RUNNING HEAD: Epistemic rationality

Epistemic Rationality: Skepticism toward Unfounded Beliefs Requires Sufficient Cognitive Ability and Motivation to be Rational

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Abstract

Why does belief in the paranormal, conspiracy theories, and various other phenomena that are not backed up by evidence remain widespread in modern society? In the present research we adopt an individual difference approach, as we seek to identify psychological precursors of skepticism toward unfounded beliefs. We propose that part of the reason why unfounded beliefs are so widespread is because skepticism requires both sufficient analytic skills, and the motivation to form beliefs on rational grounds. In Study 1 we show that analytic thinking is associated with a lower inclination to believe various conspiracy theories, and paranormal phenomena, but only among individuals who strongly value epistemic rationality. We replicate this effect on paranormal belief, but not conspiracy beliefs, in Study 2. We also provide evidence suggesting that general cognitive ability, rather than analytic cognitive style, is the underlying facet of analytic thinking that is responsible for these effects.

Keywords: Paranormal belief; conspiracy belief; cognitive ability; analytic cognitive style; epistemic rationality; importance of rationality.

Epistemic Rationality: Skepticism toward Unfounded Beliefs Requires Sufficient Cognitive Ability and Motivation to be Rational

People often believe strange things. According to a 2013 poll, 37% of Americans believe that global warming is a hoax, 21% believe that a UFO crashed in Roswell, 20% think that there is a relationship between vaccines and autism, and 15% believe that the medical and pharmaceutical industry create new diseases to sell the cure (Van der Linden, 2015). Conspiracy theories of this kind are by no means the only domain with well-subscribed unfounded beliefs. According to a 2015 poll, 71% of Americans believe in miracles, 42% believe in ghosts, 41% believe in extrasensory perception, and 29% believe in astrology (Van der Linden, 2015). These figures are in line with scientific studies that assessed nationally representative samples (Oliver & Wood, 2014), and underscore that unfounded beliefs are not pathological, but are common among regular citizens. Furthermore, unfounded beliefs predict a range of maladaptive perceptions and behaviors, including poor health choices (e.g., vaccine refusal; preference for alternative instead of regular medical approaches), climate change denial, decreased civic virtue, aggression, and ideological radicalization (Abalakina-Paap, Stephan, Craig, & Gregory, 1999; Asser & Swan, 1998; Goertzel, 1994; Grebe & Natrass, 2012; Jolley & Douglas, 2014; Nahin, Barness, Stussman, & Bloom, 2009; Shermer, 2011; Van Prooijen, Krouwel, Pollet, 2015)

What makes people believe in conspiracy theories and paranormal phenomena that are not backed up by any evidence? One pertinent insight in this research domain is that one unfounded belief predicts other unfounded beliefs. For instance, an excellent predictor of belief in one conspiracy theory is belief in different, conceptually unrelated conspiracy theories (Goertzel, 1994; Lewandowsky, Oberauer, & Gignac, 2013; Swami et al., 2010, 2011; Van Prooijen et al., 2015; Wood, Douglas, & Sutton, 2012). Furthermore, belief in conspiracy

theories strongly predicts other types of unfounded beliefs, including belief in magic, superstition, and the supernatural (Darwin, Neave, & Holmes, 2011; Lobato, Mendoza, Sims, & Chin, 2014; Newheiser, Farias, & Tausch, 2011). People hence differ in their general susceptibility to beliefs for which there is little to no evidence. This suggests that although unfounded beliefs can differ widely in content, the general tendency to endorse such beliefs may be grounded in identifiable and relatively stable psychological processes. Indeed, numerous factors contribute to irrational beliefs, including need for control (Kay, Gaucher, McGregor, & Nash, 2010; Van Prooijen & Acker, 2015; Whitson & Galinsky, 2008), uncertainty (Hogg, Adelman, & Blagg, 2010; Van Prooijen & Jostmann, 2013), and illusory pattern perception (Blackmore & Trościanko, 1985; Van Prooijen, Douglas, & De Inocencio, in press).

One individual difference factor that has received considerable attention in attempts to explain various unfounded beliefs is analytic thinking -- the tendency to reflect on problems that appear to have an intuitive correct answer (e.g., Pennycook, Cheyne, Seli, Koehler, & Fugelsang, 2012; Stanovich & West, 2008). There are several reasons to suspect that impoverished analytic thinking contributes to unfounded beliefs. First, widespread irrational beliefs often have strong intuitive appeal (e.g., Barrett, 2000, Norenzayan & Gervais, 2013). To the extent that people rely on intuitive rather than analytic thinking, they should therefore be more susceptible to ideas that seem intuitively plausible yet do not hold after careful scrutiny. Second, individuals with limited analytic thinking skills may be less able to discriminate between strong and weak evidence, and therefore be less skeptical toward ideas that are supported by anecdotal evidence and innuendo. Research has demonstrated that individuals who rely less on analytic thinking are indeed more inclined to believe in the paranormal (Hergovich & Arendasy, 2005; Musch & Ehrenberg, 2002), the supernatural (Gervais & Norenzayan, 2012; Pennycook et al., 2012), as well as various

conspiracy theories (Swami & Furnham, 2012; Swami, Voracek, Stieger, Tran, Furnham, 2014). Complementary findings indicate that lower education levels predict paranormal beliefs (Aarnio & Lindeman, 2005) and belief in conspiracy theories (Douglas, Sutton, Callan, Dawtry, & Harvey, 2016). The link between education and decreased belief in conspiracy theories is partly mediated by analytic thinking (Van Prooijen, 2017).

The present research expands on these insights by showing that analytic reasoning skills alone are not sufficient to promote skepticism toward unfounded beliefs; one also needs to value forming personal beliefs based on logic and evidence. We demonstrate this point in two studies, and in the context of two related but different types of unfounded beliefs: belief in the paranormal and conspiracy beliefs.

The Limits of Analytic Thinking

The literature discussed above suggests that analytic reasoning skills play an important role in preventing the spread of irrational beliefs. At the same time, there are good reasons to suspect that having the required reasoning skills is frequently not enough. First, a vast literature on attitude change suggests that having the necessary analytic skills does not ensure that people will scrutinize persuasive messages in a thorough manner (e.g., Chaiken, Liberman, & Eagly, 1989; Petty & Cacioppo, 1986). In the absence of strong motivation to scrutinize the persuasive message, people instead tend to rely on heuristic processing (Chaiken et al., 1989; cf., Petty & Cacioppo, 1986). Second, irrational beliefs are promoted by various epistemic and existential motives, such as the need for control (Van Prooijen & Acker, 2015; Whitson & Galinsky, 2008), uncertainty management (Van Prooijen & Jostmann, 2013), terror management (Newheiser et al., 2011), and ideology protection (Van Prooijen et al., 2015). This is important, as research on motivated reasoning (e.g., Kunda, 1990; Nickerson, 1998) has demonstrated that people are

generally biased in their reasoning when they favor a certain conclusion. In fact, evidence suggests that high cognitive ability can enhance motivated reasoning (Kahan, Peters, Dawson, & Slovic, 2017). Kahan and colleagues found that individuals who scored high on cognitive ability (numeracy) were particularly inclined to misinterpret scientific evidence that was inconsistent with their political views. This effect presumably emerged because participants with a high (vs. low) cognitive ability were better able to generate alternative (ideology-consistent) interpretations of the data.[1] Thus, it seems reasonable to suspect that strong analytic thinking skills are not sufficient to inoculate people against unfounded beliefs. They also need the motivation to use their reasoning skills in pursuit of the truth, rather than to use them in pursuit of belief confirmation, or to not use them at all. We propose that valuing epistemic rationality can serve this function.[2]

The Role of Valuing Epistemic Rationality

We suggest that valuing epistemic rationality can serve as a buffer against various unfounded beliefs, by increasing the likelihood that one's analytic thinking skills are recruited to objectively analyze the validity of ideas. Among individuals who do not strongly value epistemic rationality, by contrast, analytic thinking skills should have little effect on the rationality of their beliefs, because these skills are likely to either remain disengaged, or employed in pursuit of preferred conclusions rather than the truth (e.g., Kahan et al., 2017). Thus, we propose that a key difference between people who do versus do not strongly value epistemic rationality is that the former are more likely to respond to epistemic uncertainty by actively searching for truth, whereas the latter are more inclined to remain cognitively disengaged, or search for validation of their existing beliefs.

There are meaningful differences in the extent to which people value epistemic rationality. In fact, some people view it as a moral virtue to form and evaluate beliefs based on logic and evidence, and as a vice to rely on less rational processes (Ståhl, Zaal, & Skitka, 2016). Ståhl and his colleagues (2016) developed and validated two measures of individual differences in epistemic values: the Importance of Rationality Scale (IRS), and the Moralized Rationality Scale (MRS). The IRS centers on how important people think it is that *their own* beliefs are based on logic and evidence. Thus, the IRS measures the strength of one's preference to be epistemically rational. The MRS, on the other hand, measures to what extent people view it as a moral issue to be epistemically rational, and therefore the belief that *everyone should* rely on logic and evidence when forming and evaluating their beliefs. As should be expected, the IRS and MRS are positively related, yet clearly conceptually distinct (.*22* < *r*s < .43; Ståhl et al., 2016). Furthermore, the IRS and MRS are both negatively associated with beliefs that are not based on evidence, such as beliefs in the supernatural, and various paranormal phenomena (Ståhl et al., 2016). What is not clear, however, is whether valuing or moralizing epistemic rationality moderates the relationship between analytic reasoning skills and unfounded beliefs. Testing that idea empirically is the purpose of the present research.

We conducted two studies to examine whether analytic reasoning skills are more negatively associated with unfounded beliefs among those who strongly (vs. weakly) value or moralize rationality. In both studies we examined two domains of unfounded beliefs: the paranormal, and conspiracy theories. In Study 1 we examined whether analytic thinking--which we operationalized through general and validated measures of analytic cognitive style (i.e., the Cognitive Reflection Test)--and the extent to which one values/moralizes epistemic rationality, interactively predict belief in the paranormal and conspiracy theories. Study 2 served as an

extended replication of Study 1, with the goal to determine whether the effects of analytic thinking obtained are attributable specifically to differences in analytic cognitive style, cognitive ability, or both.

Study 1

Method

Sample, procedure, and materials. We requested 300 participants from Crowdflower, a crowdsourcing website similar to Amazon's Mechanical Turk (MTurk). Although we are not aware of any studies on the quality of data from Crowdflower, previous studies have demonstrated that the MTurk population is more representative than convenience samples frequently used in psychological research, and that MTurk data is at least as reliable as data from student samples (Berinsky, Huber, & Lenz, 2012; Buhrmester, Kwang, & Gosling, 2011; Casler, Bickel, & Hackett, 2013; Goodman, Cryder, & Cheema, 2012). Each participant received $ 0.75 for taking the survey. A substantial number of participants did not click through to the very last page of the survey. As a consequence, Crowdflower allowed participants to enter the survey even after we had reached the requested number, and we ended up with a total of 343 participants. All participants resided in the U.S. Sixty-two percent were female, 35% were male, and 3% did not report their gender (M_{age} = 35.41, SD = 12.01). Three percent reported having either no formal education or a primary level education, 36% had a high school degree, 47% had an undergraduate degree, and 14% had a graduate degree. Ten participants did not report their level of education.

Upon completing the informed consent form, participants took part in the online survey. The extent to which participants view epistemic rationality as *personally important* was measured using the six-item IRS (α = .85, Ståhl et al., 2016). An example item is: "It is important

to me personally to be skeptical about claims that are not backed up by evidence" (1 = *completely disagree*, 7 = *completely agree*). We also measured *moralization* of epistemic rationality, using the nine-item MRS (α = .82, Ståhl et al., 2016). An example item is: "Being skeptical about claims that are not backed up by evidence is a moral virtue" (1 = *completely disagree*, 7 = *completely agree*).

Analytic Cognitive Style (ACS) was measured using the 3-item Cognitive Reflection Test (CRT, Frederick, 2005), and the 4-item CRT-2 (Thomson & Oppenheimer, 2016). Scores on these two tests were highly correlated (r = .57, p < .001), and were therefore summed up to create a reliable measure of ACS (α = .77).

To measure *conspiracy beliefs*, we assessed participants' levels of belief (1 = *definitely not true*, 7 = *definitely true*) in nine well-known conspiracy theories (α = .87, Van Prooijen et al., in press). Example items are: "The U.S. government had advance knowledge of the 9/11 attacks", and "The moon landing was a hoax". We also used a validated 5-item scale of *conspiracy mentality*, which measures a general tendency to perceive a world filled with conspiracies (Bruder, Haffke, Neave, Nouripanah, & Imhoff, 2013; α = .90). Example items are: "There are secret organizations that greatly influence political decisions", and "Events which superficially seem to lack a connection are often the result of secret activities". The original scale was only slightly modified, in that we used a 7-point scale (1 = *certainly not*, 7 = *certainly*) rather than an 11-point scale in order to keep the same 7-point scale for all judgment items across our survey. To measure *paranormal belief*, we used the 6-item Paranormal Scale (α = .90, Orenstein, 2002). Participants were asked to indicate to what extent they believe in six common paranormal beliefs, including astrology, extra-sensory perception, and reincarnation. Again, we slightly modified the original measure by using a 7- rather than 4-point scale (1 = *definitely not*,

7 = *yes, definitely*). Finally, we measured a set of demographic variables (gender, age, level of education, religiosity, religious affiliation, and political orientation). After that, participants were thanked and paid for their participation.[3]

Results and Discussion

Descriptive statistics and zero-order correlations are presented in Table 1. The data were analyzed using hierarchical regression analyses. In Step 1 we entered the IRS, MRS, and ACS (all predictors were standardized). The relevant interaction terms (IRS × ACS, MRS × ACS) were entered in Step 2.

Paranormal belief. The first step accounted for a significant amount of variance, $F(3, 329) = 10.21$, $p < .001$, $\Delta R^2 = .09$. Consistent with previous work, ACS was associated with weaker paranormal belief, $b = -.44$, $SE = .09$, $t = -4.93$, $p < .001$. The MRS did not predict paranormal belief, $b = .08$, $SE = .10$, $t = .83$, $p = .41$; neither did the IRS $b = -.11$, $SE = .10$, $t = -1.14$, $p = .26$, More importantly, however, the second step also accounted for a significant amount of variance, $F(2, 327) = 6.45$, $p = .002$, $\Delta R^2 = .04$. The ACS × IRS interaction was significant, $b = -.22$, $SE = .09$, $t = -2.41$, $p = .02$; whereas the ACS × MRS interaction was not, $b = -.13$, $SE = .10$, $t = -1.27$, $p = .21$. Simple slope analyses (see Figure 1a) showed that ACS was associated with weaker paranormal beliefs among those who scored high (+1SD) on the IRS, $b = -.72$, $SE = .12$, $t = -5.94$, $p < .001$, but not among those who scored low (-1SD) on the IRS, $b = -.16$, $SE = .12$, $t = -1.34$, $p = .18$.

Conspiracy belief. The first step accounted for a significant amount of variance, $F(3, 329) = 12.28$, $p < .001$, $\Delta R^2 = .10$. Consistent with previous studies, ACS was associated with weaker conspiracy beliefs, $b = -.34$, $SE = .07$, $t = -4.96$, $p < .001$. The MRS was associated with stronger conspiracy beliefs, $b = .17$, $SE = .07$, $t = 2.27$, $p = .02$, whereas the IRS was unrelated to

conspiracy beliefs, b = -.10, SE = .07, t = -1.37, p = .17. More importantly for the present purposes, the second step also accounted for a significant amount of variance, $F(2, 327) = 7.24$, p = .001, ΔR^2 = .04. As was the case for paranormal belief, The ACS × IRS interaction was significant, b = -.19, SE = .07, t = -2.61, p = .009; whereas the ACS × MRS interaction was not, b = -.10, SE = .08, t = -1.27, p = .21. ACS was associated with weaker conspiracy beliefs among those who scored high (+1 SD) on the IRS, b = -.57, SE = .09, t = -6.13, p < .001, but not among those who scored low (-1SD) on the IRS, b =-.11, SE = .09, t = -1.22, p = .23 (see Figure 1b).

Conspiracy mentality. Step 1 was once again significant, $F(3, 329) = 8.52$, p < .001, ΔR^2 = .07. ACS was associated with having decreased conspiracy mentality, b = -.16, SE = .06, t = -2.55, p = .01. High scores on the IRS were associated with stronger conspiracy mentality, b = .26, SE = .07, t = 4.02, p < .001, whereas the MRS was unrelated to conspiracy mentality, b = .04, SE = .07, t = .57, p = .57. More importantly, Step 2 was also significant, $F(2, 327) = 8.49$, p < .001, ΔR^2 = .05. Once again, the ACS × IRS interaction was significant, b = -.25, SE = .06, t = -4.03, p < .001. ACS was associated with decreased conspiracy mentality among those who scored high (+1SD) on the IRS, b = -.38, SE = .08, t = -4.62, p < .001, but not among those who scored low (-1SD) on the IRS, b = .07, SE = .08, t = .82, p = .41 (see Figure 1c). The ACS × MRS interaction was not significant, b = .07, SE = .07, t = 1.10, p = .27.

The results provided support for the notion that an analytic cognitive style and valuing epistemic rationality interactively predict irrational beliefs. ACS was negatively associated with all three measures of unfounded belief (paranormal belief, conspiracy beliefs, conspiracy mentality), but only among those who scored high on the IRS. Consistent with our line of reasoning, the interaction was generally attributable to uniquely low levels of unfounded beliefs among individuals who scored high on ACS and the IRS. However, as can be seen in Figure 1c,

the interaction obtained on conspiracy mentality was attributable to particularly *high* conspiracy mentality scores among those low in ACS, but high in IRS. This finding may suggest that people with high conspiracy mentality can be motivated to search for truth, but lack the analytic thinking skills to do so effectively. Furthermore, note that the items of the CMQ are less concrete than the items of the conspiracy belief scale, and are hence more difficult to judge for people high in IRS and analytic thinking. Future research may examine these possibilities. For the present purposes, more important is the finding that variations in analytic thinking predicts unfounded beliefs only when people value epistemic rationality, a finding that we observed on all three measures.

When simultaneously controlling for IRS, and the ACS × IRS interaction, the MRS did not interact with ACS to predict unfounded beliefs.[4] This is noteworthy, as many studies have demonstrated that moralized values are particularly strong predictors of value-consistent attitudes and behavior (Graham, Nosek, Haidt, Iyer, Koleva, & Ditto, 2011; Morgan, Skitka, Wisneski, 2010; Skitka & Bauman, 2008; Ståhl et al., 2016; Van Zomeren, Postmes, & Spears, 2012; Zaal, Saab, O'Brien, Jeffries, Barreto, & Van Laar, 2017; Zaal, Van Laar, Ståhl, Ellemers, & Derks, 2011). A likely explanation is that the MRS primarily predicts social judgments and behaviors, but not privately held beliefs such as those investigated in the present research. We will further elaborate on this point in the General Discussion.

Study 2

A remaining question is what specific aspects of analytic thinking predict weaker unfounded beliefs among those who strongly value epistemic rationality. Specifically, in Study 1 we operationalized analytic thinking through a measure of Analytic Cognitive Style (ACS). Such ACS is strongly and positively related to general cognitive ability (CA), however, in that they

both tap into one's capacity to process complex, new information (e.g., Pennycook et al., 2012; Stanovich & West, 2000; Thomson & Oppenheimer, 2016), as well as one's acquired task-relevant knowledge (Szaszi, Szollosi, Palfi, & Aczel, 2017). However, besides cognitive ability ACS also measures the inclination to apply analytic thinking to problems for which an (incorrect) intuitive answer is readily available (e.g., Pennycook et al., 2012; Stanovich & West, 2008). Put differently, our measure of ACS does not clearly distinguish between the *inclination* versus the *ability* to think analytically. In Study 2, we aim to tease these different aspects of analytic thinking apart by adding a measure of cognitive ability (CA) that is not confounded with the inclination to think analytically.

Because paranormal beliefs and conspiracy theories are intuitively appealing, it is possible that the inclination to apply analytic reasoning when an intuitive answer is available plays an important role. This would imply that ACS should predict unfounded beliefs above and beyond CA among individuals who value epistemic rationality. Having said that, most studies that have shown a relationship between ACS and unfounded beliefs did not control for CA (Aarnio & Lindeman, 2005; Gervais & Norenzayan, 2012; Shenhav et al., 2011; Swami et al., 2014; for an exception, see Pennycook et al., 2012). Moreover, other studies have found that straightforward measures of cognitive ability (CA) predict weaker paranormal belief (Hergovich & Arendasy, 2005; Musch & Ehrenberg, 2002), belief in the supernatural (e.g., Lewis, Ritchie, & Bates, 2011; Lynn, Harvey, & Nyborg, 2009; Reeve, 2009), and conspiracy beliefs (Swami et al., 2011; Swami & Furnham, 2012). Thus, it remains an open question whether ACS is associated with a reduction in unfounded beliefs above and beyond the role of CA. In addition to serve as a replication of Study 1, Study 2 was designed to address this question. To that end, we added

complementary measures of numerical and verbal aspects of CA to the battery of measures that were used in Study 1.

Method

Sample, procedure, and materials. We once again requested 300 participants to our survey, but this time from Amazon Mechanical Turk. For the same reason as in Study 1, we ended up with a somewhat larger sample than requested (N = 322). Each participant received $0.75 for taking the survey. All participants resided in the U.S. Fifty-three percent of participants were male, and 47% were female (M_{age} = 34.95, SD = 10.86). The sample contained 79% Caucasians, 8% African Americans, 6% Asians, 5% Hispanic/Latino, and 2% indicated another ethnicity. Twenty participants did not report their race/ethnicity. Twelve percent reported having a high school degree, 33% had taken some college classes, 43% had an undergraduate degree, and 12% had a graduate degree. Twenty participants did not report their level of education.

Participants took part in the survey upon giving informed consent. As in Study 1, we used the IRS (α = .85) and MRS (α = .88) to measure ascribed importance and morality to epistemic rationality, and the CRT, and CRT-2, to measure ACS. As in Study 1, scores on the two CRT tests were highly correlated (r = .50, p < .001), and summed up to create a reliable measure of ACS (α = .77). To measure Cognitive Ability (CA) we relied on two different tests. First, to measure quantitative ability, we used the 3-item Numeracy test (Schwartz, Woloshin, Black, & Welch, 1997). This brief test is highly correlated with an extended and more difficult test of quantitative ability (Lipkus, Samsa, & Rimer, 2001). Second, to measure verbal ability, we used the 10-item WordSum test (Huang & Hauser, 1998). This test has been used in numerous studies as a measure of verbal intelligence (Malhotra, Krosnick, & Haertel, 2007). Scores on these two

tests were standardized and averaged to create a measure of general CA (α = .74; cf., Pennycook, Cheyne, Barr, Koehler, & Fugelsang, 2014).

To measure unfounded beliefs, we relied on exactly the same measure of conspiracy beliefs (α = .88) as in Study 1. We also included the same measure of paranormal beliefs, although in Study 2 participants responded on the original 4-point scale (1 = *definitely not*, 4 = *yes, definitely*; α = .93). We did not include the measure of conspiracy mentality in this study, also in light of the somewhat anomalous finding on this measure in Study 1. Finally, we measured the same demographic variables as in Study 1 (plus race/ethnicity), after which participants were thanked and paid for taking the survey.[5]

Results and Discussion

Descriptive statistics and zero-order correlations are presented in Table 2. We analyzed the data in two steps. First, we examined whether we replicated the main results from Study 1. Specifically, we investigated whether the IRS and ACS interactively predicted paranormal and conspiracy beliefs. After that, we examined whether the effects obtained were ultimately attributable to the inclination to engage in analytic thinking (ACS), or to cognitive ability (CA).

Replicating Study 1. As in Study 1, the data were analyzed using hierarchical regression analyses. In Step 1 we entered the IRS, MRS, and ACS (all predictors were standardized). The relevant interaction terms (IRS × ACS, MRS × ACS) were entered in Step 2.

Paranormal belief. Step 1 was significant, $F(3, 298) = 9.37$, $p < .001$, $\Delta R^2 = .09$. As in Study 1, ACS was associated with weaker paranormal beliefs, $b = -.18$, $SE = .05$, $t = -3.81$, $p < .001$. Unlike in Study 1, the MRS was also associated with weaker paranormal beliefs, $b = -.15$, $SE = .05$, $t = -3.14$, $p = .002$, whereas the IRS was not, $b = -.01$, $SE = .05$, $t = -.12$, $p = .90$..

More importantly, Step 2 also accounted for a significant amount of variance, $F(2, 296) = 4.77$, $p = .009$, $\Delta R^2 = .03$. We replicated the ACS × IRS interaction from Study 1, $b = -.12$, $SE = .04$, $t = -2.68$, $p = .008$. As in Study 1, ACS was associated with weaker paranormal beliefs among those who score high on the IRS (+1SD), $b = -.26$, $SE = .06$, $t = -4.09$, $p < .001$. By contrast, ACS was only marginally related to weaker paranormal beliefs among those who score low on the IRS (-1SD), $b = -.11$, $SE = .06$, $t = -1.83$, $p = .07$.

Unlike in Study 1, we also found a significant ACS x MRS interaction, $b = .12$, $SE = .05$, $t = 2.42$, $p = .02$. Surprisingly, ACS was associated with weaker paranormal beliefs among those who score low on the MRS, $b = -.25$, $SE = .07$, $t = -3.78$, $p < .001$, but not among those who score high on the MRS, $b = -.10$, $SE = .07$, $t = -1.57$, $p = .12$. We will get back to this unexpected result in the General Discussion.

Conspiracy belief. Step 1 accounted for a significant amount of variance, $F(3, 298) = 6.39$, $p < .001$, $\Delta R^2 = .06$. As in Study 1, ACS was associated with weaker conspiracy beliefs, $b = -.23$, $SE = .08$, $t = -3.08$, $p = .002$. The MRS did not predict conspiracy beliefs, $b = -.08$, $SE = .08$, $t = -1.04$, $p = .30$; neither did the IRS, $b = -.12$, $SE = .08$, $t = -1.52$, $p = .13$. Step 2 was not significant, $F(2, 296) = 2.06$, $p = .13$, $\Delta R^2 = .01$. Thus, the ACS × IRS interaction from Study 1 was not replicated, although it was in the expected direction, $b = -.10$, $SE = .07$, $t = -1.45$, $p = .15$. The ACS × MRS interaction was also not significant, $b = .07$, $SE = .08$, $t = .83$, $p = .41$

To summarize, using a sample from a different population (Amazon Mechanical Turk rather than Crowdflower), we replicated the finding from Study 1 that valuing epistemic rationality moderates the relationship between analytic cognitive style and paranormal belief. However, we did not replicate the same effect on conspiracy beliefs. We can only speculate as to why the effect on conspiracy beliefs obtained in Study 1 did not replicate. It could have to do

with the fact that conspiracy beliefs were lower in this MTurk sample than in the sample recruited from Crowdflower for Study 1. However, this fails to explain why we were able to replicate the effect on paranormal belief -- despite a considerable drop in paranormal beliefs as compared to Study 1. Alternatively it could be due to the fact that people scored higher on ACS in this sample than in Study 1. MTurk workers may be more familiar with the CRT tests than Crowdflower workers, which could reduce the predictive validity of the tests. However, recent studies have demonstrated that familiarity with the CRT does not affect its predictive validity (Bialek & Pennycook, 2017). Consistent with those findings, ACS predicted paranormal and conspiracy beliefs in Study 2 (as in Study 1), and we successfully replicated the ACS by IRS interaction on paranormal beliefs. These results demonstrate that the CRT tests had predictive validity in the MTurk sample, despite higher average scores, and possibly more familiarity with the tests. Ultimately, additional studies are needed to determine how robust the moderating role of IRS is for the relationship between ACS and conspiracy beliefs.

Are the effects driven by ACS or by CA? Consistent with previous research, the measures of ACS and CA were positively correlated in this study ($r = .58$, $p < .001$). If the effects obtained are uniquely attributable to the inclination to apply analytic thinking to problems that have an intuitive answer, then ACS, but not CA, should predict unfounded beliefs among those who value epistemic rationality. On the other hand, if the effects of ACS are ultimately due to individual differences in cognitive ability, we should expect CA to predict unfounded beliefs above and beyond the role of ACS.

To assess the independent effects of ACS and CA on unfounded beliefs, we ran a set of regression analyses in which we included ACS, CA and the IRS as predictors in Step 1, and the relevant two-way interactions in Step 2. As can be seen in Table 3, the CA × IRS interaction was

a significant predictor of paranormal beliefs. CA was associated with weaker paranormal beliefs among those who scored high on the IRS (+1 SD), b = -.18, SE = .05, t = -3.57, p < .001, but not among those who scored low on the IRS (-1 SD), b = -.01, SE = .04, t = -.20, p = .84 (see Figure 2a). As can be seen in Table 3, the CA × IRS interaction was also a marginally significant predictor of conspiracy beliefs. CA was more strongly associated with weaker paranormal beliefs among those who scored high on the IRS (+1 SD), b = -.38, SE = .08, t = -4.90, p < .001, than among those who scored low on the IRS (-1 SD), b = -.16, SE = .07, t = -2.37, p = .02 (see Figure 2b). By contrast, when controlling for the effects of CA, there was no ACS × IRS interaction on any of the dependent variables. These results suggest that the measures of CA and ACS tap into the same underlying process to skepticism. Moreover, the results are consistent with the notion that our findings are attributable to differences in cognitive ability, not to differences in a preference for analytic over intuitive thinking.

General Discussion

Conspiracy theories and paranormal beliefs remain pervasive in modern, highly educated, societies. Such unfounded beliefs shape a range of potentially harmful behavior, both for believers themselves (e.g., detrimental health behaviors) as well as for their social and physical environment (e.g., radicalization; climate skepticism). Two studies provided support for the notion that skepticism toward paranormal and conspiracy beliefs requires sufficient analytic skills, as well as motivation to form beliefs based on logic and evidence. Study 1 demonstrated that an analytic cognitive style was associated with weaker paranormal beliefs, conspiracy beliefs, and conspiracy mentality. However, these relationships only emerged among individuals who strongly valued epistemic rationality. Among those who did not value epistemic rationality, analytic cognitive style was unrelated to all three measures of irrational beliefs. Building on

these findings, Study 2 examined whether these effects were uniquely attributable to differences in analytic cognitive style, or whether they were explained by more general individual differences in cognitive ability. Results were more consistent with a general cognitive ability account. Although we replicated the (moderated) relationship between ACS and paranormal beliefs (but not conspiracy beliefs), this effect disappeared when controlling for CA. By contrast, among individuals who strongly valued epistemic rationality, CA remained a significant contributor to skepticism toward the paranormal, and conspiracy theories, while controlling for ACS.

We believe the present findings can help resolve a conundrum in modern society. Given that (1) cognitive ability is associated with weaker belief in conspiracy theories and in the paranormal (Hergovich & Arendasy, 2005; Lewis et al., 2011; Lynn et al., 2009; Musch & Ehrenberg, 2002; Reeve, 2009; Swami et al., 2011; Swami & Furnham, 2012), and (2) cognitive ability scores have increased considerably over time (Flynn, 1987), why is it that unfounded beliefs continue to be widespread in modern societies? In fact, one study coded over 100,000 published letters, that were sent to the New York Times and Chicago Tribune over a time period of 120 years (1890 to 2010), for conspiratorial content. The results revealed no evidence for a trend towards more or less conspiracy theorizing over time (Uscinski & Parent, 2014). Despite better educational opportunities and improved cognitive abilities, people nowadays are about equally likely to believe conspiracy theories as people were more than 100 years ago. Based on the present research, a possible answer to this question is that an increase in cognitive ability in the population is not sufficient to prevent the spread of irrational beliefs -- people must also value epistemic rationality.

An interesting observation in the present research was that valuing to form one's own beliefs based on logic and evidence (IRS) moderated the impact of cognitive ability on unfounded beliefs, whereas moralizing epistemic rationality (MRS) did not (when we controlled for the moderating role of IRS). Because moralized values (including moralized rationality) generally produce stronger effects on attitudes and behavior than do amoral values, this pattern of results may seem surprising. However, studies demonstrating particularly strong effects of moralized values on attitudes and behavior have generally studied *social* attitudes and behavior, such as moral judgments, social distancing from value-violators, political engagement, and collective action (Graham et al., 2011; Morgan et al., 2010; Skitka & Bauman, 2008; Ståhl et al., 2016; Van Zomeren et al., 2012; Zaal et al., 2017; Zaal et al., 2011). Notably, one of the key distinctions between amoral and moral values is that moral values prescribe how other people should think and behave (Gibbs, Basinger, Grime, & Snarey, 2007; Nichols & Folds-Bennett, 2003; Skitka, 2014; Turiel, 1978). In the present research, however, we studied highly personal beliefs, with no direct implications for other people. We believe that the focus on personal beliefs is a plausible explanation for why the IRS was a stronger moderator than the MRS in the present research. When the focus is on responses to other people's irrational (vs. rational) beliefs and behaviors, earlier studies suggest that the MRS is a stronger moderator of moral judgment, trait inferences, and behavioral intentions (e.g., social distancing) than the IRS (Ståhl et al., 2016).

Limitations and Future Research

Although the present results provide strong evidence for the interactive influence of cognitive ability and epistemic motivation on skepticism toward unfounded beliefs, the present findings are limited by not offering clear evidence for the underlying process. In the introduction,

we offered two possibilities, namely that analytic thinking and valuing epistemic rationality holds implications for (1) people's ability to discriminate between strong and weak evidence and (2) people's tendency to engage in motivated reasoning. Future research is needed to identify which of these possible underlying psychological processes explain the effects presented here. A fruitful next step therefore would be to examine whether individuals who have a high cognitive ability, and value epistemic rationality, are better than others at discriminating between strong and weak evidence, as well as whether they are less inclined to engage in motivated reasoning.

Although we had sufficiently powered samples to draw reliable conclusions, our cross-sectional designs preclude conclusions of cause and effect. To resolve questions about causality left unanswered by the present correlational studies, future research should examine whether manipulations of cognitive capacity (e.g., cognitive load), and importance of epistemic rationality, produce similar effects on skepticism as the individual difference variables relied upon in the present research. Notably, identifying effective ways of manipulating perceived importance of epistemic rationality could ultimately have practical implications as well. Educational programs designed to raise IQ scores in the population have produced modest results at best (e.g., DHHS, 2010). Interventions targeting the perceived value of epistemic rationality could be a more viable route to increased skepticism toward unfounded beliefs.

The present findings suggest that suppression of intuitive responding was not a critical component of the effects obtained, but that they were due to general cognitive ability. The brief tests of cognitive ability used in the present research have been used extensively to assess quantitative and verbal aspects of intelligence (e.g., Malhotra et al., 2007; Pennycook, Cheyne, Barr, Koehler, & Fugelsang, 2013, 2014, 2015). Nevertheless, we recommend the use of more sophisticated measures of cognitive ability in future studies, as they can help determine what

level of ability is needed to prevent acceptance of unfounded beliefs, as well as whether certain aspects of cognitive ability are more important in this process than others. We specifically recommend the use of standardized and extensively validated intelligence tests that not only provide indicators of people's cognitive ability, but also discriminate between various aspects of intelligence (e.g., fluid vs. crystallized intelligence). Such testing would not only provide more confidence in the conclusions presented here, but could also help clarify whether these findings are ultimately attributable to highly stable components of cognitive ability ('g'), or to aspects more sensitive to environmental factors (Flynn, 1987; te Nijenhuis & Van der Flier, 2013).

Conclusion

There is no shortage of widespread irrational beliefs in modern society. Many of these beliefs unfortunately have detrimental consequences for individuals' health choices, as well as for society as a whole. In the present research we sought to increase our understanding of individual difference factors that promote skepticism toward unfounded beliefs. Building on previous work linking cognitive ability to skepticism, we demonstrate that this link is primarily there among people who view it as important that their beliefs are epistemically rational. The present findings thus illustrate that a high cognitive ability does not inoculate people against irrational beliefs in and of itself; they must also be dedicated to use their cognitive ability in pursuit of the truth.

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Footnotes

[1] Ballarini and Sloman (2017) recently failed to replicate this effect. Since then, however, Kahan and Peters (2017) reported a successful replication, and also argued that Ballarini and Sloman's replication attempt suffered from insufficient statistical power.

[2] Epistemic rationality concerns whether or not one's beliefs accurately describe the world. It should not be confused with instrumental rationality, which concerns the extent to which one's beliefs and actions increase the likelihood of achieving one's goals (e.g., Stanovich, 1999). Put differently, epistemic rationality can be viewed as a *particular case* of instrumental rationality, where the focal goal is to have accurate beliefs about the world. To illustrate, believing that Santa Claus exists can be instrumentally rational, to the extent that it increases the likelihood of reaching one's focal goal (e.g., life satisfaction). However, believing in Santa Claus is not epistemically rational, because there is no evidence to suggest that he actually exists.

[3] We also included a measure of *illusory pattern perception*. We used the 11-item measure developed by Van Prooijen, Douglas, and De Inocencio (in press). Participants were presented with the results of 10 sequences of random coin tosses (10 coin tosses per sequence, e.g., "HTHHTTTTHH"). For each sequence, they were asked to indicate to what extent they thought it was random or determined (1 = *completely random*, 7 = *completely determined*), and at the end they were additionally asked if the complete sequence was random or determined. The eleven responses were averaged into a reliable illusory pattern perception scale ($\alpha = .91$). Although this measure correlated with all our three belief measures ($.20 < r\text{s} < .32$, $p\text{s} < .001$) we did not find an interaction between

ACS and IRS on illusory pattern perception. In addition, for different research purposes, we included the populism scale by Oliver and Rahn (2016).

[4] It should be noted that, when the IRS, and the ACS ×IRS interaction term were *not* included in the analysis, the ACS × MRS interaction did predict paranormal belief, $b = -.23$, $SE = .09$, $t = -2.61$, $p = .01$; and conspiracy belief, $b = -.19$, $SE = .07$, $t = -2.70$, $p = .007$; but not conspiracy mentality, $b = -.06$, $SE = .06$, $t = -.91$, $p = .36$. However, the fact that these effects disappeared when controlling for the ACS × IRS interaction, suggests that they were attributable to variance shared between the IRS and MRS ($r = .39$, $p < .001$). Thus, it is not moralization of rationality that drives the reported effects on unfounded belief. Rather, the effects are driven by the extent to which people view epistemic rationality as important for them personally.

[5] We also included the 18-item Need for Cognition scale (NFC, Cacioppo, Petty, & Kao, 1984) in this study. The intention was to combine this scale with CRT scores in an attempt to create a measure of analytic cognitive style that was conceptually distinct from cognitive ability. However, because NFC was only modestly correlated with CRT scores ($r = .21$, $p < .001$), and actually slightly more strongly correlated with CA ($r = .26$, $p < .001$), we decided not to include NFC in our analyses.

Table 1
Means, standard deviations and zero-order correlations (Study 1)

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1 IRS	5.30	1.03	-								
2 MRS	3.91	1.00	.39***	-							
3 ACS	2.94	2.09	.19**	-.08	-						
4 Paranormal beliefs	3.42	1.64	-.10	.04	-.29***	-					
5 Conspiracy beliefs	3.71	1.27	-.08	.13*	-.29***	.59***	-				
6 Conspiracy mentality	4.93	1.10	.23***	.14*	-.10	.39***	.55***	-			
7 Level of education	3.70	.76	.07	.12*	.02	-.16**	-.04	-.14**	-		
8 Political orientation	3.61	1.62	-.16**	-.04	-.11*	.04	.17**	.13*	-.06	-	
9 Religiosity	3.68	2.12	-.15**	-.10	-.22***	.17**	.14*	.11	.00	.40***	-

*** $p < .001$; ** $p < .01$; * $p < .05$

Table 2
Means, standard deviations and zero-order correlations (Study 2)

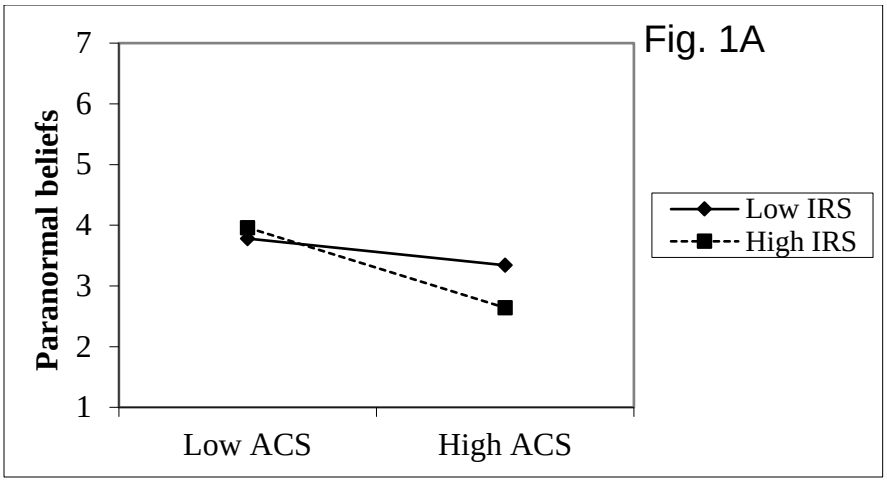
Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1 IRS	5.61	.98	-								
2 MRS	4.04	1.20	.38***	-							
3 ACS	4.27	2.08	.28***	-.01	-						
4 CA	9.05	1.51	.32***	.03	.58***	-					
5 Paranormal beliefs	1.88	.80	-.14*	-.19**	-.22***	-.23***	-				
6 Conspiracy beliefs	3.05	1.26	-.17**	-.10	-.21***	-.33***	.53***	-			
7 Level of education	3.59	.91	.10	.03	.18**	.25***	-.03	-.21***	-		
8 Political orientation	3.21	1.70	-.16**	-.13*	-.09	-.14*	.02	.20***	-.12*	-	
9 Religiosity	2.18	1.36	-.30***	-.13*	-.14*	-.17**	.21***	.21***	.05	.38***	-

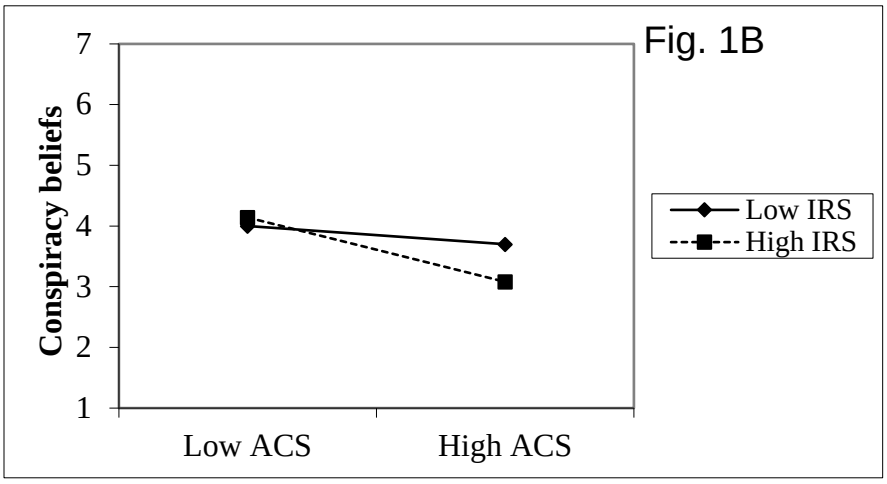
*** $p < .001$; ** $p < .01$; * $p < .05$

Table 3
Results from hierarchical regression analyses as a function of CA, ACS, and IRS (Study 2)

Criterion	Predictor	*b*	*t*	ΔR^2
PB				
	Step 1			.07***
	CA	-.08	-2.02*	
	ACS	-.10	-1.77†	
	IRS	-.05	-1.01	
	Step 2			.03*
	CA × IRS	-.08	-2.09*	
	ACS × IRS	-.01	-.17	
CB	Step 1			.11***
	CA	-.25	-4.26***	
	ACS	-.02	-.23	
	IRS	-.09	-1.28	
	Step 2			.02*
	CA × IRS	-.11	-1.76†	
	ACS × IRS	-.02	-.19	

PB = Paranormal belief, CB = Conspiracy belief, *** $p < .001$, * $p < .05$, † $p < .10$





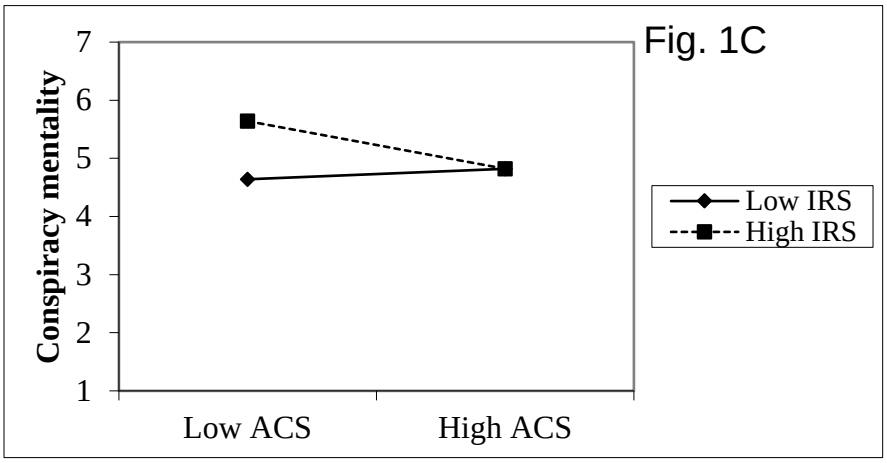


Figure 1a to 1c. *Paranormal Beliefs (1a), Conspiracy Beliefs (1b) and Conspiracy Mentality (1c) as a Function of Analytic Cognitive Style (ACS) and Importance of Rationality (IRS).*

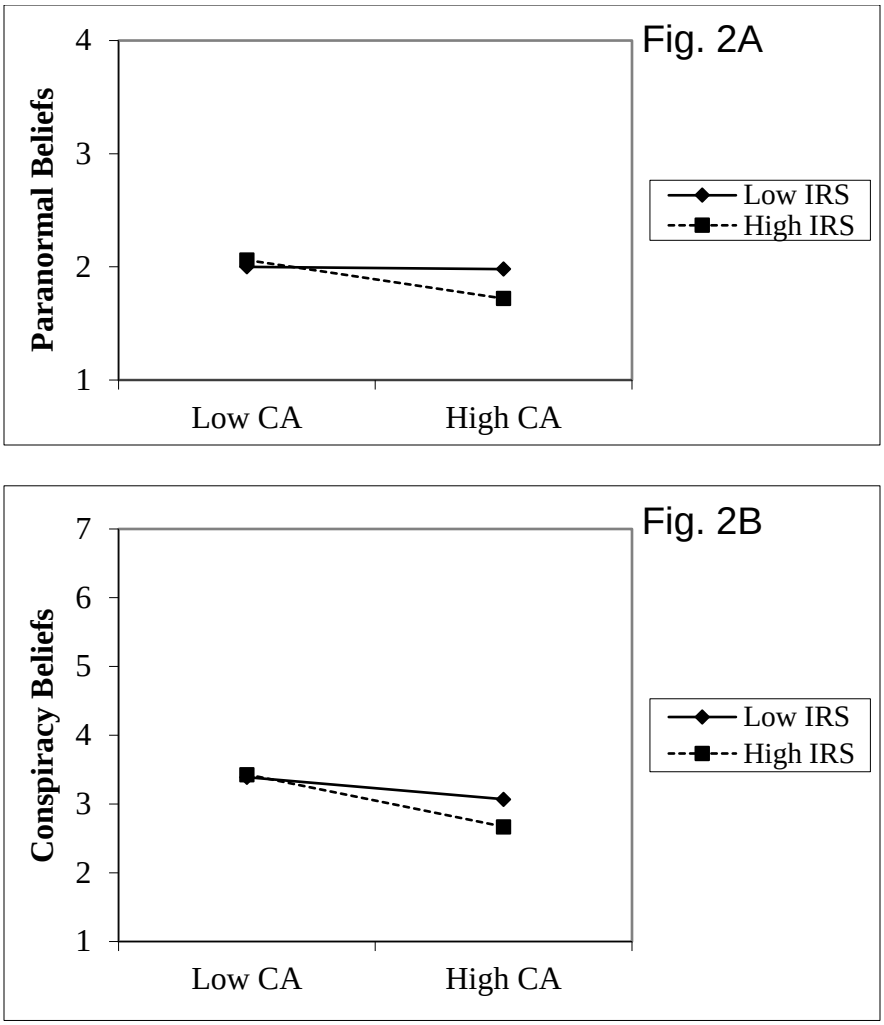


Figure 2a and 2b. *Paranormal Beliefs (2a) and Conspiracy Beliefs (2b) as a Function of Cognitive Ability (CA) and Importance of Rationality (IRS).*