PHILOSOPHICAL TOPICS
VOL. 49, NO. 2, FALL 2021

Hybrid Impermissivism and the Diachronic Coordination Problem

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ABSTRACT. Uniqueness is the view that a body of evidence justifies a unique doxastic attitude toward any given proposition. Contemporary defenses and criticisms of Uniqueness are generally indifferent to whether we formulate the view in terms of the coarse-grained attitude of belief or the fine-grained attitude of credence. This paper articulates and discusses a hybrid view I call Hybrid Impermissivism that endorses Uniqueness about belief but rejects Uniqueness about credence. While Hybrid Impermissivism is an attractive position in several respects, I show that it faces a special problem, the diachronic coordination problem, which has to do with coordinating an agent's beliefs and credences over time. I argue that the problem is fatal for Hybrid Impermissivism. I also formulate a logically weaker version of Hybrid Impermissivism which avoids the diachronic coordination problem, but under substantive assumptions about rational credence.

1. INTRODUCTION

Suppose you have a body of evidence that is relevant to whether a proposition, *H*, is true. You evaluate the evidence and form a justified belief that *H*. But, could this evidence justify any other doxastic attitude toward *H*? According to the *Uniqueness* thesis, the answer is "No," as there is always one, unique rational response to any evidence.

Several authors (e.g., Jackson 2019, 2021; Kelly 2010, 2014; Stapleford 2019) have noted that the intuitive appeal of Uniqueness is sensitive to which attitude-type we are focusing on: (categorical, qualitative) belief or (numerical) credence. For instance, Kelly (2014, 300), who is a permissivist (i.e., he endorses the negation of Uniqueness, which is called *Permissivism*), notes that:

> To my mind, Uniqueness seems most plausible when we think about belief in a maximally coarse-grained way, so that there are only three options with respect to a given proposition that one has considered: belief, disbelief, or suspension of judgment. On the other hand, as we begin to think about belief in an increasingly fine-grained way, the more counterintuitive Uniqueness becomes . . . as one cuts up the psychology more and more finely, Uniqueness looks increasingly counterintuitive.

Kelly's thought is shared by Stapleford (2019), who is an impermissivist (i.e., he endorses Uniqueness). As he (ibid., 342) writes:

> Uniqueness seems very intuitive to me—almost obviously right. So what am I missing? Why would anyone deny Uniqueness? It loses some of its luster when you start thinking in terms of fine distinctions. . . . So there's definitely something going for permissivism, especially the moderate form.

The problem with Uniqueness that Kelly and Stapleford emphasize is that, if we think about doxastic attitudes in terms of the fine-grained attitude of credence, then it seems that the evidence does not always fix a unique doxastic attitude toward any given proposition. After all, it is hard to believe that in every evidential situation, there is always a unique credence, say, a credence of 0.623491, toward a proposition; and "any slight deviation . . . [from this credence] counts as a deviation from perfect rationality" (Kelly 2014, 300). For instance, suppose that the only evidence you have on whether it will rain in the next few hours is the qualitative perceptual evidence that the sky above you is mostly blue, with a few clouds scattered here and there. Does such evidence of blue sky fix a unique credence in the proposition that it will rain? It is hard to believe that it does. Certainly, you may be quite confident—say, 90 percent confident—that it won't rain, based on the evidence. But slightly more or slightly less confidence seems just as rational.[1]

So, it is undeniable that the intuitive appeal of Uniqueness is sensitive to which attitude-type we are focusing on: belief or credence. Surprisingly, however, no one has provided a detailed, in-depth analysis or defense of a *hybrid posi-*

1. Even contemporary *objective Bayesians* like Williamson accept a *version* of Credal Permissivism. As Williamson (2010) has explicitly noted, his brand of objective Bayesianism in some cases allows subjective, arbitrary factors to influence how strongly an agent believes a proposition.

tion within the debate: that is, a position that combines Uniqueness about one attitude-type with Permissivism about another attitude-type.[2] The paper aims to fill this gap by analyzing and evaluating the prospects of the view I call *Hybrid Impermissivism* (HI) that combines Uniqueness about belief with Permissivism about credence.

Overall, two main results are reached in this paper. First, I identify a general problem for HI. Briefly put, the problem is about how to coordinate an agent's beliefs and credences over time in a way that preserves the required combination of Uniqueness and Permissivism. As I show, two equally informed and rational agents who have the same relevant beliefs and similar but non-identical credences may adopt different beliefs upon learning new information. I call this the *diachronic coordination problem* (the coordination problem, for short). I argue that the coordination problem is fatal for HI.

And second, I state a logically weaker version of HI, *Moderate Hybrid Impermissivism* (MHI), that combines a weaker version of Belief Uniqueness (which is consistent with evidence permitting both believing *H* and suspending judgment on *H*) with Credal Permissivism. I show that MHI avoids the diachronic coordination problem but under substantive assumptions about rational credence. I conclude that only the moderate hybrid positions can avoid the coordination problem.

The paper proceeds as follows. Section 2 discusses some preliminaries regarding the hybrid approach to the Uniqueness debate. Section 3 states and discusses the coordination problem for HI. First, I state the coordination problem in a relatively informal setting, and then, in section 3.1, in a more formal setting. Section 4 considers a weaker version of HI, MHI, and shows that it can avoid the coordination problem. Section 5 concludes.

2. BELIEF, CREDENCE, AND UNIQUENESS

Uniqueness comes in different forms.[3] In this paper, we are concerned with the differences among the Uniqueness theses that correspond to different doxastic attitude-types. It is useful to categorize doxastic attitudes into two types:

(1) Categorical or nongraded doxastic attitudes.

(2) Graded doxastic attitudes.

2. Jackson (2019, sec. 2) has stressed the importance of specifying the attitude-type when discussing the issues about Uniqueness. However, she has not provided a detailed examination or defense of a hybrid position.

3. For a review of different versions of Uniqueness and Permissivism, see Titelbaum and Kopec (2016) and Jackson (2021).

Much of traditional epistemology is concerned with the categorical doxastic attitude, simply called "belief."[4] Belief comes in just three types: one can either believe a proposition, disbelieve it, or suspend judgment. So, with respect to the traditional belief-attitude, we have the following version of Uniqueness that I call *Belief Uniqueness:*

> Belief Uniqueness: Given any body of evidence, *E*, and proposition, *H*, there is a unique belief-attitude (either belief, disbelief, or suspension), that any agent should adopt toward *H*.

By contrast, some of the most significant work in contemporary epistemology is centered on graded belief or degree of belief. The best-known formal model of degree of belief is the Bayesian model, according to which rational degrees of belief are numerically graded and have the structure of mathematical probabilities. I will call the Bayesian conception of degree of belief *credence*. The Bayesian model recognizes infinitely many credal attitudes toward a proposition, where each credal attitude is represented by a real number in the unit interval. The credence of 0 represents the minimal confidence, while 1 represents the maximal confidence.

So, with respect to the (Bayesian) credal-attitude, we have the following version of Uniqueness that I call *Credal Uniqueness*:

> Credal Uniqueness: Given any body of evidence, *E*, and proposition, *H*, there is a unique credence that any agent should have toward *H*.

All the currently discussed versions of Uniqueness are varieties of either Belief Uniqueness or Credal Uniqueness. The negation of Belief Uniqueness is called *Belief Permissivism*, and the negation of Credal Uniqueness—*Credal Permissivism*. Belief and Credal Permissivism make existential claims: according to these theses, some body of evidence is such that it justifies more than one belief/credence in a proposition.

Belief Uniqueness and Credal Uniqueness do not imply each other; the same is true about Belief Permissivism and Credal Permissivism. For instance, assume that Belief Uniqueness is true: that is, evidence *E* always justifies a unique belief-attitude toward a proposition, *H*. But the same evidence *E* can *permit* a range of different credences toward H. As Jackson (2019, 2481) correctly points out: "The evidence could allow one to believe *H* and have a credence of 0.8 or to believe *H* and have a credence of 0.9, but not allow for withholding belief or belief that not-*H*."[5] Therefore, an argument for Belief Uniqueness, if successful, may not establish Credal Uniqueness.

The converse is also true. Even if we have good reasons for thinking that Credal Uniqueness is true, these reasons may not establish Belief Uniqueness. For

4. I will also often use the term "belief" to denote this categorical, coarse-grained doxastic attitude. Although, sometimes, I will use the same term "belief" as an umbrella term to talk about doxastic attitudes in general. In most cases, context will disambiguate in which sense the term is used. When appropriate, I'll use the modifiers like "qualitative" or "categorical" to emphasize that we are speaking about beliefs in the traditional sense.

5. In all quoted passages, the notation is adapted for uniformity.

instance, suppose we have good reasons to think that an agent's evidence uniquely determines her credences. Still, we may think that whether an agent should outright believe a proposition depends on some non-evidential factors, such as the agent's epistemic goals and interests. Hence, it is possible to argue for Credal Uniqueness without also arguing for Belief Uniqueness.

I call a view that combines Uniqueness with respect to one attitude-type and Permissivism with respect to some other attitude-type a *hybrid view*. There are two possible hybrid views concerning the attitudes of belief and credence: the view that combines Belief Uniqueness with Credal Permissivism and the view that combines Belief Permissivism with Credal Uniqueness.

The combination of Belief Permissivism and Credal Uniqueness is a coherent but very implausible position (as discussed in the introduction, most agree with Kelly [2010, 121] that Credal Uniqueness "is an extremely strong and unobvious claim"). This paper will focus on the most appealing hybrid position: the combination of Belief Uniqueness and Credal Permissivism, which I label *Hybrid Impermissivism* (HI).[6] As discussed in the introduction, it is quite plausible to think that evidence fixes a unique coarse-grained attitude toward any proposition but permits more than one credal attitude. For instance, as there are overwhelming bodies of evidence that support the anthropogenic global warming hypothesis, the only rational response to the evidence is to believe the hypothesis. However, there seems to be no unique credence that the evidence justifies toward the hypothesis.[7]

As most serious worries with impermissivism have to do with Credal Uniqueness, by rejecting it, HI avoids some of the standard objections against impermissivism. For instance, take what Stapleford (2019) calls the problem of *fine distinctions*. The worry is that, if Credal Uniqueness is true, then even in messy and complicated evidential situations, evidence justifies a unique credence, say, a credence of 0.623491, toward a proposition; and in such cases, "any slight deviation . . .

6. HI contains both a version of Uniqueness and a version of Permissivism, but the view is closer to the impermissivist end of the spectrum than to the permissivist end. Plausibly, Belief Uniqueness imposes certain constraints on a range of credences that is permissible to adopt toward a proposition. For instance, most accept that, if an agent is rational to believe *H*, then she cannot rationally have a low credence (lower than 0.5) in that proposition. For this reason, it seems more appropriate to categorize this hybrid view as an impermissivist view (though, nothing important hangs on which label we adopt, of course).

7. It also seems equally implausible that there is some unique *range* with sharp upper and lower bounds such that all equally informed people should adopt this credal range toward the anthropogenic global warming hypothesis. After all, if one is reluctant to accept that evidence always justifies a hyper-precise, point-valued credence toward a proposition, then why should one accept that evidence justifies a hyper-precise credal range? So, contrary to Kelly (2014), I do not think that Credal Uniqueness is more plausible within the framework of *imprecise probabilities*, where an agent's credal states are represented by a *set* of probability functions, instead of a *single* probability function. I'm happy to grant that the imprecise probability framework can provide a better model for representing an agent's doxastic states. But I do not see why Credal Uniqueness is any more plausible if instead of point-valued probabilities, it requires that any given evidence justifies a unique credal range. See also Castro and Hart (2019) for a criticism of, what they call, *imprecise impermissivism*.

[from this credence] counts as a deviation from perfect rationality" (Kelly 2014, 300). And this seems implausible. But as HI rejects Credal Uniqueness, it is not open to this objection from fine distinctions.

Unfortunately, HI runs into a problem once we start looking at the view from the *diachronic* point of view; that is, once we look at how an agent's beliefs and credences change over time, due to learning new information.

3. THE COORDINATION PROBLEM FOR HYBRID IMPERMISSIVISM

In this section, I present a problem for HI, which I call the (diachronic) coordination problem. The problem is that Belief Uniqueness and Credal Permissivism are in tension once we look at how doxastic attitudes change over time: two agents who have the same beliefs but different (though similar) credences can learn the same new information that requires them to adopt different beliefs.

To explain this problem, we need to specify how belief and credence should interact. Fortunately, the presented problem with HI does not presuppose a specific view about their interaction. This being said, for the sake of simplicity and convenience, this section assumes the following weak version of the well-known *Lockean thesis*:

> The weak Lockean thesis: An agent's beliefs and credences should be such that, there is some threshold r, $0.5 < r \leq 1$, and for any proposition H believed by the agent, the agent's credence in H is greater than or equal to r.

Some clarifications are in order. The weak Lockean thesis (which has been endorsed by Leitgeb 2014, 2017) does not entail that there is one universally correct Lockean threshold for every agent and context of reasoning; rather, it permits an agent's Lockean threshold to change, depending on her evidential situation or other agent-relative factors. So, we can choose a Lockean threshold on a case-by-case basis, in a way that no plausible norm of rationality is violated.[8] In any case, the argument I present against HI goes through no matter how we choose the relevant Lockean threshold.

In section 4, I will also state the same coordination problem for HI by using Leitgeb's precise, systematic theory of belief-credence interaction, the stability

8. The weak Lockean thesis contrasts with the *strong Lockean thesis*: the view that there exists one, unique Lockean threshold r that relates belief and credence for all agents in all cases. Overall, the choice between these two versions of the Lockean thesis is inconsequential to my main argument. This said, the weak Lockean thesis is a weaker and more plausible view. (For instance, it is well-known that, for any choice of $r < 1$, the strong Lockean thesis, unlike the weak Lockean thesis, gives rise to the *Lottery Paradox*.) Hence, the case against HI that I presented is stronger if we use this weaker and more plausible thesis that permits taking into account the characteristics of a given evidential situation in choosing the Lockean threshold.

theory (2014, 2017). The coordination problem can also be stated using the main alternative to Leitgeb's theory, Lin and Kelly's *tracking theory* (2012).[9] So, the identified problem for HI is quite general and does not presuppose a specific view about how belief and credence ought to interact.

First, I will illustrate the coordination problem for HI by considering an example related to the hotly debated topic of cosmological fine-tuning. After discussing this example, I'll state the coordination problem within a more formal setting (in section 3.1), where we assume complete probability distributions over a set of propositions.

So, here is the example:

FINE-TUNING

Cathy and Julien are colleagues who often discuss various topics in philosophy and religion. On Monday, they had a lengthy discussion about the existence of God. They both concluded that, on the available evidence, it is rational to believe that the God of traditional theism does not exist. Now, while their categorical attitudes about God's existence are the same, Julien is more confident that God does not exist than Cathy. Their levels of confidence can be represented as follows, where "God" denotes the proposition that God exists:

$$P_{Cathy}(God) = 0.1$$

$$P_{Julien}(God) = 0.02$$

On Sunday, Cathy and Julien meet each other again to discuss a recent paper about the fine-tuning argument for the existence of God. The paper argues that the new evidence that the so-called cosmological constants are finely tuned supports the hypothesis that God exists.[10] Somehow, both Cathy and Julien are convinced that fine-tuning provides strong evidence for God. The paper estimates that the fine-tuning data is approximately 25 times more likely on the supposition that God exists than on the supposition that God does not exist.[11] In symbols:

$$\frac{P(FT|God)}{P(FT|\neg God)} = 25$$

Cathy and Julien think that this estimate is correct.

9. I find the stability theory easier to explain than the tracking theory; hence, I present my result using the stability theory.

10. Roughly, the fine-tuning argument appeals to relatively new evidence from physics: that the existence of life in our universe seems to depend on very precise values of the so-called fundamental constants of physics. Some think that this fine-tuning evidence speaks in favor of God (who fine-tuned these parameters for life).

11. See Hawthorne and Isaacs (2018, 161) for a discussion on estimating the relevant likelihood ratio. It is utterly inconsequential whether the likelihood ratio estimate is correct. The example is taken for illustrative purpose only.

Now, suppose that on Monday, Cathy and Julien are rational in believing that God does not exist. Further, suppose that their corresponding credences are also rational. For simplicity, let's assume that their beliefs and credences are related via a Lockean threshold of 0.6 (but, as I explain shortly, the choice of this threshold is inconsequential to my overall argument). So, it is rational for Cathy and Julien to have the following combinations of beliefs and credences:

On Monday: $Bel_{Cathy}(\neg God)$ *and* $P_{Cathy}(God) = 0.1$
$Bel_{Julien}(\neg God)$ *and* $P_{Julien}(God) = 0.02$

Now, let's suppose that after they receive and analyze the new evidence on Sunday, Cathy and Julien are rational to believe that fine-tuning is approximately 25 times more likely on the supposition that God exists than on the supposition that God does not exist. Probabilities of the form P(*evidence* | *hypothesis*) are called *likelihoods*. So, Cathy and Julien are rational in believing that the ratio of likelihoods is approximately 25. Now, there is a theorem of probability calculus that enables us to calculate the ratio of posterior probabilities, given the ratio of likelihoods and the ratio of priors. The theorem is usually called the *ratio form of Bayes' theorem*:

$$\frac{P(H|E)}{P(\neg H|E)} = \frac{P(E|H)}{P(E|\neg H)} * \frac{P(H)}{P(\neg H)}$$

If we let R_{Post} be the ratio of *posteriors*, R_L the ratio of *likelihoods*, and R_{Prior} the ratio of *priors*, then the theorem can be summarized succinctly as:

$$R_{Post} = R_L * R_{Prior}$$

Now, in the fine-tuning example, we know the corresponding values of R_L and R_{Prior} for Cathy and Julien. And the simple calculations show that, upon learning the new information about fine-tuning (denoted as "*FT*"), Cathy's and Julien's posteriors in God's existence should be:

$$P_{Cathy}(God|FT) \approx 0.73$$
$$P_{Julien}(God|FT) \approx 0.34$$

And via a Lockean threshold of 0.6, we conclude that $Bel_{Cathy}(God)$ and $Bel_{Julien}(\neg God)$. So, even if Cathy's and Julien's relevant beliefs are the same on Monday, and even if they receive the same evidence which they interpret in the same way, their corresponding beliefs on Sunday are conflicting. To summerize their beliefs:

On Monday: $Bel_{Cathy}(\neg God)$ *and* $P_{Cathy}(God) = 0.1$
$Bel_{Julien}(\neg God)$ *and* $P_{Julien}(God) = 0.02$

On Sunday: $Bel_{Cathy}(God)$ *and* $P_{Cathy}(God) \approx 0.73$
$Bel_{Julien}(\neg God)$ *and* $P_{Julien}(God) \approx 0.34$

What this example shows is that, even if two agents are rational in their beliefs and credences, and even if they receive the same body of evidence which they interpret in exactly the same way, their newly formed beliefs may still be different.

This is a serious problem for our hybrid theory, HI. The assumptions that we've made about Cathy's and Julien's doxastic states on Monday are reasonable and do not contradict any postulates of HI. Cathy and Julien start with the same categorical beliefs; their credences and beliefs are related via the (weak) Lockean thesis. However, upon learning the new information, their categorical beliefs are mutually inconsistent: Cathy believes that God exists, while Julien retains his old belief that God does not exist. So, as it stands, two fully rational individuals who do not violate any postulates of HI can come to violate Belief Uniqueness after learning new information.

In the above example, we have assumed that Cathy and Julien's Lockean thresholds are relatively low, 0.6. But this assumption is inessential. We can easily show that, no matter how we specify the Lockean threshold r (or if we specify different thresholds r for different agents), if two agents have different credences toward a proposition, then it is always possible for them to learn some new information that would require one agent to believe a proposition and the other agent—to disbelieve or suspend judgment about the proposition. For instance, suppose that Cathy's and Julien's Lockean thresholds are quite high, say, $r = 0.9$. By algebra, for any proposition H:

$$P(H) > 0.9 \textit{ iff } \frac{P(H)}{P(\neg H)} > 9$$

Now, if Cathy's and Julien's credence functions P_{Cathy} and P_{Julien} are not identical, then there is some value of R_L such that:

$$\frac{P_{Cathy}(H)}{P_{Cathy}(\neg H)} * \mathrm{R}_L \geq 9$$

$$\frac{P_{Julien}(H)}{P_{Julien}(\neg H)} * \mathrm{R}_L < 9$$

Therefore, to guarantee that Cathy and Julien won't adopt different doxastic attitudes toward H, we need to assume that they have identical credences toward H. And this assumption directly contradicts Credal Permissivism.

So, the considered fine-tuning example illustrates a general point: when we start to look at HI from the diachronic point of view, the two principles of HI, Belief Uniqueness and Credal Permissivism, are in tension.

How can we respond to this? One simple defense of HI is as follows:

> In the fine-tuning example, Cathy or Julien are rationally required to *change* their old Lockean thresholds. So, for instance, if their new Lockean threshold is 0.8, instead of 0.6, then both of them would be rationally required to suspend judgments on the existence of God.

This response is compatible with the weak Lockean thesis. But why should Cathy and Julien change their standards of categorical belief in this case? There seems to be no motivation behind this proposal, except shielding HI from the coordination problem. I should emphasize that there are cases where a change in an agent's Lockean threshold seems permissible, if not rationally required. For instance, if an agent's old Lockean threshold licenses her to adopt internally inconsistent beliefs, then the agent might well be required to revise this threshold. But in the fine-tuning example, there is no internal inconsistency in either Cathy's or Julien's beliefs. The conflict is entirely *interpersonal*: Cathy's belief in God conflicts with Julien's corresponding belief. Therefore, it is rather unconvincing to respond that Cathy should change her old standard of rational belief (i.e., her Lockean threshold) only because her new belief contradicts Julien's belief.

As I show next, the same coordination problem for HI can be illustrated within a more idealized setting where the agents' credence functions are fully specified. In this setting, we do not need to assume that the agents agree about the value of the ratio of likelihoods, R_L.

3.1. THE COORDINATION PROBLEM IN A FORMAL SETTING

First, I'll provide a well-known formal setting for representing and analyzing an agent's beliefs and credences. This setting will also be used in the next section.

Propositions—the objects of doxastic attitudes—are assumed to be sets of *possibilities* or *possible worlds*. More precisely, let $W = \{w_1, w_2, \ldots w_n\}$ be a finite set of mutually exclusive and jointly exhaustive possible worlds. Proposition X (over W) is the set of worlds in which X is true. For instance, X can be set $\{w_1, w_3, w_7\}$. Hence a proposition over W is nothing but a subset of W. On this approach, propositions fully inherit a *set-theoretic structure*. The conjunction, $X \wedge Y$, is understood as a set-theoretic intersection, $X \cap Y$. The disjunction, $X \vee Y$, is equivalent to the union, $X \cup Y$. While the negation, $\neg X$, is the *complement* of X with respect to W, $W \backslash X$. Any tautological proposition is equivalent to W and any contradictory proposition is equivalent to the empty set $\emptyset$.

The logical relationships between propositions are equivalent to the set-theoretic relationships. Propositions A and B are inconsistent iff they have an empty interaction: $A \cap B = \emptyset$. So, A and B are consistent iff they have a non-empty intersection: $A \cap B \neq \emptyset$. Proposition X entails proposition Y iff X is a subset of Y: $X \subseteq Y$. And, a proposition X is true at a world w iff $w \in X$.

We will be concerned with the agents who think in terms of a finite partitioning of possibilities, W (or a finite set of possible worlds). So we define both the agent's beliefs and credences with respect to some fixed W (I'll illustrate this with an example shortly).

An agent's categorical beliefs will be represented by *Bel*, which is a set of propositions. For any proposition X, X is believed iff $X \in Bel$. For convenience, I will write *Bel(X)* instead of $X \in Bel$. In this model, the attitude of disbelief in a proposition is identical to the attitude of belief in the *negation* of the proposition. So, disbelief in a proposition, X, is written as *Bel(¬X)*. Regarding the attitude of suspension: if neither *X* nor *¬X* is a member of *Bel*, then our agent suspends judgment on X.

An agent's credences will be represented by function *P*. We assume that *P* is a probability function. This assumption entails that, for any proposition *X*, *P(X)* is the sum of each $P(\{w_i\})$, where *X* is true at w_i. So, for instance, if *X* is true at worlds w_1 and w_7 only, then $P(X) = P(\{w_1\}) + P(\{w_7\})$.

Now, we can restate the coordination problem for HI within this setting. Consider set *W* of four possible worlds: $W = \{w_1, w_2, w_3, w_4\}$. We can think about these possible worlds as corresponding to all logical possibilities associated with the two propositions in our fine-tuning example:

> *God*: God exists.
>
> *FT*: Our universe is fine-tuned for life.

w_1 corresponds to $God \wedge FT$, w_2 to $God \wedge \neg FT$, w_3 to $\neg God \wedge FT$, and w_4 to $\neg God \wedge \neg FT$.

Now, let's define two probability distributions, P_1 and P_2 over *W*, represented by the table below:

Table 1

Possible worlds	P_1	P_2
w_1	$P_1(\{w_1\}) = 0.03$	$P_2(\{w_1\}) = 0.08$
w_2	$P_1(\{w_2\}) = 0.02$	$P_2(\{w_2\}) = 0.02$
w_3	$P_1(\{w_3\}) = 0.18$	$P_2(\{w_3\}) = 0.09$
w_4	$P_1(\{w_4\}) = 0.77$	$P_2(\{w_4\}) = 0.81$

As we see, God's existence is very improbable on these credence functions, $P_1(God) = 0.05$; $P_2(God) = 0.1$. And more than that, these credence functions are similar in other ways: on these credence functions w_4 is more probable than w_3, w_3 is more probable than w_1, and w_1 is more probable than w_2.[12]

Now, suppose that relative to these credence functions, we have a Lockean threshold of 0.7. In that case, we get the same belief set *Bel* relative to both P_1 and P_2, which contains $\{w_4\}$ and everything that follows from $\{w_4\}$: as on both of these credence functions, $\{w_4\}$ has a probability greater than 0.7, and, trivially, only propositions that follow from $\{w_4\}$ have a probability greater than 0.7.

12. There is a reason why I choose the credence functions that agree on the order of the probabilities of the worlds. We discuss this in the next section.

Now, suppose that we revise these credence functions with new information, *FT*, or $\{w_1, w_3\}$. That is, we assume that $\{w_1, w_3\}$ is true and calculate new credences in *God* via Bayes' theorem:[13]

$$P_1(God|FT) = \frac{P_1(God\ and\ FT)}{P_1(FT)} = \frac{P_1(\{w_1\})}{P_1(\{w_1, w_3\})} = \frac{0.03}{0.21} \approx 0.14$$

$$P_2(God|FT) = \frac{P_2(\{w_1\})}{P_2(\{w_1, w_3\})} = \frac{0.08}{0.17} \approx 0.47$$

So, while prior to receiving the new evidence *FT*, God's existence was very improbable on these credence functions, $P_1(God) = 0.05$; $P_1(God) = 0.1$, the new information changes what it is rational to believe relative to these credence functions. Given a Lockean threshold of 0.7, it is rational to believe $\neg God$ relative to P_1; but relative to P_2, it is rational to suspend judgment: as neither $P_2(God\ |FT)$ nor $P_2(\neg God\ |FT)$ reaches the probability of 0.7.

Now, in response to this example, one may think that if credence functions P_1 and P_2 were more similar, then this coordination problem could have been avoided. However, at the end of the next section, we will see that even under quite substantive constraints on P_1 and P_2, HI is still susceptible to the coordination problem.

4. MODERATE HYBRID IMPERMISSIVISM

A logically weaker version of HI that we shall consider substitutes Belief Uniqueness with the following thesis that I call *Moderate Uniqueness*:

> Moderate Uniqueness: Given any body of evidence, *E*, and proposition, *H*, it is not the case that *E* rationally permits belief that *H* and belief that $\neg H$.

Moderate Uniqueness is strictly logically weaker than Belief Uniqueness. Unlike the latter thesis, the former is consistent with the situation where evidence equally justifies both the attitude of belief and suspension of judgment toward a proposition.[14]

I call the combination of Moderate Uniqueness and Credal Permissivism *Moderate Hybrid Impermissivism* (MHI, for short). In this section, I show that MHI, unlike HI, can avoid the coordination problem, but under some substantive assumptions.

13. Here I assume the familiar principle of Conditionalization. This is just a simplifying, inessential assumption. The presented argument does not need to presuppose that the new information is learned for certain.

14. I consider Moderate Uniqueness as an impermissivist view. I think any substantive permissivist thesis should be consistent with evidential situations where belief and disbelief are equally justified on the evidence.

To show that MHI avoids the coordination problem, we need to use a precise, fully specific bridge principle between belief and credence. We will use Leitgeb's stability theory (2014, 2017) to understand the relationship between an agent's belief set *Bel* and her probability function *P*.

Fortunately, the stability theory can be simply explained by using Leitgeb's notion of a *stable proposition*:

> Stable Proposition (Definition): For any proposition X and credence function P over W, X is a stable proposition (relative to P) iff $P(X) = 1$ or for all worlds w_i where X is true, $P(\{w_i\}) > P(\neg X)$.

To put it simply, X is a stable proposition iff $P(X) = 1$ or each world in which X is true is more probable than $\neg X$. Let us illustrate this new definition with an example.

Consider again a set W of four possible worlds: $W = \{w_1, w_2, w_3, w_4\}$ and suppose we have the following probability distribution over each of these possibilities:

Table 2

Possible worlds	P
w_1	$P(\{w_1\}) = 0.03$
w_2	$P(\{w_2\}) = 0.02$
w_3	$P(\{w_3\}) = 0.18$
w_4	$P(\{w_4\}) = 0.77$

As it can be easily verified (by following the above definition), there are four different stable propositions over P: $\{w_4\}$, $\{w_3, w_4\}$, $\{w_1, w_3, w_4\}$, and W (the tautological proposition, which is stable by definition). As we see, the first stable proposition, $\{w_4\}$, is logically strongest as it entails all the other stable propositions. And, in general, given any probability distribution P (over finite W), there must be the first or strongest stable proposition relative to P.

Now given this definition, Leitgeb's theory can be stated as follows (for simplicity, I assume that each world in W has a non-zero probability):

> *The Stability Theory*: For an agent with belief set *Bel* and credence function P, $Bel(X)$ if and only if there is a stable proposition Y in *Bel* and $Y \subseteq X$.[15]

So, according to the stability theory, a rational agent's belief set *Bel* must include a stable proposition, such that everything that the agent believes follows deductively from this stable proposition. Following Leitgeb, we let "B_W" to denote the stable

15. If some worlds in W have zero probability, then we should add the following proviso to the stability theory: "If $P(Y) = 1$, then Y is the *least* proposition over W with the probability 1." But, in all our examples, we assume W to include only the worlds with non-zero probabilities.

proposition that entails each and every belief of the agent. B_W is the least (or the strongest) proposition believed by the agent.

To illustrate the stability theory, let's consider the probability distribution in Table 2. Given the stability theory, there are four choices for the least believed proposition, B_W: $\{w_4\}$, $\{w_3, w_4\}$, $\{w_1, w_3, w_4\}$, and W. So, for instance, if $B_W = \{w_3, w_4\}$, then Bel = $\{\{w_3, w_4\}, \{w_1, w_3, w_4\}, \{w_2, w_3, w_4\}, W$. As far as the stability theory is concerned, any of these stable propositions could be the least believed proposition B_W. While the choice between different B_W makes the difference for what the agent's belief set *Bel* is, it does not make the difference between believing a proposition and believing its negation. In the above example, $\{w_4\}$ is contained as a subset in any stable proposition. So, any believed proposition X and Y should be true at w_4. Hence, X and Y cannot be contradictory.

Now, I will state a novel theorem that I call the *coordination theorem* that shows that MHI and the stability theory, under certain assumptions, avoid the diachronic coordination theorem.

THE COORDINATION THEOREM

Definition

For any credence function P and P', defined over a set of possible worlds W, we say that P and P' are order equivalent relative to W iff P and P' determine the same ordering of the worlds in W. More precisely:

For any w and w' in W, $P(\{w\}) \geq P(\{w'\})$ iff $P'(\{w\}) \geq P'(\{w'\})$.

Theorem

For any two agents with prior credence functions P and P' and prior belief sets *Bel* and *Bel'* defined over the same W, if these agents (*i*) satisfy the stability theory, (*ii*) update their credence functions via Conditionalization, and (*iii*) their credence functions are order equivalent, then the following obtains:

For any evidence (proposition) E and proposition X over W and for any permissible posterior belief sets Bel_E and Bel'_E over W_E (i.e., the set of worlds in W compatible with E), it is not the case that $Bel_E(X)$ and $Bel'_E(\neg X)$.[16]

16. To prove this theorem, we need to know that conditioning on E *preserves* all ratios of the probabilities of the worlds compatible with E. That is, for any w and w' over W and for any P, if E is compatible with each w and w', then $P(\{w\}) > P(\{w'\})$ iff $P_E(\{w\}) > P_E(\{w'\})$. So, conditioning *preserves* all the relevant ratios.

Now, assume that P and P' over W are order equivalent. Let W_E be the set of worlds compatible with E. We know that P_E and P'_E must agree with respect to the orderings of these worlds (as conditioning preserves the ratios, and hence, the orderings of these worlds). Define w_{Max} to be a member of W_E which is at least as probable as any world in W_E. By definition, w_{Max} must exist. And, by definition of a stable proposition, for any stable proposition over W_E relative to either P_E and P'_E, this stable proposition must contain w_{Max}. So, relative to both P_E and P'_E, there is no stable proposition over W_E that does not contain w_{Max}. Because of this, for all propositions X and

Some clarifications are in order. According to the above definition, order equivalent credence functions agree with respect to the at-least-as-probable relation over the worlds. That is, for any order equivalent functions P and P', if w is at least as probable as w' according to P, then w is at least as probable as w' according to P', and vice versa. Order equivalence should not be conflated with what is usually called *ordinal equivalence*. P and P' are ordinally equivalent relative to W iff for any propositions X and Y (over W), $P(X) \geq P(Y)$ iff $P'(X) \geq P'(Y)$. So, if P and P' are ordinally equivalent then they are order equivalent as well; but not the other way around. For instance, consider the two probability distributions from the previous section, represented by Table 1:

Table 1

Possible worlds	P_1	P_2
w_1	$P_1(\{w_1\}) = 0.03$	$P_2(\{w_1\}) = 0.08$
w_2	$P_1(\{w_2\}) = 0.02$	$P_2(\{w_2\}) = 0.02$
w_3	$P_1(\{w_3\}) = 0.18$	$P_2(\{w_3\}) = 0.09$
w_4	$P_1(\{w_4\}) = 0.77$	$P_2(\{w_4\}) = 0.81$

P_1 and P_2 are order equivalent but not ordinally equivalent: for instance, $P_1(\{w_3\}) > P_1(\{w_1, w_2\})$, but $P_2(\{w_3\}) < P_2(\{w_1, w_2\})$.

The coordination theorem includes a proviso that the agents' beliefs are defined with respect to the same partitioning of possibilities W.[17] How should W be fixed? The short answer is: in a way that best represents the agents' shared evidence concerning a proposition or topic they are attending to. Here is how we can precisify this answer. Consider two agents concerned with whether to believe a hypothesis H in light of their shared evidence E. Call W their *relevant partitioning of possibilities* with respect to H and E when W includes the possibilities representing the logical combinations of H and E as well as all relevant alternatives to H available to the agents.[18] For instance, suppose that the agents are concerned with

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Y, such that $Bel_E(X)$ and $Bel'_E(Y)$, X must contain w_{Max} and Y must contain w_{Max}. Therefore, X and Y cannot be contradictory. As required.

17. This proviso is needed because credence functions that are order equivalent relative to a partitioning W may not be order equivalent if we, say, coarse-grain W by combining some partition cells in W. So, the theorem only shows that two agents won't adopt opposing beliefs relative to some partitioning (which may be one among equally appropriate partitionings that these agents could attend to). This qualified (or special) result can still be useful. However, I will show that we can identify a partitioning that, given the agents' evidence and context of reasoning, has a special role in what they could rationally believe.

18. Think about relevant alternatives to H as *case relevant* alternatives to H: a proposition X is not case relevant to H for an agent iff presupposing either X or ¬X does not affect what the agent is permitted to believe about H. So, case relevant alternatives to H need to be sufficiently probabilistically relevant to H to be included in the relevant partition (where the meaning of "sufficiently probabilistically relevant" depends on the agent's Lockean threshold).

how the evidence of fine-tuning—represented by proposition *FT*: "Our universe is fine-tuned for life"—bears on the following two hypotheses:

> *God* : God exists.
>
> *M* : There are a vast number of universes, and most (maybe all) possible values of cosmological constants are actualized in some universes (so, the majority of universes are not fine-tuned. We just happen to inhabit the universe which is fine-tuned).

In this case, the agents' relevant partitioning *W* is a set of eight worlds representing the logically possible combinations of these three propositions: *FT*, *God*, *M*. The more relevant alternatives to *God* the agents consider, the more fine-grained the relevant partitioning.[19]

So, given the notion of relevant partitioning, the coordination theorem can be stated as follows:

> For any two agents with prior credence functions *P* and *P'* and prior belief sets *Bel* and *Bel' defined over the same relevant partitioning W*, if these agents (*i*) satisfy the stability theory, (*ii*) update their credence functions via Conditionalization, and (*iii*) their credence functions are order equivalent, then these agents won't adopt opposing beliefs no matter which new evidence from *W* they learn.

The theorem establishes a *condition* under which the stability theory, Moderate Uniqueness, and Credal Permissivism are consistent (over the relevant partitioning). I call this condition *Order Uniqueness*:

> Order Uniqueness: For any two equally informed agents whose credence functions P_1 and P_2 are defined over the same relevant partitioning *W*, there is a unique order of worlds that their evidence justifies over *W*.

Now, using the coordination theorem, we can state under what conditions MHI avoids the coordination problem:

> *For any agents who form their beliefs with respect to the same relevant partitioning and revise their credences via Conditionalization, the following theses are consistent:*
>
> 1. *The Stability Theory,*
> 2. *Moderate Uniqueness,*
> 3. *Credal Permissivism,*
> 4. *Order Uniqueness.*

19. Whether there is a precise, mechanical procedure for determining the agents' relevant partitioning is not important for the presented argument. We only assume that such special partitioning can be identified that accurately represents the agents' total relevant body of evidence relative to their context of reasoning (i.e., a proposition or a topic they are attending to).

Hence, the theorem shows that to solve the coordination problem for MHI (for the agents who form their beliefs relative to the shared relevant partitioning), we only need to endorse Order Uniqueness.

But is Order Uniqueness significantly more plausible than Credal Uniqueness? I argue that it is. Order Uniqueness is logically weaker and significantly less demanding than Credal Uniqueness. According to Credal Uniqueness, *evidence parses extremely finely*: even when one has vague, qualitative evidence, there is still a unique credence function that the evidence justifies over any proposition. By contrast, according to Order Uniqueness, *evidence may parse coarsely*: in some cases, evidence may not justify a unique credence function over a set of propositions, but only the unique order of worlds associated with these propositions. Hence, the requirements of evidence on rational credence are far less demanding on Order Uniqueness compared to Credal Uniqueness.

Cannot we also appeal to the coordination theorem to defend HI from the coordination problem? The answer is "No." We can easily verify that even on the supposition of Order Uniqueness, HI is still open to the coordination problem. This is so because, on the stability theory, if two credence functions P and P' are order equivalent, it is still possible that P permits believing H while P'—prohibits believing H. To illustrate this, consider Table 1 again, and suppose we revise the credence functions by new information $\neg\{w_4\}$. By Bayes' theorem, we will get the following credence distributions (which is obtained by revising Table 1 by $\neg\{w_4\}$):

Table 3

Possible worlds	P_1^{New}	P_2^{New}
w_1	$P_1(\{w_1\}) \approx 0.13$	$P_2(\{w_1\}) \approx 0.42$
w_2	$P_1(\{w_2\}) \approx 0.09$	$P_2(\{w_2\}) \approx 0.1$
w_3	$P_1(\{w_3\}) \approx 0.78$	$P_2(\{w_3\}) \approx 0.48$

By the definition of a stable proposition, proposition $\{w_3\}$ is stable with respect to P_1^{New} but not with respect to P_2^{New}. Hence, given the stability theory, it is rationally permissible to believe $\{w_3\}$ relative to P_1^{New} but not relative to P_2^{New}. So, even on the supposition of Order Uniqueness, HI, unlike MHI, is still open to the coordination problem.[20]

The next section concludes by summarizing the main themes and arguments of this paper.

20. Assuming the stability theory, even if two credence functions are o*rdinally equivalent* over W, they can still permit non-identical beliefs over W under some plausible assumptions. This is easy to verify within the stability theory framework. Very briefly: suppose two credence functions are ordinally equivalent over W and permit the same beliefs relative to some Lockean threshold. Now, there will be some W and some subset X of W such that, these credence functions license different beliefs after we condition them on X. The reader can easily verify this result.

5. CONCLUSION

This paper has shown that plausible hybrid views about Uniqueness face the (diachronic) coordination problem: the problem of coordinating an agent's beliefs and credences over time without violating the required combination of Uniqueness and Permissivism.

I've shown that the coordination problem is fatal for Hybrid Impermissivism (HI)—the view that endorses Belief Uniqueness and Credal Permissivism—but not for Moderate Hybrid Impermissivism (MHI)—the view that substitutes Belief Uniqueness with Moderate Uniqueness. I have shown this via the coordination theorem, which proves that given the stability theory, MHI avoids the coordination problem under the supposition of Order Uniqueness: the view that any evidence determines a unique order of worlds over an agent's relevant partitioning.

Whether this result is good news for MHI depends, mainly, on one's attitude toward Order Uniqueness. While I have argued that Order Uniqueness is significantly more plausible than Credal Uniqueness, some permissivists may still consider it a very demanding view. This said, Order Uniqueness seems an affordable price to pay for a plausible hybrid theory that combines moderate, highly plausible versions of Uniqueness and Permissivsm: Moderate Uniqueness and Credal Permissivism.

ACKNOWLEDGMENTS

I am very grateful to Tony Booth, Corine Besson, and Nina Abesadze for helpful comments and discussion. I am especially indebted to the participants of the reading group on Hannes Leitgeb's "The Stability of Belief": Simon Mcgregor, Sophie Machavariani, and Richard Lohse.

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