $M = .38$, $SE = .05$) as opposed to those in the low-risk conditions ($n = 488$, $M = .23$, $SE = .05$), which contradicts H3b.

Besides, a significant Personal Relevance X Uncertainty X Attitudinal Congruence with Correction interaction that was also obtained in the univariate analysis. As shown in Figure 5, when participants perceived low personal relevance and low uncertainty of the Twitter news, their sharing intention decreased similarly regardless of correction source (congruent: $n = 121$, $M = .38$, $SE = .11$ or incongruent: $n = 113$, $M = .16$, $SE = .11$, $p = .15$); similarly, the decline in the intention to share did not vary significantly for participants in the high-uncertainty condition when they perceived the news to be of low personal relevance regardless of the correction source (incongruent: $n = 126$, $M = .37$, $SE = .10$, congruent: $n = 102$, $M = .23$, $SE = .12$, $p = .37$). When the Twitter news was perceived as highly relevant but of low uncertainty, participants' intention to share reduced similarly regardless if the correction came from organizations with incongruent ($n = 129$, $M = .41$, $SE = .10$) or congruent ($n = 123$, $M = .31$, $SE = .10$) views, $p = .47$. However, when participants perceived the news as highly relevant and highly uncertain, their intention to share the news decreased significantly more when they received the correction from organizations with the same ($n = 137$, $M = .44$, $SE = .10$) than opposite ($n = 122$, $M = .14$, $SE = .11$) attitudes on genetically

modified food, $p < .05$. Therefore, H3b was disconfirmed, H5b was partially supported, H6b was supported, and H2b and H4b were not supported.

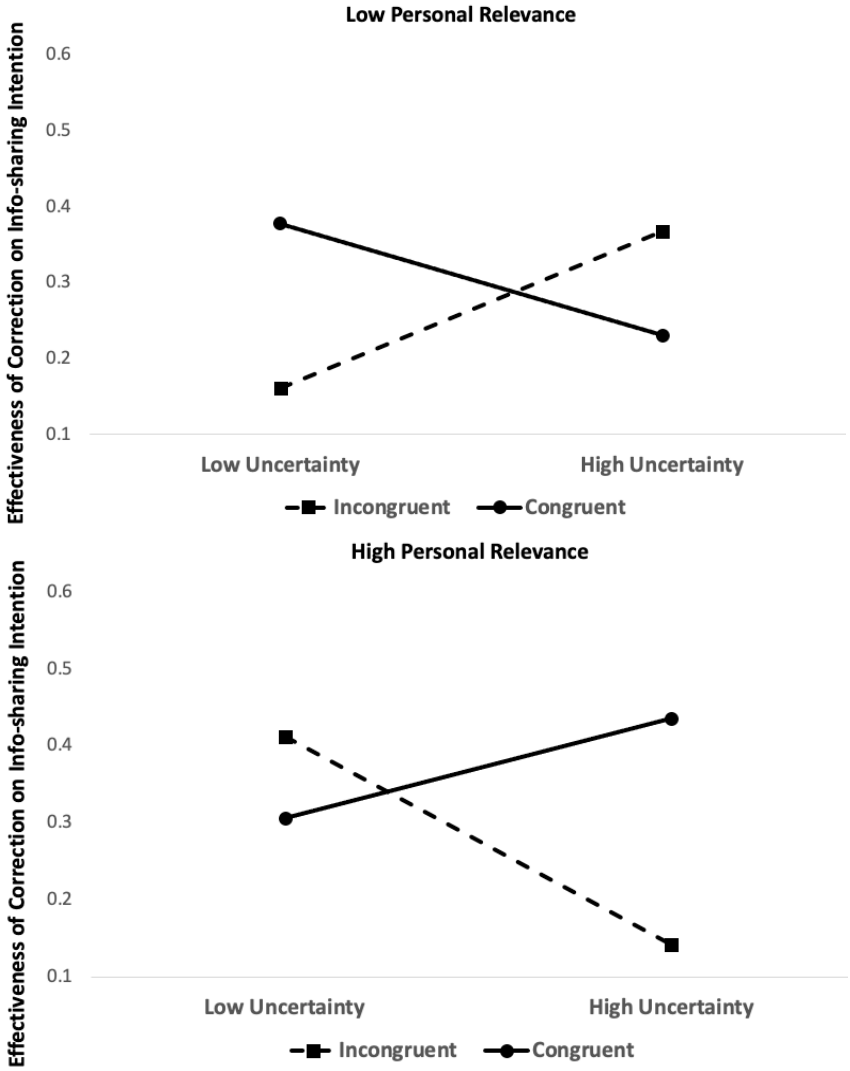


Figure 5. Effect of correction on decreasing information sharing intention: Relevance X uncertainty X attitude congruence interaction.

Note. A higher mean means a greater decrease, hence, greater effectiveness of the correction.

Discussion

This study aims to examine the effectiveness of misinformation correction on social media with the assumption from the majority of previous literature that motivations will encourage the widespread of misinformation (e.g., Chadwick & Vaccari, 2019) and potentially upset correction (Lewandowsky et al., 2012; Nyhan & Reifler, 2010). Surprisingly, the captivating trend found is that misinformation correction is significantly more effective when users are motivated with vested interest coupled with ego involvement triggered by misinformation on social media. In other words, this research study seems to align with a small but growing segment of literature that warns of a more dire scenario: perhaps a lack of motivation (e.g., laziness) might drive misinformation to spread even more (Pennycook & Rand, 2019).

Our study, first and foremost, confirms the necessity of correcting misinformation (Chan et al., 2017; Walter & Murphy, 2018), however imperfect it has been criticized, as users' perceived credibility and sharing intention toward misinformation significantly decreased after being exposed to the correction regardless of their perceived uncertainty, risk, and personal relevance of the misinformation, as well as the attitudinal (in)congruence with the correction even when they were already strongly opinionated.

In line with previous literature (Bordia & DiFonzo, 2002; Ha et al., 2019), risk emerged as a significant determining factor to the effectiveness of misinformation correction, such that correction worked significantly more effectively in reducing users' perceived message credibility and their sharing intention when users perceived high risks of genetically edited farm animal food. Even when participants perceived the misinformation as not very relevant to themselves, those who viewed genetically edited farm-animal food as highly risky reported significantly lower perceived message credibility of the misinformation after receiving the correction than those who saw low risks of genetically edited farm animal food.

The degree to which users' perceived credibility of the misinformation was reduced by the correction also depends on the levels of experienced uncertainty. When the Twitter news invoked little uncertainty from participants, their perceived credibility reduced similarly regardless of whether the correction came from counteraltitudinal or proattitudinal organizations. However, the correction was significantly more effective when users experienced high uncertainty from the news, especially when the correction came from organizations that held congruent views on gene-editing technology with theirs. While this result confirms that individuals are still biased toward proattitudinal correction (Berinsky, 2017), it is important to notice that proattitudinal correction was only more significantly effective when users experienced high uncertainty at the same time.

The benefits of motivations also manifest in the effectiveness of correction on the sharing intention of misinformation. When users perceived the misinformation as marginally relevant to themselves, their sharing intention declined to a similar degree after the exposure of the correction no matter if they experienced low or high uncertainty invoked by the Twitter news. However, when users deemed the news as highly relevant and uncertain, their intention to share the misinformation diminished significantly more when the correction matched their attitudes on gene-editing technology. Again, these findings support that users tend to accept correction from attitude-congruent sources, but the counterattitudinal correction sources did not backfire on the correction in preventing users from sharing the misinformation, either.

So why does motivation make correction more effective? One explanation may be that correction brings in more information, thereby offering clarity that is much needed when personal relevance, uncertainty, and/or risks are high. This aligns with Weeks's (2015) finding that the motivation of anxiety reduction will help reduce misconceptions as people are motivated to seek clarity even at the expense of holding personal judgment against opposing views. Correction, even in the form of a simple dispute, still provides extra information to participants who are uncertain and worried about the risks of genetically modified animal food. Another possible explanation might be that being vested in the (mis)information, either because of its personal relevance, uncertainty, and/or risks, makes participants more motivated to process the correction. Even though users still favor correction from proattitudinal sources, it is not motivated reasoning or vested interest but rather a lack of motivations that prevents correction from being able to effectively reduce perceived credibility and sharing intention toward misinformation.

The revelation of our findings across the board bears an intriguing question about whether or not lacking motivations might be more concerning in our fight against misinformation. Pennycook and Rand (2019) found that it was laziness (i.e., unmotivated, automatic information processing) instead of biased, motivated reasoning that made people susceptible to misinformation. Lacking motivation to carefully and systematically process information will significantly promote beliefs in misinformation (Bago, Rand, & Pennycook, 2020; Pennycook, McPhetres, Zhang, Lu, & Rand, 2020). Our findings further reveal that being unmotivated or undermotivated also means the correction will work at a significantly discounted degree. As such, more scholarly attention should be devoted to understanding the role of lacking motivations in misinformation spread as well as misinformation correction.

Theoretical Implications

This study adds to the current misinformation literature by exploring the effectiveness of misinformation correction, contingent upon several motivating factors—uncertainty, risk, personal relevance, attitudinal congruence with correction—when users hold strong opinions on a controversial health or scientific issue. Despite continuous doubt cast on the efficacy of misinformation correction on social media, this study empirically demonstrates that even the simplest form of correction—directly disputing the accuracy of the misinformation without providing substantive evidence or contextual information—is influential on social media users' perceptions and intention even when they are already polarized on the issue.

More importantly, the findings of this study raise an interesting question to the literature that cautions the driving force of motivations behind the spread of misinformation. That is, being motivated by misinformation might not be so dreadful after all because correction could also work more effectively when motivations are high. The benefits of motivations for correcting misinformation, albeit counterintuitive at first sight, align with the classic persuasion literature on central/peripheral (Petty et al., 2001) or systematic/heuristic processing (Chaiken, 1980) that motivation is the first criterion for any persuasive messages to take effect (Petty et al., 2001). Therefore, when vested interest and ego involvement associated with misinformation are high, users are also more likely to take its correction more seriously and be more receptive to its effect, especially when the correction comes from sources with congruent attitudes.

Practical Implications

Important practical implications stem from this study as well. First, as this study confirms the efficacy of misinformation correction on social media even for strongly opinionated users on a controversial issue, it is, therefore, imperative to continue implementing correction on social media whenever possible, though the outcomes might not be as perfect. Second, it is particularly efficient to perform correction on misinformation that is likely to motivate users on social media (e.g., issues invoking enormous uncertainty and high perceived risks to users personally). While these motivations may stir up misinformation spread, as previous literature has informed (Allport & Postman, 1947; Bordia & DiFonzo, 2004, 2005; Bordia et al., 2005), this study also reveals that correction is also significantly more effective when users are motivated.

Limitations and Future Research

It is important to note the limitations of the current research so that future research can be built. First, the pretest and posttest experimental design could have introduced some artificiality to participants' self-reported responses. Future research, therefore, could draw on some implicit measures of responses (e.g., implicit attitudes) that are less likely to be consciously controlled by participants and thus more ecologically accurate to reflect individuals' attitudes and intentions. Second, the current study did not differentiate various types of misinformation sharing as prior literature suggested that sheer repetitions of misinformation (even in the form of correction) could help strengthen its continued effect (e.g., Ecker et al., 2014; Lewandowsky et al., 2012). Future research, nevertheless, should build on this research and further explore the nuances of different sharing intentions and behaviors (e.g., sharing it offline as real information vs. sharing it online as a joke). Third, it is important to note that this current study chose a scientific topic in the United States that, compared with other topics such as politics, requires more specialized knowledge to evaluate. Future research, hence, can diversify the issue topics and further explore how the current findings may vary by different topics (e.g., health vs. politics) and in different cultures.

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Appendix A. Measures of the Key Variables Under Analyses.

Variables	Items
Perceived believability (Yale, 2013)	Please indicate your agreement with the following statements (7-point Likert scale of 1 = "strongly disagree" to 7 = "strongly agree") • I believe this story could be true • This story was plausible • This story seems to be true
Sharing intention (DiStaso et al., 2014)	How likely are you going to _____? (7-point Likert scale of 1 = "extremely unlikely" to 7 = "extremely likely") • "Like" the article • Share the article on social networking sites such as Twitter, Facebook, etc. • Comment on the article • Talk about the post offline • Recommend this post offline
Message credibility (Appelman & Sundar, 2016)	How well the following adjectives represent the news article you just read? (7-point Likert-type scale of 1 = "describes very poorly" to 7 = "describes very well") • Consistent • Concise • Complete • Well-Presented • Objective • Representative • No Spin • Expert • Will Have Impact • Professional
Perceived risk (Klerck & Sweeney, 2007)	Please indicate your agreement with the following statements (7-point Likert scale of 1 = "strongly disagree" to 7 = "strongly agree") • The thought of purchasing genetically modified food makes me feel psychologically uncomfortable • If I were to purchase genetically modified food I would become concerned about the potential long-term risks to my family, myself and others • If I were to purchase genetically modified food I would worry about the product not tasting as good as it should
Personal relevance (Darley & Lim, 1991)	The issue of gene-edited animal food reported in the news is_____(7-point Likert scale of 1 = "strongly disagree" to 7 = "strongly agree") • Important to me • Meaningful to me • Worth remembering

Perceived uncertainty (Ashill & Jobber, 2010)	After reading the news of genetically edited farm animal food _____(7-point Likert-type scale of 1 = "extremely uncertain" to 7 = "extremely certain") • How certain are you to predict the future of genetically edited farm animal food? • How certain are you to predict regulations of genetically edited farm animal food in the future? • How certain are you to make your own decision on consuming (or not consuming) genetically edited farm animal food? • How certain are you to predict the impact of genetically edited farm animal food on the society? • How certain are you to fully understand the effect of genetically edited farm animal food on individual health? • How certain are you about the consequences or outcomes of your decision on consuming (or not consuming) genetically edited farm animal food? • How certain do you feel that you know how to respond to genetically edited farm animal food? • How certain do you feel you are able to determine what the options should be about genetically edited farm animal food?