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How to Be Humean

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There are no ideas, which occur in metaphysics, more obscure and uncertain, than those of power, force, energy or necessary connexion.

(Hume 1902, 61–2)

The Doctrine and the Program

David Lewis famously said in the introduction to his second volume of *Philosophical Papers* that he saw a lot of his career in retrospect as being devoted to the defence of Humean supervenience (HS), the metaphysical doctrine that "all there is to the world is a vast mosaic of local matters of particular fact, just one little thing and then another."[1]

The research program as he conceived it was to provide truth conditions for all contingent truths in terms of what he came to call the Humean mosaic.

I have become increasingly confused over the years about what Humean analyses are supposed to achieve. I will argue that if they are supposed to provide content-preserving reductions, they fail for one reason. If, on the other hand, they are supposed to tell us what it is in the realm of Being, according to the Humean, that our beliefs about various things – laws, chances, the value of a dollar bill, or the beauty of a sunset – refer to, they fail for different reasons. I will suggest a significant shift in how the Humean research program is conceived.

In the first section, I argue that Humean analyses don't provide content-preserving reductions. In the second section, I argue that Humean analyses don't provide non-trivial accounts of the reference. In the remaining sections, I introduce a distinction between structure in the realm of Being and structure in our representations of Being and argue that there are good reasons not to expect content-preserving reductions of the modal to the non-modal at the level of content, or useful mappings of content-level structures into structures at the level of Being. I spend the rest of the paper groping towards a reconception of the relationship between content-level structure and structure at the level of Being. I will argue that the debate between the Humean and non-Humean should be

reconceived as a debate about whether non-Humean facts play a substantive role in the story of how beliefs about laws and chances are formed and used.

These are issues that challenge assumptions about the way that content-level structure relates to structures at the level of Being built into practices in analytic metaphysics that Lewis himself had a substantial hand in developing. His work in every area of analytic metaphysics has stood as paradigmatic for a generation for good reason. I think of the shift that I am suggesting in how the program is conceived as something that will advance the program.

12.1 Humean Supervenience and the Failure of Content-Preserving Reduction

There are reasons for worrying about the claim that all there is in the world is a vast mosaic of local matters of particular fact stemming from the apparently non-local correlations connected with quantum phenomena. I will not be addressing those, although they raise important issues.[2] Aside from problems with quantum non-locality, the biggest challenge for HS comes from modalized concepts that are central to science: laws and chances.[3] Lewis devoted a substantial part of his career to Humean analyses of these concepts and his analyses are widely regarded as triumphs of philosophical analysis. Humean supervenience is, as Lewis remarks, named after the great denier of necessary connections in Nature. The difference between Humeans and non-Humeans is that the non-Humean sees patterns in the Humean mosaic as *distinct from*, and typically *explained by*, facts about laws and chances. The Humean, by contrast, sees patterns in the Humean mosaic as *constituting such facts*.

There is a massive literature on details of Lewis's analyses. But the primary motivating factors for the Humean view are that it is metaphysically modest and fits very well with scientific practice. If beliefs about laws and chances and such are veiled beliefs about patterns in the Humean mosaic, that explains very nicely both how we arrive at defeasible beliefs about them and the role they play guiding expectation. It gives us a nice account of confirmation and explains scientific practices and proves remarkably adept at navigating its way through the minefield of objections that have been leveled against it. It is not an accident that physicists and philosophers of science tend to be Humeans.

Lewis's analyses build on a long tradition that includes regularity accounts of law and frequency accounts of chance. Regularity accounts of law hold out the promise of reducing claims about laws to claims about regularities. In its simplest form, a law is a true, universally quantified proposition that holds without exception. Frequentist accounts of chance hold out the promise of reducing claims about chance to claims about the frequencies, or relative frequencies of events (really, event *types*) in a certain kind of reference class. Both types of account, in their simplest form, suffer from obvious counterexamples, and have undergone refinements. The Humean wants to refine them without invoking modality in an ineliminable role. Since he is looking to give truth conditions that invoke only patterns in the Humean mosaic it wouldn't do the Humean any good, for example, to respond to counterexamples to regularity accounts of law by saying laws are not only those regularities that hold in fact, but also those regularities that hold with physical *necessity*. Or to respond to counterexamples to frequency accounts of probability by identifying chances not just with actual frequencies, but with long-run *hypothetical* frequencies. Modal facts are supposed to be part of the output of a Humean analysis, not part of the input.

12.1.1 Best Systems

Lewis, following leads from Ramsey and Mill, saw the need to move from an attempt to give conditions that individual regularities have to satisfy to qualify as laws to holistic reduction of the *systems* of laws associated with a physical theory. The early view ran as follows.

> Take all deductive systems whose theorems are true. Some are simpler, better systematized than others. Some are stronger, more informative than others. These virtues compete: an uninformative system can be very simple; an unsystematized compendium of miscellaneous information can be very informative. The best system is the one that strikes as good a balance as truth will allow between simplicity and strength.... A regularity is a law iff it is a theorem of the best system.[4]

Later, he extended the account to accommodate chance. In the new view, a claim about the laws and chances that obtain at our world formed a theoretical package that could be reduced only all at once to a claim about patterns in the Humean mosaic.

What the Best System account (BSA) gets right is the holistic epistemology of beliefs about laws and chances. What Lewis describes is, more or less, an accurate schematic description of the standards that govern choice of a fundamental theory in physics. The theorist doesn't start with a full description of the Humean mosaic, but he uses information about the Humean mosaic and generates hypotheses about laws and chances in a way that is governed by norms of simplicity and strength of the kind that Lewis was pointing to. It is a great virtue of Lewis's account that, instead of consulting his intuitions about what laws and chances are, he looked to science and gave a recognizable description of how claims about laws and chances are generated from information about actual facts.

Where the BSA goes wrong is that it fails to capture the truth conditions right for claims about laws and chances for something like the same reasons that regularity accounts fail to capture the truth conditions right for claims about laws and frequency accounts fail to capture the truth conditions for claims about probability. The problem is a straightforward generalization of a characteristic problem faced by the more simple-minded regularity accounts of law and frequency accounts of chance. The problem with those accounts is that they seem to fail the test for identity. If facts about laws are constituted by facts about regularities, there ought not to be possible worlds in which the facts about laws come apart from the facts about regularities.[5] But no one that doesn't recognize the possibility of regularities that are not laws is a competent user of the notion of law. And it doesn't matter how fancy you get in characterizing the type of regularity in question. And if facts about chances are constituted by facts about frequencies, there ought not to be possible worlds in which the facts about chances come apart from the facts about frequencies. But no one that doesn't recognize the possibility of divergence between chance and frequency is a competent user of the notion. In this case, the possibility of chances that diverge arbitrarily far from the frequencies is explicitly codified in the axioms of probability. Bernoulli's theorem says that it doesn't matter how large your sample is, the possibility that the chance of an event will diverge from its frequency in the sample remains. The logic of law beliefs (by which I mean their inferential relations to beliefs about local matters of particular fact) explicitly recognizes the possibility of worlds in which there are regularities (even exceptionless regularities) that are not laws and the chances diverge from the frequencies. And any competent user of those concepts has to recognize those possibilities.

The problem for the BSA is quite similar. There is a modal gap between the facts about laws-and-chances and the categorical facts. It is part of the logic of those concepts, embodied in the norms that govern inferences with them. In physical contexts, to say that x is possible according to theory T just is to say that there is model of T in which x is the case. And we can show that there are models of our law + chance packages in which the categorical facts are very different than they actually are, and there are worlds in which the categorical facts are as they actually are, but the laws and chances are different. Let C be the categorical facts at a world W, and T the best systematization of C. There are worlds at which C but not T (C is a model of other theories), and worlds at which T but not C (there are models of T in which not C). It is sometimes remarked that in T-worlds that are not C, the laws are different as well. It is unclear that this is so. Non-C T-worlds are still *T-worlds*, even if T is *not* the best systematization of the facts at those worlds. The situation is exactly the same as in

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the link between laws and regularities, or chance and frequencies. At the level of belief, categorical facts are treated as *evidence* for beliefs about chance, but there is no reduction. Just as the truth conditional content of claims about probability explicitly recognizes the possibility of frequencies that diverge as far as you please from the probabilities, the truth conditional content of T explicitly recognizes the possibility of T-worlds in which T is not the best systematization. To say that L is a law is to add something to the claim that it is an exceptionless regularity. To say that an event e has a high chance of occurrence is to say both more and less than that it actually occurs. And likewise, to say that T is the correct theory is to say both more and less than C. It is to say less than C because there are worlds in which T and not C, and it is to say more, because there are worlds in which C and not T.

This sort of argument is not new. Maudlin gives a version of it in application to the laws:

> Let us suppose (and how can one deny it) that every model of a set of laws is a possible way for *a world governed by those laws* to be. Then we can ask: can two different sets of laws have models with the same physical state? Indeed they can…The situation is even worse for probabilistic laws. Consider a law that assigns a probability to any given event, say the decay of a radioactive atom. The models of such a law will include worlds where every decay event assigns a different probability to the event…again since different laws share the same models, either the laws cannot supervene on the matters of particular fact or else some models of the laws cannot be regarded as physical possibilities relative to those laws.[6]

Why is this not a knockdown argument? Lewis never to my knowledge addressed this form of argument. Loewer holds that arguments that point to putatively possible worlds in which beliefs about law + chance packages and beliefs about their putative Humean truthmakers come apart does little more than express "intuitions of non-supervenience." "The only 'evidence' that the anti-Humean can point to that would, without begging the question, count in favour of the existence of [non-Humean truthmakers for law statements] is our intuitions of nonsupervenience."[7] And he thinks that these intuitions have little probative value:

> There is a long tradition in philosophy of evoking intuitions that are associated with concepts in order to discover the nature of the concepts' reference. This method seems more appropriate for some concepts than for others. But…when [the] subject matter is scientific and when the intuitions concern modality, the argument is very weak and easily defeated by alternative explanations of why we have the intuitions we do.[8]

He argues that, even if they do not capture all of our pre-theoretic beliefs about laws, Lewis-style Humean replacements for laws serve all of the important scientific functions of laws, and we can reject the anti-Humean intuitions without loss and with the reward of a sensible ontology.

But that is not what is going on here. The problem with the BSA is that it tries to understand a physical theory as providing a summary of information about the manifold of actual events, but we don't get the inferential calculus in which beliefs about laws and chances are related to beliefs about matters of actual fact right if we identify them with beliefs about patterns in the Humean mosaic. Knowing how to reason with claims about laws and chances demands recognition that even if it is a good *epistemic* inference from a pattern in the manifold of actual fact to a belief about laws or chances the logic of the inference undermines any equivalence by explicitly allowing for the possibility of worlds in which that inference fails. This is so even *more* explicitly for reasoning in the context of a physical theory. In such a context we don't have to rely on intuitions about what is possible. Physical possibility is represented by the theory's models and we can point to models that falsify the supervenience claim. The content of claims about laws and chances clearly distinguishes them from any set of claims about actual facts.

To think otherwise is to make the same mistake that the behaviorists make with respect to mental facts: that is, to go from the innocent and undeniable observation that behavior forms the basis for beliefs about mental states to the view that such *represent* complicated facts about behavior. Understanding what attributions of mental states *mean*, in a sense that can be understood purely in terms of their inferential connections to other beliefs, demands recognition that the inference from behavior to mentality is defeasible in both directions. The doxastic outputs of the BSA cannot be understood in purely categorical terms any more than the doxastic outputs of a theory of mind can be understood in purely behavioral terms. The BSA undoubtedly provides acceptance conditions, but the connection it establishes between beliefs about patterns in the Humean mosaic and beliefs about laws and chances falls short of equivalence. It is – as we say – an *ampliative* inference.

This shows that if the BSA may provide a goods account of how beliefs about laws and chances are generated from beliefs about the pattern of actual fact, it doesn't provide a content-preserving reduction of modal claims to non-modal ones. Loewer wants to say that maybe, in our everyday reasoning, we treat beliefs about laws and chances *as though* they were separable from beliefs about the pattern of actual fact, and maybe *as though* they explained those patterns, but really any claim about the laws and chance is just a redescription, a summary, a compact way of saying something very general about the pattern of actual fact. This is, of course, the same kind of thing that the behaviorists say about claims about the mental. There are two things to say. First, it is elimination, not an analysis. More importantly, if we add the inference that the Humean wants us to add to our theory – that is, the inference from a description of the Humean mosaic to (L + C) – we close a modal gap that the theory itself recognizes, we eliminate models that the theory itself recognizes as physical possibilities. That means that adding that inference is not a conservative extension, and *that* is enough to show that the BSA can't be a content-preserving reduction. It doesn't get the content of law and chance claims right even within the inferential calculus provided by a theory.

12.1.2 The Function of Beliefs about Law and Chance

There is a welcome emphasis on the pragmatic motivation for theorizing in Lewis's discussions of the BSA that is even more explicit in the discussions of contemporary Humeans. David Albert, for example, makes it clear that the BSA is a description of nature that answers to the pragmatic needs of agents with our limitations. He introduces the BSA as a response that God would make to the following kind of demand:

> Imagine that you have an audience with God who provides you with as much information about the particular facts of the world as you could possibly want to have. One way to provide with information is to recite long lists of particular facts concerning which properties are instantiated at which spatiotemporal locations. Yet, as God begins to recite particular matters of fact, it begins to look as if all this is likely to drag on for a while. And you explain to God that you're actually a bit pressed for time, that this is not all you have to do today, that you are not going to be in a position to hear out the whole story. And you ask if maybe there's something meaty and pithy and helpful and informative and short that He might be able to tell you about the world which (you understand) would not amount to everything, or nearly everything, but would nonetheless still somehow amount to a lot. Something that will serve you well, or reasonably well, or as well as possible, in making your way about in the world.[9]

There is a focus on summarizing in these remarks, but that's not quite enough. Scientific theories represent in terms that are designed to facilitate more specific practical and epistemic tasks and they are formed under epistemic constraints. Criteria for choice of best system (the criteria by which best-ness is judged) reflect this function. These will give content to what is meant by "meaty and pithy and helpful and informative and short." So, for example, the information that goes *into* the

construction of the best system has to be discoverable by limited beings, and the packaging it affects gives it a shape that answers to human needs. To be informative they have to be stated in a language from which we can extract information about the things we are interested in. To be helpful, they have to help us solve the kinds of problems we frequently encounter. Meatiness, pithiness, and short-ness can be measured by strength and compactness. They also have to be accessible to the likes of us under the kinds of epistemic conditions we face. If the only way of forming (not necessarily infal-lible, but reasonable, defeasible) opinions about best systems were to have a private audience with God, they wouldn't provide practicable solutions to real problems.[10] The point is that the criteria by which best systems are judged need to be filled out in terms that are relative to human abilities and ends.[11] A better understanding of the kinds of cognitive tasks that BSAs subserve gives more specific content.

Cognition is in every way shaped and designed to help us overcome the informational bottleneck created by the low bandwidth of perception with an eye to facilitating effective action. Unlike pre-cognitive systems that respond to information contained in sensory states, we process sensory infor-mation through an evolving model of the world that serves as a repository for information acquired from multiple sources over a whole history of experience. These models contain all kinds of structures poised to facilitate practical and empirical inferences, without any clear distinction between those that perform a purely descriptive function and those that have some more practical role. Science is an extension of cognition, with the same epistemic and practical interests. In these terms, we can see more clearly why the structures that play those roles can't be given content-preserving Humean reductions. Functionally, information about laws and chances are partially prepared inferences. They provide recipes for generating a good guess or strategies for making a good choice. To serve that func-tion, they have to have implications not only for what *will* happen, but what would happen under conditions that may or may not be realized. Their modal implications outrun any summary of cat-egorical facts and that play a crucial role in the kinds of cognitive tasks for which they are employed. The modal gap – that is, the ineliminable looseness of fit we saw between chance and frequency and also between law and regularity – has to do with the role of these shortcuts for solving practical and epistemic problems with the kind of loose fit to the facts that they need to play that role.

Consider the role that chances play guiding the formation of expectation in the absence of specific information about the outcome. In Lewis's framework, chances are single-case probabilities derived from history-to-chance conditionals which give the general probability of a particular event condi-tional on the history (or in a relativistic setting, the back light cone) up to the moment at which the event is slated to occur. Since chances are supposed to guide opinion in the absence of specific infor-mation from the future, these general probabilities can't be defined only for the actual future. They have to cover an open-ended class of potential futures, specifically all of those potential futures that are epistemically possible for the agent. Or consider the role that laws play in practical reasoning. An agent faced with a choice about how to act uses the laws to predict the downstream consequences of potential actions and her assessment of those consequences guides their choice. To play that role, they need to support conditional expectations about what *would* occur under alternative choices. And that means that no reduction that eliminates the modal content of law and chance beliefs could play the role they play in choice.[12]

The BSA does a very good job of capturing how beliefs about local matters of particular fact are transformed into beliefs about laws and chances. But the functional role of beliefs about law and chance demands that the content of those beliefs outrun any beliefs about what actually happens. This means that as an account of acceptance conditions, the BSA succeeds. But Lewis is absolutely clear that he intends it as a constitutive account of what laws and chances are. In his words: "I insist that I am not talking about how evidence determines what's reasonable to believe about laws and chances. Rather, I'm talking about how nature – the Humean arrangement of qualities – determines

what's true about the laws and chances."[13] He is equally clear that an analysis of what chance is has to answer to its role in cognition. As he puts it: "A feature of Reality deserves the name of chance to the extent that it occupies the definitive role of chance; and occupying the role means obeying PP." PP, of course, is the Principal Principle, which Lewis intended to capture the epistemic role of chance. It says that chances have the role of guiding belief about future events in the absence of specific information about their outcome.[14] If it can be shown that beliefs about laws and chances are not interchangeable in cognition with beliefs about patterns on the Humean mosaic, by his lights that would be a reason to reject the analysis. He spends a lot of time wringing his hands about whether the possibility of undermining futures (epistemically possible futures that are incompatible with the present chances) disqualify the distributed patterns that serve as truthmakers for best systems from playing the cognitive role of chance. The worry there is that the facts about chance are "inadmissible," which is to say that they defeat the application of PP (briefly, chances guide credence in the absence of inadmissible information, but information about chances itself looks like it turns out to be inadmissible). Lewis thinks that a solution to the undermining problem was found, but I'm suggesting that he should have seen it as a symptom of the more general problem that that emerges very clearly when we view the role of beliefs about probabilities and law in the cognitive life of the agent. *In the epistemic and practical context in which beliefs about laws and chances are deployed, they are not interchangeable with any set of beliefs about what actually happens.* Law and chance beliefs are not interchangeable in inferences with beliefs about categorical facts. They have modal implications that outrun those of any set of categorical facts, and those modal implications play an indispensible role in practical and epistemic reasoning. That is enough to show that no content-preserving Humean reduction of such claims is possible.

The BSA is a recipe for generating beliefs about what will or would happen from beliefs about what has happened. It takes the partial knowledge we have about the past and generates inductive hypotheses in the form of best systems, or chance + law packages, or scientific theories that tell us not what *does* happen, but what *would* happen under a range of epistemically and practically possible conditions. To eliminate the modal content of these packages is to eliminate a part of the inductive content that plays a crucial role in epistemic and practical reasoning. No Humean replacement for beliefs about law and chance that recasts them as summaries of information about the categorical facts can play that role.[15] If the fight between the non-Humean and the Humean is conducted on this battleground – that is, as a fight about the *content* of claims about law and chance – the non-Humean wins.

12.2 A Different Conception of Humean Reduction: Identifying Truthmakers

Suppose we acknowledge that Humean analyses don't provide content-preserving reductions of law and chance claims. There is a somewhat different conception of what Humean reductions are supposed to accomplish that is closer to the way that Lewis seems to have conceived it that I will now consider. When Lewis raised the question about what chance is, he raised it as a question not about the content of beliefs about chance, but a question about semantics, that is, a question about what features of the world those beliefs *refer to*, or what facts about the world make beliefs about chance *true*. Lewis holds as a general metaphysical doctrine that every truth must be made true by some feature of Being, and so, if HS is the right account of Being, every truth must be somehow *made true* by the local arrangement of qualities.[16] The Principal Principle was introduced as an implicit definition that identified chance by its connection to belief and then he set about looking for something in the Humean account of Being that could act as truthmaker for beliefs about chance. The Principal Principle says that believers without crystal balls should adjust their credences to the chances where

they are known, and so this means that, as he says: "Whatever *makes it true* that the chance of decay [of a radioactive atom within a given interval] is 50% must also, if known, make it rational to believe to degree 50% that decay will occur."[17] The idea is that we can think of any class of beliefs as picking out some aspect of what there is (something, we might say, in the realm of Being) in a manner that is implicitly defined by their role in reasoning, and it is left to the metaphysician to give an explicit characterization of what those beliefs pick out. The question for the metaphysician interested in chance is "What could we assign as truthmakers to beliefs about chance from the perspective of Being that would make sense of their cognitive role?"[18] And the Humean answer has to be some pattern in the Humean mosaic.

But if that is the question Lewis set out to answer, he didn't end up answering that question in an informative way. He effectively gave up on an interesting semantic story in terms of non-trivial correspondence to specifiable features of the Humean mosaic when he moved from individual reductions of chance and law to reduction of the content of chance + law packages. The holistic restructuring effected by the BSA undermined the hope of identifying specific features of the Humean mosaic that could be assigned as reference to beliefs about chance. What he ended up saying effectively was that nothing less than the whole pattern of categorical fact serves as truthmaker for the BSA as a whole and each of its theorems.[19] And that means that if beliefs about chance refer to *anything* in a Humean world, they refer to *everything*. If we ask "What makes it true that the chance of radium decaying at a particular moment in history is 50 percent?" the answer is the fact that it is a theorem of the best systematization of the whole unfolding history of the world that the chance of decay is 50 percent. Literally. Period. If we ask "What makes it true that the chance that a spin-half particle entering a measuring device at another moment, in a different place will show an up result is 50 percent?" the answer is the same. If we ask "What makes it true that the fundamental laws prohibit acceleration of massive particles past the light barrier, or that it is possible for a human being to swim the English Channel?" the answer is the same. And so it goes for every theorem of the BSA.

What Lewis really ended up doing is giving us a schematic account – in the BSA – for forming modal beliefs. The BSA was a good schematic account of how best systems package information for useful deployment in practical and epistemic problems. And the pragmatic criteria that govern that repackaging were immediately recognizable to many of those who work in the philosophy of science as the right account of theory choice in science. What Lewis *didn't* provide was either a content-preserving reduction of modal to non-modal belief or a non-trivial account of reference.

12.3 Digging Deeper

Let's make a distinction between what I call *content-level structure* and structure in the realm of Being. Content-level structures are structures defined over the contents of representations, whether these are theories, maps, mental models, or beliefs. Structure in the realm of Being is structure that is intrinsic to the mind-independent fabric of Being. There's a very confusing ambiguity in the notion of truth conditions that runs through philosophy and that doesn't distinguish content-level relations from relations that bridge the gap between content-level phenomena and Being. Sometimes truth conditions are construed as part of formal semantics. In that capacity, truth conditional equivalence preserves inferential role. Sometimes, however, truth conditions are thought of as assigning extensions from one's account of Being.[20] The arguments that I gave in section 12.1 against construing Humean analyses as content-preserving reductions were really arguments against the interchange-ability of claims about laws and chances with claims about patterns in the Humean mosaic at the level of content. At the level of content, there is a separability canonized in the inferential calculus that relates beliefs about laws and chances to beliefs about categorical facts. When we thought about

the function of beliefs about laws and chance, we saw why that was so. Laws and chances have an inductive modal content that plays a role guiding expectation and decision, they have implications not only concerning what *does* happen, but also what *would* happen in epistemically and practically possible situations. We then considered a different view of what Humean analyses were supposed to achieve, which conceived of them as bridging the space between content-level structures and Being. In this capacity, Humean analyses were conceived as assigning truthmakers to law and chance beliefs drawn from the Humean mosaic. And we saw that Lewis failed to find informative correspondences. He ended up saying that every truth is made true by the whole pattern of fact.

I want to look a little more deeply now into why Lewis failed to find useful correspondences. Here I want to take a side-on look at the relationship of content-level phenomena and Being, when the contents in question are those of the structured representations that situated agents use to steer by (whether we are talking about beliefs, or the internal maps that we form to steer by, or the structured representations embodied in a scientific theory) and Being is characterized, as Aristotle would have said, qua Being, which is to say, a thoroughly deperspectivalized, intrinsic description of reality often referred to nowadays, somewhat misleadingly, as the God's Eye view.[21] Lewis offered the Humean Mosaic as an account of what there is in this sense, and he thought that if he was right, for every structure at the level of content, there has to be some corresponding structure at the level of Being that that structure reflects.[22] There are localized correspondences between particular localized objects and occurrences at the level of Being and structures on our models. But there won't be these localized correspondences between localized structures at the level of Being and laws and chances. Each law and chance belief is going to be made true by the way things generally hang together. The extension is distributed, but the truthmaker relation is going to be the same.

There are two ways of understanding the idea that every true belief, or every structure on our scientific models of the world, reflects some structure at the level of Being. One is harmless, but empty. The other is substantive, and intuitive, and it has played an important role guiding imagination about representation, but wrong. The harmless way is the one that has become known as the deflationary interpretation. I'll say little about it here, except as an alternative that avoids the pitfalls of the substantive and intuitive interpretation. The substantive and intuitive interpretation I want to make explicit because seeing what is wrong with it is the best way to get the right view. The substantive and intuitive interpretation of the "every truth has a truthmaker thesis" holds that every structure at the level of content has the job of *standing for* some feature of the way things *are*, that is, as Bernard Williams used to put it, "there anyway." This is an idea of truthmaking built on the paradigm of what Huw Price calls "matching games."

> Imagine a child's puzzle book, designed like this. On the right side of each page there's a picture of a complex scene, on the left side a column of peel-off stickers. For each sticker – the Opera House, the Harbour Bridge, the koala, and so on – the child needs to find the corresponding object in the picture. The game is successfully completed when every sticker has been placed in its correct location.
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> Now think of the right-hand side as the world, and the column of stickers as the set of statements we take to be true of the world. For each statement, it seems natural to ask what makes it true – what fact in the world has precisely the "shape" required to do the job. Matching true statements to the world seems a lot like matching stickers to the picture…[23]

The paradigm of representation built on the model of the matching game fails to be a fully general account of the relations between content-level structure and Being. There are many different reasons that we might fail to find correspondences: emergence (some high-level structures will be the product of complex interactions at lower levels and resist mapping onto any structure in a static representation of Being), holism (some will carry partial information about the whole pattern, but

not full information about any part), implicit relationality (some will be implicitly relativized to the situation of a participant in Nature and appear only in a relational form). The reason that it fails when we look at structures like laws and chances is a little more general. It has to do with the job these structures play.

Laws and chances act in our cognitive lives as partially prepared solutions to frequently encountered problems, a job that only makes sense in a representational setting characterized by asymmetries in our practical and epistemic relations to events. Our representations of Nature are organized around the distinction between what is known and what merely is, and the distinction between what I do and what merely happens. Some beliefs have the role of standing in for features of the world as it appears in our account of Being: the kind of inner proxy for outer objects that is the paradigm of reference in the matching game. But some of them are designed to help us overcome epistemic and practical limitations.[24] Best systems repackage information in forms that are poised to play a role in the kinds of practical and epistemic problems we face. In the case of chance, the right account of their function has to be connected to seeing how they help us resolve opinion in the absence of specific information about an event.[25] And in the case of laws (and other alethic modalities like propensities and capacities and dispositions), the right account has to be connected in a very deep way to seeing how they help resolve decision, where counterfactual implications matter.

To conceive of representation (whether it is the formation of beliefs, or the construction of best systems) as wholly engaged in reflecting features of a landscape that is separate and independently well-defined treats it as a kind of passive reproduction, as though history, from the mind's perspective, were a fixed field of events that simply comes into view in stages. But there is no stable position that sees cognitive activity as in the business of merely reflecting what is "there anyway" or "there already." It views history as partly constituted by its own activity.[26] Our *decisions* about what *to* do make a difference to our *beliefs* about what *we will* do, and our beliefs about what we will do, make a difference to how we expect history to play out. If I haven't decided whether to pin with my rook or castle with my knight, my expectations about what will happen are as open as my decisions. To the extent to which what happens at later stages depends on what happens next, it hangs on my decision. Until a decision is rendered, my expectations about how the game will play out are conditional. There is no way of stabilizing our beliefs about the part of the Humean mosaic that lies in the future without stabilizing our plans. And the ordinary way of stabilizing one's plans involves imagining the results of different potential paths. That is what makes reasoning for an embedded agent – that is, a participant in the events that he represents, not merely an observer – necessarily, in part *practical*. And it is in their role in practical reasoning that makes alethic modalities indispensable for the agent. When he is reasoning about the future, his beliefs about what will happen are inseparable from his beliefs about what he will do. And his beliefs about what he will do depend on his beliefs about what *would* happen under various possible choices for action.

When we adopt the perspective of Being, we abstract from asymmetries in our relations to events around which much ordinary cognition is organized. We abstract not only from the epistemic limitations that give chance its *epistemic* role, we abstract from the practical perspective of a contributor to history that gives the alethic modal beliefs their *practical* role. The distinction between known and unknown and the distinction between what I do and what merely happens introduce asymmetries at the level of content around which many of the structures and concepts that are central to both cognition and science are structured.[27] These give rise to two concomitant notions of modality: the concept of a range of ways the world might actually be so far as I know, and the concept of a range of ways the world could be, only one of which is actual. There are epistemic possibilities and practical possibilities. Belief for an embedded agent is belief about a future that is both uncertain and unsettled. It is uncertain because he has limited information. And it is unsettled because the future is partly constituted by decisions he has yet to make. It is simply not true that every non-logical

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term has the job of *standing for* some feature of the world that is "there anyway." If we want an interesting and informative account of epistemic and alethic modality we have to locate modal beliefs in the epistemic and practical context created by the embedded perspective and see what role they play.

Now we can see more clearly both why Lewis failed to provide reductions and why he failed to find useful correspondences. He failed to find reductions because best systems have to have inductive content that can help them resolve uncertainty and decision. And he failed to find useful correspondences because when we adopt a four-dimensionalist perspective and look for static mappings of content-level structures into Being, we abstract from the distinctions that allow us to distinguish the roles that different structures play. There are two sorts of distinctions: distinctions in extension, and differences in internal role. One of the results of the holistic restructuring affected by the BSA is that we won't expect to find differentiation in extension. All of the outputs of a best system reflect the way things generally hang together. We get interesting differentiation among the different structures by looking at the roles they play in our cognitive and epistemic lives.

This doesn't just go for beliefs about laws and chances. Agents form all kinds of belief – beliefs about dogs, colors, democracy, about the value of the American dollar, what tastes good and looks good, what is beautiful, and what is right, what should be eaten, and what should be avoided. Not all of these have the job of standing for something that is there anyway. A fully articulate reproduction of the relationship between belief and Being will exhibit the full variety of relationships between content-level phenomena and Being. There are a lot of distinctions to be drawn in terms of the roles of various structures and the widely distributed facts about world and agent that jointly support those roles. But there is no more compact story about a class of beliefs relates to the world from a God's Eye view than the full dynamic story of the role it plays in the complex two-way coupling between mind and world. The distinctions we draw in the roles different classes of belief play from the side-on are not distinctions between what is *real* and what is not, or what really *refers* and what does not, or between is in *the world* and what is in *us* (as though we weren't in the world). Those dichotomies are all too simple to provide a fully general account of the complex, intertwined coalition of factors concerning how things are with us, on the one hand, and with the world, on the other, that are implicated in even in very simple cases of belief. And they are too simple to capture the array of different roles beliefs play in mediating the interaction between agent and world. These coalitions are revealed in the side-on account of the facts about the world and our situation in it that open up the space for belief in all of its forms.[28]

12.3.1 The Side-On View as a Generalization of the Search for Truthmakers

The side-on account will tell the full story of how such beliefs are formed and used, replacing the expectation of static two-term truthmaker relation between belief-contents and Being with something dynamic and a good deal more complex, something that is both world and agent involving, and opens up a range of differences in direction of fit and cognitive role. The problem with the "every truth has a truthmaker" thesis is that either it interprets the truthmaker relation in a way that tries to assimilates all belief to the paradigm of Price's "matching game," in which case it gets the wrong account of laws and chances. Or it remains neutral about the structure of the truthmaking relation abstracting from differences in cognitive role and direction of fit. In this case, it leaves us with a wholly uninformative mapping of the full body of outputs of theorizing into Being. All theorems of the best system turn out to have the same truthmaker.

Whatever story you tell about how situated agents repackage information for useful deployment in practical and epistemic inferences is going to be complex, dynamic, both agent and world involving. Differentiation between the outputs of the holistic restructuring affected by a theory is going to invoke

differences in *function*, not *extension*. If we want an interesting and informative account of how a class of beliefs finds a place in our view of the world, we have to locate those beliefs in the epistemic and practical context created by the embedded perspective and see what role they play. This means (i) reintroducing the agent as a third term relating model to world, and (ii) taking a dynamic perspective. Representation is thought of not as a relation, but an activity, and an activity pursued by agents. Resituating models in the dynamics that mediates the interaction between agent and environment frees us from an outmoded, a-practical idea of representation is for, and gives us the tools for understanding the complicated ways in which content-level structures relate to Being, and why the idea of truth built on the paradigm of unmediated correspondences between representation and representatum is just not very helpful in this capacity.

12.3.2 The New Humean

My suggestion to the Humean is to distinguish content-level relations from relations between belief and Being. Deny that law and chance beliefs are interchangeable with beliefs about categorical facts at the level of content. Firmly reject extensional analysis of modal belief as "picking out" some feature of the world that is "there anyway"; replace extensional analysis with a side-on account of the role beliefs about laws and chances play in the coupling between agent and world.[29] The side-on account is presented as the generalization of the truthmaker relation. Beliefs are not distinguished just in extension, but internal role. The BSA is presented is presented as part of a side-on view of how beliefs about laws and chances are formed. It is supplemented with a story about the role they play in our cognitive and epistemic lives, facilitating the practical and epistemic inferences.

The Humean agrees with the non-Humean about relations at the level of content. Where the Humean and non-Humean part company is that they have a different side-on view. The anti-Humean thinks that there are modal objects or properties among the fundamental furniture of Being that explain the acquisition and use of modal beliefs in the way that dogs and donuts explain the acquisitions of dog and donut beliefs. The Humean story starts with the BSA and says how beliefs about law and chance package information about the Humean mosaic in forms that are poised to guide belief and action for creatures like us invoking nothing as input to the formation of modal beliefs but local matters of particular, actual fact. What does God see according to the Humean when he views the world *sub specie aeternitatis*? He sees a world that exhibits enough regularity to support scientific activity. He sees the formation of local open subsystems that exhibit behavior robust and regular enough to support modelling. He sees the stabilization of chances and causal pathways at the local level. He sees the emergence of cognitive agents that exploit that regularity to direct behavior to their advantage and how such agents construct models that allow them to gauge the effects of potential interventions in the world. He sees the transformation of the informal construction of models into an inductive art in the hands of science and tells the story of how our expectations under uncertainty and beliefs about the modal substructure of the world become systematized and cast in the form of beliefs about laws and chances much as the BSA said they did. All of this is part of the natural history of Being. And that is all there is.

I will put this by saying that, for the anti-Humean, modal beliefs reflect modal facts. For the Humean, modal facts are shadows of modal beliefs.[30] This changes the site of the dispute so that it is a dispute about the correct account of how modal beliefs are acquired and deployed. This is where I think the dispute should be conducted, and it is where I think the Humean has an advantage. The demand for an intelligible side-on story is the demand to do what Shimony described as "closing the circle," integrating one's ontology with one's epistemology and with one's pragmatics. I haven't tried to fight that battle here for the Humean, but it is the field on which the battle should be fought, and the one on which the Humean has an advantage.

12.3.3 Lewis's Transition from a Deflationary to an Inflationary Modal Ontology

Interestingly, Lewis's own account of belief formation about modal facts – at least the modal beliefs that are the output of scientific theories – doesn't mesh very well with his modal metaphysics. And one of the most important arguments about his modal metaphysics is precisely that it fails the test for providing an intelligible side-on story. Anyone that introduces things into her ontology as truth-makers for modal beliefs owes a side-on account that tells an intelligible story about how our ways of forming modal belief are ways of forming beliefs about *those* things, and why beliefs about *those* things play the role that modal beliefs play in our practical lives. And it is very hard to give such an account if modal beliefs are beliefs about Lewisian possible worlds.

Let us introduce a distinction between inflationary and deflationary realism.[31] The difference between the two is not a difference in the cognitive function or psychological attitude one should take to modal belief. Both are forms of modal realism. The difference between them emerges from the side-on view and has to do with where and how modal beliefs arise. The inflationary realist thinks about A that there is something in the mind-independent fabric of reality, something that is, as I have been saying "there anyway," well defined independently of A-beliefs, and which plays an explanatory role in the production of those beliefs. The deflationary realist tells a story about how A-beliefs arise that doesn't invoke A-facts, and thinks of the A-facts as shadows of A-beliefs. In an inflationary story, the facts about As are part of the input to the formation of A-beliefs. In a deflationary story, the A-facts are part of the output. The deflationist about modal facts denies that the existence of possible worlds, or other kinds of specifically modal truthmakers plays the same sort of explanatory role in the formation of modal beliefs that the existence of trees plays in the formation of tree beliefs, or the existence of dogs plays in the formation of dog beliefs. One gets to be a modal realist without being an *inflationary* realist if one can tell about how modal beliefs get up and running, how they are used, and the role they play in guiding belief and action that doesn't invoke possible worlds, or other kinds of specifically modal truthmakers in an explanatory role.

It is interesting to see the development of Lewis's own views through these lenses. Lewis gave an entirely valid deflationary argument for the existence of possible worlds in *Counterfactuals*:

> I believe, and so do you, that things could have been different in countless ways. But what does this mean? Ordinary language permits the paraphrase: there are many ways things could have been besides the way they actually are. I believe that things could have been different in countless ways; I believe permissible paraphrases of what I believe; taking the paraphrase at its face value, I therefore believe in the existence of entities that might be called "ways things could have been." I prefer to call them "possible worlds."[32]

As far as Lewis says in this passage, possibilities are just ways things might have been. Possible worlds are shadows of beliefs about the way things might have been, leaving open for hermeneutic interpretation beliefs about the way things might have been. But there was a switch between the deflationary argument in *Counterfactuals* and *On the Plurality of Worlds*, where Lewis began defending an inflationary ontology for possible worlds. There Lewis argues that possible worlds are same in kind, different in number from our world. They are distinct, non-overlapping, unified, concrete structured objects.[33]

> When I profess realism about possible worlds, I mean to be taken literally. Possible worlds are what they are, and not some other thing. If asked what sort of thing they are, I cannot give the kind of reply my questioner probably expects: that is, a proposal to reduce possible worlds to something else. I can only ask him to admit that he knows what sort of thing our actual world is, and then explain that possible worlds are more things of *that* sort, differing not in kind but only in what goes on at them.[34]

The reasons he gave were that including possible worlds in our ontology the best account of modal speech involves quantification across possibilities, that our best theory of counterfactuals relies on comparisons between possible worlds, that our best theory of mental and verbal content analyses content in terms of sets of possibilities, and that quantification over properties is best understood as quantification over possibilia.[35] Given the availability of deflationary realism, the question to ask is not whether the right account of these matters quantifies over possible worlds, but whether the world-sized concrete particulars that Lewis introduces as truthmakers for modal beliefs play any explanatory role in those accounts. I don't know the answer to this. One can certainly accept all of the work Lewis did formalizing the semantics for everyday counterfactuals without being committed to his inflationary ontology.

Even among those that reject Lewis-worlds, much of the post-Lewisian discussion of modal meta-physics is organized around the search for truthmakers for modal beliefs.[36] From the point of view of the new breed Humean, this is all scratching where there is no itch. The whole story about laws and chances is given in the side-on account of use.

12.3.4 Objections and Queries

Is this instrumentalism? That depends. I certainly think that laws and chances are tools that help us solve practical and epistemic problems, part of a wider class of structures like dispositions and capaci-ties and causal relations that guide expectation and interaction with a world that is partially known and subject to our input. But I deny some of the traditional accompaniments of instrumentalism, that is, that they are uninterrupted nodes in a formal calculus, that they don't have representational content, or that they are not truth-bearing. In my view, they are structures that are defined on our practical and epistemic interface with Nature, akin to the embellishments we might add to a map of our neighborhood to make it easier to steer by.

Doesn't the fact that the side-on story makes ineliminable use of modal vocabulary show that modal facts have to be part of the fundamental furniture of the world? This is an objection that I've heard several times. Of course we give the side-on account in fully modalized vocabulary. The side-on account is an explanation of how modal belief arises, and all explanations occur at the level of content and presuppose the connexions that are built into that level. I acknowledge that modality is primitive at the level of content. What I deny is that primitive content-level structures correspond to primitive structures at the level of Being. A lot of the structures that define the space within which cognition operates are contingent, emergent, approximate, and perspectival from the point of view of physics. A good many of them are organized around epistemic and practical asymmetries in our relations to events rather than among events themselves. The relationship between content-level structure and structure at the level of Being is mediated by the side-on account which tells us how modal belief arises without inflationary realism.

12.4 Conclusion

I argued that either Humean analyses present themselves as an account of the relations among Ideas, or they present themselves as accounts of the relations between Ideas and Being.[37] If they present themselves as accounts of the relations among Ideas, they fail for one reason. If they present them-selves as relations between Ideas and Being, they fail for another. They fail as accounts of the relations among Ideas because there is a separability between beliefs about laws and chances, on the one hand, and beliefs about local matters of particular fact, on the other, in something like the way there is a separability of beliefs about meaning and linguistic behavior or beliefs about the value of a dollar bill

and economic behavior.[38] We can stabilize beliefs about laws and probabilities (regularities distilled out of what we know of the past and projected into the future and epistemically and practically possible situations) because there are regularities that are robust across differences in space and time, and largely indifferent to the results of the individual interactions they are used to guide. They guide our expectations about what does happen, but they are not reducible to claims about what does happen because, in both cases, they have implications for what happens in epistemically and practically possible situations that is indispensable to their cognitive role. If they present themselves as accounts of the relations between Ideas and Being, they fail, because there is no interesting and informative mapping of beliefs about laws and chances into the Humean mosaic.

The lessons to be drawn from this: give up the project of providing content-preserving reductions or mapping Ideas into Being; reconceive the BSA as part of a side-on story about how beliefs about laws and chances are generated. Supplemented with an account of the cognitive and epistemic role they play for situated creatures like us – an explanation of how we form beliefs about laws and chances, and the role those beliefs play guiding expectation and choice – they tell the whole story of how laws and chances earn their place in the world-view of Beings like us.

My advice to the Humean is to dissociate himself from any attempt to provide content-preserving reductions or a semantics for modal belief. Present the BSA as part of a side-on account of the roles that beliefs about laws and chances play in the cognitive and epistemic life of situated agents living in a world constituted wholly by the Humean mosaic. To scratch one's head at the end of the hermeneutic story and insist that there must be something outside the Humean mosaic, that modal beliefs refer to, something that makes them true, something that they represent, is to get bewitched by a picture of *representation* built on the model of Price's "matching game." Wittgenstein once accused philosophers of behaving like little children who, as he said,

> scribble some marks on a piece of paper at random and then ask the grown-up "What's that?" – It happened like this: the grown-up had drawn pictures for the child several times and said "this is a man," "this is a house," etc. And then the child makes some marks too and asks: "what's this then?"[39]

Nowhere is this remark more apt than in the interpretation of the models presented by a scientific theory. It is as though we take a map, embellished with structures we ourselves have developed to guide epistemic and practical reasoning, and then look at it and ask "What is that, then?"

Notes

1 Lewis 1986b, ix.
2 Maudlin 1994.
3 I will focus on laws and chances because they appear in fundamental physical theories and have the most straightforward treatment. What I say will apply also to causes, dispositions, capacities, and potencies.
4 Lewis 1994, 478.
5 That is to say, they ought to pass the logical test for identity: $A \neq B$ iff there are possible worlds in which $(A\&\sim B)$ or $(B\&\sim A)$.
6 Maudlin 2007, 68. The second disjunct can be accepted only on pain of divorcing the notion of physical possibility from the one that science employs.
7 Loewer 1996, 199.
8 Loewer 1996, 198.
9 Albert (n.d.).
10 Of course, in practice, beliefs about the BSA are themselves formed under epistemic constraints; and so we are always simultaneously using information about local matters of particular fact to form opinion about

laws and chances, and using opinion about laws and chances to form particular expectations on the basis of past fact. But this won't affect the discussion here. See Ismael 2008.

11 Loewer recognizes this and fills it out in his version of the BSA. See his remarks about length, etc., in Loewer 1996.

12 We can divide modal notions into two classes: the epistemic modalities which involve the notion of a way the actual world could be, so far as I know, and the alethic modalities which involve the idea of an alternative way the world could have been, *otherwise* than it actually is. Epistemic modalities (e.g. chance and probability) guide belief. Alethic modalities (e.g. cause and law) guide choice.

13 Lewis 1994, 481–2.

14 Lewis 1994, 489

15 A successful reduction would eliminate the need for *specifically* modal beliefs by showing them to be summaries of facts that could be stated in purely categorical vocabulary.

16 "If HS is true, then contingent truths about chance are in the same boat as all other contingent truths: they must be made true, somehow, by the spatiotemporal arrangement of local qualities" (Lewis 1994, 476).

17 Lewis 1994, 476, my emphasis. It is also worth noting here that the "if known" is crucial. I have argued that it makes the revisions to the principle unnecessary. See Ismael 2008.

18 Loewer goes a little farther, expanding the role of chances and laws to include the scientific and explanatory practices in which they figure. In this expanded account, our beliefs and practices form a kind of implicit theory, and, again, the question is what in the world could we assign as reference to law and chance beliefs that would (more or less) satisfy the implicit theory. As he says "[Humean analyses of concepts like law and chance] should be evaluated in terms of how well they ground and illuminate the practices involving the concepts. These practices are reflected in and are to an extent codified by our beliefs involving them" (1996, 183).

19 He writes: "What pattern in the arrangement of qualities makes the chances? In part, features of history up to the moment in question. For the rest, it is the pattern that makes the probabilistic laws, whatever that is" (Lewis 1994, 476).

20 The confusion is, I suspect, a good part of what is concealing the unclarity about Humean reductions.

21 It is misleading, as often remarked, because it uses the notion of "point of view," where what is really wanted is a *non-perspectival* characterization.

22 This is just the generalization of the idea that, as he put it, "every true belief [or every truth statement] is *made true* by some feature of the Humean Mosaic."

23 Price 2007.

24 The notion of the direction of fit commonly invoked to draw some of these differences is not a static one. Nor is it, by itself, enough to draw the distinctions we want to draw among all of the different ways in which a representational state can relate to the world. There is no simple dichotomy that can draw them and the attempts to characterize the notion of direction of fit is testament to that complexity. The notion is usually introduced with a collection of examples – we have belief and memory on one side, and intention and imagination on the other – and attempts to capture the differences (e.g. in terms of direction of counterfactual dependence, normative guiding, or the direction of the controlling conditional intentions, or any such thing) all fail as fully general characterizations of the class of cases, and even if the notion of direction of fit could be characterized to distinguish the menu of examples, it would not be enough to draw all of the differences that need to be drawn among classes of belief. It would fail notably, for example, to provide an account of counterfactual belief.

25 When we adopt the perspective of Being, we abstract not only from the epistemic limitations that give chance its *epistemic* role, we abstract from the practical perspective of a contributor to history that gives the alethic modal beliefs their *practical* role.

26 Even if we distinguish mental activity from physical activity, and restrict history to include only the publicly observable domain of action, from the agent's perspective history bears the marks of her mental activity. Her beliefs about history are not *closed* with respect to beliefs about her own mental activity. She decisions about how to behave, she has beliefs about the effects her decisions will have, and her decisions feed right into her expectations for the future.

27 These asymmetries are reconstructed in relational terms restoring symmetry at the level of Being.

28   Examples of the kind of side-on account I have in mind: Blackburn on ethical beliefs, Callendar on the temporal value asymmetry, Kutach on causation.

29   See Price 2011.

30   This way of putting it captures the fact that the difference is one that is visible only from a dynamic perspective.

31   See Price 2011 and Thomasson forthcoming.

32   Lewis 1973, 84.

33   More explicitly:

1.   Possible worlds are just as real as our world;
2.   Possible worlds are the same sort of things as our world – they differ in content, not in kind;
3.   Possible worlds cannot be reduced to something more basic – they are irreducible entities in their own right.
4.   Actuality is not a property but an indexical. Each world is actual relative to itself and merely possible relative to other worlds.

These four claims form the foundation of Lewis's inflationary realism.

34   Lewis 1973, 85.

35   Lewis 1986a, chapter 1, sections 1.2–1.5.

36   See, for example, Adams 1974; Stalnaker 1976; Forrest 1982; Forrest and Armstrong 1984; Sider 2002.

37   I use "Ideas" neutrally to mean the kinds of structured representations that we form mentally or build in science (concepts, maps, models).

38   Beliefs about linguistic meaning are stabilized out of a very complicated set of linguistic interactions and play a role at the individual level guiding behavior. Beliefs about the value of the American dollar are stabilized out of a very complicated set of facts about economic behavior and can play a role at the individual level guiding economic behavior. In each case the separability depends on de facto stability of the former relative to the individual interactions that they guide.

39   Wittgenstein 1978, 17.

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