

Ambiguity Undermines Persuasive Effectiveness: Ego Involvement, Motivated Reasoning, and Message Ambiguity

DAVID M. KEATING*¹
QINJUN FAN
University of New Mexico, USA

Motivated reasoning is a form of biased processing where people evaluate messaging in such a way that it allows them to confirm their preexisting beliefs. The self-concept approach to motivated reasoning assumes that ego involvement drives this process, such that greater ego involvement leads to greater post-message dissonance and increases the likelihood of motivated reasoning. However, the theoretical framework proposes that motivated reasoning can be mitigated when message ambiguity is minimized. Across two experiments, we tested components of the self-concept approach to motivated reasoning, including this ambiguity principle. In general, the results did not provide support for the framework or the ambiguity principle. However, the direct effects of ambiguity suggest that it dampens the persuasiveness of messages. We consider what these results mean for the self-concept approach to motivated reasoning, theorizing about message ambiguity, and designing real-world messages that minimize ambiguity.

Keywords: message ambiguity, motivated reasoning, message design

Motivated reasoning is a form of biased processing where people evaluate information, such as information contained in persuasive messages, in such a way that it allows them to confirm their preexisting beliefs and attitudes (Enders & Smallpage, 2019; Kahan, 2013; Kunda, 1990). For example, when exposed to a health message that challenges one's existing belief, a person might denigrate the source of the message or counterargue the evidence provided in the message. In other words, motivated reasoning permits people "to believe what they want to believe because they want to believe it" (Kunda, 1990, p. 480). A better understanding of this process—and, specifically, how to mitigate it—is important for a variety of communication contexts. Most relevant to this study, it is important to investigate how persuasive messages can be designed to promote healthy and prosocial beliefs.

David M. Keating: davekeating@unm.edu

Qinjun Fan: qinjunfan25@unm.edu

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One proposed route to mitigating motivated reasoning involves eliminating ambiguity in messages (Carpenter, 2019). This can be challenging in practice because scientific findings are constantly evolving (e.g., findings on specific behaviors that help prevent the spread of the coronavirus disease 2019 [COVID-19]), but it is a worthwhile avenue to explore. The present study reports the results of two experiments testing the ability of this messaging approach to mitigate motivated reasoning outcomes. As part of this, we follow the self-concept approach to motivated reasoning (Carpenter, 2019; Carpenter & Cruz, 2021), which incorporates ego involvement as a primary driver of the process. We first outline our rationale, including the theoretical framework, and state our central predictions. Then, we present the methodology and results of the two experiments.

Motivated Reasoning and the Self-Concept Approach

Motivated reasoning broadly involves biased processing of information (Taber & Lodge, 2006; Weeks & Garrett, 2014). One central characteristic of motivated reasoning is that it occurs when people are motivated to process information to arrive at a preferred conclusion rather than an accurate one (Bergan, 2021; Carpenter, 2019; Carpenter & Cruz, 2021; Kahan, 2013; Kunda, 1990). In other words, when encountering information in a persuasive message, people may process that message with an accuracy goal—such that they are motivated to arrive at the correct conclusion—or a directional goal—such that they are motivated to arrive at a particular conclusion that is consistent with their prior beliefs and attitudes. Motivated reasoning occurs when directional goals are operative.

The self-concept approach to motivated reasoning assumes that ego involvement is the primary driver of the process (Carpenter, 2019). Ego involvement refers to the extent to which a person's belief, attitude, or identity associated with some topic is tied to their self-concept. For example, a person who strongly links their concept of self to their feelings about gun accessibility, abortion, or vaccinations would be highly ego involved in those topics. On receiving a counter-attitudinal message that targets an ego-involved belief or attitude, people are likely to experience cognitive dissonance and engage in defensive processing (Carpenter, 2019; Chang, 2015; Kahan, 2013). In such instances, the directional goal is tied to protecting one's self-concept (Carpenter & Cruz, 2021). The underlying principle that arguably governs this process is a need for cognitive consistency (Pavitt, 2010, 2016).

Regarding specific persuasive outcomes, when receiving a persuasive message, people who engage in motivated reasoning are more likely to generate counterarguments (Taber & Lodge, 2006), less likely to view the source as credible (Chang, 2015), and less likely to modify their beliefs or attitudes (Carpenter & Cruz, 2021). The self-concept approach proposes that these responses occur when people are exposed to counter-attitudinal messaging, that these responses are especially likely to occur when message recipients are highly ego involved in the topic, and that greater ego involvement additionally generates greater feelings of cognitive dissonance (Carpenter, 2019). It may be possible to mitigate these outcomes, however, through effective message design.

Designing Messages to Mitigate Motivated Reasoning

The self-concept approach to motivated reasoning proposes two principles for when motivated reasoning may be less likely to occur (Carpenter, 2019). The ambiguity principle, which is the focus of this study, suggests that motivated reasoning is mitigated when the evidence unambiguously points to the correct way of thinking about some topic or issue. For example, if this theoretical principle holds, then on receiving a message from the Intergovernmental Panel on Climate Change (IPCC) that climate change researchers “unanimously” agree that anthropogenic global warming is a high-priority threat to public health, people should be less likely to engage in motivated reasoning compared with when they see a message from the IPCC that “most” climate change researchers agree on that point. Though the other principle—the utilitarian principle—is also worthy of attention, we focus on the role of ambiguity in message design in this study.

Some existing work on motivated reasoning has directly or indirectly examined the role of ambiguity. For instance, research has found that people are more likely to interpret scientific information in ways that support their prior beliefs when ambiguity about the correct interpretation is higher (Dieckmann, Gregory, Peters, & Hartman, 2017), and people are less likely to view information as credible when contradictory research findings are discussed (Chang, 2015). Though not specifically about designing persuasive messages to mitigate motivated reasoning outcomes, findings such as these offer some evidence consistent with the ambiguity principle.

Message ambiguity can involve the amount of, adequacy of, consensus about, and/or reliability of information presented (Han, Moser, & Klein, 2006; Han et al., 2018). In communication research, message ambiguity has been defined as conflicting information (Han et al., 2006), inadequate consensus about the correct way to interpret information (Dieckmann et al., 2017), lack of clarity about the relevance of presented information (Nagler, 2014), and/or uncertainty about the reliability of information (Park & Shapiro, 2023). Given that the discussion of the ambiguity principle alludes to the consensus and reliability components (Carpenter, 2019), in this article, we generally refer to ambiguity as being characterized by a lack of expert agreement and/or lack of dependability about the correct way of thinking about an issue. In the context of persuasive message design, a message can be classified as less ambiguous to the extent that it conveys that (1) there is consensus about the optimal course of action to take and (2) there is a reliable outcome associated with that course of action. Regarding the former component, communication research studying consensus messaging has defined it as “evidence that there is compelling scientific evidence for a given claim” via endorsement by a group of experts with authority on the topic (Landrum & Slater, 2020, p. 1035). In climate change contexts, the available evidence shows that consensus messages have a small but significant effect on attitudes (Rode, Dent, & Ditto, 2023) though some findings suggest that skeptical and politically conservative individuals may experience psychological reactance as a result of viewing such messages (e.g., Ma, Dixon, & Hmielowski, 2019).

In any case, if the ambiguity principle from the self-concept approach to motivated reasoning holds, then persuasive messages characterized by lower ambiguity, compared with messages with comparatively higher levels of ambiguity, should reduce the likelihood that recipients engage in motivated reasoning. Specifically, as ambiguity in the message decreases, the impact of ego involvement on persuasive outcomes should decline.

Central Predictions

The primary goal of the present project was to evaluate the utility of the ambiguity principle for designing persuasive messages that might mitigate motivated reasoning. In doing so, we tested components of the self-concept approach to motivated reasoning (Carpenter, 2019; Carpenter & Cruz, 2021). We conducted two experiments to test our central predictions; the first experiment involved beliefs about peer drinking behavior among a sample of U.S. college students, and the second experiment involved beliefs about COVID-19 prevention and gun safety laws among a nationwide sample of U.S. adults. Both experiments were conducted in an online survey format.

To summarize the preceding arguments, the theoretical framework assumes that ego involvement with a topic produces greater dissonance when people receive a persuasive message targeting their beliefs about that topic. Cognitive dissonance refers to a state of psychological discomfort stemming from two cognitive elements, such as persuasive information received and an existing belief, which “do not fit together” (Festinger, 1957, p. 12). In addition to greater dissonance, ego involvement increases the likelihood of motivated reasoning when encountering persuasive messages. In the two experiments reported, the focal motivated reasoning outcomes that we examined included counterarguing (i.e., thinking of ways to refute a message), credibility judgments (i.e., judgments about the message source’s expertise on the issue and trustworthiness about the issue), and influence on targeted beliefs (i.e., subjective estimates about the truth of some proposition about an attitude object). Following the arguments above, we expected to observe the following responses among participants after viewing a persuasive message:

- H1: As ego involvement increases, participants who do not already endorse the targeted belief experience greater feelings of dissonance.*
- H2: As ego involvement increases, participants who do not already endorse the targeted belief are more likely to engage in motivated reasoning strategies, including (a) increased counterarguing and (b) decreased credibility judgments.*
- H3: As ego involvement increases, participants who do not already endorse the targeted belief are less likely to be influenced by that belief.*

However, following the ambiguity principle, it is possible that the motivated reasoning outcomes specified in H2 and H3 are less likely when ambiguity is low. In other words, when persuasive messaging is designed to be less ambiguous, compared with when it is relatively more ambiguous, the impact of the target audience’s ego involvement on motivated reasoning outcomes should decline. Accordingly, if the ambiguity principle holds, we would expect to observe the following pattern of results:

- H4: When message ambiguity is lower, compared with when it is higher, motivated reasoning becomes less likely such that the effects specified in (a) H2 and (b) H3 are weaker.*

Study 1

Study 1 Method

We conducted an initial experiment in which participants were randomly assigned to either a lower-ambiguity (L-A) condition or a higher-ambiguity (H-A) condition. All procedures were approved by the institutional review board at our home university before data collection. The data can be obtained from the corresponding author on request.

Before executing the main experiment, we first conducted a pilot study to assess the appropriateness of three different topics. The three topics included drinking norms among peers, health consequences of vaping, and COVID-19 prevention measures. The goal of the pilot study was to evaluate variability in participants' beliefs and ego involvement associated with each topic to identify at least one where participants reported a range of responses, and no floor or ceiling effects were observed. Pilot study participants ($N = 37$) were undergraduate students enrolled in three sections of a public-speaking course during the spring 2022 semester at a university in the Southwestern United States. Participants completed a series of items regarding their health-related beliefs (e.g., how much alcohol their peers consumed; health consequences associated with vaping; the effectiveness of COVID-19 prevention measures). Participants' level of ego involvement with each topic was also measured. Based on those results, we selected beliefs about drinking norms among peers as the focal topic.

Participants and Procedure

As with the pilot study, participants in the main study ($N = 112$) were undergraduate students enrolled in public-speaking courses during the spring 2022 semester at a university in the Southwestern United States. Participants were recruited from 10 other sections of the public-speaking course, and they reported majoring in more than 30 different programs at the university. Participants were between the ages of 18 and 53 years ($M = 19.96$, $SD = 3.98$) and most frequently identified as men ($n = 54$, 48.2%), followed by women ($n = 52$, 46.4%) and nonbinary ($n = 3$, 2.7%). Participants most frequently reported being White ($n = 47$, 42%), followed by Latinx ($n = 28$, 25%), multiracial ($n = 20$, 17.9%), Asian or Asian American ($n = 7$, 6.3%), Black or African American ($n = 4$, 3.6%), and Indigenous or Native American ($n = 2$, 1.8%). Two participants exited the study before the experimental manipulation.

Participants first completed items measuring their beliefs and ego involvement related to the topic. Following this, they were randomly assigned to one of two experimental groups. In each case, participants viewed a persuasive message. After viewing the message, they responded to items measuring their cognitive responses, including their feelings of dissonance, counterarguing against the message, evaluations of source credibility, and post-message beliefs.

Each message was seemingly from the department of health in the state where the university was located. One of the messages was lower in ambiguity (i.e., the message's language suggested that there was consensus and reliability about the message's conclusion), and one was higher in ambiguity (i.e., the message's language suggested that there was a lack of consensus and reliability about the message's

conclusion). Although we refer to the latter group as the H-A condition for ease of discussion, we emphasize that the condition is higher merely in comparison with the L-A condition. Our reasoning was that crafting a highly ambiguous message would artificially undermine message strength in an unrealistic way and make it more likely to observe that the L-A message was comparatively successful.

The messages were designed to visually resemble messages that have been disseminated by the state's department of health previously. The language in the H-A message explicitly noted that a lack of expert consensus existed, while language in the L-A message explicitly noted that there was expert consensus. Additionally, the language in the H-A message implied a lack of certainty and reliability in how experts thought about the topic (e.g., "most researchers believe"), while the language in the L-A message implied that certainty and reliability existed (e.g., "scientists agree").² The exact messages used in both experiments can be found on our study's Open Science Framework (OSF) page: https://osf.io/52hx8/?view_only=f51f538a4f3843e2b4dcc4d987efb25f

Measured Variables

The variables were all measured using 7-point Likert-type items. The list of items used in both studies can be found on our OSF page. For each variable, the order of items was randomized. The multi-item scales were subjected to a confirmatory factor analysis (CFA) before testing the hypotheses (see Table 1). The descriptive statistics reported in this section are based on the final scales created following the CFA results. Table 1 displays the correlations among the measures.

Table 1. Correlations Among Measured Variables in Study 1.

Variable	1	2	3	4	5	6	7
1. Perceived ambiguity							
2. Ego involvement	.18						
3. Dissonance	.24*	.19*					
4. Counterarguing	.17	.21*	.31*				
5. Expertise	-.22*	-.04	.01	-.38*			
6. Trustworthiness	-.28*	-.07	.02	-.41*	.80*		
7. Target belief (pre-message)	.20*	.23*	-.03	.22*	-.13	-.19*	
8. Target belief (post-message)	.37*	.22*	.22*	.22*	-.14	-.14	.52*

Note. * $p < .05$

² This approach is generally consistent with existing communication research on ambiguity. For example, Han and colleagues (2006) measured ambiguity as the extent to which people believed there were "many different recommendations" about the topic; Nagler (2014) conceptually defined ambiguity as involving reliability and relevance of information and subsequently measured it with items focused on confusion about recommendations; Dieckmann and colleagues (2017) conceptually defined it as involving uncertainty about the "correct" way to interpret information and subsequently manipulated it as lack of scientific consensus; and Park and Shapiro (2023) defined it as the "lack of reliability, credibility, or adequacy" of information and manipulated it as lack of certainty and reliability (p. 327).

Before viewing the message, participants' *ego involvement* was measured using a five-item scale adapted from Cho and Boster's (2005) value-relevant involvement measure ($M = 4.39$, $SD = 1.36$, $\alpha_{SI} = .90$). The scale instructed participants to think about the topic of alcohol use among college students and then rate their agreement with five statements (e.g., "My views on this topic reflect who I am").

After viewing the message, participants reported on their perceptions of ambiguity stemming from the message, feelings of dissonance, counterarguing, perceived source expertise, and perceived source trustworthiness. *Perceived ambiguity*, which served as a check on our experimental manipulation, was measured using a five-item scale ($M = 3.87$, $SD = 1.37$, $\alpha_{SI} = .79$). We created the scale by drawing from existing work that considers perceptions of ambiguity (e.g., Han et al., 2006; Taber et al., 2015). The items were designed to measure the extent to which participants believed that there was a lack of consensus and certainty about the information and recommendations presented in the message (e.g., "The message suggested that there is no consensus about the topic").

Dissonance was measured with a four-item scale ($M = 2.34$, $SD = 1.11$, $\alpha_{SI} = .83$), which was adapted from Metzger, Hartsell, and Flanagin (2020). Participants were instructed to think about the feelings they had when viewing the message and rate their agreement with a series of related items (e.g., "I felt uncomfortable while viewing this message"). *Counterarguing* was measured using a four-item scale ($M = 3.85$, $SD = 1.46$, $\alpha_{SI} = .83$), which was adapted from two studies (Igartua & Casanova, 2016; Nabi, Moyer-Gusé, & Byrne, 2007). Participants were asked to consider their response to the message and rate their agreement on a series of related items (e.g., "I sometimes felt like I wanted to 'argue back' to what I saw"). *Perceived expertise* ($M = 4.25$, $SD = 1.21$, $\alpha_{SI} = .90$) and *perceived trustworthiness* ($M = 4.29$, $SD = 1.30$, $\alpha_{SI} = .87$) were measured using two five-item scales adapted from McCroskey and Teven's (1999) measure of perceived source credibility. The scales asked participants to think about the source of the message they saw and rate their judgments about the source's expertise (e.g., "The source of the message was competent") and the source's trustworthiness (e.g., "The source of the message was honest").

Lastly, both before and after viewing the message, participants' *belief* about drinking norms among peers was measured. Specifically, we measured the extent to which participants believed that most students at the university drank a lot of alcohol regularly (pre-message: $M = 4.17$, $SD = 1.41$; post-message: $M = 3.92$, $SD = 1.43$).

Study 1 Results

Preliminary Analyses

Before testing the hypotheses, we conducted a series of preliminary analyses. First, we conducted a CFA with the six scales measuring perceived ambiguity, ego involvement, dissonance, counterarguing, perceived expertise, and perceived trustworthiness. Global fit indices suggested that there was meaningful error in the measurement model, comparative fit index (CFI) = .88, non-normed fit index (NNFI) = .87, standardized root mean square residual (SRMR) = .08. Inter-item correlations, factor loadings, and normalized residuals were examined to identify problematic items. Based on that, two items were dropped from the perceived ambiguity scale, one item was dropped from the dissonance scale, and two items were

dropped from the perceived trustworthiness scale. After removing these items, global fit indices suggested that there was reduced error in the measurement model, CFI = .94, NNFI = .93, SRMR = .06. The descriptive statistics reported in the previous section are based on the final scales containing retained items.

Second, we tested whether our ambiguity manipulation was adequate using a series of *t*-tests. An independent-samples *t*-test showed that participants' perceived ambiguity in the H-A condition ($n = 53$, $M = 4.16$, $SD = 1.20$) and the L-A condition ($n = 57$, $M = 3.60$, $SD = 1.46$) were significantly different in the intended direction, $t(109.36) = 2.20$, $p = .030$, $M_{diff} = 0.56$, $r = .21$. Further, a one-sample *t*-test showed that participants' perceived ambiguity in the L-A condition was significantly below the midpoint of the scale, $t(56) = -2.08$, $p = .042$, $M_{diff} = -0.40$. Their perceived ambiguity in the H-A condition was not significantly different from the midpoint, $t(52) = 0.95$, $p = .346$, $M_{diff} = 0.16$. Overall, we concluded that the manipulation was successful although somewhat weak.

Primary Analyses

To test the hypotheses, we ran a series of hierarchical regression models for each of the outcomes (i.e., dissonance, counterarguing, perceived expertise, perceived trustworthiness, and the target belief). In each model, the experimental variable, belief before viewing the message, and ego involvement were entered into the first block as control variables; the two-way interaction of pre-message belief and ego involvement was entered into the second block to test H1, H2, and H3; and the three-way interaction of the experimental variable, pre-message belief, and ego involvement was entered into the third block to test H4. Although no significant three-way interaction was expected for the dissonance outcome, we decided to include it to maintain consistency across tests. The full results of these regression models are reported in Supplementary Table 1 in the OSF. Additionally, we ran a series of supplemental regression models that included only participants who did not already endorse the target belief; as we used the pre-message target belief to filter participants, we removed it from these models.

In summary, the results of these analyses provided some support for H2a but not for H1, H2b, H3, or H4. Specifically, as participants' level of ego involvement with the topic increased, they were more likely to report counterarguing in response to the message; however, this was observed only in the supplemental model for participants who did not already endorse the target belief, $b^* = .36$, $t = 3.26$, $p = .002$, $R^2_{change} = .12$. Additionally, although several of the correlations between ego involvement and the outcome variables appeared to differ between the two experimental groups, we did not observe a significant three-way interaction of message ambiguity, pre-message target belief, and ego involvement. For example, the correlation between ego involvement and counterarguing was significant and moderate among participants in the H-A condition, $r(51) = .42$, $p = .002$, and nonsignificant and weak in the L-A condition, $r(55) = .07$, $p = .582$; however, although this would seem to support H4a on the surface, the three-way interaction term was not a statistically significant predictor in the regression model.

Post Hoc Analyses

We executed a series of post hoc analyses to further explore the impact of ambiguity. First, we conducted a series of basic *t*-tests, which ignored the possible influence of the control variables from the

regression analyses, to evaluate whether the L-A and H-A conditions differed on any of the outcomes. No statistically significant differences were observed (t s ranged from -1.95 to 0.36). Second, we examined the associations between perceived ambiguity and the outcome variables (i.e., dissonance, counterarguing, perceived expertise, perceived trustworthiness, and target belief after viewing the message). We computed semi-partial correlations that controlled for ego involvement and the target belief reported before viewing the message. Participants' perceived ambiguity stemming from the message was associated with greater feelings of dissonance, semi-partial $r(106) = .22, p = .019$, lower evaluations of source expertise, semi-partial $r(106) = -.20, p = .035$, and lower evaluations of source trustworthiness, semi-partial $r(106) = -.26, p = .008$. Additionally, perceived ambiguity was associated with greater endorsement of the risky belief (i.e., most peers drink a lot of alcohol regularly), semi-partial $r(105) = .31, p = .001$.

Study 1 Discussion

The results were consistent with one prediction derived from the self-concept approach to motivated reasoning. Specifically, the results supported the assumption that persuasive messages targeting ego-involved beliefs produce defensive processing in the form of increased counterarguing. Additionally, our post hoc analyses found that greater perceptions of ambiguity were associated with greater dissonance, lower credibility judgments, and reduced endorsement of a message-targeted belief. In other words, perceived ambiguity may meaningfully undermine the persuasiveness of a message. However, the overarching results of Study 1 did not support the ambiguity principle in that message ambiguity did not moderate the effect of ego involvement on motivated reasoning outcomes.

The primary limitations of the first experiment concern the sample and the message ambiguity manipulation. First, the sample size may have been too small to detect some effects. Second, the manipulation was fairly weak. Accordingly, we sought to test our central predictions in the second experiment with a larger sample and a more general population. We also revised the experimental design to contain a stronger manipulation and cover a new set of topics.

Study 2

Study 2 Method

As with Study 1, in the second experiment, participants were randomly assigned to either an L-A condition or an H-A condition. We attempted to strengthen the ambiguity manipulation without undermining the message in the H-A condition. In addition, participants were randomly assigned to one of two topics, and a larger sample was drawn from a nationwide participant panel. All procedures were approved by the institutional review board at our home university before data collection. The data can be obtained from the corresponding author on request.

Given that we intended to recruit a nationwide sample of adults in the United States, we examined public opinion data to evaluate suitable topics. We decided to focus on (1) wearing face masks while using public transportation, such as airplanes, and (2) banning the use of semiautomatic weapons, such as assault rifles. We chose these topics for two reasons. First, at the time we collected data, organizations that can be

considered experts had issued multiple statements regarding their stance on the issues—the Centers for Disease Control and Prevention (CDC) had formally stated the benefits of wearing face masks while using public transportation, and the American Academy of Pediatrics (AAP) had formally stated the benefits of banning semiautomatic weapons. This aided the goal of designing language about expert consensus and reliability in the messages. Second, these topics were well-suited for designing messages about the optimal course of action to take (i.e., mask-wearing helps prevent the spread of COVID-19; banning assault rifles helps prevent the deaths of children and adolescents).

Participants and Procedure

Participants were recruited from Prolific's participant panel between July 28, 2022, and July 30, 2022. At the time of data collection, a total of 36,428 participants were eligible for recruitment. A total of 602 participants were initially sampled, of which 11 were dropped from the sample (three participants were dropped because they failed an attention check, and eight participants were dropped because they were affiliated with the same IP address). Retained participants ($N = 591$) were between the ages of 18 and 82 years ($M = 45.61$, $SD = 15.91$, $Mdn = 45.50$), and they most frequently identified as women ($n = 297$, 50.3%), followed by men ($n = 285$, 48.2%) and non-binary ($n = 6$, 1%). Participants most frequently reported being White ($n = 445$, 75.3%), followed by Black or African American ($n = 74$, 12.5%), Asian or Asian American ($n = 37$, 6.3%), multiracial ($n = 20$, 3.4%), Latinx ($n = 10$, 1.7%), and Indigenous or Native American ($n = 3$, 0.5%). When asked which census region of the United States they lived in, most of the participants reported living in the South ($n = 234$, 39.6%), followed by the Midwest ($n = 134$, 22.7%), Northeast ($n = 118$, 20%), and West ($n = 102$, 17.3%).

The participants first responded to a series of items measuring their beliefs about and ego involvement with the two topics, including the specific beliefs targeted by the messages. Then they were randomly assigned to one of four experimental groups in a 2 (ambiguity: lower vs. higher) by 2 (topic: COVID-19 prevention vs. gun safety laws) between-subjects design. After viewing the message, participants responded to items measuring their feelings of dissonance, counterarguing against the message, evaluations of source credibility, and beliefs about the topic.

The COVID-19 prevention messages were seemingly from the CDC, and the gun safety messages were seemingly from the AAP. All the messages were initially designed to visually resemble CDC messaging because, beyond their statements about their stance on gun safety laws, concrete AAP messaging on the topic did not appear to exist; we then changed the icons and images used to create the gun safety messages. The colors, font, image placement, and structure were the same regardless of the topic.

Across the two topics, one set of messages was designed to be lower in ambiguity, and one was designed to be higher in ambiguity. To strengthen the manipulation, we italicized and increased the font size of the text that mapped onto the primary differences between ambiguity conditions. In addition, we changed some of the language used. For example, we used "Many medical experts believe" at the outset in the H-A condition in Study 2, compared with "Most researchers believe" in Study 1, and we used more reliable language about the best course of action to take in the L-A condition (e.g., a certain course of action

“helps” prevent something) compared with the H-A condition (e.g., a certain course of action “can help” prevent something). The exact messages are provided on the OSF page.

Measured Variables

The measurement used in Study 2 mirrored the measurement used in Study 1 with three exceptions. First, ego involvement with two different topics, rather than only one, was measured. Second, beliefs about two different topics, rather than only one, were measured. Third, we added a measure of political ideology that we included as a control variable in our analyses. The ideology measure consisted of one item in which participants were asked to identify the response that best described their political ideology (1 = very liberal; 4 = neither liberal nor conservative; 7 = very conservative). The descriptive statistics reported in this section are based on the final scales created following the CFA results. Table 2 displays the correlations among our primary measures.

Table 2. Correlations Among Measured Variables in Study 2.

Variable	1	2	3	4	5	6	7
1. Perceived ambiguity							
2. Ego involvement	-.07						
3. Dissonance	.39*	-.15*					
4. Counterarguing	.47*	-.06	.61*				
5. Expertise	-.46*	.21*	-.44*	-.65*			
6. Trustworthiness	-.41*	.23*	-.49*	-.68*	.88*		
7. Target belief (pre-message)	-.15*	.18*	-.38*	-.55*	.56*	.61*	
8. Target belief (post-message)	-.20*	.18*	-.43*	-.58*	.59*	.64*	.89*

Note. The ego involvement, target belief (pre-message), and target belief (post-message) variables regard the topic from the condition to which participants were assigned; * $p < .05$.

Before viewing the message, participants' *ego involvement* was measured for the topic of COVID-19 prevention ($M = 5.13$, $SD = 1.30$, $\alpha_{SI} = .92$) and the topic of gun safety laws ($M = 5.25$, $SD = 1.33$, $\alpha_{SI} = .94$). In the analyses, we included only the participants' reported ego involvement with the topic of the message from their experimental condition ($M = 5.16$, $SD = 1.34$). Immediately after viewing the message, participants reported on their *perceived ambiguity* ($M = 3.12$, $SD = 1.54$, $\alpha_{SI} = .86$). Next, participants reported on their feelings of *dissonance* ($M = 1.91$, $SD = 1.12$, $\alpha_{SI} = .82$), their level of *counterarguing* ($M = 2.75$, $SD = 1.69$, $\alpha_{SI} = .93$), their evaluation of *perceived expertise* ($M = 5.12$, $SD = 1.43$, $\alpha_{SI} = .94$), and their evaluation of *perceived trustworthiness* ($M = 5.07$, $SD = 1.48$, $\alpha_{SI} = .96$).

Lastly, before and after viewing the message, participants reported on their *beliefs* about the topics. The target belief for the COVID-19 prevention topic regarded whether wearing a face mask while using public transportation, such as airplanes, helps prevent the spread of the virus (pre-message: $M = 5.75$, $SD = 1.70$; post-message: $M = 5.74$, $SD = 1.73$). The target belief for the gun safety topic regarded whether banning semiautomatic weapons, such as assault rifles, would help prevent the deaths of children and adolescents (pre-message: $M = 5.34$, $SD = 1.96$; post-message: $M = 5.37$, $SD = 1.94$). As with ego

involvement, we included only the participants' target belief about the topic of the message from their experimental condition (target belief pre-message: $M = 5.55$, $SD = 1.81$; target belief post-message: $M = 5.59$, $SD = 1.81$).

Study 2 Results

Preliminary Analyses

Before testing the hypotheses, we again conducted a set of preliminary analyses. First, we conducted a CFA with the seven scales measuring perceived ambiguity, ego involvement with the COVID-19 prevention topic, ego involvement with the gun safety laws topic, dissonance, counterarguing, perceived expertise, and perceived trustworthiness. Global fit indices suggested that there was acceptable error in the measurement model, $CFI = .94$, $NNFI = .94$, $SRMR = .04$. Inter-item correlations, factor loadings, and normalized residuals were examined to identify any problematic items. Based on that, only one problematic item was dropped from the dissonance scale. After removing it, it remained the case that there was acceptable error in the measurement model, $CFI = .95$, $NNFI = .94$, $SRMR = .04$.

Second, we tested whether our ambiguity manipulation was adequate using a series of analysis of variance (ANOVA) tests and t -tests. A two-way ANOVA showed that participants' perceived ambiguity in the H-A condition ($n = 304$, $M = 3.72$, $SD = 1.52$) and the L-A condition ($n = 287$, $M = 2.48$, $SD = 1.30$) were significantly different in the intended direction, $F(1, 586) = 114.65$, $p < .001$, $M_{diff} = 1.23$, $r = .40$. The effect size observed here (95% confidence interval [CI; .36, .44]) was stronger than the effect size observed in the first experiment (95% CI [.14, .30]). Additionally, there was a main effect for topic, $F(1, 586) = 6.26$, $p = .013$, $r = .10$, but no interaction effect, $F(1, 586) = 0.00$, $p = .973$, $r < .01$, which suggests that the effect of the ambiguity manipulation did not depend on the topic. A one-sample t -test showed that participants' perceived ambiguity in the L-A condition was significantly below the midpoint of the scale, $t(285) = -19.70$, $p < .001$, $M_{diff} = -1.52$. Their perceived ambiguity in the H-A condition was also significantly below the midpoint, $t(303) = -3.25$, $p = .001$, $M_{diff} = -0.28$. Overall, we concluded that the manipulation was successful.

Primary Analyses

To test the hypotheses, we ran a series of hierarchical regression models for each of the outcomes (i.e., dissonance, counterarguing, perceived expertise, perceived trustworthiness, and the message-targeted belief). The models were identical to the ones described in Study 1 with two exceptions: The experimental variable corresponding to the topic and participants' self-identified political ideology were also included in the first block. The full results of these regression models are reported in Supplementary Table 2 in the OSF. We again ran a series of supplemental regression models that included only participants who did not already endorse the target belief.

In summary, the results were not consistent with H1, H2, or H3. None of the two-way interactions of pre-message belief and ego involvement were significant; similarly, ego involvement was not a significant predictor of the outcomes in the supplemental models. Additionally, the results were not consistent with H4.

With one exception, none of the relevant interaction terms explained significant variance in the outcome variables. The exception concerned a significant three-way interaction for counterarguing. On probing the three-way interaction, it appeared that the correlation between ego involvement and counterarguing diverged more starkly between pro-attitudinal message recipients, $r(223) = -.12, p = .076$, and counter-attitudinal message recipients, $r(60) = .23, p = .076$, in the L-A condition, $z = -2.42, p = .015$, than it did between pro-attitudinal message recipients, $r(238) = -.01, p = .901$, and counter-attitudinal message recipients, $r(62) = .15, p = .232$, in the H-A condition, $z = -1.12, p = .262$. This pattern is ultimately inconsistent with what we would expect from the ambiguity principle (see Figure 1).

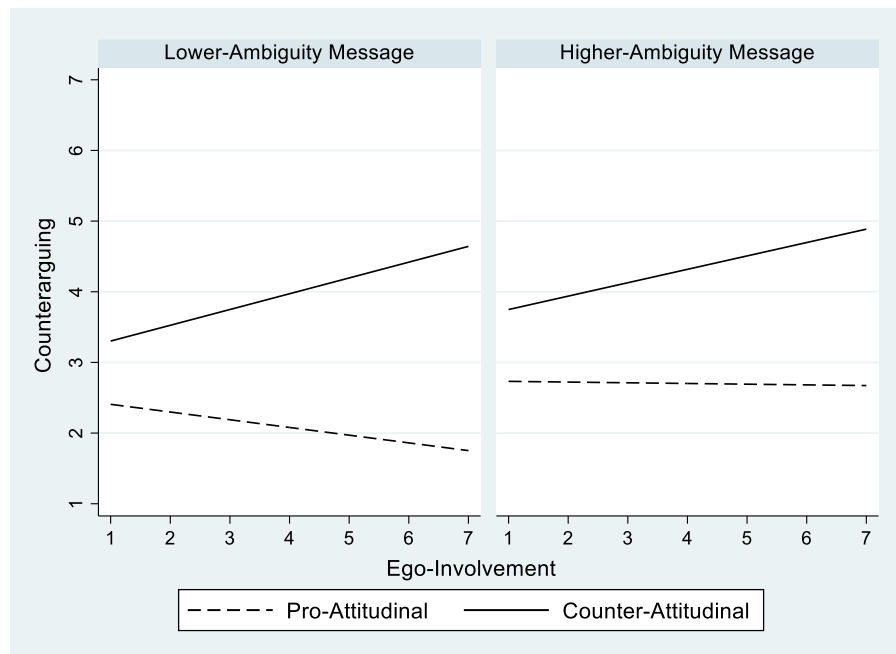


Figure 1. Three-way interaction for counterarguing in Study 2.

Post Hoc Analyses

Again, we conducted a series of post hoc analyses to explore the impact of ambiguity. First, we conducted two-way ANOVA tests to evaluate whether the L-A and H-A conditions differed in the outcomes and whether the differences there were modified by the topic variable. Participants who viewed the H-A message, compared with the L-A message, were more likely to report experiencing dissonance, $M_{\text{higher}} = 2.01, M_{\text{lower}} = 1.80, F(1, 587) = 6.27, p = .013, \eta^2 = .01$; more likely to report counterarguing, $M_{\text{higher}} = 3.06, M_{\text{lower}} = 2.42, F(1, 587) = 23.71, p < .001, \eta^2 = .04$; less likely to report that the source was an expert, $M_{\text{higher}} = 4.91, M_{\text{lower}} = 5.35, F(1, 587) = 17.47, p < .001, \eta^2 = .03$; and less likely to report that the source was trustworthy, $M_{\text{higher}} = 4.91, M_{\text{lower}} = 5.23, F(1, 587) = 8.06, p = .005, \eta^2 = .01$. None of the interaction effects were statistically significant, which suggests that these main effects were not modified by the topic variable.

Second, as with Study 1, we examined the associations between perceived ambiguity and the outcome variables using semi-partial correlations that controlled for ego involvement and the message-targeted belief reported before viewing the message. Consistent with the ANOVA results, participants' perceived message ambiguity was associated with greater dissonance, semi-partial $r(588) = .35, p < .001$, greater counterarguing, semi-partial $r(588) = .47, p < .001$, lower perceived expertise, semi-partial $r(588) = -.44, p = .031$, and lower perceived trustworthiness, semi-partial $r(588) = -.40, p < .001$. Additionally, perceived ambiguity was associated with lower endorsement of the message-targeted belief after viewing the message, semi-partial $r(584) = -.13, p = .001$.

Study 2 Discussion

Overall, the results of Study 2 were inconsistent with predictions derived from the self-concept approach to motivated reasoning and the ambiguity principle. The finding related to counterarguing in Study 1 was not replicated in Study 2, and although there was a significant interaction corresponding to our test of the ambiguity principle, the nature of that interaction was not consistent with the pattern that was expected. Additionally, our post hoc analyses strongly suggested that message ambiguity and perceived ambiguity undermined persuasive effectiveness. Specifically, relatively higher levels of message ambiguity produced greater post-message dissonance, greater counterarguing, and lower judgments of credibility. Furthermore, consistent with Study 1's post hoc analyses, relatively greater perceived ambiguity was also associated with those outcomes as well as lower endorsement of the message-targeted belief. These analyses showcase the disadvantages of conveying ambiguity, even modestly, in persuasive messaging.

The primary limitations of the second experiment concern the baseline beliefs of the participants, the limited time between measuring baseline beliefs and post-message beliefs, the message ambiguity manipulation, and the source chosen for the gun control topic. First, although we used public opinion data to identify topics on which U.S. adults are roughly split and recruited a nationwide sample of that population, the majority of the recruited participants ended up weakly or strongly endorsing the message-targeted belief before viewing the message. Second, given the substantial correlation between the pre-message and post-message target belief, it is possible that participants' pre-message responses on the belief variable swayed their post-message responses. A longitudinal design in which there was a longer time frame between the measurement of the baseline belief and the experimental manipulation would have alleviated this possibility.

Third, though the message ambiguity manipulation was much stronger compared with Study 1, there was room to strengthen it further without artificially reducing message quality. Future work examining message ambiguity would benefit greatly from pilot testing the messages before the main experiment. Related to this, although we sought to balance our prioritization of internal validity and external validity, because we ultimately placed more weight on strong experimental manipulations in Study 2, a possible trade-off is that the ecological validity of the messages was reduced. Fourth, among participants who opposed stricter gun control laws, it is possible that they were especially unlikely to view the AAP as a credible source on the topic; as a result, crafting unambiguous language in other parts of the message may not have generated truly unambiguous message content.

General Discussion

The primary purpose of the two reported experiments was to test core predictions derived from the self-concept approach to motivated reasoning and evaluate the ambiguity principle proposed in the framework (Carpenter, 2019; Carpenter & Cruz, 2021). Specifically, the experiments tested the extent to which ego involvement affected post-message dissonance, the implementation of motivated reasoning strategies, and change in message-targeted beliefs among recipients of counter-attitudinal messaging; additionally, they evaluated the extent to which mitigating message ambiguity also mitigates these outcomes. Overall, despite support for one of the predictions in Study 1, the overall pattern of findings from these experiments did not offer support for the self-concept approach to motivated reasoning, in general, or the ambiguity principle, in particular. However, ambiguity played a meaningful role in participants' responses to persuasive messaging. Next, we elaborate on the theoretical and practical implications of our findings.

Implications for Theorizing About Motivated Reasoning and Message Ambiguity

We highlight two implications of the two reported experiments. First, the most straightforward theoretical implication stems from the null results related to our tests of H1, H2, and H3. Ultimately, the findings across these experiments did not support predictions derived from the self-concept approach to motivated reasoning. It is possible that some aspect of the contexts or beliefs targeted contributed to the null results and the failure of Study 2 to replicate the counterarguing finding observed in Study 1. For instance, the messaging in Study 1 regarded a topic that can be directly quantified (e.g., the actual percentage of people in a group who engage in certain behaviors), while the messaging in Study 2 regarded topics that are less easily quantified (e.g., there is an increased likelihood of some outcome). However, this speculation cannot be evaluated with these data.

Second, both studies offer insight into the impact of message ambiguity and perceived ambiguity on persuasive effectiveness. The clearest implication is that neither experiment found evidence that is consistent with the ambiguity principle. In brief, although message ambiguity and perceived ambiguity had direct effects on persuasive effectiveness, they did not modify the impact of ego involvement on the measured outcomes among participants receiving counter-attitudinal messaging. One possibility is that these results imply boundary conditions for the ambiguity principle—perhaps the ambiguity principle does not apply to the types of topics or beliefs addressed in Study 1 and Study 2. In any case, although the results were not consistent with H4, the direct effects of ambiguity are worth considering further.

It is possible that message recipients' perceived ambiguity serves as a heuristic when evaluating messaging such that ambiguity triggers judgments that a message is low in quality. One explanation worth exploring concerns processing fluency, which refers to "the subjective experience of ease with which people process information" (Alter & Oppenheimer, 2009, p. 219; also see Schwarz et al., 1991). In brief, it is possible that processing fluency is impacted by message ambiguity, which subsequently affects people's judgments. As a result of reduced processing fluency, people tend to negatively appraise information presented to them (Alter & Oppenheimer, 2009). There is also some evidence to suggest that processing fluency mediates the effect of stimulus ambiguity on stimulus evaluations (Wu, Chen, Wang, & Zhou, 2022),

and it is possible that markers of ambiguity disrupt how people encode and understand the evidence or arguments presented in a persuasive message. Our speculation about processing fluency cannot be evaluated with these data; however, we believe a formal test of that explanation may help to better understand how and why ambiguity undermines persuasive effectiveness.

Implications for Message Design in Applied Settings

In addition to the theoretical implications discussed in the previous section, these findings have one central implication for message design efforts. Namely, persuasive messages should be designed in such a way that they minimize ambiguity. The direct effects of message ambiguity observed in Study 2 and the effects of perceived ambiguity observed in both studies underscore their ability to weaken persuasive efforts. As noted above, the message labeled as “higher ambiguity” represents a moderate amount of ambiguity that tracks with real-world messages that people may encounter.

Granted, completely removing ambiguity is not always possible. Evidence-based messages often require caveats because the evidence base in question is continually evolving, such as when findings are emerging about a novel public health emergency or an ongoing environmental crisis. Further complicating the delivery of such messages is the fact that when people feel that they have received conflicting information, they are less likely to follow recommendations (e.g., Carpenter, Elstad, Blalock, & DeVellis, 2014). One potential solution would be to remove markers of ambiguity while stating that the message is based on the existing base of evidence at the time of message design and delivery (e.g., “Experts currently agree”; “Here is the correct course of action at the moment”).

Conclusion

Two experiments were conducted to test components of the self-concept approach to motivated reasoning (Carpenter, 2019; Carpenter & Cruz, 2021), including the ambiguity principle. The overall pattern of results did not provide support for the theoretical framework, and we did not find evidence consistent with the ambiguity principle. Additionally, these results highlight the potential for message ambiguity to undermine persuasive effectiveness. Although we recognize that real-world messages cannot simply eliminate markers of ambiguity in every case, our findings suggest that is an important consideration for persuasive message design.

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