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*Dinosaurs and Reasonable Disagreement*

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Most philosophical discussions of disagreement have used idealized disagreements to draw conclusions about the nature of disagreement. I closely examine an actual, non-idealized disagreement in dinosaur paleobiology and show that it can not only teach us about the features of some of our real world disagreements, but can help us to argue for the possibility of reasonable real world disagreement.

**I. INTRODUCTION**

Within social epistemology, lively debates about the possibility of reasonable disagreement have been ongoing since at least the early 2000s (including Rosen 2001; Feldman 2006 and 2007; Schoenfield 2014; White 2005; Greco and Hedden 2016). While these discussions often casually mention scientific disagreement (for example, Rosen 2001: 71), they have focused on analyzing idealized disagreements, going on to draw general conclusions about the nature of disagreement from these analyses conducted in the world of idealization. In this paper, I attempt to move beyond consideration of idealized disagreement (Kenyon 2018). I analyze an actual, real world disagreement in the practice of contemporary dinosaur paleobiology and show that this disagreement can not only teach us more about the terrain of real world disagreements, but can lead us to unappreciated ways to argue for the possibility of reasonable real world disagreement.

This disagreement, as I’ll show in what follows, is complicated. It involves a limited body of evidence which is difficult to analyze and will likely never settle the disagreement. However, in scientific disagreement, agents go to great pains to share their evidence with each other and to communicate the reasoning which leads to their opposing conclusions about that evidence. So while this disagreement is far messier than idealized disagreements, it is positioned for philosophical analysis in a way that most real world disagreements are not. In section II, I explicate this case of disagreement in the practice of dinosaur paleobiology, which concerns the function of bizarre dinosaurian structures.[[1]](#endnote-1) In section III, I note an interesting feature of the disagreement. The dinosaur paleobiologists involved disagree not merely about the proposition under debate but also about which items of empirical data serve as evidence for and against that proposition. In section IV, I argue that this feature changes how we can argue for the possibility of reasonable real world disagreement. In section V, I show how epistemologists can argue that both sides of the debate in paleobiology can believe rationally simultaneously. I conclude that this disagreement can demonstrate how ordinary agents like dinosaur paleobiologists may reasonably disagree.

**II. STEGOSAURUS’ PLATES AND BIZARRE STRUCTURES IN DINOSAURS**

First, I’ll provide some background to this disagreement and address some opening worries to its use in the epistemology of disagreement. The disagreement concerns the function of bizarre structures in numerous dinosaurian species and occurs between established dinosaur paleobiologists. In what follows, I’ll adopt Padian and Horner’s identification of bizarre structures as “features that are unusual enough, to the trained eyes of paleobiologists, to invite explanations beyond the basic functions of feeding, locomotion, respiration and so on” (2010: 3). There are numerous bizarre structures of interest to the paleobiologists I’ll discuss, including *Stegosaurus*’s plates and spikes, *Triceratops*’s horns, *Pachycephalosaurus*’s dome, and *Ankylosaurus*’s scutes and tail club (Padian and Horner 2010: 6–8; Hone and Naish 2013: 172). While each bizarre structure under discussion has its own evolutionary history and there are literatures focusing on the functions of bizarre structures individually, some dinosaur paleobiologists have advanced general hypotheses that are intended to account broadly for the function of many, if not most, of the bizarre structures under discussion. For example, Padian and Horner (2010) argue that bizarre dinosaurian structures generally served to help individuals to recognize other members of their particular species. Hone et al. (2012) and Knell and Sampson (2011) argue that at least some of the structures likely served a sexually selective function, making an individual with more attractive (usually larger) bizarre structures more likely to attract a mate. For the purposes of illustration, I’ll use discussions of *Stegosaurus*’s plates and spikes as an exemplar of these disagreements.

A genus-specific hypothesis in the debate over the function of *Stegosaurus*’s plates and spikes is the **Thermoregulation Hypothesis**.[[2]](#endnote-2) Some dinosaur paleobiologists have defended the view that the plates served a thermoregulatory purpose, allowing *Stegosaurus* to exchange heat with her environment in order to adjust her internal body temperature (de Buffrenil, Farlow, and de Ricqlès 1986; Farlow, Hayashi, and Tattersall 2010; Farlow, Thompson, and Rosner 1976; Hayashi, Carpenter, Watabe, and McWhinney 2012). Commonly, this hypothesis is supported by evidence of apparent vascular structures in the plates of extant remains. A second genus-specific hypothesis, the **Defense Hypothesis**, proposes that the plates and spikes helped *Stegosaurus* to defend herself from predators (Christiansen and Tschopp 2010; Hayashi, Carpenter, and Suzuki 2009, Hayashi et al. 2012). General hypotheses concerning the function of bizarre dinosaurian structures have also been applied to account for the function of *Stegosaurus*’s plates and spikes. Advocates of the **Species Recognition Hypothesis** have argued that the plates helped the different species of *Stegosaurus* to recognize other members of their particular species (Main, de Ricqlès, Horner, and Padian 2005; Padian and Horner 2010).[[3]](#endnote-3) Saitta (2015) provides evidence that *Stegosaurus*’s plates were sexually dimorphic (that the plates of the male and female members of the species differed in appearance), increasing the plausibility of the **Sexual Selection Hypothesis** as an account for the function of *Stegosaurus*’s plates and spikes.

I’ll use this disagreement about the function of *Stegosaurus*’s plates and spikes to address opening worries about the use of scientific disagreement to draw lessons about the epistemology of disagreement. First, many of our non-scientific disagreements come in the following form: one of us believes p, the other believes ~p. In these disagreements, one of us usually holds a false belief since most of the propositions we find ourselves in disagreement about in everyday contexts are bivalent propositions.[[4]](#endnote-4) But in scientific disagreement, unlike many non-scientific disagreements, we have the possibility of pluralism. In many scientific disagreements, it is possible that more than one hypothesis is an accurate one. Perhaps the plates and spikes of *Stegosaurus* served both a thermoregulatory and a sexually selective function. Padian and Horner explicitly note that they “see no reason to be dogmatic about particular hypotheses and no reason not to be pluralistic about explanations when appropriate” and later that “a given structure may have several purposes” (2010: 4, 14). If many of these dinosaur paleobiologists don’t really disagree about these hypotheses and are merely advancing multiple, mutually compatible hypotheses, then it seems that their disagreements might be of little use to our understanding of the possibility of reasonable disagreement.

While it is logically possible and perhaps even likely that multiple hypotheses concerning the function of bizarre structures in dinosaurs are in fact accurate ones, we should still characterize these discussions among dinosaur paleobiologists as involving some genuine disagreements. Dinosaur paleobiologists, even in acknowledging the possibility of pluralism about the hypotheses concerning the function of *Stegosaurus*’s plates and spikes, regularly argue on behalf of their chosen function for the structures while proposing that at least some alternate hypotheses are false.[[5]](#endnote-5) Pluralism is jettisoned, Hone and Naish (2013: 174) explain, because these disagreements involve not merely disagreement about what functions these structures served but also about what single function was evolutionarily predominant. For example, even though they explicitly recognize the possibility of pluralism in their discussion, Padian and Horner (2010) argue that palebiologists should accept the Species Recognition Hypothesis and reject the Sexual Selection Hypothesis. Hone and Naish (2012; 2013) and Knell and Sampson (2011) argue that we should reject the Species Recognition Hypothesis as accounting for the primary evolutionarily significant function of bizarre dinosaurian structures and accept the Sexual Selection Hypothesis. As Hone and Naish put it, “the issue is whether [a proposed function] was the primary mechanism driving the acquisition and maintenance of any, or all, of these structures” (Hone and Naish 2013: 174). And dinosaur paleobiologists, we will see, regularly disagree about what function of the bizarre structures was most important to the structures’ evolutionary origin. So even though accepting pluralism about these hypotheses is possible, there are some genuine disagreements available for our analysis.

A second set of worries concerns the use of this particular example from the practice of science. Dinosaur paleobiology is a discipline within historical science, where relevant evidence is particularly difficult to come by and what evidence there is frequently does not settle our choices between hypotheses (Turner 2005). In other words, disagreements in dinosaur paleobiology are a far, far cry from the idealized disagreements often used by epistemologists of disagreement in which agents can specify, detail, and discuss bountiful evidence which is readily available to them. I’ve chosen to analyze a disagreement in dinosaur paleobiology precisely because the evidence available is so limited. The real world in which we live our actual, non-idealized epistemic lives is messy. Evidence outside of the arm chair is scattered and often difficult to decipher. It does not come pre-packaged. If social epistemological analyses of disagreement cannot help us to better understand these disagreements, then social epistemologists either need to be more explicit that they don’t intend their conclusions about disagreement to have purchase in the real world or we must examine actual, real world, messy disagreements and make our analyses responsive to the actual features of those disagreements. Examining a disagreement in the practice of dinosaur paleobiology is a first foray into the latter project.

Finally, note also that because I’m analyzing just one particular case of disagreement, my conclusions about the nature of disagreement will be circumscribed. This disagreement does not resemble every other disagreement in scientific practice or even most non-scientific disagreements. It can, however, teach us about the features of some actual, real world disagreements. More specifically, it can serve as a suitable counterexample to universal claims about disagreement in general. With these aims clarified, I’ll proceed to analyze this disagreement in more detail.

**III. A DUAL DISAGREEMENT**

For the rest of the paper, I’ll narrow my focus in this disagreement to two groups of dinosaur paleobiologists, Padian & Horner and Hone & Naish, using the ampersand to group them. I’ll narrow this focus even further to focus attention on their disagreement over one hypothesis, the Species Recognition Hypothesis (S), as an attempt to account for the primary driving factor in the evolutionary history of bizarre dinosaurian structures. Padian & Horner argue that dinosaur paleobiologists should believe S and Hone & Naish argue that dinosaur paleobiologists should believe ~S.[[6]](#endnote-6) Further, I’ll discuss this disagreement under the assumption that we should count these groups of dinosaur paleobiologists as epistemic peers. Not only are they each well-respected reasoners in matters of dinosaur paleobiology, but they have made each other aware of their opposing views and discussed much of the evidence relevant to the functions of bizarre dinosaurian structures in published responses to each other. Though, as I’ll show in what follows, they fail to share the exact same evidence, their similar levels of experience as dinosaur paleobiologists seem to qualify them as epistemic peers, at least on any account of epistemic peerhood which could apply to real world, non-idealized agents.

Before examining this disagreement in greater detail, I want to clarify what I mean when I say that some paleobiologist, B, uses some state of affairs, x, as **Evidence**.[[7]](#endnote-7) In rough terms, B uses x as evidence with respect to S when B thinks that x bears on S, when B thinks that x makes it more or less likely that S and as a function of this, typically uses x in the formation of her doxastic attitude towards S.[[8]](#endnote-8) In what follows, I’ll abbreviate this definition of evidence with the phrase “B takes x to bear on S.” Of course, B may be wrong about whether x bears on S, so when I use this construction, I don’t mean to indicate that x objectively bears on S. Rather, all I mean is that B, subjectively, whether correctly or incorrectly, thinks that x makes it more or less likely that S.

Let’s call the states of affairs which agents merely could take as evidence bearing on a proposition, items of **Information**.[[9]](#endnote-9)While Evidence, as I defined it above, is some state of affairs which an agent *does* take to bear on a proposition, Information is merely some state of affairs which an agent *could* take to bear on a proposition.

Let’s return to the Species Recognition Hypothesis, S: *Stegosaurus and other dinosaurs with bizarre structures used those structures to recognize other members of their particular species and this function was, in Hone & Naish’s terms, “the primary mechanism driving the acquisition and maintenance” of these structures.* Padian & Horner provide a new argument for S by showing that S passes a test based on phylogenetic analyses.[[10]](#endnote-10)

Padian & Horner identify a prediction from S. If S is accurate, they argue that “the pattern of diversification of bizarre structures . . . should be relatively random: it should not show trends that could ostensibly be related to selection” (Padian and Horner 2010: 12).[[11]](#endnote-11) Plausibly, if the primary function of bizarre dinosaurian structures is to allow members of the same species to recognize each other, then distinct species should demonstrate structures that differed from each other in appearance as markedly as possible rather than exhibiting shared structures across species that over time allowed the bizarre structures to serve a function (such as regulation of body temperature). According to Padian & Horner, “morphological diversification in the bizarre structures of dinosaurs does not seem to show clear patterns of directional evolution”; the prediction derived from S is, in their view, borne out in the phylogenetic analyses (2010: 12). S passes the test. Given their analyses of the phylogenetic data showing an apparent lack (L) of directional selection, they argue that dinosaur paleobiologists should accept S: *Stegosaurus and other dinosaurs with bizarre structures used those structures to recognize other members of their particular species and this function was, in Hone & Naish’s terms, “the primary mechanism driving the acquisition and maintenance” of these structures* (Padian and Horner 2010: 12; Hone and Naish 2013: 174).

As I’ve already noted, Hone & Naish disagree with Padian & Horner about S. Hone & Naish propose that dinosaur paleobiologists should endorse ~S instead of S. But the method by which they disagree with Padian & Horner about S should attract the notice of epistemologists interested in analyzing disagreements between peers. In arguing against Padian & Horner, Hone & Naish demonstrate that they do not think that the lack of evolutionary directionality of bizarre structures, L, demonstrated by phylogenetic analyses, makes it more or less likely that S. In other words, if we pay close enough attention to their disagreement, we can see that Hone & Naish reject L *as evidence* with respect to S.[[12]](#endnote-12)

Recall my definition of evidence: if Hone & Naish use L as evidence with respect to S, they must think that L bears on S, that L makes it more or less likely that S. But Hone & Naish do not think that L bears on S when we interpret S, as Padian & Horner do, as an account of the function which drove the evolution of bizarre structures (Hone and Naish 2013: 174–5). Hone & Naish argue that a lack of evolutionary directionality in phylogenetic analyses of bizarre structures is also completely consistent with alternative hypotheses to S, including the Sexual Selection hypothesis and the hypothesis that the structures evolved under no selection whatsoever. As they note, “at least some sexually selected structures in extant taxa are known to have high levels of variation…and may evolve at random; indeed, any neutrally selected character may evolve randomly” (2013: 175). The results of the phylogenetic analyses don’t make it any more likely that S than they do the hypothesis of neutral selection, according to Hone & Naish (2013: 175–6). Obviously, if the phylogenetic data merely charts the bizarre structures evolving under neutral selection, then the Species Recognition hypothesis fails to receive support from the data which Padian & Horner take to offer one of its most plausible sources of confirmation. Naish (2013) puts their rejection of L as evidence bearing on S more bluntly, “there’s no clear support from the ‘directionality’ or diversity of exaggerated structures for the species recognition hypothesis.”[[13]](#endnote-13)

By recognizing that Hone & Naish and Padian & Horner disagree both about S and about whether L bears on S, we come to the recognition that ordinary (rather than idealized) agents of similar training, reasoning capacities, and exposure to evidence relevant to a proposition, those ordinary agents we call peers, sometimes disagree both about S and about what evidence bears on S.[[14]](#endnote-14) In the following section, I’ll draw some philosophical lessons from this feature.

**IV. UNIQUENESS, RATIONALITY, AND EVIDENCE**

Social epistemologists have often argued that reasonable disagreement, disagreement between two agents who hold opposing but equally rational doxastic attitudes towards the proposition under disagreement, is impossible (including Feldman 2007 and 2006; Greco and Hedden 2016; Dogramaci and Horowitz 2016). More specifically, they have argued that reasonable disagreement between two individuals *who share the same total evidence* is impossible. And they have typically done so by defending Uniqueness, the thesis which holds that at most one doxastic attitude can be rational given a single body of evidence (Feldman 2007: 205).[[15]](#endnote-15)

This focus on the impossibility of reasonable disagreement between agents who share the same total evidence makes sense given the definition of Uniqueness in its focus on a single body of evidence. Daniel Greco and Brian Hedden state that Uniqueness applies to agents who “have the same *total* evidence, which will include background information and experience” (2016: 366). Roger White agrees that Uniqueness is a thesis about agents with the same total evidence and indicates that agents who have the same total evidence have the same background beliefs and past experiences (2005: fn. 6; 2013: 312).

While it’s quite clear that Padian & Horner and Hone & Naish have access to the same paleontological data and previous research, it’s less clear that they have all the same past experiences and background beliefs which result from those experiences. Though they are comparably trained dinosaur paleobiologists, they have not attended all of the same professional conferences, been trained at the same institutions, or conducted all of the same field studies. As Nathan King (2012) recognizes in a different context, all of these past experiences will be relevant to their disagreement about L and S since these experiences and the background beliefs gained from them inform their assessment of paleobiological hypotheses and the methods by which they evaluate those hypotheses. To the extent that you’re of the bent of Greco and Hedden and White, who take even similarly educated agents like “jurors” in a courtroom and even “paleontologists who disagree about what killed the dinosaurs,” to fail to share the same total evidence, you’ll think that the disagreement between Padian & Horner and Hone & Naish is not one to which Uniqueness applies since it seems that the dinosaur paleobiologists involved do not share the same total evidence (Greco and Hedden 2016: 366; Rosen 2001: 71). So defenders of Uniqueness and the ensuing impossibility of reasonable disagreement are not interested in targeting real world individuals like Padian & Horner and Hone & Naish who fail to share the same total evidence.

But, as I’ve repeatedly noted, social epistemologists must be willing to see beyond the narrow confines of idealized disagreement if they want to draw conclusions about the nature of disagreement as a whole. We must be able to assess the possibility of reasonable real world disagreement, not merely reasonable idealized disagreement. I’ll show in what follows that reasonable real world disagreement *is* possible.

To get to my argument that reasonable disagreement in real world contexts is possible, we must reflect on the feature I discussed in Section III. Recall that Padian & Horner and Hone & Naish disagree both about S and about whether L bears on S. If one of them is necessarily believing irrationally, as at least one of them must be if reasonable real world disagreement is impossible, then it seems quite plausible that one of them may be irrationally taking some evidence with respect to S when it in fact does not bear on S or failing to take into account some evidence which does, in fact, bear on S. If Padian & Horner’s belief that S is irrational, then it seems they hold that irrational doxastic attitude in part due to their irrationally taking L as bearing on S. If Hone & Naish’s belief that ~S is irrational, then they hold that irrational doxastic attitude, at least in part, on the basis of their holding L as irrelevant to whether S. So it seems likely that a significant potential source of irrationality in this disagreement is the selection of evidence relevant to S. This gives us reason to think that assessing how Padian & Horner and Hone & Naish select their evidence is important to determining whether they can simultaneously be believing, and thereafter disagreeing, rationally.

This recognition leads us to two new views about rationality and evidence selection. Call **Evidence Pick Uniqueness** the view that at most one body of evidence can rationally be taken from a body of generally shared information as bearing on a proposition. If you hold Evidence Pick Uniqueness, you’ll conclude that at least one group of dinosaur paleobiologists is irrationally selecting the evidence they take to bear on S from their generally shared paleobiological information. If at least one group of dinosaur paleobiologists is irrationally selecting their evidence, the paleobiologists will not be able to view their opposing doxastic attitudes towards S, arrived at on the basis of at least one irrational selection of evidence, as simultaneously rational. In anticipation of this move to defend the impossibility of reasonable real world disagreement, I’ll defend **Evidence Pick Permissivism,** the view which holds that both groups of dinosaur paleobiologists can be rational in selecting their evidence.[[16]](#endnote-16)

Before I continue to this defense though, there is a clarification that merits attention. First, in keeping with my focus on a disagreement in the practice of dinosaur paleobiology between non-ideal, ordinary agents, the shared body of importance to Evidence Pick Uniqueness and Evidence Pick Permissivism will not be strictly, completely shared by Padian & Horner and Hone & Naish. We’ve just seen that we have good reason to think that Padian & Horner and Hone & Naish don’t share the same total evidence as understood by proponents of Uniqueness since they were trained at different institutions in addition to conducting research in different contexts. The problems which make it difficult or unlikely for agents to share the same evidence will similarly make it unlikely for them to share the same information.

But for the purposes of this paper, I’m interested in asking whether it can be rational for Padian & Horner and Hone & Naish to have access to significantly overlapping (if not exactly the same) sets of information relevant to their disagreement and yet take divergent sets of evidence from that generally shared body of information. In the disagreements I’ve highlighted here, both Padian & Horner and Hone & Naish are aware that they disagree about S and whether L bears on S and they have discussed L and S and the reasons they take or fail to take L to bear on S at great length in published journals. They have publicly done their level best to share the information from which they have drawn their evidence, on which they base their doxastic attitudes towards S. Put another way, they have done as much as we could reasonably expect ordinary agents to share their information and evidence. While they fail to meet the requirement of sharing the same total evidence as set out by proponents of Uniqueness, this should not prevent us from assessing rationality in their disagreement and evidence selection. I’ll now turn to argue that assessing rationality in their disagreement leads us to see how they can be engaged in reasonable disagreement.

**V. IN DEFENSE OF MODERATE EVIDENTIAL PICK PERMISSIVISM**

I’ll call the view that more than one distinct but overlapping body of evidence can, in some cases, be rationally taken from a shared body of information, **Moderate Evidential Pick Permissivism**. Note that Moderate Evidential Pick Permissivism is not a thesis about all bodies of evidence. Like its predecessors in the Permissivism literature, it is an existential thesis about certain bodies of information and evidence and does not specify which bodies of evidence and information are permissive. I’ll take Padian & Horner and Hone & Naish’s disagreement as I’ve sketched it above as an illustration of distinct but overlapping bodies of evidence. While the bodies of evidence which they make use of are similar and involve a good deal of overlap, they are importantly distinct in the presence or absence of L. In addition, the bodies of information they have access to are similar.[[17]](#endnote-17)

To argue for Moderate Evidential Pick Permissivism (hereafter “MEPP”), I will defend MEPP in the context of real world disagreement from the understanding of rationality that leads epistemologists to reject MEPP’s cousin, the thesis of Permissivism. Permissivism is the thesis that in some cases, it can be rational for agents to hold different doxastic attitudes in response to a specific body of evidence. Since MEPP has not been articulated in the literature before, there are no extant arguments against MEPP. But by showing that MEPP is defensible in the face of the central understanding of rationality which leads to rejections of Permissivism, I will demonstrate that MEPP makes reasonable real world disagreement possible.

Some epistemologists take evidential support to be a relation between evidence and proposition in which evidence, from an objective standpoint, points in a single direction towards a doxastic attitude which the evidence supports. Call this the **Unidirectional Understanding of Rationality**, an understanding which directly motivates the thesis of Uniqueness.Richard Feldman (2006: 231) advances the Unidirectional Understanding of Rationality (hereafter “the Unidirectional Understanding”) and, adding it to an evidentialist understanding of justification, uses it to reject the possibility that agents could both believe rationally in disagreement since the evidence objectively supports only one of their doxastic attitudes. Roger White (2005: 447) also advocates for the Unidirectional Understanding. “Whatever is evidence for P is evidence for the falsity of not-P and hence is evidence against not-P . . . it is incoherent to suppose that a whole body of evidence could count both for and against a hypothesis” (White 2005: 447).

The Unidirectional Understanding is often used to motivate rejection of Permissivism. But MEPP, in the context of real world disagreements, is defensible in the face of the Unidirectional Understanding. Before I show this, however, we should first recognize clearly that the Unidirectional Understanding doesn’t strictly apply to MEPP since MEPP is about significantly overlapping, not identical bodies of information and evidence. And there is a cheap response from MEPP to advocates of the Unidirectional Understanding here. We could simply note that adding or subtracting pieces of evidence from a body of evidence can change what doxastic attitude a body of evidence justifies. It’s rational for me to believe given the evidence I have now that the Jacksonville Jaguars will win a football game next weekend, but it will be rational for me to believe that that they won’t win if I hear tomorrow that star quarterback Gardner Minshew II is injured. From this notice, we could conclude that since the body of information that Padian & Horner and Hone & Naish select their evidence from is not strictly or completely shared, the differences in their information could make it rational for them to select different bodies of evidence from their significantly overlapping but non-identical bodies of information. But this response is much too cheap and doesn’t give us a robust reason to accept MEPP.

Given the fact that Padian & Horner and Hone & Naish have done so much work in their writings and discussions to explain and share the reasoning and evidence which lead them to accept or reject L as bearing on S, it is unlikely that their disagreement about S and whether L bears on S is due solely to some difference in their total evidence or information. Other explanations of their dual disagreement seem far more likely. Perhaps Padian & Horner and Hone & Naish simply differ in how plausible it seems to them that L bears on S. We could suggest this and like explanations of their disagreement without typifying their disagreement as merely a response to a difference in total evidence.[[18]](#endnote-18) With the cheap response from MEPP to the Unidirectional Understanding set aside, I’ll show how MEPP is defensible from the Unidirectional Understanding.

Since the Unidirectional Understanding concerns just one, shared body of evidence, we will first need to imagine how it might be extended to the context of selecting our evidence from a body of information. Perhaps there are some states of affairs which objectively make it more or less likely that S.[[19]](#endnote-19) In this case, the proponent of the Unidirectional Understanding might decide that the rational agent is the one who selects as evidence from her information only those states of affairs which objectively bear on S.[[20]](#endnote-20) Feldman even hints at this possibility, suggesting that making a move similar to the one I’ve made here “just pushes the question back a step” to the rationality of how agents use the evidence (or in my terms, information) available to them (2007: 206).

But note what the proponent of the Unidirectional Understanding should not say here. He should not say that rational agents take as evidence *all* the states of affairs which objectively bear on propositions under disagreement. There is too much information in the world to begin to grapple with all the states of affairs which bear on a proposition, to say nothing of the information we may fail to have access to given the passing of time in disciplines like paleobiology. Further, it seems obvious that there could be subsets of the states of affairs which objectively bear on a proposition which could lead us to the same doxastic attitude towards that proposition. Requiring that we take as evidence all the states of affairs which objectively bear on propositions under disagreement is not a plausible tactic for the proponent of the Unidirectional Understanding.

It seems more reasonable to attribute to the proponent of the Unidirectional Understanding the idea that rational agents take as evidence *only* states of affairs which objectively bear on propositions. Under this view, it seems that Hone & Naish and Padian & Horner cannot be engaged in reasonable disagreement about S because L either objectively bears on S or it does not objectively bear on S and the group of paleobiologists which incorrectly takes L to bear or not to bear on S is believing irrationally.[[21]](#endnote-21) I’ll show in what follows that this appearance is deceptive.

Before we go on to consider their disagreement in the real world context, let’s consider given this Unidirectional Understanding of evidence selection on what possibilities about L’s bearing or non-bearing on S would Padian & Horner and Hone & Naish fail to be engaged in reasonable disagreement.

First, consider the possibility that L objectively doesn’t bear on S. In this case, Padian & Horner, in the Unidirectional Understanding view, are believing irrationally, since they take L to bear on S and L does not objectively bear on S. I’ll argue later in this section that we can’t know whether this possibility obtains in the context of real world disagreements, so this will be our later route to defending MEPP. But before we head in that direction, let’s consider the second possibility.

What if L objectively bears on S? Then Padian & Horner’s belief that S faces no threat of irrationality from the proponent of the Unidirectional Understanding since they are correctly taking L to bear on S. Do Hone & Naish’s beliefs that ~S and that L does not bear on S fall to irrationality on this possibility? They do not. The proponent of Unidirectional Understanding must require, for reasons we’ve already specified, that rational agents take as evidence *only* those states of affairs which objectively bear on propositions. So he cannot claim that Hone & Naish are irrational for failing to take L as bearing on S, since he cannot require that they take as evidence all those states of affairs which objectively bear on S. MEPP survives the worries of the proponent of the Unidirectional Understanding since MEPP states that there exist some cases where more than one distinct but overlapping body of evidence can be rationally taken from a shared body of information. In this disagreement, that case is when L objectively bears on S. Hone & Naish can go on believing ~S and that L fails to bear on S and may do so rationally even if the Unidirectional Understanding view is right about rationality in evidence selection.

But maybe the proponent of the Unidirectional Understanding will counter my argument here by altering his understanding of rationality in evidence selection. Maybe he will say that rational agents take as evidence all those states of affairs which they: (a) have access to and (b) objectively bear on propositions.[[22]](#endnote-22) In discussing their disagreements, Hone & Naish learn that Padian & Horner take L to bear on S. So Hone & Naish clearly have access to L. Since L objectively bears on S in the possibility we are considering, the proponent of the Unidirectional Understanding can say on this revised view that Hone & Naish fail to believe rationally. But let’s pay attention to what this move this would mean for proponents of the Unidirectional Understanding.

To deny the possibility of reasonable disagreement, proponents of the Unidirectional Understanding must require that rational agents only take as evidence all those states of affairs which they: (a) have access to and (b) objectively bear on propositions. This is a significant argumentative burden for the proponent of the Unidirectional Understanding to bear. Rational agents on this view must not only believe what their evidence supports, but they must correctly identify as evidence every state of affairs they have access to which objectively bears on the proposition they are considering.

Proponents of this view will need to clarify what it takes for an agent to have access to some state of affairs. Is it merely that the agent *could* access that state of affairs, such that agents are required to actively seek out and take as evidence all states of affairs within their broader epistemic environment which objectively bear on a proposition? Or does access merely consist of having that state of affairs currently accessible to an agent’s awareness? Adapting a related argument from Charity Anderson (2018: 254–256), will the states of affairs need to be accessible to an agent’s awareness in the absence of defeaters which would prevent those states of affairs from being taken as evidence for the proposition under disagreement? The problems which arose for the view that rational agents must take as evidence all states of affairs which objectively bear on a proposition will crop up readily here. These are weighty worries which must be adequately addressed by proponents of the Unidirectional Understanding if they are to advance an argument denying MEPP and the possibility of reasonable disagreement. And any substantial requirements of access will make rationality even more difficult to achieve for idealized epistemic agents, let alone epistemic agents like us.

As promised, let’s now consider the context of specifically real world disagreements. In the context of real world disagreements, it is hard to know how we would accuse Hone & Naish of epistemic irrationality for failing to take L to bear on S, whether L objectively bears on S or not. If L objectively bears on S as we just considered, the groups of paleobiologists would have no way of accessing the fact about epistemic rationality that L objectively bears on S. If L objectively does not bear on S, then similarly, Padian & Horner would have no way of accessing this feature of objective rationality in evidence selection. Clearly, both Padian & Horner and Hone & Naish have reflected closely on their reasoning for believing that L does not bear on S and have been open to each others’ criticism and opposing reasoning on this point. And yet, they still adamantly maintain on the basis of articulated, careful paleobiological reasoning that L does or does not bear on S.

To assess rationality in the context of real world disagreement, we must make use of understandings of rationality which take into account the messy features of our actual, not idealized, epistemic contexts as well as the limits of what non-idealized agents can know about the dictates of epistemic rationality.[[23]](#endnote-23) In real world disagreement we (philosophers) might be aware of some features of objective rationality, we might intuit that states of affairs in general objectively bear or don’t bear as evidence for propositions, but this awareness of objective rationality doesn’t tell us as acting epistemic agents which states of affairs objectively bear on propositions and which actual doxastic attitudes our evidence objectively supports. It is easy to idealize cases in which the dictates of objective rationality are known to us, but it is impossible to determine with certainty how objective rationality works out in the messy, real world disagreements we find ourselves in outside the armchair.

Assessing rationality in the context of real world disagreement leaves us unable to rule out the possibility of reasonable disagreement between Padian & Horner and Hone & Naish. Labeling them irrational from a non-idealized vantage point would require them to have some way of relating to or accessing objective facts about whether L bears on S that they have no way of coming into contact with. To do so would be to fault careful reasoners for failing to epistemically respond to a fact about their epistemic environment which they cannot have access to. We’ve seen that if L objectively bears on S, there is a plausible defense available for MEPP. And I’ve suggested that given the limits of our access to facts about objective rationality in the real world, we simply can’t know whether L objectively bears on S. So from a non-idealized epistemological perspective, since it’s possible that L objectively bears on S, it seems that in at least Padian & Horner and Hone & Naish’s case, it is possible for more than one distinct but overlapping body of evidence to be rationally taken from a shared body of information. MEPP is left standing and reasonable disagreement is possible in this disagreement between dinosaur paleobiologists.

**VI. CONCLUSION**

I’ve argued that two groups of dinosaur paleobiologists are engaged in disagreement in part because they disagree about whether some state of affairs bears on the hypothesis they disagree about. I extended the Unidirectional Understanding of Rationality to the territory of agents who disagree not merely about a proposition but also about what evidence bears on that proposition. I then showed that if we are interested in assessing real world disagreements, taking into account our access to facts about epistemic rationality as non-idealized agents, then MEPP is not only defensible, but reasonable real world disagreement between dinosaur paleobiologists is possible.

To show that reasonable disagreement is not merely possible but also actual in this case of disagreement, we would not only need to know that L objectively bears on S.[[24]](#endnote-24) We would also need to know countless other facts about Padian & Horner and Hone & Naish, including specifics of the epistemic practices they employed in arriving at their doxastic attitudes towards S. So we cannot know certainly whether Padian & Horner and Hone & Naish are engaged in actual reasonable disagreement.

But explicating the disagreement between dinosaur paleobiologists and recognizing that reasonable real world disagreement is possible is not merely worthwhile for our theoretical analysis of disagreement. Examining the disagreement between Padian & Horner and Hone & Naish shows us that sometimes real world agents disagree in part because they disagree about what evidence bears on the proposition they disagree about. This can lead agents like us engaged in real world disagreement to fruitful conversations about our reasoning and evidence selection with those we disagree with. And, when we find ourselves in disagreement, knowing that we sometimes can’t rule out the possibility that both parties to disagreement are believing rationally should lead us to treat those we disagree with even greater intellectual respect than we might otherwise.[[25]](#endnote-25)

**BIBLIOGRAPHY**

Anderson, Charity. 2018. “On Providing Evidence.” *Episteme,* 15(3): 245–260.

Beddor, Bob. 2019. “Subjective Disagreement.” *Noûs*, 53(4): 819–851.

Bokulich, Alisa. 2018. “Using Models to Correct Data: Paleodiversity and the Fossil Record.” *Synthese*.

Christensen, David. 2007. “Epistemology of Disagreement: The Good News.” *Philosophical
 Review,* (116)1: 187–217.
Christiansen, Nicolai A. and Emanuel Tschopp. 2010. “Exceptional Stegosaur Integument
 Impressions from the Upper Jurassic Morrison Formation of Wyoming.” *Swiss Journal of
 Geosciences*, 103: 163–171.
de Buffrenil, Vivian, James O. Farlow, and Armand de Ricqlès. 1986. “Growth and Function of
 Stegosaurus Plates: Evidence from Bone Histology.” *Paleobiology*, 12(4): 459–473.
Dogramaci, Sinan and Sophie Horowitz. 2016. “An Argument for Uniqueness About Evidential
 Support.” *Philosophical Issues,* 26(1): 130–147
Dretske, Fred. 1981. *Knowledge and the Flow of Information*. Cambridge, MA: MIT Press.

Egan, Andy. 2010. “Disputing About Taste.” In *Disagreement,* ed. Ted Warfield and Richard Feldman. New York: Oxford University Press, 247–286.

Elgin, Catherine. 2010. “Persistent Disagreement.” In *Disagreement,* ed. Ted Warfield and
 Richard Feldman. New York: Oxford University Press, 53–68.
———. 2018. “Reasonable Disagreement.” In *Voicing Dissent*, ed. Casey Johnson. New York:
 Routledge.

Farlow, James O., Shoji Hayashi, and Glenn J. Tattersall. 2010. “Internal Vascularity of the Dermal Plates of Stegosaurus (Ornithischia, Thyreophora).” *Swiss Journal of Geosciences*, 103:173–185.

Farlow, James O., Carl V. Thompson, and Daniel E. Rosner, 1976. “Plates of the Dinosaur Stegosaurus: Forced Convection Heat Loss Fins?” *Science*, 192(4244): 1123–1125.

Feldman, Richard. 2006. “Epistemological Puzzles About Disagreement.” In *Epistemology Futures,* ed. Stephen Hetherington. New York: Oxford University Press, 216–236.

———. 2007. “Reasonable Religious Disagreements.” In *Philosophers Without Gods: Meditations on Atheism and the Secular Life*, ed. Louise M. Anthony. New York: Oxford University Press, 194–214.

Foley, Richard. 1992. *Working Without a Net: A Study in Egocentric Epistemology*. New York:
 Oxford University Press.
Greco, Daniel, and Brian Hedden. 2016. “Uniqueness and Metaepistemology.” *Journal of
 Philosophy*, 113(8): 365–395.
Hayashi, Shoji, Kenneth Carpenter, and Daisuke Suzuki. 2009. “Different Growth Patterns
 Between the Skeleton and Osteoderms of Stegosaurus.” *Journal of Vertebrate
 Paleontology*, 29(1): 123–131.
Hayashi, Shoji, Kenneth Carpenter, Mahito Watabe, and Lorrie A. McWhinney. 2012.
 “Ontogenetic Histology of Stegosaurus Plates and Spikes.” *Palaeontology*, 55(1): 145–
 161.
Hone, David W. E., and Darren Naish. 2013. “The ‘Species Recognition’ Hypothesis Does Not
 Explain the Presence and Evolution of Exaggerated Structures in Non-Avialan
 Dinosaurs.” *Journal of Zoology*, 290: 172–180.

Hone, David W. E., Darren Naish, and Innes C. Cuthill. 2012. “Does Mutual Sexual Selection Explain the Evolution of Head Crests in Pterosaurs and Dinosaurs?” *Lethaia*, 45(2): 139–156.

Kenyon, Tim. 2018. “Disagreement.” *The Routledge Handbook of Applied Epistemology,* ed. David Coady and James Chase. New York: Routledge: 233–246.

King, Nathan. 2012. “Disagreement: What’s The Problem? Or A Good Peer Is Hard To Find.” *Philosophy and Phenomenological Research*, 85(2): 249–272.

Knell, Robert J., and Scott D. Sampson. 2011. “Bizarre Structures in Dinosaurs: Species Recognition or Sexual Selection? A Response to Padian and Horner.” *Journal of Zoology*, 283: 18–22.

Kopec, Matthes, and Michael G. Titelbaum. 2016. “The Uniqueness Thesis.” *Philosophy Compass*, 11(4): 189–200.

Main, Russell P., Armand de Ricqlès, John R. Horner, and Kevin Padian. 2005. “The Evolution and Function of Thyreophoran Dinosaur Scutes: Implications for Plate Functions in Stegosaurus.” *Paleobiology*, 31(2): 291–314.

McCain, Kevin. 2014. *Evidentialism and Epistemic Justification*. New York: Routledge.

Naish, Darren. 2013. “Dinosaurs and their Exaggerated Structures: Species Recognition Aids, or Sexual Display Devices?” *Tetrapod Zoology, Scientific American*.

Padian, Kevin, and John R. Horner. 2010. “The Evolution of ‘Bizarre Structures’ in Dinosaurs: Biomechanics, Sexual Selection, Social Selection, or Species Recognition?” *Journal of Zoology*, 283: 3–17.

———. 2011. “The Definition of Sexual Selection and Its Implications for Dinosaurian Biology.” *Journal of Zoology*, 283(1): 23–27.

Rosen, Gideon. 2001. “Nominalism, Naturalism, Epistemic Relativism.” *Philosophical Perspectives*, 15: 69–91.

Saitta, Evan T. 2015. “Evidence for Sexual Dimorphism in the Plated Dinosaur Stegosaur mjosi (Ornithischia, Stegosauria) from the Morrison Formation (Upper Jurassic) of Western USA.” *PLoS One*: 10(4): e0123503.

Schoenfield, Miriam. 2014. “Permission to Believe: Why Permissivism Is True and What It Tells Us About Irrelevant Influences On Belief.” *Noûs*, 47(1): 193–218.

Turner, Derek. 2005. “Local Underdetermination in Historical Science.” *Philosophy of Science,*72(1): 209–230.

White, Roger. 2005. “Epistemic Permissiveness.” *Philosophical Perspectives*, 19(1): 445–459.

———. 2013. “Evidence Cannot Be Permissive.” In *Contemporary Debates in Epistemology*, 2nd Edition, ed. Ernest Sosa and John Turri. Hoboken, NJ: Wiley Blackwell, 312–323

**ENDNOTES**

1. In addition, there is disagreement in evolutionary biology about the origin of the function ascribed to *Stegosaurus’s* plates and spikes. Some dinosaur paleobiologists claim that the plates and spikes served an adaptive function, immediately serving a function which made the dinosaur more likely to survive, while others seem to endorse the view that the function(s) of the plates and spikes was exaptive, that the plates and spikes first evolved and after their evolution, dinosaurs developed uses for them for which they were not originally suited. In what follows, I will consider disagreement about the function of the plates and spikes, irrespective of the adaptive or nonadaptive nature of that function. I’m grateful to Sharyn Clough for helpful discussion about this issue. [↑](#endnote-ref-1)
2. In what follows, I will be using ‘*Stegosaurus*’s plates and spikes’ to refer solely to the plates and spikes on the spine of *Stegosaurus*. These are more broadly referred to as “osteoderms,” in the paleobiological literature. I will also not be concerned with the osteoderms near *Stegosaurus’*s throat. [↑](#endnote-ref-2)
3. See Hone and Naish 2013: 173 for clarificatory discussion of the several functions which have often been grouped under the umbrella of “Species Recognition.” [↑](#endnote-ref-3)
4. Unless, of course, p is not a bivalent proposition, such as a proposition which expresses a predominantly subjective opinion. In cases like these, it’s possible that neither of us holds a false belief. See Egan 2010 and Beddor 2019 for discussion of disagreement about preferences and taste. [↑](#endnote-ref-4)
5. This group includes Padian and Horner 2010, de Buffrenil et al. 1986, Hone and Naish 2012; 2013, Knell and Sampson 2011, and Main et al. 2005. [↑](#endnote-ref-5)
6. But perhaps you don’t think that scientists of the kind I’ll discuss “believe” hypotheses at all. Perhaps you think they merely “accept” them or “take them to be more likely than not.” If so, then you may readily substitute my use of “belief” for “acceptance” or your preferred doxastic attitude. My conclusions will still apply, involving your doxastic attitude of choice. Thanks to Catherine Elgin for this concern. [↑](#endnote-ref-6)
7. I use the term “state of affairs” as a neutral term which is intended to capture the various ontologies of evidence which have been proposed. [↑](#endnote-ref-7)
8. I use the verb “thinks” here to ward off the requirement that for B to use x as evidence, B must *believe* that x makes it more or less likely that S. There are involved literatures concerning what it means for B to possess x as evidence and to base her belief in S on x. See McCain 2014 for a survey of these literatures. The account which follows is neutral with respect to one’s views on these discussions. [↑](#endnote-ref-8)
9. My use of ‘information’ is thus broader than Dretske’s 1981 use of the term. As I understand ‘information,’ any state of affairs *could* be taken to bear on a proposition. A rational agent, however, will only take states of affairs to bear on S when it’s rational to think that that state of affairs makes it more or less likely that S. Thanks to an anonymous reviewer for clarification on this point. [↑](#endnote-ref-9)
10. See Bokulich 2018 for a philosophical analysis of the use of phylogenetic analyses in paleobiology. [↑](#endnote-ref-10)
11. Padian & Horner also emphasize this point elsewhere in Main et al. 2005: 310–11. [↑](#endnote-ref-11)
12. I have chosen to simplify this extensive disagreement between Padian & Horner and Hone & Naish by focusing on the role of one piece of evidence, L, and their disagreement about both L and S. However, as detailed in Padian and Horner 2010; 2011, Hone and Naish 2013, Knell and Sampson 2011, and Naish 2013, this disagreement involves numerous additional disagreements and opposing claims. [↑](#endnote-ref-12)
13. Naish has confirmed this reading of his and Hone’s view in personal correspondence. And again, “To conclude, neither the presence of a fairly random pattern of diversification in exaggerated structures, nor the lack of sexual dimorphism, represent clear support for the species recognition hypothesis,” Hone and Naish 2013: 176. As Naish 2013 notes, Knell and Sampson 2011 join Hone & Naish in this view. Hone & Naish also argue that the data fails to rule out the hypothesis that the structures served an incrementally developed function like regulation of body temperature, in addition to failing to distinguish between the Species Recognition, neutral selection, and Sexual Selection hypotheses in 2013: 174–6. In other words, the phylogenetic data fails to rule out any of the hypotheses under serious consideration in the debate, on Hone & Naish’s view. [↑](#endnote-ref-13)
14. Relatedly, Charity Anderson 2018 argues that agents may non-culpably fail to regard as evidence certain states of affairs which other rational agents regard as evidence. [↑](#endnote-ref-14)
15. I am interested in Interpersonal, Synchronic forms of Uniqueness and Permissivism in this paper. See Kopec and Titelbaum 2016. [↑](#endnote-ref-15)
16. Catherine Elgin 2010; 2018: 10–12 recognizes that peers who weight the evidence available to them differently may find themselves in reasonable disagreement. [↑](#endnote-ref-16)
17. In what follows, I’ll defend Interpersonal Moderate Evidential Pick Permissivism rather than Intrapersonal Moderate Evidential Pick Permissivism. While Intrapersonal Moderate Evidential Pick Permissivism says that it can be rational for the same agent to take different sets of evidence as bearing on a proposition, Interpersonal Moderate Evidential Pick Permissivism says that it can be rational for different agents to take different sets of evidence as bearing on a proposition. For further discussion, see Kopec and Titelbaum 2016. [↑](#endnote-ref-17)
18. Thank you to Charity Anderson for helpful conversations on this point. [↑](#endnote-ref-18)
19. I am personally not convinced that such an objective relation exists, but am willing to consider it for the purposes of argument. [↑](#endnote-ref-19)
20. This extension of the Unidirectional Understanding as it applies to evidence gathering seems to rely on a conception of evidence-gathering norms as purely epistemic (rather than practical) since failure to abide by them, it asserts, constitutes a failure of epistemic rationality. I am not interested in endorsing a particular conception of the nature of evidence-gathering norms for present purposes and merely am addressing this extension of the Unidirectional Understanding as one immediately obvious tactic of argument against MEPP. [↑](#endnote-ref-20)
21. This is only the case if we add on an evidentialist understanding of justification as Feldman does. White implicates something very vaguely along these lines as well 2005: 447. [↑](#endnote-ref-21)
22. It’s important to note here that I am not suggesting that the proponent of the Unidirectional Understanding is committed to a view on which she can only take as evidence those states of affairs which she (a) has access to and (b\*) knows objectively bear on some proposition. Rather, I am suggesting that the Unidirectional Understanding proponent will need to require that she take as evidence only those states of affairs which objectively bear on a proposition, whether she knows that they do or not. As I show later in this section, I think this consequence is particularly unreasonable when we are considering real world disagreements where not even trained epistemologists have access to the objective determinations of epistemic rationality. Further, (a) and (b) require agents to take as evidence states of affairs which they have access to and yet which they fail to know, when those states of affairs objectively bear on a proposition. This consequence of the view seems disconcerting. [↑](#endnote-ref-22)
23. Richard Foley’s egocentric epistemology, in its search to determine “what it is rational for individuals to believe at a given moment,” is the kind of epistemological approach best suited to real world, rather than idealized disagreements in Foley 1992: 94. [↑](#endnote-ref-23)
24. Again, I’m personally not convinced that states of affairs objectively bear on propositions to begin with, but am willing to consider that they might do so for the purposes of addressing proponents of the Unidirectional Understanding. [↑](#endnote-ref-24)
25. I am grateful to Charity Anderson, Richard Atkins, Alisa Bokulich, Sharyn Clough, Catherine Elgin, Sam Hall, Liz Jackson, Thi Nguyen, Michael Pope, Russell Powell, John Rosenbaum, Katherine Valde, two anonymous reviewers, the members of the Gonzaga University Philosophy Department, and audiences at the 2017 and 2018 meetings of the Conference on Values in Medicine, Science, and Technology at the University of Texas, Dallas for tremendously helpful feedback. I am especially grateful to Darren Naish for his willingness to correspond with me about these issues. [↑](#endnote-ref-25)