TRUST IN SCIENCE IS NOT THE ANSWER TO CONSPIRACIES: IT'S THROWING WATER ON A GREASE-FIRE

BY

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THESIS

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Abstract

Conspiracy theories can be quite dangerous and have risen in prevalence. The rise of conspiracy theories has been met with an outcry to increase public trust in science. However, using trust in science to stop conspiracy theories may have unintended negative consequences. Trust in science entails the blind acceptance of information based on the inclusion vs. exclusion of scientific content. This, combined with the fact that many conspiracy theories contain scientific content, suggests that trust in science may actually increase belief in conspiracy theories that contain science. Thus, we hypothesized that trust in science would interact with the presence of scientific content to predict beliefs and dissemination, such that individuals high in trust in science would depend more on the presence of scientific content in their judgments of legitimacy. In Experiment 1, we gave 148 Amazon Mechanical Turk workers articles varying on presence of scientific content and conspiratorial nature and measured their beliefs in the article. Participants high in trust in science were more likely to believe in the articles containing science and less likely to believe in the conspiratorial articles. In Experiment 2, we gave 73 Amazon Mechanical Turk workers exclusively conspiratorial articles varying on presence of scientific content and measured their beliefs in the articles, as in Experiment 1, and dissemination decisions. A significant interaction was found between trust in science and presence of scientific content on both beliefs in and dissemination of the articles, such that those high in trust in science were more likely to believe in and disseminate articles that contained science. These findings suggest that while trust in science may be beneficial in certain respects, when conspiracy theories contain scientific content, it can be detrimental.

Acknowledgments

I would like to acknowledge and thank my adviser, Dr. Dolores Albarracín. Through patient help and guidance, she has turned me into a capable researcher, ready to take on a master's thesis.

To my parents, without whom I could not have gotten here

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Introduction

I believe in science!

–Hillary Clinton, 2016 Democratic National Convention

When Hillary Clinton bellowed these four simple words, she was met with resounding applause. Attendees of the 2016 Democratic National Convention applauded because Clinton conveyed her trust in science. In many respects, trust in science, a person's willingness to believe in and accept the judgment and actions of scientists and the field of science (Crease, 2004), is beneficial and necessary to the functioning of society (Arimoto & Sato, 2012; Hendriks, Kienhues, & Bromme, 2016; Sztompka, 2007). For example, it leads to more public support and funding for science, which in turn increases the number of scientific discoveries (Miller, Pardo, & Niwa, 1997; Muñoz, Moreno, & Luján, 2012; National Science Foundation, 2016). Other presumed consequences of trust in science, however, seem less certain. For example, politicians and news outlets posit that increasing the public's trust in science will decrease belief in conspiracy theories (Houser, 2017; Requarth, 2017). In contrast to this assertion, this thesis examined the possibility that trust in science increases belief in conspiracy theories that contain scientific contents.

Several facts lead to the hypothesis that trust in science may increase belief in conspiracy theories with seemingly scientific contents. First, although conspiratorial information is extremely prevalent (Oliver & Wood, 2014; Public Polling Policy, 2013) and has seen a stark increase in prevalence due to the rise of the internet and social media (Bessi et al., 2015), recent population reports in the United States suggest that trust in science has remained stable (Funk & Kennedy, 2016; Gauchat, 2012; NORC, 2017). Therefore, social trends do not suggest an association between conspiracy theories and trust in science. Second, at its core, trust requires accepting a statement as true without evidence or investigation (English Oxford Living Dictionaries, 2018). In the case of trust in science, whether to trust or distrust information depends on the presence of scientific content, with little emphasis on the validity of the information itself. Thus, trust in science might increase belief in information containing scientific content, which, against common misconception, includes many conspiracy theories. This possibility was examined in this research.

What Are Conspiracy Theories?

The Oxford English Dictionary defines a conspiracy theory as “a belief that some covert but influential organization is responsible for a circumstance or event” (English Oxford Living Dictionaries, 2018a). Psychology researchers define conspiracy theories as “lay beliefs that attribute the ultimate cause of an event, or the concealment of an event from public knowledge to a secret, unlawful, and malevolent plot by multiple actors working together” (Furnham, 2013; Swami, Voracek, Stieger, Tran, & Furnham, 2014; Zonis & Joseph, 1994). Although these definitions differ slightly, they both claim that conspiracy theories have two main components. The first and most central component, is claiming that a cover-up has taken place; something evil has happened and the true actors behind the curtain have hidden the truth from the public. The second component of conspiracy theories regards the type of cause being claimed: an evil entity is behind the horrid acts and is covering-up their misdoings. Therefore, for the sake of this thesis, a conspiracy theory is defined as a theory that claims both a cover-up of malicious actions and an intentional, human cause.

Why Worry About Conspiracy Theories?

Conspiracy theories are prevalent. Conspiracy theorists are primarily portrayed as “a small demographic composed primarily of middle-aged white male internet enthusiasts who live in their mothers' basements" (Uscinski & Parent, 2014). The average person believes that conspiracy theories are quite rare and that only a select few irrational individuals believe in them (Melley, 2000; Uscinski & Parent, 2014; van der Linden, 2013). In truth, however, over 50% of United States citizens endorse at least one conspiracy theory (Oliver & Wood, 2014). The rise of the internet and social media has allowed conspiracy theories to reach countless more people than was previously possible (Bessi et al., 2015).

Conspiracy theories are dangerous. Conspiracy theories are commonly perceived as irrational but harmless. Many conspiracy theories are indeed amusing and harmless, but others have resulted in pain, suffering, and death (Goertzel, 2010; McConnachie & Tudge, 2008). In recent years, anti-vaccination theories have led to the resurgence of serious diseases (Rodrigo Gonzalo de Liria, 2017). In 2014 alone, over 667 cases of the previously thought extinct German measles were reported in the United States (Centers for Disease Control and Prevention, 2016). In 2017, President Donald Trump's conspiracy theory that climate change is a Chinese hoax aimed to undermine American manufacturing (Trump, 2012) may have influenced his decision to withdraw the United States from the Paris Climate Change Agreement ("United States announces plans to withdraw from Paris Agreement on climate change.," 2017).

Trust in Science

Trust is the willingness to accept information from another entity, not based on reasoning and analysis, but based on faith in the entity providing the information (Tseng & Fogg, 1999). Trust therefore entails blind acceptance and the risk of being misinformed if the benefactor provides incorrect information (Hendriks et al., 2016; Mayer, Davis, & Schoorman, 1995). For example, trust in science entails accepting scientific material based on the merit of scientists and science as a whole (Hendriks et al., 2016; Sztompka, 2007) instead of questioning and reasoning through the information (Crease, 2004). Thus, trust in science may ironically encourage people to naively accept information based on the presence of scientific content, while discouraging deeper rational thought.

Trust in science vs. scientific literacy. It is important to distinguish trust in science from the similar, but distinct, concept of scientific literacy. As previously mentioned, trust in science is the willingness to believe in, and accept, the judgment and actions of scientists and the field of science (Crease, 2004). Contrarily, scientific literacy is "an appreciation of the nature, aims, and general limitations of science, coupled with some understanding of the more important scientific ideas" (Jenkins, 1994). The important distinction between these two concepts is that scientific literacy helps one understand scientific information (Krause & Corts, 2011), whereas trust in science tells one whether or not to believe said information (Hendriks et al., 2016).

Trust in Science as the Answer to Conspiracy Theories

Conspiratorial thinking is extremely common in society (Bessi et al., 2015; Oliver & Wood, 2014; Public Polling Policy, 2013). As ease of access to the internet and social media outlets has increased, so too has the prevalence of "echo chambers" where conspiracy theories can spread quickly and easily (Del Vicario et al., 2016; Stewart, 1999). Many news outlets and politicians propose that the answer to the rising tide of conspiracy theories is to increase trust in science (Houser, 2017; Requarth, 2017). The reasons for this proposal are twofold. First, science is seen as diametrically opposed to conspiracy theories (Bessi et al., 2015; Soentgen & Bilandzic, 2014). Second, the rise of conspiracy theories appears to have occurred at roughly the same time as they claim trust in science fell (Cohnitz, 2017). However, although some researchers and politicians make claims such as "to oppose [the decay of trust in science] is necessary to rejuvenate the ethos of science" (Sztompka, 2007), others doubt whether the public's trust in science has actually declined. One research team found that between 1970 and 2010, trust in science stayed constant for groups other than conservatives in the United States (Gauchat, 2012). Findings from other research, such as the Pew Research Center's survey of "a nationally representative panel of randomly selected U.S. adults living in households", suggest that trust in science is currently relatively high (Funk & Kennedy, 2016). Furthermore, the National Data Program for the Social Sciences' General Social Survey of United States citizens found that public confidence in scientists has remained stable since the 1970's (NORC, 2017).

Conspiracy theories can contain scientific content. In practice, conspiracy theories are not diametrically opposed to science. Many conspiracy theories utilize scientific content to gain persuasive legitimacy (Díez Arroyo, 2013; Freedom Free For All, 2016; Thomas, 2001). To clarify, the integrity of the "science" that is being claimed may be lacking, but an appeal to science is made nonetheless. For example, the Flat Earth Society claims: "The evidence for a flat Earth is derived from many different facets of science and philosophy" (The Flat Earth Society, 2017). Furthermore, many of these theories, such as the one proposing that the measles, mumps, and rubella (MMR) vaccine causes autism, rely on forms of scientific reasoning (Gerber & Offit, 2009). The current version of this theory makes detailed claims that small traces of mercury or aluminum in the MMR vaccine cause autism (Gerber & Offit, 2009). Regardless of the validity of the claims, conspiracy theories can clearly contain science-like contents.

Overview of Studies and Hypotheses

The present experiments were designed to test whether or not trust in science can trap audiences into believing and disseminating conspiratorial information. To test this hypothesis, we created conspiratorial articles varying on their presence or absence of science and measured participants' beliefs in the articles and, in one of the experiments, whether or not they voted to disseminate them. We hypothesized that trust in science would moderate the effect of scientific content on belief, such that higher trust in science predicts a greater positive effect of scientific content on belief. Furthermore, we hypothesized that trust in science would also moderate the effect of scientific content on dissemination of information. Additionally, in Experiment 1, we directly tested whether trust in science can reduce belief in the conspiratorial aspect of these misconceptions, specifically whether human (vs. natural) causes are purported to cause an event.

Experiment 1

Overview

The purpose of Experiment 1 was to test our hypothesis that trust in science moderates the relationship of scientific content on belief in conspiracy theories. Experiment 1 also sought to examine scientific literacy, which was expected to operate differently, perhaps in a manner that leads to less belief in conspiratorial information. In addition, Experiment 1 aimed to test the hypothesis that trust in science can help individuals distrust conspiratorial information. To test this possibility, the conspiratorial nature of articles was manipulated through the type of cause being claimed: either the intentional, human cause inherent to definitions of conspiracy theories, or an unintentional, less conspiratorial, natural cause. If the claims of proponents of trust in science are correct, trust in science should interact with the type of cause being claimed (intentional, human cause vs. unintentional, natural cause), such that high (vs. low) levels of trust reduce belief in conspiracy theories.

Design

This experiment utilized a 2 (presence of scientific content: present vs. absent) x 2 (type of cause: human vs. natural) x continuous (trust in science and scientific literacy) between-subjects design.

Participants

One-hundred fifty-five Amazon Mechanical Turk workers participated in a between-subjects experiment for $0.30. All participants were from the United States, spoke English, and had an approval rating on Amazon Mechanical Turk of 95% or higher. Seven participants were removed from analysis for failing at least one of two attention checks, resulting in a final sample size of N = 148. The sample was 54.7% female, with a mean age of 40.79 years.

Procedure

After consenting to participate, participants were informed that they would be reading an article to help the researchers understand how people comprehend media postings and how grammar and fonts influence comprehension. They were instructed to read the article carefully and take as much time as they needed. Following the instructions, participants were randomly presented with one of the four articles. After reading the article, participants were asked to summarize what they had read in as much detail as possible (Attention check 1). Next, participants answered six distractor questions (on a 5-point Likert scale) about the article's language and characteristics. Following the distractor questions, participants were presented with the belief measure. At the end of the belief measure participants were asked to leave a 1 to 7 scale blank and type "Yes" in a box if they were paying attention (Attention check 2). Next, participants were told that they would answer some questions about science and were presented with the trust in science and scientific literacy measures respectively. Finally, participants were asked a series of demographic questions, were debriefed as to the true nature of the study, and were given a code which could be redeemed on Mechanical Turk for $0.30.

Materials

Conspiratorial articles. We created a set of four conspiratorial articles which did or did not contain scientific content and varied on the level of their conspiratorial nature by means of the type of cause claimed (intentional, human vs. unintentional, natural). All articles contained a conspiracy theory about the same fictional virus, discussed its status as a global threat, and stated that the authors knew the hidden truth of its origins, unlike the authors' opposition, which was hiding these origins. Discussion of a cover-up was included to designate the theories as conspiratorial, in line with the definitions of conspiracy theories detailed earlier. The articles with scientific content cited that researchers at prestigious universities analyzed the viral structure of the virus to discovery its true origins. The articles without scientific content stated that investigative activists for truth had discovered the true origins of the virus during their investigations. Furthermore, half of the articles claimed an intentional, human cause, which involved an extreme terrorist group that had created the virus to kill off those they disagreed with ideologically. The other half claimed a natural cause, which involved the virus having mutated naturally from a similar virus found in bats. In pilot testing, all 4 articles were tested for how interesting audiences found them, with no significant differences found between them. The scientific articles can be found in Appendix A and the non-scientific articles can be found in Appendix B.

Belief measure. We created a belief measure (see Appendix C) containing six statements regarding the argument strength, persuasiveness, and believability of the articles ($\alpha = .947$). A 5-point Likert scale, from 1 (Strongly Disagree) to 5 (Strongly Agree) measured agreement to each of the six statements. The ratings on the six statements were averaged for each participant (participants' ratings were summed and divided by 6) to create their mean belief score, which was used for analyses.

Trust in science. To measure trust in science, we created a continuous measure by combining three items taken from Nadelson and colleagues' *Trust in Science and Scientists Inventory* (Nadelson et al., 2014) and seven of our own creation (ten total items, $\alpha = .776$). Agreement with each of the ten items was measured using a 5-point Likert scale, from 1 (Strongly Disagree) to 5 (Strongly Agree). The ratings on the ten statements were averaged for each participant (participants' ratings were summed and divided by 10), then centered using z-scores to create their centered composite trust in science score. The trust in science scale can be found in Appendix D. The items with asterisks were reverse coded.

Scientific literacy. To assess participants' scientific literacy, we created a continuous scale containing eight multiple-choice items (α = .580). Each of the eight multiple-choice items asked a question and told participants to choose the correct answer from four possible choices. For each question there was only one correct answer. An example question is below:

What is a hypothesis?

○ a. The right answer to an experiment

○ b. The wrong answer to an experiment

○ c. An educated guess made before testing

○ d. The true underlying effect of a variable

Four out of the eight items were taken from a previously created scientific literacy scale (Gormally, Brickman, & Lut, 2012), two were taken from an online basic scientific methods quiz, and two were of our own creation. We calculated the number of questions each participant got correct, then centered this value using z-scores to create their centered composite scientific literacy score. The complete set of scientific literacy questions appears in Appendix E.

Results

A univariate analysis of covariance with trust in science and scientific literacy as centered covariates analyzed whether trust in science and scientific literacy interacted with presence of science or type of cause to affect beliefs. This ANCOVA also included the interaction between the two centered covariates, the interaction between the two manipulated variables, as well as the

3-way interaction of each manipulated variable with both centered covariates, to assure that these interactions were not responsible for any significant effects.

Presence of scientific content. On average, participants rated articles that contained scientific content (N = 77, M = 3.641, SE = .116) as significantly more believable than those that lacked it (N = 71, M = 2.950, SE = .119), $F(1, 135) = 17.293$, $p < .001$, partial $\eta^2 = .114$. Furthermore, as indicated by a significant 2-way interaction between scientific content and trust in science, $F(1, 135) = 6.100$, $p = .015$, partial $\eta^2 = .043$, this effect was significantly stronger for participants high in trust in science than for those weak in trust in science. Figure 1 presents the means corresponding to this analysis. In contrast to the effects of trust in science, at one standard deviation above the marginal mean, participants believed significantly more in scientific articles (M = 3.889, SE = .184) than nonscientific articles (M = 2.752, SE = .169), $F(1, 135) = 20.578$, $p < .001$, partial $\eta^2 = .132$. Conversely, at one standard deviation below the marginal mean of trust in science, participants' belief ratings between scientific (M = 3.393, SE = .155) and nonscientific articles (M = 3.148, SE = .182) did not significantly differ, $F(1, 135) = 1.048$, $p = .308$, partial $\eta^2 = .008$. The main effect of trust in science was not significant, $F(1, 135) = .079$, $p = .779$, partial $\eta^2 = .001$. Scientific literacy had no significant direct effects, $F(1, 135) = 2.739$, $p = .100$, partial $\eta^2 = .020$, nor did it interact with the presence or lack of science to predict belief scores, $F(1, 135) = .704$, $p = 0.403$, partial $\eta^2 = .005$.

Type of cause. On average, participants did not significantly differ in their beliefs depending on the type of cause being claimed, $F(1, 135) = 3.481$, $p = .064$, partial $\eta^2 = .025$. However, as indicated by a significant 2-way interaction between type of cause and trust in science, trust in science significantly interacted with type of cause to predict belief scores, $F(1, 135) = 12.816$, $p < 0.001$, partial $\eta^2 = .087$. Figure 2 presents the means corresponding to this analysis. In contrast to the effects of trust of science, at one standard deviation above the mean, participants believed significantly more in articles containing an unintentional, natural cause (M = 3.781, SE = .174) than an intentional, human cause (M = 2.860, SE = .172), $F(1, 135)$ = 14.695, p < .001, partial η^2 = .098. Conversely, at one standard deviation below the mean of trust in science, participants' belief ratings of the articles did not significantly differ depending on its type of cause (Intentional, human: M = 3.424, SE = .174 vs. Unintentional, natural: M = 3.117, SE = .160), $F(1, 135)$ = 1.702, p = .194, partial η^2 = .012. Scientific literacy did not interact with type of cause to predict belief scores, $F(1, 135)$ = .574, p < 0.450, partial η^2 = .004.

Tests for additional interactions. As expected, presence of science did not significantly interact with type of cause to predict belief scores, $F(1, 135)$ = .190, p = .664, partial η^2 = .001. Likewise, trust in science did not significantly interact with scientific literacy to predict belief scores, $F(1, 135)$ = 3.049, p = .083, partial η^2 = .022. Furthermore, the 3-way interaction between trust in science, scientific literacy, and presence of scientific content did not significantly predict beliefs, $F(1, 135)$ = .010, p = .922, partial η^2 = .000. Similarly, the 3-way interaction between trust in science, scientific literacy, and type of cause did not significantly predict beliefs either, $F(1, 135)$ = .076, p = .784, partial η^2 = .001.

Discussion

In support of our first hypothesis, trust in science interacted with the presence or lack of scientific content, such that participants with high trust in science based their beliefs on the presence of scientific content more than did those with low trust in science. Furthermore, trust in science also interacted with the type of cause, such that participants with high trust in science believed more in articles with the unintentional, natural cause, whereas participants low in trust in science believed more in articles with the intentional, human cause. Scientific literacy, on the other hand, did not affect the influence of either presence of scientific content or type of cause on belief. Additionally, as expected, there were not significant 2-way interactions between either the independent variables (presence of science and type of cause) or between the covariates (trust in science and scientific literacy), nor were there any significant 3-way interactions.

Our findings suggest that trust in science can have both beneficial and detrimental effects on beliefs in conspiracy theories. The significant interaction of trust in science and type of cause suggests that trust in science can help people recognize and decide not to believe in conspiratorial information. However, the significant interaction of trust in science and presence of scientific content suggests that trust in science may force users to make belief judgments based off of the inclusion vs. exclusion of science. This is dangerous, given the high prevalence of scientific content in conspiracy theories.

Experiment 2

Overview

Experiment 2 did not look further into the possible benefits of trust in science, instead focusing solely on its negative effects, given the lack of research on this topic. Experiment 2 aimed to replicate the findings of Experiment 1 that trust in science can be detrimental and once again demonstrate that as trust in science decreases, so does the persuasive power of scientific content. Furthermore, Experiment 2 also aimed to test our second hypothesis, that trust in science interacts with the presence or lack of scientific content to determine the likelihood of dissemination of the information. We expected greater influence of scientific content on dissemination among information recipients with high (vs. low) trust in science. Experiment 2 was pre-registered with the Open Science Framework (https://OSF.IO/4XVYH).

Design

Experiment 2 used a 2 (presence of scientific content: present vs. absent) x continuous (trust in science and scientific literacy) between-subjects design.

Participants

Eighty-two Amazon Mechanical Turk workers participated in this experiment for $0.30. All participants were from the United States, spoke English, and had an approval rating on Amazon Mechanical Turk of 70% or higher. Nine participants were removed from analysis for failing at least one of two attention checks, resulting in a final sample size of $N = 73$. The sample was 42.5% female, with a mean age of 35.21 years.

Materials

Conspiratorial articles. Experiment 2 utilized only two articles, eliminating the variations in type of cause between articles. Instead, both articles claimed a human cause, ensuring that both of them were conspiratorial (English Oxford Living Dictionaries, 2018a; Hagen, 2018; Swami et al., 2014). Furthermore, two words were changed in both articles to state that the true origins of the virus were covered up by the government. This change aimed at increasing the conspiratorial nature of the articles, since governmental forces covering up information is central to many definitions of conspiracy theories (Panchenko, 2016).

Dissemination measure. We created the following dichotomous choice measure to determine whether participants would vote to disseminate the articles online:

> Before we continue, the researcher in charge of this study also teaches an online current-events (contemporary news, media) class. We would like to have a ballot as to whether different news articles might be of interest or value for such a class. Please vote on whether or not this article should be emailed out to all of the students as part of their participation in the class:
>
> - o I vote YES; I want this article sent to the students.
> - o I vote NO; I do not want this article sent to the students.

Participants' choices were scored by assigning a value of 1 to "Yes votes" and a value of 0 to "No votes".

Belief, trust in science, and scientific literacy measures. Experiment 2 used the same belief, trust in science, and scientific literacy scales as Experiment 1.

Procedure

Experiment 2 utilized the same procedure used in Study 1, with two exceptions. The first is there were two instead of four articles. The second is that, directly after completing the distraction questions and before seeing the belief measure, participants were presented with the dissemination choice and asked to vote on whether to disseminate the articles.

Results

Belief. As in Experiment 1, an analysis of covariance found that on average participants rated articles that contained scientific content (N = 34, M = 3.722, SE = .168) as significantly more believable than those that lacked it (N = 39, M = 3.084, SE = .148), $F(1, 65) = 8.142$, p = .006, partial η^2 = .111. Furthermore, participants' trust in science significantly interacted with the presence or lack of scientific content to predict belief in the information, $F(1, 65) = 6.570$, p = .013, partial η^2 = .092, but the main effect of trust in science was not significant, $F(1, 65) = .004$, p = .952, partial η^2 = .000. Figure 3 presents a visual representation of our analysis involving trust in science. At one standard deviation above the mean, participants believed significantly more in scientific articles (M = 4.035, SE = .291) than nonscientific articles (M = 2.756, SE = .202), $F(1, 65) = 13.078$, p = .001, partial η^2 = .167. Conversely, at one standard deviation below the mean of trust in science, participants' belief ratings between scientific (M = 3.409, SE = .245) and nonscientific articles (M = 3.412, SE = .201) did not differ, $F(1, 65) = .000$, p = .992, partial η^2 = .000. As in Experiment 1, scientific literacy had no significant main effect on belief: $F(1,65)$ = 1.017, p = 0.317, partial η^2 = .015, or interaction with presence of science: $F(1, 65) = .695$, p = .408, partial η^2 = .011. However, in contrast to Experiment 1, participants' trust in science significantly interacted with their scientific literacy to predict their belief scores, $F(1, 65)$ = 9.065, p = .004, partial η^2 = .122, such that participants higher in trust in science believed in articles less if their scientific literacy was higher than if it was lower. Contrarily, participants lower in trust in science believed in articles more if their scientific literacy was higher than if it was lower. The 3-way interaction between the covariates and presence of science was not significant, $F(1, 65) = .568$, p = .454, partial η^2 = .009.

Dissemination. A binary logistic regression found no significant differences in the percentage of participants who voted to disseminate the articles between those whose article contained science and those whose lacked it, Wald χ^2 (1) = 2.007, *B* = 1.073, *p* = .157. However, participants high in trust in science voted to disseminate scientific articles more often than non-scientific articles, as indicated by a significant 2-way interaction between trust in science and presence of scientific content, Wald χ^2 (1) = 4.673, *B* = 1.890, *p* = .031. There were no direct effects of trust in science, Wald χ^2 (1) = 1.551, *B* = -.505, *p* = .213. Scientific literacy had no significant main effect on dissemination: Wald χ^2 (1) = 1.294, *B* = -.435, *p* = .255, nor did it significantly interact with presence of science: Wald χ^2 (1) = .739 , *B* = -.616, *p* = .390. Additionally, trust in science did not interact with scientific literacy, Wald χ^2 (1) = 1.577, *B* = -.578, *p* = .209, nor did they interact with presence of science, 3-way interaction: Wald χ^2 (1) = 1.075, *B* = -.944, *p* = .300.

Discussion

Once again, we found evidence supporting our first hypothesis that trust in science moderates the persuasive power of scientific content on beliefs. Furthermore, we found evidence supporting our second hypothesis that trust in science also moderates the power of science on dissemination. There was no main effect for the presence of scientific content on dissemination, but its significant interaction with trust in science suggests that scientific content affects dissemination in highly trusting audiences. Additionally, against expectations, participants' trust in science and scientific literacy significantly interacted to predict belief ratings.

General Discussion

The results of Experiments 1and 2 supported our first hypothesis that trust in science can lull people into believing in conspiracy theories merely because they contain science. Experiment 1 also found support for the claim that trust in science can help people recognize and decide not to believe in conspiratorial information. The results for Experiment 1 suggest that trust in science may not be the answer to the rise of conspiratorial beliefs because it can have both beneficial and detrimental effects. Experiment 2 found support for our second hypothesis that trust in science can cause people to disseminate conspiratorial information if it contains scientific content. Lastly, an unexpected, significant interaction between trust in science and scientific literacy was found in Experiment 2 for belief. However, this effect was not found in Experiment 1, nor Experiment 2 for dissemination, making it difficult to draw conclusions regarding this interaction. Further research should investigate this link further.

Previous research has shown that numerous factors affect the belief and dissemination of conspiracy theories. Many of these factors are related to inherent, unchanging personality traits of individuals. Studies have demonstrated that people high in cognitive closure (Leman & Cinnirella, 2013) or anxious attachment style (Green & Douglas, 2018) are more likely to support conspiracy theories. However, the majority of research surrounding the dissuasion of conspiracy theories is related to reasoning about the theories' contents. Swami and colleagues used a verbal fluency task to force participants to think analytically about the contents of conspiracy theories (Swami et al., 2014). Participants who thought analytically about the contents reported less support for the theories than those who did not think analytically (Swami et al., 2014). Research has found that, when deciding whether information is conspiratorial or legitimate, audiences use additional factors, such as the strength of the consequences to reach their decision (Van Prooijen & Van Dijk, 2014). Lastly, although facts have been shown to be ineffective at dissuading conspiracy theories, framing of the theory's information has been shown to significantly predict conspiratorial beliefs (Swami et al., 2013). Throughout these factors there is a commonality: when deciding whether information is conspiratorial or legitimate, audiences reason about the theory's contents to reach their decision. Therefore, trust in science could make people more susceptible to conspiracy theories because it causes people to make legitimacy judgments based off the inclusion versus exclusion of science, as opposed to analyzing the information's contents. However, given that trust of science increased scrutiny of conspiratorial information in Experiment 1, this hypothesis is unlikely. People who trust science can invalidate conspiratorial contents but believe scientific-like contents, suggesting that they are able to analyze the information at hand.

Limitations and Future Directions

Both studies used epidemiological conspiracy theories. It is possible that science interacts differently with different types of conspiracy theories, given that some theories, such as epidemiological theories, are more prone to containing scientific content. Future studies should extend the generalizability of our findings with a variety of real-world theories. These studies should also aim to replicate the findings of trust in science increasing the persuasive power of science for both belief in and dissemination of conspiracy theories.

Conclusion

Trust in science is seen as the golden answer to the surge of conspiracy theories that has accompanied the rise of online communications. However, encouraging people to trust in science may not always have the desired effect. Although trust in science can seemingly decrease belief in conspiracy theories, it can also cause the opposite effect and increase belief in these dangerous theories, so long as they contain scientific content. Therefore, in the context of pseudo-scientific information, trust in science may be to conspiracy theories as water is to a grease-fire: it looks like the answer but can make the problem worse.

Figures

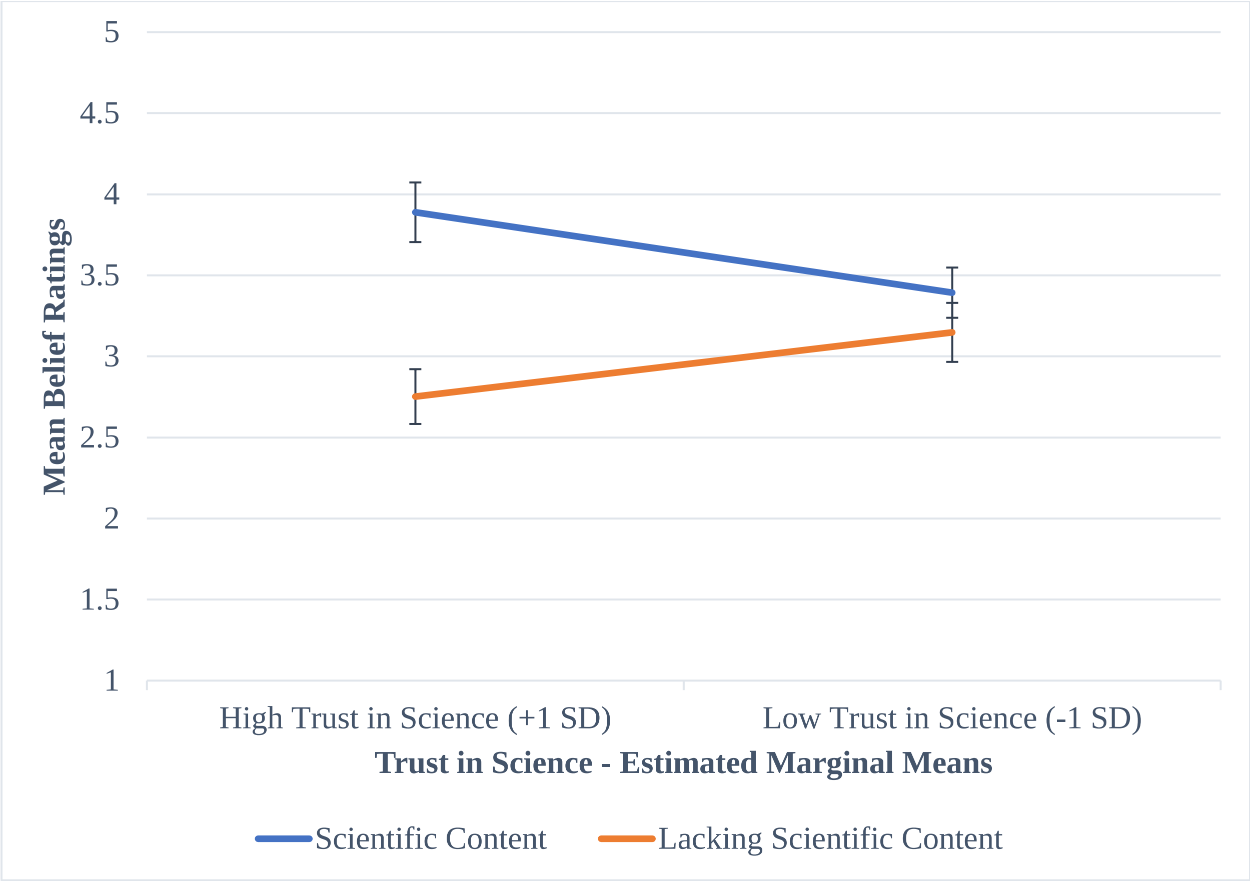

Figure 1. Study 1: The interaction of trust in science and presence of scientific content on mean belief ratings.

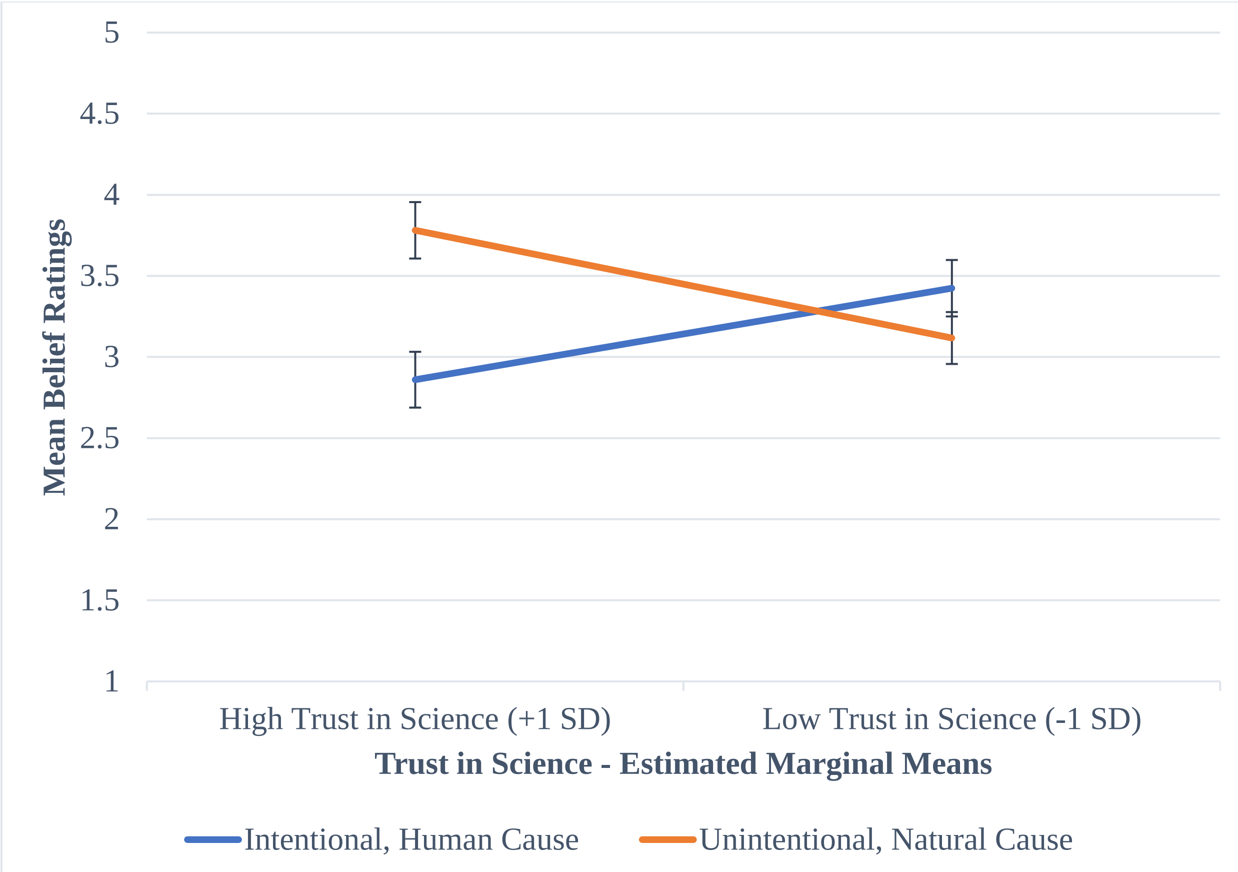

Figure 2. Study 1: The interaction of trust in science and type of cause on mean belief ratings.

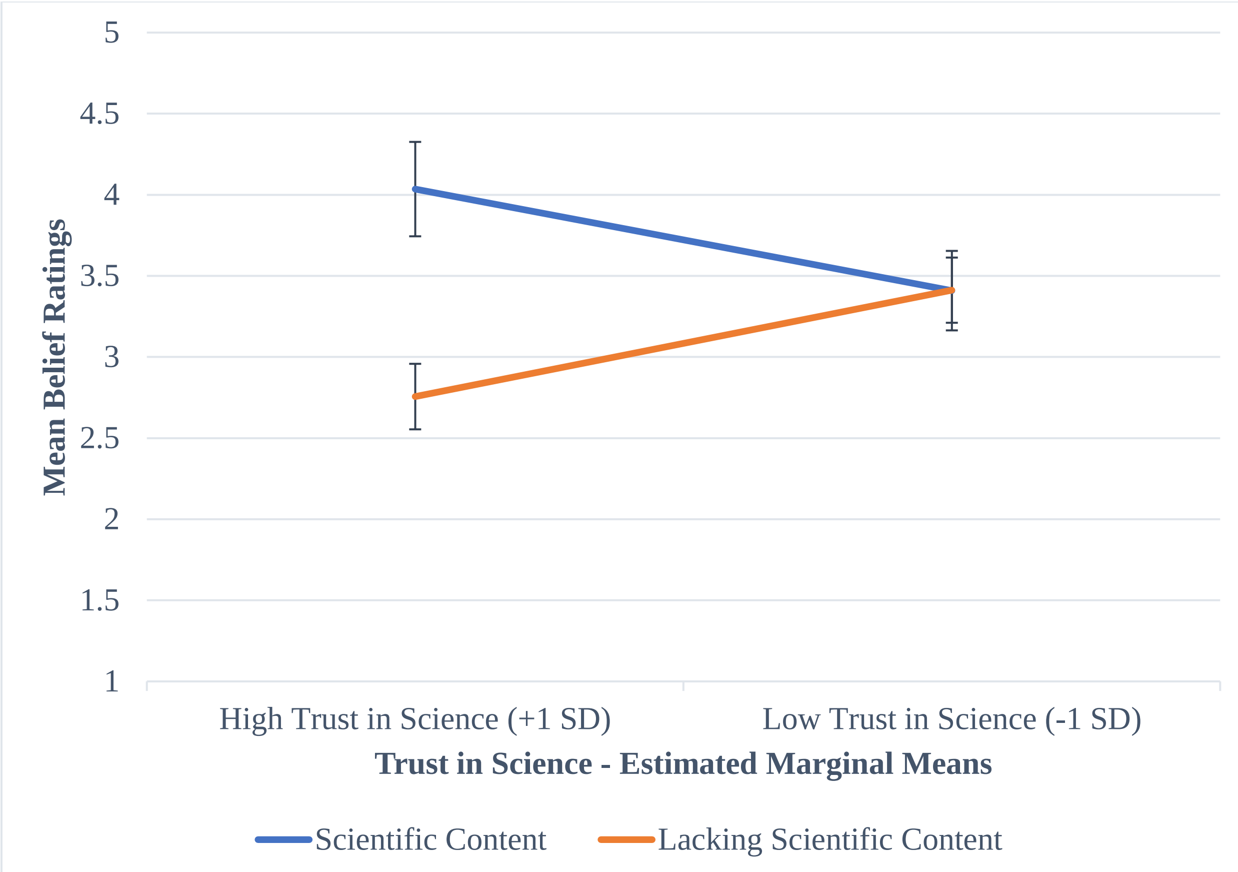

Figure 3. Study 2: The interaction of trust in science and presence of scientific content on mean belief ratings.

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Appendix A – Articles Containing Science

Article 1: Scientific Content x Human Cause

Studies at Princeton and Cambridge have reported that the Valza Virus was created by humans to be a biological weapon (Wyer et al., 2016; Petty & Cacioppo, 2016; Trope et al., 2016). According to this research, the structure of the virus is not a structure found in nature, as those who attempt to obscure the truth claim. Instead, the viral structure of the Valza Virus is one that is common in viruses that are engineered in a lab, often with the support of terrorist groups. There are many similarities with the manmade Citron Virus, which currently inhabits a well-guarded Federal lab and is used only for research purposes. Furthermore, the researchers claim that there is zero evidence that the Valza Virus occurred naturally, and that this misinformation was most likely created to cover up the true origins of the virus. Comments from Professor C. Stern, the epidemiologist analyzing this problem follow:

"Our research conclusively demonstrates that the Valza Virus does not have natural origins. We believe that the government created this incorrect theory to hide the virus's true origins from the general populous. Moreover, we have evidence that the Valza Virus shares many features with the Citron Virus, a lab virus used for experimental purposes. The structures of the viruses are similar, suggesting that the Valza Virus was created as a weapon, the consequences of which are dangerous for humanity. In conclusion, our evidence shows that there is absolutely no truth to the attempted governmental cover-up that claims that the Valza Virus came into being naturally."

Article 2: Scientific Content x Natural Cause

Studies at Harvard and Oxford have concluded that the viral structure of the Valza Virus is extremely similar to that of the Vilzi Virus (Hoffman, et al., 2016; Johnson and Watanabe, 2016; Radvansky et al., 2016). The studies have found zero evidence that the Valza Virus was manmade, as those who attempt to obscure the truth claim. The reports from these universities state that the extreme similarities of the Valza Virus to the pre-existing Vilzi Virus, a virus that only affects a Middle Eastern bat, mean that it most likely evolved through mutation from the Vilzi Virus. Furthermore, the researchers claim that there is nothing to suggest that the Valza Virus was manmade, and that this misinformation was most likely created to cover up the true origins of the virus. When asked about the origins of the Valza Virus, Dr. Jeremy Hoffman of Oxford University said:

"Our research conclusively demonstrates that the Valza Virus does not have manmade origins. We believe that the government created this incorrect theory to hide the virus's true origins from the general populous. Moreover, we have evidence that the Valza Virus clearly originated from the Vilzi virus. This virus only affects the parti-coloured bat, which is found primarily in the Middle East. Recently however, the virus mutated and this strain, deemed the Valza Virus, has brought pain and suffering upon all who encounter it. In conclusion, our evidence shows that there is absolutely no truth to the attempted governmental cover-up that claims that the Valza Virus came into being as a manmade creation."

Appendix B – Articles Lacking Science

Article 3: Lacking Scientific Content x Human Cause

It has been concluded by experts that the Valza Virus has manmade origins and not the natural origins that the people trying to cover up the truth claim. Outspoken activists for truth, Mark and Lauren Smith have been campaigning across the nation to tell people the true origins of the Valza Virus. They say there is zero reason to believe that the Valza Virus was naturally created and that this incorrect theory was created by the government with the intent to obscure the truth from the public. They claim that their sources tell them that the horrible Valza Virus was manmade by terrorists to attack those who they disagree with ideologically. When asked about the origins of the Valza Virus, Mark Smith said:

"The Valza Virus clearly has a manmade origin. We have thoroughly looked into the virus's origin and the evidence all conclusively points to a human cause. Furthermore, we have found evidence to suggest that those who claim that the virus has natural origins are doing so to hide its true origins from the general populous. The virus deemed the Valza Virus has brought pain and suffering upon all who encounter it, and the fact is: it came into being as a human creation. We believe that terrorists created this virus as a biological weapon which they have released upon the world. Lastly, there is absolutely no truth to the attempted governmental cover-up that claims that the Valza Virus came into being naturally."

Article 4: Lacking Scientific Content x Natural Cause

It has been concluded by experts that the Valza Virus came into being naturally and that it was not manmade as the people trying to cover up the truth claim. Outspoken activists for truth, Daniel and Mary Johnson have been campaigning across the nation to tell people the true origins of the Valza Virus. They say there is zero reason to believe that the Valza Virus was manmade and that this incorrect theory was created by the government with the intent to obscure the truth from the public. They claim that their sources tell them that the Valza Virus, while horrible, came into being completely on its own; the birth of the Valza Virus was unfortunate, but natural. When asked about the origins of the Valza Virus, Daniel Johnson said:

"The Valza Virus clearly has a natural origin. We have thoroughly looked into the virus's origin and the evidence all conclusively points to a natural cause. Furthermore, we have found evidence to suggest that those who claim that the virus has manmade origins are doing so to hide its true origins from the general populous. While the virus deemed the Valza Virus has brought pain and suffering upon all who encounter it, it does not change the facts: it came into being completely naturally. Lastly, there is absolutely no truth to the attempted governmental cover-up that claims that the Valza Virus came into being because of human intervention."

Appendix C – Belief Measure Items

1. The information in the article was strong.
2. I believe that the information in the article is probably true.
3. The article contained meaningful information.
4. The information in the article seemed credible.
5. The article was convincing.
6. The argument in the article seems plausible.

Appendix D – Trust in Science Items

1. Scientists usually act in a truthful manner and rarely forge results.
2. Science should be trusted blindly.
3. Scientists intentionally keep their work secret. *
4. The bible provides a stronger basis for understanding the world than science does. *
5. Scientific theories are trustworthy.
6. Scientific theories are often taken too seriously. *
7. Scientists' training should be sufficient to make audiences trust them.
8. Scientific theories do not matter very much because they can be wrong. *
9. Science is a trustworthy way to better understand the world we live in.
10. When scientists change their mind about a scientific idea it diminishes my trust in their work. *

Appendix E – Scientific Literacy Items

1) In an experiment, the independent variable is the one thing you:

- ○ a. Change/Manipulate
- ○ b. Keep the same/Do not manipulate
- ○ c. Investigate
- ○ d. Avoid

2) Creators of the Shake Weight, a moving dumbbell, claim that their product can produce "incredible strength!" Which of the additional information below would provide the strongest evidence supporting the effectiveness of the Shake Weight for increasing muscle strength?

- ○ a. Survey data indicates that on average, users of the Shake Weight report working out with the product 6 days per week, whereas users of standard dumbbells report working out 3 days per week.
- ○ b. Compared to a resting state, users of the Shake Weight had a 300% increase in blood flow to their muscles when using the product.
- ○ c. Survey data indicates that users of the Shake Weight reported significantly greater muscle tone compared to users of standard dumbbells.
- ○ d. Compared to users of standard dumbbells, users of the Shake Weight were able to lift weights that were significantly heavier at the end of an 8-week trial.

3) What is a hypothesis?

- ○ a. The right answer to an experiment
- ○ b. The wrong answer to an experiment
- ○ c. An educated guess made before testing
- ○ d. The true underlying effect of a variable

4) Which of the following is a valid scientific argument?

○ a. Measurements of sea level on the Gulf Coast taken this year are lower than normal; the average monthly measurements were almost 0.1 cm lower than normal in some areas. These facts prove that sea level rise is not a problem.

○ b. A strain of mice was genetically engineered to lack a certain gene, and the mice were unable to reproduce. Introduction of the gene back into the mutant mice restored their ability to reproduce. These facts indicate that the gene is essential for mouse reproduction.

○ c. A poll revealed that 34% of Americans believe that dinosaurs and early humans co-existed because fossil footprints of each species were found in the same location. This widespread belief is appropriate evidence to support the claim that humans did not evolve from ape ancestors.

○ d. This winter, the northeastern US received record amounts of snowfall, and the average monthly temperatures were more than 2°F lower than normal in some areas. These facts indicate that climate change is occurring.

5) Which of the following is false? (choose only 1 answer)

○ a. The scientific method helps protect science from bias.

○ b. Correlation does not imply causation.

○ c. Results from a single study can prove the existence of an effect.

○ d. Peer-reviewing scientific articles help scientists publish strong scientific work.

6) In an experiment, the variable that you measure is the:

○ a. Independent variable

○ b. Dependent variable

○ c. Controlled variable

○ d. Repeated trial

7) Which of the following research studies is **least likely** to contain a confounding factor (variable that provides an alternative explanation for results) in its design?

○ a. Researchers randomly assign participants to experimental and control groups. Females make up 35% of the experimental group and 75% of the control group.

○ b. To explore trends in the spiritual/religious beliefs of students attending U.S. universities, researchers survey a random selection of 500 freshmen at a small private university in the South.

○ c. To evaluate the effect of a new diet program, researchers compare weight loss between participants randomly assigned to treatment (diet) and control (no diet) groups, while controlling for average daily exercise and pre-diet weight.

○ d. Researchers tested the effectiveness of a new tree fertilizer on 10,000 saplings. Saplings in the control group (no fertilizer) were tested in the fall, whereas the treatment group (fertilizer) were tested the following spring.

8) A researcher hypothesizes that immunizations containing traces of mercury **do not** cause autism in children. Which of the following data provides the **strongest** test of this hypothesis?

○ a. A count of the number of children who were immunized and have autism

○ b. Yearly screening data on autism symptoms for immunized and non-immunized children from birth to age 12

○ c. Mean (average) rate of autism for children born in the United States

○ d. Mean (average) blood mercury concentration in children with autism