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Review

Reconciling scientific and commonsense values to improve reasoning

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Scientific reasoning is characterized by commitments to evidence and objectivity. New research suggests that under some conditions, people are prone to reject these commitments, and instead sanction motivated reasoning and bias. Moreover, people's tendency to devalue scientific reasoning likely explains the emergence and persistence of many biased beliefs. However, recent work in epistemology has identified ways in which bias might be legitimately incorporated into belief formation. Researchers can leverage these insights to evaluate when commonsense affirmation of bias is justified and when it is unjustified and therefore a good target for intervention. Making reasoning more scientific may require more than merely teaching people what constitutes scientific reasoning; it may require affirming the value of such reasoning in the first place.

Highlights

People espouse a 'lay ethics of belief' that defines standards for how beliefs should be evaluated and formed.

People vary in the extent to which they endorse scientific norms of reasoning, such as evidentialism and impartiality, in their own norms of belief. In some cases, people sanction motivated or biased thinking.

Variation in endorsement of scientific norms predicts belief accuracy, suggesting that interventions that target norms could lead to more accurate beliefs.

Normative theories in epistemology vary in whether, and how, they regard reasoning and belief formation as legitimately impacted by moral or pragmatic considerations.

Psychologists can leverage knowledge of people's lay ethics of belief, and normative arguments about when and whether bias is appropriate, to develop interventions to improve reasoning that are both ethical and effective.

The relationship between normative and everyday standards of reasoning

Many philosophers of science and epistemologists argue that, when forming and evaluating beliefs about the world, one ought to be objective, open-minded, and bound by evidence [1–4]. This kind of reasoning has been canonized as **scientific reasoning** (see Glossary), with norms of **objectivity** and **evidentialism** identified as defining norms of the **scientific ethos** [5,6]. According to the scientific ethos, inquirers can and should incorporate their preferences and values into some aspects of inquiry (such as determining which questions are worth answering; Box 1), but the process by which they form beliefs about the world ought to be objective and based purely on evidence. And yet, everyday belief formation often violates these norms and is instead thoroughly infused with bias, motive, and value. This observation raises two pressing questions. First, do people actually agree that violating norms of objectivity and evidentialism is bad? In other words, does the **lay ethics of belief** share the commitments of the scientific ethos? And second, what do people's beliefs about what constitutes good reasoning entail for scientists who aspire to improve reasoning?

A long-standing assumption in cognitive science has been that the lay ethics of belief approximates the scientific ethos, such that failures to live up to objectivity or evidentialism reflect unconscious biases [7–9]. However, recent studies have called this assumption into question. In many contexts, people explicitly devalue scientific norms of reasoning and instead regard **biased reasoning** as good reasoning. For example, people sometimes believe it is appropriate to assume a friend's innocence (even when the evidence suggests otherwise), or inappropriate to judge an individual based on the statistics of their social group [10]. Such departures from objectivity find counterparts in recent arguments within epistemology, where philosophers have defended alternative norms to those espoused by the scientific ethos [11]. These new developments raise important questions about when and how psychologists should try to align the lay ethics of belief with the scientific ethos. We suggest that insights from epistemology can inform psychological inquiry by helping researchers identify and evaluate widespread intuitions about what constitutes good reasoning. This can in turn provide a promising strategy for changing everyday standards for reasoning by correcting any misconceptions that underlie them. We propose that this coordination between

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Box 1. Roles for values in scientific inquiry

A major project in the philosophy of science and epistemology has been to characterize how moral and social values should (and should not) influence inquiry and belief [85,86]. Philosophers agree that there are several ways social values ought to influence inquiry (Figure I). First, the questions we ask ought to reflect the observation that not all knowledge is equally valuable. This is why scientists articulate 'broader impacts' when submitting grants. Second, the value of acquiring particular knowledge can be outweighed by moral and practical costs. This is why experiments involving humans and other animals must be evaluated by an Institutional Review Board. And third, the effort and resources spent on inquiry should reflect the costs and benefits associated with getting things right or wrong. When making risky or important decisions, for example, scientists and decision makers are held to high standards of evidence, which is sometimes codified as standards of 'due diligence' or as evidential 'readiness levels' (e.g., [87]).

There is striking continuity between normative and lay attitudes concerning these indirect roles for values in inquiry. Students put more effort into learning about topics that they think are important [88–90] and people are more curious to learn about topics that they expect to be useful [91–93]. Additionally, people consider the costs of inquiry and knowledge acquisition against other costs. For instance, if additional evidence gathering will be especially costly, say because people will miss an opportunity to make a decision, then they will suspend evidence gathering [8]. Likewise, people spend more time collecting evidence, and more energy scrutinizing that evidence, for decisions involving significant risk [94,95].

While there is broad expert and intuitive agreement that values should influence these aspects of inquiry, normative claims and descriptive practice diverge when it comes to the role of values in *forming beliefs*. Many scholars believe that values should not affect the factual beliefs that result from inquiry. For instance, values might influence the decision to pursue research to produce a vaccine and even the level of evidence demanded before the vaccine is distributed within and beyond clinical trials, but values should not influence whether scientists believe that the vaccine is safe or effective. In the main text we argue that this is where the scientific ethos and the lay ethics of belief diverge: For many people, moral and personal concerns are perceived to have a legitimate role not only in inquiry, but also in forming beliefs.

Figure I. The relationship between value, inquiry, and belief in the scientific ethos.

Glossary

Actively open-minded thinking (AOT) scale: scale measuring lay attitudes about the importance of considering alternatives to one's current beliefs, changing one's mind in response to new evidence, and avoiding dogmatic or absolutist thinking. This scale closely resembles a disposition towards what we label scientific reasoning.
Biased belief: a belief that is the product of biased reasoning.
Biased reasoning: belief formation characterized by a goal to adopt or avoid adopting a particular belief, or otherwise, a belief formed on the basis of evidence that has itself been weighted or interpreted in light of one's values; eschews at least one of evidentialism or objectivity.
Evidentialism: a normative standard of belief according to which someone only ought to hold beliefs that are based on sufficient evidence.
Lay ethics of belief: norms that guide everyday belief evaluation, which may or may not accord with the scientific ethos.
Objectivity: a norm of reasoning according to which evidence is evaluated without regard for values or features of the evidence that are irrelevant to truth.
Scientific ethos: a normative model of belief formation stating that scientific reasoning is the only permissible and justified form of belief formation.
Scientific reasoning: belief formation characterized by a goal to be accurate and so also characterized by evidentialism, objectivity, and open-mindedness. This can include the subset of motivated reasoning that is non-directional and motivated by accuracy.
Unbiased belief: a belief that is the product of scientific reasoning.

normative epistemology, the lay ethics of belief, and psychological models of biased reasoning can shape educative interventions that have the potential to be both effective and normatively defensible.

Are people dedicated (but mediocre) disciples of the scientific ethos?

At first glance, the lay ethics of belief appears to resemble the scientific ethos. Across the lifespan and across cultures, people display an affinity for acquiring and sharing knowledge [12]. Consistent with a motivation to learn, most people report that they want their beliefs to be based on evidence and sound reasoning [13]. Indeed, the dominant view in social and cognitive psychology is that people not only

endorse the scientific ethos, but naively believe that they are its paragons [7,9,14]. That is, many psychologists attribute to lay reasoners the meta-beliefs that they reason scientifically and that anyone else reasoning as they do, and with access to the same evidence, would share the same beliefs [9,14].

The assumptions that people want to be scientific reasoners, think that they are, and demand that others be so as well have influenced how psychologists explain the existence and persistence of biased reasoning. Explanations for biased reasoning are manifold, but many share the assumption that biased reasoning is unintentional and that the psychological mechanisms that generate **biased beliefs** are unconscious. That is, people are unaware that they search for evidence in biased ways [15], unaware that they apply pernicious double-standards for preference-consistent and preference-inconsistent propositions [16], unaware that they over-rely on discredited sources of information (such as intuition [17]), unaware that they under-rely on useful information (such as base rates [18]), and so on. Even when people are motivated to hold beliefs that conflict with their evidence (and these motivations impact what they believe), it is widely thought that they deny any influence [19]. In relegating violations of the scientific ethos to unconscious processes, these views explain how people can maintain a subjective sense that their beliefs, even the highly biased ones, are consistent with their commitment to the scientific ethos.

Based on this traditional portrait of biased reasoning, a sensible strategy for improving reasoning is to educate people about how to better live up to their own ideals [1,20]. Some such interventions have been successful [21]; however, teaching people how to reason rarely generalizes beyond the training context or domain [22–24]. This is a puzzling result if people genuinely aspire to satisfy the norms of reasoning they are being taught to uphold. Of course, transfer learning is hard, especially when the target of intervention is a domain-general skill [25,26]. But we suggest that an additional factor is at work: in many areas of everyday life, the traditional view that people's ethic of belief aligns with the scientific ethos is wrong.

People may not, in fact, think that they should always approach questions about what to believe 'scientifically'. When evaluating their own and others' beliefs, people sometimes reject the principles of objectivity and evidentialism and instead maintain that considerations of what is morally or socially good *ought* to influence what they believe. This suggestion complements prior proposals that people sometimes depart from the mold of 'intuitive scientist', instead acting as intuitive politicians, theologians, or prosecutors, and in so doing, knowingly adopt belief goals that eschew accuracy [27]. It also echoes prior critiques in the decision-making literature that putatively irrational behaviors in fact reflect people's sensitivity to different (perhaps defensible) normative standards [28,29]. Yet, it is only very recently that evidence has emerged to support the claim that many people explicitly recognize and endorse nonscientific norms for belief and that these norms support and maintain biased beliefs.

The bounds of scientific reasoning in the lay ethics of belief

If people internalize the scientific ethos, then they should dutifully recommend that others adopt **unbiased beliefs** and they should evaluate biased beliefs as unjustified and impermissible. However, recent studies show that, beyond considerations of evidence or objectivity, people evaluate beliefs on moral and pragmatic grounds. As a result, people sometimes prescribe biased beliefs to others.

In the first studies to suggest that people prescribe biased beliefs, participants read about characters facing a decision about what to believe, such as judging whether they would win an essay contest or succeed in a business venture [30]. Participants indicated whether the character should be accurate by selecting a value on a nine-point response scale with 'accurate' as the midpoint and 'extremely pessimistic' and 'extremely optimistic' as the lowest and highest anchors, respectively.

Participants tended to prescribe optimism over accuracy. However, it is unclear whether optimism was associated with an inaccurate belief or, instead, with a feeling or attitude, along the lines of 'staying positive' [31]. Recent work has replicated prescribed departures from accuracy while avoiding this ambiguity and has additionally identified the grounds on which people recommend bias.

One recent study found that people think overconfidence can be detrimental or beneficial, depending on the context, and that they prescribe beliefs that depart from accuracy on this basis [32]. For instance, overconfidence should be detrimental to decision makers when deliberating about what to do, since it could lead to poor decisions. However, people also tend to think that confidence can be motivating and so may prescribe overconfidence to people who have already committed to a decision and need motivation to follow through. If people prescribe beliefs to others based in part on how beneficial they judge those beliefs to be, rather than just how evidentially sound they are, then they ought to prescribe overconfidence to others when aiming to motivate them, but not when informing decision making. This is precisely what has been found: when someone is deciding whether to open a small business, participants think that person should be clear-eyed about their chance of success. But when someone has already started their business, participants think that person should be overconfident.

Additional evidence that a belief's anticipated consequences can factor into its perceived justification comes from research on scientific and religious believers [33]. In these studies, most participants agreed that expert testimony and strong evidence are good grounds for holding a belief, consistent with the scientific ethos. However, some justifications suggested that participants accepted nonscientific reasons as good grounds for belief, too. For instance, many participants thought that 'leading to ethical behavior' constitutes a good reason for belief. This finding, in conjunction with the results already reviewed, shows that beliefs are evaluated in part on the basis of their consequences, such as helping people behave successfully or ethically, rather than their evidential value alone.

The most direct examination of the lay ethics of belief comes from experiments investigating people's reactions to situations that pose a dilemma between believing based on evidence and believing based on what is morally laudatory [10]. For instance, in one study, participants read about someone who had evidence that their spouse is terminally ill (a doctor informs them that there is a low chance of recovery) but who also knows that staying optimistic will improve their spouse's emotional well-being in the months to come. Participants reported what that person would believe if they formed a belief based solely on their evidence and also reported what that person 'ought' to believe. If participants endorsed norms of scientific reasoning, these two judgments should be identical. Instead, participants reported that others should hold a more optimistic belief than warranted by their evidence and did so to the extent they thought over-optimism improved others' welfare, signaled loyalty (e.g., giving a friend the benefit of the doubt), or indicated respect (e.g., treating someone as an individual). Strikingly, participants sometimes reported that someone was more justified in holding an evidentially unsupported (but morally beneficial) belief than in holding an evidentially supported (but morally risky) belief. For instance, in another vignette, participants judged that a newlywed was more justified to believe that he had a 0% chance of divorce than a high chance of divorce, even though the same participants reported that a high chance of divorce better reflected the newlywed's own evidence (Figure 1). Thus, in the lay ethics of belief, moral considerations do not just influence how people evaluate others' beliefs, they sometimes dominate these evaluations.

Taken together, these studies provide strong evidence against the view that the lay ethics of belief accords with the scientific ethos. People evaluate biased reasoning as legitimate when it can be self-fulfilling, improve someone's behavior, or further moral ends. As we review next, widespread

Figure 1. Moral obligations sometimes override objectivity during third-party belief evaluation. Case study: evaluations of others' beliefs about divorce [10]. (A) Most participants reported that a groom had an obligation to remain optimistic about marriage and, simultaneously, reported that the groom's evidence favored divorce. (B) Participants then read that the groom either formed the morally sanctioned belief (0% chance of divorce) or the evidence-based belief (70% chance of divorce). (C) Participants then evaluated the groom's belief. Participants judged that the morally good (but biased) belief was morally better and more justified. Moreover, participants more strongly agreed that the groom had sufficient evidence for his belief when it was biased versus objective (see Box 2 for more detail regarding this finding).

endorsement of nonscientific norms helps explain the prevalence of biased reasoning and biased belief. Contra the view that biased reasoning is unconscious or maligned, biased reasoning is sometimes intended, encouraged, and enforced.

Devaluing the scientific ethos may explain common and persistent misbelief

Intrapersonal processes

Nonscientific norms for belief could explain how people come to hold or maintain biased beliefs by either shaping their reasoning process or by affecting their attitudes towards particular beliefs they already hold. Illustrating the former, people could adopt belief-formation practices that often support biased reasoning at an unconscious level (such as biasing their exposure to evidence or holding beliefs to biased standards [7,34–36]), but with full conscious awareness and endorsement. Illustrating the latter, people could feel justified in maintaining beliefs that they regard as beneficial, or in rejecting those they regard as detrimental, and so resist demands from the scientific ethos to scrutinize them. If people's norms for belief have such effects, then variation in norms should be associated with variation in belief.

Consistent with this prediction, recent studies show that variation in peoples' tendency to affirm scientific norms of reasoning predicts how people tend to reason and how accurate their beliefs tend to be as a result. For instance, more strongly endorsing ideals of logical consistency and evidentialism is negatively associated with religious, supernatural, and paranormal belief [13,37–40]. Similarly, individuals who score high on the **actively open-minded thinking (AOT) scale** (and so, for instance, more strongly endorse statements like 'people should take

into consideration evidence that goes against their beliefs') are more likely to hold beliefs supported by evidence, such as believing in anthropogenic climate change [38,41,42]. AOT is also associated with more accurate evaluations of arguments [43] and lower susceptibility to cognitive biases [44,45] and it predicts a greater tendency to collect and integrate additional information into one's beliefs [46]. As a consequence, people who value such thinking make more accurate predictions, from basketball wins [46] to major world events [47].

Scientific norms of belief may also protect individuals against others' biased reasoning. People high in AOT temper their confidence in others who engage in biased reasoning, such as ineptly weighing the balance of evidence [48]. And in studies on social media behavior, these individuals make more accurate assessments of others [49] and are less susceptible to fake news [50]. These findings reveal a systematic association between the value placed on scientific norms of belief, on the one hand, and the types of beliefs that individuals ultimately endorse, on the other.

Interpersonal processes

Norms for belief are also likely to perpetuate bias and poor reasoning by affecting people's evaluations of others. People often think others have control over what they believe and, accordingly, hold them responsible and blameworthy when they hold undesirable beliefs [51,52]. In turn, people try to form (or at least report) beliefs that they think others want them to hold [53,54]. Thus, norms for belief have consequences for the kinds of reasoning and corresponding beliefs that will be rewarded and in turn what kinds of beliefs people are motivated to form. People who value scientific reasoning judge others harshly for being illogical or ignoring evidence [13]. In contrast, people who tend to value a belief's moral qualities think it is impermissible for others to believe on the basis of evidence at the expense of morality [10].

Social transmission of biased reasoning need not occur intentionally through explicit social approval or disapprobation. People align their beliefs with what they think those around them believe and pay particular attention to prestigious and confident members of their community [55,56]. For instance, displays of overconfidence from one person can cause observers to reason in ways that lead to overconfidence in themselves, a process that can then extend to other members of the community [57]. Likewise, people copy the poor evidential standards of their peers, thereby propagating inaccurate beliefs through groups [58]. Norms that favor biased reasoning can propagate given these dynamics of social transmission: people are more likely to feel (and so act) overconfident if they reason in accordance with norms that eschew accuracy; and people with biased beliefs are more likely to acquire positions of prestige when norms of belief reward bias and devalue objectivity.

Just as endorsing the scientific ethos influences the beliefs of individuals, it is likely that groups that endorse and act on scientific norms of reasoning will end up with more accurate beliefs. Like individuals, groups that engage in comprehensive evidence gathering and scientific reasoning make better decisions [59]. And indeed, the recent renaissance in psychological science speaks to the power of the scientific ethos in group settings: increased emphasis on transparency and higher standards of evidence in psychological science have led to the identification and correction of widely held falsehoods in the scientific canon and curtailed the dissemination of new errors [60].

Evaluating and intervening on the lay ethics of belief

Though many scholars endorse the scientific ethos, a survey of the normative arguments favoring a pure and steadfast dedication to objectivity and evidentialism reveals that each argument faces formidable objections (Table 1). For instance, some have questioned whether these values ought to outweigh norms of friendship and loyalty [61]. If they should not, then the common practice of forming partial and overly favorable beliefs about one's relationships [62] may be justified.

Table 1. Normative arguments for scientific reasoning (or against biased reasoning) and common objections

Appeals to…	Typical line of reasoning	Typical objection	Refs
The instrumental value of scientific reasoning	More complete and more accurate representations of the world enable more optimal behavior and, therefore, better outcomes.	If the reason to reason scientifically is the moral or pragmatic benefit of doing so, then people should depart from scientific reasoning if it would be morally or pragmatically valuable to do so.	[1,24,70–72]
The intrinsic value of scientific reasoning	Pursuing truth and knowledge are inherently valuable activities. Engaging in scientific reasoning is an intellectual virtue and a mark of virtuous character.	Some beliefs reflect values related to beneficence, respect, or loyalty. Even if pursuing truth is intrinsically valuable, it is not clear why these values ought to outweigh moral values when they conflict.	[2,61,73,74]
The function of belief	Beliefs, by definition, are supposed to accurately represent the world. Therefore, beliefs are only properly evaluated with respect to accuracy-preserving norms.	Grounding the ethics of belief in the function of belief leaves open why people ought to desire well-functioning beliefs.	[4,75]
The difficulty of purposefully adopting biased beliefs	Beliefs are constrained by evidence. It is unfair to demand that people form biased beliefs if they are incapable of doing so.	It is controversial to what degree beliefs are constrained by evidence. If people can regulate their beliefs, then they plausibly have moral and practical reasons to exercise that capacity.	[8,51,52,68,76]

Likewise, some scholars have argued that forming beliefs about others based on statistical demographic information denies those individuals due respect [63–65]. And some scholars have argued that belief in the existence of powerful and benevolent deities, free will, or karma [66,67] is justified on the basis of the practical benefits those beliefs confer to their adherents [68,69]. If these arguments are successful, then biased reasoning may not be *bad* reasoning and norms that may be ideal in the domain of science may not be ideal in the domain of everyday life. In the sections that follow, we draw connections between these arguments, the lay ethics of belief, and everyday motivated reasoning. We then articulate a strategy for modifying people's valuation of scientific reasoning.

The relationship between biased reasoning, normative theory, and commonsense values

Philosophers who have argued that values play a legitimate role in belief formation have suggested two ways in which this could occur [11]. On one view, which we call *value-dependent evidential reasoning*, values should bias belief by affecting how people weigh evidence to form beliefs [11]. For instance, values could limit the kinds of evidence that justify certain beliefs (e.g., statistics versus testimony), or they could affect how strict or lenient one's evidential support must be to justify a belief (Box 2). On another view, moral and other values constitute independent grounds for belief and so act as *value-based justifications for belief* [61,69,77]. For instance, a person might be justified in believing something they lack evidence to believe on the grounds that the belief is loyal (in the case of forming a favorable opinion about a friend) or useful (in the case of belief in God or free will).

These two proposals for how values might legitimately influence belief formation can be roughly mapped onto two psychological models of biased reasoning. For instance, prominent models of belief formation posit that people accept (or reject) beliefs during inquiry once their evidence has passed a critical threshold [36]. On these models, thresholds for adopting (and rejecting) belief operate similarly to how they do for decision making (Box 1), in that they shift according to the costs of error, in this case, the costs associated with believing falsely. One way people bias this process is by holding desirable and undesirable beliefs to double-standards: submitting 'risky' (undesirable) conclusions to more stringent evaluation and higher thresholds compared with 'safe' (desirable) conclusions [16,36,78]. This form of biased reasoning may be justified according to some proposals of value-dependent evidential reasoning (Box 2).

Box 2. Varieties of value-dependent evidential reasoning

There is an ongoing debate in epistemology regarding whether values ought to affect how people reason about evidence [11]. Even if people ought to be evidentialists (and so form beliefs only on sufficient evidence), values could influence belief by affecting what counts as 'sufficient' evidence. Here we review a few normative proposals in favor of value-dependent evidential reasoning and draw connections between these proposals and the lay ethics of belief.

One proposal is that the risks of making a wrong decision carry over to the risks of forming a false belief [76,96–99] (see also the concept of 'inductive risk' in philosophy of science [100–102]). Accordingly, risks raise the 'evidential readiness level' for decisions (Box 1) *and for beliefs*. For instance, if it would be bad for a scientist to publish an article wrongly suggesting that race correlates with IQ, then they ought to collect an extraordinary amount of evidence before doing so. Likewise, the scientist should acquire more evidence before believing (or 'accepting the hypothesis') that race correlates with IQ. As noted in the main text, some work suggests that people believe evidence should be stricter for morally risky beliefs [10]. And related work suggests that, in risky situations, laypeople raise evidential thresholds for attributing knowledge to others [103,104] (but see [105]).

A closely related debate concerns whether people ought to form beliefs about others based on 'naked statistical evidence'. For instance, ought someone judge that a well-dressed Black man in an exclusive club is a staff member merely because that is statistically likely [106]? Some argue 'no' on the grounds that others have the right to avoid being wrongfully racially profiled [107] or the right to be treated as potential exceptions to generalizations [63–65]. Laypeople also often believe it is impermissible to judge others based on bare statistical information [10,108]. However, it is not clear whether people actually temper their impressions in this way [108–111].

The use of statistical evidence is also hotly discussed in the domain of judging others' guilt [112–114]. Some argue that, in order to judge someone guilty of some wrongdoing, people ought not rely solely on statistical evidence, but must obtain evidence that individualizes that person [115] (or has other properties [114,116]). Laypeople share these intuitions [117–119]; however, it is not clear why.

Emerging empirical work therefore suggests a variety of conditions under which people may endorse value-dependent evidential reasoning. However, questions remain about how often people do so, whether endorsing such reasoning affects belief formation, and finally, whether such reasoning is ultimately justified.

Other models of motivated reasoning posit that biased beliefs emerge in part because people value the social, moral, or practical value of a belief above the value of accuracy [27,79]. Accordingly, people adopt goals to acquire specific beliefs and reason in ways that enable them to do so. This kind of motivated reasoning may be justified by theories according to which beliefs are valuable or not based on their moral and practical qualities, corresponding to value-based justification.

Studies on the lay ethics of belief, reviewed earlier, show that people sometimes endorse both value-dependent evidential reasoning and value-based justifications for belief [10,32,33]. Corresponding to value-dependent evidential reasoning, people report that others need less evidence for morally beneficial beliefs, compared with morally risky ones, before judging that they have sufficient evidence [10]. For instance, in one study participants judged that a spouse had insufficient evidence to form a pessimistic belief about his marriage but sufficient evidence to form an optimistic belief, even though they judged that, objectively, his evidence suggested a pessimistic outcome (i.e., divorce) (Figure 1). And, corresponding to value-based justifications, the work reviewed earlier demonstrated that people often treat the positive effects of belief, such as whether a belief motivates someone, produces good behavior, or displays loyalty, as justifications for belief even in the absence of sufficient evidence [10,32,33].

Taken together, these observations suggest that people may explicitly endorse reasoning that psychologists hypothesize gives rise to biased belief and this advocacy may be vindicated by normative theories of belief formation (Figure 2).

Figure 2. Relationship between motivated reasoning, lay ethics of belief, and normative models of belief.

Identifying promising interventions

Interventions that aim to replace biased reasoning with scientific reasoning, what we call 'value debiasing' interventions, face two challenges in light of the preceding discussion. First, if people reject the premise that they ought to be objective or that they ought to form beliefs on the basis of evidence, then they will reject interventions that merely instruct them to do so. And second, because many normative questions about how people ought to reason remain unsettled, interventions that promote scientific reasoning may not result in 'better' reasoning. Indeed, in some cases, people may not be biased *enough*, in which case interventions to be more objective would produce worse reasoning. For instance, it is possible that, for moral reasons, people ought to withhold forming beliefs about others based on race- or sex-based stereotypes, but that people rarely abide by these injunctions.

In light of these challenges, what sorts of interventions to induce scientific reasoning might be defensible (normatively) and also effective (psychologically)? From the perspective of normative warrant, contexts in which it is clear that the potential objections to scientific reasoning (featured in Table 1) do not apply are less likely to be problematic. From the perspective of psychological efficacy, we propose that efforts to promote scientific reasoning can leverage the commitments behind people's own ethic of belief. To this end, psychologists can ask which of the arguments for and against the scientific ethos align with people's existing attitudes. Insofar as these attitudes lead people to devalue scientific reasoning, we can subsequently ask: is this devaluation the result of a misconception? If so, interventions can target this misconception, with the expectation that scientific reasoning will be valued more highly as a result [80,81]. This procedure offers a defensible and potentially effective way to improve reasoning despite uncertainty about what, ultimately, constitutes good reasoning in difficult cases.

As an example, which we develop in Box 3, consider instrumental arguments for scientific reasoning. According to such arguments, scientific reasoning is valuable insofar as it maximizes welfare. This has the consequence that biased reasoning will be favored when *it* maximizes welfare instead. But if people are too liberal in their assumptions about the conditions under which biased reasoning

Box 3. Case study: misconceptions about the practical benefits of biased reasoning

One argument for the scientific ethos is that scientific reasoning is critical for optimal behavior and, therefore, for maximizing welfare (Table 1). In the context of value debiasing, this argument raises three questions. First, do people consider improving welfare to be a good foundation for norms? *Yes*. Second, do people devalue scientific reasoning in part because they believe that biased reasoning will produce better outcomes? *Yes* [10,32]. And third, are people *wrong* to believe that biased reasoning will produce better outcomes? People may not be wrong in all cases [120,121]; for instance, some studies show that people benefit from holding biased beliefs about themselves [122] (but see [123]). Nevertheless, it is likely that people often sanction biased reasoning in error [84].

Even if inaccuracy accrues some minor advantage to believers, people tend to overestimate that advantage. In a recent series of studies, participants played short games and received either false information that they had performed well (and so should be optimistic about how well they will continue to perform) or that they had performed poorly (and so should be pessimistic) [32]. Across all tasks, including an age guessing game, a math test, and a *Where's Waldo* game, optimists never outperformed their pessimistic counterparts. However, a separate group of participants who were told about the experiment, exposed to the games and the manipulation, and financially incentivized to make accurate predictions, expected the optimists to outperform the pessimists across all of these tasks. People were reliably unrealistic about the benefits of unrealistic optimism.

People also appear to discount the benefits of accuracy while overweighting the costs of honesty and transparency. For instance, people will provide inaccurate, overly positive feedback to others about their performance to avoid hurting their feelings [124], even though the long-term costs of inaccuracy likely outweigh the short-term negative feelings associated with criticism. In these situations, people may be overestimating the costs of hurtful, honest feedback [125]. If people were better calibrated to the costs of honesty, and to the long-term benefits of fostering accurate beliefs in others, they would likely prioritize honesty more than they currently do.

Thus, educating people that unbiased belief and honesty align with human welfare more often than people currently anticipate appears to be a viable route to increasing their valuation of scientific reasoning. After all, people already consider welfare a good reason to think unscientifically; they just happen to hold demonstrably false beliefs about the effectiveness of bias in promoting welfare.

is productive, then, by their own lights, they are failing to implement their own values and would do better to engage in scientific reasoning in a wider range of circumstances. Interventions might therefore focus on educating people about the norms for belief that in fact maximize welfare. Recent data also suggest other potentially promising routes to intervention. For instance, people likely often overestimate other people's ability to voluntarily change their beliefs [52]. This in turn may lead observers to demand biased beliefs from others when those others are unable to acquiesce (such as when a friend or spouse fails to adopt an overly favorable belief). Educating people about others' limited ability to adopt biased beliefs may reduce demand for such beliefs and, in so doing, reduce conflict that stems from people valuing beliefs based on their moral or other desirable qualities. And of course, future research may uncover new errors within people's lay theory of belief.

To our knowledge, no prior work has manipulated people's valuation of scientific norms as a strategy for encouraging scientific reasoning. Such interventions are promising for a few reasons. First, as noted earlier, there is a strong association between norms for belief and the kinds of beliefs people hold. Indeed, given that the association between the endorsement of scientific norms and belief replicates across a wide range of beliefs, value debiasing has the potential to have similarly wide-ranging effects. Second, holding people accountable for their judgments affects how, and often how scientifically, people reason [82]. In the present context, internalized norms of belief constitute a form of self-governance that may similarly affect an individual's own reasoning. At the same time, it is important to acknowledge some challenges. Many errors in reasoning are resistant to even large incentives to be accurate [83], suggesting that value-based interventions may need to be accompanied by effective strategies for implementation. Thus, while value debiasing may reflect a promising starting point for improving reasoning, the most effective interventions will likely pair both information about why scientific reasoning should be highly valued with tools and advice for implementing that reasoning [84].

Concluding remarks

It is no secret that humans are biased reasoners. Recent work suggests that these departures from scientific reasoning are not simply the result of unconscious bias, but are also a consequence of endorsing norms for belief that place personal, moral, or social good above truth. The link between devaluing the 'scientific ethos' and holding biased beliefs suggests that, in some cases, interventions on the perceived value of scientific reasoning could lead to better reasoning and to better outcomes. In this spirit, we have offered a strategy for value debiasing. This strategy leverages work in epistemology to identify reasons for adopting or rejecting norms of belief and generating hypotheses for why people may devalue scientific reasoning in some situations. By targeting and correcting errant assumptions underlying the devaluation of scientific reasoning, psychologists may be able to increase the value people place on scientific reasoning and therefore improve reasoning. There are two caveats to this approach (see Outstanding questions). First, biased reasoning is not necessarily *bad* reasoning. Resolving what constitutes justified or unjustified biased reasoning remains an important project for philosophers and psychologists. And second, boosting the perceived value of scientific reasoning may not be sufficient to reason well. Nevertheless, a comprehensive approach to improving reasoning will benefit not only from educating people about what constitutes scientific reasoning, but from affirming the value of scientific reasoning in the first place.

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No interests are declared.

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Outstanding questions

When, if ever, does biased reasoning improve welfare? A large literature has tackled this question in the domain of self-assessment, but recent results suggest an answer is far off.

Do any of the four common arguments for scientific reasoning (Table 1) offer the basis for effective interventions on lay attitudes?

Is manipulating the perceived value of scientific reasoning sufficient to improve reasoning? If not, what else is required?

Can psychologists develop 'value debiasing' interventions that generalize across situations? Cognitive training interventions have had difficulty generalizing outside the training context, but interventions that target the perceived value of scientific reasoning may have the potential to generalize more broadly.

Some work documents individual differences in valuation of scientific reasoning. Absent intervention, what gives rise to low or high valuation of scientific reasoning?

Are people who score highly in dispositional acceptance and valuation of scientific reasoning less likely to accept moral and social arguments in favor of biased reasoning? Or do (some) moral or social cases constitute a special exception?

What are limits on people's morally motivated reasoning? Are people more successful at acquiring motivated beliefs for moral reasons compared with other reasons, or does unambiguous evidence constrain morally motivated reasoning, too?

We have focused on a subset of the norms considered central to the scientific ethos, namely those concerned with evidence and impartiality. What role, if any, do other norms, such as universalism and communalism, play in the lay ethics of belief?

Are there cases in which people are *less* biased than they ought to be? Answering this question requires settling both normative and empirical matters.

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