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Valuing epistemic rationality bolsters the effect of analytic thinking on skepticism toward pseudo-profound bullshit

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ABSTRACT

We examine in three studies whether skepticism toward pseudo-profound bullshit (BS) requires sufficient analytic sophistication as well as motivation to form beliefs based on logic and evidence. Across studies, the positive relationship between individual differences in cognitive sophistication and skepticism toward BS was stronger among people who ascribe high (vs. low) value to being epistemically rational. Moreover, experimentally reducing people's ability to engage in analytic thinking (by inducing cognitive load) reduced skepticism toward BS among individuals who ascribe high value to being epistemically rational. By contrast, skepticism toward BS was equally low in the no-load condition as under cognitive load among people who ascribe low value to epistemic rationality (Study 2). We also demonstrate that cognitive sophistication, coupled with ascribing high value to being epistemically rational, predicts skepticism toward BS, regardless of the source's credibility (Study 3).

1. Introduction

A growing body of research seeks to identify factors that promote skepticism toward various kinds of epistemically suspect ideas and misinformation, such as outlandish conspiracy theories, paranormal phenomena, supernatural entities, and fake news (e.g., Douglas et al., 2019; Lindeman & Aarnio, 2006; Norenzayan & Gervais, 2013; Pennycook & Rand, 2021). One explanatory factor that has received substantial empirical attention in this area is cognitive sophistication. Having high cognitive ability, as well as an inclination to rely on analytic (vs. intuitive) thinking, is generally associated with increased skepticism toward various epistemically suspect ideas (e.g., Aarnio & Lindeman, 2005; Binnendyk & Pennycook, 2022; Gervais & Norenzayan, 2012; Pennycook et al., 2012; Pennycook & Rand, 2021; Ståhl & Van Prooijen, 2018, 2021; Swami et al., 2014; Swami & Furnham, 2012; Van Prooijen, 2017).

Although cognitive sophistication has shown promise for protection against epistemically suspect ideas, there are good reasons to think that it is frequently not enough. Research on persuasion has shown that people do not engage in careful processing of messages unless they are sufficiently motivated to do so (Chaiken et al., 1989; Petty & Cacioppo, 1986). In the absence of strong motivation to reach an accurate conclusion, people instead tend to process persuasive messages more superficially. Moreover, many epistemically suspect beliefs are supported by strong 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). When people have strong motives to reach a certain conclusion, they are prone to engage in motivated reasoning (Kunda, 1990; Nickerson, 1998). In fact, when those motives are moral in nature, people have been shown to recognize their own motivated reasoning, and to view it as appropriate (Cusimano & Lombrozo, 2023). Moreover, some evidence suggests that cognitive sophistication can exacerbate motivated reasoning (Kahan et al., 2017, but see Pennycook & Rand, 2019; Stagnaro et al., 2023; Tappin et al., 2020). In short, cognitive sophistication alone may frequently provide limited protection against epistemically suspect ideas because people either engage in motivated reasoning to reach a preferred conclusion or lack sufficient motivation to carefully process the information.

Based on this line of reasoning, Ståhl and Van Prooijen (2018) proposed that cognitive sophistication should primarily promote skepticism toward epistemically suspect beliefs when coupled with strong motivation to form beliefs based on logic and the best available evidence. Consistent with this hypothesis, individual differences in analytic thinking and cognitive ability primarily predicted skepticism toward the

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paranormal, and various conspiracy theories, among people who ascribed high (vs. low) value to being epistemically rational (Ståhl & Van Prooijen, 2018). More recent studies have produced similar results regarding religious belief. Specifically, analytic thinking was more strongly negatively associated with religious faith and belief in God among people who ascribed high (vs. low) value to epistemic rationality (Ståhl & Van Prooijen, 2021).

Support for this hypothesis has thus far come from studies focusing on various epistemically suspect beliefs that had presumably already been formed, and were retrieved from memory, at the time of the study (e.g., belief in God, paranormal beliefs). Thus, there is no direct evidence that cognitive sophistication and valuing epistemic rationality interactively predict the quality of people's reasoning when exposed to novel suspect claims. Moreover, most of prior studies relied exclusively on correlational methods. As a consequence, it remains unclear whether cognitive sophistication and motivation to be epistemically rational interactively *cause* people to be more skeptical toward unfounded ideas. A rare exception is a study by Adam-Troian et al. (2019) in which the salience of the goal to be epistemically rational was experimentally manipulated. As predicted, individual differences in cognitive ability were more strongly associated with skepticism toward the supernatural, and more strongly negatively associated with having a conspiratorial mindset, when the goal to be rational was made salient (vs. control).

1.1. The present research

In the present research we seek to provide more conclusive support for the hypothesis that cognitive sophistication and motivation to be epistemically rational interactively promote sound reasoning about epistemically suspect claims. Consistent with previous research (Ståhl & Van Prooijen, 2018, 2021), we report three studies in which we measured individual differences in cognitive ability, as well as in how much value people ascribe to being epistemically rational, using the importance of rationality scale (IRS, Ståhl et al., 2016). However, the present research goes beyond previous studies in three important ways. First, rather than focusing on already formed beliefs, we examine receptivity to pseudo-profound bullshit (Pennycook et al., 2015); the extent to which people view statements that imply, but do not contain, any intended meaning or truth as profound, credible, and important. BS-receptivity is suitable for our purposes, because it is highly unlikely that participants have already formed opinions about randomly generated BS-statements prior to taking part in this research. Therefore, to the extent that individual differences in cognitive ability and the value ascribed to epistemic rationality predict BS-receptivity, it provides direct evidence that these factors predict reasoning quality. Notably, BS-receptivity is positively related to various epistemically suspect beliefs (Pennycook et al., 2015; Van Prooijen et al., 2022), and negatively related to analytic thinking (Pennycook et al., 2015), as well as cognitive ability (Cavojova et al., 2019). Based on these findings, coupled with studies showing that the association between analytic sophistication and various epistemically suspect beliefs is moderated by how much value people ascribe to epistemic rationality (Ståhl & Van Prooijen, 2018, 2021), it seems plausible that the same interaction should predict BS-receptivity.

A second important way in which the present research goes beyond previous studies is that we test the causal role of analytic thinking experimentally. Specifically, in addition to measuring individual differences in cognitive ability (Studies 1–3), we also experimentally vary the ability to engage in analytic thinking when evaluating BS-statements using a cognitive load manipulation (Study 2). This is yet another reason why we opted to use BS-receptivity as our dependent variable. Because judgments of randomly generated BS-statements are presumably formed in the moment, they should be more sensitive to an experimental manipulation of cognitive load, as compared to already established beliefs retrieved from memory.

A third novel contribution of the present research is that we investigate whether cognitive ability coupled with motivation to be epistemically rational is associated with skepticism toward BS regardless of the source. Building on research on persuasion (e.g., Chaiken & Maheswaran, 1994; Petty & Cacioppo, 1986; Pornpitakpan, 2004), recent studies have shown that people are generally more inclined to view BS-statements as credible and important when coming from a credible source (Gligorić & Vilotijević, 2020; Hoogeveen et al., 2022; Ilić & Damnjanović, 2021). For example, a cross-cultural study demonstrated that people view BS-statements as more credible and important when coming from a scientist rather than from a spiritual leader (Hoogeveen et al., 2022). This so-called 'Einstein effect' was less pronounced among more (vs. less) religious people, presumably because they view spiritual leaders as more credible sources, and perhaps view scientists as less credible sources.

Notably, cognitive sophistication, as well as ascribing value to epistemic rationality, are negatively associated with religiosity (e.g., Gervais & Norenzayan, 2012; Pennycook et al., 2012; Ståhl et al., 2016; Ståhl & Van Prooijen, 2021), and positively associated with trust in science (Ståhl et al., 2016), and scientists (Pennycook et al., 2020). It therefore seems possible that having a high cognitive ability coupled with strong motivation to be epistemically rational may cease to predict skepticism toward BS when it stems from a (trusted) scientist. On the other hand, research on persuasion suggests that, unless the quality of the argument is ambiguous (Chaiken & Maheswaran, 1994), source credibility generally influences evaluations of persuasive messages more when the information is processed superficially (Chaiken et al., 1989; Hovland & Weiss, 1951; Kiesler & Mathog, 1968; Petty & Cacioppo, 1986; Petty et al., 1981; but see Briñol et al., 2004), or when people fail to comprehend the message (Ratneshwar & Chaiken, 1991). Based on such findings, it seems plausible that high cognitive ability coupled with strong motivation to be epistemically rational would continue to predict skepticism toward BS regardless of source credibility, as having both high capacity and motivation to reach epistemically rational conclusions should promote more thorough processing of information. We examine these competing hypotheses directly in Study 3.

2. Study 1

For all studies reported in this article, we determined the sample size prior to any data analyses, and we report all manipulations, measures, and exclusions. This study was pre-registered (https://aspredicted.org/NHD_MNK). Based on previous work on epistemically irrational beliefs (Ståhl & Van Prooijen, 2018), we predicted and pre-registered a two-way interaction between cognitive ability (CA) and the IRS on BS-receptivity. Specifically, we expected individual differences in CA to be more strongly negatively associated with BS-receptivity among people who score high (vs. low) on the IRS (Hypothesis 1).

2.1. Method

2.1.1. Sample, procedure, and materials

We requested 400 participants from Amazon Mechanical Turk. Eleven participants never completed the survey, resulting in a final sample of 389 participants. A sensitivity power analysis indicated that we had 80 % power to detect an effect with $R^2 = 0.0198$ ($p < .05$). A slight majority of participants (54.9 %) were male, 44.9 % were female, and 0.3 % were non-binary/third gender ($M_{age} = 39.72$, $SD = 11.71$). Most participants (75.1 %) were Caucasian, 11.8 % were African American, 6.4 % were Asian, 5.1 % Latino/Hispanic, 0.3 % Native Americans, and 1.3 % other. Each participant received $ 0.13 per minute for taking the survey.

Upon completing the informed consent form, participants took part in the online survey. BS-receptivity was measured using the 10-item BSR ($\alpha = 0.93$, Pennycook et al., 2015). An example item is: "Imagination is inside exponential space time events" (1 = *Not at all profound*, 5 = *very profound*). We also included the same ten motivational quotations (MQ,

α = 0.85) used by Pennycook et al. (2015), that are generally perceived as relatively profound. We pre-registered the computation of a BS-sensitivity score for each participant by subtracting their BSR-score from their evaluations of the motivational quotations. Thus, the purpose of the BS-sensitivity measure is to assess to what extent an individual discriminates between pseudo-profound BS and statements that contain actual meaning. We predicted and pre-registered a two-way interaction on BS-sensitivity, such that CA should be more strongly positively associated with BS-sensitivity among people high (vs. low) on the IRS (Hypothesis 2).

We used the 3-item Numeracy test (Schwartz et al., 1997) as a proxy for numerical ability. An example item is: "In the BIG BUCKS LOTTERY, the chance of winning a $10 prize is 1%. What is your best guess about how many people would win a $10 prize if 1000 people each buy a single ticket to BIG BUCKS?". We used the 10-item WordSum vocabulary test (Huang & Hauser, 1998) as a proxy for verbal ability. For each WordSum item, participants are asked to select the description (out of 6 options) that best captures the meaning of a word (e.g., emanate). Scores on these two tests were standardized and averaged to create a measure of general CA (cf., Pennycook et al., 2014; Ståhl & Van Prooijen, 2018).

The extent to which participants ascribe personal value to epistemic rationality was measured using the 6-item IRS (α = 0.88, 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*). As pre-registered, we also included the 9-item Moralized Rationality Scale (α = 0.88, Ståhl et al., 2016), and the 8-item AOT-E scale (α = 0.86, Pennycook et al., 2020), for exploratory purposes. Lastly, 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.

2.2. Results and discussion

Descriptive statistics and zero-order correlations are presented in Table 1. As pre-registered, our hypotheses were tested using hierarchical regression analyses. In Step 1 we entered CA and the IRS (both predictors were standardized). The CA × IRS interaction term relevant for our hypotheses was entered in Step 2.

2.2.1. BS-receptivity

Step 1 explained a substantial amount of variance in BS-receptivity, $F(2, 386) = 39.5$, $p < .001$, $R^2 = 0.170$. Consistent with previous studies, CA was negatively associated with BS-receptivity, $b = -0.50$, $SE = 0.06$, $t = -8.76$, $p < .001$. The IRS was unrelated to BS-receptivity, $b = -0.50$, $SE = 0.046$, $t = -1.61$, $p = .85$. More importantly, Step 2 did not explain a significant amount of additional variance, $F(1, 385) = 2.58$, $p = .109$, $\Delta R^2 = 0.006$. Thus, the IRS did not significantly moderate the relationship between CA and BS-receptivity, $b = -0.09$, $SE = 0.06$, $t = -1.61$, $p = .11$. Therefore, these results do not provide support for Hypothesis 1.

2.2.2. BS-sensitivity

Step 1 explained a substantial amount of variance in BS-sensitivity, $F(2, 386) = 25.2$, $p < .001$, $R^2 = 0.115$. CA was positively associated with BS-sensitivity, $b = 0.336$, $SE = 0.052$, $t = 6.47$, $p < .001$. The IRS was also positively associated with BS-sensitivity, $b = 0.088$, $SE = 0.041$, $t = 2.14$, $p = .033$. More importantly, Step 2 did not explain a significant amount of additional variance, $F(1, 385) = 2.46$, $p = .117$, $\Delta R^2 = 0.006$. Thus, the IRS did not significantly moderate the relationship between CA and BS-sensitivity, $b = 0.082$, $SE = 0.052$ $t = 1.57$, $p = .117$. Therefore, we did not find support for Hypothesis 2.

In summary, Study 1 did not provide support for our hypotheses, as neither of the two predicted two-way interactions reached statistical significance. One possibility is that the predicted effects are somewhat weaker than expected, and thereby would require higher statistical power to be detected. We will explore this possibility later in this article, as we pool the data from Study 1 with similar data from Study 2. The main purpose of Study 2, however, was to directly test the causal effect of analytic thinking on BS-receptivity and BS-sensitivity among people high (vs. low) on the IRS. We did so by experimentally varying whether participants answered the BSR and motivational quotations under cognitive load or no-load.

3. Study 2

This study was pre-registered (https://aspredicted.org/XSN_TSJ). We pre-registered four hypotheses. First, based on previous research (Ståhl & Van Prooijen, 2018, 2021) we expected people who score high (vs. low) on the IRS to be more motivated to engage in analytic thinking in pursuit of epistemically rational judgments. To the extent that judgments of BS-statements among people who score high (vs. low) on the IRS are more reliant on analytic thinking *by default*, they should be more sensitive to an experimental induction of cognitive load. Thus, we predicted a two-way interaction between cognitive load and the IRS on BS-receptivity. Specifically, we predicted that cognitive load (vs. no-load) would increase BS-receptivity more among people who score high (vs. low) on the IRS (Hypothesis 1). Similarly, we predicted that cognitive load (vs. no-load) would reduce BS-sensitivity more among people who score high (vs. low) on the IRS (Hypothesis 2)

We also pre-registered two hypotheses for which individual differences in cognitive ability (CA) were added to the equation. As in Study 1, we expected CA to be more strongly negatively associated with BS-receptivity among people who score high (vs. low) on the IRS. However, we expected this two-way interaction to disappear in the cognitive load condition, as people should be less able to rely on analytic thinking. Thus, we predicted a three-way interaction between cognitive load, the IRS, and CA on BS-receptivity (Hypothesis 3). We also predicted a three-way interaction on BS-sensitivity, such that CA should be more strongly positively associated with BS-sensitivity among people high (vs. low) on

Table 1
Means, standard deviations, and correlation coefficients (Study 1).

Variable	*M*	*SD*	1	2	3	4	5
1. Bullshit Receptivity	2.31	0.98					
2. MQ	3.07	0.78	0.55*** [0.48, 0.62]				
3. Bullshit Sensitivity	0.76	0.85	−0.65*** [−0.70, −0.59]	0.27*** [0.18, 0.36]			
4. Cognitive Ability	9.56	2.32	−0.44*** [−0.51, −0.35]	−0.19*** [−0.28, −0.09]	0.33*** [0.24, 0.42]		
5. IRS	5.61	1.06	−0.07 [−0.17, 0.03]	0.09 [−0.01, 0.19]	0.16** [0.06, 0.25]	0.20*** [0.11, 0.30]	
6. MRS	4.02	0.78	0.21*** [0.11, 0.30]	0.24*** [0.14, 0.33]	−0.03 [−0.13, 0.07]	−0.11* [−0.21, −0.01]	0.39*** [0.30, 0.47]

Note. Values in square brackets are 95 % confidence intervals. * $p < .05$. ** $p < .01$, *** $p < .001$. MQ = Motivational quotations, IRS = Importance of rationality scale, MRS = Moralized rationality scale.

the IRS, but only in the cognitive load condition (Hypothesis 4). Finally, because the no-load condition constituted an exact replication of Study 1, we also examined whether CA and the IRS interactively predicted BS-receptivity and BS-sensitivity when combining the two datasets.

3.1. Method

3.1.1. Sample

We requested 500 participants from Amazon Mechanical Turk. Participants received $0.13 per minute, plus a $1 bonus (explained below). Sixty-one participants never finished the survey, thus, we ended up with a sample of 439 participants. Consistent with our pre-registered exclusion criteria, three participants were excluded for failing both attention checks, resulting in a final sample of 436 participants. A sensitivity power analysis indicated that we had 80 % power to detect an effect with $R^2 = 0.0178$ ($p < .05$). A slight majority (54.6 %) were male, 44.7 % were female, and 0.7 % were non-binary/third gender ($M_{age} = 39.36$, $SD = 11.32$). Most participants (71.6 %) were Caucasian, 9 % Asian, 8.8 % African American, 5.6 % Latino/Hispanic, 1.8 % Native American, and 3.2 % other.

3.1.2. Design, procedure, and materials

Participants took part in the study upon giving informed consent. Participants were randomly assigned to the cognitive load condition ($n = 204$) or to the no-load condition ($n = 232$). We used the same BS-receptivity items ($\alpha = 0.92$), and motivational quotations (MQ, $\alpha = 0.82$) as in Study 1. We once again computed a BS-sensitivity score for each participant by subtracting their BS-receptivity score from their MQ-score.

3.1.2.1. Cognitive load manipulation. Participants in the no-load condition evaluated each of the BS-receptivity and MQ-items without any distractions. To experimentally induce cognitive load, we used a dot-matrix manipulation that has been demonstrated to reduce analytic thinking (Isler & Yilmaz, 2022). Participants in the cognitive load condition were informed that they would have to remember a pattern of dots in a matrix while evaluating the profundity of each statement. To ensure that participants took the cognitive load task seriously, they were informed that they could earn up to $1 if they correctly recalled all dot-matrices. In reality, all participants, including those in the no-load condition, received a $1 bonus at the end of the experiment. To prevent cheating (e.g., taking a picture of the dot matrix), participants had to simultaneously press the escape button (using their left hand) and the backspace button (using their right hand) in order for the dot matrix to appear on the screen. The dot matrix remained on screen for a maximum of 5 s, or until the participant ceased to press either of the two buttons. After that, a statement appeared on the screen, and participants were asked to evaluate its profundity. Then four different dot matrices appeared on the screen, one of which was the one they had just seen, and participants were asked to identify it. Upon selecting a matrix, the cycle started over with the presentation of a new dot matrix, followed by a new statement to be evaluated. This sequence was repeated for each of the BS-receptivity items and motivational quotations.

Upon completion of all BS-receptivity and MQ-items, we administered the individual difference measures relevant for our hypotheses. To measure Cognitive Ability (CA), we once again used the 3-item Numeracy test (Schwartz et al., 1997), as well as the 10-item Word-Sum (Huang & Hauser, 1998). Scores on these two tests were standardized and averaged to create a measure of general CA (cf., Pennycook et al., 2014; Ståhl & Van Prooijen, 2018).

The extent to which participants ascribe personal value to epistemic rationality was once again measured using the IRS ($\alpha = 0.85$, Ståhl et al., 2016). As pre-registered, we also included the Moralized Rationality Scale ($\alpha = 0.88$, Ståhl et al., 2016), and the AOT-E ($\alpha = 0.86$, Pennycook et al., 2020), for exploratory purposes. Lastly, we measured the same demographic variables as in Study 1 (gender, age, level of education, religiosity, religious affiliation, and political orientation). After that, participants were thanked and paid for their participation.

3.2. Results and discussion

3.2.1. Dot matrix recall

Participants in the cognitive load condition took the dot matrix task seriously, as indicated by high recall scores across the 20 trials ($M = 17.28$, $SD = 2.97$). Recall performance did not differ between BSR items ($M = 8.68$, $SD = 1.60$) and motivational quotations ($M = 8.59$, $SD = 1.67$), $t(203) = 0.971$, $p = .333$ 1. As should be expected from a task relying on working memory, recall performance was positively associated with individual differences in cognitive ability, $r\,(202) = 0.31$, $p < .001$.

3.2.2. Independence checks

Neither cognitive ability, $t(434) = 0.607$, $p = .544$, nor scores on the IRS, $t(434) = 0.725$, $p = .50$, differed between the cognitive load and no-load conditions.

3.2.3. Hypothesis testing

Descriptive statistics and zero-order correlations are presented in Table 2. We tested our hypotheses using hierarchical multiple regression. First, we examined whether the IRS moderated the effect of cognitive load on BS-receptivity and BS-sensitivity (Hypotheses 1–2). After that, we added individual differences in cognitive ability to the equation to see whether CA, IRS, and cognitive load interactively predicted BS-receptivity and BS-sensitivity (Hypotheses 3–4).

3.2.4. Hypotheses 1–2

In Step 1 we entered the IRS (standardized), and cognitive load (1 = cognitive load, 0 = no load). The interaction term relevant for our hypotheses (IRS × cognitive load) was entered in Step 2. Step 1 did not explain a significant amount of variance in BS-receptivity, $F(2, 433) = 1.4$, $p = .248$, $R^2 = 0.006$. Specifically, neither cognitive load, $b = 0.137$, $SE = 0.091$, $t = 1.50$, $p = .13$; nor the IRS, $b = -0.031$, $SE = 0.045$, $t = -0.68$, $p = .50$, were significantly associated with BS-receptivity. More importantly, however, Step 2 did explain an additional amount of variance in BS-receptivity, $F(1, 432) = 4.85$, $p = .028$, $\Delta R^2 = 0.011$. Thus, the predicted cognitive load by IRS interaction was significant, $b = 0.201$, $SE = 0.091$ $t = 2.20$, $p = .028$. As depicted in Fig. 1, cognitive load (vs. no load) increased BS-receptivity among people high (+1SD) on the IRS, $b = 0.34$, $SE = 0.13$, $t = 2.62$, $p = .009$, but not among people low (-1SD) on the IRS, $b = -0.06$, $SE = 0.13$, $t = -0.50$, $p = .62$. Thus, we found support for Hypothesis 1.

Step 1 did explain a significant amount of variance in BS-sensitivity, $F(2, 433) = 3.62$, $p = .027$, $R^2 = 0.016$. Specifically, the IRS was positively associated with BS-sensitivity, $b = 0.10$, $SE = 0.040$, $t = 2.46$, $p = .014$. By contrast, cognitive load was unrelated to BS-sensitivity, $b = -0.081$, $SE = 0.081$, $t = -1.00$, $p = .317$. More importantly, Step 2 did not explain an additional amount of variance in BS-sensitivity, $F(1, 432) = 2.29$, $p = .131$, $\Delta R^2 = 0.005$, as the CA by IRS interaction was non-significant, $b = -0.122$, $SE = 0.081$, $t = -1.51$, $p = .131$.

In summary, we found support for the prediction that analytic thinking causes skepticism toward pseudo-profound BS among people who are motivated to be epistemically rational. Specifically, we showed that cognitive load reduced skepticism toward BS, but only among people who scored high (vs. low) on the IRS. Notably, the predicted interaction effect was small, and it was only statistically significant for BS-receptivity (not BS-sensitivity). The small effect size may in part be due to a relatively weak manipulation of cognitive load, as indicated by high recall scores.

3.2.5. Hypotheses 3–4

We entered cognitive load, CL, and the IRS in Step 1. In Step 2 we

Table 2
Means, standard deviations, and correlation coefficients (Study 2).

Variable	*M*	*SD*	1	2	3	4	5	6
1. Cognitive Load	–	–						
2. Bullshit Receptivity	2.43	0.95	0.07 [−0.03, 0.16]					
3. MQ	3.19	0.77	0.02 [−0.07, 0.12]	0.53*** [0.46, 0.60]				
4. Bullshit Sensitivity	0.76	0.85	−0.05 [−0.15, 0.04]	−0.64*** [−0.69, −0.58]	0.31*** [0.22, 0.39]			
5. Cognitive Ability	9.69	2.29	−0.03 [−0.13, 0.06]	−0.40*** [−0.48, −0.32]	−0.21*** [−0.30, −0.12]	0.26*** [0.17, 0.35]		
6. IRS	5.67	0.92	−0.03 [−0.12, 0.06]	−0.03 [−0.13, 0.06]	0.10* [0.00, 0.19]	0.13** [0.03, 0.22]	0.19*** [0.10, 0.28]	
7. MRS	4.07	0.78	−0.06 [−0.15, 0.04]	0.25** [0.16, 0.33]	0.16** [0.07, 0.25]	−0.13** [−0.22, −0.04]	−0.14* [−0.23, −0.04]	0.38*** [0.30, 0.46]

Note. Values in square brackets are 95 % confidence intervals. * $p < .05$. ** $p < .01$, *** $p < .001$. MQ = Motivational quotations, IRS = importance of rationality scale, MRS = Moralized rationality scale.

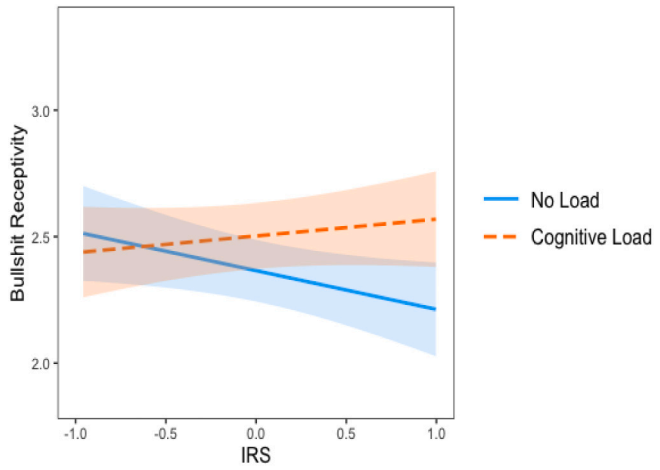

Fig. 1. Bullshit receptivity as a function of cognitive load and the IRS (Study 2).

entered all two-way interactions, and in Step 3 we entered the three-way interaction. Step 1 explained a significant amount of variance in BS-receptivity, $F(3, 432) = 27.8$, $p < .001$, $R^2 = 0.162$. CA was negatively associated with BS-receptivity, $b = -0.468$, $SE = 0.052$, $t = -8.95$, $p < .001$. By contrast, neither cognitive load, $b = 0.12$, $SE = 0.084$, $t = 1.43$, $p = .15$, nor the IRS, $b = 0.05$, $SE = 0.043$, $t = 1.15$, $p = .25$, were significantly associated with BS-receptivity. More importantly, Step 2 explained an additional amount of variance in BS-receptivity, $F(6, 429) = 3.43$, $p = .017$, $\Delta R^2 = 0.020$. The CA by IRS interaction was significant, $b = -0.145$, $SE = 0.057$, $t = -2.52$, $p = .012$. Consistent with previous research on epistemically suspect beliefs, CA was more strongly negatively associated with BS-receptivity among people high (+ 1SD) on the IRS, $b = -0.62$, $SE = 0.08$, $t = -7.59$, $p < .001$, than among people low (-1SD) on the IRS, $b = -0.33$, $SE = 0.07$, $t = -4.53$, $p < .001$. Neither the cognitive load by IRS, $b = 0.121$, $SE = 0.086$, $t = 1.40$, $p = .161$, nor the cognitive load by CA interaction, $b = 0.094$, $SE = 0.104$, $t = 0.90$, $p = .370$, were significant. Step 3 did not explain a significant amount of additional variance, $F(1, 428) = 1.76$, $p = .186$, $\Delta R^2 = 0.003$. Thus, the CA by IRS interaction was not significantly moderated by the cognitive load manipulation, $b = 0.15$, $SE = 0.115$, $t = 1.33$, $p = .186$.

Step 1 accounted for a significant amount of variance in BS-sensitivity, $F(3, 432) = 10.7$, $p < .001$, $R^2 = 0.069$. Cognitive ability was negatively associated with BS-sensitivity, $b = -0.468$, $SE = 0.05$, $t = 4.93$, $p < .001$. By contrast, neither the IRS, $b = 0.06$, $SE = 0.04$, $t = 1.44$, $p = .15$, nor cognitive load, $b = -0.07$, $SE = 0.079$, $t = -0.92$, $p = .36$, predicted BS-sensitivity. Moreover, neither Step 2, $F(1, 429) = 0.608$, $p = .61$, $\Delta R^2 = 0.004$, nor Step 3, $F(1, 428) = 1.374$, $p = .24$, $\Delta R^2 = 0.003$ accounted for any significant additional variance. Thus, there was no support for Hypothesis 4, as the three-way interaction was not statistically significant, $b = -0.128$, $SE = 0.11$, $t = -1.17$, $p = .24$.

In summary, consistent with previous research, CA was a stronger predictor of skepticism toward pseudo-profound BS among people who scored high (vs. low) on the IRS. Contrary to our hypotheses, however, this effect was not significantly moderated by cognitive load, nor obtained for BS-sensitivity. We will get back to this issue in the General Discussion.

3.3. Pooling data from both studies

Because the control condition in Study 2 constituted an exact replication of Study 1, we pooled these datasets together to test whether CA and the IRS interactively predicted BS-receptivity and BS-sensitivity when we have considerably higher statistical power ($N = 620$). A sensitivity power analysis indicated that we had 80 % power to detect an effect with $R^2 = 0.0125$ ($p < .05$). Step 1 accounted for a significant amount of variance in BS-receptivity, $F(2, 618) = 65.7$, $p < .001$, $R^2 = 0.175$. CA was negatively associated with BS-receptivity, $b = -0.50$, $SE = 0.044$, $t = -11.19$, $p < .001$, whereas the IRS was not, $b = -0.003$, $SE = 0.037$, $t = -0.09$, $p = .93$.

More importantly for the present purposes, Step 2 accounted for an additional amount of variance in BS-receptivity, $F(1, 617) = 8.01$, $p = .005$, $\Delta R^2 = 0.011$, as the hypothesized CA by IRS interaction was significant, $b = -0.135$, $SE = 0.05$, $t = -2.83$, $p = .005$. As depicted in Fig. 2, CA was more strongly negatively associated with BS-receptivity among people high (+1SD) on the IRS, $b = -0.658$, $SE = 0.071$, $t = -9.18$, $p < .001$, than among people low (-1SD) on the IRS, $b = -0.39$, $SE = 0.057$, $t = -6.86$, $p < .001$. Thus, across the two studies, we have support for the hypothesis that the extent to which people value epistemic rationality moderates the relationship between CA and BS-receptivity.

For BS-sensitivity, Step 1 accounted for a significant amount of variance, $F(2, 618) = 34.5$, $p < .001$, $R^2 = 0.100$. Both CA, $b = 0.28$, $SE = 0.040$, $t = 7.03$, $p < .001$, and the IRS, $b = 0.096$, $SE = 0.034$, $t = 2.85$, $p = .005$, were positively associated with BS-sensitivity. However, Step 2 did not account for a significant amount of additional variance, $F(1, 617) = 3.77$, $p = .053$, $\Delta R^2 = 0.006$, as the CA by IRS interaction was not statistically significant, $b = 0.084$, $SE = 0.043$, $t = 1.94$, $p = .053$. Thus, across the two studies, we have no reliable support for the hypothesis

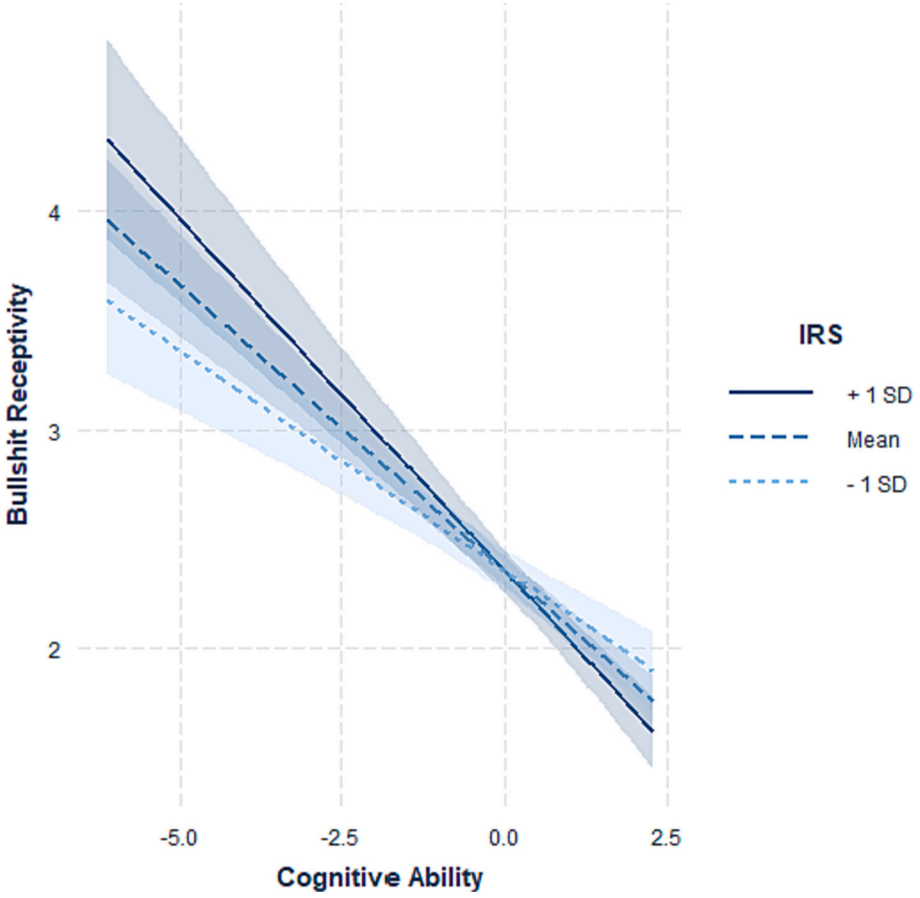

Fig. 2. Bullshit receptivity as a function of cognitive ability and the IRS (Studies 1–2, pooled data).

that valuing epistemic rationality moderates the link between CA and BS-sensitivity. We will get back to this issue in the General Discussion.

4. Study 3

Thus far, we have shown that individual differences in cognitive ability are associated with somewhat more skepticism toward pseudo-profound BS among people who strongly (vs. weakly) value epistemic rationality. Moreover, the same pattern of results emerged when we experimentally varied the ability to engage in analytic thinking rather than relying on individual differences in cognitive ability. What is not yet clear, however, is whether cognitive sophistication coupled with motivation to be epistemically rational continue to predict skepticism toward BS when it stems from a credible source. Previous research (Hoogeveen et al., 2022) has shown that BS-statements are perceived as more credible and important when coming from a scientist (vs. spiritual leader). Moreover, this effect is more pronounced among those who are less (vs. more) religious, presumably because they are particularly inclined to view scientists as more credible than spiritual leaders. This finding, coupled with the fact that measures of cognitive sophistication, as well as the IRS, are negatively associated with religiosity (e.g., Gervais & Norenzayan, 2012; Pennycook et al., 2012; Ståhl et al., 2016; Ståhl & Van Prooijen, 2021), and positively associated with favorable attitudes toward science (Ståhl et al., 2016) and trust in scientists (Pennycook et al., 2020), raises the possibility that our focal interaction effect may not generalize to situations where BS-statements stem from a scientist. At the same time, however, research on persuasion has shown that source effects are frequently stronger when people process the message superficially (Chaiken et al., 1989; Hovland & Weiss, 1951; Kiesler & Mathog, 1968; Petty & Cacioppo, 1986; Petty et al., 1981; but see Briñol et al., 2004). Because people who score high on cognitive ability, and on motivation to be epistemically rational should be the least likely to process information superficially, it seems plausible that our focal interaction effect between cognitive ability and the IRS may emerge regardless of source credibility.

In Study 3 we test these competing hypotheses by measuring individual differences in cognitive ability, as well as motivation to be epistemically rational, while experimentally manipulating whether BS-statements are coming from a scientist or from a spiritual leader. To establish that the 'Einstein effect' truly stems from the high credibility of scientists (rather than low credibility of spiritual leaders), we also included an anonymous source in this study. To the extent that our focal interaction is restricted to situations where BS stems from less credible sources, we should expect a three-way interaction between CA, IRS, and source. To the extent that our focal interaction is independent of source credibility, we should only expect to find the CA by IRS interaction.[1]

4.1. Method

4.1.1. Sample, procedure, and materials

We requested 1000 participants from Amazon Mechanical Turk. Eighteen participants chose to withdraw their data upon completion, and 12 participants failed to pass the attention checks, resulting in a

[1] [1] In addition to the primary goal of testing whether the CA by IRS interaction is dependent on the source, we also sought to replicate the previous finding that the Einstein effect is weaker among highly religious people (Hoogeveen et al., 2022), as well as explore whether the Einstein effect is *stronger* among people who have a higher level of trust in science. We tested this notion by examining whether the Einstein effect is stronger among people who score high (vs. low) on belief in science (Farias et al., 2013).

final sample of 970 participants (M_{age} = 41.31, *SD* = 12.86). The gender distribution was relatively even (55.7 % female, 43 % male, and 0.4 % other). Most participants (74.9 %) were white, 9.1 % were African American, 7.5 % were Asian, 5.1 % were Latino, 0.7 % were native American, and 2.7 % identified as other. Each participant received $ 0.13 per minute for taking the survey.

Upon completing the informed consent form, participants took part in the online experiment. The design was a single factor (source: scientist/spiritual leader/anonymous) within-subjects design. Participants were informed that they would be reading three quotes from different sources. They were asked to think about what each quote might mean and to evaluate how credible and important it was. Two of the quotes were taken from the original Einstein effect article (Hoogeveen et al., 2022), for which they were generated using the New Age Bullshit Generator (http://sebpearce.com/bullshit/). Because we included a third (anonymous) source in our study, we generated an additional quote using the same resource. The additional quote stated: "The goal of transmissions is to plant the seeds of synchronicity rather than dogma. Understanding is the driver of growth. Eons from now, we adventurers will exist like never before as we are re-energized by the dreamscape." We counterbalanced the order in which participants were exposed to the three sources, as well as which quote was associated with which source. Unlike in the original study by Hoogeveen et al. (2022), we did not include any pictures of the sources, or any background decor. We simply presented participants with the quote, and the name and occupation of the source (or anonymous) below. Consistent with the original study, participants were asked to evaluate how credible each statement was (1 = *not at all credible*, 7 = *extremely credible*), as well as how important it was (1 = *not at all important*, 7 = *extremely important*).

Upon evaluating the three quotes, we administered our set of individual difference measures. Cognitive ability was measured in the same way as in studies 1 and 2, and the extent to which participants ascribe personal value to epistemic rationality was once again measured using the 6-item IRS (Ståhl et al., 2016). Religiosity was measured using three items from the Santa Clara scale (Plante & Boccaccini, 1997). An example item is: "I look to faith for purpose and meaning in life" (1 = *not at all*, 5 = *very much*). Belief in science was measured using the 10-item Belief in Science scale (Farias et al., 2013). An example item is: "The scientific method is the only reliable path to knowledge" (1 = *strongly disagree*, 6 = *strongly agree*). Finally, we measured a set of demographic variables (gender, age, level of education, religious affiliation, and political orientation), after which participants were debriefed about the purpose of the study. Upon reading the debriefing, we asked participants whether they would like to withdraw their data from the study. After that, participants were thanked and paid for their participation.

4.2. Results and discussion

Descriptive statistics and zero-order correlations are presented in Table 3. Our results were tested using mixed model analyses. We included a random intercept for subjects, to account for individual differences in responses to the different sources. To examine the effects of source, we created two dummy-coded variables. The first dummy-variable contrasted the scientist source (1) against the anonymous source (0), and the second dummy-variable contrasted the spiritual leader source (1) against the anonymous source (0). Consistent with Hoogeveen et al. (2022), we conducted separate analyses for credibility and importance judgments. We will focus here on results directly pertaining to our competing hypotheses. However, all results from these analyses can be found in the Supplemental materials (Tables S1 and S2).

4.2.1. Credibility

Consistent with previous studies, we found a significant CA by IRS interaction, $b = -0.169$, SE = 0.051, $p < .001$. As depicted in Fig. 3, CA was more strongly negatively associated with perceived statement credibility among people who score high (+1SD) on the IRS, $b = -0.461$, SE = 0.079, $t = -5.863$, $p < .001$; than among people who score low (-1SD) on the IRS, $b = -0.123$, SE = 0.068, $t = -1.817$, $p = .069$. Notably, this effect was not qualified by the source of the statement (*p*s > 0.25).

4.2.2. Importance

Once again, we found a significant CA by IRS interaction, $b = -0.137$, $SE = 0.056$, $p < .05$. CA was more strongly negatively associated with perceived statement importance among people who score high (+1SD) on the IRS, $b = -0.497$, SE = 0.086, $t = -5.762$, $p < .001$; than among people who score low on the IRS, $b = -0.222$, SE = 0.074, $t =$

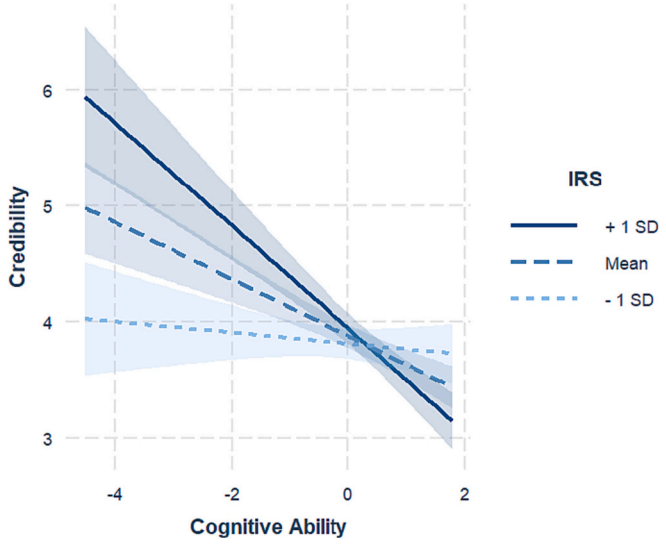

Fig. 3. Perceived credibility of statement as a function of CA and IRS (Study 3).

Table 3
Means, standard deviations, Chronbach's alphas, and correlation coefficients (Study 3).

Variable	*M*	*SD*	α	1	2	3	4	5
1. Credibility	4.07	1.64	0.97	–				
2. Importance	3.89	1.78	0.79	0.83*** [0.82, 0.84]				
3. CA	4.80	0.95	0.64	−0.12*** [−0.16, −0.09]	-0.15*** [−0.19, −0.12]			
4. IRS	5.61	0.95	0.85	0.02 [−0.02, 0.06]	0.01 [−0.02, 0.05]	0.17*** [0.14, 0.21]		
5. Religiosity	2.47	1.45	0.97	0.08*** [0.04, 0.12]	0.09*** [0.06, 0.13]	−0.14*** [−0.18, −0.10]	−0.21*** [−0.25, −0.18]	
6. BIS	4.90	1.21	0.94	0.10*** [0.07, 0.14]	0.10*** [0.06, 0.13]	0.01 [−0.03, 0.04]	0.40*** [0.37, 0.43]	−0.55*** [−0.57, −0.52]

Note. Values in square brackets are 95 % confidence intervals. CA = Cognitive Ability; IRS = Importance of Rationality Scale; BIS = Belief in Science. * $p < .05$. ** $p < .01$, *** $p < .001$. CA = Cognitive ability, IRS = Importance of rationality scale, BIS = Belief in Science.

−2.984, $p = .003$. As was the case for credibility judgments, this effect was not qualified by the source of the statement ($ps > 0.31$). Taken together, these findings suggest that the combination of high cognitive ability, and ascribing high value to epistemic rationality, promotes skepticism toward BS, regardless of whether it stems from a more (vs. less) credible source.[2]

5. General discussion

In the present research we set out to test whether analytic sophistication coupled with motivation to be epistemically rational provide protection against pseudo-profound bullshit. Data from three studies provided support for this notion, although the effect sizes obtained were notably small. First, when pooling data from the first two studies, individual differences in cognitive ability were more strongly associated with skepticism toward pseudo-profound BS among people who ascribed high (vs. low) value to epistemic rationality. This finding constitutes a conceptual replication of previous studies that have documented a similar pattern of results for paranormal beliefs, conspiracy beliefs, and belief in God (Adam-Troian et al., 2019; Ståhl & Van Prooijen, 2018, 2021). Notably, the present finding goes beyond the extant literature in one important way. The fact that we obtained this interaction effect on judgments of BS-statements that were made in the moment, rather than retrieved from memory, provides the first direct evidence that these factors predict actual reasoning quality when people are confronted with suspect claims. However, because the data was correlational, we cannot rule out the possibility that unknown confounds account for these results.

In Study 2 we provided more conclusive causal evidence for our interpretation of these results. We reasoned that, because people who score high (vs. low) on the IRS should be more motivated to reach accurate conclusions when evaluating the BS-statements, they should be more inclined to rely on analytic thinking by default. As a consequence, their judgments of the BS-statements should be more sensitive to a manipulation that makes it more difficult to engage in analytic thinking. Consistent with this line of reasoning, we demonstrated that cognitive load (vs. no load) only increased BS-receptivity among people who ascribed high (vs. low) value to epistemic rationality. Combined with previous evidence that making the goal to be rational salient strengthens the negative associations between cognitive ability and various epistemically suspect beliefs (Adam-Troian et al., 2019), there is now direct evidence that a combination of analytic thinking and motivation to be epistemically rational promotes skepticism toward epistemically suspect ideas, and BS-statements.

Study 3 examined whether the combination of high cognitive ability and ascribed value to epistemic rationality predicts skepticism toward BS-statements regardless of the credibility of the source. The focal CA by IRS interaction was once again obtained, on judgments of how credible as well as how important the BS-statements were. Furthermore, these effects were observed regardless of whether the BS-statements stemmed from a scientist, a spiritual leader, or an anonymous source. These findings are consistent with previous studies showing weaker effects of source credibility on persuasion when people process the persuasive message thoroughly (Chaiken et al., 1989; Hovland & Weiss, 1951; Kiesler & Mathog, 1968; Petty & Cacioppo, 1986; Petty et al., 1981. Notably, however, people can be influenced by a source's credibility despite processing the information carefully, for example when the strength of the argument is ambiguous (Chaiken & Maheswaran, 1994). It seems highly plausible that similar boundary conditions may apply to the present findings. As it gets increasingly difficult to assess whether a claim is credible or not, people who score high on cognitive ability, and ascribe high value to epistemic rationality, may eventually rely on the credibility of the source to guide their judgments. Future research should manipulate the ambiguity of epistemically suspect claims to explore the boundary conditions of the present findings.

It is noteworthy that the CA by IRS interaction was substantially smaller in the present studies (and not statistically significant on measures of BS-sensitivity) than what has been observed in studies looking at paranormal and conspiracy beliefs (Ståhl & Van Prooijen, 2018). A possible explanation for the smaller effect sizes obtained in the present studies is that the temptation to read meaning or truth into randomly generated BS-statements might be considerably weaker than is the case with various conspiracy theories and paranormal phenomena, that are frequently tied to existential as well as epistemic motives (e.g., Newheiser et al., 2011; Van Prooijen & Acker, 2015; Whitson & Galinsky, 2008). Therefore, relatively little epistemic motivation may have been required to resist this temptation, and to evaluate the BS-statements objectively. Consistent with this interpretation, cognitive ability remained a robust predictor of skepticism toward BS across different levels of epistemic motivation in the present studies, and was only a slightly stronger predictor among those who scored high (vs. low) on the IRS. By contrast, previous studies have found that cognitive ability *only* predicted skepticism toward paranormal and conspiracy beliefs among people who score high (vs. low) on the IRS (Ståhl & Van Prooijen, 2018). Future studies are needed to examine the validity of this interpretation, ideally by experimentally manipulating people's motivation to adopt epistemically suspect beliefs, or to read meaning into pseudo-profound BS.

Given that cognitive ability predicted both BS-receptivity and BS-sensitivity, it is surprising that we did not find a negative main effect of the cognitive load manipulation on these variables in Study 2. Taken together with the high recall scores from the dot-matrix task, these results suggest that the cognitive load manipulation was relatively weak. Although it made it more difficult to engage in analytic thinking when evaluating the BS-statements compared to the no-load condition, it did not completely prevent participants from doing so. The fact that dot-matrix recall was predicted by individual differences in cognitive ability clearly shows that the manipulation successfully added some cognitive load. Moreover, the fact that cognitive load increased BS-receptivity among people who score high (vs. low) on the IRS, as hypothesized, provides additional evidence that the manipulation was successful. However, the relatively weak manipulation of cognitive load may have contributed to the small size of this effect and may explain why cognitive load failed to significantly moderate the CA by IRS interaction on BS-receptivity. Based on these results, we recommend the use of stronger manipulations of cognitive load in future studies on BS-receptivity – or a reliance of substantially larger samples, sensitive enough to detect small effects.

[2] We also explored whether religiosity and belief in science served opposite moderating roles for the Einstein and Guru effect, respectively. As can be seen in Tables S3 and S4 (Supplemental materials), this was the case for perceived statement credibility. Whereas the Einstein effect was accentuated by belief in science, it was attenuated by religiosity. By contrast, whereas the Guru effect was accentuated by religiosity, it was attenuated by belief in science. As can be seen in Tables S5 and S6, results were virtually identical for perceived importance, with the exception that the Einstein effect was not significantly moderated by religiosity. Taken together, this pattern of results suggests that Einstein and Guru effects are moderated by levels of trust in science vs. religion, respectively.We also conducted an exact replication of Study 3 ($N = 969$), with the exception that we did not include a measure of belief in science. The results from this replication study can be found in the Supplemental materials (Tables S6-S8). In brief, we replicated the Einstein effect and the Guru effect. However, the focal CA x IRS interaction was *not* significant in the replication study. When pooling the data from Study 3 and the replication study, however, the CA x IRS interaction was statistically significant for both perceived statement credibility and statement importance. The main results from analyses of the pooled dataset can also be found in the Supplemental materials (Tables S9-S10).

6. Conclusion

Previous studies have shown that various epistemically suspect beliefs are less prevalent among people who are cognitively sophisticated as well as motivated to be epistemically rational. However, because those studies focused on correlational studies of presumably pre-existing beliefs, it is unclear whether cognitive sophistication and motivation to be epistemically rational interactively predict people's quality of reasoning when exposed to novel suspect claims, as well as whether these findings represent causal relationships. The present studies sought to address these limitations (1) by studying receptivity to randomly generated BS-statements rather than already established beliefs (Studies 1–3), (2) by experimentally manipulating people's ability to engage in analytic thinking (Study 2), and (3) by examining whether this effect is independent of source credibility (Study 3). The present results were generally consistent with previous studies, albeit with smaller effects. Among people who ascribe more (vs. less) value to epistemic rationality, cognitive load uniquely increased BS-receptivity, and individual differences in cognitive ability were somewhat more strongly negatively associated with BS-receptivity. Moreover, cognitive ability and value ascribed to epistemic rationality interactively predicted BS-receptivity regardless of the source's credibility. Taken together, the present findings suggest that cognitive sophistication coupled with motivation to be epistemically rational may promote skepticism toward a host of epistemically suspect ideas and misinformation. Future research is needed to determine if this is especially the case as the temptation to adopt the belief in question gets stronger.

CRediT authorship contribution statement

Tomas Ståhl: Conceptualization, Methodology, Writing – original draft, Visualization, Project administration. **Sinem Yilmaz:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Nathan Digby:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Philip Stasko:** Investigation, Writing – review & editing.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2023.112452.

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