Cognitive substrates of belief in fake news

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Abstract

A number of cognitive factors are thought to influence susceptibility to belief in fake news, including an individual's tendency to engage in analytical thinking and actively open-minded thinking, trait levels of delusion-proneness, and trait levels of dogmatism. However, previous research has yet to examine the role of cognitive mechanisms that affect the probability that analytic thinking will be initiated (such as conflict monitoring and decision confidence), or that the initiation of analytic thinking will result in the selection of a normatively correct response (such as cognitive decoupling). Additionally, results suggesting that actively open-minded thinking, delusion-proneness, and dogmatism are related to belief in fake news have not been replicated to date. The present study seeks to address these research gaps by (1) exploring the effects of conflict monitoring, decision confidence, and cognitive decoupling on belief in fake news, and (2) attempting to replicate the results of previous research. Participants completed a Rapid Response Base-Rate Task assessing the effect of response conflict on engagement in analytic thinking and degree of decision confidence, a News Evaluation Task assessing belief in real and fake news, and several individual difference measures assessing analytic thinking, actively open-minded thinking, delusion-proneness, and dogmatism. The results of this study suggest that (1) a decreased effect of response conflict on confidence is correlated with belief in fake news (but not real news), (2) reduced decoupling efficiency is associated with increased belief in fake news (but not real news), (3) a reduced effect of response conflict on engagement in analytic thinking is associated with belief in fake news (but not real news), and (4) reduced engagement in actively

open-minded thinking and analytic thinking are correlated with belief in fake news. These findings indicate that inefficiencies in conflict processing and cognitive decoupling contribute to belief in fake news. Interventions that target these inefficiencies in vulnerable individuals may therefore decrease belief in fake news.

Keywords: fake news, analytic thinking, conflict processing, dual process reasoning, actively open-minded thinking, delusion-proneness, dogmatism

Introduction

A type of misinformation called fake news has recently proliferated across social media platforms like Facebook and Twitter. "Fake news" refers to fictitious news stories generated to advance an ideological agenda or increase financial gain, and presented in the style of real news items (Lazar et al., 2018). Notably, fake news regarding presidential candidates Hillary Clinton and Donald Trump was widely disseminated prior to the 2016 US Presidential Election (Pennycook et al., 2017). Fake news has also been leveraged to sway public opinion about topics outside the political sphere, including nutrition, vaccinations, and stock values (Lazar et al., 2018).

The potential for fake news to influence beliefs on the population level stems partially from its mode of delivery. As social media sites have grown in popularity, an increasing number of Americans have begun to rely on them for updates on current events. As of 2016, 62 percent of US adults got news from social media and 18 percent indicated that they did so often (Gottfried & Shearer, 2016). In other words, a significant segment of the population is at risk of encountering fake news while searching for daily headlines.

Furthermore, even superficial encounters with fabricated news stories are often sufficient to instigate false belief. Mere exposure to fake news items has been found to increase people's perceptions of their accuracy (regardless of the ideological bent of the content), with each additional exposure further increasing the credulity of the falsified information (Pennycook et al., 2017). This effect holds when media content is explicitly tagged as disputed by third-party fact-checkers (Pennycook et al., 2017). Even when false information presented in a fake news story is unambiguously corrected later on, it continues to influence consumers' beliefs and belief-driven behaviors (Levy, 2017).

In short, the contemporary media climate promotes the spread of misinformation through fake news, with lasting effects on belief that may perpetuate maladaptive behaviors. It is therefore crucial to identify the cognitive substrates underlying belief in fake news. Beyond contributing to a broader theoretical understanding of the topic, this would facilitate the development of interventions to reduce the impact of fake news on public opinion.

Previous research examining the link between cognition and news belief has largely sought to determine whether individual differences in reasoning style influence a person's susceptibility to the effects of fake news. This work builds upon theories of dual process reasoning, which distinguish between two major types of reasoning. Type I reasoning, or "intuitive thinking", is autonomous processing that operates independently from working memory. Type II reasoning, or "analytic thinking", is a type of processing that depends upon working memory and supports hypothetical thought (Tversky & Kahneman, 1982; Evans & Stanovich 2013). Individuals who score higher on measures of analytic thinking can more accurately differentiate between real and fake news media

content (Pennycook & Rand, 2019; Ross et al, 2019). Consistent with this finding, interventions that prime critical thinking (Lutzke et al., 2019) or that encourage the adoption of a deliberative mindset (Grant et al., 2019) decrease judgments of veracity for fake news but not for real news. Directly manipulating engagement in analytic reasoning also has an effect on belief in fake news, suggesting a causal relationship between these two variables (Bago, Rand & Pennycook, 2020). In light of these findings, researchers have concluded that deficits in analytic thinking beget belief in fake news (Bago, Rand & Pennycook, 2020).

In addition, some work has been done to identify other traits that are associated with increased acceptance of the fabricated information presented in fake news media content. One of these traits, referred to here as "delusion-proneness", is the endorsement of delusion-like ideas (such as conspiracy theories) reflecting the subclinical expression of certain cognitive features of psychosis (Bronstein et al., 2019; see Van Os et al., 2000). Individuals with heightened delusion-proneness appear to have a generalized vulnerability to believe a range of unusual or implausible ideas— including conspiracy theories and paranormal phenomena— which might explain their susceptibility to fake news (Bronstein et al., 2019). Another trait associated with belief in fake news is reduced actively open-minded thinking (Bronstein et al., 2019). Actively open-minded thinking is closely related to analytic thinking; it comprises the dispositional tendencies to seek out evidence opposing one's own viewpoint (Stanovich & West, 1997) and to appropriately weight that evidence when forming and updating beliefs (Campitella & Gerrands, 2014). Thus, individuals who exhibit reduced actively open-minded thinking are likely generating fewer alternative ideas when presented with implausible content in fake news

articles, and may then underweight the alternatives they do generate during belief formation (Bronstein et al., 2019). A third trait predicting belief in fake news is dogmatism, or relatively unchangeable and unjustified certainty in one's beliefs (Altemeyer, 2002). Increased dogmatism overlaps definitionally with reduced actively open-minded thinking (see Stanovich & West, 1997) and has been correlated with reduced analytic thinking (Martin, 2008; Friedman & Jack, 2018), suggesting a potential common pathway of causality among these three constructs and false belief.

In addition to analytic thinking, actively open-minded thinking, delusion-proneness, and dogmatism, the present study considers other cognitive factors that might influence an individual's ability to discriminate real news from fake news. Notably, if analytic thinking has an effect on news belief, then cognitive mechanisms that influence analytic thinking can be expected to have downstream effects on belief in fake news.

One such mechanism, called "conflict monitoring", has been causally linked to analytic thinking. Recent research has proposed a multistage model of dual process reasoning in which problems requiring an individual to make a decision cue intuitive responses that come to mind with varying fluencies (Pennycook et al., 2015). A conflict monitoring process then checks whether the problem has cued competing responses (Pennycook et al., 2015). If this process detects conflict between intuitive responses, analytic thinking may be initiated, which may involve the generation and selection of less intuitive, alternative responses (Pennycook et al., 2015). Otherwise, the intuitive response that came to mind most fluently will be selected (Pennycook et al., 2015).

According to this model, failures at the stage of conflict monitoring create deficits in analytic thinking (Pennycook et al., 2015). As reduced analytic thinking predicts belief

in fake news, these failures may be expected to increase an individual's judgments of plausibility for fabricated information. More specifically, there are two main ways that conflict monitoring can break down. An individual can fail to detect a conflict between competing intuitive responses when, in fact, such a conflict exists (Pennycook et al., 2015). Alternatively, an individual can successfully detect a conflict but fail to adequately initiate analytic thinking in response (Pennycook et al., 2015). Either of these disruptions to the reasoning process is likely to impact an individual's ability to discern truth from fiction.

One particular variable that may influence the probability that the detection of response conflict will initiate analytic thinking— which would in turn protect against belief in fake news— is the effect of response conflict on an individual's subjective confidence in the response they select. Two convergent lines of research support this idea. The first finds that individuals are less confident in their intuitive responses when they implicitly register conflict between these responses and normative logical principles (De Neys et al., 2011). This suggests that the successful detection of response conflict during decision-making generally decreases a person's confidence in their decisions (De Neys et al., 2011). A second line of research proposes that lower decision confidence cues engagement in analytic thinking (Thompson & Morsanyi, 2012). Taken together, these findings indicate that a reduced impact of response conflict on decision confidence might limit engagement in analytic thinking, ultimately increasing belief in fake news.

Additionally, cognitive mechanisms that influence the probability that engagement of analytic reasoning during decision-making will result in the selection of a normatively correct response may have an effect on belief in fake news. To this point, the

multistage model of dual process reasoning theorizes that the engagement of analytic thinking can have one of two results (Pennycook et al., 2015). The individual might initiate the process of cognitive decoupling, in which they consider and ultimately select one of the alternatives to the most fluently generated intuitive response (Pennycook et al., 2015). Otherwise, they will rationalize and select this response despite the fact that it conflicts with other possible responses (Pennycook et al., 2015). In the case that intuitive responses conflict with normatively correct responses that come to mind with less fluency, successful cognitive decoupling is necessary to select a correct response. Thus, reduced decoupling efficiency can be expected to predict false belief, including belief in fake news.

The Present Study

The multistage model of dual process reasoning predicts several hypotheses. The first is that reduced effects of response conflict on decision confidence and analytic thinking will be correlated with belief in fake, but not real, news. The second is that reduced decoupling efficiency will be correlated with increased belief in fake, but not real, news. Finally, in line with previous research (Bronstein et al, 2019), this study tests the hypothesis that increased delusion-proneness, dogmatism, analytic thinking, and actively open-minded thinking will be associated with increased belief in fake news.

Method

Participants

A total of 96 subjects (including a mixture of students at a local university and members of the surrounding community) participated in this study in exchange for financial compensation ($30). Undergraduate and graduate students at the university were

overrepresented in the sample. Participants were recruited using posters and online advertising. Prior to enrollment in the study, all participants completed a brief survey over the phone to determine their eligibility. Individuals were considered eligible if they reported that they were fluent English speakers between the ages of 18 and 40 with no self-reported history of psychopathology, brain surgery, or traumatic brain injury (i.e. concussions). Demographic information can be seen in Table 1.

Table 1.

Demographic Information

Demographic	**Subsample 1**	**Subsample 2**
Age	23.99 (*SD* = 5.57)	24.12 (*SD* = 5.82)
Gender	Male: 40 | Female: 56	Male: 44 | Female: 52
Race		
White/Caucasian	45	41
Black/African American	20	22
Asian	28	32
Pacific Islander	2	1
Native American	1	0
Hispanic	Yes: 10 | No: 86	Yes: 9 | No: 87
Level of Education		

GED	0	2
High School Graduate	18	17
Some College, No Degree	30	31
Associates Degree	2	4
Bachelors	27	28
Masters	14	11
PhD/Prof. Degree	5	3
Native English Speaker	Yes: 74 | No: 22	Yes: 75 | No: 21
Family History of Receiving Psychiatric Care	Yes: 17 | No: 79	Yes: 20 | No: 76

Note. Subsample 1 = individuals included in analyses using the Rapid Response Base-Rate Task. Subsample 2 = individuals included in analyses using the Rethinking Paradigm. In both overlapping subsamples, $n = 96$.

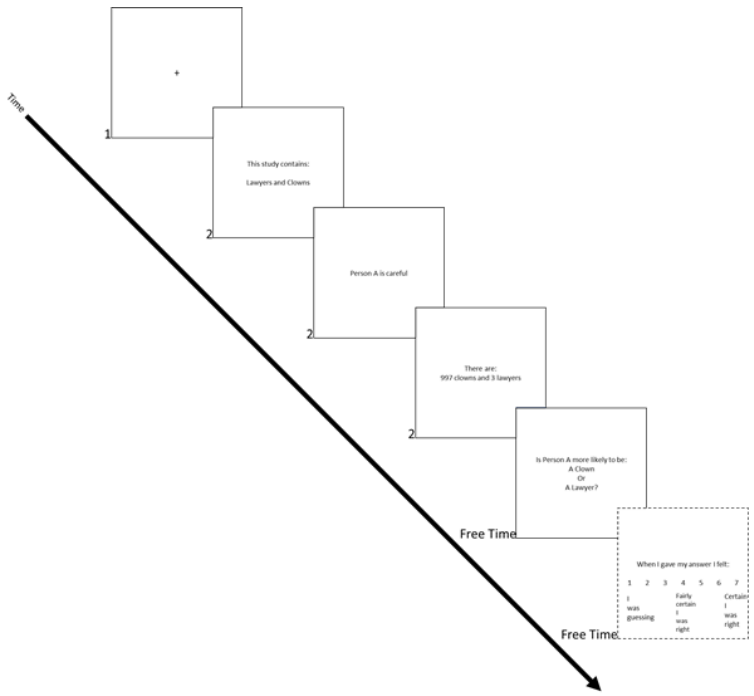
Rapid Response Base-Rate Task (Pennycook)

The Rapid Response Base-Rate Task (Pennycook et al., 2014) was administered to participants in this study. Each problem in the task featured a sample of 1,000 individuals divided into two social groups. Participants were told about a fictional person and asked to indicate to which of these two groups the person most likely belonged. Two sources of information were provided on which participants could base this decision. The first was a personality trait of the fictional person (for example: “Person A is intelligent”). The second was the base-rate of each group within the broader sample of

1,000 people (for example: “There are 5 farmers and 995 doctors”). The personality trait of the fictional person was based on a stereotype about one of the two groups (for example: “Doctors are intelligent”). The saliency of these stereotypes was evaluated via a large pretest (Pennycook & Rand, 2018).

In this study, participants completed 132 base rate problems. Problems were presented in a random order using the PsychToolbox package for MatLab. In each problem, participants were first rapidly shown one-word descriptions of two social groups, a personality trait of a fictional person, and the base-rates of the two groups. Each of these pieces of information remained on the screen for two seconds. Participants were then asked to decide which of the two groups the fictional person was most likely to belong to. Unlimited time was allowed to provide a response, but participants were urged to respond as quickly as possible and response time was recorded. A diagram of the task procedure can be seen in Figure 1.

Figure 1. Rapid Response Base-Rate Task procedure. Text at panel corners denotes durations of stimulus presentation. Dashed lines = shown to a subset of participants. An incongruent problem is depicted.



The Rapid Response Base-Rate Task contained two types of problems: congruent and incongruent. In congruent problems, the stereotype information suggested that the fictional person belonged to the social group with the higher base-rate. Thus, the stereotype information and the base rate information were designed to cue the same intuitive response. In incongruent problems, the stereotype information suggested that the fictional person belonged to the social group with the lower base-rate. Thus, the two sources of information provided to participants conflicted and likely cued competing intuitive responses.

Additionally, in both types of problems, stereotype information was designed to cue intuitive responses that would come to mind more fluently than responses cued by base-rate information. Thus, engagement in analytic thinking and successful cognitive decoupling were thought to facilitate the selection of base-rate-consistent responses to incongruent problems. As such, throughout the task, engagement in analytic thinking due to response conflict was calculated as the difference between average response times for stereotype-consistent responses to incongruent problems and information-consistent responses to congruent problems. Decoupling efficiency was calculated as the difference between average response time for base-rate consistent answers to incongruent problems and average response time for information-consistent answers to congruent problems.

A subset of participants (58 in total) completed an additional measure of response confidence on each problem. After providing an initial response, these participants were asked to rate their confidence in the decision they had just made on a 7-point scale (1 = “Guessing,” 7 = “Certain I’m Right). Unlimited time was allowed for this response. For

those participants that completed this measure, percent change in confidence due to conflict— the difference in response confidence for problems intended to cue competing responses (incongruent problems) compared to problems intended not to cue competing responses (congruent problems)— was calculated as the percent change in confidence between stereotype-consistent answers to incongruent problems and information-consistent answers to congruent problems. Confidence in information-consistent answers to congruent problems was used as the divisor in this calculation. A greater percent-change indicated a greater decrease in confidence due to the presence of information cueing competing responses (De Neys, Cromheeke, & Osman, 2011).

Participant data were included in statistical analyses if the participant provided correct responses on at least 80 percent of congruent trials and if they provided at least two responses that were consistent with base-rate information and two that were consistent with stereotype information on incongruent trials.

News Evaluation Task

The news evaluation task (Pennycook & Rand, 2019) assessed belief in real and fake news, where fake news is false information presented as truth by a news source. Individuals were presented with 12 real and 12 fake news headlines in random order and formatted to mimic typical social media posts (each headline was accompanied by a photo and a brief caption). Example stimuli can be seen in Figure 2. Fake news headlines were political headlines judged false by Snopes.com (a popular fact checking website). Real news headlines were selected from articles published by credible mainstream media sources at around the same that fake news articles were circulated. According to a large pretest, real and fake news headlines made an equal number of pro-Democrat and pro-

Republican claims (Pennycook & Rand, 2018b). After viewing each headline, participants indicated the degree to which they believed it represented something that actually happened. Ratings were made on a 4-point scale (1 = *Not at all accurate*, 4 = *Very accurate*). A higher average across ratings for all real news headlines indicated greater belief in real news, while a higher average across ratings for all fake news headlines indicated greater belief in fake news. These averages were also used to compute bias and sensitivity metrics. News bias, or an individual's propensity to believe all news media content (regardless of its veracity) with which they were presented, was calculated as the sum of the z-scores of average ratings for all headlines. News sensitivity, or an individual's propensity to selectively endorse either real or fake news, was calculated as the difference between the z-scores of average ratings for real news headlines and average ratings for fake news headlines. The internal consistency (omega) for ratings of real ($\omega_t = .82$) and fake ($\omega_t = .82$) news stories was good.

Figure 2. News Evaluation Task stimuli

Delusion-Proneness (PDI)

The Peters et al. Delusion Inventory (PDI; Peters, Joseph, Day, & Garety, 2004; example item: "Do you ever feel as if there is a conspiracy against you?") measured delusion-proneness, or the degree of delusion-like ideation an individual experiences. Individuals responded to 21 items, each of which asked whether they had ever had a particular delusion-like experience. For items that individuals endorsed, they were asked to indicate how distressing (1 = *Not distressing at all*, 5 = *Very distressing*), preoccupying (1 = *Hardly ever think about it*, 5 = *Think about it all the time*), and convincing (1 = *Don't believe it's true*, 5 = *Believe it's absolutely true*) they perceived this experience to be using three separate five-point scales. To score this measure of delusion-like ideation, the number of experiences that an individual endorsed was summed with their ratings of distress, preoccupation, and conviction associated with those experiences to produce a total score. The internal consistency (omega) of the PDI-21 in this study was good ($\omega_t = .82$).

Dogmatism

The dogmatism scale (DOG; Altemeyer, 2002) asked individuals to report the degree to which they agreed with each of 20 items on a nine-point scale (example item: "The things I believe in are so completely true, I could never doubt them"). The sum of these ratings (after items were reverse-scored as appropriate) was used to measure dogmatism, or relatively unchangeable and unjustified certainty in one's beliefs (Altemeyer, 2002). Higher scores indicated greater dogmatism. Items on the scale did not contain markers of specific ideologies so as to capture dogmatism independent of a person's beliefs,

including their political stance (Altemeyer, 2002). Multiple studies have confirmed that the DOG scale is a valid measure of dogmatism (Altemeyer, 2002, Crowson et al., 2008). The internal consistency (omega) of the DOG scale in this study was excellent ($\omega_t = .92$).

Analytic Reasoning Engagement

The present study employed a version of the Cognitive Reflection Test (CRT) that comprised three items from the original CRT (Shenhav, Rand, & Greene, 2012) and four items from the non-numeric CRT (Thomson & Oppenheimer, 2016). The total number of correct answers a participant provided to these seven items was used to measure their tendency to override incorrect intuitive responses with correct responses reached through analytic reasoning (Thomson & Oppenheimer, 2016). The version of the CRT used in this study included the following items: (1) "The ages of Mark and Adam add up to 28 years total. Mark is 20 years older than Adam. How many years old is Adam?"; (2) "If it takes 10 seconds for 10 printers to print out 10 pages of paper, how many seconds will it take 50 printers to print out 50 pages of paper?"; (3) "On a loaf of bread, there is a patch of mold. Every day, the patch doubles in size. If it takes 40 days for the patch to cover the entire loaf of bread, how many days would it take for the patch to cover half of the loaf of bread?"; (4) "If you're running a race and you pass the person in second place, what place are you in?"; (5) "A farmer had 15 sheep and all but 8 died. How many are left? (6) Emily's father has three daughters. The first two are named April and May. What is the third daughter's name?"; (7) "How many cubic feet of dirt are there in a hole that is 3' deep x 3' wide x 3' long?" The internal consistency (omega) of the CRT in this study was good ($\omega_t = .85$).

Actively Open-Minded Thinking

A truncated version of the actively open-minded thinking scale (AOT; Pennycook, Cheyne, Koehler, & Fugelsang, 2019) asked individuals to report the degree to which they agreed with each of eight items on a 6-point scale (example item: "A person should always consider new possibilities"). The sum of these ratings was used to measure actively open-minded thinking, or the dispositional tendencies to seek out evidence opposing one's own viewpoint (Stanovich & West, 1997) and to appropriately weight that evidence when forming and updating beliefs (Campitella & Gerrands, 2014). Higher scores (after items are reverse-scored as appropriate) indicated greater actively open-minded thinking. The truncated version of the scale included the following items (items 3,4,5,7, and 8 are reverse-scored): (1) A person should always consider new possibilities; (2) People should always take into consideration evidence that goes against their beliefs; (3) It is important to persevere in your beliefs even when evidence is brought to bear against them; (4) Certain beliefs are just too important to abandon no matter how good a case can be made against them; (5) One should disregard evidence that conflicts with your established beliefs; (6) Beliefs should always be revised in response to new information or evidence; (7) No one can talk me out of something I know is right; (8) I believe that loyalty to one's ideals and principles is more important than "open-mindedness". The internal consistency (omega) of the AOT scale in this study was good ($\omega_t = .83$).

Procedure

Participants provided informed consent in accordance with the guidelines of the Yale Institutional Review Board. They were then administered the Rapid Response Base-Rate Task, followed by the remaining individual difference measures (the News Discrimination Task, measures of dogmatism and delusion-proneness, the Cognitive Reflection Test, and the Actively Open-Minded Thinking Scale) in randomized order. Completing these tasks took approximately ninety minutes. This procedure took place as part of a larger study, in which participants also completed the Rethinking Paradigm (Thompson et al., 2011) and additional individual difference measures. The results of these measures are beyond the scope of the present study. However, the present study analyzed data provided by all participants in the larger study that completed measures of delusion-proneness, dogmatism, actively open-minded thinking, and analytic reasoning engagement (N = 117).

Statistical Analysis

Participant data were analyzed using non-parametric correlations (Spearman's Rho) and multiple regression models. Non-parametric correlations were selected because the data do not fall on a normal distribution. For all analyses, outliers were detected using the method of Hubert & Van Der Veeken (2008). Detected outliers were winsorized (Fuller, 1991).

Results

Rapid Response Base-Rate Task and News Evaluation Task

Analytic thinking engagement due to response conflict was negatively correlated with belief in fake news, $\rho(94) = -0.28$, $p = 0.01$, but had no significant relationship to belief in

real news, $\rho(94) = 0.05$, $p = 0.61$. Reduced decoupling efficiency was moderately positively correlated with belief in fake news $\rho(94) = 0.23$, $p = 0.03$, but had no significant relationship to belief in real news, $\rho(94) = -0.02$, $p = 0.84$. Similarly, percent change in confidence due to response conflict was negatively correlated with belief in fake news $\rho(94) = -0.35$, $p = 0.01$, but had no significant relationship to belief in real news $\rho(94) = 0.03$, $p = 0.83$.

As a consequence, analytic thinking engagement due to response conflict was positively correlated with news sensitivity, $\rho(94) = 0.28$, $p = 0.01$, although it did not have a significant relationship with news bias, $\rho(94) = -0.14$, $p = 0.19$. Reduced decoupling efficiency was also positively correlated with news sensitivity, $\rho(94) = -0.20$, $p = .05$, but did not have a significant relationship with news bias, $\rho(94) = 0.12$, $p = 0.24$. Finally, percent change in confidence due to response conflict did not have a significant relationship with either news sensitivity $\rho(94) = 0.25$, $p = 0.06$, or news bias, $\rho(94) = -0.17$, $p = 0.21$.

Additionally, when belief in fake news was entered into a multiple regression model as the criterion variable, with decoupling efficiency and engagement in analytic thinking due to response conflict as predictor variables, decoupling efficiency and engagement in analytic thinking due to response conflict significantly predicted belief in fake news, $F(2,93) = 4.30$, $p = 0.02$. This model explained 6.5% of the variance in belief in fake news. While decoupling efficiency contributed significantly to the model ($B = 0.09$, $p = 0.02$), engagement in analytic thinking due to response conflict did not ($B = -0.07$, $p = 0.10$). The final predictive model was: belief in fake news = 1.98 + (-0.07*engagement in

analytic thinking due to response conflict) + (0.09*decoupling efficiency). In contrast, when news sensitivity was entered into a multiple regression model as the criterion variable, with decoupling efficiency and engagement in analytic thinking due to response conflict as predictor variables, decoupling efficiency and engagement in analytic thinking due to response conflict did not significantly predict news sensitivity, $F(2,93) = 2.28$, $p =$ 011. Similarly, when news bias was entered into a multiple regression model as the criterion variable, with decoupling efficiency and engagement in analytic thinking due to response conflict as criterion variables, decoupling efficiency and engagement in analytic thinking due to response conflict did not significantly predict news bias, $F(2,93) = 2.43$, $p = 0.09$.

Attempted Replication of Previous Research

In contrast to the results of previous research, delusion-proneness was not significantly correlated with belief in fake news, $\rho(115) = 0.16$, $p = 0.09$, or real news, $\rho(115) = 0.11$, $p = 0.22$. Similarly, dogmatism was not significantly correlated with belief in fake news, $\rho(115) = 0.06$, $p = 0.55$, or real news, $\rho(115) = -0.10$, $p = 030$. Cognitive Reflection Test scores, however, was moderately negatively correlated with belief in fake news, $\rho(115) = -0.18$, $p = 0.05$, and positively correlated with belief in real news, $\rho(115) = 0.24$, $p = 0.01$, as expected based on previous research. Actively open-minded thinking was also positively correlated with belief in real news as expected $\rho(115) = 0.20$, $p = 0.07$, but had no significant relationship to belief in real news, $\rho(115) = -0.17$, $p = 0.04$.

Discussion

The results of the present study support several conclusions about the relationship between cognition and belief in fake news. First, this study finds that a decreased effect of response conflict on confidence is correlated with belief in fake news (but not real news). Additionally, the results of this study suggest that reduced decoupling efficiency is associated with increased belief in fake news (but not real news), independent of the effects of engagement in analytic thinking due to response conflict on news belief. Similarly, the results suggest that a reduced effect of response conflict on engagement in analytic thinking is associated with belief in fake news (but not real news), although this effect did not remain significant when controlling for the effect of decoupling efficiency on fake news belief. Finally, the results of this study were consistent with previous research indicating that reduced engagement in actively open-minded thinking and analytic thinking are correlated with belief in fake news, but inconsistent with the previous finding that individuals with heightened trait levels of delusion-proneness and dogmatism are more likely to believe fake news.

These results are consistent with a model of belief formation that implicates inefficiencies in conflict processing in the formation of false beliefs, including belief in fake news. Previous research on the relationship between cognitive style and news belief indicates that reduced engagement in analytic thinking promotes belief in fake news (Bago, Rand & Pennycook, 2020). However, no study to date has empirically examined the role of cognitive mechanisms that might drive engagement in analytic thinking. The present study attempts to address this research gap, drawing on theoretical work proposing that analytic thinking can be initiated as part of a multistage reasoning process,

with failures at the conflict monitoring stage resulting in reduced analytic thinking (Pennycook et al., 2015). This study found that two discrete indices of inefficiency in conflict monitoring— less engagement in analytic thinking due to response conflict and a reduced effect of response conflict on decision confidence— each predicted belief in fake news. Given that conflict monitoring may initiate analytic thinking and that analytic thinking may protect against belief in fake news, these results suggest that impaired conflict monitoring may constitute a mechanism of action contributing to the formation of beliefs based on fake news media content. As the analyses performed in this study were correlational, further research is needed to investigate whether there is also a causal relationship between conflict processing and belief formation. A study testing the effects of a direct manipulation of efficiency in conflict processing on belief in fake news might be particularly useful in addressing this question. For example, Pennycook et al., 2015 speculates that the extreme base-rates (5/1,000 and 995/1,000) used in the Rapid Response Base-Rate Task may facilitate successful conflict detection in the majority of participants; if this is true, varying the base rates used in the task might have a direct effect on the efficiency with which participants can detect response conflict. An investigation of the effect of this manipulation on belief in fake news might further contribute to a theoretical understanding of the relationship between conflict processing and belief in fake news.

The results of this study also support the theoretical integration of research pertaining to cognitive decoupling with current models of false belief formation. Previous research linking reduced analytic thinking to belief in fake news treated analytic thinking as a uniform construct. In contrast, the multistage model of dual process reasoning

proposes that two subsidiary cognitive mechanisms—rationalization and cognitive decoupling—can operate during engagement in analytic thinking, and each may influence response selection independently from the other (Pennycook et al., 2015). In particular, successful decoupling may encourage the selection of a normatively correct response when fluently generated intuitive responses conflict with normative logical principles (Pennycook et al., 2015). The present study therefore isolated the effect of cognitive decoupling on news belief, finding that reduced decoupling efficiency was associated with belief in fake news. This result suggests that decoupling efficiency during analytic thinking may have a discrete impact on the formation of belief formation, such that inefficient decoupling contributes to the formation of some false beliefs, including the endorsement of some fake news media content. Again, further research is needed to investigate the possibility of a causal relationship between these variables; to this end, a study testing the effects of a direct manipulation of efficiency in cognitive decoupling on belief in fake news may be useful. De Neys and colleagues propose that inhibiting intuitive responses during cognitive decoupling requires more cognitive resources than initially selecting or rationalizing an intuitive response (De Neys & Franssens, 2009). Thus, increasing participants' cognitive load while they complete the Rapid Response Base-Rate Task (or a similar task) may allow for the direct manipulation of efficiency in cognitive decoupling. Future research employing this methodology might therefore help to clarify the nature of the relationship between cognitive decoupling and belief in fake news.

Finally, the results of the present study are inconsistent with previous findings that individuals with higher trait levels of delusion-proneness and dogmatism are more

likely to believe in fake news. This may reflect the fact that previous findings were not generalizable to the population sample that participated in the present study. However, methodological differences between past and present research also may have contributed to the discrepancy in study outcomes. Notably, past research recruited an unselected sample of participants (Bronstein et al., 2019), while the present study excluded participants who self-reported a history of psychopathology and were therefore at the greatest risk for expressing high trait levels of traits like delusion-proneness. As a result, there may have been less variance in individual differences within the group of individuals participating in this study than in the general population. Statistical analyses that depended on variance in individual differences to find significant effects-- such as those probing relationships between delusion-proneness, dogmatism, and fake news-- may not have identified statistically significant relationships between variables due to this feature of the population group tested in the present study. Furthermore, the high degree of comorbidity among most clinical disorders, including psychosis (Hayward & Moran, 2008), suggests that traits like delusion-proneness share variance with other traits that are commonly found in individuals with a history of psychopathology. For this reason, excluding individuals with a history of psychopathology from the present study likely altered the nature of the construct referred to throughout this paper as "delusion-proneness" and measured by the PDI.

In addition to advancing the current understanding of false belief formation on the level of theory, the research presented in this study can be used to inform interventions intended to combat fake news belief in the general population. Specifically, the results of this study suggest that interventions aiming to increase the impact of response conflict on

decision confidence, thereby increasing the probability that an individual engages in analytic thinking when evaluating the veracity of news media content, might discourage belief in fabricated news stories. Previous interventions, such as labels indicating that fake news items are disputed by fact-checkers, have often been found ineffective, perhaps because they target cognitive mechanisms that may only be engaged after conflict monitoring occurs in a sequential reasoning process (Pennycook et al., 2017). Interventions that interceded during the conflict monitoring stage may therefore represent more effective alternatives. Further research is needed to design and test such interventions.

The implications of the present research must be considered in light of several limitations of the methodology employed in this study. First, the group of individuals that participated in the study may not be representative of the general population in terms of their cognitive or behavioral responses to fake news. The outreach strategies used to recruit participants for this study largely targeted individuals from two populations: affiliates of a local private university and residents of the surrounding community. These two subgroups of participants may have significantly differed in socioeconomic status and education level. In 2016, the US Census reported that just under two thirds of American adults had not pursued postsecondary education (U.S. Census, 2017), meaning that education levels in the general population are lower on average than education levels among university-affiliated individuals, including undergraduate and graduate students. Furthermore, individuals enrolled in undergraduate and graduate university programs are more likely to come from families of higher socioeconomic status as compared to individuals who do not pursue postsecondary education (Young Adult, 2019). Therefore,

the participants in this study likely clustered around two opposing poles of education level and socioeconomic status. To the degree that these factors may be correlated with traits influencing fake news belief, the present research may not be generalizable to segments of the population falling in between these two poles, or to broader population samples. A future study could explore this possibility further by recruiting participants from a wider variety of social backgrounds and administering them the set of tasks used in the present study.

A second limitation pertains to the measure of decision confidence inserted into the Rapid Response Base-Rates task. This measure was added to the task partway through the study. As a result, 58 participants out of a total of 96 completed the measure, while the remaining 38 did not. Given the smaller sample size for data related to decision confidence, results involving this measure were more likely to reflect the influence of sample-specific noise, and therefore less likely to be generalizable to population groups not tested in this study. Future research could address this concern by testing the measure of decision confidence employed in this study on a larger sample of participants. Examining the relationship between decision confidence and fake news remains particularly relevant in consideration of previous research finding an effect of decision confidence on engagement in analytic thinking, which strongly suggests a potential common causal pathway between these three variables (Thompson & Morsanyi, 2012).

Despite these methodological limitations, the present study contributes to the current corpus of research on fake news by identifying several cognitive mechanisms— conflict processing and cognitive decoupling— that may contribute to the formation of false beliefs, including belief in fake news media content. These findings suggest

potential directions for the development of new interventions to reduce the impact of fake news on beliefs. Future research building upon this work may therefore help to prevent the social impact of economic, political, and personal choices driven by belief in fake news.

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