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Mental Computations of Ideological Choice and Conviction: The Utility of Integrating Psycho-Economics and Bayesian Models of Belief

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A quick scan of the political landscape reveals that people differ in the ideologies they embrace and advocate. Why do individuals prefer certain ideologies over others? A formal analysis of psychological needs and consumption desires suggests that it is possible to compute the subjective utility of selecting one ideology over another, as though it were a purchasing decision (Gries, Müller, & Jost, this issue). Given resources, constraints, and available options, individuals can rationally choose the ideology that best matches or resonates with their interests. It is a compelling framework that can take into account how diverse ideologies satisfy people's diverse and multidimensional psychological and material needs. This psycho-economic model is ambitious and informative, and I will argue that it can be even more encompassing and enlightening if it is expanded to incorporate two critical components of ideological cognition: (1) the nature of ideological conviction and extremism and (2) the dynamic, probabilistic mental computations that underlie belief formation, preservation, and change.

Here I will extend Gries et al.'s (this issue) account of the marketplace model of ideological choice in two ways: firstly, I will argue that a formal model of ideological choice cannot escape the question of the strength of ideological commitment. In other words, we need to ask not only about *which* ideologies individuals choose but also about *how strongly* they adhere to these ideologies once those are chosen. An analysis of ideological choice needs to be accompanied by an analysis of ideological conviction. Secondly, in order to build a robust sense of the rationality behind ideological thinking, it is useful to incorporate principles of uncertainty and probability-based belief updating into the formal model of ideological worldviews. I thus propose that a more comprehensive framework can be developed by complementing Gries et al.'s psycho-economic approach with Bayesian models of belief formation and maintenance. Bayesian models highlight how human brains seek to build predictive models of the world by updating their beliefs and preferences in ways that are proportional to their prior expectations and sensory experiences. Consequently, incorporating Bayesian principles into the formal model of ideological choice will provide a more wholistic understanding of what happens when a mind enters the market for belief systems—and why

a mind can, at times, purchase toxic doses of the ideologies that sellers and entrepreneurs offer on display.

From Ideological Choice to Ideological Conviction

Unlike most purchasing decisions, ideologies are not passively consumed. Once an ideology is “chosen”, all other incoming information are processed through the ideology's lens, and so people develop varying levels of conviction about—and attachment to—the ideology. Some individuals will adhere to a belief system in a radical, passionate way, while others will be more moderately committed and loosely attached (Zmigrod, 2022). For example, one religious individual may participate in daily religious rituals whereas another religious individual will only occasionally attend religious services or consult theistic doctrines. Similarly, one environmentalist will undergo radical personal and social sacrifices as part of adhering to an environmentalist doctrine, whereas another environmentalist will believe in the same principles but to a weaker degree of personal commitment. One economic populist will attend marches and advocate relentlessly for their cause, while another economic populist will sit on the side-lines. What separates the convert from the mildly convinced?

Ideological commitment can be manifest in terms of an individual's *doctrinal* orientation, that is, how rigidly they uphold the espoused dogma, and *relational* orientation, how antagonistic and hostile they are to ideologically dissimilar others (Zmigrod, 2022). A person may begin as a weakly-committed member of an ideology and later become strongly dedicated, as psychological needs and economic conditions change. A formal model of ideological choice, as proposed by Gries et al.'s (this issue), therefore needs to incorporate *variation in ideological commitment*. This variation exists inter-personally between people and intra-personally within an individual over time. Ideological choice and strength of conviction are *both* subject to psychological and economic pressures.

Gries et al. recognize the value of a model that can reflect the possibility of ideological extremism. As they note, extremism can facilitate “various forms of violence, including murder, assassination, and suicide bombing” (p. 79). But for Gries et al. the way in which ideological extremity

features into a psycho-economic framework is by assuming that there are extremist ideologies which can be neatly separated from supposedly non-extremist ideologies. As such, in Gries et al.'s model, extremism comes into play in the *initial* choice of ideologies, rather than in the active process of immersing in an ideology. Gries et al. conclude that “individuals whose specific epistemic, existential, and relational needs have been thwarted are more likely to choose certain kinds of extremist belief systems (especially those that emphasize religious fundamentalism and far-right ideology), as long as they have been exposed to them in the marketplace of political ideas” (p. 79). Hence, individuals with pronounced psychological needs (such as needs for security or certainty) and grievances will gravitate toward available extremist ideologies. This idea has intuitive and empirical support (e.g., Müller, 2021), but it is an incomplete portrait because it does not make room for the possibility of normative ideologies being practiced dogmatically or extremely. In reality, extremity and dogmatism can always emerge; every ideology can be adopted and practiced in an extreme fashion—extremity is not reserved for ideologies which are overtly radical and violent in content or mission (Zmigrod, 2020, 2021, 2022).

Indeed, a growing line of research indicates that psychological needs and predispositions shape both *what* ideology individuals adopt as well as *how* dogmatically or extremely individuals hold ideological beliefs (Zmigrod, 2020, 2021, 2022; Zmigrod & Goldenberg, 2021). Examining the psychological similarities and differences between strong adherents to different ideologies has revealed symmetries as well as asymmetries (e.g., Crawford & Brandt, 2020; Jost, 2017; Pliskin, Ruhrman, & Halperin, 2020; Ruisch, Anderson, & Krosch, 2021; van Prooijen & Krouwel, 2019; Zmigrod, 2020; Zmigrod, Eisenberg, Bissett, Robbins, & Poldrack, 2021; Zmigrod, Rentfrow, & Robbins, 2018, 2019, 2020; Zmigrod & Goldenberg, 2021). This indicates that, in the relationship between ideology and psychology, there are both *doctrine-specific* effects (i.e., effects reserved for specific ideological doctrines, such as those emphasizing tradition and hierarchies or those concerned with supernatural agents) and *extremity-specific* effects (i.e., effects manifest across all dogmatic ideological thought). In economics' language of 'subjective utility', which captures the degree to which needs and desires are satisfied, this implies that subjective utility can be increased both by choosing an ideology that matches one's psychological and material interests and by adhering to the ideology dogmatically, if this further satisfies psychological and material needs. Notably, psychological needs can, at times, for some people, be satisfied by weak or moderate belief in the chosen ideology, rather than dogmatic or extreme adherence. As a result, we should model both ideological choice and the spectrum of ideological conviction in order to appreciate the cocktails of psycho-economic traits and processes that produce diverse profiles of ideological engagement.

In order to calculate the subjective utility which individuals gain from engaging with ideologies in the specific ways they do, we need to consider the complex interactions

between psychological dispositions and processes (Zmigrod & Goldenberg, 2021). For instance, an individual marked by high perceptual caution and high need for closure may gravitate toward religious fundamentalist (rather than atheistic) worldviews that offer comfort and certainty (e.g., Brandt & Reyna, 2010; Saroglou, 2002; Zmigrod et al., 2021). High perceptual caution and need for closure may also contribute to a tendency to hold these ideologies with zeal and rigidity in the face of counterevidence (Zmigrod et al., 2021). This individual may thus be predisposed not only to selecting resonant religious ideologies but also to participating in them passionately and committedly. In another example, an individual who is low in intelligence may choose ideologies that simplify the complexity of the world into more manageable bites. But if the individual is high in cognitive flexibility, they may not be highly dogmatic about these ideological beliefs, and may in fact be receptive to alternative perspectives (Zmigrod, 2020; Zmigrod, Rentfrow, & Robbins, 2019). As a result, a person who may have characteristics that can predispose them to ideologies that shun nuance might not necessarily be ideologically dogmatic, especially if they are exposed to a rich set of alternative perspectives and worldviews. Unpacking such interactions between psychological variables can thus emphasize the role of informational environments, upbringing, and the socioeconomic conditions that envelope an individual's ideological choices and convictions.

Similarly, it is likely that economic and material pressures sculpt not only what ideologies people choose but also how rigidly they hold on to ideological beliefs. In an example of an individual who opposes environmentalism, if their economic situation would be significantly worsened by environmentalist policies that seek to replace fossil fuels with renewable energies, their subjective utility is increased not just by holding this ideology but also by participating in it with strong conviction, and galvanizing others to join the cause. If an individual endorses a feminist ideology, the extent to which they will strongly adhere to feminist principles in their private and public lives may depend on the material (financial, effort-based, time-based) costs or benefits of championing equality. Consequently, we can apply psycho-economic principles not just to ideological choice but also to strength of ideological commitment.

Psychological and consumption needs can affect the subjective value obtained from certain ideological choices as well as degree of ideological conviction. It is imperative that theoretical models allow for extremism to emerge following the selection of *any* ideology. Neglecting the natural variation in ideological conviction across the population of an ideology's adherents is akin to observing only the tip of the ice berg—or tail of the Gaussian distribution—and not the whole spectrum of the phenomenon of ideological thinking.

In the context of Gries et al.'s model, this means that we need to observe that for a given ideology, there will a natural distribution of weak, moderate, and strong adherents¹ (Figure 1A). Weak believers are only lightly attached to the ideology—epistemically or existentially—and so can be persuaded by alternative ideas without excessive force or

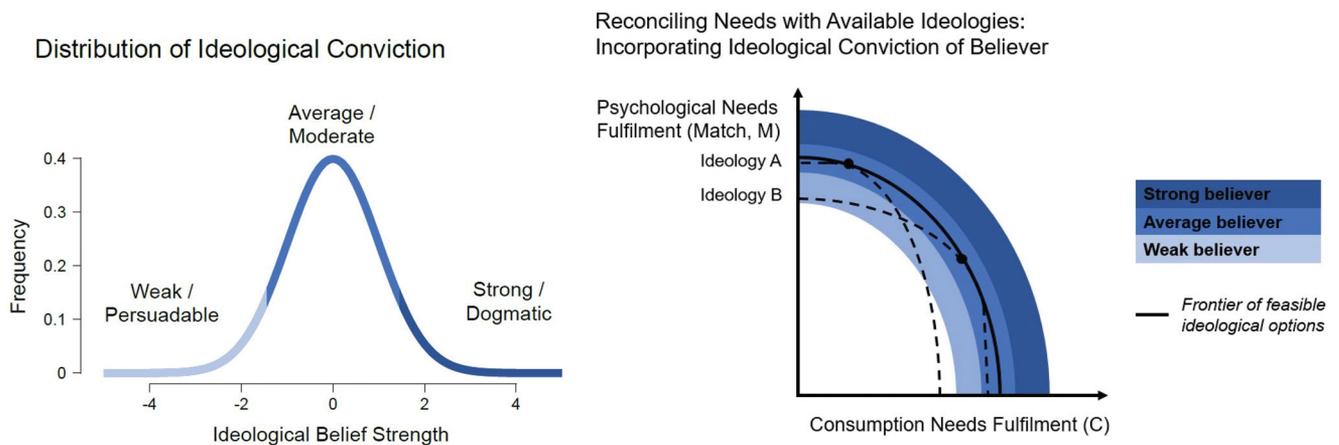


Figure 1. (A) A continuous distribution of ideological conviction for a given ideology, from weak to strong belief. (B) As per Gries et al.'s model, ideologies are expected to satisfy an individual's psychological and consumer needs to different degrees, and plausibly in a curved tradeoff relationship (captured by the dotted lines for each ideology, such as Ideology A and Ideology B). An individual's frontier of feasible ideological options is captured by the bolded line. The proposed extension here is to acknowledge that there is a continuum of ideological conviction for any given point along the frontier of options, and so individuals may become stronger or weaker believers of their chosen ideology, as psychological and economic conditions change.

evidence. Moderate believers reflect the average commitment expected by the ideological doctrine or group. Strong believers are dogmatic adherents of the ideology, and believe stringently in its claims and seek to prescribe these to others. It is entirely possible that a given individual will transition or oscillate between levels of ideological conviction over time. These transitions are shaped by dispositional and contextual factors that may amplify or reduce psychological or consumption needs. We can take the example of an individual who has chosen ideology A, which is matched well with their psychological needs and consumption needs. If the person's psychological or material needs intensify over time, they may become more dogmatic or extreme believers of ideology A.² In Figure 1A and B, this is reflected by a shift toward the 'strong believer' bands. Alternatively, if the individual has chosen ideology A but their psychological needs are fulfilled by other sources (e.g., other intellectual or social pursuits), they may continue holding ideology A but to a lesser degree, in a more flexible, evidence-receptive way.³ Variation in ideological convictions can therefore fit well into Gries et al.'s model if we appreciate that psychological and consumer needs affect convictions too, and so degree of ideological commitment is part of the story of ideological choice.

One might argue that ideological commitment is *subsequent* to ideological choice and so the two can be separated: *at the agora* versus *after the agora*. But given that the nature and number of available ideologies continually changes in response to social and political events, and even true believers must grapple with doubt in the face of realities that rarely neatly conform to the accounts described by ideologies, human beings are always at the marketplace of both ideological choice and commitment. With ever-growing transparency and informational networks facilitated by technology, even citizens in ideologically-homogenous communities or nondemocracies can generate and seek out exposure to alternative ideas and ideologies. These information searches may be costly and vary between people,⁴ but they are certainly possible and probable. In the language of

cognitive science, at extended timescales, rational agents will not only *exploit* their known states and rely on existing knowledge, but will also inevitably *explore* to sample and gain additional information. Part of ideology reconciliation involves exploration of different states of certainty and doubt with respect to the dominant ideology one is born into or exposed to.

Formally accounting for the strength of ideological conviction is therefore essential for a more complete understanding of how ideological choices arise, advance, and evolve. Indeed, formalizing ideological commitment becomes even more central to the interactions between buyers and sellers of ideology when we acknowledge that ideologies are not single purchases—they entail chained *series* of choices and exchanges. Individuals do not merely pick an ideology off a shelf, and the story ends there. People dynamically engage with the ideologies that surround them; with every new piece of (ideologically-relevant) information, the mind must undergo processes of selection, resistance, or assimilation of the incoming evidence. This process may result in shifting opinions—sometimes in more moderate or extreme directions—or in the eventual maintenance of the belief and confidence in its veracity. Importantly, there *is* a set of mental computations that agents continually undergo as they roam the world and encounter evidence in favour or against their chosen ideologies. The mental computations are not by virtue of an "invisible hand" or a black box. Humans are rarely passive, thoughtless, or immobile in their convictions—even maintaining one's beliefs entails complex cognitive computations.

I argue that it is possible and fruitful to translate Bayesian models of belief formation, maintenance, and revision, into a framework for mapping out the processes of ideological choice and conviction. By considering the dynamic and probabilistic nature of ideological beliefs, Bayesian models of belief can be integrated with psycho-economic models of ideological belief. This synthesis allows us to account for the processes that give rise to ideological conviction and which govern how ideological choice manifests in daily political cognition. Gries, Müller, and Jost note

Prior Beliefs: Precision of Ideological Convictions

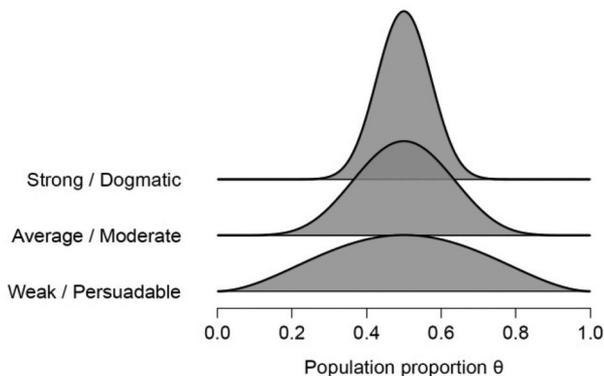


Figure 2. Ideological convictions vary from weak to strong, and when beliefs are modeled as probabilistic distributions, stronger beliefs have a narrower, more precise distribution (due to greater certainty) and weaker beliefs have a wider, less precise distribution (capturing the uncertainty in the belief).

that the process of selecting an ideology is a “process of trial and error” through which “the individual is likely to settle upon a belief system that satisfies (or even optimizes, depending upon external constraints) the resolution of his or her needs and demands” (p. 19). Let us formalize this process of trial-and-error and observe the ways in which it reflects rational principles laid down by Bayesian theories of reasoning. This endeavour can reveal how and why ideological choice has cascading consequences for individuals’ cognition and convictions, as well as a society’s ideological polarization and tribalism.

The Bayesian True Believer: Modeling the Dynamics of Ideological Convictions

“From the point of view of the brain, nothing is certain” write Chater, Oaksford, Hahn, and Heit (2010), “a fundamental information processing task of the brain is to weld scraps of information together to produce an integrated model of the external world; and to use this model to help determine action and choice”. How does the brain generate and embody models of the world it inhabits? Bayesian theories of cognition conceptualize beliefs as akin to subjective probabilistic distributions. These distributions have a central tendency and variability (also called *precision*) which reflects the degree of certainty in any given proposition. Such probabilistic models of beliefs have been shown to explain sensory perception (e.g., Kersten & Yuille, 2003), causal learning (e.g., Gopnik et al., 2004; Griffiths & Tenenbaum, 2005; Tenenbaum & Griffiths, 2001), language processing (Chater & Manning, 2006), and memory (Steyvers, Griffiths, & Dennis, 2006), and here I argue they can also be usefully applied to explain the dynamics of ideological beliefs and emergence of conviction.

At the most fundamental level, Bayesian theories argue that rationality involves updating prior beliefs in a way that is proportional to the incoming evidence. Thus, in Bayesian terms, the strength of a person’s belief can be modeled by their belief’s resistance to change in response to new evidence.

As evident in Figure 2, strong or dogmatic beliefs have a narrow, highly precise distribution while weak beliefs have a wide distribution around the mean, which reflects uncertainty. We can think of individuals’ particular ideological beliefs as strong or weak, and we can also view individuals’ entire belief systems in these terms—with dogmatic belief systems having a narrower probability distribution (marked by greater certainty and precision) and weak, flexible belief systems having wider distributions which are less certain and precise.

The impact of the precision (i.e., certainty) of ideological convictions is illuminated every time new ideologically-relevant information is encountered. If an agent encounters a piece of evidence that confirms their prior belief, their confidence will grow and so the representative probability distribution will become more certain and hence narrower and more precise (see Figure 3). Repetition of evidence is therefore key for building strong ideological convictions.

If an agent encounters evidence that diverges from their prior belief, then the impact of new evidence on the degree to which the agent updates their beliefs depends on the certainty of their prior convictions (Figure 4). An agent with weak beliefs, i.e., low confidence in their prior expectations, will be more likely to shift their beliefs in the direction of the evidence. In other words a weak believer is more persuadable by evidence, because they are less certain in what they believe and so are sensitive to new inputs. In contrast, a moderate believer who has greater certainty in their prior beliefs will shift their beliefs to a lesser degree than the weak (uncertain) believer.⁵ This is even more pronounced in strong, dogmatic believers who will barely shift their beliefs in the face of disconfirmatory evidence, even when the disconfirming evidence is reliable and overwhelmingly different to their prior (Figure 4).

At the level of belief systems, ideological indoctrination follows the same principles: if the same evidence is presented repeatedly and with confidence, then beliefs will become sharper, more precise and dogmatic. If the flow of information coming in is mixed and ambiguous, then beliefs will remain uncertain and imprecise, and therefore susceptible to change and persuasion. Naturally, these belief updating and maintenance systems depend on characteristics of the believer and the context and source of incoming information. Ample research suggests we believe fellow ingroup members and friends more strongly than outgroup members or strangers (e.g., Cohen, 2003; Van Bavel & Pereira, 2018), and that we are drawn to confirmatory political evidence (e.g., Madson & Hillygus, 2020). In order to delineate the dynamic mechanisms of ideological choice and conviction, empirical and theoretical research needs to integrate the probabilistic dynamics governing beliefs with the psychological, economical, and ecological conditions that shape the expression of ideological thought and action.

The Ideologue at the Marketplace: Rationality, Evidence, and Mobility of Beliefs

How does this Bayesian framework link to the psycho-economic model’s claims about the ways in which psychological and material needs shape the ideologies we choose?

Bayesian Inference of Ideological Beliefs *Confirmatory Evidence* → *Sharper, More Confident Beliefs*

Bayes Theorem:
 Prior Belief × Evidence ∝ Posterior Belief
 $P(\theta) \times P(y|\theta) \propto P(\theta|y)$

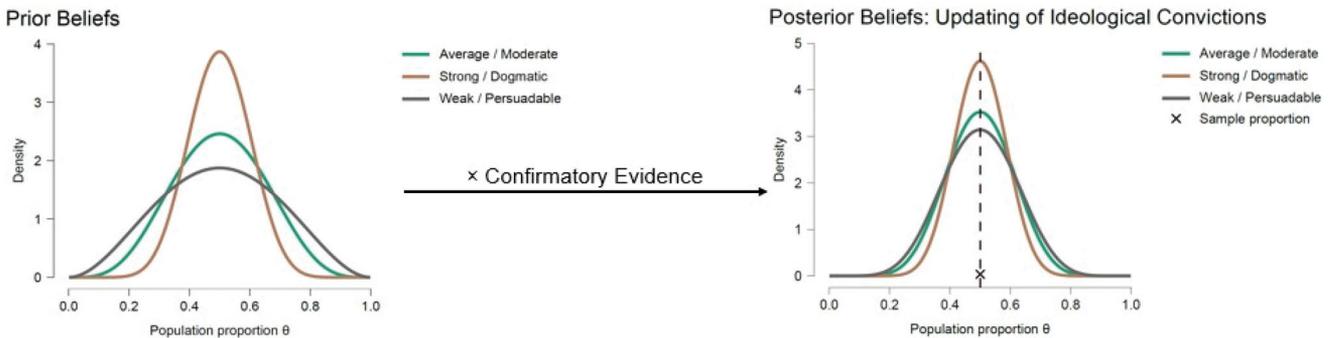


Figure 3. Bayes theorem posits that posterior beliefs are proportion to one’s prior beliefs updated by the incoming evidence. If agents are presented with confirmatory evidence in relation to their prior beliefs, in this case that the mean = 0.5, their subsequent posterior beliefs will be sharper and more confident in this claim.

Bayesian Inference of Ideological Beliefs *Alternative Evidence* → *Belief Updating According to Strength of Prior Convictions*

Bayes Theorem:
 Prior Belief × Evidence ∝ Posterior Belief
 $P(\theta) \times P(y|\theta) \propto P(\theta|y)$

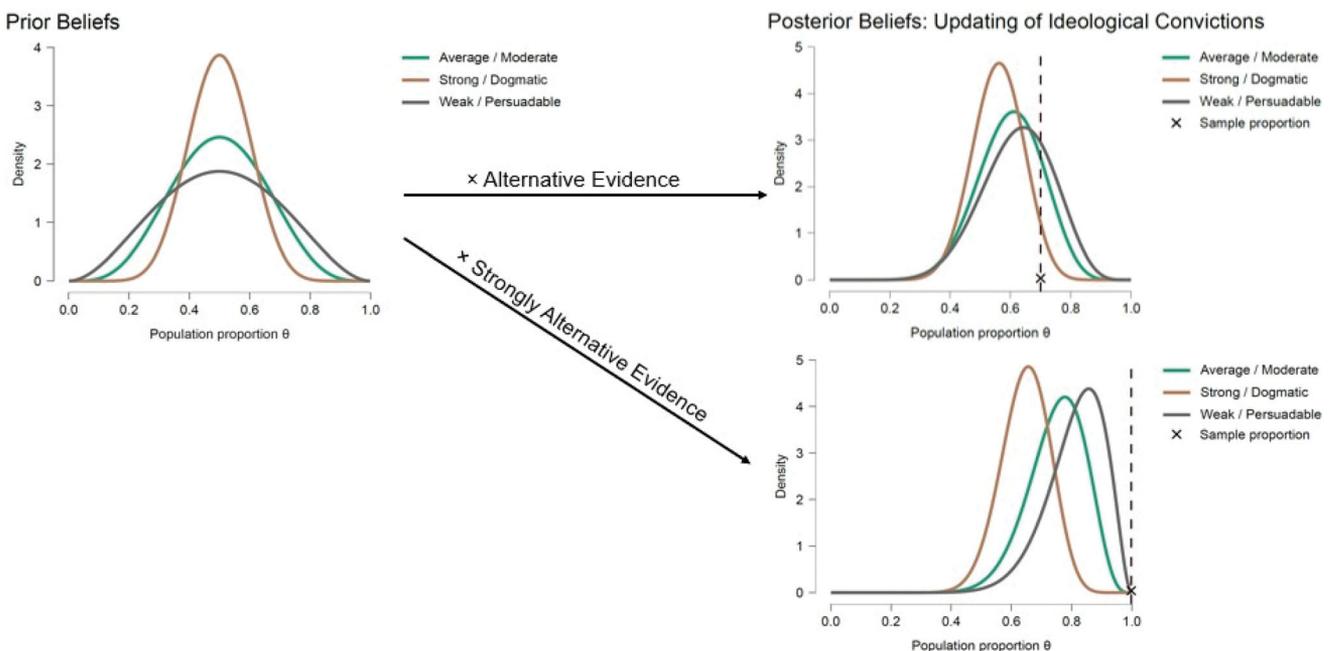


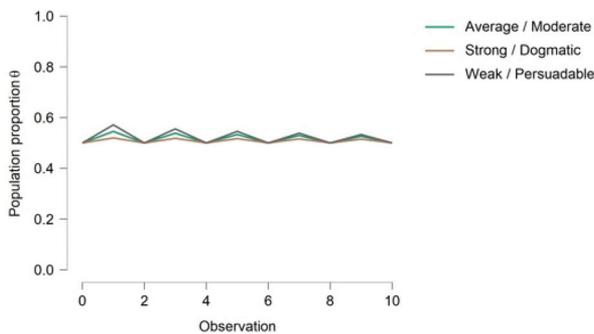
Figure 4. Belief updating when the evidence presented differs from prior expectations. The precision of one’s prior beliefs affects the extent to which evidence leads to a change in beliefs. Strong prior beliefs will be relatively immobile, whereas weak prior beliefs will be more susceptible to change in accordance with the presented evidence. Here the prior beliefs are centered on 0.5, and the alternative evidence is that the mean = 0.7, and the strongly alternative evidence is that the mean = 1.0.

Firstly, it highlights that psychological and material needs may impact ideological beliefs by influencing the content and precision of prior beliefs, and hence persuadability or dogmatism. Viewing ideological inferences as probabilistic inferences offers a formal mediating mechanism of the “trial-and-error” processes that govern ideological choice and conviction. Such a synthesis makes room for the notion that the formation of convictions depends on a range of

traits (including needs, desires and psychological tendencies such as intolerance of ambiguity, perceptual rigidity, poor complex cognition) and contextual states (such as stress, limited resources, limited informational environments). Theory can thus move beyond “invisible hands”, “black boxes” and the idea that ideologies operate by instilling “thoughtlessness”. Ideological doctrines and groups give adherents a system of beliefs which are transmitted

Building Convictions Over Observation Sequence

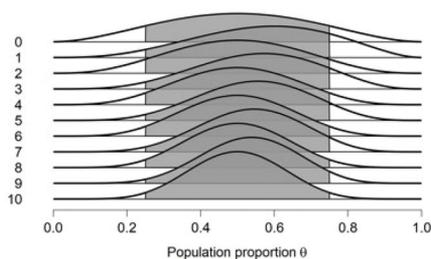
Belief Maintenance According to Strength of Prior Convictions



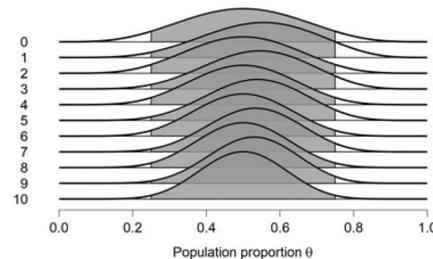
Observation N	Evidence	Prior Belief Strength		
		Weak / Persuadable	Average / Moderate	Strong / Dogmatic
0		0.500	0.500	0.500
1	1	0.571	0.545	0.520
2	0	0.500	0.500	0.500
3	1	0.556	0.538	0.519
4	0	0.500	0.500	0.500
5	1	0.545	0.533	0.517
6	0	0.500	0.500	0.500
7	1	0.538	0.529	0.516
8	0	0.500	0.500	0.500
9	1	0.533	0.526	0.515
10	0	0.500	0.500	0.500

Sequential Belief Updating in Response to Evidence

Weak Prior Belief



Moderate Prior Belief



Strong Prior Belief

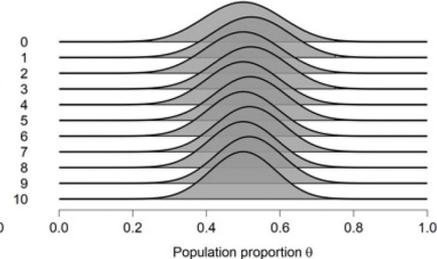


Figure 5. An example of sequential belief maintenance across 10 observations of evidence (can be conceptualized as coin tosses, with 1 as “heads” and 0 as “tails”). Although the value of the prior and posterior belief is unchanged after the 10 observations—it remains at 0.5—Bayesian inferential processes still need to happen as the mind integrates evidence with prior expectations. Strong prior beliefs will move little with every incoming evidence, while weak prior beliefs will initially move substantially with every observation. All beliefs will become increasingly sharper (more precise) by the end of the 10 observations because there is now greater certainty about the original claim.

repeatedly and with high confidence. From a Bayesian perspective, repeated evidence and high confidence translate into very precise and immobile beliefs. Hence, individuals who are highly immersed in ideologies come to have ultra precise and rigid prior beliefs. Counter evidence will struggle to overturn such rigid beliefs.

Even if an agent’s ideological choice does not change—the person continues to believe the same claim over a stretch of time—their minds will work hard to maintain this belief, and the level of certainty they have in the belief might continually fluctuate as they wander through the market of ideas and ideologies. Take the example of three people who all believe in a certain claim, for instance that a coin toss should yield “heads” or “tails” with equal, 50%, probability (Figure 5). They are then exposed to 10 pieces of information—i.e., coin tosses—which alternate in whether they reflect “heads” or “tails”. So overall the three people have been exposed to 5 “heads” and 5 “tails”, which ultimately confirms their prior belief that “heads” or “tails” have equal probability of being flipped. As a result, the content of their prior and posterior beliefs are the same: 50% chance of “heads” or “tails”. But by the end of this exposure to evidence, they will be more confident in their belief. If we look at the belief maintenance process, there is a series of mental computations that breed convictions. With every evidence of “heads” which is followed by “tails”, the believers return to the equilibrium belief of 50% probability, but their persuadability diminishes with every additional observation (Figure 5). Although all three people are exposed to the same evidence, the belief updating and maintenance process

varies in its volatility, depending on the certainty of these three people’s original convictions. The “strong believer” will experience the smallest shifts in beliefs, whereas the “weak believer” will initially exhibit strong fluctuations which will gradually settle with rising confidence in the belief.

We can easily translate this basic example into an ideological or political belief. The claim may concern the likelihood of a nation (or a person) being conservative (1) or liberal (0), or about whether supernatural agents exist (1) or not (0). Future, more complex elaborations on this Bayesian inference framework for ideological thought will incorporate the ideas of predictive coding, active inference, and free energy principle accounts of the mind (Constant, Clark, Kirchoff, & Friston, 2020; Friston, 2009; Lupyan & Clark, 2015), as well as ways to model the incoming evidence itself as a probability function, with a certain degree of reliability. In the given examples (Figures 2, 3, 4, and 5), the beliefs were mostly impartial, centering on 0.5, but more partial examples of skewed beliefs or those in multidimensional space can be modeled. These additional steps are beyond the scope of the present analysis.

Ideological agents can thereby be rational not simply when their ideological beliefs match with their psycho-economic interests and preferences (as conceptualized by Gries et al., p. 74)—agents can also be rational (and, provocatively, rationally dogmatic) because of how they respond to evidence. The crux of the psycho-economic model of ideological choice is that humans are happiest and most fulfilled when their beliefs satisfy their needs and desires. When humans believe inconvenient ideas, there is

discomfort and a drive to change. More formally, expected utility is maximized by choosing the closest match between one's psychological and material needs with the available ideologies. "Individuals are able to improve their subjective utility if they find a belief system—among those on offer—that better satisfies their psychological needs, interests, and concerns" write Gries et al. (p. 70). This is sensible and intuitive. Movement between ideologies can be understood as shifts in maximizing subjective utility. Bayesian models of belief also argue that agents maximize expected utility, but add that there is an additional pressure for agents to maximize epistemic value or information gain. In other words, human behavior is not only driven by motivations to maximize expected utility—it is also guided by cognitive control processes that seek to gain accurate information about the world in order to minimize unexpectedness and uncertainty.

These two notions of rationality can be happily married. In fact, they reinforce each other because both conceptualizations of rationality demonstrate that the world in which believers exist matters enormously for their capacity to be rational and optimize utility and understanding. As per Gries et al.'s formulation, if there are insufficient resonant available ideologies (or information about them), people can make suboptimal ideological resolutions. The Bayesian framework suggested here adds that if individuals are immersed in forceful and totalizing ideological environments, they may form beliefs in a way that is rational *relative to the available evidence*.⁶ But if the available information is skewed or sparse or selective, agents are likely to form dogmatic convictions that render future ideological shifts difficult. When the informational ecology is diverse, rich, and pluralistic, people's inferences about reality have a better chance of being both reflective of their needs and accurately reflective of the world. *Ideological rationality is rational relative to the informational ecology.*

This insight is tightly connected to an emerging empirical literature on the political brain depicting that political minds reflect the environments in which they reside (Zmigrod & Tsakiris, 2021). If believers choose to immerse deeply and committedly in an ideological cause or group, their minds, preferences, and dispositions can change as a result. Choosing an ideology has consequences, as evidenced by the findings that ideologies reflect and potentially alter believers' brains (e.g., Ahn et al., 2014; Goudarzi, Pliskin, Jost, & Knowles, 2020; Hibbing, Smith, & Alford, 2014; Jost, Nam, Amodio, & Van Bavel, 2014; Jost, Noorbaloochi, & Van Bavel, 2014; Nam, 2020; Nam, Jost, Meager, & Van Bavel, 2021; Waldfogel, Sheehy-Skeffington, Hauser, Ho, & Kteily, 2021; Zmigrod, 2020, 2021; Zmigrod & Tsakiris, 2021). Minds may become more rigid (Zmigrod, Rentfrow, & Robbins, 2019) or more sensitive to risks or threats (Zmigrod et al., 2021) if they engage repetitively and ritualistically with certain ideological doctrines. The agent making an initial decision at the marketplace of ideological choice can therefore be changed by intense engagement with the ideology they choose. This is also true if one is coerced into an ideology by birth, circumstance, context, or a lack of diverse options. The "buyer" of ideologies is not a blank

slate of static motivations and consumption needs—each purchase and ideological commitment can shape the characteristics of the agent's mind. These ideologically-induced changes may be implicit or explicit, psychological, physiological, or neural, trivial or consequential for the agent's perception and politics. Regardless of the extent or precise mechanisms by which ideologies transform adherents' brains, it is reasonable to assume that these changes can be more influential than those produced by common purchasing decisions when consumers enter physical markets. As a result, a psycho-economic mode of ideological choice cannot shy away from the cyclical and complex processes governing persuasion and confidence in worldviews.

Future Directions for Formalizing Ideological Inferences

One core insight that emerges from this proposed integration of psycho-economic and Bayesian approaches is that we need to think of the agent which enters and exists in the marketplace of ideologies as both an agent that seeks to satisfy their psycho-economic interests and an agent that seeks to create a reliably predictive model of the world that can guide expectation and action. This means that *what* a person believes is as important as *how* they believe, and these two components of belief can be theorized about jointly, as an integrated phenomenon (Zmigrod, 2022). In the processes of ideological resolution and inference, the agent comes to embody their ideological choices and convictions. Formalizing the sequence of mental computations that govern such processes is a powerful and essential step in developing models of political cognition that genuinely merge psychology, economics, and neuroscience.

The next frontier in the theoretical and empirical psychology of ideology is to integrate the neurocognitive, motivational, and situational levels of explanation (Zmigrod, 2021). How do psychological and material motivations, or situations of stress and scarcity, shape the neurocognitive dynamics of belief updating and extremity? The synthesis of psycho-economics and Bayesian models of belief is thus an exciting and fruitful avenue for research, which can begin to unpack complex questions such as:

- **The flexibility paradox:** *If ideologues are dogmatic and rigid, how and when do they become "persuadable"? How do believers move from persuadability to dogmatism, and back from dogmatism to persuadability?* The psycho-economic framework and Bayesian framework can help explain some features of movements between ideologies, but the question still remains—if minds prone to extremism are rigid and dogmatic, how are they ever converted? Identifying the psychological, economic, and ecological conditions for ideological changes is thus a key next step for the field.
- **The economics of ideological choice and rigidity:** *How do economic pressures shape ideological beliefs and convictions?* One of the suggestions in the present commentary is that while we have a growing knowledge of the

psychological factors shaping ideological choice and extremity, the economic literature is more sparse. Research by Krosch and Amodio (2014, 2019), Krosch, Tyler, and Amodio (2017), illustrates how conditions of scarcity can promote neural dehumanization of racial minorities and hence promote discriminatory behavior. Similar creative methodological approaches can and should be applied to questions of ideological immersion and adherence more broadly.

- **The moderators of ideological rationality:** *How does the brain evaluate ideologically confirmatory and disconfirmatory evidence? What are the relative weights of psychological and material interests in shaping ideological belief updating mechanisms for confirmation and disconfirmation?* While a basic Bayesian model is a useful starting point, there is a lot of conceptual and empirical scope to elaborate on the specificities of ideological cognition, which involve asymmetrical belief updating when evidence is confirmatory or disconfirmatory (e.g. Eil & Rao, 2011; but not always: Tappin, Van Der Leer, & McKay, 2017), and depending on the information source. Delineating these mechanisms behind ideological rationality (and irrationality), and how they are shaped by psychological and material factors, is essential for further theoretical development. Gries et al. suggest that it is possible to weigh which psychological interests are most influential for a given individual. Theoretically, this is valuable and necessary. Empirically, how can this be achieved? Perhaps data-driven research approaches can help wholistically examine the psychological (and economic) underpinnings of different ideological profiles (e.g. Zmigrod et al., 2021).
- **Probabilistic inferences about perception and politics:** *Are ideological beliefs akin to sensory beliefs? Does the brain learn about ideological causes and effects like it learns about perceptual causes and effects?* Applying Bayesian inference models to the questions of ideological cognition inherently involves acknowledging parallels between sensory beliefs **about** the causes and effects of sensory experiences (such as visual or linguistic inputs) and political beliefs about the causes and effects of ideologically-relevant experiences. To what extent is this parallel between perceptual and political processes useful? Elaborating on this model by incorporating the theories of active inference, predictive processing, and cognitive niche construction (Constant et al., 2020) will further illuminate the relationship between perception and politics, and add neurobiology and action to the mix.
- **Utility-maximization versus error-minimization:** *To what extent do ideologues aim to optimize utility or optimize understanding—or both?* Theories of social norms and ideological **beliefs** often note that pragmatic considerations (e.g. social belonging, maximizing subjective utility) come into conflict with epistemic considerations to understand the world accurately (Williams, 2021). Some theorists have posited that epistemic computational principles of error minimization shape why ideologies emerge in the first place and how they play out socially

(Wheeler et al., 2020), whereas other theorists have argued that motivated political reasoning is not driven by epistemic goals (to achieve an accurate representation of the world) but rather by utility-maximizing goals (Rigoli, 2021). Experimentally, when monetary incentives are given for accuracy—such that utility-maximizing and error-minimizing goals align—individuals’ political beliefs appear to reflect a cautious Bayesian learner (Hill, 2017). Future research can outline more clearly how and when utility-maximization and error-minimization shape ideological belief formation and the situations or boundary conditions when one motive supersedes the other.

A merging of psycho-economic and probabilistic models of ideological cognition is a highly fruitful avenue for scholarship on political thought and behavior. Indeed, a framework that captures both the notions of elective affinities and probabilistic dynamics underlying cognition will reflect old theories of social action as well as new theoretical approaches to the mind. Moreover, this synthesis may even elucidate the origins and utility of sacred values (Atran, Sheikh, & Gomez, 2014; Ginges & Atran, 2013; Tetlock, 2003; Whitehouse, 2018) as these emerge from ideological groups and narratives. Notably, the importance of a theoretical endeavor to map out ideological choice and conviction is not merely one of scientific discovery and interest—it holds critical implications for political, philosophical, historical, and sociological theories of how ideologies captivate the minds of adherents. While Hannah Arendt famously posited that totalitarianism and its tyrannical logic render citizens “mindless” or “thoughtless” (1951), the proposed model illustrates that a theory of “mindlessness” or “thoughtlessness” is not a credible or probable theory of ideologies. Prior beliefs and preferences are not static; they move, mutate, and react to the realities (and distortions) that agents are confronted with. Ideologies are complex dynamical systems, whose mechanics and impact on the mind we can model and scrutinize. We must imbue ideologies with a complex mind if we are to understand the processes of totalitarianism and extremism—otherwise, we may be doomed to mindlessly repeat history’s toxic and violent mistakes.

Notes

1. In Figure 1A this is modelled as a normal distribution, but it may be that some ideologies are highly skewed, with a high proportion of dogmatic believers or a high proportion of weak believers.
2. Strong belief in an ideology can be manifest in the *doctrinal* feature of ideological adherence (Zmigrod, 572021a), where adherents are dogmatic about the specific description of the world offered by the doctrine and seek to prescribe its thoughts and actions to others. Alternatively, strength of ideological attachment may be manifest in the *relational* aspect of ideologies (Zmigrod, 572021a), wherein adherents’ ideological convictions are manifest in the rigidity and passion with regards to group membership, hostility, and prejudice.
3. One may ask whether the ‘weak believer’s’ subjective utility is lower than the ‘average believer’s’ or ‘strong believer’s’

subjective utility. Mathematically, perhaps this can be resolved via individuals' shifting indifference curves or by modelling the frontier of options in more clearly probabilistic terms. Conceptually, the answer depends on whether we allow the theoretical lens to stretch slightly more widely than the realm of ideologies. Individuals may have lower expectations that their psychological (or consumption) needs will be served by ideologies, and other intrinsic or extrinsic factors may compensate for the lower expected utility derived specifically from ideologies. A less dogmatic believer may feel freer and happier when their lives are extricated from dependency on ideologies for fulfilment of needs and interests. Utility can be optimized (or satisfied) when we remember that existences extend beyond the axes of the psycho-economic framework, and so needs, desires, and predispositions can be fulfilled via multiple avenues.

4. As captured by the revelation factor RK in Gries et al.'s proposed model.
5. In Bayesian inference, this will also depend on the reliability of the incoming evidence, but we can park aside the computations of reliability and precision of evidence for the current purposes.
6. While ideological dogmatism or persuadability can emerge as rational responses to polarized or pluralistic societies, this is by no means a guarantee that people actually *are* behaving rationally, updating their ideological beliefs and preferences in accordance with available options and evidence. Indeed, as Gries et al. note: "All ideological outcomes – whether or not they are normatively defensible in terms of standards of morality or rationality – may be understood as the result of a decision-making process under circumstance of uncertainty and limited resources" (p. 6).

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