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Title: Dogmatism manifests in lowered information search under uncertainty

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Abstract: When knowledge is scarce, it is often adaptive to seek information to resolve uncertainty and obtain a more accurate worldview. Biases or reduction in such information-seeking behavior may contribute to the maintenance of dogmatic views. Here we investigate whether alterations in uncertainty-guided information seeking are related to individual differences in dogmatism, a phenomenon that is linked to entrenched beliefs in political, scientific and religious discourse. We study this in a perceptual decision-making task, allowing us to rule out motivational factors and isolate a role of uncertainty in information search. In two independent general population samples (N = 370 and N = 364), we find that more dogmatic participants are less likely to seek out new information to refine an initial perceptual decision, leading to a reduction in belief accuracy despite similar initial decision performance. Computational modelling revealed that dogmatic participants used internal signals of uncertainty (confidence) to a lesser degree to guide their search, such that they were less likely to seek additional information to update beliefs based on weak or uncertain evidence. Together our results highlight a novel cognitive mechanism that may contribute to dogmatic worldviews.

Significance Statement: Dogmatic individuals often appear reluctant to seek out information in order to refine their views, but the cognitive drivers of this reluctance are poorly understood. Here, we isolate the influence of uncertainty on information search through a low-level perceptual decision-making task. We show that people with dogmatic views are less likely to seek information before committing to a decision, and were also less likely to use fluctuations in uncertainty to guide their search. Our results highlight a novel cognitive mechanism that may contribute to dogmatic world views.

Main Text. Information seeking decisions are all around us – from opening a newspaper or switching on the radio to clicking on a link in our newsfeed. Whether we seek out information, and what information we seek, is in turn a crucial determinant of our beliefs. Cognitive science provides a rich empirical and theoretical perspective on these information-seeking choices. On the one hand, people prefer looking for information that confirms their beliefs and has positive valence, such as reading an additional news story about the election win of a favored political party. Such motivated search is evident both in laboratory experiments (1–3) and in real-world data (4–6) . On the other hand, normative frameworks propose that uncertainty, rather than valence, should determine where and when we look for information (7–10). Empirical data also bears out such predictions (11–16), with people being more likely to seek information when they express low confidence (i.e. certainty) in their decisions (13, 14).

In turn, both motivation- and uncertainty-guided influences on information search may lead people to form biased or inaccurate beliefs, but do so via different mechanisms. For example, a person who does not believe in climate change might prefer to consume media refuting it (17), reinforcing their pre-existing beliefs. Alternatively, people might hold doubts about the science of climate change but be unconfident in this opinion (18). If they fail to act on this uncertainty and do not seek out further information, they will not be exposed to potentially corrective evidence. Such unwillingness to seek out potentially corrective information might lead to a dogmatic worldview. Dogmatism is defined as a rigid maintenance of one's beliefs (19–21), regardless of their accuracy (22), and is a trait that transcends specific issues, affecting political (23), scientific (24), and religious debate (19, 24). Prior questionnaire-based research suggests a link between this style of holding beliefs and the willingness to seek further information (19, 25), but is yet to disentangle the roles of motivation and uncertainty in lowering information search.

Here, we address this question by developing a precise assay of uncertainty-guided information search in the context of a low-level perceptual decision-making task, and seek to explain (in both exploratory and replication samples) individual differences in the tendency to hold dogmatic beliefs. Our approach builds on previous research on the influence of confidence on search in perceptual decision-making (14, 26), allowing us to rule out motivational influences: participants are unlikely to approach our task with any vested interests or prior knowledge, nor should they hold differing appraisals of the helpfulness of further information. A momentary trial-by-trial measure of confidence further enabled us to mechanistically understand how participants employ their uncertainty to guide their information search.

Results. We investigated the relationship between information search and dogmatism in a sample of 370 US adults (study 1) and replicated all key findings in an independent second sample of 364 participants (study 2). Both samples were recruited through Amazon Mechanical Turk and comprised a wide range of ages and educational backgrounds (see Methods for details). Participants first completed an information-seeking task and then answered a battery of questionnaires to assay general belief rigidity and dogmatism, and also political beliefs, authoritarianism, intolerance to opposing political attitudes (see Methods for details regarding the questionnaires). Such methodology builds on our previous research on how dogmatic individuals construct a sense of confidence (22).

Our measure of dogmatism was derived from a factor analysis applied to this questionnaire battery (see Fig. 1). The breadth of the battery allowed us to quantitatively distinguish dogmatism from other, possibly related, constructs and study their interplay. The most parsimonious structure contained three factors, with the first factor representing position on a left-right political spectrum, a second factor representing domain general dogmatism and rigidity of worldview (19), while a third

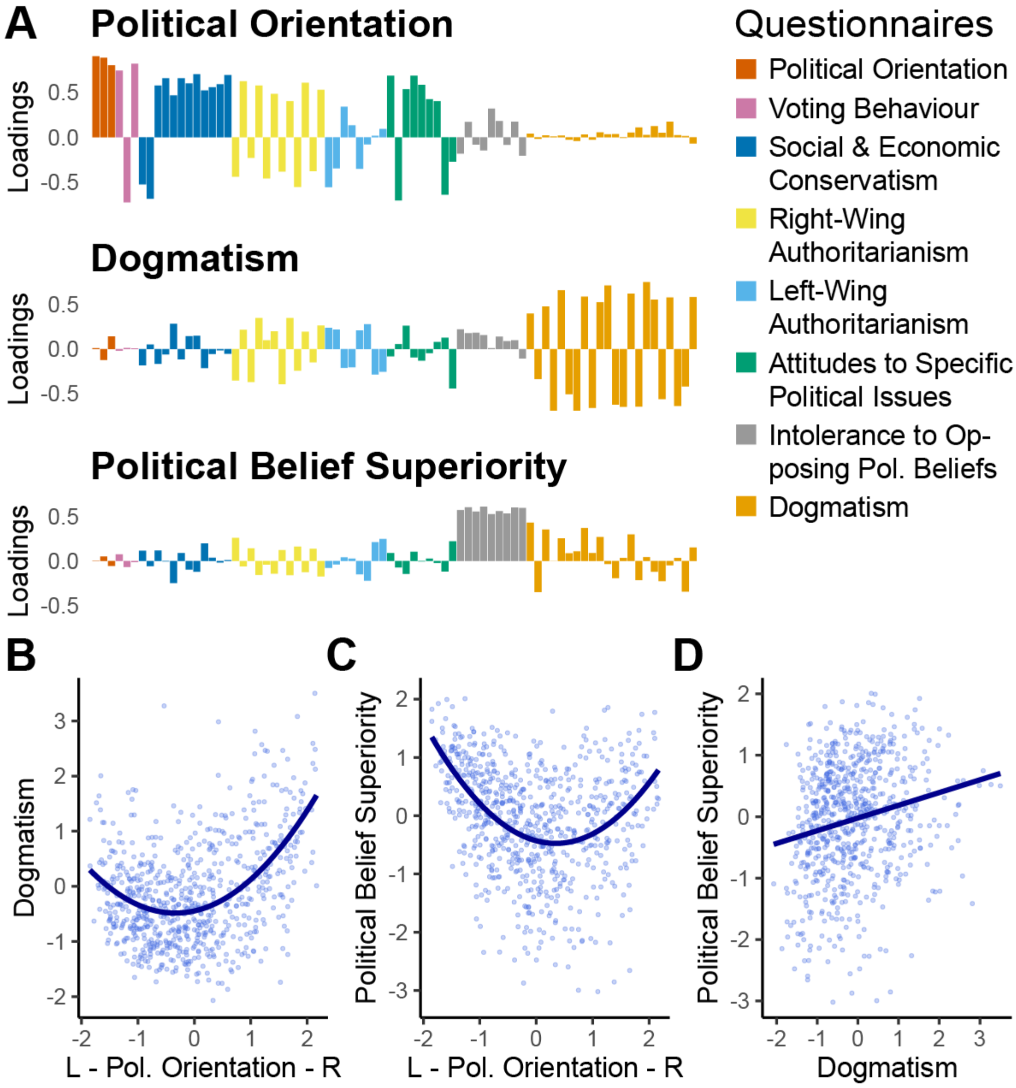

Fig 1. Liberal and conservative extremes of the political spectrum predict levels of dogmatism and belief superiority. (A) A factor analysis revealed a three-factor structure underlying responses to multiple questionnaires assessing political convictions, authoritarianism and belief rigidity. The three factors identified (1) "political orientation" (liberal to conservative), (2) "dogmatism" representing a domain-general belief certainty and (3) "political belief superiority" characterizing participants' confidence in specific political convictions. Item loadings for each question are presented with individual questionnaires indicated by colors**. (B-D)** We examined the relationships between these constructs by investigating individual scores for each factor (combined data for study 1 and 2 are plotted). **(B, C)** We observed a combined linear-quadratic model provided the best fit to the relationship between both political orientation and dogmatism and between political orientation and political belief superiority**. (D)** The relationship between dogmatism and political belief superiority was best characterized by a linear relationship (see SI for further details about the factor analysis).

factor captured variance in beliefs in the superiority of participants' policy preferences, a factor related to but also theoretically independent of dogmatism (20). Whereas this last factor is specific to political policy, dogmatism is a broader concept that describes the general way beliefs are held and acted upon (21, 27, 28) and transcends specific political issues - as evident for example in the reported link between dogmatism and religious fundamentalism (19).

We first explored inter-relationships between individuals' political orientation, dogmatism and political belief superiority (see also Table S2). We found both positive linear (study 1: $\beta_{linear} = .16$, $p = .001$; study 2: $\beta_{linear} = .24.$, $p < 10^{-6}$) and quadratic (study 1: $\beta_{quadratic} = .35$, $p < 10^{-13}$; study 2: $\beta_{quadratic} = .37$, $p < 10^{-13}$) relationships between political orientation and dogmatism in both samples. This indicates that individuals on both the far left and far right of the political spectrum show enhanced dogmatism, but that this increase in dogmatism is more marked for the far right (see Fig. 1 B, Methods and Table S1 for further information). Conversely, a negative linear (study 1: $\beta_{linear} = -.33$, $p < 10^{-10}$; study 2: $\beta_{linear} = -.32$, $p < 10^{-9}$) and positive quadratic relationship (study 1: $\beta_{quadratic} = .43$, $p < 10^{-20}$; study 2: $\beta_{quadratic} = .34$, $p < 10^{-10}$) between political orientation and political belief superiority reveals that individuals on both the far left and far right show heightened beliefs in the superiority of their respective policy positions, and more so on the far left. Finally, we found a positive linear relationship between political belief superiority and dogmatism, showing that more dogmatic subjects also tended to be more confident in the superiority of their political convictions (study 1: $\beta = .26$, $p < 10^{-06}$; study 2: $\beta = .14$, $p = .006$).

We next set out to test our primary hypothesis of a link between dogmatism and uncertainty-guided information search. To probe this, we presented participants with a perceptual information-seeking task (Fig. 2, see Methods for details) where they received monetary reward for correctly judging which of two boxes of flickering dots contained more dots. On each trial of our task, participants were first presented with an initial pair of boxes, made an unincentivized judgement as to which box contained more dots and expressed their confidence in this judgment. Following this *initial decision*, participants were asked whether they wanted to see additional evidence to improve their decision accuracy. If participants decided to see this additional information, they were presented with another set of flickering dots. This was always helpful (the correct option continued to have a greater number of dots) and was presented at a higher stimulus strength (greater dot difference). We imposed a variable cost for seeing this information by deducting points, allowing concurrent assessment of participants' sensitivity to the cost of information. On the other hand, if participants decided *not* to see more information, they saw two empty black boxes for an identical duration and were not deducted any points. Finally, regardless of whether subjects decided to see more information or not they were asked to give a final decision and confidence rating. To incentivize

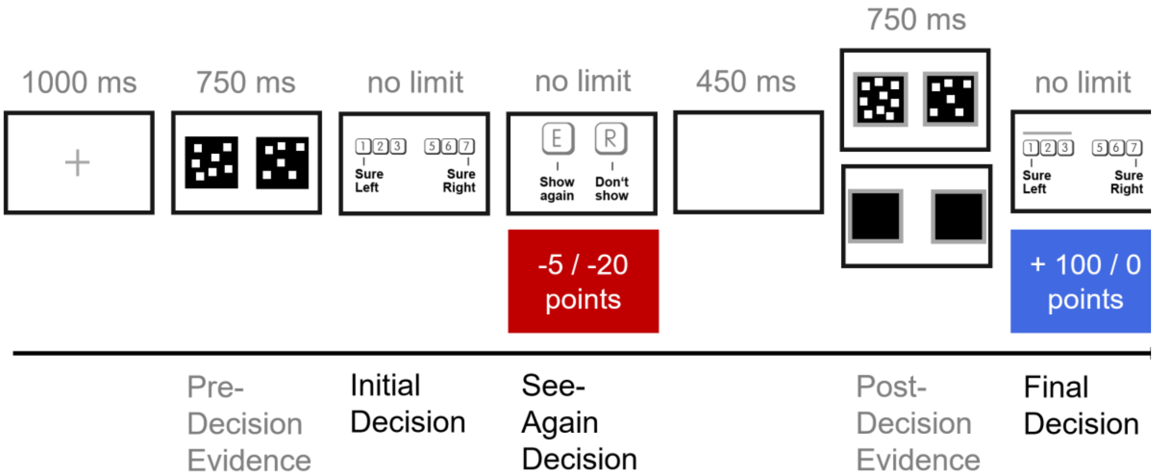

Fig 2. Example experimental trial. Participants first had to judge whether a left or right square contained more flickering dots. They then chose whether they wanted to see a stronger, more helpful, version of this stimulus again, costing them either 5 or 20 points. After either seeing this additional stimulus or blank boxes, they again made a judgment as to which box contained more dots. We compensated participants only for the accuracy of this final decision (100 points for a correct judgement, 0 points for an incorrect judgement). Participants rated their confidence (on a six-point scale from "sure left" to "sure right") at both the initial and the final decision. The difficulty of the initial decision was fixed through an individually pre-determined difference in dot number that resulted in approximately 71 % accuracy. Post-decision evidence strength was based on this (information on stimulus calibration is provided in Methods/SI).

subjects to strive for the best possible overall accuracy, they were paid only for their performance on this *final decision*.

First, we validated that participants used the additional information adaptively (see Methods for details, see figure S1 for overview). Participants chose to see the additional information more often after initial mistakes (study 1: $\beta = -.76$, $p < 10^{-34}$; study 2: $\beta = -.77$, $p = 10^{-25}$) and were more likely to make an accurate final decision after having decided to see the additional information (study 1: $\beta = 1.33$, $p < 10^{-68}$; study 2: $\beta = 1.19$, $p < 10^{-62}$). Similarly, examining individual differences in information search revealed that participants who sought the additional information more often performed better in their final decisions (study 1: $\beta = .68$, $p < 10^{-50}$; study 2: $\beta = .71$, $p < 10^{-57}$) and received a higher pay-off (study 1: $\beta = .43$, $p < 10^{-17}$, study 2: $\beta = .49$, $p < 10^{-22}$). Importantly participants were also sensitive to the cost of information, seeking information less often when it was more expensive (study 1: $\beta = -1.29$, $p < 10^{-49}$; study 2: $\beta = -1.42$, $p < 10^{-50}$). Finally, participants sought out additional evidence less often when they were more confident in their initial decision (study 1: $\beta = -1{,}83$; $p < 10^{-77}$; study 2: $\beta = -1.84$, $p < 10^{-68}$). This highlights that internal signals of uncertainty were used to guide information search.

We next asked whether more dogmatic participants differed in their propensity to seek out information. To that end, we aimed to explain variance in the dogmatism factor scores using behavioral measures derived from the information-seeking task. In line with our hypothesis, higher levels of dogmatism were associated with a generally reduced willingness to seek out information (study 1: $\beta = -.15$, $p = .005$, $R^2 = .021$, Fig. 3). This effect was found in the absence of differences in initial decision accuracy (study 1: $\beta = .02$, $p = .71$) and overall confidence level (study 1: $\beta = -.03$, $p = .59$) and after controlling for key demographic variables including age, gender and education (see Fig 3, Panel B, Methods for details). We replicated this lowered willingness of dogmatic subjects to seek out information in the second, independent sample of study 2 ($\beta = -.10$, $p = .038$, one-tailed, $R^2 =$

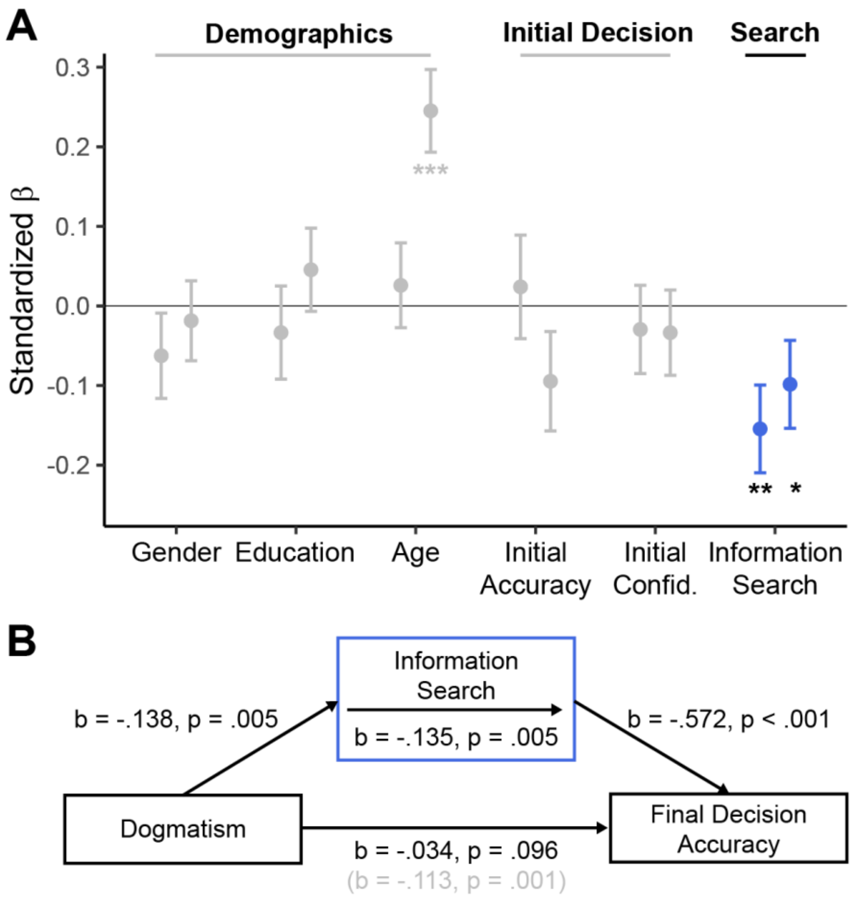

Fig 3. Dogmatism is characterized by a reduction in information search, leading to less veridical judgements. (A) Dogmatism was predicted by a reduced willingness to seek out more information before committing to a decision, controlling for several demographic as well as task variables. We present standardized beta coefficients ± standard error of predictors for study 1 (left markers, N = 370) and study 2 (right markers, N = 364). Effects in study 2 were tested one-tailed based on the directional hypothesis derived from study 1. *p<.05, **p<.01, ***p<-.001. **(B)** A reduction in information search mediated the less accurate overall final judgements in more dogmatic participants (mediation results for study 1 are presented in the figure, see main text for results from study 2).

.008, Fig. 3), again in the absence of differences in initial decision accuracy (β = -.09, p = .13) and confidence (β = -.03, p = .53). These findings highlight that, even in the absence of motivational factors, dogmatic participants tend to seek out less information before committing to a decision – even when this information is helpful.

A key question arising from this finding is whether dogmatic individuals' final accuracy and pay-off suffered because of their lowered information search or whether they simply sought information more efficiently. Here, a mediation analysis (Fig. 3, panel B, see Methods for details) showed that more dogmatic participants were in fact less likely to be accurate on their the final decision (total effect: study 1, β = -.11, p = 0.001; study 2, β = -.09, p = .01, one-tailed), and that this effect was fully mediated by a lowered willingness to seek information (mediation effect: study 1: β = -.08, p = .005; study 2: β = -.05, one-tailed p = .038; corrected direct effect, study 1: β = -.03, p = 0.10; study 2: β = -.03, p = .12). Dogmatic participants also earned less money overall indicating that their lowered information seeking did not entail any strategic benefits (study 1: β = -.24, p = 0.008, R^2 = .019; study 2: β = -.21, p = .009, one-tailed, R^2 = .014).

We next sought to develop a more detailed account of how dogmatic individuals' trial-by-trial information seeking choices were informed by their confidence judgments and the cost of information through a simple computational model. Our model can be expressed as a logistic regression predicting the choice to seek information:

$$P(Information\ Seeking) = \frac{1}{1 + \exp(-(\beta_0 + \beta_1 * Confidence + \beta_2 * Cost))}$$

The three β's thereby capture three independent behavioral phenomena (see Fig. 4, panel A and B): Differences in the model's intercept, β_0, represent a general shift in the willingness to seek out information; β_1 represents how strongly participants' information seeking choices are influenced by their confidence; and β_2 indicates the influence of information cost on subjects' willingness to seek out more information. We embedded the estimation of the relationship between these parameters and dogmatism scores into a hierarchical model (see Fig. 4, panel C for an intuition, Methods for details), enabling us to gain both more accurate as well as less biased estimates of how dogmatism affected the profile of information-seeking behavior (29).

We found that more dogmatic subjects had lower values of β_0 (Figure 4, panel D; CI = -.40, -.06; p = .003), thus replicating our model-agnostic findings that dogmatic participants show generally lower information-seeking behavior. Notably, however, dogmatism was also associated with higher values of β_1 (CI = .02, .27, p = .011). Because β_1-values were generally negative (see Fig.

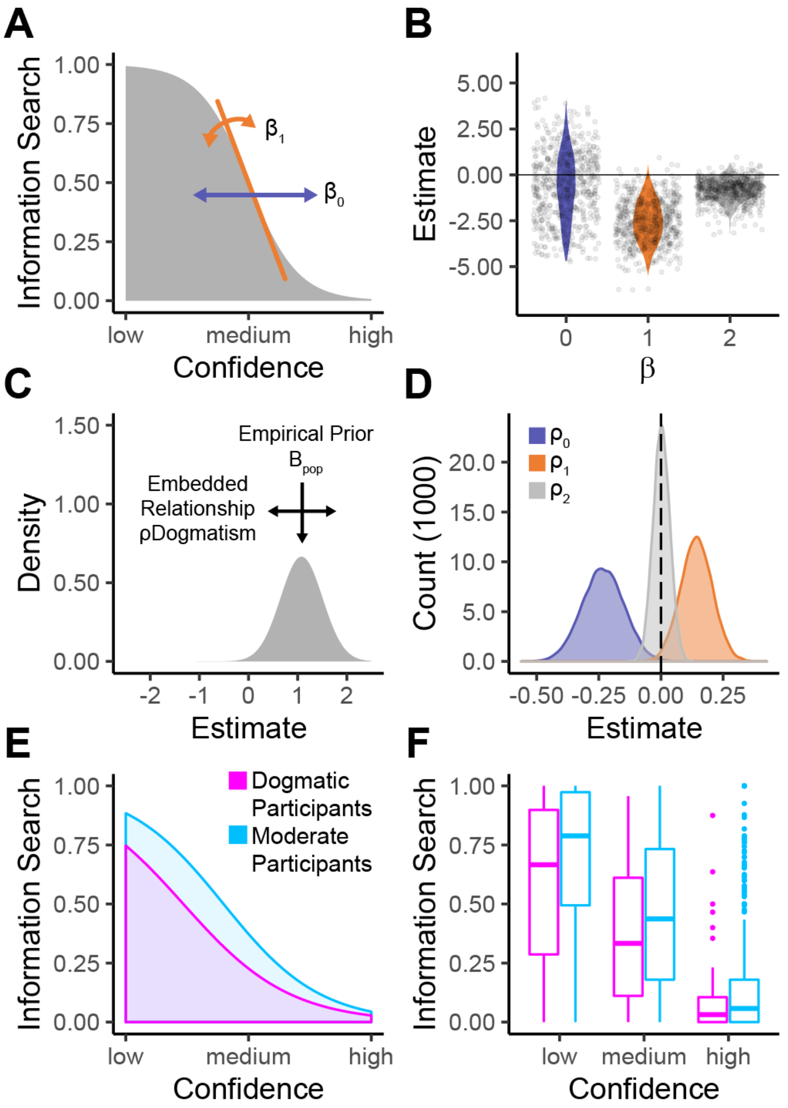

Fig. 4. Individual differences in confidence-driven information search as captured by a computational model. (A) The decision to see additional information was modelled through a model with three parameters, an intercept β_0, a confidence parameter β_1, and a cost-parameter β_2 (not depicted here). **(B)** Distribution of individual level parameters displaying the generally negative influence of higher confidence (β_1) and higher cost (β_2) on information. **(C)** We captured dogmatism-related differences in this prior through an embedding procedure, whereby each parameters' empirical prior varies by ρ as a function of subjects' dogmatism score in a hierarchical estimation scheme. **(D)** Posterior distribution of embedding ρ parameters encoding dogmatism-driven shifts in parameter means. We found a dogmatism-related decrease in the parameters capturing baseline information search (ρ_0) and an increase in the parameter capturing the tuning of information search to participant's confidence (ρ_1). No effect of dogmatism on the cost parameter was observed (ρ_3). The dotted vertical line represents a null effect (*p<.05, **p<.01). **(E, F)** Dogmatic individuals seek out less information than moderates when they are uncertain. To visualize this effect, we compared the 10% most dogmatic participants to the remainder of the sample. We plot **(B)** model predictions and **(C)** actual data (medians with upper/lower quantiles), averaged over both levels of information cost.

4, panel B, for distribution of individual parameter values), this positive shift suggests that dogmatic individuals' information search was coupled less to fluctuations in subjective confidence compared to non-dogmatic individuals. In other words, dogmatic participants were less likely to use feelings of confidence or uncertainty to guide their search for more information. Together, this dual shift in both β_0 and β_1 parameters combined to produce marked differences in information search under low confidence (high uncertainty) – on these trials, non-dogmatic individuals were more likely to (adaptively) seek out new information, but highly dogmatic individuals were not. In contrast, both participants with high and low dogmatism showed similar profiles of information-seeking behavior when they were very certain in their decision (Fig 4, panel E & F).

Given the long-standing debate over the diverging cognitive profiles of liberals and conservatives, we also investigated the relationship between information search and political orientation. Here, we found that position on the political spectrum (right vs. left) were not predicted by a willingness to seek information (study 1: β = -.07, p = .19; study 2: β = -.07, p = .23, see Fig, S2, panel A). Additionally, there was no consistent association between the extremity of political opinion, as indexed by the absolute value of the political orientation, and information-seeking behavior (study 1: β = .04, p = .21; study 2: β = -.07, p = .02). Similarly, political belief superiority was not related to changes in information seeking (study 1: β = .03, p = .62; study 2: β = -.06, p = .26, see Fig, S2, panel B).

Discussion. We show that dogmatic individuals are less likely to seek out additional information before committing to a decision. By foregoing this opportunity, they in turn tend to form less accurate overall judgements. Modelling analyses revealed that two factors drove dogmatic individuals' altered information seeking: a) a shift in the general willingness to seek information and b) a decrease influence of confidence on information seeking. Together, these effects gave rise to a distinct pattern: whereas dogmatism had little effect on information seeking after high confidence decisions, more dogmatic subjects were less likely (relative to moderates) to seek out more information when they were uncertain about their decision.

A key aspect of our results is that we find this disadvantageous pattern in a low-level perceptual decision-making task. This stands in contrast with previous studies on information seeking in the political domain which have often relied on questionnaires or experimental tasks with overt political content (25, 30–33). Here, by capitalizing on the neutral valence and personal irrelevance of simple dot stimuli, we were able to isolate uncertainty-driven information seeking behavior from the possibly confounding effects of motivated reasoning. The observation that the encoding and use of uncertainty is seen to distinguish dogmatic from moderate participants even when using such a task is consistent with the proposal that domain-general cognitive factors contribute to such real-world attitudes (34–36). Nevertheless, in most real-world decision-making scenarios it is likely that both motivational and cognitive (uncertainty-driven) effects will contribute to biases in information seeking (37), and it is interesting to consider that the latter may even be magnified in the presence of affective influences.

Our computational model fits revealed that while participants generally used internal signals of uncertainty (as assayed by confidence ratings) to guide information search, dogmatic individuals did so to a lesser extent. This points to a general alteration in the way that confidence guides actions. Such a process is often broadly described as metacognitive control (38) and not only hypothesized to regulate information search but also similar phenomena such as the speed-accuracy trade-off (39) or cognitive offloading (40). From a theoretical perspective, metacognitive control thereby complements metacognitive monitoring (38) which describes the process that gives rise to and updates representations of confidence. However, while metacognitive monitoring has received considerable attention from a neural (41, 42) and individual difference perspective (22, 43, 44), metacognitive control processes are less well studied. Such research might therefore provide fruitful for understanding the drivers of altered information search.

Dogmatic individuals displayed lowered information search in situations of uncertainty compared to their peers. At the single-trial level, this is consistent with basing an overall judgement on less evidence, leading to less accurate judgments. Because uncertain decisions are also less likely to be correct, this meant that dogmatic individuals were also less likely to seek out contradictory evidence when they were wrong – a form of confirmation bias. Over a longer time horizon, and in the absence of external feedback, such a self-reinforcing feedback loop (45) might in turn convince dogmatic individuals that their initial judgments are already sufficiently optimal, such that investing in more information becomes unnecessary. In general, a useful extension of our work will be to investigate how dogmatic individuals manage information search situations that span more than one trial and require iterative learning. In such scenarios, adequately managing the exploration/exploitation trade-off becomes central to effective learning (9, 46, 47) such that the small differences in the tendency for uncertainty-driven information seeking may summate, leading to highly skewed representations of reality.

While psychophysics provides us with the precise control necessary to characterize dogmatic individuals' information search, our task is necessarily highly contrived relative to real-world decision problems. It remains unknown whether the types of search behavior observed here are representative of real-world search behavior, for instance on the internet (48). However, we can be cautiously optimistic about the generalizability of the current results, given the domain-general nature of the task used and recent observations that real-life human behavior adheres to cognitive models of uncertainty-based exploration (12). One difference between our paradigm and daily life is the guaranteed helpfulness of future information. As a result, search is always beneficial. This calculus changes when a first source is trustworthy, but future information is expected to be unreliable. In that case, it might be adaptive to solely rely on one's initial judgment, and refrain from seeking new information even when uncertain.

In sum, our findings highlight a generic resistance to seek out more information in dogmatic compared to moderate individuals, a difference that was most marked when initial decisions were uncertain. This bias in information search may have implications for how information is provided to consumers of news and social media to limit belief polarization. For example, the simple availability of correcting information online might not be enough to stop the formation of incorrect beliefs, because even feelings of uncertainty do not seem sufficient to trigger information seeking behavior. This in turn raises the stakes for the veracity of an individuals' first exposure to, for example, a news story. In turn, because incorrect information appears to spread more quickly than correct information via social media (49), a failure to seek out corrective information may prove self-perpetuating. As a result, our data reinforces the need for platform providers to improve the accuracy provided on their networks, a task insurmountable for humans but possibly achievable through machine-learning (50, 51).

Methods

Online recruitment and sample

Both studies were conducted online and recruited US adults through the online labor market place Amazon Mechanical Turk (52–54). They were approved by the Research Ethics Committee of University College London (#1260-003) and subjects gave informed consent.

In Study 1, 370 subjects' data was analyzed (see SI for exclusion criteria). We based this sample size on previous studies conducted to detect interindividual differences in cognition across the political spectrum (22, 34) and in disorders (43). Subjects were paid a basic payment of $ 1 and earned a bonus of up to $ 6 based on their adequate completion of the questionnaires and their performance on the information-seeking task (see below). Participants were 50 % percent female and the mean age was 36.62 years (SD = 11.61, range: 19 to 81 years, see Fig, S1, panel A). In Study 2 (replication), we analyzed data from 364 participants with the same payment scheme as in Study 1. An a priori power analysis based on the information-seeking effect size from Study 1 determined our sample size in study 2, giving us a power above 80 % to detect the association between dogmatism and average information search. The sample consisted of 52 % women (mean age was 36.55, SD = 11.09, 18 to 74 years, see Fig S1, panel A). Participants in both studies came from a broad range of educational backgrounds, which was comparable to the general US adult population (see Fig. S1, panel B).

Factor Analysis

There is significant debate about the exact structure of political ideology and its relationships to related constructs (20, 23, 55–57). Thus, we did not rely on simple self-report measures of specific factors. As used previously (22), we instead administered multiple questionnaires measuring political orientation, identification with the two major US parties, the social and economic conservatism scale (58), as well as a questionnaire assessing specific policy positions and subject's belief in the superiority of these positions (20). Additionally, right- and left-wing (59, 60) authoritarianism was assessed. Finally, participants also filled out a dogmatism questionnaire (19). We conducted a factor analysis (see SI for details) on the entirety of the 78 questionnaire items using maximum likelihood estimation with an oblique rotation (oblimin), as used previously both in a political (22) and non-political setting (43). We determined the number of factors through the

Cattell-Nelson-Gorsuch test (61) where a sharp drop in the eigenvalues indicates the point at which there is little benefit to retaining additional factors. To maximize the precision of the factor loading estimates and the factor scores, we pooled the present sample with the one from Rollwage et al. (22) where subjects had completed the same questionnaire battery. This resulted in total sample of 2,135 participants for the factor analysis.

Experimental design.

Stimuli

We used the JavaScript library JsPsych (version 5.0.3) (62) to program the task and hosted the experiment on the online research platform Gorilla (63), which subjects could access through their browser. Two black squares, each 250 pixels in height and width, were presented as discrimination stimuli, with one square positioned left and one square right of center (see Fig. 3 for task overview). Each square consisted of 625 cells, randomly filled with white dots, so that one baseline square always held 313 dots and the other, "stronger" one, a greater number determined during a calibration phase (see SI). During each dot-discrimination, subjects were presented with five such configurations for 150 ms each in order to create the impressions of flickering dots. Within each trial, the location of the individual dots per configuration within one square was random. However, the difference in number of dots and the stronger side remained the same within each trial. The location of the stronger side was pseudo-randomized between trials.

Task and procedure

Both studies followed the same protocol and participants spent around 45 minutes on the experiment, which was divided into three parts. Participants first received information and reported their demographic information. Following this, they then first completed a 120-trial calibration phase to individually determine task difficulty (see SI), identical to previous procedures (22). There, they simply had to indicate which of the two flickering dots contained more dots, as indicated by a press of the "2" or "6" key (indicating left and right). This was followed by the information-seeking task (see Fig. 2), consisting of four blocks, each containing 25 trials. Having finished these two behavioral tasks, subjects then went on to fill out the aforementioned questionnaires.

Information-seeking task

Across the 100 trials of the information-seeking task, participants were presented with the same stimulus strength determined in the calibration phase (study 1: mean = 73.80 %, SD = 6.57; study 2: mean = 73.67 %, SD = 6.50 %). As in the calibration phase, participants had to decide whether more dots were in the left or in the right box (the initial decision). Simultaneously, they indicated their confidence in this decision through the presses of three buttons per side ("1" – "3" and "5" – "7"). Crucially, the information-seeking task allowed participants to choose whether they wanted to see a second, additional display of the stimulus to improve the accuracy of their initial judgement. Subjects were specifically instructed about the helpful nature of this information. If they decided to see the stimulus again, the subjects saw a stronger version of the stimulus (i.e. one with a higher dot difference, see SI). If they had decided to forego the second stimulus, they were instead presented with two empty black boxes, to stop them from speeding up the task through a rejection. Therefore, the only cost associated with the additional information was the deduction of points (5 points or 20 points, depending on the block). Regardless of whether subjects had decided to see the additional information or not, they made another judgement (the *final decision*), indicating both the side they believed to hold more dots and their confidence in this decision as in the initial decision. Importantly, we only incentivized the accuracy of this decision: Subjects received 100 points for a correct and 0 points for an incorrect final decision.

Participant's final bonus payment was linked to the performance in the task, so that they received an additional baseline $ 2 bonus for completing the task and an extra 4 cents per 100 points they had earned on the task (average points-based bonus, study 1 = 3.11 $, SD = .34 $; study 2: mean = 3.12 $, SD = .35 $).

Behavioral analysis

We conducted several analyses to ensure participants understood the task and were able to perform it adequately (see Fig. S1 for an overview). Within-participant effects (see Table S1 for an overview) were investigated using trial-by-trial hierarchical mixed effects models computed and analyzed in the "afex" package (64). Specifically, we constructed logistic models with binary outcomes as respective dependent variables and the corresponding predictors as fixed effects (see table S1 for details). We included per-participant random intercepts and slopes and employed likelihood-ratio test to obtain p-values as is recommended (65). For the between-subject relationship between subject's average information seeking and their average final decision accuracy we set up a general linear model using the lm() function in R. All analyses were done separately for the two studies.

Statistical analysis

We conducted the following regression analysis using the lm() function in R. All analyses were performed separately for the two studies and effects were tested two-tailed if not stated otherwise.

1. To investigate the relationship between the factor scores themselves we constructed polynomial regression models. Specifically, we built these models for each possible factor combination and compared (1) a linear fit, (2) a quadratic fit and (3) a combined linear and quadratic fit based on their BIC (see Table S2 for an overview).
2. To investigate the relationship between information seeking and the factors observed through our questionnaire, we set up one GLM per factor, explaining the respective variance in this factor score through subject's average information seeking. Thereby, we controlled for the following covariates: age, gender, education, the subject's average accuracy and confidence level on the initial decision as well as the objective stimulus strength (indicated by the logarithm of the dot difference) and their performance on the stronger version of the stimulus (as recorded during the calibration phase, see SI). For significant models, we calculated R^2 values by comparing the variance explained by the full model including information seeking to a model excluding it.
3. Finally, to check whether dogmatism was associated with a reduction in points earned on our task, we set up the same model used for the information-seeking analysis, but replacing the information-seeking predictor with the points earned on the task.

To investigate whether dogmatism was linked to a reduction in final decision accuracy and whether this arose from a lowered propensity to seek out information, we conducted a mediation analysis. This analysis was conducted using the "mediate" package in R (66) which uses a quasi-Bayesian Monte-Carlo method based on normal approximation to estimate the significance of the mediation effect (67). We again entered the covariates used for the original information-seeking analysis as control variables into all paths of the mediation analysis.

Computational modelling

To probe the underlying mechanisms of dogmatists' information search, we set up a computational model that investigated the factors contributing to an individual's decision to seek out more information. Specifically, we modelled the trial-by-trial information-seeking choice based on the trial-by-trial confidence participants expressed as well as the current information cost (see main text and SI).

Because classical maximum-likelihood based methods can frequently provide noisy estimates with so few data, we employed a hierarchical fitting procedure (68). In such hierarchical fitting procedure, individual parameters are drawn from a group level prior distribution:

$$p_{pop}(\beta_1) = \mathcal{N}(B_{1_{pop}}, \sigma_{pop})$$

Conventionally, parameters obtained through such an approach are then correlated with an external criterion. However, this can entail potentially detrimental consequences when examining individual differences. Specifically, this procedure assumes *no* variability in the mean of the population as a function of an external factor, in our case for example dogmatism (contrary to the aims of individual difference research). It can therefore mute the relationship between the parameter and an external factor or produce non-veridical estimates of these relationships (29). To maintain the advantages of hierarchical fitting while avoiding its pitfalls regarding individual differences, we here employ a procedure recently prescribed by Moutoussis and colleagues (29). There (see also Fig. 4, panel C), the relationship between the parameters and an external criterion is embedded into the estimation of the parameters themselves through the prior, so that:

$$p_{pop}(\beta_i) = \mathcal{N}(B_{i_{pop}} + \rho_i * Dogmatism, \sigma_{pop})$$

Here, the population distribution $B_{i_{pop}}$ represents the population mean that then informs the estimation of β_{i_j}, the individual parameters of β_i for participant j, from a population distribution, $p_{pop}(\beta_i)$. However, we allow $B_{i_{pop}}$ to vary as a function of dogmatism, so that we quantify the relationship between each parameter and dogmatism through the embedded relationship parameter, ρ_i. To allow for the most accurate hierarchical estimation, we pooled the samples from both studies and only included subjects that sought out information on at least 5 % and at most on 95 % of trials. In doing so, we achieved a total sample of 568 subjects. We built the computational model using the programming language Stan (69) which uses a form of Markov chain Monte Carlo sampling, Hamilton Monte Carlo sampling, to estimate the continuous parameters.

Further details on model fitting and visualizations as well as on the influence of the different parameters on participant's pay-off are presented in the SI.

Data Availability: Fully anonymised data are available from the corresponding author on reasonable request. Upon publication, the final code for data analysis and computational model fits will be uploaded to a dedicated Github repository (https://github.com/metacoglab).

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