EXPLANATION, TRUTH, AND THE EXTERNAL WORLD

We take for granted that our sensory experiences arise veridically, so that what we think about the world is largely true. But it is metaphysically possible that we are the victims of massive sensory deception, so that much of what we believe about the world is false. Skepticism, as I understand it here, is the thesis that we have no more reason to believe that things are one way rather than the other. In other words, our choice is underdetermined by whatever evidence is available to us.[1]

One line of response to skepticism is *explanationism*. The explanationist maintains that:

(a) The Real World Hypothesis (RWH), the body of beliefs about the world we ordinarily hold, is a better explanation of various experiential facts than skeptical hypotheses are.[2]

and

(b) It follows that the choice between the RWH and skeptical hypotheses isn't underdetermined by the evidence constituted by the experiential facts. We are justified in accepting the RWH and rejecting its skeptical competitors.

Both claims are controversial. With respect to (a), there are broad issues about what makes one explanation superior to another. There are also more specific questions as to whether and why the RWH might have more explanatory merit than skeptical hypotheses do. Claim (b) is also open to doubt. One concern is that explanatory considerations like simplicity are merely aesthetic or pragmatic. Aesthetic or pragmatic factors may make it pleasant, useful, or satisfying to adopt a hypothesis, but such factors don't provide (epistemic) justification for believing a hypothesis. This misgiving may be associated with another, although the latter can arise independently.[3] The further concern is that explanatory inference (inference to the best

explanation) doesn't yield justified belief, because there is some kind of gap or disconnection between the explanatory success of a hypothesis and its truth.

The last of these objections is the focus of this paper. I begin by clarifying what the problem facing inference to the best explanation is supposed to be, and argue that it is less substantial than many have assumed. I then take on directly the claim that considerations about truth vitiate the explanationist reply to skepticism. My response will be that the explanatory advantages of the RWH make it more highly confirmed by facts about experience than skeptical hypotheses are. Consequently, the RWH is more likely to be true than its competitors, vindicating the explanationist approach.

1.   Inference to the Best Explanation and Truth

The worry that inference to the best explanation isn't appropriately related to truth has been expressed many times. For example:

> "Voltaire's objection" was that Inference to the Best Explanation makes the success of our inferential practices a miracle. We are to infer that the hypothesis which would, if true, provide the loveliest explanation of our evidence, is therefore the explanation that is likeliest to be true. But why should we *believe* that we that we inhabit the loveliest of all possible worlds? Why should loveliness...*line up* with truth? (Lipton 2004, p. 143 emphasis added).[4]

> Simplicity is quite an instructive case.[5] It is obviously a criterion in theory choice, or at least in theory appraisal. For that reason, some writings on the subject of induction suggest that simpler theories are more likely to be true. But it is surely absurd to think that the world is more likely to be simple than complicated. (Van Fraassen 1980, p. 90).

> Such views typically make no attempt at all to argue that the simpler hypothesis should be preferred...because it is in virtue of its simplicity more likely to be true. Nor, once this issue is explicitly raised, is it all clear that such an argument is available: why, after all, should it be supposed that reality is more likely to be simple than complex? (Bonjour 1985, p. 181).

I will call this sort of challenge the "truth-demand".[6]

A question arises immediately. Is the truth-demand satisfied if beliefs licensed by inference to the best explanation *are* likely to be true or, rather, if *we have good reason to think* that such beliefs are likely to be true? Consider Lipton's exposition. In his terminology, the world is "lovely" if it is such that beliefs arrived at by inference to the best explanation are likely to be true. Lipton asks why "loveliness [should] line up with truth", which suggests the first possibility. However, he also asks why we "should...believe that we that we inhabit the loveliest of all possible worlds", which suggests the second. It will be helpful to put these different versions of the truth-demand as arguments for the conclusion that inference to the best explanation doesn't yield justified beliefs. Consider the following line of thought, in which 1.1 sets out the first version of the truth-demand:

1.1   A belief licensed by inference to the best explanation is justified only if such a belief is likely to be true.

1.2   A belief licensed by inference to the best explanation is likely to be true only if the world is lovely.

1.3   The world isn't lovely.

1.4   Therefore, a belief licensed by inference to the best explanation isn't likely to be true.

1.5   Therefore, a belief licensed by inference to the best explanation isn't justified.

The trouble with this argument is that 1.3 is essential to its success, but 1.3 seems too strong. The critic of inference to the best explanation doesn't claim that the world *isn't* lovely, so that beliefs licensed by inference to the best explanation are likely to be false.

Instead, the critic's claim seems to be that we aren't *justified* in believing that the world is lovely. An argument incorporating this claim (as 1.8) would be:

1.6   A belief licensed by inference to the best explanation will be justified only if we are justified in believing that such a belief is likely to be true.

1.7   We are justified in believing that a belief licensed by inference to the best explanation is likely to be true only if we are justified in believing that the world is lovely.

1.8   We aren't justified believing that the world is lovely.

1.9   Therefore, we aren't justified in believing that a belief licensed by inference to the best explanation is likely to be true.

1.10   Therefore, a belief licensed by inference to the best explanation isn't justified.

The argument was made valid by changing 1.1 to 1.6, where 1.6 sets forth the second version of the truth-demand. This revised argument seems to capture the way the truth-demand is supposed to pose a difficulty for inference to the best explanation.

Despite how often the truth-demand is brought up as an objection to inference to the best explanation, one may doubt how serious a challenge it really is. To make a preliminary point, the assumption 1.6 ought to arouse some suspicion. We may ask what "likely to be" means in this context. The most straightforward reading, I think, is to understand "x is likely to be true" as "x has high epistemic probability". But it is natural in this setting to take "x has high epistemic probability" to entail "x is justified." Given these clarifications, 1.6 implies:

1.6*   A belief licensed by inference to the best explanation will be justified only if we are justified in believing that such a belief is justified.

1.6* is an instance of the dubious and controversial principle that second-order justification is a necessary condition for first-order justification (the "JJ Principle"). One might set aside the argument 1.6-1.10 on that basis alone. To avoid this problem, it would seem that the truth-demand has to be formulated in terms of some kind of non-epistemic probability, as in 1.6**:

> 1.6** A belief licensed by inference to the best explanation will be justified only if we are justified in believing that such a belief has high non-epistemic probability.

However, it is by no means clear that there is any construal of non-epistemic probability which makes 1.6** straightforwardly acceptable.[7]

There are broader reasons to resist the truth-demand. Arguably, we engage in explanatory inference throughout everyday life, in legal matters, and in the practice of science.[8] It is incredible to suppose that in doing so we are all being irrational. So, the use of inference to the best explanation is rational: If a hypothesis H has a good deal more explanatory merit than its rivals, it is rational for you to believe H. The import of the truth-demand is that, unless you have some *additional* reason to hold that beliefs generated by inference to the best explanation are likely to be true, it isn't rational for you to believe H. The proponent of inference to the best explanation might then respond:

> That H is a good explanation, and has a good deal more explanatory merit than its rivals, is sufficient to make it rational for you to believe H (or, even, to believe that H is true) . To maintain that, unless you do something *further* in order to satisfy the truth-demand, you don't have good reason to believe H is to say that you don't have good reason to believe what it is rational for you to believe. That is absurd.

Here, both the proponent and the critic of inference to the best explanation accept the conditional "If the truth-demand is legitimate, then accepting the deliverances of inference to the best explanation isn't rational". The critic asserts the antecedent and applies *modus ponens*. The proponent denies the consequent and applies *modus tollens*. Or, more guardedly, he claims that observations about our practice tell strongly against the consequent, without any sufficient motivation being given for the antecedent.[9]

This response in behalf of IBE is an application of what Roderick Chisholm (1974) called "particularism" in epistemology. Particularism is a methodological commitment, according to which a suitably sophisticated inspection of our epistemic judgments is a way to recover what the operative epistemic norms are. But it may still seem that a community could engage in an epistemic practice for which a truth-demand is appropriate, and that failure to meet the demand would discredit that practice. For example, people who speak with an accent are generally regarded as less credible than those who don't.[10] We have overwhelming reason to believe that there is no connection between a proposition's being expressed in unaccented language and its being more likely to be true. Such information discredits the practice. But this is not to say that all the ways we form beliefs are guilty until proven innocent. Rather, when we see that specific features of a particular practice make it unable or unlikely to deliver the truth, then it becomes rationally unsustainable.[11][12]

I've maintained that the truth-demand is illegitimate insofar as it imposes an additional substantive requirement on rational or justified belief.[13] Another reason to reject the truth-demand is the observation that, if it impeaches inference to the best explanation, it does the same with respect to inductive inference of any sort. Take enumerative induction as an example.[14]

You observe many green emeralds, and believe on this basis that all emeralds are green. Presumably, your belief is justified. But that assessment can be challenged by raising the truth-demand:

1.11   A belief licensed by enumerative induction is justified only if we are justified in believing that such a belief is likely to be true.

1.12   We are justified in believing that a belief licensed by enumerative induction is likely to be true only if we are justified in believing that the world is uniform in the right way.

1.13   We aren't justified in believing that the world is uniform in the right way.

1.14   Therefore, we aren't justified in believing that a belief licensed by enumerative induction is likely to be true.

1.15   Therefore, a belief licensed by enumerative induction isn't justified.

The lesson here is that, so far as the truth-demand goes, inference to the best explanation is on just as good or bad a footing as any other kind of inductive inference. We have no more reason to abandon inference to the best explanation than we have to abandon inductive inference generally.

There is a further point. External world (Cartesian) skepticism and inductive (Humean) skepticism are distinct. A Cartesian skeptic isn't necessarily a Humean skeptic. The question posed by Cartesian skepticism is whether perceptual knowledge is possible, not whether inductive knowledge, broadly speaking, is possible. So, if inference to the best explanation provides an otherwise satisfactory response to Cartesian skepticism, bringing up the truth-demand is no way for the Cartesian skeptic to preserve *her* position. To raise the truth-demand is

to challenge the possibility of inductive knowledge in general, and, thus, to change the subject under discussion from Cartesian skepticism to something else.[15]

In my view, what has just been said ought to be enough to establish that the truth-demand leaves the explanationist response to skepticism unscathed. But I will try to address the demand in a more direct way. It will emerge that the explanatory superiority of the RWH with respect to skeptical hypotheses really does make the RWH more likely to be true than its rivals.

2.   Coherence, Unification, and Confirmation

The truth-demand seems to flow from a certain picture of cognition. On this view, we seek true beliefs about the world, but we seek truth by acquiring something else–namely, evidentially supported or rational belief. As Timothy Williamson writes:

> The standard conception of rationality depends on a distinction between the *aims*
> and *methods* of cognitive activity. On that conception, truth is an aim. We cannot
> attain it directly; we cannot follow the rule 'Believe truly!' when we do not know
> what is true. Therefore we must use methods to reach the truth. Rationality is a
> method. (2000, p. 179).

These remarks may be applied to inference to the best explanation in particular. Truth is the aim of cognitive activity, which we attempt to secure by the "method" of inference to the best explanation. The truth-demand can be raised as follows. Suppose a belief has the property of being supported by evidence via inference to the best explanation. Does this belief also have the property of being true? That a belief is the best explanation of the data doesn't entail that the belief is true. Still, we may demand (or desire or require) that there be *some* kind of positive

connection between a belief's explanatory success and its truth.   Beliefs licensed by inference to

the best explanation must "have a tendency to be true", or be "reliably associated with truth", or

be "likely to be true", even if they aren't invariably true.

What such thoughts really amount to isn't immediately clear, but as before, it is natural to

take "likely to be true" as denoting some kind of probability, and, more specifically as denoting

epistemic probability.[16] A comparison may be useful at this point. On the conception just set

out, inference to the best explanation is a "method" for determining the truth of a proposition in

something like the way that a litmus test is a method for determining the acidity of a sample. In

the absence of background information about the behavior of litmus paper in acids, the paper's

turning red is no reason to believe that a given sample is acidic. However, users of the litmus

test typically know that litmus paper "tends to" turn red in acids, or that its turning red is

"reliably associated" with acidity of the sample, and so forth. With this background information

in place, the litmus paper's turning red does make it rational to believe that the sample is acidic.

One could put this point in terms of epistemic probabilities by saying that Pr(Sample is an

acid/Paper turns red) is low, but Pr(Sample is an acid/Paper turns red & Background) is high.

Analogously, if one thinks of inference to the best explanation as a "method" for determining the

truth of a hypothesis, then it may seem that simply applying the "method", without further

information about its efficacy, does no good. Let 'B' stand for 'H is the best explanation for E'.

Then the thought is that Pr(H/B & E) is low. The legitimate use of inference to the best

explanation requires further information Q, such that Pr(H/B & E & Q) is high.[17]

This way of framing the challenge brings out its problematic character. To assume that

Pr(H/B & E) is low is to assume that IBE per se doesn't yield justified belief. That said, a more

forthcoming, and perhaps more conclusive, response to the truth-demand would be to provide

some kind of direct demonstration that Pr(H/B & E) is high. A demonstration of this sort could

proceed by showing that if a hypothesis H has the property of being the best explanation of the

evidence, it also has some other property which, indisputably, makes it likely to be true given the

evidence. In that event no supplemental information is needed to secure rational belief in H.

Recent work on the coherence of theories suggests an approach along these lines.[18] One

virtue of an explanation is to be non-ad hoc. Ad hoc explanations of data are, in some way, too

isolated from other data and (perhaps) other theory to be acceptable. In other words, a theory

containing ad hoc explanations lacks a certain sort of integration. Another explanatory virtue is

simplicity. A theory that isn't simple has too many elements. If it had fewer, it would be more

compact.   A well-integrated and compact theory is a coherent one, on some understanding of

"coherence". So, if it could be shown that coherent theories (in the relevant sense) are likely to

be true, the truth-demand with respect to inference to the best explanation would be met.

Unfortunately, this line of thought encounters various difficulties. For one thing, no

single satisfactory coherence measure has yet been found, and there is reason to think that the

leading proposals are defective.[19] For another, the link between coherence and truth has been

elusive at best. Some negative results due to Olsson (2001, 2005) and to Bovens and Hartmann

(2003, 2005) indicate that coherence does not make a theory likely to be true, after all.[20]

Taking another direction, Kevin Kelly has proposed a way of meeting the truth-demand

which bears on the use of simplicity as a criterion of theory choice, specifically. Kelly maintains

that preferring simpler hypotheses is the most efficient method, in a very precise sense, for

reaching true theories. However, Kelly's results apply only to choosing among theories such

that, if they are untrue, they will be empirically falsified at some point in the long run.[21] The

falsity of hypotheses of massive sensory deception will not, or need not, emerge in this manner.

Therefore, Kelly's approach seems not to support reliance on simplicity considerations in

choosing between the RWH and skeptical hypotheses, despite whatever other promise it may

have. A further limitation, for present purposes, is that efficiency considerations may not

underwrite aspects of inference to the best explanation other than the application of a simplicity

criterion for theory choice.[22]

There is yet another approach to establishing that inference to the best explanation

satisfies the truth-demand. Friedman (1974), Kitcher (1981) and others have held that

explanation is a matter of unification. Suppose, then, that H_1 unifies the phenomena more than

H_2 does. If explanation if a matter of unification, then H_1 is a better explanation of the

phenomena than H_2 is. This claim dovetails with another, due to Friedman (1983) and Glymour

(1980). They argue that more unified theories tend to be more thoroughly tested, and thus more

highly confirmed, by the data than less unified theories of the same domain. Glymour writes:

> More tests are preferable to fewer...How well a theory is tested by a body of
>
> evidence depends on how tight the linkages are, according to the theory, among
>
> the properties with which the theory is concerned. (1980, p. 43).

In a similar vein, Friedman remarks:

> A theoretical structure that plays an explanatory role in many diverse areas picks
>
> up confirmation from all these areas. The hypotheses that collectively describe
>
> the molecular model of a gas of course receive confirmation via their explanation
>
> of the behavior of gases, but they also receive confirmation from all the other

areas in which they are applied: from chemical phenomena, thermal and electrical

phenomena, and so on. (1983, p. 243).

The idea is that, in a unified theory, the elements are connected (directly and indirectly) to one

another and to the data in numerous ways. When the data impinge on such a theory, they do so

more multifariously than they would if the theory were less unified. For that reason, a more

unified theory is more thoroughly tested by a body of data than a less unified one would be; in

particular, a more unified theory will be more strongly confirmed than a less unified one, all else

being equal. Suppose that explanation is a sort of unification or promotes unification (see

above).[23] It follows that a more explanatory theory will be better confirmed by the data than a

less explanatory theory.

Assume further that a well confirmed a theory is likely to be true.[24] We can then

conclude that a good explanation, as such, is likely to be true. To reject this additional

assumption is to say that being confirmed or successfully tested--getting the data right rather than

wrong--is no indication of truth. Such a view is highly implausible, to say the least.[25] Consider

an example. You're a pharmacologist evaluating the safety of two drugs, Expensiva and Balm of

Gilead. Expensiva has been given without bad results to a hundred people, while Balm of Gilead

has been given without bad results to a hundred thousand people. In these circumstances, 'Balm

of Gilead is safe' is more highly confirmed than 'Expensiva is safe'. It would be hard to think

seriously that, given the evidence, 'Balm of Gilead is safe' isn't more likely to be true than

'Expensiva is safe'.[26]

What's more, given a requirement that justification must make a belief likely to be true,

denying that confirmation promotes truth would mean that highly confirmed beliefs may well be

unjustified. Such a position is barely distinguishable, if distinguishable at all, from blanket

Humean skepticism about inductive justification. Hence, at least for present purposes, there is no

denying that if a hypothesis is well-confirmed, it is likely to be true. Once this point is granted, it

is quite in order to argue that if explanatory merit promotes unification, and unification promotes

confirmation, then explanatory merit promotes likeliness of truth.

This approach is promising, but to carry it through one would have to provide a clear

specification of what unification and confirmation are, as well as a rigorous exposition of the

supposed connection between them. Fulfilling these requirements is a daunting task.[27] Happily,

though, vindication of the explanationist reply to skepticism is a narrower and more tractable

project than defending inference to the best explanation across the board. Let it be granted that

confirmation promotes truth, for the reasons rehearsed above. The question now is: *In the*

situations where inference to the best explanation favors the RWH over a skeptical competitor,

do facts about one's experience confirm the former more highly than the latter? If the answer is

yes, then the RWH is more likely to be true than the skeptical alternative is. The truth-demand is

satisfied in this special instance.

3.   The Superiority of the RWH over SH

 Our environment is made up of material objects that interact in regular ways with each

other and with us. More abstractly, the world around us can be characterized as a causal

structure plus the items that occupy that structure.[28] These items are familiar objects like

eyeglasses and meadows, and familiar properties like being round and being a liquid. Our beliefs

about physical reality, the RWH, add up to an endorsement of the claim that a particular

structure, populated by specific occupants, actually obtains.

The *Skeptical Hypothesis* (SH), as I will call it, is the claim that the RWH is *radically* incorrect. SH is much stronger than the denial of the RWH; SH implies that both the causal structure of the world and its occupants are thoroughly different from those described by the RWH.[29] That said, SH is meant to be the most minimal radical alternative to the RWH. It doesn't specify that any particular alternative causal structure obtains, although SH can be embellished by adding various conjuncts to it (see below). A consequence of SH is that your experiences are unveridical. Let's say that you have a perceptual experience as of a tree before you. If SH is true, your experience isn't caused by the presence of a tree, and there are no trees in any case. Your experience is at odds with the way things are, and so isn't veridical.[30]

The skeptic's position is more delicate and vulnerable than it is often taken to be. Her fundamental claim is that we aren't justified in believing that the RWH is true, not that we are justified in believing that the RWH is false. We arrive at the result she desires if some skeptical hypothesis equals the RWH in confirmation, but no skeptical hypothesis surpasses the RWH.[31] If some skeptical hypothesis did prevail over the RWH, we would have some justified beliefs about the external world after all – we would be justified in believing that it is utterly different from the way it appears to be.[32]

A second constraint applies. The skeptic's purposes won't be served if the choice between the RWH and SH is underdetermined with respect to a limited range of experience, but not in general. SH must maintain parity with the RWH in light of further experience as well. For this reason, we may grant *arguendo* that the RWH and SH are equally well confirmed up to a certain point. If the RWH is better confirmed by experience than SH is, this difference will make itself felt as experience unfolds. Underdetermination between the RWH and SH will be broken

in favor of the RWH, making skepticism untenable. This is the approach I will adopt below.

An explanationist response to skepticism begins with the observation that the RWH provides a good account of why your experience has the character it does. For example, according to the RWH, you seem to see a tree before you because there is a tree before you and the conditions for your seeing it are met (your eyes are open, there is nothing in the way, etc.). The explanations offered by the RWH are generally rich, comprehensive, and efficient. By contrast, SH does little or nothing to explain various facts about your experience. Why, according to SH, do you have experience as of a tree before you? All there is to say is that your experience is caused by something other than a tree, which isn't much of an explanation. So, the RWH explains experiential facts well, while SH explains those facts poorly if at all. Under these circumstances, inference to the best explanation licenses acceptance of the RWH and rejection of SH.

This inference isn't jeopardized by the truth-demand, as we will see.[33] Even on unfavorable assumptions, *viz*., those a skeptic would make, the RWH is more highly confirmed than its rivals. To that extent, an explanatory inference which favors the RWH over SH takes us towards the truth. The truth-demand is no obstacle to accepting the RWH and rejecting SH.

The resources of formal confirmation theory can be used to substantiate this point.[34] Consider a toy example. (RE) You have experience as of your refrigerator door opening. If the RWH is true, then (R) there really is a refrigerator door opening. Let's say that, according to the RWH, opening the refrigerator door causes it to be the case that (C) a cat to run into the kitchen. In turn, the cat's running into the kitchen brings it about that (CE) you seem to see it run into the kitchen. Here is a diagram of the situation, in which the arrows represent causation:

$$R \quad \Rightarrow \quad C$$

$$\Downarrow \qquad \Downarrow$$

$$RE \qquad CE$$

If SH is true, then this description is wrong and your experiences CE and RE come about in some very different way.[35] What needs to be shown is that, given (RE & CE), the RWH is more likely to be true than SH:

3.1   Pr(RWH/RE &CE) > Pr(SH/RE & CE).

We may begin by noting that, according to the skeptic, underdetermination between the RWH and SH holds with respect to all the experiences we ever have. So, according to the skeptic, the RWH and SH must be equally well confirmed by RE in particular. Let's concede that much for the sake of argument:

3.2   Pr(RWH/RE) = Pr(SH/RE)

3.2 is a good place to start from a methodological standpoint. Bayes Theorem implies that the probability of a hypothesis given one's evidence is determined, in part, by the unconditional probability of the hypothesis itself. Therefore, any claim that the RWH is better confirmed than SH rests on some prior assessment of how likely it is that each hypothesis is true. Such dependence threatens to make any argument for 3.1 question-begging as a response to the truth-demand.[36] Beginning with 3.2 circumvents this problem. The best case for the skeptic is that the unconditional probabilities of the RWH and SH are such that the choice between them is underdetermined by RE. We are granting that.

If the RWH is better confirmed by experience than SH is, underdetermination between them ought to give way as experience unfolds. The RWH has it that opening the refrigerator

door causes a cat to run into the kitchen. Hence, CE is very likely to follow RE. SH denies that

CE will come about this way, but SH is otherwise noncommital about how experience will

develop. So far as SH goes, practically anything could happen. Thus:

      3.3 $Pr(CE/RE \ \& \ RWH) > Pr(CE/RE \ \& \ SH).$[37]

An objection to 3.3 is bound to arise: Experience itself exhibits prominent regularities.

Again, let's say that your experiences as of the refrigerator door opening have always been

followed by experiences as of a cat running into the kitchen. In light of that regularity:

      3.4 $Pr(CE/RE)$ is high.

The objector supposes that:

      3.5 $Pr(CE/RE \ \& \ SH)$ is high.

So, even if

      3.6 $Pr(CE/RE \ \& \ RWH)$ is high

the RWH enjoys no advantage over SH. Hence, 3.3 is false, or at least unmotivated.

This response turns on a non-sequitur. Allow, on inductive grounds, that $Pr(CE/RE)$ is

high. It simply doesn't follow that $Pr(CE/RE \ \& \ SH)$ is high. To that extent, there is no reason to

endorse 3.5, and no reason to give up 3.3. More concretely, if the RWH is true, conditions in the

world sustain the regularity exhibited in experience. SH, by contrast, subverts that regularity by

opening up (additional) possibilities in which your experience diverges from the way it has gone

before. Therefore, CE is more likely to occur given (RWH & RE) than given (SH & RE).[38]

An analogy may be helpful here. Say it's January, and so far Mort hasn't come down

with the flu. It might be that Mort has had the flu vaccine, which will keep him from getting sick

for the rest of the winter. Alternatively, Mort hasn't been vaccinated. If, from now on, Mort

doesn't get exposed to a carrier, he will stay healthy. But there is also a chance that he will encounter someone who has the flu and catch it. In the terms used above, Mort's getting a flu shot sustains the regularity that he hasn't yet come down with the flu, while his not getting a shot subverts it. Formally:

> 3.7   Pr(No flu later/No flu yet & Vaccinated) > Pr(No flu later/No flu yet & Not
>
> vaccinated).

In a similar way, the RWH supports the regularity that CE follows RE, while SH doesn't. It follows that Pr(RE & CE/RWH) is greater than Pr(RE & CE/SH), as 3.3 says.

Taken together, 3.2 and 3.3 imply 3.1. The significance of 3.1 is that the combination of RE and CE confirms the RWH more highly than SH. A stronger result seems within reach.   The argument for 3.1 shows that if underdetermination between SH and the RWH holds at some time t1, then it will lapse at a later time t2. But the skeptic is committed to saying that underdetermination obtained before t1, at t0.   Applying the same line of thought that supports 3.1, if underdetermination holds between the RWH and SH at t0, then the RWH outstrips SH in confirmation at t1. So, underdetermination doesn't obtain at t2 or t1. By mathematical induction, there is no stretch of experience for which the choice between the RWH and SH is underdetermined.[39]

Now, someone might protest that the arguments to this point have been misdirected. SH may be less well confirmed than the RWH is, but that is because SH itself is so impoverished. A richer skeptical hypothesis that has the same consequences for experience as the RWH does ought to be immune to (relative) disconfirmation by facts about experience. Consider the claim:

> (EA)   The RWH is *empirically adequate*.[40]

The RWH entails EA, and is confirmed to the extent that EA is true. But (SH & EA) also entails EA. Hence, the RWH and (SH & EA) have the same implications for experience.[41] The skeptic may ask what makes either strengthening of EA more likely to be the case than the other? Or, more pointedly, why isn't our acceptance of the RWH just the manifestation of a groundless bias?

One part of the answer lies in the fact that an empirically adequate hypothesis like (SH & EA) is strictly stronger than SH. It follows that:

3.8 $\Pr(\text{SH \& EA/RE}) < \Pr(\text{SH/RE})$.

Suppose that (SH & EA) and the RWH are equally probable given RE:

3.9 $\Pr(\text{SH \&EA/RE}) = \Pr(\text{RWH/RE})$.

From 3.8 and 3.9:

3.10 $\Pr(\text{SH/RE}) > \Pr(\text{RWH/RE})$.

In words: Given RE, your picture of the world is more likely to be utterly wrong than largely right.[42]

For the skeptic, 3.10 is an unwelcome result. Skepticism is philosophically interesting to the extent that it is supported by an argument that seems weighty and worthy of attention. Taking SH as the foil to the RWH, the skeptic can proceed as follows:

3.11a   The choice between the RWH and SH is underdetermined.

3.11b   If the choice between the RWH and SH is underdetermined, our beliefs about the external world are unjustified.

3.11c   Therefore, our beliefs about the external world are unjustified.

3.11a-c seems like a powerful train of thought.

However, if (SH & EA) replaces SH, the skeptic's argument becomes:

3.12a   The choice between the RWH and (SH & EA) is underdetermined.

3.12b   If the choice between the RWH and (SH & EA) is underdetermined, our beliefs
         about the external world are unjustified.   ,

3.12c   Therefore, our beliefs about the external world are unjustified.

As noted above, (SH & EA) is strictly stronger than SH. It follows that if the RWH and (SH &

EA) are equally likely to be true, then SH is more likely than the RWH is. Thus:

3.13   The choice between RWH and (SH & EA) is underdetermined $\Rightarrow$ SH is more
         likely to be true than the RWH is.[43]

In light of 3.13, 3.12a is logically equivalent to:

3.14a   The choice between the RWH and (SH &EA) is underdetermined and SH is more
         likely to be true than the RWH is.

The rest of the argument becomes:

3.14b   If the choice between the RWH and (SH &EA) is underdetermined and SH is
         more likely to be true than the RWH is, then our beliefs about the character of the
         external world are unjustified.

3.14c   Therefore, our beliefs about the character of the external world are unjustified.

The natural response would be to reject the claim that SH is more likely to be true than

the RWH is, which is the second conjunct of 3.14a. There is no apparent reason why we aren't

free to do just that. We are then in a position to reject 3.14a as a whole, and with it the entire

argument 3.14a-c. 3.14a-c is just a restatement of 3.12a-c. So, if 3.12a-c is the best argument for

skepticism, we need not be detained for very long.[44]

 3.10 ought to be unacceptable to the skeptic even if questions about dialectical efficacy

are set aside. His view is that we should withhold or suspend belief with respect to the RWH.

Rather than asserting that SH is more highly confirmed than the RWH, the skeptic will deny it; he can't endorse 3.10 without abandoning his own commitments. And, since 3.9 leads to 3.10, the skeptic has to steer clear of 3.9 as well. He can't claim that the choice between (SH & EA) and the RWH is underdetermined.[45]

There is more to say, however. I've maintained that if underdetermination holds between RWH and (SH & EA), then it doesn't hold between RWH and SH, and this is a consequence the skeptic can't accept. The skeptic might respond that underdetermination is more pervasive than I have acknowledged. He may have a broader reason to take this view, insofar as skeptical hypotheses in general vary in logical strength. For example:

> (BIV) Your experience is caused by a computer which makes it appear to you that the RWH is true

is weaker than

> (BIV+) Your experience is caused by a computer which makes it appear to you that the RWH is true & the computer is operated by a creature with blue hair.

The skeptic denies that we have grounds for rejecting either BIV or BIV+. He thinks that if either were true, we would be none the wiser. Suppose your evidence is E. Underdetermination between the RWH and BIV+ with respect to E amounts to:

3.18 $Pr(BIV+/E) = Pr(RWH/E)$

Since BIV+ is strictly stronger than BIV, 3.18 implies:

3.19 $Pr(BIV/E) > Pr(RWH/E)$.

By the skeptic's lights, the choice between BIV and the RWH is underdetermined as well:

3.20 $Pr(BIV/E) = Pr(RWH/E)$.

3.19 and 3.20 are incompatible.

Faced with this inconsistency, the skeptic may blame the formal framework in which it arises. He will assert that there is some sense, not captured by orthodox probabilities, in which BIV+, BIV and the RWH are equally likely to be true in light of RE. The same will hold for SH, (SH & EA) and the RWH. If this point of view is sustainable, then the skeptic can maintain that the choice between (SH & EA) and the RWH is underdetermined without having to agree that SH is better confirmed than the RWH is.

This line of response raises difficult formal and substantive issues. What follows is provisional and incomplete, but I hope it will provide some clarification even so.[46] In the first place, (SH & EA) is constructed to agree with the RWH about the evidence EA, even though SH itself does not. The same procedure can be applied whenever any hypothesis H enjoys inductive support from evidence E. (¬H & E) is a competitor to H. If underdetermination is construed so that the RWH and (SH & EA) are equally well confirmed, then by parity of reasoning the same should be true for H and (¬H & E). Then, neither hypothesis is preferable to the other, and we have no basis for accepting H. Ultimately, insistence that the RWH and (SH & EA) are equally well confirmed is inseparable from skepticism about induction, and we are no longer discussing Cartesian skepticism as a distinct position.

In the second place, why should we agree with the skeptic that there is no basis for choosing among the RWH, BIV and BIV+? The idea, presumably, is that one's experience carries no "signature" of how it arises. It could be caused by just about anything, so no hypothesis about its source is better or worse than any other.[47] However, this blanket assumption is incorrect. Differences between causal structures can be reflected, to one degree or another, in the effects they tend to bring about. The discrepancy between Pr(RE & CE/RWH)

and Pr(RE & CE/SH) is a case in point, as we have already seen. More broadly, the details of experience constrain how the causes of experience might be arrayed. The nexus posited by the RWH meets those constraints. An effective skeptical hypothesis has to agree with the RWH in that regard, yet remain radically different from the RWH at the same time. The extent to which this is possible isn't obvious.[48] I will return to such issues at the end of the next section.

To summarize: The RWH includes causal claims which explain why experience is the way it is, while SH doesn't. The explanatory superiority of the RWH is accompanied by an advantage with respect to confirmation. If confirmation promotes truth, then the truth-demand is no obstacle to the use of inference to the best explanation in this instance. Complications arise if we grant that hypotheses of different logical strength can be equally likely to be true. It is unclear whether an allowance of this sort is workable or appropriate in the present context. And SH, (SH & EA) and the like may be unable to serve the skeptic's purposes in any event.[49]

4.   The Isomorphic Skeptical Hypothesis

The RWH is more highly confirmed than SH, because the latter doesn't provide a satisfactory causal account of how experience arises. To make good this deficiency, the skeptic might advance a competitor to the RWH which takes over the causal content of the RWH itself. Call this competitor the *Isomorphic Skeptical Hypothesis* (ISH). According to the ISH, our beliefs about the causal structure of the world are generally accurate, but we are completely wrong about what occupies the nodes of that structure. Where the RWH says that some ordinary material object o has a certain property F, the ISH says that some corresponding, but different, object o* has a different property F*. I'll call the counterparts of ordinary objects "pseudo-objects", and the counterparts of ordinary properties, "pseudo-properties", indicating the

difference with an asterisk. I assume that the pseudo-objects are material items of some sort, but not the familiar ones we take to exist. If the ISH is true, pseudo-properties interact with each other and with us in just the way we suppose ordinary properties do. The pseudo-property F*, not F, "plays the F-role". For the sake of concreteness, suppose that you are a massively deceived brain in a vat whose sensory inputs are generated by a computer. Think of o* as a portion of the computer's memory where a file corresponding to o resides, and think of F* as the property of containing a certain inscribed magnetic pattern which corresponds to the ordinary property F.[50]

Since the RWH and the ISH agree with respect to how experience comes about (on an abstract level), one might think that the ISH and the RWH will be equally well confirmed. Perhaps this outcome wouldn't be so dire. Roughly speaking, we could still know what the furniture of the world *does*, even if we can't know what it *is*. But we shouldn't settle for that little unless we have to.[51]

We saw in §3 that the RWH is better confirmed than SH, but that result has no bearing on the ISH. The ISH doesn't entail SH. The former affirms, while the latter denies, that the causal structure of the world is correctly described by the RWH. Consequently, even though the RWH is better confirmed than SH The RWH and the ISH may be equally well confirmed,. Since the results of §3 don't apply to the ISH, a different approach is called for.

 To determine whether the ISH matches the RWH in confirmation, we must first consider the RWH in more detail. According to the RWH, we are surrounded by ordinary material objects that we perceive. Material objects are spatial entities. They have shapes and positions, and these features of material objects substantially determine how the world is. If you know the shapes and

locations of the objects around you, you thereby have a largely accurate picture of your environment. Let's call this constellation of spatial facts the *layout of the world*. The layout of the world does a great deal to explain why your experience is the way it is. For example, you don't have visual experience of an object if your view of it is occluded--that is, if something like a heavy curtain or a brick wall is located between you and that object. Facts about occlusion are fixed by the shapes and positions of the objects in your environment.[52] In this way, and in many others, the layout of the world determines the character of your experience.

Now, certain truths about spatial properties and relations are metaphysical necessities.[53] In particular:

(LOC) Every material object has a location

is necessarily true. LOC contributes to our ordinary understanding of what is the case and why. Here is an illustration:

Ayer's fountain pen. A. J. Ayer recounted that "Not long ago I did have a fountain pen that suddenly vanished. At one moment I was looking at it, touching it, writing with it, and the next moment it had disappeared. I could not find it any more and never have found it to this day. Of course, I do not really believe that it vanished ...What I say is: 'There must be some explanation. Perhaps I turned my back on it for an instant, though I do not remember doing so, and somebody crept in and took it. Or, more probably, it dropped somewhere and I have not searched for it hard enough.'" (Ayer 1946, 172-173).

One thing Ayer didn't doubt for a moment was that if his pen didn't vanish, it had some location or other, as LOC stipulates. And because it does, Ayer would eventually find it if he kept

looking.[54]

An essential difference between the RWH and the ISH now emerges. As I said earlier, the RWH appeals to the layout of the world to explain a wide range of facts about experience. A skeptical hypothesis has to give some other explanation of the same facts, because according to any skeptical hypothesis the layout of the world is nothing like what we take it to be. More specifically, where the RWH ascribes genuine locations to things, the ISH will ascribe pseudo-locations to pseudo-objects. I am assuming that pseudo-locations are not locations at all.

Consider, then, the ISH counterpart of LOC:

(LOC*) Every pseudo-object has a pseudo-location.

Since LOC enters into RWH explanations, LOC* must be incorporated within the ISH and discharge an analogous explanatory function. LOC* isn't a necessary truth. To put the point using our example, it is metaphysically possible for there to be some pseudo-object (a file on the computer disk) which lacks a pseudo-location (doesn't have a magnetic pattern of the right sort inscribed within it).

The modal status of LOC* calls for further comment. If pseudo-locations are to mimic (i.e., play the same causal role as) genuine locations, pseudo-locations must obey LOC*. It may seem, then, that LOC* is a necessary truth about pseudo-locations. But we must guard against a confusion here. LOC in modalized form can be restated as:

4.1 $\Box$ (The property being located is such that every object has it).

The corresponding version of LOC* is:

4.2 $\Box$ (The property of being pseudo-located is such that every pseudo-object has it)

One could define 'pseudo-location' to include the stipulation that pseudo-location mimics

genuine location in every respect. In that case, it would be analytic, and necessary, that every

pseudo-object has a pseudo-location. But, as I am using the expression, 'pseudo-object'

designates physical items of a specific sort, e.g., files inscribed on a computer disk. 'Pseudo-

location' refers to a particular property these objects may have, such as containing an entry <x, y,

z> realized as a magnetic pattern. Therefore, 4.2 should be read along the lines of:

> 4.3   □ (The property of containing an <x, y, z> pattern is such that every file on the
> computer disk has it).

Certainly, it is possible for a file on the computer disk not to contain an <x, y, z> pattern, so 4.3

is false. LOC* isn't a necessary truth.[55]

Still, it appears that the ISH could implemented in a way that makes LOC* a necessary

truth after all. Let pseudo-objects be files on a computer disk and let pseudo-location be just the

property of being a computer file. No pseudo-object (computer file) can exist without being

pseudo-located (without being a computer file). Therefore, every pseudo-object has a pseudo-

location as a matter of necessity, and 4.4 holds.[56] But even if this response is right as far as it

goes, locations figure in other necessary truths besides LOC. For example, it is necessarily the

case that:

> 4.5   Distances between objects are determined by their locations.

Suppose pseudo-objects necessarily have pseudo-locations. That in itself does nothing to specify

the pseudo-distances, if any, that happen to be assigned to pairs of pseudo-objects. So

> 4.6   Distances* between objects* are determined by their locations*.

even if true, isn't necessarily true. There is undoubtedly more to say about 4.5 and 4.6. But, in

any case, location (along with other spatial properties and relations) figures in an extensive web

of necessary truths. Very plausibly, no material object property participates in a constellation of necessary truths that mirrors exactly the body of necessary truths about location.[57] It will be convenient to treat LOC as representing one of these distinctive principles, so I'll continue to suppose that LOC is necessarily true, while LOC* isn't.

The important point for our purposes is that the ISH contains contingent regularities where the RWH contains necessary truths. To that extent, the RWH is more parsimonious than the ISH.[58] If parsimony is an explanatory virtue, inference to the best explanation will allow us to accept the RWH and reject the ISH.

An objection may arise at this point. Some philosophers believe that necessary truths can't explain any contingent facts. A consequence is that necessary truths do nothing to explain the character of your experience. In that event, there is no basis for preferring the RWH to the ISH.[59] The assumption that necessary truths are non-explanatory is contentious, however.[60] What's more, the entire issue can be side-stepped. Whether necessary truths about location, distance and the like make any positive explanatory contribution to the RWH is moot. It is enough that (i) the RWH appeals to *fewer* contingent regularities than the ISH does; and (ii) the ISH is no more explanatory than the RWH is. We might concede that, for both the RWH and the ISH, contingent claims do all the explaining that gets accomplished. The difference then is that the fewer regularities invoked by the RWH "work harder" than the more numerous regularities invoked by the ISH. In any case, (i) and (ii) suffice for the RWH to be more parsimonious than the ISH is. This difference gives us a reason to favor the former over the latter via inference to the best explanation.

Such an appeal to explanatory considerations might be challenged by raising the truth-

demand: Why suppose that a theory which is simpler in the way described is thereby more likely to be true? The answer–niceties aside–is that believing a necessary truth presents less risk of error than believing a contingent claim. Since the RWH contains necessary truths where the ISH contains contingent claims, the RWH is more likely to be true than the ISH is.

Of course, more needs to be said. We can make progress by taking the question just raised and turning it around. Why suppose that the RWH and the ISH are equally likely to be true, given some experiential evidence EXP? That is, under what conditions would it be the case that:

4.7 $Pr(RWH/EXP) = Pr(ISH/EXP)$?

According to Bayes Theorem, 4.7 will hold if two conditions are met:

4.8 $Pr(EXP/RWH) = Pr(EXP/ISH)$

4.9 $Pr(RWH) = Pr(ISH)$.

A skeptic who deploys the ISH will endorse both 4.8 and 4.9.

The thought behind 4.8 is that if two hypotheses posit the same causal structure, then the evidence will be the same regardless of which hypothesis is true. By construction, the ISH explains the character of experience by invoking the same causal nexus that the RWH does. So, 4.8 ought to hold with respect to the ISH, the RWH and the evidence EXP, in particular.

4.9 is underwritten by the principle that a causal structure is indifferent to what occupies it.[61] That is, there is no more reason to suppose that a given structure has one set of occupants rather than another set. Some notation will help to make the idea clearer. Let C stand for the common structure posited by a pair of hypotheses. The two differ as to which entities occupy the nodes of C. Let V be one such specification, and V* be the other. Then one hypotheses is (C &

V) and the other is (C & V*).   :

     4.10 $Pr(V/C) = Pr(V*/C)$.

By the laws governing conditional probability, 4.10 implies:

     4.11 $Pr(C \& V) = Pr(C \& V*)$.

4.10 and 4.11 have to be restricted in certain ways.   For example, the role of a vectorial quantity in C can't be filled by a scalar quantity.[62] It is essential to the argument below that limitations on 4.10 and 4.11 are inevitable.

     4.10 and 4.11 are pertinent here because the RWH and the ISH postulate the same causal structure, call it **S**. Let S be the claim that **S** obtains. The RWH adds O, that **S** is populated by familiar objects, while the ISH adds O*, which specifies that **S** is occupied by an entirely different set of objects.[63] 4.11 implies:

     4.12 $Pr(S \& O) = Pr(S \& O*)$.

Since 'S & O' is a way of stating the RWH and 'S & O*' is a way of stating the ISH, 4.12 is equivalent to 4.9. It will turn out that there is good reason to reject 4.9. To establish the point, I'll work through an illustration and then generalize.

     Again, imagine a brain in a vat connected to a computer that simulates the RWH. This machine hosts pseudo-objects, physically realized files corresponding to the objects we take to exist, and these files contain entries which function as pseudo-properties. If the match with the RWH is exact, every object* file contains a location* entry. Alternatively, the parallelism might break down at this point. In that case, one or more objects* lacks a location*.

     There are, then, two causal structures for us to consider. One is the full structure **S** posited by the RWH and the ISH. **S** includes a node for the location of every object (or,

equivalently, a node for the pseudo-location of every pseudo-object). Consider Ayer's pen as an example. If the RWH is correct, then there is a node in **S** for the pen and a node for its location. If the ISH is correct, the first node is occupied a pen* and the second is occupied by the pen's* pseudo-location. Besides **S**, there is the substructure **S-**. **S-** is just like S, except that the node for the pen's location (or, equivalently, the pseudo-pen's pseudo-location) is omitted. Otherwise, **S-** exactly matches **S**. Note that **S-** contains all the machinery necessary to generate the effects of the pen's/pen's* being in one location/location* or another.[64] Let 'S-' abbreviate the claim that **S-** is realized.

Next, consider the pseudo-objects and pseudo-properties that figure in the ISH, as enumerated by O*. O* designates items that occupy the nodes of **S-** as well as items that would fill the rest of **S** if **S** happens to obtain in full.[65] Consequently, (S- & O*) entails that the pen* exists and occupies a node in S-, but (S- & O*) *doesn't* entail that there is an additional node that is filled by some pseudo-location of the pen*. The pen* file might not contain any entry for location* as a matter of fact. So, if (S- & O*) is true, it might be the case that **S-** is embedded in **S**:

4.13   S- & O* & S.

But, it could be the case that (S- & O* is true), yet **S-** isn't embedded in **S**:

4.14   S- & O* & ¬S.

Therefore:

4.15   Pr(S & S- & O*/S- & O*) < 1.

Because **S-** is a substructure of **S**, S entails S-, and S is logically equivalent to (S & S-). If we substitute logical equivalents, 4.15 becomes:

4.16 $\Pr(S \& O/S- \& O) < 1.$[66]

Less cryptically:

4.17 $\Pr(S$ in full is occupied by ISH items/$S-$ is occupied by ISH items$) < 1.$[67]

The RWH says that **S** is populated by familiar objects and properties. O designates the ordinary items that occupy **S-** as well as the rest of **S**. If (S- & O) holds, then a certain node in **S-** is occupied by a genuine pen. And, crucially, if a genuine pen exists, then it has to be someplace or other. **S** differs from **S-** by including a node that is filled by the location of the pen (or the location* of the pen*, as may be). So if (S- & O) is true, then the pen must have a location, and **S** obtains. It follows that:

4.18 $\Pr(S \& S- \& O/S- \& O) = 1.$

Again, S- is a substructure of S, so 4.18 can be simplified:

4.19 $\Pr(S \& O/S- \& O) = 1.$

In something closer to English:

4.20 $\Pr(S$ in full is occupied by RWH items/$S-$ is occupied by RWH items$) = 1.$

Combining 4.16 and 4.19 gives us:

4.21 $\Pr(S \& O/S- \& O) > \Pr(S \& O^*/S- \& O^*).$[68]

Now, the skeptic is committed to 4.11 (see above). 4.11 entails:

4.22 $\Pr(S- \& O) = \Pr(S- \& O^*).$

4.21 and 4.22 imply:

4.23 $\Pr(S \& O) > \Pr(S \& O^*).$[69]

Rewriting:

4.24 $\Pr(RWH) > \Pr(ISH).$[70]

This line of thought can be generalized. Let S be the structure common to the RWH and

the ISH. Let **$** be some substructure of **S**, and let O and O* designate different rosters of

occupants for **$** (and thus for **S**, as above. **S** may differ from $ by including more nodes than $

does or by including additional connections between nodes.[71] Suppose that N is a necessary

truth, and N, $, and O are such that:

4.25   (N & $ & O) $\Rightarrow$ (S & O).

To have a better sense of what 4.25 says, consider the example just discussed. There, the

necessary truth N is LOC and $ is S-. (S- & O) contains the information that a pen exists, so

(LOC & S- & O) entails that the pen has a location. That is, (LOC & S- & O) entails that the

entire structure S obtains and is populated by the objects and properties specified by the RWH,

i.e., (S & O). Hence:

4.26   (LOC & S- & O) $\Rightarrow$ (S & O).

4.26 is an instance of 4.25.

Now, suppose further:

4.27   (N & $ & O*) $\nRightarrow$ (S & O*).

Staying with the same illustration, suppose a computer simulates the RWH in nearly every

respect, but its pen* file doesn't include an entry for location*. Then the substructure **S**- obtains,

but the full structure **S** doesn't. Therefore, (S- & O*) doesn't entail (S & O), and the truth of

LOC does nothing to the close the gap:

4.28   (LOC & S- & O*) $\nRightarrow$ (S & O)

 4.28 is an instance of 4.27, where N is the necessary truth LOC and **$** is **S**-.

More broadly, 4.27 will be satisfied when three conditions are met. First, N is a

necessary truth whose contingent counterpart N* is a component of the ISH. Second, the structure N* contributes to the ISH is left out of **$**:

    4.29   ($ & O*) $\not\Rightarrow$ (N* & S & O*).

Finally, **$** plus the additional structure specified by N* becomes **S** in full. Then:

    4.30   (N* & $ & O*) $\Longleftrightarrow$ (S & O*)

4.29 and 4.30 yield:

    4.31   ($ & O*) $\not\Rightarrow$ (S & O*).

    The pieces fit together as follows. Because N is a necessary truth (N & $ & O) is logically equivalent to ($ & O). Then, substituting into the left hand side of 4.25 yields:

    4.32   ($ & O) $\Rightarrow$ (S & O).

From 4.31 and 4.32:

    4.33   Pr(S & O*/$ & O) < Pr(S & O/$ & O).

According to the general principle 4.11, which the skeptic accepts:

    4.34   Pr($ & O*) = Pr($ & O).

4.33 and 4.34 imply:

    4.35   Pr(S & O*) < Pr(S & O).[72]

And 4.35 can be rewritten as the desired result:

    4.24   Pr(RWH) > Pr(ISH).

    There are various ways to develop 4.24. We may agree with the skeptic that:

    4.8   Pr(EXP/RWH) = Pr(EXP/ISH).

Combining 4.24 and 4.8, and dividing both sides by Pr(EXP):

    4.36   Pr(EXP/RWH) Pr(RWH) / Pr(EXP) > Pr(EXP/ISH) Pr (ISH) / Pr(EXP)

From 3.36 and Bayes Theorem:

     4.37 $Pr(RWH/EXP) > Pr(ISH/EXP)$.

4.37 contradicts the skeptic's primary claim 4.7.

The argument which leads to 4.24 can also be seen in a somewhat different light. The derivation of 4.24 rests on 4.11, but 4.24 is inconsistent with 4.11. The lesson is that 4.11 can't be unrestricted, on pain of contradiction; the indifference of a causal structure to its occupants has limits. One restriction is that necessary truths about properties may enhance or diminish their capacity to fill certain causal roles.[73] More specifically, genuine spatial properties are perfectly well suited to play the part that the RWH ascribes to them. The same isn't true of the pseudo-spatial properties invoked by the ISH.[74] The skeptic assumes that substituting one set of occupants for another in a causal structure makes no difference otherwise. That is why, supposedly, we have no basis for choosing between the RWH and the ISH. But the skeptic's assumption is wrong, undercutting her rationale for deploying the ISH in the first place.

To summarize: The RWH is preferable to the ISH from an explanatory standpoint, because the RWH posits fewer contingent regularities than the ISH does. The RWH is better confirmed than the ISH for the same reason. If confirmation is an indication of truth, the truth-demand is no impediment to adopting the RWH .

The inadequacy of the ISH has wider implications. Skepticism prevails only if the choice between the RWH and some radical alternative is underdetermined. It is highly plausible that if any skeptical hypothesis is as well-confirmed as the RWH, it ought to be one that is isomorphic to the RWH. But the RWH is more highly confirmed than the ISH. So, it seems, no story the skeptic can tell will compete on equal terms with the RWH. The point can be turned around.

Suppose that some skeptical hypothesis is just as well confirmed as the RWH is. This competitor

would have to be superior to the ISH in some way. Presumably, it would do better by invoking a

more comprehensive or efficient causal-explanatory structure than the one common to the ISH

and the RWH. But what improvements would secure that result? Why suppose that such a gain

can be achieved?   No good answer to these questions suggests itself.[75] To that extent, we have

reason to conclude that the RWH is more highly confirmed than any skeptical hypothesis is.

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Appendix

There is an alternative formulation of the truth-demand which has certain advantages over the two discussed in §1. Unlike 1.1 - 1.5, it doesn't require the suspect premise

1.3   ¬(The world is lovely).

And unlike 1.6 - 1.10, this restatement seems to avoid problematic assumptions about higher-order justification. The two main responses to 1.6 - 1.10 set out in the text apply to this new proposal as well, so it has limited force at best. But, that said, this version of the truth-demand is interesting and worthy of attention.

Let H be some proposition whose acceptance would be licensed by inference to the best explanation. *J(X)* stands for *Acceptance of X is justified* and *L(X)* stands for *It is likely to be true that X*. The truth-demand can be framed as follows:

1. $J(H) \Rightarrow L(H)$.

2. $L(H) \Rightarrow L(\text{The world is lovely})$.

3. $\neg L(\text{The world is lovely})$.

4.   ¬L(H).

5.   ¬J(H).

Note that (3) is weaker than

   1.3*   L(¬(The world is lovely))

which may be objectionable in the same way that 1.3 is.

   The argument (1) - (5) has notable weaknesses, nevertheless. Consider premise (3).

There might, in principle, be a priori or empirical considerations in its favor. However, it's hard

to see how a satisfactory priori defense of (3) would go. One might assert on purely

metaphysical grounds that there are many possible ways for the world not to be lovely, and few

ways for it to be lovely. Hence, the thought goes, it isn't likely that the world is lovely.

However, the status of such counting arguments is highly questionable.[76]   It seems, then, that the

critic of inference to the best explanation needs some empirical basis for advancing (3).   It isn't

clear that (3) enjoys empirical support, either. A familiar idea from debates about scientific

realism is that past reliance on inference to the best explanation has been successful. If such

success requires that the world be lovely, then the past efficacy of inference to the best

explanation may furnish (inductive) evidence that the world is lovely, after all. Or, more

minimally, it isn't obvious that whatever empirical considerations bear on (3) will go the critic's

way.[77] A further point applies. We don't simply observe that (3) is true. So, if there is inductive

justification for (3), that must be in virtue of some mechanism of ampliative justification.

Enumerative induction doesn't seem capable of doing the job. What else, then? The worry is

that any support (3) may have will be as vulnerable to the truth-demand as inference to the best

explanation is alleged to be.[78]

Premise (2) calls for scrutiny as well. As a working example, suppose that the existence

of Neptune by was discovered by explanatory inference from observed perturbations in the orbit

of Uranus. Let's add that it wouldn't have been legitimate to proceed that way unless it was

likely that the Solar System is lovely.[79]   More specifically:

2.*   L(Neptune exists) $\Rightarrow$ L(The Solar System is lovely).

Clearly, (2*) falls short of (2). To obtain (2) from (2*) the *critic* of inference to the best

explanation requires:

2.**   L(The Solar System is lovely) $\Rightarrow$ L(The world is lovely).

Suppose that (2**) holds. If so, the rest of the world is like the Solar System with respect to the

likeliness of its being lovely. But to allow as much is to concede that the world is uniform or

simple–*lovely*–in at least one key respect. Such a claim runs counter to the thrust of premise (3).

To that extent, there is a significant tension in the critic's own view.[80]

Here is a variant of the same point. Suppose the critic endorses (2**). We have, by now, explored the Solar System pretty extensively, and it has turned out to be well-behaved or lovely, as a matter of fact. So, for us, it is (at least) extremely likely that the Solar System is lovely. Thus, the antecedent of (2**) holds. And then *L(The world is lovely)* follows by detachment, contradicting the critics's claim (3).

One might think that this issue can be side-stepped. The critic might accept (2*). And, then, instead of insisting on (3), he might venture only the weaker claim:

3.*   ¬L(The Solar System is lovely).

With (3*) in hand, the critic will argue that the explanatory inference to the existence of Neptune was no good when it was performed. But this fallback view is untenable. Presumably, the critic maintains that inference to the best explanation doesn't yield justified belief under *any* circumstances, i.e. with respect to any subject matter. It's not enough for his purposes that, in isolated instances, it isn't likely that loveliness obtains with respect to this or that particular subject matter (along the lines of 3*). If that were all, then there might well be a rational general presumption that one's circumstances are likely to be lovely. To support a thoroughgoing objection to inference to the best explanation, the critic needs to invoke (3) in its undiluted form. And, in that case, he risks the embarrassment of presupposing and attacking (3) at the same time, as above.

Endnotes

1.   In some writings on the philosophy of science, theory choice is said to be underdetermined by the data so long as the data are logically compatible with more than one hypothesis. My usage here is different. I'll say, in the first place, that the choice between hypotheses is underdetermined just in case, given the evidence, there is no more reason to believe the one than the other. (See Vogel, 2004). I thank Elliot Sober for raising the point. Throughout the paper, I discuss whether experience or facts about experience provide evidential support for ordinary beliefs and their skeptical rivals. Some philosophers believe that this "Cartesian" picture is deeply wrong-headed; see Williams (1992) and Byrne (2004). I am unpersuaded, but the objection can be circumvented, in any case. See Vogel (1997).

2.   Two clarifications. First, to be more explicit, the RWH includes specific claims like "There is a rabbit in front of me", "Rabbits hop from place to place", and so forth. The RWH isn't the bare thesis that perceptual experience is, by and large, veridical. See §3. Second, what individuals believe about the world varies, and any one individual's body of beliefs is very likely to include some falsehoods here and there. The discussion below prescinds from complications of both kinds.

3.   **See Note 9. ????**

4.   For example, assume that inference to the best explanation licenses belief in hypotheses which provide simple, rather than complex, accounts of phenomena. Then the world is lovely only if it is simple, rather than complex (in the appropriate way) Unfortunately, Lipton's characterization suggests that explanatory considerations are aesthetic in character. See below.

5.   Presumably, what is said here about simplicity could be said about other explanatory virtues.

6.   Lipton and Bonjour think that the truth-demand can dealt with, to one degree or another, while Van Fraassen doesn't. For the view that the truth-demand vitiates explanationist responses to Cartesian skepticism in particular, see, among others, Fumerton (1992) and Beebe (2009). Of course, there are further doubts about the status of inference to the best explanation beyond those discussed here. See especially Van Fraassen (1980), (1989) and Fumerton (1980), (1989).

7.   There may be versions of the truth-demand which skirt the levels problem. See §2 and the Appendix for some relevant discussion. A complication here is that phrases like "It is probable that..." or "It is likely that" occur in natural language, but it is difficult to know what to make of them as they are ordinarily used. See Swanson XXX. I won't enter into such questions here.

8.   See Harman (1965), Lipton (2004), White (2005). **See Lombrozo (XXXX) for empirical findings concerning the pervasiveness of explanatory inference in our cognitive lives. Actually, Lombrozo's findings suggest that the ordinary application of IBE is too**

much of a good thing. But do we over-explain?

9. **[Domestic skepticism]. [See Note XXX].**

10. See Lev-Ari and Keysar, 2010.

11. Some opponents will argue that IBE is faulty in exactly this way: Explanatory criteria are pragmatic or aesthetic, so the explanatory success of a theory is relative to one's interests or tastes. Truth has nothing to do with one's interests or tastes. Hence, we have reason to believe that the pursuit of explanatory success and the pursuit of truth diverge. There is a risk here of begging the question. If you insist that the truth-demand is legitimate, and observe that it isn't met, you may fall into the conclusion that explanatory virtues can only be pragmatic or aesthetic. Whether and in what ways explanatory goodness may be interest-relative, and the relation of those questions to the status of IBE, are beyond the scope of this paper. For relevant discussion see Van Fraassen (1989) and Harman (XXXX); in my view, Lipton (2004) and Lycan (XXXX) provide largely effective responses. Also, someone impressed by the "pessimistic meta-induction" from the history of science might have another reason to worry about the use of IBE in certain circumstances.

12. No one is a skeptic in everyday life. Does particularism immediately underwrite the conclusion that it is rational to reject the claim that we are subject to massive sensory deception? Perhaps. But even then there is a substantial question as to the nature of the justification we have for denying skeptical hypotheses. Explanationism is a particular answer to that question, and the tenability of that answer is the concern of this paper.

13. It rejects either 1.6, 1.7, or both.

14. For any inductive inference from E to H, it is logically consistent with E that (E & ¬H). (I'm setting aside inductive inferences about mathematics and the like). The truth-demand is a requirement that you establish that the (sort of) inference you make is likely to yield a true conclusion. It amounts to a requirement that you must establish independently that ¬(E & ¬H) is true, or likely to be true. See Vogel (2004) and (2014).

15. For more about these ways of replying to the truth-demand, and about the difference between Cartesian and Humean skepticism, see Vogel (2004) and (2005).

16. Waiving any worries about the use of epistemic probability which may remain from §1.

17. There are various questions and disputes about how inference to the best explanation may be represented probabilistically. For recent discussion, see Psillos (2004) and Weisberg (2009) among others. Ultimately, the formulation in the text isn't meant to bear much very much weight. It is just a way to get certain issues out into the open.

18. For an overview of formal approaches to coherence, see Olsson (2007).

19.   Moretti (2004) and Douven and Meijs (2005) discuss a number of prominent proposals.

20.   **Moretti (2007)** and Wheeler and Scheines (forthcoming) take a more sanguine outlook.

21.   Kelly explains, "'Effects' (e.g. causal influences, correlations, monomial coefficients in polynomial laws) may be small or arcane and may not show up right away, but when they do, they reveal that our current, simplistic models are wrong. In such circumstances, Ockham's razor is understood to favor waiting to add a parameter until the corresponding effect is verified" (2004, p. 495).

22.   Like Kelly, Elliott Sober defends the use of simplicity considerations in theory choice, but with qualifications. Sober's views sit poorly with the explanationist approach to skepticism, nevertheless. First, he doesn't regard parsimony as, primarily, an explanatory virtue, and he is unfriendly toward the view that scientists engage in inference to the best explanation as such (2010, p. 127; 1999, p. 68-69). Second, Sober would agree with Kelly that simplicity considerations don't license a choice between empirically equivalent hypotheses (2010, p. 129-131). Finally, for Sober, parsimony may enhance the "predictive accuracy" of a hypothesis without making that hypothesis likely to be true and worthy of acceptance (2010, p. 124-125). What I say below may respond to, or circumvent, some reservations along these lines.

23.   **Coherence versus explanatory unification. Are elements of theory mutually reinforcing (coherence) or do they establish richer connections with the data?**

24.   There is an important distinction between absolute confirmation and relative confirmation which is relevant here (see Hempel, XXXX). The level of absolute confirmation, $Pr(H/E)$, is the degree to which H is probable given evidence E. The issue at this point is whether H is likely to be true if it has a high level of absolute confirmation. Absolute confirmation contrasts with relative confirmation, which measures the impact of evidence E on the probability of H: $[Pr(H/E) - Pr(H)]$. (Other measures of relative confirmation have been proposed). Framed in these terms, the Friedman-Glymour argument would show that, other things being equal, the relative confirmation of a theory by the evidence is greater if the theory is more unified. But it would be fallacious to argue: (i) T1 is more unified than T2. (ii) Therefore, other things being equal, T1 enjoys greater relative confirmation than T2 does. (iii) Therefore, other things being equal, T1 enjoys greater absolute confirmation than T2 does. (iv) Therefore, T1 is more likely to be true than T2 is. There is a gap between (ii) and (iii). It can be closed if $Pr(T1) = Pr(T2)$. Suppose T1 gets greater relative confirmation from E than T2 does, $[Pr(T1/E) - Pr(T1)] > [Pr(T2/E) - Pr(T2)]$. If $Pr(T1) = Pr(T2)$, then $[PrT1/E) - Pr(T1)] > [Pr(T2/E) - Pr(T1)]$. Hence, $Pr(T1/E) > Pr(T2/E)$. In words, greater relative confirmation carries with it greater absolute confirmation and then greater likelihood of truth. For the purposes of the arguments to come, the prior probabilities of the competing hypotheses are assumed to be equal, and the distinction between absolute and relative confirmation creates no special difficulties.

25.   For a dissenting view, see Sober (2010). Sober maintains that confirmation (model selection) rightly understood directs us towards hypotheses that have predictive accuracy, where

predictive accuracy and truth are two different things.

26.   This response may be unnecessary, because the objection itself may be nugatory. 'Is likely to be true' may mean nothing other than 'is highly confirmed given the evidence'. Then there is no possibility that a hypothesis could be highly confirmed yet unlikely to be true. **But see NOTE XXXX**.

27.   For objections to this strategy, see **Kukla (XXXX), Morrison (XXXX) and** Kelly (2004, 2007). Kelly also provides sophisticated criticisms of other attempts to meet the truth-demand with respect to simplicity. Myrvold (XXXX) sets out a proposal that is similar in spirit to the Friedman-Glymour approach. For criticism, see Lange (XXXX). **Mention Harman's recent papers?**

28.   What does 'structure' mean in this context? One answer is that two theories have the same structure just in case they have the same Ramsey sentence (with suitable constraints on which terms that get Ramsified). XXX; Lewis. A different approach is that causal structures are features of the world that may be suitably represented by directed acyclic graphs. **Pearl.** The discussion which follows is quite abstract and is meant to be neutral about such matters.

29.   Other skeptical hypotheses are less far-reaching than SH. It might be that, although our beliefs about the causal structure of the world are generally accurate, we are entirely wrong about what occupies the nodes of that structure. For discussion, see §4.

30.   Why shouldn't we take the basic skeptical hypothesis to be the claim that (UNV) your experience is thoroughly unveridical? For that matter, why shouldn't the primary anti-skeptical claim be that (VER) your experience is (largely) veridical, rather than the RWH? One problem is that what it is for an experience to be veridical is by no means clear–hence the hedge in the text. See Siegel (2010), Chapter Two. In any event, a retreat from SH to UNV doesn't appear to be an improvement from the skeptic's point of view. For relevant discussion, see Vogel (2010) and (in preparation).

31.   It will be helpful at this point to put a new gloss on the notion of underdetermination. From now on, let's say that the choice between two hypotheses is undetermined just in case the two are equally well confirmed by the available evidence.

32.   Some philosophers, including Parmenides and Schopenhauer, have maintained on a priori grounds that our ordinary picture of the world is thoroughly mistaken. Contemporary science may provide empirical grounds for the same conclusion. Eddington's (1927) two-tables problem is a classic statement of this issue.

33.   There is more to say about the relative explanatory merit of the RWH and SH, to be sure. See Vogel (**XXXX, XXXX**). Anyone who is unpersuaded that the RWH betters SH in this way may read what follows as a defense of a conditional conclusion: If inference to the best explanation favors the RWH over SH, then this inference withstands the truth-demand.

34.   I have in mind less-than-full-strength Bayesian confirmation theory. The discussion to come does presuppose that the level of confirmation can be treated as a conditional probability, computed according to Bayes Theorem. But throughout, I make use of comparative probabilities rather than numerical probabilities, and I try to stay neutral about various controversial issues. I should stress that there is an intuitive motivation for each of the main points made below. Ultimately, the purpose of the formal apparatus is just to police and substantiate these "pre-formal" claims. They might be regimented in some other way, and in any event the final burden rests on them.

35.   For convenience, I sometimes use 'RE' to stand for the proposition that you have experience as of the refrigerator door opening and sometimes to designate the experience itself. The difference should be clear from the context. Similarly for 'CE'.

36.   Some Bayesians will shrug off any such concern. Their view is that if we do, as a matter of fact, assign SH low unconditional probability, then we can legitimately reject SH and no more needs to be said. For a less brazen but similar position, see White (2006).

37.   Reichenbach's famous Principle of the Common Cause (PCC) entails that $Pr(A \& B/C) > Pr(A \& B/\neg C)$, where 'C' affirms the existence of a common cause of A and B. See Reichenbach (1956). If PCC applies here, the presence of a causal relation between RE and CE enhances their joint probability. The RWH affirms the existence of such a connection, while SH denies it, which provides some motivation for 3.3. However, the argument for 3.1 doesn't require the full force of the PCC, and at this point causation doesn't have to enter into the discussion at all. What matters is that SH says nothing positive about how experience evolves; it contains no "dynamics" (I am indebted to Ned Hall for this way of putting the matter). Therefore, the evolution of experience provides no test, and no confirmation, for SH. Elliot Sober seems to be of the same mind when he notes that "the negation of a model need not be a model." **Parsimony Arguments, p. 135**

38.   Here is one way to make the idea more explicit. If RWH is true, then it is inevitable or nearly inevitable that CE will follow RE: $Pr(CE /RE \& RWH) \approx 1$. On the other hand, if SH is true, it isn't at all inevitable that CE will follow RE: $Pr(CE/RWH \& RE) < 1$. Hence, $Pr(CE/RE \& RWH) > Pr(CE/RE \& SH)$. I'm taking for granted, here and throughout, that every metaphysical possibility consistent with one's evidence receives non-zero probability on that evidence. This sort of regularity assumption is controversial, but we don't need to enter into such matters on this occasion. **See Lewis (XXXX).**

39.   In his **(1938)**, Hans Reichenbach offered a probabilistic argument against solipsism, i.e., an argument to show that something external to experience causes experience. Sober (2011) provides a valuable analysis and reconstruction of Reichenbach's position. Let me highlight some important differences between the Reichenbach-Sober approach and my own. First, solipsism isn't the issue in the present context. Skeptical hypotheses can allow that experiences have extra-experiential causes. Second, Reichenbach and Sober make stronger, more specific assumptions about causation than I do (2011, p. 8-9; see **Note XXX, above)**. Third, Sober's

presentation of the argument relies solely on comparisons of likelihoods, because he finds the relevant prior probabilities "difficult to justify" (2011, p. 19). As a result, Sober is unable to establish that "we are justified in believing that external objects exist" (2011, p. 9). But, as I've just argued, no stable assessment of priors gives the skeptic what she needs, namely underdetermination between SH and the RWH relative to *all* evidence bases. Laurence BonJour (1985) also appeals to probabilistic considerations in an effort to refute external world skepticism. For discussion, see Vogel **(2010).**

40.   Van Fraassen's "preliminary exposition" of empirical adequacy is: "A theory is empirically adequate exactly if what it says about the observable things and events in this world is true" (1980, p. 12). In the present context, replace "the observable things and events in this world" with "one's experience". It is worth noting that, while EA itself may be more highly confirmed than the RWH, EA isn't a competitor to the RWH.

41.   The skeptic will maintain that the RWH and (SH & EA) are equally well confirmed by any information EXP about the course of experience. By construction, (i) Pr(EXP/SH & EA) = Pr(EXP/RWH). (ii) Pr(RWH) = Pr(SH & EA). From (i) and (ii), (iii) Pr(EXP & RWH) = Pr(EXP & SH & EA). From (iii), (iv) Pr(EXP & RWH)/Pr(EXP) = Pr(EXP & SH & EA)/Pr(EXP). From (iv), (v) Pr(RWH/EXP) = Pr(SH & EA/EXP).

42.   What if, instead of (3.8) Pr(SH & EA/E) = Pr(RWH/E), we had (*) Pr(SH/E) ≤ Pr(RWH/E), which is consistent with Pr(SH/E) = Pr(RWH/E)? The trouble is that (*) is too weak. It is consistent with the RWH's being better confirmed than every one of its radical competitors, which the skeptic is bound to deny.

43.   I use the sign "⇒" for the entailment relation and the sign "⟺" for logical equivalence.

44.   There is another way to put what is essentially the same point. A theorem of the probability calculus is that (i) Pr(SH & EA/EA) = Pr(SH/EA). The reasoning which establishes 3.1 can be modified to show that (ii) Pr(SH/EA) < (RWH/EA). Claims (i) and (ii) imply (iii) Pr(SH & EA/EA) < Pr(RWH/EA). To that extent, (SH & EA) poses no threat to the acceptability of the RWH.

45.   **[Compare Cosmology Example.]**

46.   On the formal side, one approach would be to represent the epistemic strength of the RWH, SH, and (SH &EA) via a family of probability functions. See Joyce (XXXX). Other treatments are available and may be preferable for present purposes.

47.   Descartes, Meditation One: "But I cannot forget that, at other times I have been deceived in sleep by similar illusions; and, attentively considering those cases, I perceive so clearly that there exist no certain marks by which the state of waking can ever be distinguished from sleep".

48.   Authors such as Pearl (2000) and Spirtes, Glymour, and Scheines (2000) have maintained that causal structure can be recovered from observed regularities (or, more precisely, relations of

probabilistic dependence and independence among observed variables). What they have accomplished is a matter of some controversy. The techniques they employ depend on certain methodological assumptions, and the difference between patterns of causal relations can't be detected in certain cases. Still, this research may reinforce the view that our ordinary beliefs about the causal framework of our environment are better confirmed than radical alternatives would be. For helpful overviews, see Cooper (1999), and Scheines (XXXX).

49.   **[What about BonJour?]**

50.   As formulated in the text, the ISH says only that the world contains simulacra for ordinary objects and properties; it doesn't specify what those simulacra are. However, it will often be helpful for expository purposes to discuss particular ways that the ISH might be implemented, as I do here.

51.   On one way of viewing the matter, the identity of a property is fully determined by its causal profile. See Shoemaker (XXXX). In that case, the ISH is merely a notational variant of the RWH, and the problem of choosing between them evaporates. Otherwise, the thesis that we don't know whether the RWH or the ISH is true has affinities with certain philosophical positions, such as causal structuralism (see, *inter alia*, Hawthorne 2001) and "Ramseyan Humility" (see Lewis 2009). To explore the relations among these views lies beyond the scope of this paper.

52.   Attempts have been made to systematize such facts in an "occlusion calculus". See Koehler (2002).

53.   **[They can be known a priori. Zardini?]**

54.   Elizabeth Spelke's seminal work on object perception in infants indicates that their judgments about the identity and distinctness of items in their environments are guided by what Spelke calls the "cohesion principle". The cohesion principle requires one and the same object to follow a spatiotemporally continuous path, so it implies LOC. (Spelke, 1990).

55.   The difference, roughly, is between taking an expression to denote a role property and taking it to denote the realizer of that property. It may be helpful to compare 4.2 with (*) □ (Keys to the front door unlock the front door). There is a reading of (*) which makes it true. But let's specify that 'key to the front door' designates a certain kind of physical object, say a piece of metal with shape K. Actually, pieces of metal with shape K do unlock the front door. However, the modalized version of (*) is: (**) □ (Pieces of metal with shape K unlock the front door). (**) is false. The lock could be changed, for one thing. In such circumstances, pieces of metal with shape K wouldn't unlock the front door.

56.   Any property that o* has essentially will do the job. **Putnam on Models and Reality.**

57.   These necessary truths might correspond to axioms for various types of "spatial logic", which are meant to capture in a rigorous way how spatial reasoning works. See, for example,

Randell, Cui, and Cohn (1992), Casati and Varzi (1999), and Cohn and Renz (2008). In addition, Dehaene *et al*. (2006) and Spelke (2010) maintain that infants and adults apply and make use of fundamental geometrical concepts in navigating their environments and in recognizing objects. See Vogel (1990, 2005, 2008, and in preparation) for related discussion.

58.   Vogel (1990), (2005), (2008).

59.   See Gifford (XXXX).

60.   Perhaps this stance is abetted by the dubious view that all necessary truths are analytic, and therefore devoid of any content whatsoever. See Glymour (1980) for defense of the claim that necessary truths are explanatory; Glymour also sets out a full-scale argument that a theory which deploys necessary truths is epistemically preferable to a competitor that has to make do with contingent truths instead. Notably, proponents of the Quine-Putnam indispensability argument for Platonism have made the case that necessary mathematical truths enter into substantive scientific explanations. See Baker (2005).

61.   4.8 will seem attractive to those who hold broadly Humean metaphysical views. See Lewis (2009) and, for discussion, Vogel (1990) and (in preparation, b).

62.   Lewis makes this point (2009, p. XXX).

63.   This way of formulating O and O* is rough. For needed refinements, see Note XXXX

64.   See Pearl's conception of surgery on a causal graph (Pearl XXXX, p. XXXX). An alternative way to describe things would be to treat S and S- as the same structure. What varies then is whether the location/location* node in that structure is occupied. Nothing turns on the difference between these formulations; the argument below would go through *mutatis mutandis*.

65.   To be more explicit, the content of O* is 'If **S-** obtains, its nodes n^*_1, n^*_2, ... are filled by o^*_1, o^*_2, ... respectively & If **S** obtains, the remaining nodes n^*_n, n^*_{n+1} ... are filled by o^*_n, o^*_{n+1} ... respectively'. O may be formulated as 'If **S-** obtains, its nodes n_1, n_2, ... are filled by o_1, o_2, ... respectively & If **S** obtains, the remaining nodes n_n, n_{n+1} ... are filled by o_n, o_{n+1} ... respectively'. O* by itself doesn't imply that the o^*_i exist, and O by itself doesn't imply that the o_i exist. I assume that nodes can't be multiply occupied. O* says which specific location a pseudo-object o* will have, if it exists and does indeed have a location. O says which specific location an object has if it exists; if it exists it must have some location or other. See below.

66.   See Note XXXX.

67.   To say a bit more, the ISH does attribute a pseudo-location* to the pen* (say in-the-desk-drawer*), and if the ISH is true, then the structure **S-** is, in fact, embedded in **S**. The key point, however, is that it *could* have been the case that the pen* didn't have a location*, so it *could* have been the case that **S-** wasn't embedded in **S**. Here is an analogy. As things actually go, the boss, the workers, and the shop steward are all on the job. But, as a matter of metaphysical possibility,

there *could* have been just the boss and the workers (if, say, the company had managed to bust the union). That is, the substructure **S-** (boss and workers) is actually embedded in **S** (boss, workers, and shop steward). But that there is a boss and workers doesn't entail that there is another node–that of shop steward–filled by anyone.

68.   Another way to get at the main idea: O implies claims like (The pen has a genuine location $\supset$ The pen is in the drawer). (S- & O) $\Rightarrow$ (The pen has a genuine location). Hence, (S- & O) implies (The pen is in the drawer), which is to say that (S- & O) implies S in full. On the other side, O* implies claims like (The pen* has a pseudo-location $\supset$ The pen* is in-the-drawer*). If (S- & O*) did entail (The pen* has a pseudo-location), then the disparity set out in 4.21 wouldn't emerge. But that entailment doesn't hold, so (S- & O*) doesn't imply S in full.

69.   Here are the intermediate steps: From 4.20 and 4.21, (i) Pr(S & O/S- & O) Pr(S- & O) > Pr(S & O*/S- & O*) Pr(S- & O*). From (i) and laws for conditional probability, (ii) Pr(S & O & S- & O) > Pr(S & O & S- & O). From (ii), deleting the redundant occurrence of 'O' on both sides, (iii) Pr(S & S- & O) > Pr(S & S- & O). S is equivalent to (S & S-), so simplifying both sides of (iii) yields (iv) Pr(S & O) > Pr(S & O*).

70.   **Cf. BonJour**

71.   For example, N could be 4.5 and N* could be 4.6.

72.   See Note XXXX.

73.   Another case in point comes from the philosophy of mind. There is reason to think that spectrum inversion in conscious subjects doesn't occur because necessary truths about colors constrain the functional role that a specific kind of color-experience can occupy. See Palmer (1999).

74.   For a different view about spatial properties, which underwrites a different response to skepticism, see Chalmers (XXXX). For dissent, Vogel (in preparation, b).

75.   **[Science; reply to Enc]**

76.   See Beebe, etc.

77.   The no miracle argument. Rule-circularity? Not concluding IBE is successful; making a substantive claim.

78.   One might argue that, while we lack a priori or empirical grounds for accepting ¬L(The world is lovely), we also lack grounds of either sort for L(The world is lovely). Hence we ought to suspend judgment on L(The world is lovely). Suppose so. Then we might have to suspend judgment on J(X), so that ¬JJ(X). But this result won't impugn our first-order justification for X unless the suspect JJ Thesis is in force.

79.   That claim is virtually tautological, to the extent that x is lovely if and only if inference to the best with respect to x is bound to be successful.

80.   One might worry that the argument given in the text proves too much. It may seem to be of a piece with the following: Suppose the world is unlovely throughout. Hence, all sub-regions R are unlovely. Hence, the world is lovely (in this "epistemically significant respect"). Hence, by reductio, the world isn't unlovely. This train of thought may not be so bad after all; it bears some resemblance to the well-known argument that counter-induction is incoherent. In any case, the more focused points made below shouldn't raise these sorts of qualms.