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# Countering conspiracy theory beliefs: Understanding the conjunction fallacy and considering disconfirming evidence

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## Abstract

Research suggests that a number of cognitive processes—including pattern perception, intentionality bias, proportionality bias, and confirmation bias—may underlie belief in a conspiracy theory. However, there are reasons to believe that conspiracy theory beliefs also depend in part on a failure to understand the probability of actual events allegedly supporting those conspiracy theories as well as a failure to entertain disconfirming evidence that may contradict those beliefs. Study 1 examines the relationships between general beliefs in conspiracy theories, belief in a novel conspiracy theory, conjunctive error propensity, and the propensity to consider disconfirming evidence. Study 2 investigates the roles of confronting both the propensity to make conjunctive errors and the failure to consider disconfirming evidence in changing conspiracy theory beliefs as well as attitudes associated with those beliefs. The results of both studies suggest that corrections to one's propensity to make conjunctive errors and mindful consideration of disconfirming evidence may serve as viable methods of self-persuasion pertaining to conspiracy theory beliefs.

**KEYWORDS**
conjunction fallacy, conjunctive errors, conspiracy theory beliefs, disconfirming evidence, persuasion

## 1 | INTRODUCTION

Conspiracy theories are used to explain the causes of significant social and political events through claims of secret plots by individuals or organizations (Aaronovitch, 2010; Byford, 2011; Coady, 2006; Dentith & Orr, 2017; Douglas et al., 2019; Keeley, 1999; Lewandowsky et al., 2013). While some conspiracy theories may actually be true–Watergate serving as a famous example–inadequately substantiated and unjustified beliefs in conspiracy theories can have negative impacts on individuals' behaviors ranging from personal health decisions (e.g., increased likelihood to violate COVID-19 regulations; van Prooijen, 2021) to participation in mass political events (e.g., the U.S. Capitol riots on January 6, 2021; Klepper, 2022). Thus, beliefs in conspiracy theories are consequential beyond mere epistemological divergence from mainstream thinking. Moreover, though past research has demonstrated an association between pathological personality traits and conspiracy theory beliefs (Hofstadter, 1964; van Prooijen et al., 2018), researchers have found that belief in one or more conspiracy theories is very common (Oliver & Wood, 2014; Sunstein & Vermeule, 2009) even when beliefs are induced through minimal exposure to relevant theories (Douglas & Sutton, 2008).

The relatively widespread belief in conspiracy theories has resulted in negative social outcomes that have been particularly evident during the COVID-19 pandemic. For example, belief in COVID-19 conspiracy theories has been associated with reduced adherence to distancing guidelines (Bierwiaczonek et al., 2020), greater endorsement of

pseudoscientific health practices (Lobato et al., 2014; van Mulukom et al., 2022), and more negative attitudes towards vaccinations (Hornsey et al., 2018), all of which may increase the risk of contracting and spreading COVID-19 and place resource and financial pressures on health care systems (Leonard & Philippe, 2021). Moreover, conspiracy theory beliefs have been associated with negative social effects like prejudice towards those of Asian descent (van Mulukom et al., 2022), higher levels of willingness to engage in violence ( Jolley & Paterson, 2020), and greater sympathy for violent radicalization among Canadian young adults (Levinsson et al., 2021). Thus, conspiracy theory beliefs may rightfully be considered a public health issue (Leonard & Philippe, 2021). Understanding the cognitive processes that may spur the formation of conspiracy theory beliefs, and developing interventions to disrupt or weaken said processes, is of great theoretical and applied importance.

## 2 | WHO BELIEVES IN CONSPIRACY THEORIES?

While conspiracy theory beliefs are popularly characterized as irrational beliefs held by those living on the fringe of society, in reality around 50% of Americans hold one or more conspiracy beliefs (Oliver & Wood, 2014) on both the political left and right (Enders et al., in press; Goertzel, 1994; Hofstadter, 1964; Olmsted, 2009; although recent research suggests greater beliefs on the extreme right; see Imhoff et al., 2022). Such widespread endorsement of conspiracy theories would indicate that a pathological basis for said beliefs is unlikely. Yet, prior research has demonstrated much in the way of dispositional and situational differences that appear to strengthen beliefs in conspiracy theories. Notably, researchers have found links between conspiracy theory beliefs and dispositional and situational factors such as powerlessness (Abalakina-Paap et al., 1999), paranoid (Darwin et al., 2011) and superstitious ideation (Swami et al., 2011), political distrust or cynicism (Abalakina-Paap et al., 1999; Swami et al., 2010), perceived lack of control (Kay et al., 2008; Kramer, 1994; Sullivan et al., 2010; van Prooijen & Acker, 2015; Whitson & Galinsky, 2008), heightened need for uniqueness (Imhoff & Lamberty, 2017; Lantian et al., 2017), agreeableness (Swami et al., 2010), and high individual narcissism coupled with low self-esteem (Cichocka et al., 2016). Beliefs in conspiracy theories are especially likely to emerge when adopting such beliefs satisfies psychological needs for order, certainty, or control (e.g., Crocker et al., 1999; Kay et al., 2008; Kramer, 1994; Sullivan et al., 2010; Whitson & Galinsky, 2008). After all, conspiracy theory beliefs can provide simplified explanations for complex, threatening phenomena (Douglas et al., 2017; Graeupner & Coman, 2017; Miller et al., 2016; Sunstein & Vermeule, 2009; Uscinski & Parent, 2014). Other research is suggestive of a potential conspiracy theory belief-related personality factor, whereby individuals may have a greater propensity towards "conspiracy thinking" (Brotherton et al., 2013; Imhoff & Bruder, 2014; Lewandowsky et al., 2013; Moscovici, 1987; Uscinski & Parent, 2014). Such findings indicate those who believe in an individual conspiracy theory are likely to believe in other conspiracy theories (Goertzel, 1994; Swami et al., 2011), even when they may be unrelated (Wood et al., 2012). These findings also demonstrate that an individual's bias towards explanations can depart from official accounts or serve as a basis for blaming well-known or controversial groups (Douglas et al., 2019).

## 3 | WHY DO PEOPLE BELIEVE IN CONSPIRACY THEORIES?

People may believe in conspiracy theories for existential, social motivational, and epistemological reasons (Douglas et al., 2017; van Prooijen & Douglas, 2018). Because conspiracy theories often include speculations about the origins of consequential events with grave or widespread impacts (e.g., terrorist attacks, assassinations, pandemics), researchers have proposed that people may believe in conspiracy theories because they provide straightforward explanations for complex events that may be otherwise difficult to comprehend or threaten one's existential well-being (Douglas et al., 2019; Hofstadter, 1964). Researchers have also identified unique social motivations that underlie beliefs in conspiracy theories. First, if one upholds a strong ingroup identity, it may increase the perceiver's sensemaking motivation when they believe their group is under threat by outside forces, thus increasing endorsement of conspiracy theories (van Prooijen & Douglas, 2018). Second, one may be motivated to protect themselves from a threatening outgroup, who may be considered controversial or powerful (van Prooijen & Douglas, 2018). Indeed, research has shown that those who identify as part of an undervalued or under-threat group are more likely to purport that entities are conspiring against their socio-political group, and that members of low-status groups more readily endorse conspiracy theories than members of high-status groups (Abalakina-Paap et al., 1999; Crocker et al., 1999; Goertzel, 1994; Uscinski & Parent, 2014). Insofar as group membership can impact belief in conspiracy theories, group polarization may influence an individual's likelihood to endorse a conspiracy theory (Sunstein & Vermeule, 2009). When individuals discover many members of their ingroup endorse a given conspiracy theory, they often adjust their beliefs in the direction of the dominant position (Castelli et al., 2001).

Finally, there are epistemological factors that may contribute to beliefs in conspiracy theories. Sunstein and Vermeule (2009) proposed that beliefs might be due to a "crippled epistemology," which arises from limited informational sources. In this case, believing in a conspiracy theory is justified from the perspective of the individual, even if such a belief is unjustified relative to the information available. One can imagine how online filter bubbles, which can create insulated informational ecosystems or one choosing to exclusively view certain television or radio news programs, may create the epistemological conditions ripe for belief in conspiracy theories.

### 3.1 | Cognitive processes underlying conspiracy theory beliefs

Of particular focus to the current research is the distinctive cognitive processes that may influence beliefs in conspiracy theories. Research has supported the relationship between belief in conspiracy theories

and at least six cognitive processes: proportionality bias, intentionality bias, pattern perception, jumping to conclusions, confirmation bias, and the conjunction fallacy. Proportionality bias refers to the intuition that important events could not have benign causes; for example, some may struggle to believe that a celebrity could die of mundane causes, and speculate alternative explanations (Wagner-Egger, 2022). Intentionality bias refers to the tendency to see human intention where there may be none, while pattern perception is the tendency to perceive patterns where there may be none (Wagner-Egger, 2022). Past research has demonstrated that even recognizing patterns in abstract art is positively correlated with belief in conspiracy theories (van Prooijen et al., 2018). The jumping to conclusions bias refers to the tendency to draw conclusions preemptively (i.e., believing without sufficient evidence; MacCoun, 1998; Sanchez & Dunning, 2021), while the confirmation bias refers to the tendency to search for, remember, and evaluate information such that it does not contradict one's established views (Klayman & Ha, 1987; Wagner-Egger, 2022). Finally, the conjunction fallacy refers to the tendency to incorrectly estimate the probability of a combination of two or more events as greater than that of the probabilities for any one of the independent events to occur (Brotherton & French, 2014; Dagnall et al., 2017; Drinkwater et al., 2018; Moulding et al., 2016; Wagner-Egger, 2022). One or more of these cognitive processes appear to be employed in support of most beliefs in conspiracy theories.

### 3.2 | The current investigation

Though there are potentially many viable cognitive processes or biases that may be used to confront conspiracy theory beliefs, we propose two independent, but somewhat related, interventions to reduce belief in conspiracy theories: a conjunction fallacy training and a disconfirming evidence inquiry. The conjunction fallacy states that people incorrectly estimate the probability of a combination of two or more events as greater than that of the probabilities for any one of the independent events to occur. Mathematically, the incorrect estimation corresponds to estimating Probability(A + B) > Probability (A) or Probability(B). Conjunctive errors may be thought to emerge from by an overreliance on the representativeness heuristic (i.e., the subjective probability estimate of A belonging to B, or originating from process B, by the degree to which A is representative of, similar to, or resembles B), as well as the availability heuristic (i.e., perceived frequency of a class, or probability of an event, based on the ease with which it comes to mind), making a conjunction *appear* more (subjectively) probable than one of its constituents (Tversky & Kahneman, 1983). Comprehension of how conjunctions may directly apply to probability estimates of an event or a conspiracy theory's truth requires mentally unpacking the conditionals that compose a conjunctive event—a cognitive unpacking process of which people are unlikely to employ without direct guidance or practice (see: *support theory* in Tversky & Koehler, 1994; also see: Johnson et al., 1993).

While past research has established conjunctive error propensity and the propensity to believe conspiracy theories (Brotherton & French, 2014; Dagnall et al., 2017; Drinkwater et al., 2018; Moulding et al., 2016), none have examined if training designed to reduce the propensity to commit the conjunction fallacy can be used to change beliefs in conspiracy theories. Yet, some evidence provides reason for optimism that cognitive errors, like the conjunction fallacy, may be corrected through training (Sellier et al., 2017) and access to more information (see: Rieger, 2012). For instance, following the 2020 presidential election won by Joe Biden, many people claimed that incumbent nominee, Donald Trump, was somehow cheated and the fraudulent outcome of the election was being upheld. Of course, the upholding of a fraudulent outcome in favor of Joe Biden would have required mass collusion by voters, poll workers, media, Bill Barr (former Attorney General), election security, and all courts including the supreme court. Furthermore, conspiracy theorists would need reason to trust the leading individual promoting the allegations of a conspiracy—notorious for lying and bullshitting (Petrocelli, 2018, 2021). Each of these conditions make the probability that the claim is true increasingly unlikely. Ignorance of such realities may be a source underlying unjustified beliefs in a conspiracy theory. Does becoming aware of the fact that each additional conditional makes an event increasingly less likely (i.e., implications of the conjunction fallacy) translate to more warranted (i.e., unlikely) estimates of conspiracy theories?

While an exercise to reduce conjunction fallacy errors may help to improve one's ability to accurately evaluate the likelihood of a conspiracy theory actually occurring, a disconfirming inquiry would address the tendency of individuals to ignore evidence that may be contradictory to their own beliefs. Indeed, the observation of the *confirmation bias*, whereby people tend to notice, seek, recall, favor, or interpret evidence in ways that confirm their existing beliefs, expectations, or hypotheses, as well as ignore, dismiss or underweight disconfirming evidence contrary to one's beliefs is well-established (Klayman & Ha, 1987; Mahoney, 1977; Nickerson, 1998; Platt, 1964). Consistent with Boghossian and Lindsay's (2019) observations, however, we contend that asking people to provide reasons for why they believe what they do, or to describe how they know their beliefs to be true, may further facilitate the recruitment of confirmatory reasons for their beliefs. Rather, to recruit and entertain disconfirmatory evidence contrary to their beliefs, we propose that people must be directly asked to consider how or why their beliefs *might be wrong*.

## 4 | OVERVIEW OF STUDIES

Study 1 was designed to examine the links between conspiracy theory beliefs with that of the general propensity to make conjunctive errors and the failure to consider disconfirming evidence for conspiracy theory beliefs. Study 2 was designed to investigate the roles of confronting both the propensity to make conjunctive errors and the failure to consider disconfirming evidence, in changing conspiracy theory beliefs as well as attitudes towards the primary object associated with those beliefs.

## 5 | STUDY 1

The purpose of Study 1 was to examine the links of conspiracy theory beliefs with that of the general propensity to make conjunctive errors and the failure to consider disconfirming evidence for conspiracy theory beliefs. Given that past research (Brotherton & French, 2014; Dagnall et al., 2017; Drinkwater et al., 2018; Moulding et al., 2016) has already established the link between the propensity to make conjunctive errors with global conspiracy theory beliefs, we sought to examine any relationships that conjunctive errors and neglect of disconfirming evidence might have with a novel conspiracy theory.

Although we believe the propensity to make conjunctive errors and the neglect of disconfirming evidence are theoretically orthogonal, there may be no better way to recognize conjunctive fallacy than to consider why the pulls of the representativeness and availability heuristics may be wrong. Therefore, we expect to find a positive correlation between the propensity to make conjunctive errors and the neglect of disconfirming evidence that is contrary to a conspiracy theory belief.

## 6 | METHOD

### 6.1 | Participants and design

An a priori power analysis using G*Power (Faul et al., 2009) revealed a required sample size of $N = 254$ to detect a small-to-medium-sized effect ($f = 0.175$) from a bivariate normal correlation and a power of $1 - \beta = 0.80$. Correspondingly, a total of 302 participants (48.7% female, $M_{age} = 38.84$, SD = 15.35) were recruited using Prolific (www.prolific.co) [2022]. Recruitment of participants was restricted to a minimum approval rating of at least 90% and those who passed a reCAPTCHA v3 bot detection protocol. Participants were paid $1.00 USD for the approximate 6-min study. All data and procedures are available online: https://osf.io/dpbc5/?view_only=f606b635b44f45a2885b03043e672fc9. All study materials were presented through a self-administered, online questionnaire, which was hosted using Qualtrics Online Survey Platform (https://www.qualtrics.com); participants advanced by clicking appropriate response keys. Post-hoc statistical decisions were not pre-registered.

#### 6.1.1 | Novel conspiracy theory beliefs

Following Swami et al. (2011), participants were informed about ¡Arriba!, a supposedly popular energy drink which was created in Mexico in 2008. They were also informed that the beverage is available in six countries, and records nearly 1 billion cases sold annually. Participants then responded to 12 items (e.g., "Regular consumption of ¡Arriba! raises cortisol levels, which causes damage in the long term."; "If a can of ¡Arriba! is heated up to 40°C, it releases health-threatening substances.") using a 9-point response scale with 1 (*completely false*) and 9 (*completely true*) as the anchor labels. Internal consistency was high (Cronbach's $\alpha = 0.89$).

#### 6.1.2 | Conjunctive error propensity

Participants then responded to a brief measure of the conjunctive error propensity developed by Rogers et al.'s (2009) measure. Specifically, participants were randomly assigned to read a series of three brief scenarios describing a variety of everyday situations (i.e., Robert goes to a seafood restaurant, Jo has experienced pain in her back, the small café in the middle of a busy town). Each scenario is followed by three statements relating to it (A, B & C), and participants are asked to judge how likely they think each event is to happen by indicating the chances in 100 (choosing any number between 0 and 100) that they feel each event will occur.

For example, participants read that Robert goes to a seafood restaurant for dinner with his friends. They have not eaten there before, but they do not have much time and are hungry so they decide to try it. The restaurant is an unclean, grubby, rundown place, which generally gets few customers. It sells food at cheap prices. Participants were then asked to indicate the likelihood of the following three statements: (A) The crab is off, (B) Robert is ill the next day, and (C) The crab is off and Robert is ill the next day. Following others (see: Brotherton & French, 2014; Fisk, 2017; Rogers et al., 2009), Conjunctive Error Propensity was scored by summing the instances whereby the probability estimate of statement C was greater than or equal to either the probability estimate of statements A or B. Because it is conceivable, and sometimes reasonable, to judge the probability of both components of a conjunction (A and B) to be zero, when the conjunctive event (C) was also recorded as zero it was not scored as a conjunction error.

#### 6.1.3 | Thought-listing of confirming and disconfirming evidence

Next, participants were asked to complete a thought-listing task with two separate parts. The first part of the task requested participants to consider their beliefs about the extent to which the ¡Arriba! Company was engaged in questionable, corrupt, or dangerous business practices and permitted them to list any *confirming evidence* for how their beliefs might be *correct*. They were instructed to type only one thought per screen frame. Participants were permitted to list up to five thoughts and instructed to type "N/A" for any remaining thought-listing boxes that they did not list a thought for. The second part of the thought-listing task permitted participants to list any *disconfirming evidence* by again requesting participants to consider their beliefs about the extent to which the ¡Arriba! Company but to also consider how their beliefs might be *incorrect*. The order of the confirming and disconfirming evidence listings was counterbalanced and did not affect any of the results.

#### 6.1.4 | Global conspiracy theory beliefs

Then, participants were asked to complete the Generic Conspiracist Beliefs Scale (GCBS; Brotherton et al., 2013) that measures

beliefs in government malfeasance, extraterrestrial coverup, malevolent global conspiracies, personal wellbeing, and control of information. Participants indicated their belief in the truth of 15 items (e.g., "The power held by heads of state is second to that of small unknown groups who really control world politics.") using a 5-point response scale with 1 (*definitely not true*) and 5 (*definitely true*) as the anchor labels. Internal consistency was high (Cronbach's $\alpha = 0.93$).

Finally, participants completed a brief demographics questionnaire, were debriefed, and thanked for their participation in the study.

## 7 | RESULTS AND DISCUSSION

The average number of Total Thoughts listed, regardless of confirming or disconfirming thought instructions, was 3.21 (SD = 2.27). However, as expected, participants listed a significantly greater Proportion of Confirming Thoughts ($M = 0.49$, SD = 0.24) than Proportion of Disconfirming Thoughts ($M = 0.39$, SD = 0.23), $F(1, 301) = 25.59$, $p < .001$, $\eta^2_{partial} = 0.08$.

In all subsequent analyses, we controlled statistically for the GCBS score. As displayed in Table 1, Novel Conspiracy Theory Belief failed to correlate with both the Conjunctive Error Propensity and the Proportion of Disconfirming Thoughts.

However, it is important to note that the only thing participants knew directly about ¡Arriba! was that it was created in Mexico and that it sells reasonably well within the six countries it is available. Therefore, the only statement reasonably impactful of sales, if it was true, was "¡Arriba! contains illegal substances that raise the desire for the product."; an item that did not correlate significantly with the other more relatively far-fetched claims measured by the ¡Arriba! conspiracy scale (e.g., "The slogan '¡Arriba! Makes You Strong' is used because in animal experiments, rats produced unnaturally high levels creatine."; "The recipe of ¡Arriba!, originally used as doping for soldiers, was bought from an American officer."). Furthermore, some of the ¡Arriba! conspiracy scale described practices that most any advertising effort would do, and thus do not particularly signal belief in a conspiracy (e.g., "Commercials in sports give the impression that ¡Arriba! is healthy.").

Thus, we explored the data further. As expected, the belief in the Illegal Substances Conspiracy for ¡Arriba! was significantly correlated with both Conjunctive Error Propensity and the Proportion of Disconfirming Thoughts. As the belief in the Illegal Substances Conspiracy for ¡Arriba! increased, the Conjunctive Error Propensity also increased whereas the Proportion of Disconfirming Thoughts decreased. Also of interest was the relationship between Conjunctive Error Propensity and the Proportion of Disconfirming Thoughts; as expected, the propensity to commit conjunctive errors increased as a smaller proportion of listing disconfirming thoughts for the novel conspiracy theory was observed.

## 8 | STUDY 2

Study 2 investigated the roles of confronting both the propensity to make conjunctive errors and the failure to consider disconfirming evidence, in changing conspiracy theory beliefs as well as the attitudes associated with those beliefs. Given that past research (Brotherton & French, 2014; Dagnall et al., 2017; Drinkwater et al., 2018; Moulding et al., 2016) has already established the link between the propensity to make conjunctive errors with global conspiracy theory beliefs, we sought to examine whether an educational module that reduced the tendency to make conjunction fallacy errors may also reduce belief in a novel conspiracy theory. Moreover, given that self-generated persuasion can be much better at belief change than the same thoughts from outside sources (Briñol et al., 2012), we sought to examine whether the listing of disconfirming evidence can reduce beliefs in a novel conspiracy theory. Thus, we expect to find those in the conjunction fallacy-training group and those in the disconfirming inquiry group will report weaker belief and less negative attitude towards the novel conspiracy theory than those in the control group. Moreover, we also believe that the combined interventions will impart a synergistic effect, whereby those in the combined intervention group will report even weaker beliefs and less negative attitudes towards the novel conspiracy theory than those in the control group or each of the intervention groups on their own.

**TABLE 1** Intercorrelations, partial Intercorrelations, and descriptive statistics of study variables (Study 1)

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | *M* | SD |
|---|---|---|---|---|---|---|---|---|
| 1. GCBS | – | .27** | .19** | .08 | −.02 | −.04 | 2.69 | .90 |
| 2. Novel conspiracy T. belief | – | – | .74** | .01 | −.08 | −.03 | 4.36 | 1.31 |
| 3. Illegal substances conspiracy | – | .72** | – | .16** | −.10 | −.13* | 3.74 | 1.87 |
| 4. Conjunctive error propensity | – | −.04 | .14* | – | .02 | −.14* | 2.16 | .96 |
| 5. Prop. confirming thoughts | – | −.08 | −.10 | −.01 | – | −.09 | .49 | .24 |
| 6. Prop. disconfirming thoughts | – | −.02 | −.12* | −.13* | −.09 | – | .39 | .22 |

*Note*: *$p < .05$; **$p < .01$.

Abbreviations: GCBS, generic conspiracist beliefs scale; T, theory; Prop., proportion of all zero-order correlations are above the diagonal and all partial correlations below the diagonal control for GCBS mean.

## 9 | METHOD

### 9.1 | Participants and design

An a priori power analysis using G*Power (Faul et al., 2009) revealed a minimum sample size of $N = 259$ to detect a small-to-medium-sized effect ($f = 0.175$) in a $2 \times 2$ between-subjects factorial design and a moderate power of $1 - \beta = 0.80$. Correspondingly, a sample of 525 participants (49.9% female, $M_{age} = 41.83$, SD = 14.37) were recruited using Prolific (www.prolific.co) [2022]. Recruitment of participants was restricted to a minimum approval rating of at least 90% and those who passed a reCAPTCHA v3 bot detection protocol. Participants were paid 1.50 USD for the approximate 6-min study. All data and procedures are available online: https://osf.io/dpbc5/?view_only=f606b635b44f45a2885b03043e672fc9. A 2 (Conjunction Fallacy Training: yes vs. no) $\times$ 2 (Disconfirming Inquiry: yes vs. no) complete between-groups design was employed, whereby participants were randomly assigned to conditions. The dependent variables included Belief in Novel Conspiracy as well as Attitude towards the object of the conspiracy theory.

### 9.2 | Procedure

All study materials were presented through a self-administered, online questionnaire using a self-administered, online survey, which was hosted using Qualtrics Online Survey Platform (https://www.qualtrics.com); participants advanced by clicking appropriate response keys.

#### 9.2.1 | Novel conspiracy theory belief

Following Swami et al. (2011), the novel conspiracy theory was adapted from Study 1 to address some of the weaknesses in capturing belief in conspiracy theories (e.g., removing items which describe practices that most any advertising effort would do, and thus do not particularly signal belief in a conspiracy). Participants were informed about ¡Arriba!, a popular energy drink that was created in Mexico in 2008. They were also informed that the beverage is available in six countries, and records nearly 1 billion cases sold annually. Participants then were given a series of hearsay statements (e.g., Some people are saying that ¡Arriba! contains illegal substances that raise the desire for the product; Some people are saying that about 5 years ago, a man died of cerebral hemorrhage, caused by overly high consumption of ¡Arriba!.). Participants then answered the question, *What do you believe is the likelihood that ¡Arriba! is involved in a conspiracy?* using a 9-point response scale with 1 (*completely false*) and 9 (*completely true*) as the anchor labels.

#### 9.2.2 | Conjunction fallacy training

Adapted from Rogers et al.'s (2009) measure, participants read three brief descriptions of everyday scenarios and answered questions that asked which outcome was more likely, an outcome that did not include the conjunction of two events, and an outcome which did (e.g., *Bill is an accountant* or *Bill is an accountant who plays jazz for a hobby*). After each question, participants received feedback on their response and an explanation of why their response was incorrect/correct (e.g., *The occurrence of any single event is always more probable than the occurrence of that event in addition to another event. In other words, one outcome occurring is always more likely than that outcome occurring in conjunction with another outcome).*

#### 9.2.3 | Disconfirming inquiry

Next, participants assigned to the *disconfirming inquiry condition* were asked to complete a thought-listing task where they considered their beliefs about the extent to which the ¡Arriba! Company engaged in questionable, corrupt, or dangerous business practices, and to what extent these beliefs are incorrect. Participants were permitted to list up to five thoughts and instructed to type "N/A" for any remaining thought-listing boxes that they did not list a thought for. The other half of the participants, assigned to the *no disconfirming inquiry condition*, were asked to list five of their favorite beverages.

#### 9.2.4 | Conjunction fallacy test

Participants then responded to a brief measure of the conjunctive error propensity developed by Rogers et al.'s (2009) measure. Specifically, they read a series of three brief scenarios describing a variety of everyday situations (i.e., Robert goes to a seafood restaurant, Jo has experienced pain in her back, the small café in the middle of a busy town). Each scenario is followed by three statements relating to it (A, B and C), and participants are asked to judge how likely they think each event is to happen by indicating the chances in 100 (i.e., choosing any number between 0 and 100) that they feel each event will occur. Conjunction Fallacy Error Total was calculated using the same scoring procedures employed in Study 1.

#### 9.2.5 | Global conspiracy theory beliefs

Then, participants were asked to complete the Generic Conspiracist Beliefs Scale (GCBS; Brotherton et al., 2013) which measures beliefs in government malfeasance, extraterrestrial cover up, malevolent global conspiracies, personal wellbeing, and control of information. Participants indicated their belief in the truth of 15 items (e.g., "The power held by heads of state is second to that of small unknown groups who really control world politics.") using a 5-point response scale with 1 (*definitely not true*) and 5 (*definitely true*) as the anchor labels. Internal consistency was high (Cronbach's $\alpha = 0.93$).

Finally, participants completed a brief demographics questionnaire, were debriefed, and thanked for their participation in the study.

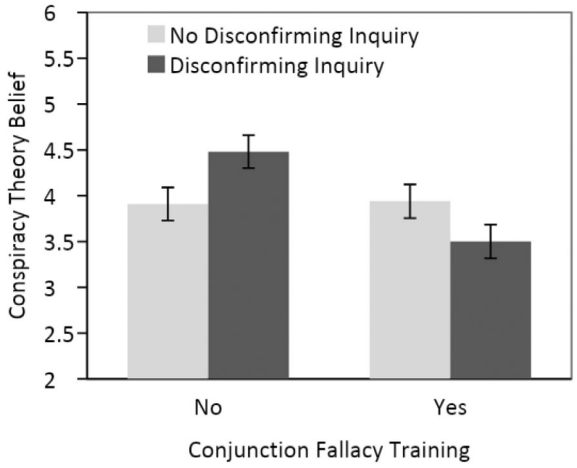


**FIGURE 1** Conspiracy theory belief means by conjunction fallacy training and disconfirming inquiry conditions (Study 2). Error bars display ±1 SE above and below the mean

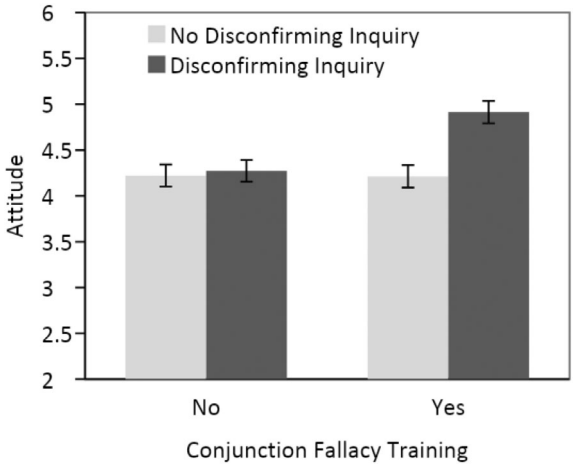


**FIGURE 2** Attitude means by conjunction fallacy training and disconfirming inquiry conditions (Study 2). Error bars display ±1 SE above and below the mean

## 10 | RESULTS AND DISCUSSION

The average Novel Conspiracy Theory Belief regardless of condition was 3.96 (SD = 2.11) and the average attitude towards the novel conspiracy theory regardless of condition was 4.40 (SD = 1.40). The manipulation check of Conjunction Fallacy Training revealed that mean Conjunction Error Propensity was significantly influenced by Conjunction Fallacy Training, such that participants who received the training showed significantly fewer conjunction errors ($M$ = 1.06, SD = 1.17) than their counterparts who did not receive the training ($M$ = 2.22, SD = 0.90), $F(1, 523) = 161.15$, $p < .001$, $\eta^2_{partial} = .24$. Additionally, among the participants who were asked to list disconfirming thoughts, those who received the conjunction fallacy education did not write any more disconfirming thoughts ($M$ = 2.34, SD = 1.20) than their counterparts who did not receive the conjunction fallacy education ($M$ = 2.50, SD = 1.28), $F(1, 255) = 0.94$, $p = .331$. As expected, the correlation between Novel Conspiracy Theory Belief and Attitude was negative, $r(523) = -.46$, $p < .001$. Also as expected, GCBS scores for the sample ($M$ = 2.51, SD = 0.96) were positively correlated with Novel Conspiracy Theory Belief, $r(522) = .38$, $p < .001$, and negatively correlated with Attitude, $r(522) = -0.14$, $p = .001$.

Next, the Novel Conspiracy Theory Belief data were subjected to a 2 (Conjunction Fallacy Training: yes vs. no) × 2 (Disconfirming Inquiry: yes vs. no) analysis of variance (ANOVA) test. A statistically significant main effect of Conjunction Fallacy Training emerged, $F(1, 521) = 6.70$, $p = .010$, $\eta^2_{partial} = 0.01$; as expected, participants assigned to the training were less likely to report a belief that ¡Arriba! was involved in a conspiracy ($M$ = 3.73, SD = 2.10) than those not assigned to the training ($M$ = 4.19, SD = 2.08). No main effect was observed for Disconfirming Inquiry, $F(1, 521) = .13$, $p = 0.721$. However, these findings were qualified by a statistically significant Conjunction Fallacy Training × Disconfirming Inquiry interaction, $F(1, 521) = 7.61$, $p = .006$, $\eta^2_{partial} = 0.01$ (see Figure 1). Follow-up pairwise comparisons revealed that among participants who *did not receive/i> the conjunction fallacy training, those not asked to list disconfirming thoughts reported a surprisingly, weaker belief in the conspiracy theory than their counterparts who did list disconfirming thoughts*, t *(521) = −2.21*, p = *.027. However, as was expected, among participants who* did receive *the conjunction fallacy training those not asked to list disconfirming thoughts reported a marginally, though not significantly, stronger belief in the conspiracy theory than their counterparts who did list disconfirming thoughts*, t*(521) = 1.72*, p = *.086. From another angle, among participants who* were not asked *to list disconfirming thoughts, no difference in Conspiracy Theory Belief was found between those who had and had not received the conjunction fallacy training*, t*(521) = −0.12*, p = *.906. However, consistent with our hypothesis, among participants who* were asked *to list disconfirming thoughts, Conspiracy Theory Belief was significantly greater among those who had not received the conjunction fallacy training than those who did receive the training*, t*(521) = 3.77*, p < *.001*.

Next, the Attitude towards the object of the novel conspiracy theory (i.e., ¡Arriba!) data were subjected to a 2 (Conjunction Fallacy Training: yes vs. no) × 2 (Disconfirming Inquiry: yes vs. no) ANOVA test. A statistically significant main effect of Conjunction Fallacy Training emerged, $F(1, 521) = 6.91$, $p = .009$, $\eta^2_{partial} = 0.01$; as expected, participants assigned to the training on average reported more positive attitudes towards the ¡Arriba! company ($M$ = 4.21, SD = 1.49) than those not assigned to the training ($M$ = 4.22, SD = 1.35). A statistically significant main effect of Disconfirming Inquiry emerged, $F(1, 521) = 9.85$, $p = .002$, $\eta^2_{partial} = 0.01$; as expected, participants assigned to the Disconfirming Inquiry on average reported more positive attitudes towards the ¡Arriba! company ($M$ = 4.27, SD = 1.49) than those not assigned to the Disconfirming Inquiry ($M$ = 4.22, SD = 1.35). However, these findings were qualified by a statistically significant Conjunction Fallacy Training × Disconfirming Inquiry interaction, $F(1, 521) = 7.27$, $p = .006$, $\eta^2_{partial} = 0.01$ (see Figure 2). Follow-up pairwise comparisons revealed that among

participants who *did not receive* the conjunction fallacy training, those not asked to list disconfirming thoughts reported similar attitudes towards the ¡Arriba! company to their counterparts who did list disconfirming thoughts, $t(521) = -0.31$, $p = 0.756$. However, as was expected, among participants who *did receive* the conjunction fallacy training, those not asked to list disconfirming thoughts reported significantly more negative attitudes towards the ¡Arriba! company than their counterparts who did list disconfirming thoughts, $t(521) = -4.14$, $p < .001$. From another angle, among participants who *were not asked* to list disconfirming thoughts, no difference in attitude towards the ¡Arriba! company was found between those who had and had not received the conjunction fallacy training, $t(521) = 0.05$, $p = .961$. However, consistent with our hypothesis, among participants who *were asked* to list disconfirming thoughts, attitude towards ¡Arriba! company was significantly more negative among those who had not received the conjunction fallacy training than those who did receive the training, $t(521) = -3.73$, $p < .001$.

## 11 | GENERAL DISCUSSION

Conspiracy theory beliefs are prevalent (Oliver & Wood, 2014; Sunstein & Vermeule, 2009), can be induced through minimal exposure (Douglas & Sutton, 2008), and represent a serious public health issue (Leonard & Philippe, 2021). However, research regarding interventions to reduce beliefs in conspiracy theories is incredibly limited. The current proof of concept investigation set out to evaluate the efficacy of two plausible interventions to reduce the strength of beliefs and adjust attitudes towards the primary object of the conspiracy theory: the conjunction fallacy training and the disconfirming inquiry. Consistent with the expectations from previous research (Brotherton & French, 2014; Dagnall et al., 2017; Drinkwater et al., 2018; Moulding et al., 2016), we found a positive relationship between the global propensity to believe in conspiracy theories and belief in a novel conspiracy theory in Study 1. Moreover, the results are consistent with the notion that beliefs in a novel conspiracy theory are associated with both the propensity to commit conjunctive errors and a propensity to ignore disconfirming evidence contrary to the conspiracy theory. To our knowledge, Study 1 is the very first to establish a negative association between the propensity to commit conjunctive errors and the consideration of disconfirming thoughts for a novel conspiracy theory.

The data of Study 2 provide encouraging support for the efficacy of the conjunction fallacy training as an intervention to reduce beliefs and change attitude towards a novel conspiracy theory. Much like in the tradition of inoculation theory research, which preemptively confers psychological resistance against persuasion attempts (Compton, 2013; McGuire & Papageorgis, 1961), the conjunction fallacy training improves participants' statistical reasoning skills *prior* to exposure to the conspiracy theory. Specific strengths of the conjunction fallacy training include its potential broad applicability for conspiracy theories (because it does not rely on prior exposure to the *contents* of the conspiracy theory) as well as its consistency with established findings (see: Brotherton & French, 2014; Dagnall et al., 2017; Drinkwater et al., 2018; Moulding et al., 2016). Yet, when *only* given the conjunction fallacy training, participants may not have been particularly motivated to apply their new statistical reasoning skills to consider alternative explanations for the novel conspiracy theory; indeed, prior research demonstrates that people tend to ignore, dismiss or underweight disconfirming evidence contrary to one's beliefs (Klayman & Ha, 1987; Mahoney, 1977; Nickerson, 1998; Platt, 1964). Thus, enabling participants to apply their statistical reasoning skills when evaluating conspiracy theories may help to improve the efficacy of this intervention. The results, on the other hand, did not support the use of the disconfirming inquiry—on its own—to reduce belief and change attitude towards the novel conspiracy theory. One plausible explanation for this finding is that without an improved ability to evaluate a conspiracy theory (e.g., through training regarding a salient logical fallacy like the conjunction fallacy training), participants may have experienced: (1) a greater subjective sense of difficulty in generating disconfirming beliefs; and/or (2) a greater difficulty generating sufficiently persuasive disconfirming beliefs to change their own beliefs and attitudes. Both factors could contribute to a participant feeling that there are few good reasons to doubt one's beliefs about the conspiracy theory, leading to the failure of the persuasion attempt. On the other hand, our results provide initial support for the efficacy of a combined conjunction fallacy training and disconfirming inquiry intervention to reduce beliefs and change attitudes towards a novel conspiracy theory. One plausible explanation for why we saw beliefs and attitudes change in the desired directions in the combined intervention group is that the conjunction fallacy intervention may have provided participants with the opportunity to improve their statistical reasoning skills, while the disconfirming inquiry enabled participants to apply their new understanding of statistical reality to the conspiracy theory at hand.

The empirical research regarding conspiracy theory beliefs is still in its infancy, and more research is required to fully understand the nature of said beliefs and how they may be changed. The current research provides initial insights into how beliefs and attitudes towards conspiracy theories may be altered through use of interventions that target certain cognitive processes. Particularly, in the current investigation we employed a novel conspiracy theory, which allowed for greater control for existing biases. Yet, more research is needed to address the limitations of our study and improve our understanding of the interventions employed. While we believe that the novel conspiracy theory bears resemblance to conspiracy theories often touted in popular culture and thus effects may generalize, future research would do well to investigate how the interventions perform on a broad range of conspiracy theories (economic, political, etc.), especially those with more cultural weight. Moreover, future research would do even better to consider the potential impact of attitude strength, persistence, and stability on the efficacy of the interventions. Stronger attitudes, more stable attitudes, and more persistent attitudes may be more difficult to change, especially when they strengthen the attitude-behavior relationship. Past actions then may serve as grounds for current attitudes (e.g., "I voted for a political

figure who endorses this conspiracy theory, so I would likely endorse it too."; Bem, 1967; Bem, 1972). Researchers may also do well to consider why the combined conjunction fallacy and disconfirming inquiry intervention was especially effective compared to each intervention on its own. Though we have provided plausible explanations, greater insights into the mechanics of conspiracy theory belief change using the combined intervention could provide valuable insight. For example, is the disconfirming inquiry more effective when combined with the conjunction fallacy training because it increases the subjective sense of ease in formulating disconfirming thoughts? Alternatively, could it be that after receiving the conjunction fallacy training, participants were able to generate more convincing disconfirming thoughts? It is even possible that the combined intervention was more effective simply because it offered more opportunities for participants to reconsider the accuracy of their beliefs. Knowing precisely how the two interventions work together could provide guidance for future research on interventions to reduce beliefs in conspiracy theories. Finally, it is important to note that the effects found across both of the studies conducted were fairly small. Future research would do well to account for the relationship among the conjunction fallacy, disconfirming evidence consideration, and attitudes and beliefs regarding both novel and more broadly established conspiracy theories measured by the GCBS. Future research may also require larger sample sizes to detect this effect, and should consider how the presentation of the conspiracy theory (e.g., more elaborated conspiracy theories) and interventions may be able to strengthen the effect.

## 12 | CONCLUSION

Conspiracy theory beliefs are not merely an epistemological divergence from mainstream thinking. Such beliefs are widely held, and have a range of negative impacts, from influencing individuals personal health behavior during the COVID-19 pandemic to affecting individuals' engagement in or approval of violent or discriminatory behavior. The current investigation is the first to empirically test interventions to reduce beliefs in conspiracy theories through conjunction fallacy training and disconfirming inquiries. We sought to understand the cognitive processes that may spur the formation of conspiracy theory beliefs, and develop interventions to disrupt or weaken said processes. We found that belief in conspiracy theories can be changed, and that the combined conjunction fallacy training and disconfirming inquiry intervention are promising techniques to change beliefs and attitudes towards conspiracy theories that deserve the attention of future research. While there may be other cognitive processes involved in the formulation and maintenance of conspiracy theory beliefs, these findings may be a useful stepping stone for much needed cognitive intervention research in conspiracy theory beliefs.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

### DATA AVAILABILITY STATEMENT

All data and procedures are available online at https://osf.io/dpbc5/?view_only=f606b635b44f45a2885b03043e672fc9

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