How Beliefs Persist Amid Controversy: The Paths to Persistence Model

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Abstract

On controversial issues from abortion to vaccination, we frequently know that millions disagree with us, yet remain firmly rooted in our beliefs. What enables this capacity to sustain controversial beliefs? To answer this question, we connect insights across the social sciences to develop the Paths to Persistence Model (PPM). The PPM outlines four causes of persistence: People may perceive disagreeing others as ignorant, biased, or stupid (*informational*), consider the issue to be subjective or unknowable (*ontological*), expect changing their beliefs to have bad social or personal consequences (*functional*), or lack the cognitive resources to update their beliefs (*computational*). We explain how the PPM integrates previous theories across disciplines into interacting 'paths' that jointly explain persistence. We then present a pre-registered study with a sample quota-matched to the U.S census on race and sex ($N = 1,250$) investigating responses to societal disagreement on 96 issues spanning science, politics, morality, and religion. We find that most participants persist in their beliefs amid controversy—even when they learn that they vastly underestimated the extent of societal dissent. Moreover, we find that the paths jointly predict whether people persist, and that the paths are associated with important social outcomes, such as people's willingness to befriend disagreeing others. Four additional pre-registered open- and close-ended studies support these findings (total other $N = 1,921$) and our theoretical model.

Keywords: disagreement, controversy, persistence, belief, judgment

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When, how, and why do people persist in their beliefs amid controversy? Why don't the dissenting opinions of millions give us pause about whether God exists, whether vaccinations should be mandated, or whether abortion is immoral? Why does controversy so rarely make us question or update our beliefs instead? Our aim in the current paper is to address this puzzle of persistence: people's tendency to remain anchored to their beliefs amid large-scale disagreement.

Despite pertinent work in psychology (Minson et al., 2023), philosophy (Frances, 2014), political science (Iyengar et al., 2019), economics (Golman et al., 2016), linguistics (Angouri & Locher, 2012), and sociology (Wagner-Pacifici & Hall, 2012), recent reviews highlight major gaps in our understanding of disagreement and persistence. For instance, compared to other topics in philosophy, the study of disagreement is "a mere infant" that has focused almost exclusively on disagreement among peers (Frances & Matheson, 2019). In the sociological literature on large-scale opinion dynamics, "basic empirical questions about how to underpin model assumptions [e.g., about how individuals respond to evidence from disagreement] remain unanswered" (Flache et al., 2017). Similarly, relevant work in political science rests on "a rather shaky foundation; there are legitimate differences of opinion—sometimes explicit, often implicit—about what disagreement is" (Klofstad et al., 2013). Underlying this cross-disciplinary uncertainty is a dearth of communication: Studies of disagreement are highly siloed across disciplines, in part due to the absence of a model of persistence that can bridge across literatures.

Such gaps in our understanding of disagreement are especially worrying in light of persistent political, scientific, and moral divisions within the U.S and in democracies across the globe (Carothers & O'Donohue, 2019; Levitsky & Ziblatt, 2018). Severe societal disagreements carry drastic consequences for individuals, such as partisan discrimination (Iyengar & Westwood,

2015) and for states, such as a loss of trust in democratic institutions (Hetherington & Rudolph, 2015). Developing a principled understanding of persistence can facilitate the design of interventions aimed towards mitigating such harmful consequences.

Even this brief summary reveals that there is a lack of clarity, and much at stake—practically, scientifically, and philosophically—when it comes to our understanding of the psychology of belief persistence. In this paper, we present and test a model that furthers this understanding by distilling findings across disciplines into four explanations for persistence.

Overview

This paper is structured in four parts. In Part 1, we define disagreement and situate persistence as one of several possible responses to it. We clarify how disagreement is both related to and distinct from other forms of contrary evidence (such as scientific evidence contradicting one's beliefs).

In Part 2, we present a broad taxonomy of drivers of persistence called the 'Paths to Persistence Model' (PPM). This model is comprised of four primary paths, each of which offers a conceptually distinct basis for persistence supported by prior research. We outline key points of convergence and divergence between the PPM and alternative explanations of persistence.

In Part 3, we test this model through a large-scale study. We investigated whether people's responses to disagreement accord with the structure of the PPM, whether the PPM can predict persistence, and whether taking different paths to persistence is associated with important social outcomes, such as silencing dissent, across 96 contentious issues. We also outline several other studies that replicate and extend these findings using different measures, questions, and outcomes.

In Part 4, we discuss key theoretical, practical, and normative implications of our model—from the design of belief-change interventions to whether people should persist—and conclude with important open questions about the psychology of societal disagreement.

Part 1: Defining and Responding to Disagreement

What is Disagreement?

Philosophers conceptualize disagreement as the state that obtains when two or more parties have differing beliefs about a proposition (Frances, 2014). In Bayesian epistemology, for instance, beliefs are conceptualized as subjective probability assignments called 'credences': If I believe in climate change, that means I assign a high credence to it—say, 80% probability of climate change being real (Bovens & Hartmann, 2004).

This naturally leads to a probabilistic interpretation of disagreement, whereby discrepancies in people's credences (i.e., subjective probabilities) about the truth of a proposition can characterize how much they disagree. For example, we can define disagreement as a state in which two parties, A and B, do not hold the same credence regarding a proposition, S (i.e., $P_A(S) \neq P_B(S)$). Using another definition, disagreement can be any state where the difference between the two parties' credences exceeds some threshold, Δ (i.e., $| P_A(S) - P_B(S) | \geq \Delta$).

Which of these definitions best corresponds to people's judgments of disagreement is an open empirical question. We therefore broadly define disagreement as divergence in credences, without committing to a particular measure of divergence. For instance, individuals who meaningfully differ in the probability they assign to the proposition that climate change is real can be said to disagree. Generalizing to group settings, large-scale disagreement can be defined in terms of divergence over the set of every agent's credences (Lackey, 2021).

What Kind of Evidence Does Disagreement Provide?

Disagreement is thus a state in which others' beliefs often contradict our own (for instance, when differences in credences are substantial). Consequently, persistence amid disagreement can be seen as an instance of people under-weighting contradictory evidence—a tendency studied across psychology under many guises, from confirmation bias (Nickerson, 1998) to closed-mindedness (Kruglanski, 2004), cognitive rigidity (Schultz & Searleman, 2002) to conservatism in updating (Peterson & Beach, 1967), among others (Hilbert, 2012; Kunda, 1990; Munro & Ditto, 1997; Stanovich et al., 2013). Though it is part of this broad family of phenomena, persistence amid disagreement involves different psychological mechanisms. This is because disagreement offers a fundamentally distinct kind of evidence than typically studied in this literature.

Consider the following paradigmatic examples: research on dissonance presents participants with essays of counter-attitudinal facts and arguments (Bochner & Insko, 1966), research on conservatism presents participants with data statistically relevant to a hypothesis (Phillips & Edwards, 1966), and research on biased assimilation presents participants with studies that disconfirm the validity of their position (Lord et al., 1979). In each case, the evidence provided is *first-order* evidence, in that it bears directly on the truth of the proposition in question. Notice, however, that learning about disagreement on an issue does not offer direct evidence about that issue. Instead, disagreement offers indirect reasons to question our beliefs. For instance, we may infer that people disagree because they have access to evidence that we lack, or they may be better at reasoning than we are. Philosophers thus identify disagreement as providing *higher-order* (i.e., indirect) evidence (Christensen, 2010; Kelly, 2010).

The following example clarifies how higher-order evidence influences beliefs. Suppose you try to mentally calculate 32 x 47 and find 429. After performing the calculation, you note that

you are extremely fatigued and thus prone to making mistakes. You should grow less confident in your calculation, not because fatigue bears on mathematical truth (i.e., provides direct evidence about the product of 32 and 47), but because the mental evidence you generated is less reliably related to mathematical truths than it would be normally. Similarly to fatigue, disagreement provides us with an indirect reason to question our judgment.

Since disagreement is a distinct kind of evidence, evaluating disagreement often involves distinct psychological processes, and these processes are key drivers of persistence. We briefly describe three differences between these processes here, simply to make the point that existing explanations of resistance to disconfirmation do not provide a comprehensive account of persistence (though they do form core components of the account we provide later). Note that these three points are not intended to capture the features of higher-order evidence generally—they are intended to specifically illustrate features of *disagreement* as a form of higher-order evidence.

First, responding to disagreement involves distinct evaluations of reliability. Whereas evaluating first-order evidence (e.g., how diagnostic a medical test is of some illness) requires expertise in the subject matter, evaluating higher-order evidence from disagreement requires judging the relative epistemic standing of disagreeing others; such as evaluating how diagnostic a physician's opinion is of some illness (Plunkett et al., 2020; Shanteau, 2015). Second, whereas evaluating multiple pieces of first-order evidence requires tracking contingencies across data-points, evaluating dissent from multiple informants requires inferring the social and informational relationships between them, for which people utilize distinct cognitive strategies (Desai et al., 2022; Son et al., 2021). Finally, whereas first-order disconfirmation often entails updating one's beliefs about the proposition at hand, higher-order evidence from disagreement can call into question your expertise in a domain, or even your overall capacity for reasoning, undermining self-

trust. This is because disconfirmation provides direct evidence that one can use to update, whereas disagreement suggests that some part of the belief-generating process may be suspect, without specifying which. Evidence from disagreement can therefore be cognitively risky, as evident in cases of gaslighting or conservative responses to unfamiliar advisors (Soll & Larrick, 2009; Spear, 2019).

In brief, learning that other people's beliefs diverge from ours gives us higher-order evidence that we may be wrong. Evaluating and responding to such evidence involves overlapping and distinct mechanisms from those involved in typical cases of disconfirmation.

How Can People Respond to Disagreement?

In principle, an individual can respond to disagreement in one of four ways: conciliation, suspension, persistence, and polarization. As illustrated in Figure 1, conciliation involves moving one's credences towards the disagreeing other; suspension involves withholding judgment on the issue; persistence involves remaining steadfast in one's prior credences; and polarization involves moving one's credences away from the disagreeing other.

Figure 1

Four Possible Responses to Disagreement
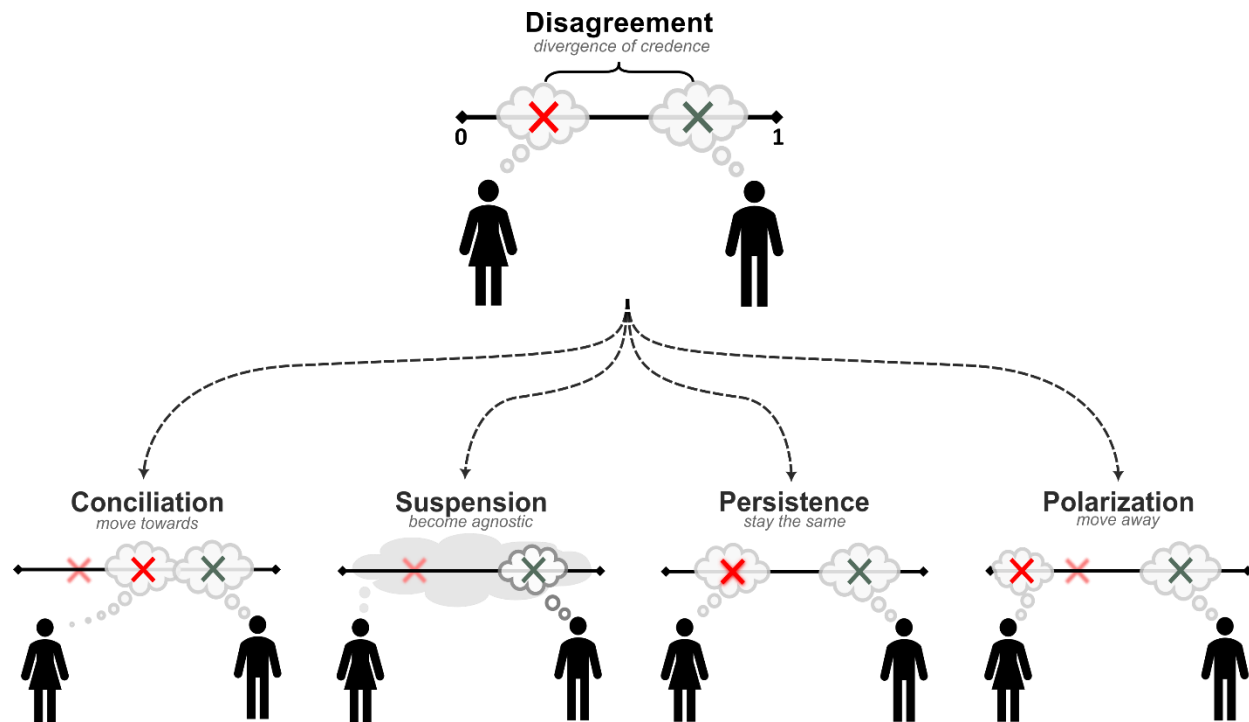
Note. Responses to divergence shown through changes in the left figure's credences.

Psychologists have shown that people provide all four responses to disagreement in different cases. For instance, people optimally conciliate when learning about trivia from the aggregated opinions of a jury (Oktar et al., *in press*), children suspend when peers disagree with their observations (Langenhoff et al., 2023), but persist in their beliefs when disagreeing with unreliable informants (Kominsky et al., 2016), and learning about dissent can cause polarization if dissent is assumed to be insincere or manufactured (Cook & Lewandowsky, 2016). Philosophers, on the other hand, argue that all four responses can be appropriate responses to dissent in different cases: some advocate for persistence (Kelly, 2005), others for conciliation (Christensen, 2007),

and others for suspension (Feldman, 2007); recent work argues that polarization can be a rational response to some contradictory evidence as well (Dorst, 2023).

In sum, there are four possible responses to dissent, all of which can be empirically observed and normatively defended under various circumstances. Thinking back to our starting examples, however, it seems as though societal disagreement often results in persistence—our beliefs seem resilient to dissent on whether God exists, vaccinations should be mandated, or abortion is immoral. In Part 3, we empirically show that this intuition is correct: persistence is in fact the typical response to novel evidence of societal dissent concerning such issues. But why would this be the case? In the next section, we outline a model that clarifies persistence theoretically and thus grounds our later empirical investigation.

Part 2: The Paths to Persistence Model

In part, persistence is prevalent because there are many causes of persistence. The PPM distills these well-studied causes into a coherent framework for understanding persistence, in the spirit of other broad and fruitful frameworks such as the Stereotype Content Model (Fiske et al., 2002) or the Appraisal Theory of Empathy (Wondra & Ellsworth, 2015). Its key innovations are synthesis and parsimony: the PPM subsumes existing explanations of persistence across decades and disciplines into four comprehensive and intuitive factors, while clarifying how they relate to one another. These factors offer theoretically distinct (though potentially interacting) paths to persistence. The model's key value proposition is that it supports empirical generalizations and provides the language necessary to broaden and integrate siloed perspectives—exposing, for instance, the theoretical importance of interactions across paths (which we concretely demonstrate in Part 3), and the practical importance of tailoring interventions to multiple paths in a case-specific manner (as we detail in the General Discussion). We briefly introduce each path before considering

them in more detail. Note that we turn to a more formal discussion of how these four paths were generated—and why they offer a comprehensive taxonomy—after outlining each path (in the section *The Structure of the Model*).
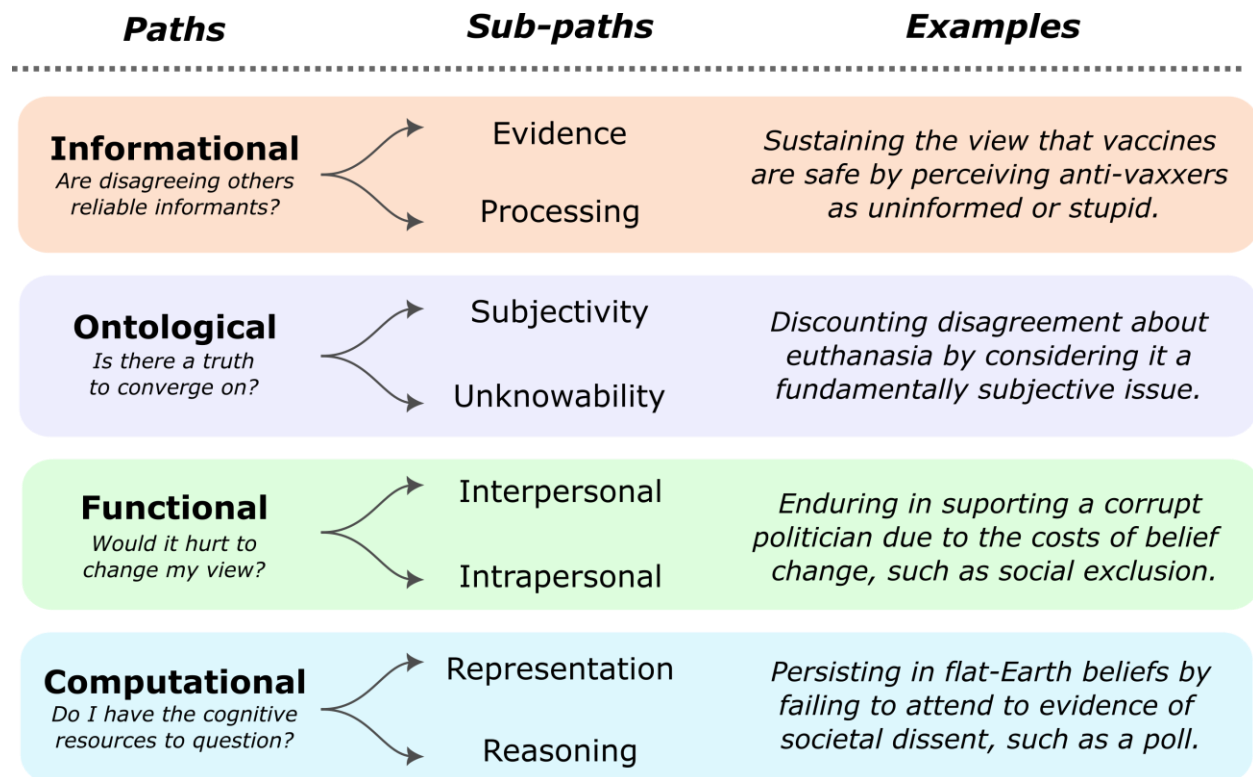
The *informational* path captures how belief persistence can result from considerations such as the quality of evidence or competence attributed to those who disagree. For instance, an individual might persist in their belief that the moon landing was staged despite disagreement if they believe that everyone else is entirely misled by unreliable sources.

The *ontological* path captures how people can persist if they don't see an issue as having an underlying 'truth' for people to converge on. For instance, an individual might persist in their belief that euthanasia is morally permissible because they regard this proposition as fundamentally subjective.

The *functional* path captures how beliefs can persist due to factors beyond their presumed truth, such as their personal or social value. For instance, a fervent supporter of a politician accused of crimes might not be swayed by disagreeing strangers. This may occur because the belief is held out of loyalty or social pressures, rather than epistemic considerations.

Finally, the *computational* path captures the possibility that persistence may result from a failure to adequately process the implications of dissent. This failure may be intentional or unintentional: for instance, an anti-vaxxer may see a poll on the news that indicates societal dissent but switch to a different channel—choosing not to deploy cognitive resources—or focus on and still fail to draw reasonable conclusions about what that poll implies (see Figure 2).

In the rest of this section, we describe these intertwined paths individually. After introducing the paths, we describe how the content and structure of the PPM builds on prior work in a later section (*The PPM Subsumes Alternative Models of Persistence*).

Figure 2

A Taxonomy of Four Paths to Persistence

Paths	Sub-paths	Examples
Informational *Are disagreeing others reliable informants?*	Evidence / Processing	*Sustaining the view that vaccines are safe by perceiving anti-vaxxers as uninformed or stupid.*
Ontological *Is there a truth to converge on?*	Subjectivity / Unknowability	*Discounting disagreement about euthanasia by considering it a fundamentally subjective issue.*
Functional *Would it hurt to change my view?*	Interpersonal / Intrapersonal	*Enduring in suporting a corrupt politician due to the costs of belief change, such as social exclusion.*
Computational *Do I have the cognitive resources to question?*	Representation / Reasoning	*Persisting in flat-Earth beliefs by failing to attend to evidence of societal dissent, such as a poll.*

Note. Each branch in the taxonomy represents a distinct explanation for belief persistence. Importantly, the paths are not mutually exclusive: A given instance of belief persistence can involve multiple paths acting simultaneously.

The Informational Path to Persistence

Theo buys organic produce for his family because he believes that genetically modified foods are less healthy for human consumption. Theo is aware of the GMO controversy and has spent time carefully researching it. He is not bothered by disagreement over this issue because he considers himself to be a smart, informed consumer, unlike those who disagree—they either do not care enough to seek the facts, or are dumb enough to be misled by the same corporate lies.

Theo's case illustrates how epistemic explanations can sustain controversial beliefs. He is aware of the deep disagreement over GMOs (Pew Research Center, 2016), but thinks that disagreeing others are less reliable than he is at tracking scientific truths. He thus does not update his views based on their credences.

We organize our discussion of such epistemic explanations around inferences of others' *evidence* and *processing.* These components are correlated—a biased or incompetent person is likely to be poorly informed—but distinct: A climate change denier may believe that others are honest and competent but misinformed by mass media, for instance.

Informational Persistence: Inferences of Inferior Evidence

Research in social and developmental psychology has shown that people readily attribute evidential inferiority when evaluating disagreement. The literature on naïve realism (people's tendency to assume that their own perceptions reflect reality as it is) has documented that people often judge disagreeing others as ignorant (Robinson et al., 1995; Ross & Ward, 1996), with larger disagreements leading to inferences that others have correspondingly worse evidence (Pronin et al., 2004).[1]

Children also judge disagreeing individuals as uninformed and ignorant in some domains of disagreement, such as moral disagreements, but not cultural disagreements (Wainryb et al., 2001). Such inferences are not necessarily unfounded—selectivity in learning is a basic component

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[1] We note that the vast majority of the empirical evidence in this paper comes from studies conducted in the U.S and should not be assumed to generalize to all people (Henrich et al., 2010). For the sake of conciseness and readability, we will use the term 'people' when referring to the results of studies, but readers should keep in mind that much research is needed to investigate whether mechanisms of persistence vary across cultures.

of our social reasoning toolkit, and undergirds epistemic vigilance (Harris et al., 2018; Koenig & Harris, 2005; Sperber et al., 2010). Accordingly, even young children consider informants' sources when deciding who to believe (Aboody et al., 2022), and novices conciliate towards the opinions of trusted experts because they are thought to possess more (and better) evidence in their areas of expertise, rather than merely being influenced by their authority (Kruglanski et al., 2005).

Much work has documented attributions of inferior evidence to disagreeing individuals. To our knowledge, there has been no direct work on whether people make biased evidential inferences about disagreeing *groups.* Note that attributing evidential inferiority to a group requires taking a strong stance: That the disagreeing group, as a whole, has access to worse evidence compared to oneself (or the agreeing group). One approach to justifying these attributions is through perceptions of source dependence. If all disagreeing others are perceived as receiving their information from the same single source, for example, their informativeness would be reduced to that one source. Given that 87% of both Republicans and Democrats perceive each other to be "brainwashed" (Yudkin et al., 2019), that people consider others to be more easily persuaded by mass media than themselves (Duck & Mullin, 1995; Sun et al., 2008), and that outgroups are perceived to be highly homogenous (Quattrone & Jones, 1980; Rubin & Badea, 2012), inferences of dependency can plausibly justify attributions of inferior evidence to entire groups.

Informational Persistence: Inferences of Inferior Processing

People are sensitive to asymmetries in processing as well. For instance, children learn from their parents not just because adults have better evidence about the world, but also because adults are more competent—that is, more likely to make the right inference given the same evidence (Harris, 2012). Adults, on the other hand, persist on the basis of their greater knowledge and

competence. We can break down inferences of inferior processing into two varieties: attributions of intellectual inferiority and attributions of bias.

Anecdotally, people often denigrate disagreeing groups, labelling them "childish, stupid people" or claiming that they are "ignorant, stupid, or insane" (quotes from opinion pieces on controversies; Cunningham, 2021; Dawkins, 1989). There is little work in psychology on such inferences of inferior intellect. As Hartman et al. point out in a recent paper, "the only investigations (...) [of political attributions of] unintelligence were conducted by polling organizations" (Hartman et al., 2022). Their results show that these attributions are distinct from other negative judgments (e.g., immorality and dislike) and echo the findings of these polls: Partisans are likely to view each other as unintelligent (a third agree with such attributions; Pew Research, 2019). Developmental studies suggest that children often make domain-dependent attributions of 'unintelligence' in response to disagreement as well (Wainryb et al., 2004).

A much larger body of evidence in social psychology has shown that people consider disagreeing others to be more biased (Kennedy & Pronin, 2008), driven by self-interest (Reeder et al., 2005), unfair (Frantz, 2006), and influenced by group pressures (Cohen, 2003) than themselves. While these uncharitable inferences are not identical, they function similarly in the context of disagreement: If an informant is perceived to be biased, their beliefs should carry less epistemic weight.

One way people may justify the intellectual inferiority (or greater bias) of entire groups is through stereotypes (Fiske et al., 2007; Gelman, 2004). For instance, ethnographies suggest that some flat-earthers justify their epistemic superiority over disagreeing others by placing them into a social category ('sheeple' or 'globies') and stereotyping them as intellectually inferior, "blind

and uncritically obedient" (Toseland, 2019). Similarly, opposing partisans hold many stereotypes of one another, likely including unintelligence (Judd & Park, 1993; Rothschild et al., 2019).

The Ontological Path to Persistence

Brandon loves eating meat, and believes that it is morally okay to do so. He is aware that many vegetarians disagree with him—and he respects their personal preference. Yet their views do not influence his: To Brandon, there are no right or wrong answers to moral questions, just subjective opinions. And even if there were some universal moral code that establishes the 'truth' about the morality of eating meat, he's convinced that no one knows what it is, anyway.

Brandon persists in his view about the morality of eating meat based on issue-level inferences—such as the impossibility of identifying shared moral 'truths.' This impossibility can result from either the truth of a statement being fundamentally agent-relative (i.e., subjective), inaccessible (i.e., unknowable), or both. These inferences are ontological, in the sense that they concern the *kind* of issue at stake, such as whether it is a matter of preference or fact.

Ontological Persistence: Inferences of Subjectivity

Whereas beliefs and decisions in some domains (such as medicine and mathematics) are perceived as objective, other domains (such as fashion and romance) are seen as subjective (Kuhn et al., 2000). There is a deep connection between such subjectivity and disagreement captured by the Latin adage *de gustibus, non est disputandum* ('in matters of taste, there can be no disputes'). This is because aggregate 'truths' about subjective issues are ill-defined—there is no such thing as the best song for everyone, for instance, but there may be a best treatment for an illness (Kivy, 2015). To the extent that an issue is considered subjective, others' opinions thus become epistemically irrelevant to our beliefs (Egan, 2010). Note how perceptions play a key role here:

Ontological persistence does not require a statement to in fact be subjective—it merely requires people to believe that it is.

We are not aware of any direct work examining measures of belief change in response to subjective vs. objective disagreements. However, research in three domains provides support for the idea that subjectivity can generate persistence. First, linguists, psychologists, and philosophers have examined 'faultless disagreements,' (Kölbel, 2004) cases where people are willing endorse claims such as 'both people can be right' instead of the claim that 'one person is wrong' despite characters explicitly negating each other (e.g., if Sam says, 'this wine is tasty,' and Alex says 'no, this wine is not tasty'). The fact that people frequently endorse these claims for both aesthetic (Kaiser & Rudin, 2021) and moral disagreements (Sarkissian et al., 2011) suggests that they may persist by not recognizing others' views as having a bearing on their own (e.g., by forming a relativist or multiplist framing; Goodwin & Darley, 2008; Kuhn, 2020). Second, consumer psychologists have shown that people draw stronger inferences from others' judgments and decisions for objective choices (e.g., for purchasing electronics) than subjective choices (e.g., choosing movies to stream), and find others' reviews more helpful in these domains (Dai et al., 2020; Spiller & Belogolova, 2017). This suggests that subjectivity can generally lead to a discounting of others' views. Finally, research in advice taking and social comparison has shown that people are more likely to seek consensus information for tasks that they perceive to be objective (Olson et al., 1983; Spears et al., 2009).

What underlies perceptions of subjectivity? One factor is the presence of disagreement itself. For instance, presenting people with evidence that many others disagree with them decreases their perceptions of the objectivity of moral claims, such as whether downloading a TV program in violation of copyright laws is immoral (Goodwin & Darley, 2012). Similarly, greater perceived

consensus regarding the moral status of a claim predicted greater perceived objectivity (for similar findings about non-moral claims, see Ayars & Nichols, 2020; Heiphetz & Young, 2017). Disagreement can thus lead to inferences of subjectivity, which in turn allow individuals to persist amid said disagreement, resulting in entrenched cleavages of opinion.

In contrast to informational persistence, subjectivity-based persistence does not depend on negative inferences about the disagreeing party. Perhaps for this reason, 'ice-breakers'— introductory activities that establish rapport—often rely on sharing of preferences (Chlup & Collins, 2010). However, not all beliefs justified on ontological inferences are ice-breaker material.

Ontological Persistence: Inferences of Unknowability

Does hell exist? Some domains, such as religion, raise important questions that many expect to be beyond human understanding; others, such as science, raise questions that we expect to have discoverable answers (e.g., .g., whether the moon causes tides; Davoodi & Lombrozo, 2022; Liquin et al., 2020). If people expect the truth of a statement to be fundamentally unknowable, they may persist in their beliefs amid disagreement without assuming that others have weaker epistemic standing (since no one's judgment on the issue is informative).

Recent work has found that people have systematic beliefs about what is knowable, and by what means (Heiphetz et al., 2021). For instance, people judge some psychological phenomena (such as conscious experience and belief in God) as more likely than other phenomena (such as depth perception) to fall beyond the scope of what science can explain (Gottlieb & Lombrozo, 2018). Similarly, children and adults gravitate towards informants who show 'virtuous ignorance'—that is, acknowledging ignorance about unknowable matters, such as the number of blades of grass in New York (Kominsky et al., 2016).

More direct evidence pertaining to unknowability judgments comes from recent studies on 'paradoxical knowledge,' where people recognize something as unknowable, but claim to know it nonetheless. Paradoxical knowledge is commonplace across domains (with a majority of participants in a recent study endorsing at least one claim similar to the following participant-generated example: "I know that there is no God... I know this, even though it is unknowable"). Paradoxical knowledge is particularly prevalent for goal-relevant beliefs, and is associated with a willingness to join and adhere to extreme groups (Gollwitzer & Oettingen, 2019). Relatedly, research on conspiracy theories has identified widespread incoherence in conspiratorial beliefs that is accompanied by paradoxical inferences of unknowability (e.g., that climate change cannot be predicted, but that we are heading into an ice age; Lewandowsky et al., 2018; Wood et al., 2012). And people can inject unknowability into their construal of key political and religious issues when facts threaten pre-existing worldviews (Friesen et al., 2015).

In sum, persistence can result from the ontological relevance of others' views to our own: If there is no accessible truth about an issue, either because it is subjective or unknowable, there is no epistemic reason to update one's beliefs due to disagreement.

The Functional Path to Persistence

Matt works at a rifle store in Texas and often discusses gun laws with his family. He shares their belief that gun laws in the U.S. are too restrictive and owns an impressive collection of munitions at home. Moreover, his belief in the unrestricted right to bear arms grounds much of his understanding of what it means to be an American, a Republican, and a proud Texan.

Matt's case illustrates the many functions that beliefs serve, which can justify persistence: Changing his views about guns could cost him his job and alienate him from his loved ones, in

addition to jeopardizing his larger worldview and sense of self. We cluster these functional values of beliefs into two categories: inter- and intrapersonal.

Functional Persistence: Interpersonal Drivers of Belief

Beliefs play a profound role in our social lives. Having the wrong beliefs in the wrong context can get you shunned, exiled, or executed (Poliakov, 2003). Historically, clashes between groups with different sets of beliefs have driven much animosity, war, and bloodshed (Golman et al., 2016)—and even today, much armed conflict in the world arises over differences in beliefs (Svensson, 2013).

Beliefs are consequential in part due to their social function as signals of group affiliation. Signaling the right affiliations by curating group-congruent beliefs can allow people to reap the benefits of social integration (Thoits, 2011), while avoiding the costs of social exclusion (Roberts et al., 2021). Accordingly, people form beliefs on novel issues that align with those of their in-group (Kahan, 2010), and infer that out-groups have beliefs that differ from their own (Dion, 2003). Foundational studies in social psychology, such as Sherif's studies in group conflict, demonstrate the strength of these pressures: even groups that are formed randomly and arbitrarily can generate prejudice and discrimination (Sherif, 1956; Tajfel, 1970).

Alternatively, people may privately conciliate in response to encountering disagreement with the out-group, but choose not to express divergent beliefs to their in-group (Noelle-Neumann, 1977). That 62% of Americans today say they have political beliefs they are afraid to share (Cato Institue, 2020), and recent evidence that partisans "parrot the party line, but do not vote it" (Lenz, 2013) support this idea. However, such dissonant beliefs may erode over time (Harmon-Jones & Mills, 1999), in part due to the difficulty of sustained deception (Hippel & Trivers, 2011;

Schwardmann & van der Weele, 2019), and in part due to a preference for expressing authentic beliefs (Brown et al., 2022; Oktar & Lombrozo, 2022).

In sum, beliefs have important social functions and consequences—such as exclusion and prejudice—that can drive people to maintain group-consistent beliefs, and persist.

Functional Persistence: Intrapersonal Drivers of Belief

Dissent can induce uncertainty and ambiguity, which complicate decision-making. Accordingly, people may persist amid dissent to preserve decision-promoting beliefs (Kagan, 1972; Kruglanski, 2004): I may have to decide whether to vaccinate on a given date, and it may be inefficient for me to debate the pros and cons endlessly, as opposed to committing to a course of action. Relatedly, self-esteem facilitates decision-making and the pursuit of long-term goals (Bandura, 1982). Given that disagreement can lower confidence (Pool et al., 1998), people may also persist in their beliefs to protect their self-esteem: If I am a staunch pro-vaccine advocate, doubting my stance on vaccines could lead me to doubt my capacity to form robust beliefs on key issues, reducing my self-esteem. Accordingly, self-affirmation makes people more persuadable on controversial issues (e.g., beliefs regarding capital punishment) amid dissent (Cohen et al., 2000).

Beyond providing value by guiding decisions, mounting evidence suggests that beliefs are a source of value in and of themselves—that is, beliefs are not merely a means to an end (in service of decision-making or signaling), but also directly confer utility (Bénabou & Tirole, 2016; Bromberg-Martin & Sharot, 2020; Loewenstein & Molnar, 2018). For instance, beliefs have affective consequences: religious belief can buffer against existential anxiety (Norenzayan, 2013), and just-world beliefs promote a sense of safety and happiness (Hafer & Sutton, 2016); similar examples abound (Abramson et al., 1989; Altay et al., 2023; Davoodi & Lombrozo, 2022a). When these considerations anchor beliefs, epistemic evidence from disagreement may not be relevant.

Relatedly, theories of persuasion underscore the functional role of emotions in guiding attitude change: For instance, if messages can associate negative affect with one's existing beliefs, attitude change is more likely (Petty & Briñol, 2015).

In sum, both inter- and intrapersonal benefits of belief can drive persistence. Such 'returns' provided by a belief can consciously or subconsciously guide people's likelihood of persisting in that belief, in line with the literature on motivated reasoning (Cusimano & Lombrozo, 2023; Epley & Gilovich, 2016), and with influential work on the functional approach to the study of attitudes (Katz, 1960; Shavitt, 1989).

The Computational Path to Persistence

Lisa believes that many vaccines cause infertility. She has no expertise in biology and could not articulate a plausible mechanism that would explain how vaccines might cause infertility—but she is unaware of how shallow her understanding is. She was recently channel-surfing when a poll on vaccination beliefs flickered on her television. She skipped it without paying much attention; there were better things to watch and she was already convinced that many people agree with her.

Lisa's case illustrates how cognitive constraints—from patchy representations to limited attention and flawed reasoning—can drive persistence. Lisa (falsely) believes that many support her views, and when she encounters evidence to the contrary, she prioritizes other tasks instead of revising her views based on the disagreement. Moreover, even if Lisa tried to update her beliefs about vaccination, her lack of understanding would pose challenges for how she ought to revise her views. We can categorize such limitations as constraints on our internal representations of relevant issues, and constraints on the kinds of reasoning we can deploy over those representations.

Computational Persistence: Constraints on Representations

Appropriately responding to societal disagreement requires accurately representing the presence and properties of disagreement. However, research on pluralistic ignorance suggests that people frequently "operate within a 'false' social world" (Fields & Schuman, 1976) and misestimate the distribution of others' beliefs (Shamir & Shamir, 1997)—typically by overestimating support for their own views (Mullen et al., 1985; Ross et al., 1977), and sometimes overestimating dissent on fringe issues (Westfall et al., 2015; Yudkin et al., 2019). Such inaccurate representations can drive persistence in many ways. For example, when people update their beliefs about societal dissent, they combine their prior beliefs with polling data (Stoetzer et al., 2022). If misperceptions are held with sufficient confidence, people may learn little, if anything, about societal dissent based on the poll. If people do not learn *about* dissent, and continue to underestimate it, they will not learn from it either.

Beyond inaccuracy, mental representations can lead to persistence by being redundant, incomplete, or inconsistent (Bendana & Mandelbaum, 2021; Converse, 1964; Sommer et al., 2023), rather than perfectly integrated (e.g., in a Bayesian network). Mounting research suggests that people are unaware of pervasive flaws in their representations (Chater, 2018)—for example, non-physicists may believe that gravity exists but find themselves grasping at straws if asked to explain why (Rozenblit & Keil, 2002). If people lack integrated representations of their beliefs, they may 'persist' because they do not have a particular, 'true belief' about an issue to update. As Zaller summarized, "for most people, most of the time, there is no need to reconcile or even to recognize their contradictory reactions to events and issues (...) individuals do not typically possess 'true attitudes' on issues (...) but a series of partially independent and often inconsistent ones" (Zaller, 1992). For instance, Lisa could persist in her views by seeing a poll on the news, storing

the belief that vaccines are perfectly safe, and simultaneously maintaining her view that vaccines cause infertility (Mandelbaum, 2019).

Computational Persistence: Constraints on Reasoning

Constraints on time and computation shape cognition and reasoning (Griffiths, 2020). Often, we need to solve complex problems quickly, using a finite pool of neurons, and we do so by efficiently allocating our cognitive resources: For example, strategically deploying attention to task-relevant information (Sims, 2003) and setting goals that triage tasks (Shenhav et al., 2017). Such efficiency comes at a cost: information that is not relevant or valuable is ignored, often 'going in one ear and out the other' (Craik & Lockhart, 1972). Since learning about societal controversies is often not a priority in everyday life (Lupia, 2015)—especially with the engineered distractions of the modern age (Williams, 2018)—people may persist amid dissent simply by ignoring it in many cases. These computational limitations can prevent even boundedly rational agents with epistemic aims from reaching consensus amid dissent (Pothos et al., 2021).

Beyond failing to deploy reasoning, people can reason in ways that shield their existing beliefs from societal dissent. For instance, they can reason lazily, relying on learned or heuristic associations (e.g., thinking 'I'm probably right') instead of thinking critically (Pennycook & Rand, 2019); reason in ways that preserve their capacity for constructing persuasive arguments (vs. aiming at truth; Mercier & Sperber, 2011); and come up with ad-hoc theories that explain away the informativeness of dissent (Gershman, 2019). If 65% of participants fail to accurately reason about questions as simple as the summed cost of a baseball and a bat (Frederick, 2005; Pennycook et al., 2016), then many are likely to reach flawed conclusions about complex issues, such as the implications of societal dissent for their own views. Accordingly, much research has established

various fallacies in the reasoning of conspiracy theorists (Lewandowsky et al., 2018; Wood et al., 2012)—fallacies which are a consequence of flawed reasoning, and which can result in persistence.

Ambiguous Cases and Assumptions

The examples presented so far were selected to support unambiguous classification within a single path, but some real-life instances of persistence are likely to be underspecified or hard to sort. For example, you may persist upon disagreeing with a disliked other for no reason beyond your dislike—we can impute various motivational causes to understand such persistence, but it is plausible that it may be an indecipherable response (but see Minson & Dorison, 2022). To the extent that a response is interpretable, however, the PPM should capture it.

As with all models, the PPM leaves some unexplained variation on the table, while usefully describing the rest (Box, 1976)—in particular, our model omits granular detail about context- and person-specific factors that generate persistence in any given case, while providing structure that can explain why these factors, at a high level, cause persistence; much as taxonomies do not account for individual mutations, but instead aim to capture interpretable clusters of characteristics that separate species (Padial et al., 2010).

Relatedly, our descriptions of the sub-paths were intended to provide a parsimonious illustration of the paths, not an exhaustive taxonomy of the considerations within each path. For instance, people may infer others to be well-informed and competent, yet still persist if they take disagreeing others to be *dishonest* informants (Noelle-Neumann, 1977). We intend future research to use the PPM as a generative framework and expand our understanding of the nuanced mechanisms that constitute its sub-paths.

Finally, disagreements can persist without people persisting per se. This may happen due to biased informational networks (e.g., information silos) that drive persistent opinion dynamics

at the societal level (Cinelli et al., 2021; Dinas, 2014), or in highly insulated communities where societal opinion may be inaccessible (Axelrod, 1997; Flache et al., 2017). We do not focus on external network effects here, as the paths to persistence outline individual psychological mechanisms.

The Structure of the Model

Before turning to interactions across paths and the results of our empirical study, we describe the theoretical structure underlying our model, and explain why we take it to not just summarize past literature (in bottom-up fashion), but to also form a comprehensive and principled taxonomy (in a top-down sense).

Theoretically, the first three paths align with *epistemic* (informational), *meta-epistemic* (ontological), and *non-epistemic* (functional) reasons to persist. That informational considerations are epistemic is straightforward (as the information in question relates to the amount and quality of others' knowledge regarding issues). Ontological considerations (e.g., subjectivity) are meta-epistemic, in the sense that they determine whether epistemic analyses are relevant to understanding an issue (for instance, subjectivity is a standard example of a meta-epistemic consideration; Carter, 2018). And functional considerations are canonical examples of non-epistemic reasons for holding beliefs—as one epistemologist put it, "paradigmatic non-epistemic reasons, on the other hand, are reasons which bear on the achievement of a subject's non-epistemic (non-cognitive, non-truth-related) goals [such as feeling good]." (Bondy, 2021).

These are all considerations that arise at a teleological level of analysis (what Marr called the computational level; Marr, 1982), as they offer rational reasons to persist given a believer's goals and the nature of the issue in question. Importantly, epistemic, meta-epistemic, and non-epistemic considerations exhaust this set of considerations. But at the algorithmic level, resource

limitations can also play a role, and this is captured by our computational path. From this theoretical lens, the only class of causes of persistence that the model potentially omits are those that arise from the implementation level and that are not reflected in algorithmic or teleological considerations (such as neurological deficits—for instance, anterograde amnesia can cause persistence of belief in ways that are not captured by the PPM).

Our four factors can also be motivated in a principled manner from a Bayesian perspective. For instance, consider the core components of a recent Bayesian model of learning from aggregated opinion (such as public opinion polls; Oktar, Lombrozo, & Griffiths, *in press*). This model predicts that people will persist (i.e., beliefs will not be updated) on some proposition Q in two conditions: either when people are extremely confident in their prior beliefs about the issue, or when they perceive societal opinion to be undiagnostic of the truth of Q.[2] Both of these conditions naturally correspond to the informational path. Societal opinion will be viewed as undiagnostic when disagreeing others are perceived as being ignorant, stupid, or biased. Strong prior beliefs will also serve as an informational consideration insofar as they support an epistemic asymmetry, with the learner's own prior beliefs weighed more heavily than that of others.

The remaining paths instead generate persistence by rejecting fundamental assumptions implicit in this simple Bayesian approach. The ontological (meta-epistemic) path rejects the assumption that there's a shared truth—an objective matter of fact—for different individuals to converge to. The functional (non-epistemic) path rejects the assumption that beliefs aim (only) at

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[2] Specifically, the Bayesian model uses a sample of aggregated opinions, X, to infer the probability, θ, that the statement Q is true, $P(Q) = \theta$. The model combines prior beliefs about truth, $p(\theta)$, with a likelihood function that connects observations of binary opinions, X, to inferences about θ (denoted $P(X|\theta)$). When people are assumed to be reliable informants (e.g., $P(x_i = 1|\theta) = \theta$), the optimal inference (i.e., the posterior) combines prior beliefs with the information in the opinion distribution. There are two conditions under which beliefs will not be updated. First, if prior beliefs are extreme (i.e., when people are certain that the belief is false ($p(\theta) = lim_{\alpha \to \infty} \text{Beta}(\alpha, 1)$) or true ($p(\theta) = lim_{\beta \to \infty} \text{Beta}(1, \beta)$)). Second, if opinions are uninformative about the truth of Q (e.g., $P(x_i = 1|\theta) = .5$).

truth—and hence that we should aim to update beliefs to maximize accuracy. And the computational path rejects the assumption that a believer has the resources needed to fully evaluate relevant considerations.

Taken together, these theoretical and formal arguments illustrate why our model is not merely a summary of past research, but instead provides a structure that comprehensively accounts for potential causes of persistence, and with principled distinctions among paths.

Interactions Across Paths

As Theo, Brandon, Matt, and Lisa's cases illustrate, each path can offer a sufficient basis for persistence. This gives us some insight into the prevalence of persistence: For most important real-world controversies, it is exceedingly likely that at least one path will be available to support persistence. However, there is good reason to think that these paths often interact; dynamically reinforcing or substituting for each other in generating persistence. Here, we describe three plausible pairwise interactions that emerge from the first three paths. We illustrate these interactions through examples drawn from research on adjacent questions (since no past work, to our knowledge, has investigated these interactions in the context of societal dissent).

First, paths can moderate each other's influence. Perhaps the most salient interaction in the PPM is that between the informational and ontological: For objective and knowable issues, others' evidence and intellect should have a large effect on persistence; for subjective or unknowable issues, this effect should be attenuated or eliminated. Accordingly, highlighting the subjectivity of judgments in a domain (e.g., art)—hence enabling ontological persistence—can reduce the extent to which participants judge those who disagree with them as biased (Cheek et al., 2021). Similarly, children are less likely to judge disagreeing others as uninformed or unintelligent in more subjective domains, such as cultural disagreements (Wainryb et al., 2001).

Second, paths can be synergistic. Because informational reasons can provide convincing arguments for sustaining belief, we may expect persistence to be especially likely when people have both informational and functional considerations support persistence (Mercier, 2016; Tetlock, 2002). On the flip-side, questioning may be especially likely when neither path is available. Accordingly, anti-climate change attitudes are more pliable when informational interventions are coupled with self-affirmation exercises that attenuate the discomfort of view change (van Prooijen & Sparks, 2014), and affirmation can generally increase the persuasive power of messaging (Cohen et al., 2000; Steele, 1988).

Finally, interactions can cause reversals. For example, though subjectivity is often a path to persistence, it can also enable questioning when it is socially desirable to question and conform (e.g., consider the rapid adoption of aesthetic fads; Bikhchandani et al., 1998). This is because it is harder to appear competent if you frequently change your mind in arguments about ostensibly objective issues; but subjectivity offers a route to conciliating without social costs. Accordingly, early work comparing conformity on objective vs. subjective statements in small-group discussions with *peers* found that subjectivity led to higher conformity (Blake et al., 1957), whereas similar work on *anonymous*, online interactions finds that subjectivity drives persistence (Wijenayake et al., 2020), plausibly due to the absence of interpersonal consequences to dissent.

Complex Dependencies

Beyond the relatively simple pairwise interactions we discussed here, there are likely more complex dependencies across paths that guide persistence. Most obviously, higher-order interactions (e.g., Informational x Ontological x Functional) may have an influence, and considerations from the computational path could influence whether and how other paths are pursued. Considering reasoning about controversy as a sequential process reveals more subtle

dependencies as well: Initial evaluations of one path may influence subsequent evaluations of other paths, resulting in complex, time-dependent interactions. Further complicating the picture are possible interactions across specific sub-paths (e.g., inferences of bias x unknowability). The pairwise interactions described above are thus meant to illustrate the possibility of rich dependencies, rather than offer a comprehensive analysis.

The PPM Subsumes Alternative Models of Persistence

We are not aware of any existing theories that directly tackle the question of how beliefs persist amid societal dissent, but many existing theories of belief, conformity, persuasion, and attitude change bear on persistence. We consider these models not as competing alternatives, but integral components of our broader account. As components of a larger whole, they individually fail to capture important aspects of persistence.

For instance, some of the first empirical research on when and how group disagreement shapes (or fails to influence) individual belief focused on conformity (Asch, 1955). Theories of conformity, such as Latané's Social Impact Theory (Nowak et al., 1990) or the Social Influence Model (Tanford & Penrod, 1984), focused on the contributions of the status, proximity, and quantity of disagreeing others in determining whether people persist or conciliate amid dissent—clearly capturing *functional*, and in particular, *interpersonal* considerations (for reviews, see Cialdini & Goldstein, 2004; Flache et al., 2017).

Models of social learning dating back to Condorcet's Jury Theorem (Dietrich & Spiekermann, 2023), on the other hand, focused on the *informational* roles of inferred competence (Landrum et al., 2015), source dependence (Hahn, 2024), and bias (Austen-Smith & Banks, 1996) in shaping ideal inferences from opinion. Though conformity researchers long recognized the importance of informational influences (Deutsch & Gerard, 1955), and research on social learning

recognized the importance of functional motivations (Tetlock, 2002), models that incorporate both as core components of social belief change are relatively recent—as Tetlock writes, siloed research traditions have typically treated "people as either intuitive scientists animated by epistemic goals or intuitive economists animated by utilitarian ones." Toelch and Dolan (2015), pushing for a more integrated model of conformity, argue that informational and interpersonal functions should be jointly considered. Bromberg-Martin and Sharot (2020), on the other hand, argue that belief formation and updating can only be understood by also taking the *intrapersonal functions* of belief into account—capturing the key insight that some beliefs confer value on their own (Bénabou & Tirole, 2016). Broadly, these models capture informational and functional considerations, but miss out on the ontological and computational paths.

Research on cognitive development, on the other hand, has explored how people acquire nuanced understandings of complex issues, including their subjectivity and knowability (Kuhn, 2020). The Reflective Judgment Model (King & Kitchener, 2002), for instance, describes the development of personal epistemologies—increasingly sophisticated models of what knowledge is—and how these models enable people to selectively learn from dissent on some issues, while ignoring it for others. Theories in this literature typically focus on *ontological* and *informational* considerations (Muis et al., 2006; Pintrich, 2002).

Finally, recent theoretical research on resource-rational Bayesian inference has argued that bounds on *computational* capacities can cause dysfunctional disagreements (Pothos et al., 2021). Relatedly, dual-process accounts—from the Elaboration Likelihood Model of persuasion (Petty & Cacioppo, 1986) to 'laziness' based explanations of susceptibility to misinformation (Pennycook & Rand, 2019)—posit that information is frequently processed in a cheap, biased, and lazy manner,

resulting in information being under- or over-weighted due to superficial characteristics. This literature generally focuses on *informational* and *computational* considerations.

No past framework, to our knowledge, has aimed to synthesize the potentially interacting influence of all four factors in explaining phenomena such as persistence and belief change, despite recent calls in related literature for "an overarching theoretical model that aims to integrate cognitive, social and affective factors" (Ecker et al., 2022). The PPM addresses this important gap.

Empirically Examining Paths to Persistence

When introducing the PPM, we identified its key value proposition: it supports empirical generalizations and provides the language necessary to broaden and integrate siloed perspectives. Our theoretical and empirical discussion thus far already goes some way towards making good on this proposition: we have argued on theoretical grounds that the four paths we identity are coherent and exhaustive, and we have shown that they offer a way to systematize existing work across the social sciences (generating some new predictions along the way). In this section we offer a more direct empirical test of the PPM in the form of a novel study with the primary aim of demonstrating the psychological reality and value of the model. First, we aim to show that the PPM captures responses to controversy, in the sense that the paths correspond to coherent and distinct factors. Second, to show that our paths accomplish psychological work, we test whether our factors in fact predict persistence, and whether they predict downstream consequences of persistence (such as unwillingness to befriend others who disagree). Our analyses not only consider main effects of paths on these dependent variables, but test and find interactions as well—not only supporting our theoretical predictions, but also demonstrating the importance of considering multiple paths in the context of a unifying framework.

As one of the first comprehensive investigations of responses to *societal* dissent (vs. responses to disagreeing individuals), this study also answers several basic questions about responses to dissent: Is persistence as common a response to dissent as it intuitively seems? Does it occur even when people vastly underestimate dissent? And do the mechanisms that support persistence differ across domains? These are all foundational questions, in the sense that they can ground and organize subsequent inquiry into the nature of controversial beliefs across disciplines.

We examined these questions in an online study with a novel stimulus set of 96 controversies across four domains, using a sample quota-matched to the U.S census on key demographics. After describing the design and results of this study, we also report several related studies that support and extend our results.

Methods

Participants

In Study 1, we preregistered a target sample of 1,250 participants (all pre-registrations, materials, data, and analysis scripts are available in our open-access repository at https://osf.io/389as). Participants were recruited through Prolific, and quota-matched to the U.S census on race and sex[3]. Participants were paid $2.40 for a 12-minute study (at a rate of $12 per hour). We pre-registered three criteria for exclusions, which resulted in a high exclusion rate (likely

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[3] We used the nationally representative sample provided by Prolific, which additionally quota-matches to the census on age, but failed to recruit 19 participants in the 75+ age range from the available pool after two months. We decided to fill those 19 slots with younger participants such that we maintained a sample matched on race and sex.

because a memory item was too difficult).[4] To ensure that our findings are generalizable to the

broader population, high quality, and robust to our choices about exclusion (Steegen et al., 2016),

we therefore conducted our main analyses in two ways: First, using all attention checks in

accordance with our pre-registered analysis plan; second, without using the memory items that

resulted in high exclusions. The manuscript includes results from the first set of analyses ($N =$

737)—we identify any differences across datasets where appropriate, and include both sets of

analyses in our Supplementary Materials (SMC1-2).

All reported studies were approved by the Princeton Institutional Review Board (IRB).

Materials

To investigate responses to controversy in a generalizable manner (Yarkoni, 2022), we

curated a novel stimulus set of 96 controversial propositions that span four domains: politics,

morality, religion, and science. The stimuli were drawn from recent public opinion polls conducted

by major polling agencies (primarily Gallup, Pew Research, and YouGov surveys with nationally

representative samples in the last 10 years), and were systematically sampled to cover differing

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[4] First, a time-based criterion identified participants who completed the survey in less than 5 minutes (which leaves

participants less than 5 seconds per question); 21 participants were under our threshold. Second, a self-report multiple-

choice question identified participants who were at least 'a little distracted' and 'sloppy' when taking the survey; 15

participants indicated being distracted, and 4 participants did not answer this question. Third, a memory-based

multiple-choice question identified participants who did not recognize the wording of two of the measures in the study;

224 participants did not recognize the first measure, 338 did not recognize the second, and 750 participants identified

both measures and none of the 10 distractor items. The high exclusion rate on this final check suggests that it may

have captured factors beyond attentiveness (e.g., memory capacity).

levels of disagreement with participants' beliefs, from 'low' cases of split opinion (50-66%) to

'medium' cases in which a strong majority disagrees with the participants' views (66-84%) and

'high' cases in which Americans overwhelmingly disagree (84-96%; see Figure 3). We sampled 8

controversies for each combination of our four domains and three levels of disagreement, resulting

in 96 controversies.

Figure 3

Example Issues Used in Study 1
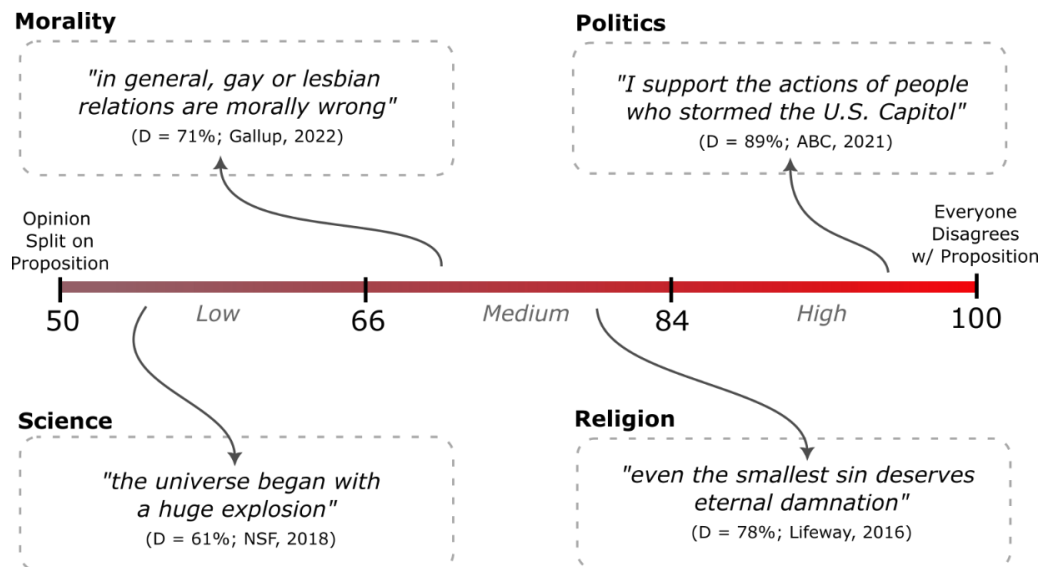
Note. Participants were assigned to one of four domains, and rated three sets of 8 controversies;

resulting in a total of 96 controversies. In the citations, "D" refers to the proportion of Americans

in the cited opinion polls who did not indicate agreeing with that proposition.

A list of the controversies included in the stimulus set is available in our Supplementary

Materials (SMA1; Table 1). To increase the accessibility of these materials for future research and

the public, we also created an interactive website (the *Controversy Explorer,* available in our OSF

repository; see Supplementary Materials SMA1 for details).

Procedure

Participants first provided consent and were randomly assigned to one of our four domains. They then completed three blocks of the same measures with different sets of issues, each corresponding to issues in a particular disagreement range. For instance, a participant assigned to Politics might first encounter the 'medium' disagreement block, in which they were asked to identify which of the 8 issues in Figure 4 they agreed with. The order of the disagreement level blocks was randomized across participants.

Figure 4

A Screenshot of the Disagreement Choice Screen for the Politics-Medium Block

Which of the following statements do you agree with? You may select multiple statements or none.

☐ scientists have too much influence in public policy debates
☐ Supreme Court justices should be limited to 18-year terms
☐ descendants of people enslaved in the U.S. should be repaid in some way
☐ income tax rates for all Americans should be increased
☐ the use of marijuana should be illegal
☐ presidential elections should be decided based on the electoral college, not the popular vote
☐ the US is providing too much support to Ukraine
☐ it is not important to reform the country's drug laws

Continue

Note. If participants selected no issues, they were initially prompted to make sure that they did not hit continue by mistake and were reminded that they could choose to skip any issues. If participants did not believe any of the issues on this screen, they would skip the block entirely.

Participants were then randomly assigned one of the issues they indicated agreeing with. They indicated how strongly they believed that issues ("I believe that this statement is..." [Definitely True (8) to Definitely False (1), with no neutral midpoint]) and how confident they

were in their belief ("How confident are you in this response?" [Very confident (5) to Not at all confident (1)]). We repeated the issue in question above each item in the study to prevent forgetting. After indicating their own beliefs, participants were asked to estimate the extent of agreement with their own view in the U.S ("What percentage of people in the United States also agree that this claim is true?" [slider-scale from 0-100]).

Participants then encountered our view questioning measure, where we reminded them of their own estimate of agreement ("You previously indicated believing that X% of the U.S. shares your view…") and then provided them with the actual extent of agreement with their own view in the population ("In fact, according to a recent public opinion poll, the actual percentage of those who share your view is Y%, whereas **[100-Y]% of Americans do not share your view.***"). The asterisk linked to a footnote displaying a reference and link to the source that the statistic was drawn from (e.g., "* This data is from a nationally representative poll of Americans conducted by a major polling organization. Source: YouGov. (2022). YouGov survey: morality [Data Set]. https://docs.cdn.yougov.com/uta5gqhscr/Morality.pdf").[5] Participants then provided a binary answer to our view questioning measure ("Does the fact that 63% of the U.S. does not share your view **make you question your own view?**").

Note that view questioning is distinct from belief change—questioning one's views does not require a change in one's beliefs or confidence, but could result in those outcomes (Sosa, 2021). To investigate these potential outcomes, we re-measured participants' beliefs using the same belief item as before, while reminding participants of their prior answers (e.g., "You previously said that

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[5] We chose the '[100 – Y%] do not share your view' wording instead of '[100 – Y%] disagree' because some of the polls in our stimulus set do not add up to 100%, so '[100 – Y%] disagree' would have been inaccurate.

you think this statement is slightly likely to be false. Your views on this issue may or may not have changed since then"). We then asked participants to indicate their confidence in their updated belief using the same measure (note that confidence change is most easily interpreted when views did not change, as participants indicated how confident they were in their updated beliefs).

Participants then rated six items intended to measure the first three paths of the PPM. We focused on these three paths, and not the computational, for two reasons. First, the design of our study involves directly asking participants to reflect on controversies and their implications. This reduces our ability to observe important aspects of computational persistence (e.g., inattention) in an ecologically valid manner. Second, we developed the items we used in this study through extensive pilot testing and pre-registered studies reported in our Supplementary Materials (see SMB1-5; we describe these studies later). In these studies, we found that participants almost never self-generated computational constraint-based explanations, nor systematically agreed with close-ended items intended to track computational constraints. We return to the question of how future studies can investigate the computational path in the General Discussion.

We measured each of the informational, ontological, and functional paths through two questions (using 7-point scales, from 'Strongly disagree' to 'Strongly agree'; see Figure 5).

Figure 5

Close-ended Likert PPM Items

Informational

Evidence	Processing
People who disagree with me on this issue are less informed than I am—they are less knowledgeable of relevant facts.	*People who disagree with me on this issue are worse at evaluating relevant evidence —they are biased or less competent.*

Conceptual

Subjectivity	Unknowability
This issue is a matter of subjective opinion—there are no right or wrong answers about it.	*The truth about this issue is currently unknowable—there is no reliable existing evidence on it.*

Functional

Interpersonal	Intrapersonal
My belief about this issue is very important to me—it is central to my worldview, values, or identity.	*It is very important to people I care about that I share their belief about this issue.*

Note. All items were displayed on the same page, in randomized order; shown here with labels not shown to the participants.

After these questions, participants answered a final set of four social impact items chosen to represent important downstream consequences of disagreement. Past research has shown that, at the individual level, people do not wish to converse (Wald et al., 2024) or become friends with (Huber & Malhotra, 2017) disagreeing others; and at the societal level, polarized discourse can erode support for free speech (Carlos et al., 2023) and lead to a loss of trust in experts (Miller et al., 2024). We investigated these outcomes through items shown in random order, and measured using 7-point agreement scales:

- [Discuss] There is no point to having conversations with disagreeing others on this issue.

- [Friends] I would not want to be friends with someone who disagrees with me on this issue.

- [Experts] Following expert consensus is the best way to resolve this disagreement.

- [Speech] Those disagreeing with me about this are entitled to publicly voice their views.

In sum, participants chose beliefs they agreed with and indicated the strength of their beliefs. They were confronted with societal disagreement and asked to reflect on whether the disagreement made them question or change their beliefs. They then rated items measuring the antecedents and consequences of their responses to controversy (see Figure 6 for an illustration summarizing the task).

Figure 6

Illustration of the Empirical Structure
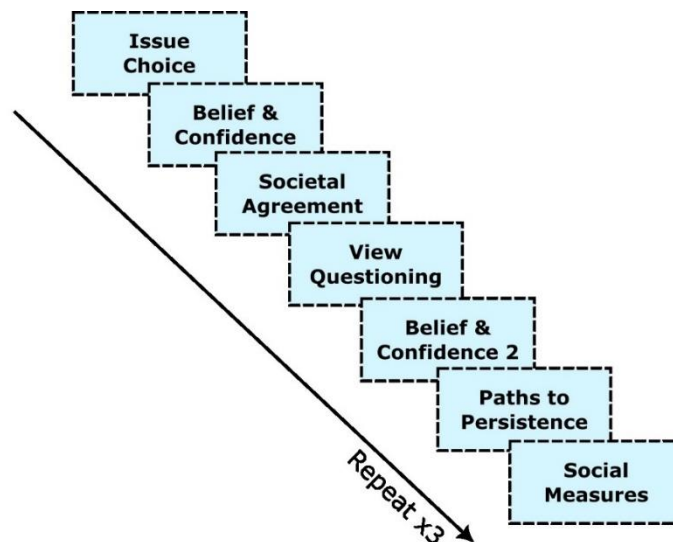
Note. Participants were free to skip any of the items they did not want to answer.

Participants then provided demographics (gender, religiosity, education, political affiliation, race, belief in public opinion polls, Leary et al.'s 6-point Intellectual Humility scale (2017) in random order) and answered the two attention check items. They were provided with an opportunity to provide optional open-ended feedback, and finally received a debriefing (that

contained the latest expert consensus on 16 of our scientific controversies, as well as links to government and academic websites providing further information). Readers interested in further details about the survey can demo it in our OSF repository.

Results

Given the richness of our data, we present our pre-registered hypothesis tests in the context of descriptive analyses; all pre-registered analyses are preceded by the label 'as pre-registered,' and accompanied by an explanation of any deviations.

We first ensured that participants responded to a diverse array of our stimuli (vs. agreeing with only a small subset). We received responses to all controversies—and after attention exclusions, 67 issues received at least 10 responses. Response rates were relatively consistent across levels of controversy: 37% of responses came from the 'low' disagreement items, 35% from the 'medium,' and 28% from the 'high.' Response rates were also consistent across domains: 27% of participants responded to religious items, 24% to political, 26% to scientific, and 22% to moral. Accordingly, we had more than 125 responses for each of the 12 disagreement-level (3) x domain (4) combinations. A full table of these descriptive statistics, as well as rates of agreement with each issue, is available in the Supplementary Materials (SMA1; Table 2).

We then analyzed perceptions of societal disagreement. Overall, participants recognized the presence of diverse opinion across issues: the average perceived agreement with one's own view was 52.2%, with substantial variation across individuals, and some variation across domains, such that participants perceived the most agreement on scientific issues (59.0%) and the least on religious issues (46.5%), with politics and morality falling in between (see Figure 7).

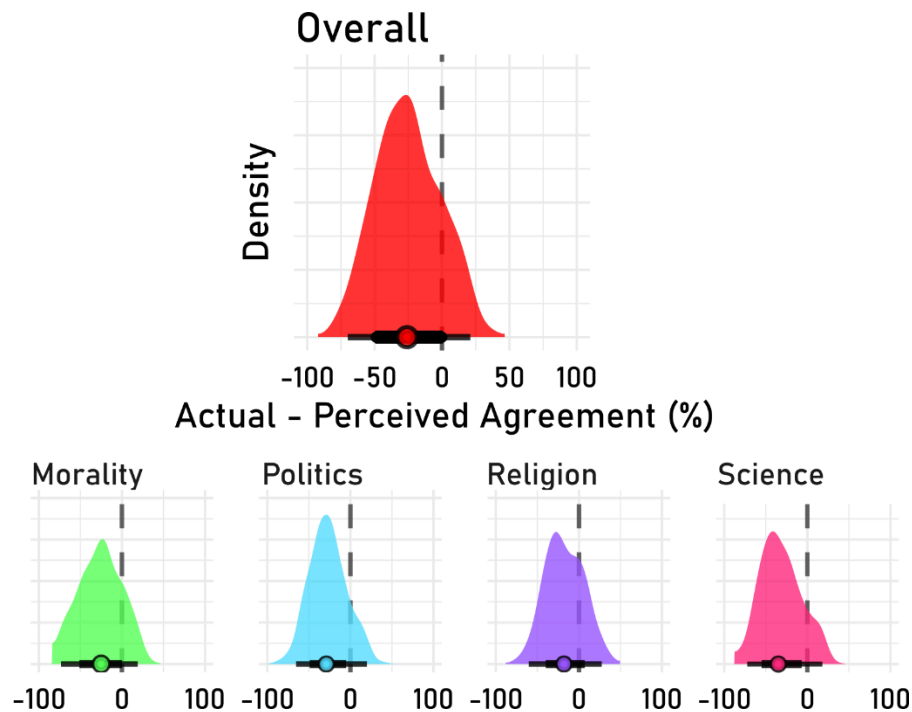**Figure 7**

Perceptions of Societal Agreement
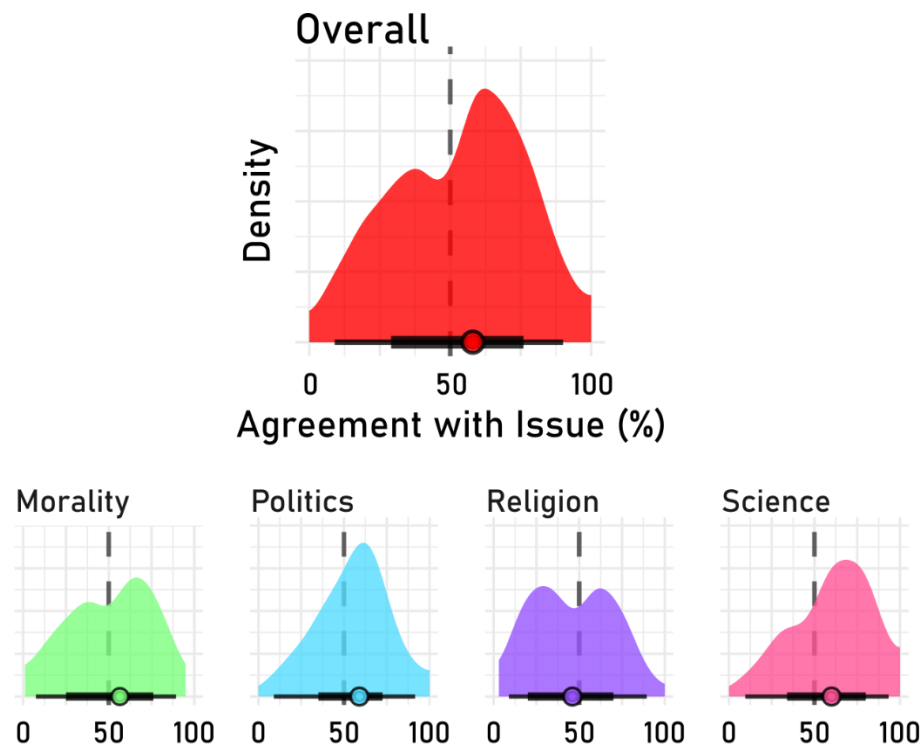
Note. Plots show the distribution of perceived agreement estimates; top plot shows all judgments, bottom facets show this broken up by domain. The dot in the middle of the interval at the bottom of the density shows the median, the center region shows 66% quantiles, and the thinner second region shows 95% quantiles. The y-axis is omitted as the plots show densities.

Since we sampled issues on which a majority do not agree—and most participants perceived at least 50% as agreeing with them—there must be a gap between participants' perceptions and the reality of public opinion. Our data shows that this gap is substantial: participants overestimated population agreement with their views by 25.5% on average (in keeping with findings on the false consensus effect; see Mullen et al., 1985). The cross-domain variation in perceived agreement noted above is reflected in the variation of these errors: Participants

overestimated agreement the most for scientific issues (with a 31.5% gap) and the least for

religious issues (a 17.4% gap), with morality and politics falling in between (see Figure 8).

Figure 8

Errors in Perceived Agreement

Note. Plots show the distribution of errors in agreement estimates; top plot shows all judgments,

bottom facets show this broken up by domain. The dot in the middle of the interval at the bottom

of the density shows the median, the center region shows 66% quantiles, and the thinner second

region shows 95% quantiles. The y-axis is omitted as the plots show densities. Each plot features

a vertical line at 0%, marking accurate inferences.

Moreover, these errors were widespread: Participants overestimated agreement on 83.7%

of judgments. This means that most participants were confronted with novel evidence of

disagreement—in some cases, quite substantial amounts of it (e.g., 16.6% of judgments were off

by more than 50%). A key predictor of the size of these errors was the size of the actual magnitude

of the disagreement: On average, participants estimated similar amounts of population agreement

for issues in our low, medium, and high disagreement groups (55.8%, 51.2%, and 50.6%,

respectively). This resulted in increasingly large errors across these issues (16.6%, 24.5%, and

37.6%).

Past work showing that belief change is predicted by the size of prediction errors

(Vlasceanu et al., 2021) suggests that many participants may have questioned or updated their

beliefs when confronted with these substantial errors in their estimates of public opinion. Across

participant judgments, however, persistence was the typical response—whether operationalized as

lack of view questioning (87.9%, $\chi^2(1) = 1119.4$, $p < .001$), lack of belief change (72.2%, $\chi^2(1) =$

516.8, $p < .001$), or lack of confidence change for participants who did not indicate belief change

(82.8%, $\chi^2(1) = 739.3$, $p < .001$). Moreover, even participants who underestimated disagreement

by more than 30% overwhelmingly did not question their views (85.1%). When beliefs did change,

they most often decreased in strength (20.1%); increased belief strength following learning about

disagreement was rare, with few beliefs increasing in strength (4.4%). Finally, there was variation

across domains in the prevalence of view questioning: scientific issues elicited the most

questioning (18.2%), and religious issues the least (6.4%), with politics (11.6%) and morality

(12.6%) falling in between.

Beyond documenting responses to disagreement, we wish to explain the mechanisms

driving these responses in a theory-driven manner. To do so, we examined the PPM items in our

dataset. As pre-registered, we first conducted a confirmatory factor analysis to investigate whether

the six items could be collapsed to the three paths posited by the theory. Our analyses show that a

three-factor solution with the six items loading exclusively onto the three paths—that is, in

accordance with the structure of the PPM—fits the data better than lower or higher-dimensional solutions, and satisfies standard benchmarks for factor analysis. Moreover, unconstrained, exploratory factor models also recover the same structure (see Supplementary Materials SMA2 for details). Our data thus suggest that the PPM passes our first criterion for usefulness: it captures the structure of people's responses to dissent (a finding that we replicate in our supplementary studies using open- and close-ended data, which we turn to later). As pre-registered, we therefore conducted the rest of our PPM analyses using standardized factor scores.

The distribution of factor scores reveals cross-domain variation in paths. Whereas religious belief is associated primarily with the ontological path, scientific belief is associated with the informational; morality and politics show greater balance across the paths (see Figure 9). Exploratory ANOVAs show that this cross-domain variation was significant ($F_{Informational}(3) = 12.8$, $p < .001$; $F_{Ontological}(3) = 113.3$, $p < .001$; $F_{Functional}(3) = 29.4$, $p < .001$). Note that the variation *within* each domain is even more substantial than the variation across domains (see SMA3; Figures 3-6), suggesting that there are issue- or person-specific factors that drive ratings of the paths (for example, disagreements about COVID vaccine efficacy and policy may involve more similar judgments than disagreements about vaccine efficacy and whether humans are made out of stardust, despite the first two being in different domains—science and politics—and the latter two both being scientific questions).

Figure 9

*Paths to Persistence Scores Across Domains*
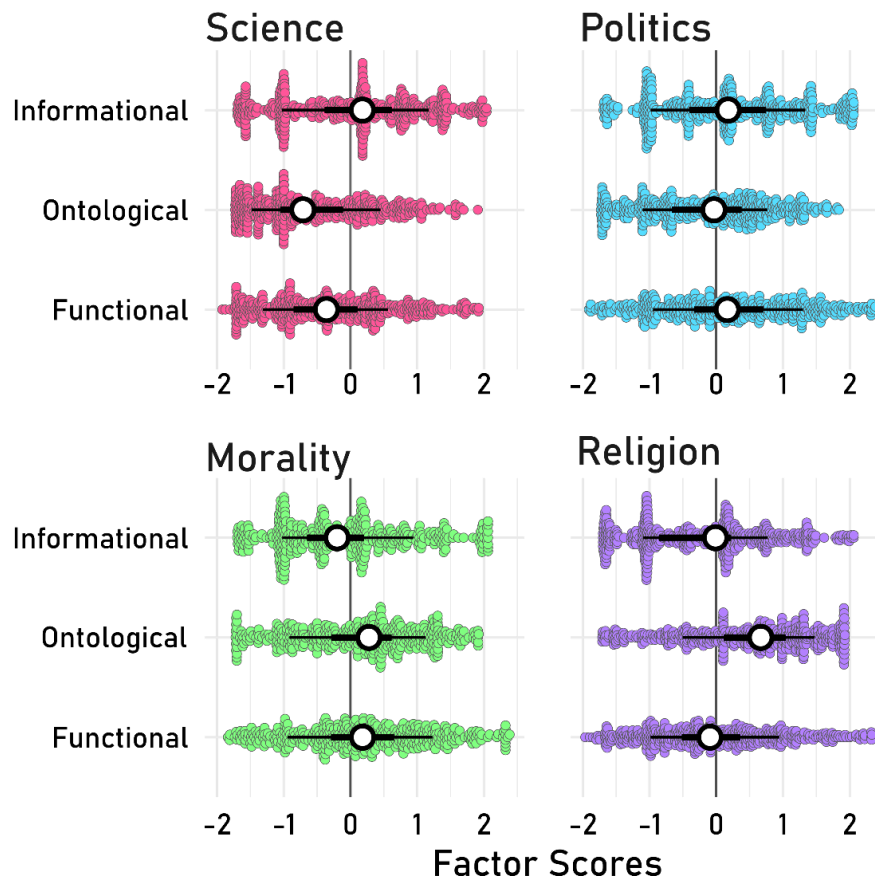
Note. The swarm plot shows jittered factor scores for each trial; the displacement from the midpoint indicates the density. The dot in the interval shows the median, the center region shows 33% quantiles, and the thinner second region shows 66% quantiles.

If the paths shed light on the mechanisms driving responses to disagreement, they should not only capture the structure of people's responses, but this structure should predict persistence. Moreover, if the paths jointly drive persistence, taking interactions across paths into account should substantially boost the predictive performance of our models. As pre-registered, we analyzed whether the effects of the paths are interdependent by conducting nested model

comparisons of all possible models (i.e., combinations of the main effects and interactions of the three paths) in predicting persistence. In accordance with our analysis plan, we use responses to the questioning measure as our outcome (though we ran all analyses using the view change measure as well, and we report any qualitative discrepancies).

To penalize models that incorporate unnecessary variables while rewarding predictive performance, we compared the Akaike Information Criterion (AIC) scores of these models. AIC is an estimator of prediction error that penalizes flexibility (i.e., models with more parameters but the same predictive performance have worse AIC scores). Since we intend our results to generalize across disagreements, we included random effects of our controversial issues in all models. In keeping with recent recommendations, we started with the maximally complex model, and iteratively simplified it until we found a model that converged (Barr et al., 2013). We found that the most complex models that converged incorporated random intercepts and random slopes for the effect of the informational factor across issues. We also included scaled prediction error and disagreement level to these analyses to isolate the effects of the PPM. Figure 10 plots the results of this analysis (see also Supplementary Materials SMA4 for detailed parameter estimates).

Intuitively, an AIC difference of 10 points means that the better model is ~148 times more likely than the worse model to minimize information loss, as the probability that the better model minimizes information loss is proportional to $e^{\Delta AIC/2}$ (Burnham & Anderson, 2004). The best performing models thus all incorporate interactions (in particular, pairwise interactions—the three-way interaction does not add meaningful predictive power). Figure 11 shows the structure of these interactions in the best performing model (which explains 32.3% of the variance in response as calculated by a measure of R^2 for mixed effects models; Nakagawa & Schielzeth, 2013).

Figure 10

Paths to Persistence as Predictors in Nested Model Comparisons
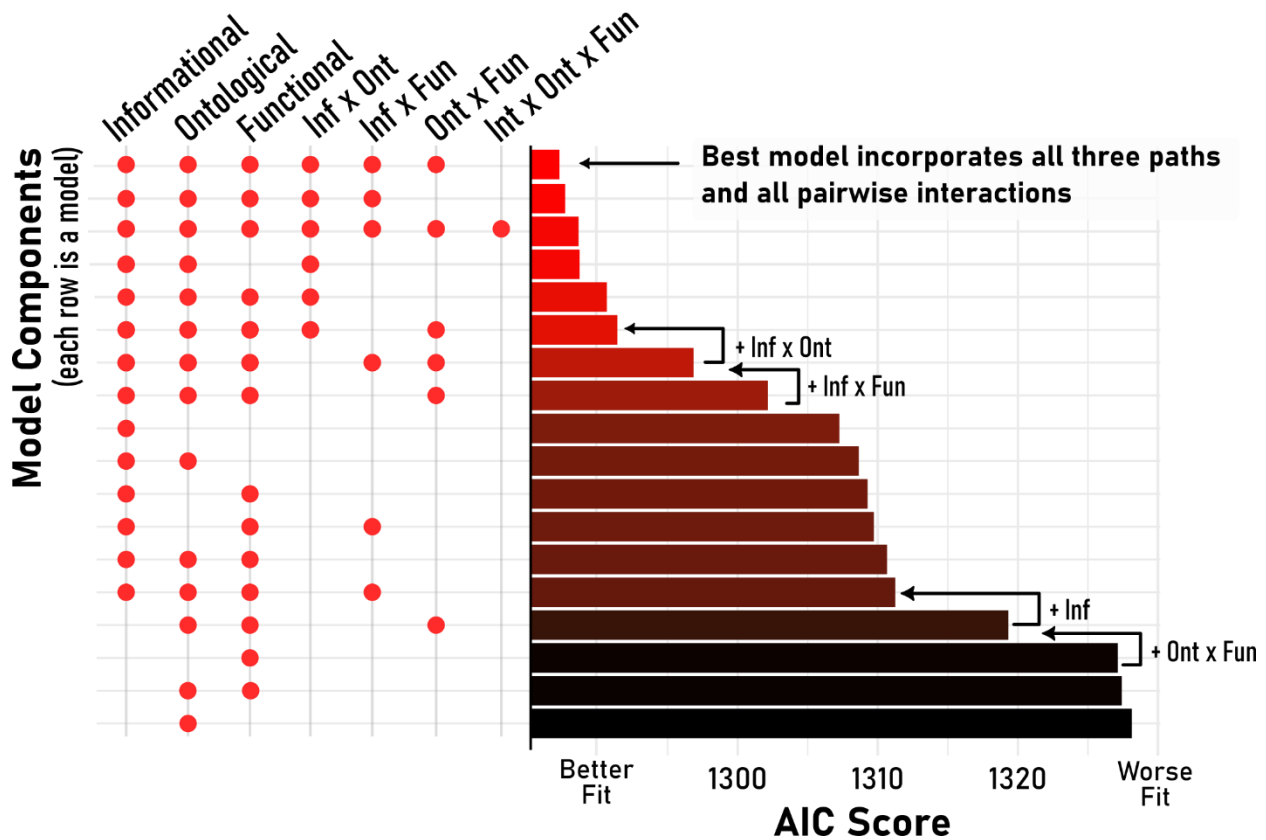

Note. Lower AIC values indicate better fit; here we plot AICc, which implements a correction known to reduce bias (Burnham et al., 2011). 'Inf' indicates the informational path, 'Ont' the ontological, and 'Fun' the functional; 'x' indicates interactions. The red circles show the predictors included in the models, which are plotted in each row; the arrows and terms on top of the bars mark terms whose addition confers a substantial boost in predictive performance.

As pre-registered, we replicated this analysis both with our measure of view change and by examining the regression coefficients for the best performing models (see Supplementary

Materials SMA4; Figures A8-A10), which revealed similar patterns.[6] Taken together, these analyses answer our second guiding question: predicting how people respond to novel evidence of societal dissent necessitates considering all paths. The PPM, in relating mechanisms across literatures, provides the theory scaffolding this analysis.

Figure 11

*Model Predictions for the Effects of PPM on Questioning*
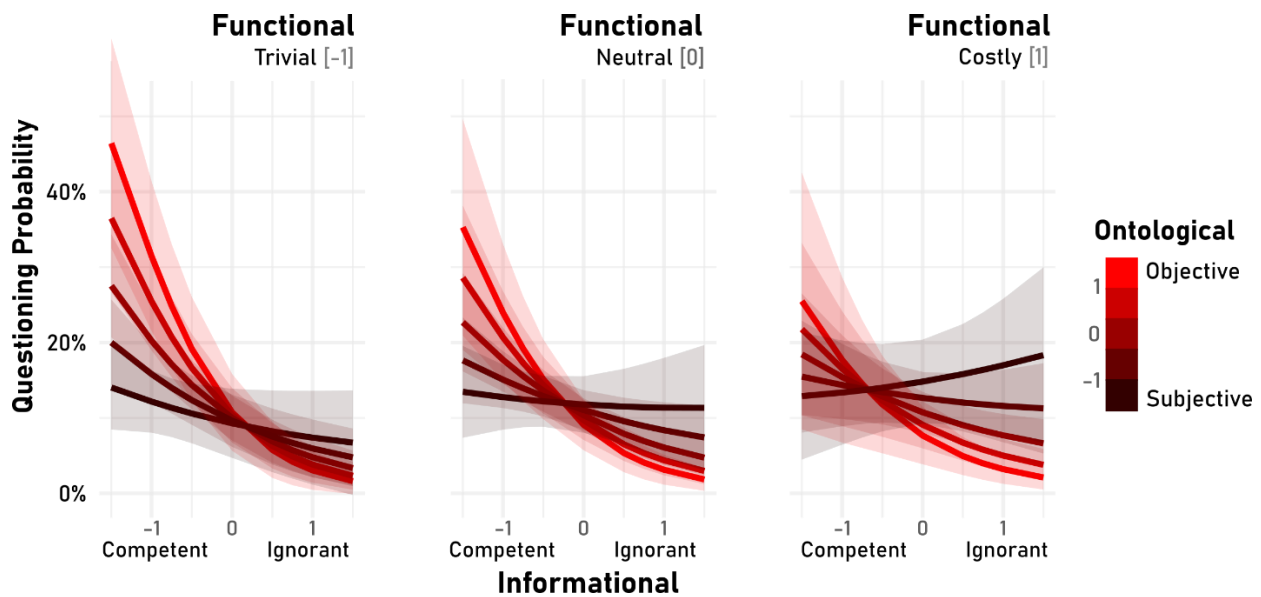
Note. Figure shows the mean predicted view change across the PPM, and model-derived 95% confidence intervals. For clarity, the axes partition the standardized factor scores: the informational path is shown continuously on the x-axis, the ontological in five color bins, and the functional in three facets. Note that the additional verbal labels on the axes are intended to provide intuition for

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[6] The only qualitative difference across these analyses is that the ontological x functional interaction does not reach significance for the view questioning best-performing regression, but it does for the equivalent view change analysis.

the graphs—they do not comprehensively capture latent dimensions (e.g., ontological is shown as going from subjective to objective, when it also incorporates unknowability).

Examining interactions across paths reveals three important points about the psychology of disagreement. First, view change is most likely when people perceive others as competent informants, the issue as objective, and the consequences of view change as minimal (i.e., the tip of the reddest line on the leftmost facet). The size of this 'all paths blocked' effect is substantial: 26.4% of responses where participants were below-mean on all paths resulted in questioning, compared to the 10.5% for other participants (Cohen's $h = .42$). For reference, this is a similarly sized effect to receiving a 'high' ($> 83\%$) vs. 'low' (50-66%) disagreement issue (Cohen's $h = .47$). Second, subjectivity moderates the effect of informational considerations: perceiving disagreeing others as competent vs. incompetent leads to a ~20% difference ($M_{question;informational<0} = 23.7\%$ vs. $M_{question;informational>0} = 5.3\%$) in questioning for objective issues, and only a ~5% difference for subjective issues ($M_{question;informational<0} = 15.2\%$ vs. $M_{question;informational>0} = 10.0\%$). Third, across all cases, persistence is high (even when examining cases where all paths are blocked and people underestimate dissent by 50% or more, ~60% persist). Qualitatively, the key conclusions listed here hold when we replicate these analyses with view change as the outcome (see Supplementary Materials SMA6 for details and figures).

We next analyzed whether taking different paths to persistence is associated with differences in social judgments. As pre-registered, we analyzed the inter-relationships between four measures of the social impact of disagreement and the paths (see Figure 12).

Figure 12

Relationship between the Paths to Persistence and Key Outcomes
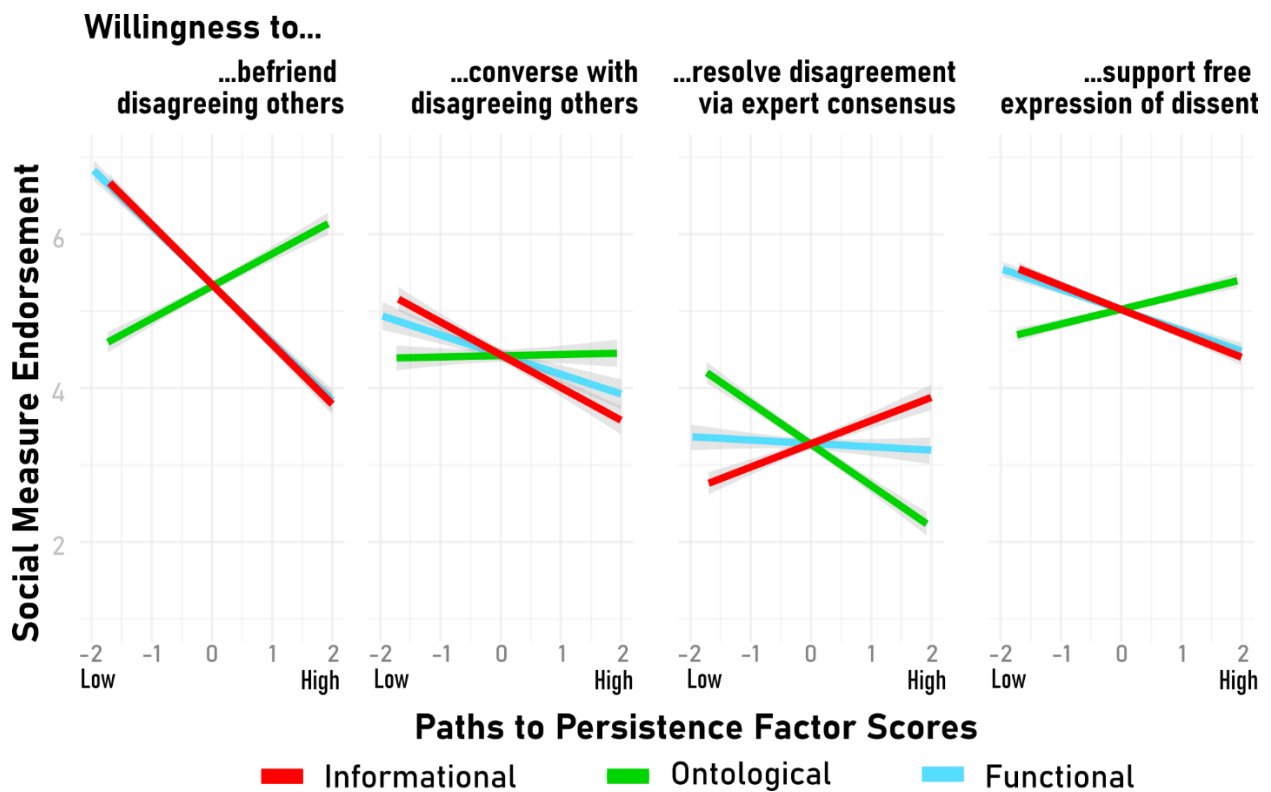
Note. Error bars show 95% confidence intervals. Additional plots showing interdependencies between paths is available in Supplementary Materials SMA6; Figures A14-15.

The paths people take to persistence had significant and varied effects on our outcomes. Perceiving disagreeing others as unreliable—that is, taking the informational path to persistence— was generally associated with negative outcomes—from a lower willingness to converse and befriend others to decreased support for the expression of dissent. The functional path showed similar effects, whereas the ontological path showed the opposite: when people persisted because they perceived issues as subjective, for instance, they were more willing to befriend and converse with disagreeing others. There were again important interactions: the ontological path blocked the

negative consequences of the informational and functional paths. In other words, people could perceive disagreeing others as unreliable, and still be willing to talk to them if they perceived the issue as subjective or unknowable (further descriptions and regression statistics are available in Supplementary Materials SMA6). However, the prosocial benefits of ontological persistence come with a trade-off: effective conflict resolution strategies—such as reliance on experts—may be less likely to be pursued when issues are seen as subjective or unknowable (an issue mirrored in debates about the possibility of moral expertise; Mcgrath, 2011). Taken together, these results show that the PPM passes our third criterion: it predicts important downstream consequences of dissent.

Results of Supplementary Studies

As we noted in the beginning of this section, the current study is the end-product of many pilots and studies through which we developed and validated the PPM. Due to limited space, we provide high-level summaries of the key conclusions of each pre-registered study in our Supplementary Materials (SMB1-5).

In Supplementary Study 1 ($N = 356$), we elicited open-ended responses to a smaller set of 16 items sampled from the same four domains. We examined whether participants tend to persist in their views and documented the explanations they provided for their responses. Two independent coders classified explanations with high inter-rater reliability, and found that participants typically appealed to informational explanations, and sometimes ontological, but that they rarely appealed to functional or computational explanations. Importantly, the coders did not identify any meaningful alternative categories that explained why participants persisted.

In Supplementary Study 2 ($N = 354$), we generated 11 close-ended items that corresponded to the kinds of explanations participants produced in the open-ended task, and examined the factor structure of participants' responses to these items. We found that a three- or four-factor structure

explained participants' judgments equally well—participants' close-ended responses to the functional items captured substantial variance, but their responses to the computational items did not. We also observed significant cross-domain variation in participant's endorsement of different explanations, as well as the 'rejecting all paths leads to questioning' effect noted in the main study. A key limitation of these first two studies, however, was that we asked participants to reflect on their own estimates of societal disagreement, rather than providing them with the actual statistics of dissent.

In Supplementary Study 3 ($N = 399$), we addressed this limitation by replicating Supplementary Study 2 using only one item for each path, and while providing participants with actual public opinion statistics. We broadly replicated our prior results in this study, and found that participants' prediction errors did not play a key role in explaining persistence. However, there was another important limitation: all of the controversies we examined in this initial set split the population in half. It was possible that participants persisted merely because they were not confronted with sufficiently large disagreements. A second limitation was that we exclusively used the view questioning measure to operationalize persistence in our prior studies.

In Supplementary Study 4 ($N = 812$), we therefore generated an expanded set of controversies similar to that used in the current study, and found that participants persisted even when they were confronted with very large disagreements (and that the paths predicted persistence even after taking the statistics of dissent into account). Moreover, we used a four-option persist/conciliate/polarize/suspend question and found that persistence was the modal response using this alternative measure (~75% persisted). This study also had important limitations: first, the importance of possible interactions across paths only became apparent to us after examining this larger dataset, and as such, we had not pre-registered an analytical strategy for examining the

joint effects of the paths. Second, we did not have any measures of downstream outcomes in these studies, so we did not know whether the tendency to persist was associated with any other outcomes. And finally, all our prior studies were conducted with random samples on Prolific, so we did not know whether the effects would replicate in a representative sample. The main study we present in this manuscript addresses all of these limitations and is the culmination of three years of research on the PPM.

In sum, we find evidence for the psychological reality of the paths identified by the PPM: open-ended responses produced overwhelmingly information and ontological considerations, while close-ended responses revealed the expected three or four factor structures. We also find evidence that the paths are psychologically meaningful, insofar as they predict persistence and social consequences of persistence, with interactions across paths that show individually unique profiles. We also find that for the controversies we examined, persistence is the overwhelming response, even when participants learn that disagreement is much more prevalent than they expected. Finally, we find heterogeneity in paths to persistence not only across individuals, but across issues and domains as well. These findings not only support the PPM, but also lay the groundwork for future work on persistence and belief change in the face of societal disagreement.

General Discussion

Is abortion morally acceptable?

Do we burn fossil fuels more than we should?

Should we mandate vaccinations in epidemics?

With policy following public opinion in democracies, answers to life-and-death questions like these end up shaping our societies. And we often have answers to them—answers that we

confidently sustain in the face of controversy. You may have found yourself holding beliefs about the issues above with confidence, for example, even when hundreds of millions disagree.

In this paper, we have developed a model of how such belief persistence operates from a psychological perspective. We first defined disagreement and persistence. Then, in Part 2, we offered a comprehensive taxonomy of explanations for persistence in the form of four 'paths.' In a nutshell, if people (i) perceive disagreeing others to be epistemically inferior, (ii) reject the possibility of evaluating the shared 'truth' of an issue, (iii) are swayed by the costs and benefits of holding particular beliefs, or (iv) fail to represent or reason about disagreement appropriately, they may persist in their belief amid disagreement. In Part 3, we leveraged these insights to conduct a comprehensive empirical examination of how the paths influence people's tendency to persist.

In this final section, we first return to our guiding puzzle. We then consider key theoretical, practical, and normative insights revealed by the Paths to Persistence Model, and discuss fruitful directions for future research.

Resolving the Puzzle of Persistence

Why is persistence so common, and when can disagreement make us question our views instead? There is an important asymmetry between persisting on the one hand, and conciliating or suspending on the other, that offers a simple solution to the puzzling prevalence of persistence. As we have seen, one path can be sufficient to persist—questioning is therefore most likely when all paths are blocked. For example, Theo can persist in his beliefs about GMOs on purely informational grounds. On the other hand, for Theo to question his beliefs about GMOs, he would ideally both become more intellectually humble, and also (i) believe that the healthiness of GMOs is an objective and knowable fact, (ii) estimate that functional costs of alternative views don't

override other considerations, and (iii) invest cognitive resources to reconsider his views about GMOs.

Beyond our empirical results, past literature has also shown that these paths are readily endorsed: partisans assume superior evidence and intelligence over their political opponents (Hartman et al., 2022), resort to subjective framings of key issues when challenged (Friesen et al., 2015), are driven by strong social motives to maintain political views (Golman et al., 2016), and find their attention spread thin across many complex and pressing issues (Williams, 2018). To the extent these paths are mutually reinforcing, rather than independent, the interactions among paths can potentially explain not only why persistence is common in such cases, but also why it is so entrenched.

Of course, questioning will be optimal in some circumstances. For trivial issues on which people do not have special expertise or social commitments, for instance, we may expect questioning to be common. Even important controversies may be widely questioned in the right contexts. For instance, in environments where critical thinking is actively rewarded; structured engagement with disagreeing others reveals the limitations of one's own understanding; and people are jointly engaged in trying to reach an objectively justifiable conclusion, views may be more pliable amid dissent.

Consider the 'America in One Room' study, where a nationally representative sample of 500 adults were brought together to deliberate on 5 major controversies over a few days. Participants were placed in small groups, where they had to formulate group questions for a balanced panels of competing experts, with the explicit aim of reaching accurate judgments (Fishkin et al., 2021). The study had depolarizing effects on controversial attitudes—that is, it allowed people to move beyond persistence. How do we explain the efficacy of this intervention?

The small group discussions plausibly allowed people to calibrate their inferences of how much they (vs. disagreeing others) know, blocking the informational path; the discussions focused on objective policy proposals, blocking the ontological path; the study moved people from their normal social contexts into one in which they had to interact with disagreeing others for an extended period, blocking many functional considerations; and the empirical context gave people ample time for deliberation, blocking many computational considerations. Though America in One Room seems like an exceptional intervention, note how higher education aims to foster such an environment for people across the globe (e.g., by fostering critical thinking and relocating students out of their normal social contexts). Accordingly, courses focused on controversial issues can allow people to question their views: For example, a college moral philosophy course can cause students' views on important moral controversies, such as the ethics of immigration, slavery reparations, and meat-eating, to flip (Oktar et al., 2023). The paths thus both explain why persistence is so common for key controversies, and when people are most likely to question their views instead.

Having addressed our guiding puzzle, we now turn to implications.

Theoretical Implications

The mechanisms underlying disagreement are rich, intertwined, and variable—in a word, complex. Here, we explain why this complexity can cause typical theorizing about disagreement to be misleading, predictively weak, and even harmful. We then describe how the paths to persistence framework can help scholars accommodate this complexity.

Historically and presently, much psychological research on disagreement revolves around establishing whether particular effects exist by examining a few issues—for instance, whether disagreements induce perceptions of bias (Kennedy & Pronin, 2008) or unintelligence (Hartman

et al., 2022). However, such marginal (i.e., direct) effects of disagreement can be unstable and misleading given the large number of factors likely to moderate or otherwise influence effects.

For instance, if we had restricted the stimulus space in our main study to disagreements on issues typically seen as subjective and important, and not investigated the role of interactions, we could have failed to find an effect of informational factors—despite their clearly playing a dominant role in the mechanisms of persistence. This misleading result would be a direct consequence of merely examining marginal effects, and not sampling stimuli in a representative manner (Yarkoni, 2022). Thus, whether an effect relating to disagreement exists is often not a helpful question—instead, we should ask how and why different factors *jointly* influence responses to disagreement, and the PPM model enables us to do so in a theory-driven manner.

The complexity of the mechanisms of persistence also complicate inverse inferences (from the tendency to persist to explanations for that persistence), potentially resulting in harmful misattributions. For instance, consider work on the 'rigidity of the right' hypothesis (RRH), according to which conservatives are more dogmatic, worse at adapting to novel circumstances, and generally more cognitively rigid than liberals (for a review, see Zmigrod, 2020). Part of the evidence behind the RRH comes from studies investigating how much conservatives and liberals update their views in the face of disconfirmatory empirical evidence (Costello et al., 2023). Does such unresponsiveness to informational interventions mean that conservatives are more rigid or dogmatic in general?

Not necessarily: if conservatives were highly sensitive to ontological considerations, such as the subjectivity of issues, and liberals were instead highly sensitive to informational considerations, we would expect differences in the efficacy of informational interventions—not because one group is less rigid, but because we happened to target the right path for that group.

Establishing rigidity would require comparing responses to a battery of interventions that cover all paths. Consistent with this concern, a recent adversarial collaboration reveals highly complex variation across issues in whether conservatives update more or less than liberals do (Bowes et al., 2023).

Importantly, our goal here is not to evaluate decades of research on rigidity. Instead, we intend our discussion of RRH to serve as an example of the general principle that establishing the marginal effects of disagreement—whether informational, ontological, or functional—can be misleading; leading to groups being labelled dogmatic or inflexible on the basis of potentially insufficient evidence.

Critically, this complexity is not insurmountable, and the PPM model helps point us to fruitful ways forward. The flexibility of our analysis allows us to consider much richer hypotheses than alternative frameworks can accommodate. For instance, explaining persistence through conformity would obscure the richness of informational considerations (Cialdini & Goldstein, 2004); solely Bayesian explanations would miss out on the functional (Gershman, 2019); and accounts that integrate practical and epistemic value, such as value-based belief (Bromberg-Martin & Sharot, 2020), would miss out on the ontological relevance of others' views to our own. The PPM outlines how these critical components come together to form the mechanisms of persistence.

Empirical Implications

Our theoretical analysis highlights new questions and opportunities for future empirical research. In particular, the integrated PPM model has direct implications for the design of interventions aimed towards changing beliefs about important issues.

As Ross and Anderson (1982) remarked, "beliefs are remarkably resilient in the face of empirical challenges that seem logically devastating." Accumulating evidence since then has

shown that interventions on controversial beliefs and attitudes tend to have small effects across domains, intervention types, and measures (around two-tenths of a standard deviation; Albarracin & Shavitt, 2018; van Stekelenburg et al., 2022). These facts seem to establish a pessimistic baseline for the potential efficacy of persistence-reducing interventions. Indeed, prominent scholars in the behavioral sciences have begun arguing for a shift away from individual-level interventions due to their inefficacy in important domains (Chater & Loewenstein, 2023).

But why do typical belief-change interventions fail? A common explanation is that people's views on important issues are simply too robust: Haidt (2001), for instance, writes that moral judgments will change "primarily in cases in which the initial intuition is weak." PPM suggests a complementary alternative explanation: Belief change interventions have the best chances of succeeding when they address the *sources* of persistence in a *targeted* manner. Much as precision medicine aims to further the efficacy and efficiency of healthcare interventions by tailoring the selection of drugs, dosage, timing, and additional treatments, *precision interventions* would optimally tailor belief-change interventions to the specific set of mechanisms driving individual beliefs.

Yet typical belief-change interventions are more akin to fast-fashion than tailored interventions. The vast majority are epistemic interventions that aim to be cheap and scalable: For example, providing factual corrections (Brashier et al., 2021), sharing relevant arguments (Jolley & Douglas, 2017), or communicating expert consensus (van Stekelenburg et al., 2022). Other paths have received much less attention—we are not aware of any work on ontological interventions for changing beliefs, for instance, except for some related work in educational psychology (Klopp & Stark, 2022). Relatedly, the vast majority of interventions examine the effects of just one intervention: as pointed out in a review of misinformation research, "most research to date has

considered each approach separately and more research is required to test synergies between these strategies" (Ecker et al., 2022).

The PPM explains why Ecker et al.'s call is of crucial importance. Persistence is driven by multiple interacting mechanisms, with potential heterogeneity in mechanisms across issues and across the population. We should therefore avoid drawing premature conclusions (e.g., that beliefs are too robust to change) without examining a broader set of intervention strategies. Much as conservatives' views may be less rigid than previous research suggests, tailored interventions may generally be more effective at fostering scientifically-informed beliefs than past interventions indicate. Moreover, there is much room for rich empirical exploration in the design of tailored interventions: Beyond developing effective ways to target the right set of paths, social scientists could draw inspiration from precision medicine in exploring optimal intervention sequences, timing, and delivery. Recent intervention tournaments can be seen as unstructured first steps towards exploring this rich space (Gelfand et al., 2022), and work on 'integrative studies' outlines how they can be scaled up in coordinated fashion (Almaatouq et al., 2022).

In sum, when designing interventions to address belief persistence, we need to pay attention to which paths underlie particular cases, and aim to address all of them.

Normative Implications

In the preceding sections, we have presented an extensive analysis of the descriptive questions relating to disagreement. Here, we outline some of the key normative questions that emerge from this discussion. These questions are important for psychologists to be aware of, because how individuals ought to react to disagreement influences how researchers should try to influence individual's beliefs through interventions, and which psychological questions should be

pursued with greater urgency and attention. Our aim is not to answer these questions, but highlight them.

Perhaps the foundational question here is whether it is good for people to persist. At the level of analysis of the individual, the answer can often be 'yes,' as the PPM outlines a broad set of psychological considerations that can justify persistence. But the question of whether it is good for people to persist is much broader than the individual—is it *societally* optimal for individuals to persist? Scholars across disciplines have long noted that individually optimal behavior does not necessarily result in societally optimal outcomes and vice versa (Ostrom, 1999). In the case of disagreement, persistence plays a particularly important role in enabling transient diversity of opinion across key issues, which can facilitate effective problem-solving (Hong & Page, 2004; Smaldino et al., 2023; Zollman, 2010). On the other hand, whether such diversity is productive depends on more complex considerations. For example, ethically, we may not want diversity on core human values, such as freedom from slavery, and epistemologically, we may want diversity on scientific questions to be proportional to the state of current evidence (Kitcher, 1990).

A related question is whether there are better or worse ways to persist. For example, different paths may lead to differentially truth-promoting or prosocial behavior. Some paths seem inferior on both counts: Attributions of bias or dishonesty may be particularly disabling of truth-promoting deliberation and community building interaction. Supporting this claim, disagreement-induced perceptions of bias lower the perceived effectiveness of communication and lead to more aggressive interactions (Kennedy & Pronin, 2008). On the other hand, some paths, such as attributions of subjectivity, may be truth-promoting both individually and societally, if they enable the formation of social relationships that allow evidence to be shared over time. Our data support this possibility—persistence on the basis of ontological subjectivity is associated with higher

willingness for friendship and conversations with disagreeing others—though our data also suggest that subjectivity may lower willingness to pursue effective conflict resolution strategies, such as reliance on expert consensus, complicating the normative analysis.

Future Directions

We hope that the PPM will motivate deep and systematic inquiry into the mechanisms of persistence. In particular, we hope that scholars pursue three lines of inquiry.

First, the field should take up the challenge of developing precision interventions that target the particular paths that drive individual beliefs. Recent work has shown that utilizing the flexible, generative capacity of LLMs might be a fruitful avenue for pursuing this strategy—models can be fine-tuned to target the particular set of paths supporting individual beliefs, allowing for effective interventions that promote view questioning (Costello et al., 2024). This strategy can allow researchers to overcome pessimistic (and potentially premature) conclusions about the inefficacy of belief-change interventions (Chater & Loewenstein, 2023).

Second, in designing studies intended to generate generalizable conclusions about the mechanisms of persistence, belief change, persuasion, and related phenomena, future research should aim to sample a representative sample of stimuli and participants, while taking potential interactions into account (Yarkoni, 2022). Beyond outlining theoretically relevant considerations through the PPM, our empirical approach demonstrates how such studies can be implemented, and the insights that can be gleaned from comprehensive sampling of stimuli.

Finally, when it comes to the next steps on the PPM model, we see three key avenues for progress. First, research should examine individual and cultural differences in the paths people take. Given the substantial cross cultural variation in agreeableness as a personality trait (Wilmot & Ones, 2022), we may expect variation in both the tendency to persist, and the mechanisms of

persistence (Kroupin et al., 2024). Such variation is important to understand when developing globally scalable interventions for belief change. Second, our theoretical and empirical investigation focused on the distinctive features of disagreement as a form of higher-order evidence. As noted earlier, however, disagreements typically involve a rich constellation of relevant beliefs that anchor and inform responses—and first- and higher-order evidence are generally related to each other in complex ways (Hedden & Dorst, 2022). There is no empirical research, to our knowledge, that has examined how people systematically integrate these two kinds of evidence. Third, our empirical investigation was limited to the first three paths—but our theoretical discussion exposed the deeply important role of computational constraints in driving persistence. Though other theoretical research has also examined computational limitations and belief change (Pothos et al., 2021), we are not aware of any corresponding empirical research. Future research can take inspiration from the meta-reasoning literature in designing studies that investigate the influence of constraints on reasoning and representations (Lieder & Griffiths, 2017).

Conclusion

In this paper, we developed and tested a model of how individuals persist in their beliefs amid societal controversy. Starting with a definition of disagreement, we situated persistence among other possible responses and explained how it is distinctive from other forms of resilience to disconfirmatory evidence. We then described the Paths to Persistence Model. We explained how each of four distinct paths (informational, ontological, functional, and computational) can individually drive persistence, and then introduced a study that empirically demonstrated the predictive power of the joint effects of the first three paths. We finally considered theoretical, empirical, and normative implications; from why typical theorizing about disagreement can result

in misleading conclusions, to how empirical research needs to evolve to precisely address the sources of persistence, and whether there are better or worse ways to persist. We hope that the PPM will guide much-needed empirical inquiry into the psychology of persistence, and thus set the stage for the development of effective interventions that bridge the widening rifts in our societies.

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