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Credal Encroachment in a Two-Stage Model

by

Pengbo Hu

Under the Direction of Juan S. Piñeros Glasscock, PhD

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

in the College of Arts and Sciences

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ABSTRACT

On a traditional, “purist,” epistemological picture, the epistemic status of mental states and attitudes depends solely on alethic factors. Pragmatic encroachment is the thesis that rejects this picture. Here I defend a particular version of pragmatic encroachment called “credal encroachment.” Specifically, credal encroachment arises in a plausible model of credence formation. I also argue that this account can respond to some outstanding objections to credal encroachment. Finally, I will close with a discussion of a neighboring but competing account based on similar empirical considerations.

INDEX WORDS: Pragmatic encroachment, Credal encroachment, Epistemic norms, Epistemic rationality, Bounded rationality, Credence

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2023

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DEDICATION

To my friends.

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I thank my advisor, Dr. Juan S. Piñeros Glasscock, for introducing to me the subject and providing invaluable feedback and suggestions on this work. I also thank Dr. Neil Van Leeuwen for his useful comments and feedback.

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1 INTRODUCTION

On a traditional, ‘purist,’ epistemological picture, the epistemic status of mental states and attitudes depends solely on alethic factors.¹ However, defenders of pragmatic encroachment argue that practical factors can also directly affect epistemic status.² Although the encroachers can be described as adhering to the general slogan “the practical encroaches on the epistemic,” they disagree on which and how epistemic states are affected by which practical factors (Kim, 2017). So far, encroachment on knowledge and justified belief has drawn the most attention, whereas encroachment on justified or rational credence (hereafter, “credal encroachment”) is seldom discussed or defended.³ This paper illustrates one strategy for defending credal encroachment based on an empirically-informed, two-stage model, only recently discussed by epistemologists. In this model, credence partly depends on one’s decision of when and how to believe. Given that the decision is sensitive to practical factors, one’s credence is also sensitive to practical factors. Insofar as credence is rationally so, credal encroachment obtains.

Here is the plan for the paper. In section 1, I briefly review pragmatic encroachment on belief and credence. In section 2, I discuss empirical works on what I will call “metareasoning” and propose a similar approach for credence. I then argue that this approach gives rise to credal encroachment. In section 3, I respond to some outstanding objections against credal

¹ I understand pragmatic encroachment to be a strictly normative thesis. Epistemic status refers to things such as knowledge or epistemic rationality. This means that I will not deem any theory in which the practical merely affects the presence of a cognitive state pertaining to the epistemic without affecting its epistemic status as a theory of pragmatic encroachment. See below. Also, see Moss (2018) for a similar point about moral encroachment. See Dinges (2021), who favors non-encroaching theses, for an exposition of the practical influence only on the presence of belief in knowledge ascription.

² It is an ongoing debate exactly how to demarcate the alethic and the practical. Some less controversial practical factors include time of making a decision, and stakes of having a false belief, etc.

³ Clarke (2013) and Gao (2019) defend descriptive accounts in which credences are sensitive to practical factors. Both hint towards a possible credal encroachment but have been mistaken by some to argue for a full-fledged normative thesis of the sort I argue for here.

encroachment with this approach. Finally, I close with a discussion of a purist account based on similar empirical considerations.

2 BELIEF, CREDENCE, AND PRAGMATIC ENCROACHMENT

Belief and credence are well-motivated doxastic states studied by philosophers. To believe something is to treat it as true or take it to be the case (Schwitzgebel, 2019). A widely accepted tripartite model assumes that belief is discrete. One can either believe, disbelieve, or suspend one's judgment that it will rain tomorrow. However, we are also sometimes more confident in some propositions. One can be more confident that it will rain tomorrow than God exists. This consideration motivates a degreed notion of doxastic attitude — credence, or partial belief. It is usually represented to vary between $[0,1]$, with 1 being the maximum confidence and 0 the minimum.⁴

Which epistemic norms govern the rationality of belief and credence?⁵ According to purism, it depends entirely on alethic factors such as evidence. However, pragmatic encroachment on rational belief rejects the purist view. One way to motivate this encroachment position is through vignettes such as follows:^{6,7}

LOW: Suppose Hannah and Sarah are driving home on a Friday afternoon. They plan to deposit their latest paycheck, but there is no urgency that they do so that same week. When they drive past the bank, they see a long line at the bank. Hannah then remembers that a couple of weeks ago, she visited the bank on a Saturday. She then says to Sarah: “the bank will be open on Saturday, so let's come back tomorrow.”

⁴ See Jackson (2020) for an in-depth review of credence, belief, and their relationship.

⁵ For my discussion, I will focus on rational belief and credence, although many others have formulated the issue in terms of justified belief (for example, see Fantl & McGrath (2002)). Any normative features of belief and credence that are subject to practical factors should suffice for a case of pragmatic encroachment.

⁶ This is a variant of the bank case adopted from DeRose (1992) and Schroeder (2018).

⁷ Pragmatic encroachment, especially on knowledge, has also been motivated with plausible epistemic norms. This approach is referred to as the principle-based arguments for pragmatic encroachment. Independent of vignettes like the bank case, encroachers of this approach proceed by defending plausible epistemic principles linking knowledge and action, preference, reasoning, assertion or other practical behaviors. These principles then put a necessary pragmatic condition on knowledge. See Fantl and McGrath (2002, 2007) for examples.

HIGH: Suppose Hannah and Sarah are driving home on a Friday afternoon. Everything remains the same as in LOW, but it matters that Hannah and Sarah deposit the paycheck by Sunday, or they will default on their house mortgage. When they drive past the bank, they also see a long line. Hannah again recalls visiting the bank on a Saturday a few weeks ago. She also says to Sarah, “the bank will be open on Saturday, so let’s come back tomorrow.”

Pragmatic encroachment on belief gets its appeal if you judge Hannah to be only rational in believing that the bank will be open on Saturday in LOW. After all, how much is at stake should not make a difference to whether the bank will be open on Saturday. The stakes of having a false belief do not affect the probability of a proposition being true and hence are not an alethic factor. However, it is undoubtedly a practical one. That a practical factor affects our intuition about the rationality of belief in the bank case provides prima facie evidence for the view that practical factors can have an epistemic impact on rational belief.

Recently, it is pointed out that our intuition can be equally strong when we substitute belief with credence in vignettes like the one above (Gao, 2019). It seems intuitive that Hannah in HIGH should be less confident than in LOW with respect to the bank opening on Saturday, although the alethic factors are the same. Does this mean that rational credence is also pragmatically encroached? Call the position that the epistemic rationality of credences depends on practical factors “credal encroachment.” How is credal encroachment possible? In the next section, I present a two-stage model in which credence is best seen as pragmatically encroached.

3 CREDAL ENCROACHMENT IN A TWO-STAGE MODEL

In this section, I aim to import insights from empirical research and motivate a two-stage framework for the formation of doxastic states, especially credence. The rough idea is that before and during our deliberation about what to believe, we also (personally or sub-personally) sometimes engage with questions about when and how to believe through an approximated cost-benefit analysis. That is, we sometimes need to balance the pursuit of accuracy in forming belief and credence against practical factors, such as time, stakes, and the costs of deliberation.⁸

Specifically, in a two-stage model of credence formation, the first stage (“metareasoning”) determines when and how to form credence and the second stage is directly responsible for its formation.⁹ The model leaves open the possibility that practical factors put pressure on which credence one epistemically ought to have. Furthermore, given that the first stage functions by approximating cost-benefit analyses, it is best considered partly assessed by practical rationality. Thus, this model leads to credal encroachment.

There are two caveats before I start. First, I cannot review the evidence supporting metareasoning and its regulatory roles in our cognition. My methodology is to assume the theories and models I mention below as the best interpretation of empirical data. I will also ignore some nuance and ongoing research programs that go beyond the mere cost-benefit analysis of metareasoning in what follows. I then show why a similar approach in epistemology

⁸ The idea I am developing below originates to some degree from Gao (2019) and Nagel (2010)’s discussion of “bounded rationality.” They both point to an additional cognitive mechanism that regulates belief and credence formation. I hope to draw more attention to the mechanism and the relevant research. Later, I will address some residual worries about a shifty rational credence from their perspective. Most importantly, I am more sympathetic to Gao but disagree with Nagel on the normative implications of research on bounded rationality for beliefs and credences. See the last section for a brief review of Nagel (2010).

⁹ I adopt the term “metareasoning” from Lieder and Griffith (2017). It comes from computational theory term “rational metareasoning”, referring to what determines the optimal way of allocating computational resources. Lieder and Griffith apply it to human cognition. I find it instructive in designating the process at the meta-level that regulates the lower-level process.

can lead to credal encroachment. Second, because of space constraints, I will only make some qualitative remarks on metareasoning and credence without getting into the formal issues.¹⁰ To this metareasoning, I now turn.

3.1 Two-stage model

We have limited cognitive resources to spend when facing various practical tasks, such as making judgments, decisions, or inferences. This is also true in solving cognitive tasks. For example, our memory and executive control are finite and limited. Furthermore, the environment is volatile and presents problems with various demands, such as different time limits and the involved stakes. Some problems and tasks must be resolved within seconds, such as deciding whether to take the incoming exit on the interstate highway, whereas others allow us to deliberate longer, such as deciding whether to have a child.

Simplified crudely, the consideration of cognitive and environmental limitations has been at the center of research projects of bounded rationality, which emphasize environmental structures and cognitive resources in theorizing human cognition (Simon, 1955; Tversky & Kahneman, 1974; Todd & Gigerenzer, 2012). What emerges from the study of bounded rationality is that there must be some process that responds to perceived contextual cues and regulates the allocation of cognitive resources, such as attention and executive functions (e.g., Boureau, Sokol-Hessner, & Daw (2016) on control). The idea is that in addition to the internal complex processes that directly solve the problems in the environment, an additional process selects from various cognitive processes and strategies and determines cognitive resources invested into solving problems. Call this higher-order process “metareasoning.”

¹⁰ Clarke (2013) and Gao (2019) have demonstrated that shifty credence in response to practical factors is formally representable. I think revamping their descriptive framework into a normative one is not per se a difficult task.

How should the metareasoning process regulate the allocation of cognitive resources? A widely-held idea is that it ought to optimize our use of cognitive resources for greater utility. If cognitive resources are limited, we should spend them only to the extent that is worth it. We probably should not deliberate too long between a can of coke and Pepsi but should spend more time and energy thinking about which Ph.D. program to apply to. Similarly, if deciding with the same amount of cognitive resources in the future seems to guarantee a better outcome, we had better wait to make that decision.

Early empirical research shows that people exhibit an adaptive pattern in decision-making and judgment as if they are computing the expected cost and reward of making an accurate judgment (Payne, Bettman, & Johnson, 1988; Gunzelmann & Anderson, 2003). For example, people are more likely to invest cognitive efforts in making judgments when the stakes are high (Payne et al., 1988). Recent approaches explore several models of cognition in which a higher-order process regulates complex cognitive processes in cognitive tasks through an approximated cost-benefit analysis of cognitive resources.¹¹ According to them, investing cognitive resources in doing cognitive tasks is costly. One way to conceptualize the cost is opportunity cost, which equates to what could have been done with the cognitive resources. If some cognitive resources have been allocated to a process, they cannot be allocated elsewhere. Therefore, the cost of spending cognitive resources can spring from the monopoly of some shared or common cognitive resources by a particular process. Furthermore, allocating cognitive resources to

¹¹ Different approaches model cognitive effort and allocation mechanism differently. For example, according to some neuroscientists, cognitive effort is best understood in terms of cognitive control. Exertion of cognitive efforts reflect our investment of cognitive control to override default and automatic processes in favor of deliberate and control-dependent processes. The latter processes monopolize more cognitive resources but can sometimes yields better results. See Shenhav et al. (2016) and Boureau et al. (2015) for reviews of this approach. For a more general framework of how cognitive resources are rationally allocated and how to build model of this sort, see Lieder and Griffiths (2020). Lieder and Griffiths (2017) also propose a sophisticated mechanism for the allocation of cognitive resources in terms of strategy selection.

different processes or allocating different amounts of resources to the same process may yield various benefits across different circumstances. Some more effortful and resource-consuming processes might generate more rewards, such as by allowing more accurate representations of outcomes or more cognitive operations on information. Very roughly, metareasoning allocates cognitive resources by trading off the expected benefit of internal processes against their expected costs.

A notable feature of these theories and models is that they assume a distinction between the two stages of cognitive mechanisms. At the first stage is a metareasoning process that allocates cognitive resources through an approximated cost-benefit analysis. The second stage involves complex cognitive mechanisms that utilize those resources and directly address problems by generating output, such as decisions, judgments, and inferences.

In this vein, I propose a similar approach for the formation of doxastic states, such as belief and credence. This approach is empirically and theoretically motivated. Philosophers have already appealed to a similar line of empirical research to argue for the adaptivity of belief and credence formation (Nagel, 2010; Gao, 2019). Others have used the notion of cognitive limitation and opportunity cost to argue for epistemological theses, such as the stability of belief (Holton, 2014) and permissivism (Podgorski, 2016). Friedman (2020) also motivated an expansive and zetetic epistemology program in which epistemic norms cover different stages, such as inquiry. In any case, it is obvious that sometimes our formation of doxastic states is quick and effortless, but other times we spend a fair amount of time, attention, and other executive resources in deliberation. An additional metareasoning process can play exactly this mediation role. For my purpose, I will now focus on credence.

Consider the following scenarios. Sarah is wondering whether vaping is safe for her health. She has researched and found a body of evidence from different sources. However, to process all of the evidence and eventually settle down on a credence, she has a choice between two strategies. One strategy is more cognitively demanding. It requires Sarah to go through every piece of evidence and weigh them carefully, but it may lead to a more accurate credence of whether vaping is safe. The alternative strategy is less demanding. She will make a rather loose assessment of the evidence. She may thoroughly consider a particular part of the evidence but browse quickly through the rest. Of course, the resulting credence is likely to be less accurate. Now in one case where Sarah is deciding whether to vape and cares a lot about her health, she selects the first strategy. In another scenario, Sarah is contemplating this issue just to kill some time, and she goes with the second strategy.

A two-stage model for credence can mimic this pattern in these two scenarios. At the first stage is a metareasoning process that allocates cognitive resources to the extent that is worth it and mediates the performance of the second stage. At the second stage are processes through which we form credence (hereafter, “credal formation processes”).¹² One can think of these two stages as responding to two different types of questions. The first stage affects when and how to form credence and answers questions such as “how hard should I deliberate?” The second stage directly addresses the question concerning credence in a proposition p , such as “how confident am I in p ?”

Assuming that a more cognitively demanding process tends to lead to a more accurate credence function, metareasoning conducts an approximated cost-benefit analysis by factoring in both alethic factors, including the expected accuracy of each process, and practical factors,

¹² Following Podgorski (2016), I will assume that the doxastic formation process is a dynamic process that occurs over time.

including the stakes of having an accurate credence and the cognitive cost.¹³ Which credal formation processes to use is a matter of weighing the utility of additional accuracy against the cost, such as the opportunity cost of investing cognitive resources in a particular process. If it matters a lot to Sarah to have an accurate representation about vaping, then a cognitively more taxing process that might come with more accuracy seems worth it. Alternatively, if she does not quite care about vaping, metareasoning can opt for a less demanding process.

3.2 Credal encroachment

If credal formation processes are governed by metareasoning, what are the epistemological implications of this two-stage model? In what follows, I will argue that a two-stage model of credence gives rise to credal encroachment.

Before presenting what I consider credal encroachment, I want to elaborate on one role metareasoning plays that does not entail credal encroachment.

Metareasoning can control when to form credence. This role concerns whether one initiates the formation at all. In the most extreme case, metareasoning finds it not worthwhile engaging with a credal formation process now, no matter how much cognitive resources one invests or which processes one selects. Cognitive resources are simply expected to be better used elsewhere, such as in processes currently irrelevant to the formation of credence. When this happens, one does not initiate a credal formation process. Metareasoning can effectively serve as a “gate.” Sarah can find it not worthwhile deliberating about how likely it is safe to vape if something more urgent awaits. Sarah subsequently does not entertain the question at all.¹⁴

¹³ I understand that this is a big “if”: it is an interesting question how it is possible that one learns to what extent a particular doxastic process is accurate. One possible mechanism involves an explore/exploit algorithm. We can sometimes experiment with different processes and figure out their overall accuracy. We later exploit these processes.

¹⁴ This role of metareasoning coheres well with the recent literature that distinguishes between when to initiate a consideration of whether p and the consideration itself of whether p , that is, deliberation of whether to believe p . See

If metareasoning only determines when to initiate a credal formation process, it poses no obvious threat to credal purism. The rational credence to form can remain the same at a time point t , and the rationality of forming and having credence can still rely only on the alethic factors. One's credence is only epistemically irrational when 1) one decides to form a credence at t and 2) one's credence deviates from the prescription of the purist epistemic rationality.

However, metareasoning can have a more subtle influence on how to form credence. Because cognitive resources can be allocated along a continuum, variation in the allocated cognitive resources can lead to different performances in the same task. For example, given the same cognitive process, how much attention one invests matters to how one performs. While there are many ways to conceptualize and model the variation in cognitive resources, I shall focus on one aspect: parameter setting. The idea is that metareasoning can modulate some parameters in the second stage process. For example, in a drift-diffusion model of perceptual decisions (e.g., judging the direction of motion of random dots) that characterizes a perceptual decision as the accumulation of evidence above a certain threshold, the metareasoning process can determine how the threshold (i.e., the parameter) is set across circumstances (Shadlen & Roskies, 2012). The difference in the threshold has been used to study the speed-accuracy tradeoff. For example, in some cases of perceptual decision, speed is favored over accuracy such that one spends a short duration of time watching the moving dots. The metareasoning process may lower the evidential threshold such that the decision process is terminated and the decision is reached faster. Its impact on parameters has a downstream influence on the performance of the second stage process.

Holton (2014) for an example for belief. Although he is a belief monist (he denies the ontology of and the theoretical need for credence), I think most of what he says can still be transferred to credence if one is a realist about credence.

Metareasoning may also modulate the parameters in the formation of doxastic states. Consider, for example, a model of belief favored by threshold pragmatists.¹⁵ In a typical case of the model, belief requires a sufficiently high evidential strength above some threshold. Furthermore, threshold pragmatists claim that the threshold can move up or down across contexts with different practical factors. A two-stage model of belief formation, in which the threshold model is paired with metareasoning, provides a story of how it is possible that the belief threshold can shift. It is a parameter that metareasoning sets up according to an approximated cost-benefit analysis. Furthermore, the change in threshold subsequently shifts the resulting belief. Given the same level of evidential strength, one can end up with either belief or no belief by moving the threshold around.

The parallel should be obvious for credence. Consider two potential aspects in a credal formation process: evidential weights and the space of possibilities.

First, evidence assessment itself can be costly. It can monopolize cognitive resources. It is plausible that when one assesses the evidence, one recruits attention to fixate on it and working memory for holding it. Given the limited cognitive resources, one does not always assess every piece of evidence as carefully as possible before one settles upon a credence function. However, as the benefit of investing cognitive resources increases, more cognitive resources might be allocated, allowing a fuller assessment of the evidence. One way to conceptualize the degree of assessment is that the evidence is weighted differently. In the vaping example, Sarah can go through all evidence as carefully as possible, or she can use the limited cognitive resources to examine more closely some evidence and only briefly browse through the rest.

¹⁵ See Paul and Morton (2018) for an example of the threshold model of belief. They commit to the threshold pragmatism in Morton and Paul (2018).

Furthermore, limited cognitive resources shape the space of possibilities. The credence function is usually defined over a space of possibilities, which one takes to be live. The outcomes of credal formation processes then crucially depend on how many possibilities one considers. Considering more alternative possibilities may nontrivially shift one's credence function (Clarke, 2013). Psychological studies have shown that it is cognitively expensive and phenomenologically exhausting to include more possibilities in one's reasoning (Bettman, Johnson, & Payne, 1990). Again, if we factor in the limit imposed by cognitive resources, it should not be surprising that including additional possibilities in one's reasoning induces opportunity cost. So, if the cost outweighs the benefit of considering additional possibilities, metareasoning may allocate fewer cognitive resources, and one will work with fewer possibilities.¹⁶

When metareasoning affects these two aspects of credal formation processes, one can end up with quite different credences. For example, when the stakes are high, the metareasoning process might warrant allocating additional cognitive resources such that one assesses one's evidence more fully and considers more possibilities. It may lead to a lower level of credence than when the stakes are low.

So far, I have argued that the approach to credence based on a respectable line of research suggests that which credences we form is a function of the metareasoning process that is sensitive to practical factors. However, I have introduced credal encroachment as a normative thesis. How could the empirical work and the descriptive two-stage model of credence formation

¹⁶ Lawlor (2021) defends a view of relevance as reasonableness and argues that in her account "greater practical interests alone do not suffice to make still more alternatives relevant." She then argues that her preferred view of knowledge based on relevance does not entail pragmatic encroachment. While I believe exploring relevance in terms of reasonableness is a very interesting project, pragmatic encroachers need not commit to the view that practical factors *fully* determine the epistemic status of doxastic states. Insofar as one concedes that practical factors can play a direct role in knowledge assessment and assignment, whether they alone are sufficient to determine knowledge, or its assignment does not seem to matter to whether one is an encroacher.

substantiate this normative thesis? My general answer is that the norms appropriate for an agent depend on her cognitive abilities.¹⁷ Consider the following case to see how this applies to the issue at hand.

Imagine two agents, X and Y, with vastly different cognitive make-ups. X has unlimited cognitive resources at her disposal, whereas Y has limited resources. Let us further assume that X and Y are now presented with the same body of evidence and asked to deliberate about how confident they are in the proposition that vaping is safe for their health. Some moderate amounts of money are at stake for both agents because they are expected to bet on the proposition later. It is plausible that given the limited cognitive resources Y has, Y cannot proceed to form credence as X does in at least two ways. First, because Y is limited in her cognitive resources, she can only consider a part of the evidence thoroughly, while she glances through the rest. For example, Y focuses more on the memory that she read about an article detailing the negative effects of vaping. In contrast, X can go through every piece of evidence as carefully as possible. Second, X can work with more alternative possibilities. Other than just considering the possibility that vaping is safe for her health, she also has the cognitive resources to consider other possibilities, such as that vaping actually makes one more susceptible to smoking.

As a result of the difference in cognitive resources, they came to have different credences on the matter. Are we to say that X has a more rational way of forming credence, and as a result, has a more epistemically rational credence than Y? Not quite. If we are mindful of the cognitive make-up of Y, we should find that this is the credence she can get at by applying appropriately what she has got, and it is perhaps the most truth-conducive process Y can engage in. There is nothing irrational in the way Y goes around and forms credences. *Prima facie*, this means that

¹⁷ cf. Simpson (2017)

even in the face of the same body of evidence, it can be rational for agents with different cognitive resources to land on different credences.

I suggest an analogue case occurs intrapersonally in a two-stage model of credence. If metareasoning can rationally allocate more or less cognitive resources to credal deliberation, depending on practical factors, such as stakes, then some parameters in credal deliberation can differ rationally across contexts with different practical factors. After all, environmental cues can affect metareasoning in estimating the costs and benefits of the credal formation processes. For example, metareasoning should sometimes rationally find it worthwhile allocating more cognitive resources to forming credence when the stakes are suitably high. Variation in practical factors can sometimes justify the shift of the allocation of cognitive resources and parameters, and as a result, the shift of rational credence.

As a result, if metareasoning has an impact on the rational status of parameters and credence, then it gives rise to credal encroachment, in which the epistemic rationality of credences depends on the practical. There are cases where given the same parameters and the resulting credence, it is not rational for the metareasoning process to select these parameters because of some practical factors. Insofar as the parameters are irrational from the perspective of metareasoning, the resulting credence is not rational. Practical factors then matter in our assessing the epistemic rationality of credences.

I have argued that a two-stage model of credence formation leads to credal encroachment. I also believe this model can also respond to some outstanding objections against credal encroachment. In the next section, I explore this virtue of the model after I respond to some remaining questions about the nature of credal encroachment and metareasoning.

4 ENCROACHMENT AND OBJECTIONS

In this section, I first further clarify my position by situating it in the broad landscape of epistemology. Then I respond to an objection concerning the rational evaluability of metareasoning. Finally, I deal with two outstanding objections against credal encroachment using the two-stage model. The first of these two objections is that credal encroachment is not well motivated from a decision theory perspective, and the second is a general worry against pragmatic encroachment that also applies to credal encroachment.

4.1 Two-stage model encroachment in Pragmatist Epistemology

Early on, I have described pragmatic encroachment of epistemic rationality. Recall that it deviates from the traditional view in that it includes practical factors in evaluating epistemic rationality. This is motivated by considering cases in which acting on one's belief and credence involves high stakes if the belief turns out to be false or credence inaccurate. It is usually claimed that some additional practical factors are needed to fully account for our intuitions.

This is, of course, not the only way through which we can "pack the court" of epistemic rationality with practical considerations. For instance, some proponents advocate for a more radical shift in the conception of epistemic rationality, calling for its replacement by practical rationality altogether (Rinard, 2021). This perspective asserts that the foundation of purist norms lies in their practical values, such as their ability to serve as the most effective means to achieve one's objectives.

Another way to depart from the traditional view is to broaden our conception of what is considered epistemic. For instance, Friedman (2020) introduces the notion of "zetetic epistemology," which asserts that the norms of inquiry behavior, such as when to open questions and how to investigate them, are integral to epistemic norms. These inquiry norms differ from

the traditional purist norms, according to Friedman. By extending the scope of epistemology, it creates room for practical considerations, though Friedman is cautious about whether and how exactly this occurs.

It may be argued that the two-stage model should not be categorized as credal encroachment, as it is more concerned with the zetetic than encroachment. Zetetic norms can conflict with traditional epistemic norms because evidence collection and the selection of inquiry strategies may be subject to practical or moral norms that diverge from the traditional norms. Similarly, the two-stage model involves the rational shift in credence due to various cognitive resource allocation strategies. It is plausible that evidence processing and belief-formation strategies can also be subject to norms that do not align with purist norms, just as evidence collection and inquiry strategies are influenced by zetetic norms. At times, sacrificing the accuracy of one credence for the sake of achieving greater accuracy in another credence later may be necessary. Spending an excessive amount of time on one trivial question can be practically irrational and have epistemic consequences, leading to less accurate credence formation on more important issues later on. Imagine Sarah spends a long time contemplating whether vaping is safe for her health and settles on a credence. As a result of her spending too much time on a trivial question, she does not have time to form credence on the more important issues, such as whether the bank is open on Saturday later. Given the time left, she has no choice but opts for some less accurate process. She is not epistemically irrational in the purist sense in having her first credence, but her overall epistemic status seems to be worse: her later credence on the more important issue is less accurate.¹⁸ Thus, practical factors unavoidably affect rational credence in the expansive sense.

¹⁸ One assumption here is that different belief and credence should be valued differently. One's overall epistemic status depends not just on the quantity of one's true and false beliefs, accurate and inaccurate credence, but also the importance of them. One may be epistemically inferior if one has a lot of trivial and useless beliefs. See

Ultimately, my view deviates significantly from traditional epistemological views, regardless of whether it is categorized as encroachment or zetetic in nature.

4.2 The rational status of metareasoning

Granted that metareasoning's rational status matters to the credence's rational status, one may worry that we cannot talk about the rationality of metareasoning in the first place. The worry is as follows. If an agent always makes a personal level cost-benefit analysis according to the principle of maximizing utility, she also needs to reason about how to reason about the allocation of cognitive resources, reason about this meta-metareasoning, and so on. If she does not stop somewhere, cognitive resources can be drained by this infinite regress of reasoning about reasoning. Therefore, metareasoning is usually seen as bottoming out at a sub-conscious level or automatic process on pain of infinite regress (Boureau et al., 2016). However, it is unclear whether automatic or sub-conscious processes are normatively evaluable because these processes are beyond our control.

All it takes to solve the problem of infinite regress, however, is for an agent to stop at a certain point. In fact, it is reasonable to think that people sometimes engage in metareasoning at a personal level. One can sometimes decide at the personal level whether one wants to spend more cognitive resources and try harder to perform certain tasks. I think we get this kind of experience all the time. We sometimes wonder at the personal level whether we should think harder or postpone making up our minds. In those cases, we can talk about whether that conscious decision is rational.

Moreover, even if it is true that metareasoning is unconscious and involuntary, there can also be unconscious and involuntary belief formation which is less controversially taken to be

McCormick (2016). However, even if one rejects this assumption, it still involves a practical question how one can acquire as many true beliefs and few false beliefs as possible.

rationally evaluable. Imagine I believe that the best way to get from downtown Atlanta to Doraville is by taking the Gold Line. It is possible that I form a belief, not knowing which base belief or memory I draw upon. I simply know Atlanta's transit system too well. This belief can also simply pop into my head without my controlling the process as soon as I am asked how to get to Doraville. Despite lack of consciousness and control, it seems that my belief about Atlanta can be evaluated.

More positively, metareasoning learns from one's experience and environment, meaning that it is potentially reason responsive. Some psychological theories about metareasoning propose that the brain selects from various approximate computational strategies based on learning the practical effectiveness of specific strategies in particular situations with different contextual features (e.g., Payne et al., 1988; Lieder & Griffiths, 2015). At the input side of the learning mechanism is the perception of tasks and contextual features and the past costs and benefits of each strategy. Recently, Jenkin (2022) defends the epistemic evaluability of perception based on the phenomenon of perceptual learning, which she takes to be evident of perception's reason-responsiveness. Similarly, I think it is possible that metareasoning's learning component is indicative of its rational evaluability.

Finally, even if it is true that metareasoning is not normatively evaluable, the possibility that metareasoning modulates the parameters in the second stage process can inform us how to evaluate these parameters. For my purpose, how these parameters are evaluated can still matter for epistemic rationality. In the case of credal formation processes, it is plausible that given that parameters are partly selected pragmatically by metareasoning, we should evaluate them at least partly in terms of practical considerations. Credal encroachment still obtains because, given the

same parameters and the resulting credence, these parameters' rational status may differ given different practical factors, and they can subsequently affect the rational status of the credence.

4.3 The double-counting objection,¹⁹ or why do we need shift doxastic states?

From a decision theory perspective, credal encroachment is rejected on the grounds that it is not motivated and seems unnecessary. There are two components in standard decision theory: the utility function of the possible outcomes and the credence function of those outcomes. A rational decision maximizes the expected utility calculated from these two functions. Now, recall that the stakes are high with regard to whether the bank will be open on Saturday in HIGH. If Hannah's credence that the bank will be open on Saturday is not 1, which means that she is not certain, the stakes will get their due weight in the utility function and be reflected in the expected utility calculus. If the stakes are high enough, the disutility of coming back on Saturday will be so high that Hannah should just join the line, regardless of her having a lower credence in the proposition. There is no need for these stakes to make any difference in the credence Hannah ought to have. To further consider these stakes on the credence side risks double-counting the stakes in a decision matrix.

Note that this line of thought per se is not so much an objection to the view as an argument showing that standard decision theory does not motivate credal encroachment. The expected utility is commonly calculated by weighing the utility function with the agent's actual credence function, instead of the credence function most supported by her evidence or the credence function she is most rational in having. Even if it happens to be the case that our rational credence is sensitive to practical factors, double-counting the stakes does not undermine one's

¹⁹ I take the name "double-counting" from Worsnip (2021). See also Schroeder (2018) for a similar worry.

rationality from the perspective of decision theory, so there is nothing worrisome as to whether Hannah is rational in her actions or doxastic states.

A double-counting case might reflect exactly how the perceived stakes rationally affect metareasoning and credence. Stakes are “double-counted” only because the stakes affect not only the utility function in the decision about what to do next but also the utility function in the metareasoning process of “deciding” how to believe. When the stakes of having an inaccurate credence about whether the bank is open on Saturday are high, they might rationalize the use of a cognitively more taxing credal formation process, which may result in a credence with better accuracy. The benefit coming from a more accurate credence is independent of the utility function that represents one’s practical interests.

Consider HIGH again. When the stakes are high, perceived stakes can have two downstream consequences. It updates Hannah’s utility function such that the disutility of coming back on Saturday is high. Moreover, if Hannah needs to form a credence on the issue before deciding, then it might seem rational for her to employ a more cognitively demanding way to form credence. Therefore, in this case, double-counting also reflects the perceived stakes’ influence on metareasoning.

4.4 Diachronic Dutch book objection

Another worry against credal encroachment is a version of the diachronic Dutch book argument (Greco, 2013; Rubin, 2015; Schroeder, 2018). Dutch-bookability is usually seen as the hallmark of irrationality. It is particularly worrisome because it applies to virtually any views in which some epistemological notion is sensitive to practical factors (Beddor, 2021). I illustrate how the two-stage model can partly deal with it in the case of credal encroachment.

Consider how credal encroachment can make one susceptible to a diachronic Dutch book.²⁰ A clever bookie can offer Hannah a series of bets, each of which seems fair and rational to take from her perspective. However, these bets together exploit her to let her keep losing money with her same initial endowment. Suppose Hannah in HIGH eventually makes the deposit on Friday, and the bookie approaches Hannah in HIGH both before and after she deposits the paycheck. Before she deposits her paycheck, suppose that Hannah's credence on the proposition that the bank will be open on Saturday is x . She therefore finds it fair and rational in accepting the bookie's first bet: Hannah pays $\$1-x$ for a bet on Friday, which pays out $\$1$ if the bank is open on Saturday and $\$0$ otherwise. After the deposit, however, because now the stakes of defaulting disappear and hence the practical factor at issue changes, her credence increases by y ($1-x > y > 0$) on Friday. She is then rational in paying $\$x + y$ for another bookie's bet, which pays out $\$1$ if the bank is closed on Saturday and $\$0$ otherwise. However, taking both bets guarantees that Hannah loses $\$y$ to the bookie.

One of the solutions to a similar challenge on belief by Schroeder (2018) is that diachronic constraints on rational belief can forbid unstable beliefs in response to practical factors over time. The stakes only affect what belief is rational to have at a particular time, but they do not necessarily affect the rationality of how belief is kept over time. For example, a diachronic constraint on belief may dictate that Hannah on Friday is rational in not believing that the bank will be open on Saturday when the stakes are high, but she can also be rationally required not to *change* her belief after the stakes go down.

²⁰ The example is adopted from Schroeder (2018)

I think this strategy is available to credal encroachment as well, especially given that it coheres well with the role of initiation by metareasoning. Insofar as one thinks metareasoning can be rationally assessed, the following principle seems plausible:

Rational Initiation: One is rational in initiating a credal formation process only if the benefits outweigh the cognitive costs of the process.

At first glance, this principle saves credal encroachment from the challenge. Shifting stakes do not always warrant rational initiation of a credal formation process, especially when the perceived stakes do not outweigh the cognitive cost of the process. After Hannah deposits her paycheck, there is not much benefit in reconsidering whether the bank will be open on Saturday as her stakes go down dramatically. Nothing much hinges on her having accurate credence about the proposition. Hannah is therefore rational in not initiating a credal formation process after she deposits the paycheck because whether her credence that the bank will be open on Saturday is more or less accurate provides no benefit anymore, given that her risk of defaulting disappears. Thus, she will be rational in preserving her previous credence level x and reject the bookie's second bet, avoiding being Dutch-booked.

This principle raises another concern regarding Dutch-bookability. If the bookie is not only clever but also well informed about Hannah's psychology, she may know that offering Hannah the second bet after she deposits the paycheck will not make her reconsider her credence, simply because there is no incentive to do so, given the principle of rational initiation. To Dutch-book Hannah, the bookie needs to make an additional offer: if Hannah reconsiders her belief about the bank being open on Saturday, she will earn $\$z$, where $\$z$ is weighted to be greater than the cost of reconsideration by Hannah, but factually smaller than $\$y$. In accordance with the principle, Hannah may find it rational to reconsider, leading to a shift in her credence,

and accepting the second bet. In this scenario, she is guaranteed to lose $\$y-z$ to the bookie, despite accepting three offers that appear reasonable and rational. How should we address this variation?

The consideration of metareasoning shows that it is not always rational to modify one's credence in response to practical considerations, even if it may be rational in some instances. It is incorrect to assume that reconsidering one's credence always leads to a change in one's credence. For instance, consider the scenario where $\$z$ is perceived to be smaller than the stakes of failing a deposit. In this case, while $\$z$ may justify a reconsideration of her credence, it may not necessitate any change in Hannah's initial strategy. This is so because a smaller benefit does not seem to warrant an increased allocation of cognitive resources, let alone a different cognitive strategy.

Although metareasoning provides justification for adopting an encroachment view, the two-stage model can still retain some evidentialist intuitions. The thought is as follows. Even if it is true that Hannah is rational in reconsidering her credence about the bank being open on Saturday, there are two related limits to what credence she can ultimately form. First, obviously, she has a finite amount of cognitive resources that she can use at most. It is indeed rational for her to spend more cognitive resources when the overall benefit of spending them increases but this is not to say that the allocated resources can increase infinitely. After a certain threshold of benefits, it is reasonable to think that cognitive resources cease to increase with the benefits. Second, there is also a limit to the body of evidence Hannah has. It can be argued that in a two-stage model the marginal utility of applying additional cognitive resources is capped by the body of evidence. While it is true that Hannah can allocate more cognitive resources in a rational way, this again does not always lead to a change in rational credence. This is so because the evidential

support the body of evidence is capable of providing is limited; and after a certain threshold of cognitive resources, additional cognitive resources cannot make the body of evidence provide additional evidential support. As a result, the lack of additional evidential support may make it irrational to change one's credence.

Despite the above two observations, it cannot be entirely ruled out that Hannah may be Dutch-booked. However, it significantly narrows down the scope in which this is possible. Even if Hannah can be Dutch-booked, it is not the case that she will keep losing money. Her Dutch-bookability will stop at certain point because of the limitations mentioned above. Hopefully, this helps to mitigate the concerns regarding Dutch-bookability at least.

5 CONCLUSION

I have presented a two-stage model of credence based on an approach in empirical research and showed that it leads to credal encroachment. I have argued that by positing the metareasoning process in addition to credal formation processes, practical factors can play a role in epistemic rationality. I conclude this paper by briefly discussing Nagel (2008, 2010), who employs a similar line of empirical research to argue for purism. Although I cannot arbitrate which view is better here, I want to flag the difference between our views and put a wager on mine by giving some preliminary support. The upshot is that metareasoning and the mechanism for human adaptivity might play a more independent role in our normative assessment of doxastic states.

Nagel rejects pragmatic encroachment on knowledge and defends a version of purism of knowledge ascription. Specifically, drawing heavily from the empirical research on human judgment and decision-making, she argues that perceived practical factors can affect the presence of belief by inducing certain psychological effects. For example, Nagel (2010) examines how epistemic anxiety, the metacognitive signal generated by a mechanism that regulates cognitive effort (e.g., engaging with more evidence-seeking activities, employing more cognitively costly processes of assessing evidence), plays a role in belief formation. Epistemic anxiety is sensitive to perceived practical factors. For example, when the perceived stakes are high, epistemic anxiety normally rises and becomes harder to satisfy. Because belief requires the satisfaction of epistemic anxiety or overshadowing of that anxiety with other desires or dispositions, belief is harder to obtain when epistemic anxiety is high.

In an important sense, epistemic anxiety is analogous to the metareasoning process I am proposing here. Both are relevant in determining the allocation of cognitive resources, and both

function by an approximated cost-benefit analysis. However, Nagel provides an error theory for our intuition in cases like HIGH and LOW.²¹ Normally when we experience high epistemic anxiety, we respond by allocating more cognitive resources. However, some rationality-compromising factors such as haste or wishful thinking can distract or undermine that anxiety to enable us to form belief prematurely by curtailing our cognitive effort. We naturally apply this pattern to HIGH and LOW and infer that when Hannah with high epistemic anxiety fails to increase her cognitive efforts, she suffers from interfering conditions such as haste or wishful thinking. As a result, if Hannah in HIGH believes that the bank will be open on Saturday, she will be judged to suffer from rationality-compromising factors and therefore less reliable in her belief formation than her low-stakes counterpart because these factors *also* lower the accuracy of her belief formation (Nagel, 2012). If Hannah in HIGH and LOW believe that the bank will be open on Saturday, they are not epistemically on par because of the perceived difference in their accuracy. As a result, we do not need pragmatic encroachment on epistemic rationality to explain the intuitive verdict that only Hannah in HIGH is irrational in holding that belief.

From a two-stage perspective, when the belief is stipulated in HIGH and LOW, however, the same verdict can still obtain, even if one judges Hannah to be equally accurate in HIGH and LOW. The thought is this: the so-called “rationality-compromising” factors affect Hannah’s epistemic anxiety even without affecting her belief-formation process. Hannah in LOW and HIGH can effectively employ the same belief-formation process with equal accuracy and reliability at the second stage, but Hannah in HIGH fails to employ a cognitively more demanding belief-formation process such that she ends with the same attitude as her counterpart.

²¹ While Nagel focuses on knowledge, her point is still pertinent to epistemic rationality, and hence relevant to my discussion. In Nagel (2012), she claims that distraction and time pressure can also compromise one’s rationality of cognitive effort and affect one’s belief-formation processes. In what follows, I will discuss her account in terms of epistemic rationality.

She is irrational in virtue of her having an irrational degree of epistemic anxiety and selects an inappropriate process to form belief. That Hannah's epistemic anxiety is shadowed for practical considerations (e.g., short of time for deliberation) may be sufficient to lead to the intuition that Hannah's belief is irrational. And this would be a case of pragmatic encroachment.²²

I don't have a stance with certainty as to which view is superior, but my credence in mine is higher. While there is no direct evidence, some consideration from the neighboring field in free will and moral responsibility, which also concerns normativity, might help. On some moral views with which I sympathize, a decision of how to make moral decisions matters to the moral assessment of the decision-maker (Strawson, 1974; Smith, 2003; Shadlen and Roskies, 2012). Shadlen and Roskies (2012), for example, define what they call "policies" as the "high-level heuristics that affect the parameters of decision-making and can be modulated in a context-dependent way" (note this is similar to metareasoning and epistemic anxiety). They claim that these policies play an important role in the assessment of moral responsibility, independently of the decision-making processes. Consider the following example they provide in support of their view. Two doctors with the same policy diagnosed two patients. Their policy favored the decision process that values accuracy over speed. Doctor A made a correct diagnosis and saved the patient, whose conditions allowed more decision time; Doctor B used the same policy but failed "to act in time to stanch the bleeding of his patient." Shadlen and Roskies claim that our moral judgment is that although both doctors had the same policy and the same decision process, they differed in their moral status because Doctor B chose an inappropriate policy in the context that allows little time to decide. They conclude that whether the application of the policy is

²² The alternative explanation I explore here resembles the criticism of Nagel suggested by Sripada and Stanley (2012), although here I sharpen the case by presenting it in the two-stage framework.

appropriate in a particular circumstance is important to our moral assessment, independently of the actual decision outcomes and decision processes.

I think their study provides a *prima facie* reason for favoring my interpretation: irrationality in metareasoning and epistemic anxiety bears independently on the epistemic rationality of doxastic states. In Shadlen and Roskies' view, meta-level policies carry normative weight. A plausible generalization of their study is that our normative assessment of the epistemic status also sometimes takes into consideration whether at the meta-level we are rational. Whereas Nagel seems to believe that people judge Hannah as irrational in holding the belief because the factors that irrationally shadow her epistemic anxiety are inferred to lower the accuracy of her belief-formation process, it is possible that mere irrationality at the meta-level (e.g., irrational metareasoning processes, inappropriately low epistemic anxiety, etc.) alone is sufficient to explain why we think Hannah in HIGH is irrational.

The crux of the matter, of course, is to figure out whether these meta-level processes (i.e., policies, metareasoning, metacognitive signals such as epistemic anxiety, etc.) really play an independent role in assessing the epistemic status of our doxastic states. One possible future direction is to test our intuitions in some hypothetical cases that resemble those presented in Shadlen and Roskies (2012) but involve doxastic states. We can ask whether a protagonist's belief or credence is rational when her higher-level processes are judged to be inappropriate in a certain circumstance.

In summary, I am more sympathetic to the moral view I discussed above. I also find the generalization quite plausible that just like moral judgment, the assessment of epistemic rationality also takes into consideration of metareasoning. Therefore, while the empirical jury is still out, I have a higher credence in my view.

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