A Tale of Two Nortons*

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Introduction

Norton's material theory of induction, introduced in Norton (2003), and further developed in 2014 and forthcoming, aims to dissolve *Hume's Problem of Induction* by eschewing universal inductive rules in favor of domain specific inductive rules. According to the material theory, these domain specific rules derive their justification from equivalently domain specific *facts*. Since rules (or more precisely, their use) are justified by facts, the regress ends, as facts, unlike beliefs or applications of rules, are not the sort of thing that require justification. The facts that license these inductive inferences are called *material facts*, since they "are the material of the induction," hence the name "material theory of induction," (Norton, 2003, pp.648). Curiously, later in the very same paper, Norton claims that inductive inferences are justified by the *knowledge* that a given material fact obtains. This is difficult to interpret, as this is a substantially different claim. The result is that Norton (2003) features not one, but two material theories of induction; one in which inductive inference is licensed by facts, and one in which inductive inference is licensed by knowledge. Norton writes as if the latter is a mere precisification of the former, but I do not believe this to be correct.

Kelly (2010) calls attention to this discrepancy, and after criticizing and dismissing the fact version of the thesis, sets his sights on the knowledge version. He then argues that the knowledge version of the material theory falls victim to a regress that is similar, although not identical, to Hume's Problem of Induction.[1] Call this the *Prior Knowledge Problem*, (Kelly, 2010, pp.760). Norton (2014) responds directly to Kelly's objection. Here, Norton supplements his previous claims with an appeal to coherentist epistemology in an attempt to avoid the Prior Knowledge Problem, (Norton, 2014, pp.682-687).

I find Kelly's arguments convincing, insofar as I believe that the Prior Knowledge Problem is a legitimate problem for the material theorist. Moreover, I am not entirely convinced the new coherentist version of the material theory espoused in Norton (2014) is able to properly avoid the Prior Knowledge Problem. It may be argued, however, that Kelly's criticism, even if apt, is, to a certain degree, unfair. Epistemology is rife with various regresses, inductive and otherwise, and it may be unreasonable to expect a given theory, especially a nascent one, to be able to solve them all. Moreover, a solution to a single regress, even

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[1]Specifically, Hume's Problem concerns justification for a rule of inference (or its use), while The Prior Knowledge Problem concerns the justification of belief. See sections 1.1 and 1.3.1 for details.

if it fails to solve all of them, can be valuable and philosophically interesting. Norton's material theory was developed for the explicit purpose of dissolving Hume's Problem, and it is unclear whether it is obligated to solve/dissolve any and all others.

What is clear, however, is that a theory *is* obligated to solve the specific problems that it explicitly claims it does. Unfortunately, it is in this capacity that the material theory falls short. In what follows, I shall argue that Norton's material theory of induction fails to provide a satisfactory dissolution of Hume's Problem, the very problem it was developed to solve. Crucially, I believe that this is the case for both the fact version, as well as the knowledge version. This is worthy of remark since, as I shall argue, it remains unclear precisely which version of the theory Norton actually endorses. It isn't obvious what to make of this from an interpretive perspective, and one may worry that Norton is vacillating between two substantially different views. Accordingly, my strategy is to attack both the fact and the knowledge version of the material theory. I ultimately conclude that neither version solves Hume's Problem.

Section 1 will introduce Hume's Problem and Norton's attempted material solutions, while highlighting the differences between each. In doing so, I also characterize Kelly's criticism of the view. Section 2 will address how each version of the material theory fails to solve the regress, and section 3 will be a brief conclusion.

1 A Material Theory of Induction

1.1 Hume's Problem

Norton motivates the material theory of induction by observing that *formal* theories of inductive inference regularly fall victim to Hume's Problem of Induction. Formal theories, for Norton, are theories which use *domain general* rules of inference, e.g. enumerative induction. Such domain general rules do not consider the content or *material* of the inference, but only concern the *form* of the inference, (Norton, 2003, pp.650). The problem can be characterized as follows:

- In order to make an inductive inference I, one must apply some inductive rule, r which licenses the inference (in the same way that deductive rules, e.g. *modus ponens*, license deductive inferences).

- However, since r, is inductive, it does not guarantee that the truth of the conclusion follows from the truth of the premises, and therefore, the application of r itself also requires justification.[2] This justification comes from some *uniformity principle*, e.g. "The future will resemble the past."

- This uniformity principle will also require justification. Moreover, uniformity principles are contingent matters, and cannot be justified deductively. Therefore, it must be justified by the application of some inductive rule r'.

    - If $r' = r$ then the justification is circular.

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[2]In the deductive case, the application of a rule is justified because the rule is valid.

– If $r' \neq r$, then r' is a new inductive rule, whose application must be justified by some uniformity principle. Return to the second step.

We observe that the chain of justification either results in an infinite regress, or a vicious circle. Hume concludes that this justificatory regress means that *induction, itself, is not rationally justified,* (Okasha, 2001, pp.309). The severity of this conclusion is matched only by the recalcitrance of the problem. The subject of the dilemma is left in an unenviable position:

- Make an inference that you do not recognize as justified.

- Make no inference at all.

Neither option is attractive.

1.2 The Material Theory, Fact Version

Norton believes that Hume's problem is an artifact of our insistence on looking at inductive inference the same way we look at deductive inference. More specifically, he believes it is bound to show up whenever domain general inductive rules are appealed to. Indeed, he observes that every inference pattern that falls victim to the problem involves domain general inductive rules, (Norton, 2003, pp.651). To illustrate this, he asks us to consider two formally identical inductive inferences.

Some samples of the element bismuth melt at 271°C. Therefore, all samples of the element bismuth melt at 271°C.

Some samples of wax melt at 91°C. Therefore, all samples of wax melt at 91°C.

According to Norton, the first inference is licensed while the second is not, (Norton, 2003, pp.649). The problem is that *formal theories*, that is, theories that try to make inductive inference fit a universal template, treat both arguments as if they had the same general template.[3]

Some A's are B's
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Therefore, all A's are B's

A proper theory, however, will need to ensure that the inference in the first argument is justified, while the inference in the second is not. However, these two inferences are, at the surface level, identical in form, despite the fact that that we like the first and do not like the second. In order to explain this discrepancy, Norton argues that the formal theorist must claim that the two arguments are elliptical and that extra conditions must be added to block misapplications of the schema, like we see in the wax argument. For instance, it might be added that induction may only be applied to A's of some universal totality, (Norton, 2003, pp.649). Unfortunately, Norton claims that this path leads in a circle since any account of

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[3]For Norton, a formal theory is any inductive theory in which inductive inference fits a universal template, and is not limited to theories which use formal tools to model induction, (Norton, 2003, pp.649).

the meaning of "universal", in this case, is just going to be a synonym for "instances in which enumerative induction works," (Norton, 2003, pp.650). Any substantive additions to the schema that were not mere synonyms would have to be about bismuth, wax, or some other *specific* thing, and would therefore undermine the universality of the schema. Norton concludes that this places the formal theorist in a tight spot. The very universality they aim to achieve is the cause of their trouble. If they abandon it, the theory is no longer a properly formal theory, (Norton, 2003, pp.649-650)

Something has to give, and Norton believes that it is the universality that formal theories have attempted to maintain. His proposed solution, the material theory of induction, claims that all induction is local, and inductive inferences are licensed by domain specific, *material facts* pertinent to the inference, rather than universal schema, (Norton, 2003, pp.650).[4] This means that for any inductive inference to be licensed, there must be a relevant fact that obtains which justifies the inference. This can be best illustrated by returning to the above example. In the case of the bismuth inference, there is a material fact: [Samples of a given element are generally uniform in their physical properties.] that obtains.[5] This fact is domain specific, since it only concerns elements and physical properties, and it is relevant to the inference, since bismuth is an element and melting point is a physical property. Importantly, this fact is not a universal law, as it only obtains generally, as opposed to universally, (Norton, 2003, pp.651). This, Norton believes, allows the inference schema to avoid the regress that plagues domain general claims.[6]

Therefore, Norton claims, this fact licenses the inference from the premises to the conclusion that all samples of the element bismuth melt at 271°C, (Norton, 2003, pp.650-651). Thus, [Samples of a given element are generally uniform in their physical properties] is the material fact that licenses the inductive inference from the premise "Some samples of bismuth melt at 271°C" to the conclusion "All samples of bismuth melt at 271°C". The inference in the wax example is blocked because there is no corresponding material fact in the case of wax.

With the material theory in tow, Norton returns to Hume's Problem, as characterized earlier. Norton claims that formal theories fall to the regress because each universal rule must be justified by belief in some uniformity principle, which in turn, must be justified by the application of an inductive rule, and so on. Not so for the material account. Each justified inductive inference is justified precisely because it is licensed by some relevant material fact that obtains. Crucially, a fact's ability to license inference is not contingent upon our epistemic access to them, (Norton, 2003, pp.650-651). As Norton puts it, "[Facts] justify the induction, whether the inducing scientist is aware of them or not, just as the scientist

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[4]Here I take Norton to be using the word "material" in the way the term is used in Sellars (1953). Sellars contrasts material principles of inference, which have to do with the specific content of the premises and the conclusion, with formal principles of inference, which have to do with the form of the argument alone, (Sellars, 1953, pp.313). The manner in which Norton contrasts formal approaches with his own material approach seems to suggest this reading.

[5]I will use brackets as a term forming operator, such that "[ϕ]" can read as "The fact that ϕ."

[6]Norton argues that this is also what separates material inductive inference from vanilla deductive inference. Notice that if the fact were domain general e.g. [All samples of a given element are uniform in their properties] then the schema would 1) be an instance of a valid deductive inference, and 2) would allegedly fall victim to Hume's problem since the justifying fact is domain general, and would itself need to be justified. This bears mention as many have alleged that the material theory actually treats instances like the case above as deductive arguments. Norton rejects this on the grounds mentioned above, (Norton, 2014, pp.673).

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may effect a valid deduction without explicitly knowing that it implements the disjunctive syllogism," (Norton, 2003, pp.650-651).[7] Thus, Norton argues, inductive inference "grounds out" in material matters of fact, and the regress is resolved.[8]

Norton supplies several of what he takes to be general cases of this process from the history of science. He cites, for example, Newton's famous discovery of the gravitational forces that act between celestial bodies. Norton believes that once these facts about gravitational forces were established, scientists were then licensed to infer new causes of previously observed phenomena. For instance, it was inferred that the moon's gravitational forces caused the tides, and that comets were deflected in their motion around the sun by the sun's own gravity. It even licensed the inferences to the existence of new bodies, like the planet Neptune, (Norton, 2003, pp.663).[9] Crucially, Norton believes that the above inferences were not licensed by any schema, but rather material facts about gravtiational forces, (Norton, 2003, pp.663).

1.3 The Material Theory, Knowledge Version

1.3.1 Different Interpretations

After developing the theory characterized in the previous section, Norton (2003) considers various case studies in an attempt to show that induction is domain specific. Curiously, during these explanations Norton deviates significantly from the material theory introduced earlier in the paper. Recall that according to the material theory, material *facts* are what license inductive inference. However, in section 3, Norton makes the following claims:

- "Experience licenses inference." (Norton, 2003, pp.655)

- "Judgements license inference." (Norton, 2003, pp.655)

- "Our choice is licensed by facts tacitly assumed to obtain." (Norton, 2003, pp.656)

- "In order to learn a fact by induction, the material theory says that we must already know a fact." (Norton, 2003, pp.666)

In the passages above Norton respects the domain specific component of his claims, but either ignores or trivializes the fact component, and does so without comment.[10]

This places the reader in a difficult interpretive quandary as they are forced to wonder what, precisely, is doing the justificatory heavy lifting in the material theory: Facts? Belief?

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[7]The idea that the infererer does not need epistemic access to the relevant material fact in order for that fact to license the inductive inference is the distinctive feature of the fact version of the material theory. The consequences of this are discussed in detail in section 2.1.

[8]Norton frequently uses the "grounding" locution, but I do not believe this should be construed in the same way as metaphysicians use the term. Rather, I take him to mean that the regress is stopped cold by *terra firma* rather than going off endlessly in the void. Construed this way, I feel as though the wording is especially appropriate, and in fairness, Norton (2003) was written before the recent grounding explosion in metaphysics. As might be expected, this language is largely absent from Norton (2014).

[9]See Norton (2003) for further examples. Also, Norton Forthcoming is especially rich with examples.

[10]Another instance of this can be seen in the above example involving gravitational forces. Norton says, "In these cases, the added inferential power that comes *from knowing*..."[emphasis added] suggesting, contra his previous claims, that epistemic access to the fact is required for justification, (Norton, 2003, pp.663).

Knowledge? Something else? This distinction is far from trivial, and I am not the first to notice it. Kelly (2010) calls attention to this discrepancy and considers the consequences. After giving a brief characterization of the material theory, Kelly takes Norton to task with the following:

> In what sense are inductive inferences "grounded in" material facts? I take it that it is not sufficient either that such grounding facts obtain or that they are believed to obtain. Rather, what is required is that the person drawing the inference knows (or at least, reasonably believes) that they obtain. After all, if the rationality of induction could be guaranteed either by (i) certain facts obtaining (regardless of whether we had any reason to believe that they obtain) or (ii) our simply believing that such-and such facts obtain, then it is hard to see how the problem of induction could pose much of a problem for anyone, including proponents of traditional, "formal" accounts of induction. On the first possibility (i), the rationality of induction would be guaranteed simply by our living in what is in fact an induction-friendly world (again, regardless of whether we had any reason to think that it is induction friendly as opposed to induction unfriendly). On the second possibility (ii), it would be enough if we simply believe, optimistically, that our world is induction friendly–as we surely do, (Kelly, 2010, pp.759).

Kelly doesn't say much more on this particular matter, but these comments are worth briefly unpacking. It seems to me that Kelly's aim is to show the consequences of Norton (2003)'s somewhat loose language with respect to the role of facts in justification, as Norton seems to make claims that are non-trivially distinct. The first reading Kelly considers falls out from what I have called the fact version of the material theory. If facts do the justifying, as reading (i) suggests, then inductive inferences are justified if the relevant material fact obtains (or as Kelly puts it, our living in an "induction friendly world"). This is so regardless of whether we have any epistemic access to that fact, any reason to believe it obtains, or any reason to think that the fact plays any justificatory role whatsoever. The alternative reading that Kelly considers, labeled (ii), has it that mere belief in the relevant material fact is sufficient to license inductive inference. Kelly concludes, by my lights correctly, that both positions are *prima facie* untenable since, if either are correct, then "Hume's Problem isn't much of problem for anyone," (Kelly, 2010, pp.759). I take this to mean that these readings trivialize the motivating problem (Hume's Problem) altogether. Recall that Norton believes that Hume's Problem is significant, and that the material theory is desirable, *inter alia*, because it avoids the problem where formal theories falter, (Norton, 2003, pp.649-650). Kelly, however, seems to be arguing that if facts can play the justificatory role, and epistemic access to the facts is not required, then this move is equally available to the formal theorist. Since epistemic access to the justifying fact is not required, then it doesn't matter whether the inference rule is formal or material. Similarly, if mere belief in a fact can justify our inductive inferences, then inductive inferences can be justified whenever a given fact is believed, regardless of how the belief was generated.

In light of the unsatisfactory consequences of readings (i) and (ii) Kelly concludes that when Norton says that "an inference is justified by a fact" he must means "an inference is

justified by knowledge of a fact," (Kelly, 2010, pp.759). Kelly calls this the *prior knowledge commitment* and characterizes it thus:

Prior Knowledge : In order to learn a fact by induction, one must have prior knowledge of the material fact that licenses the induction, (Kelly, 2010, pp.760).

Call the version of the material theory that supports prior knowledge the knowledge version of the material theory of induction. Under the knowledge version, knowledge of a fact justifies inductive inference. This contrasts with the fact version, according to which, facts themselves license inductive inference. After discarding the fact version, Kelly sets his sights on the knowledge version and poses a problem for it. The problem, which I'll call *the prior knowledge problem*, goes as follows.

Prior Knowledge Problem

- In order to make an inductive inference I, one must apply some inductive rule, r which licenses the inference.

- However, since r, is inductive, it does not guarantee that the truth of the conclusion follows from the truth of the premises, and instead is only justified in the presence of a material postulate (a material fact known by the inferer).

- The material postulate will also require justification, and since material facts are domain specific and contingent, belief therein cannot be justified deductively. Therefore, the belief in the material postulate also requires justification. This will require knowledge of another material fact.

- The belief (that is a necessary condition for knowledge) in the latter fact must itself be justified.

- Therefore, since the body of contigent human knowledge is finite, either there is some material postulate that is unjustified, or the justification of inductive inference is circular.

Kelly believes that the knowledge version of the material theory of induction falls victim to the prior knowledge problem, (Kelly, 2010, pp.760-762). Note that the Prior Knowledge Problem is not identical to Hume's Problem, at least as it is construed by Norton. Hume's Problem involves the justification of inductive inference, while The Prior Knowledge Problem concerns the justification of belief in a fact.

1.3.2 A Coherentist Defense

Norton (2014) aims to address various attacks levied against the material theory, Kelly's included. Norton's strategy here is to argue that the commitment to Prior Knowledge does not lead to the Prior Knowledge Problem. He argues that the problem only follows should we adopt further hierarchical presuppositions, which he rejects, (Norton, 2014, pp.684-685). In brief, Norton believes that the Prior Knowledge Problem would be an issue should the material theory further support commitment to what he calls "hierarchical empiricism,"

(Norton, 2014, pp.684). According to hierarchical empiricism, empirical beliefs can only justify other empirical beliefs when they are closer to the observation. As Norton put it, "The essential restriction [of hierarchical empircism] is that an inductive inference can only draw upon propositions inductively closer to observation than the inference's conclusion. This restriction is the basis of Sober's 'Principle of Empiricism' and is also...the essential content of Kelly's "Prior Knowledge" commitment," (Norton, 2014, pp.685). Norton then claims that the Prior Knowledge Problem, with this presupposition made explicit, looks like the following: "Applied to the first induction beyond the observational realm of the here and now, it tells us that this induction can only draw on propositions closer to observation. None of those are sufficiently general to warrant this first induction; hence the induction is unwarrantable," (Norton, 2014, pp.684).

After giving a rough characterization of hierarchical empiricism, Norton then argues that the Prior Knowledge Problem does not arise if we reject hierarchical empiricism. This rejection isn't especially difficult for Norton as he argues, quite plausibly, that science isn't so simple as the hierarchical empiricist suggests. Norton cites Einstein 's claims about the, at the time, budding fields of quantum physics and general relativity to make his point, arguing that, "[Quantum physics, and general relativity] as Einstein repeatedly insisted, are not recovered by simple induction from experience. As early as 1918, he protested, with a little overstatement, that 'there is no logical path to these [fundamental] laws' but that nonetheless 'in practice the world of phenomena uniquely determines the theoretical system.'... If we are to believe, as empiricists surely must, that our modern theories have good empirical credentials, then our empiricism cannot be this strict hierarchical variety," (Norton, 2014, pp.684).

Science, Norton claims, does not behave in such a strict, stratified manner. Rather, the relations of support will invariably "cross different layers" of any proposed hierarchy. Accordingly, Norton claims that we must instead concieve of the practice of science and the justification of its claims in a non-hierachical way. As he puts it, "My proposal is that the relations of inductive support in mature science form a... non-hierarchical structure," (Norton, 2014, pp.686). Norton illustrates this with a simple and effective metaphor. Hierarchical empircism treats justification like a tower, while the more correct non-hierarchical characterization of justification in science treats it like an arch. In a tower, stones are stacked on top of one another, where each stone or layer of stones is supported directly by the layer beneath it, while the foundational layer is supported by the ground. In the metaphor closeness to the ground is intended to represent closeness to the observation. Norton's prefered view treats justification in science more like an arch. In an arch, each stone receives support from above and below from each other stone in the arch. This Norton argues, is a better illustration justification in science as practiced, (Norton, 2014, pp.689).

Stepping away from the metaphor, Norton argues that in the case of science, each belief gets support from other beliefs in an intricate, web-like structure. He further claims that in the case of mature science, once the web of support has become robust enough, it can be *self-supporting*. In a self-supporting structure, justification is circular, but, (allegedly) not in a way that is vicious. Norton claims that the resulting conception of inductive support is thus non-hierarchical, and beliefs within it are justified in virtue of being part of a coherent whole, (Norton, 2014, pp.686). Justification through coherence is the characteristic feature of coherentist epistemology, and thus, Norton's account falls squarely (and explicitly) into

this epistemological camp.[11] Thus, Norton believes, Kelly's Prior Knowledge Problem is neutralized by appeal to the web-like nature of scientific beliefs, and their ability to be self-supporting.

With these further claims and commitments in tow, Norton (2014) seems to feature an updated version of the material thoery, where knowledge of facts is justified by knowledge of other facts. Moreover, this relationship of justification is non-linear, and the resulting structure is web-like,(Norton, 2014, pp.687). When the structure is suitably mature, it is self-supporting, as the coherence of the whole justifies the beliefs that are necessary conditions for the knowledge of facts that justify other knowledge of facts. Norton argues that this picture not only avoids the Prior Knowledge Problem, but also offers a fairly accurate picture of scientific practice, (Norton, 2014, pp.677). Call this the knowledge version of the material theory of induction.

Norton (2014) provides the reader with what he takes to be a historical example of this non-hierarchical kind of justification.

> [R]elations of inductive support routinely cross in a way that makes the hierarchy unsustainable. A simple example arises in Newtonian gravitation theory. When we infer inductively from the observed positions of Venus to the elliptical orbit that fits them, we select an ellipse from all possible curves, on the warrant of Newton's inverse square law of gravity that entails that planets orbit in ellipses. Yet Newton's law can have the benefit of inductive support from the very ellipses whose fitting it warrants. Take as a datum that planets do orbit the sun in what are, to very good approximation, re-entrant ellipses... Newton (1729, Book 1, Prop. 45, Cor. 1) demonstrated that, from this datum, one could infer to the inverse square law of gravity. Any deviation in the exponent of the force law from two would be revealed as a failure of re-entrance and the extent of the deviation could be computed numerically from the extent of the failure, (Norton, 2014, pp.685).[12]

I take it that Norton's point here is that support doesn't just flow in a single direction. Rather, justification is purported to flow both ways, and there does not seem to be any justificatory hierarchy related to distance from the observation.

Unfortunately, as I'm about to argue, Norton and the material theory are far from out of the woods. Norton (2014) takes the time to argue that a commitment to Prior Knowledge does not result in the Prior Knowledge Problem. Despite this fact, Norton does not explicitly commit to Prior Knowledge explicitly. More puzzlingly, the language of Norton (2014) and forthcoming feature the same lack of consistency highlighted in the previous section. These considerations make it less than clear what position Norton is, in fact, defending. If it's the knowledge version, where knowledge (and coherence) justify inductive inference, then

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[11]Any theory under which a belief can be justified through coherence with a system of other beliefs is considered coherentist. This is so, even when justification comes in degrees, or the theory recognizes other means of justification as well, Olsson (2017). This is crucial for Norton, since he is careful to mention that his espousal of coherentism does not amount to a rejection of foundationalism, (Norton, 2014, pp.687).

[12]Interestingly, the licensing fact in this case is Newton's inverse square law. Norton was careful to distinguish between laws and material facts in Norton (2003), saying that material facts weren't laws. I'd be curious to know why this has changed, and what the consequences are.

it is not at all obvious what role *facts*, material or otherwise, play in this account. Indeed, we are forced to wonder why Norton so frequently refers to facts and whether or not they obtain. The worry, from my perspective, is that Norton may be vacillating between to distinct views. I am unsure what to make of this from an interpretative perspective, so with my worry registered, I shall forgo further interpretive investigation in favor of direct engagement with each version of the material theory: fact and knowledge. In doing this I aim to highlight the differences between each, with the ultimate goal of demonstrating that each, independently, fails to dissolve Hume's Problem.

2 Why the Material Theory of Induction Fails

As I mentioned above, Norton has two different material theories, each of which attempts to dissolve Hume's Problem. In light of this, I shall engage both versions. More specifically, I shall argue that both versions fail to deliver on their promise to dissolve Hume's Problem. I will first consider the fact version, and then consider the knowledge version.

2.1 Fact Version

The fact version of the material theory of induction claims that inductive inference is licensed by material facts. It claims further that epistemic access to the material fact in question is not required in order to license the inference. This ensures that any regress "grounds out" in a material fact, supposedly halting the regress. There are two reasons why we shouldn't think that this provides a satisfactory solution to Hume's Problem.

2.1.1 Undercutting Original Motivations

The material theory of induction contrasts itself directly with formal theories of induction. In fact, Norton characterizes the material theory as the only non-formal theory on offer, Norton (forthcoming). Further, the failure of formal approaches is what motivates consideration of the material theory in the first place, (Norton, 2014, pp.677). It must be admitted that the fact version of the material theory does appear to solve Hume's Problem. Indeed, it neutralizes it altogether. The problem is that this solution works equally well for formal and informal theories alike.[13] The reason is simple. Once we allow for facts to justify our inferences, then the inference in question will be licensed precisely when those facts obtain. This will be so regardless of whether or not the inferer has any reason to believe that they obtain, (Kelly, 2010, pp.759). The key here that there is nothing crucially connecting the materiality of a given fact with the locality of a given inference. This is to say that the

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[13]Kelly 2014 seems to gesture at this consideration when he says, of the fact version, "If the rationality of induction could be guaranteed... by certain facts obtaining (regardless of whether we had any reason to believe that they obtain)... then it is hard to see how the problem of induction could pose much of a problem for anyone, including proponents of traditional, "formal" accounts of induction... [T]he rationality of induction would be guaranteed simply by our living in what is in fact an induction-friendly world (again, regardless of whether we had any reason to think that it is induction friendly as opposed to induction unfriendly)," (Kelly, 2010, pp.759). These are his comments on the matter in their entirety, so it is difficult to give a detailed account of exactly what he had in mind. With this understood, I think my argument in this section is best seen as a development of the worry mentioned in the preceding quote.

exact same explanation is available to formal and informal theories alike. There is nothing stopping the formal theorist from claiming that facts can justify formal inductive inferences in precisely the same way.[14] This renders the material component of the material theory completely immaterial, so to speak, as it doesn't seem to be doing any justificatory work. We may then reasonably wonder why we ought to consider the material theory at all.

This is a significant problem for any theory that can be considered to be interestingly material, and I take it that right, wrong, or otherwise, the material theory had better be interestingly material. This is undesriable, since adopting the fact version will undercut the dialectical motivations for the material theory in the first place. This makes the view somewhat self-defeating given the way the view is dialectically situated.

2.1.2   Trading One Problem for Another

Despite the above objection, one might be inclined to think that Norton is still onto something. Afterall, the fact version does solve the problem. What if we were to consider the fact version removed from its dialectical trappings altogether? Perhaps we may discover a worthwhile solution to Hume's Problem, material or otherwise. Unfortunately for the material theory, the outlook isn't promising. At its core, Hume's Problem, on all it's versions and construals, is a problem about justification. Justification, in the philosophical literature at large, is typically taken to be something that applies to things that we do, either actively or passively. In the epistemic domain, these can involve things like believing, inferring, or the use of a rule of inference.[15]

Of course, "justification" is nothing if not a vexed term. One of the many lines of agument regarding justification concerns whether justification of a given action is derived from features internal or external to the agent carrying out the action. These positions are colorfully referred to as internalism and externalism, respectively.

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[14]There are several ways such a view could be developed. Consider the following brief example. A domain generalist will, unlike Norton, aim to vindicate a formal schema for induction. Something like:

Some A's are B's

Therefore, all A's are B's

This rule certainly is not valid, and therefore demands justification. The formal theorist, however, may then claim that domain general facts in the world justify the inference. There are, again, myriad ways this might be done. One option might be that [All A's are B's] is a fact that could justify the inference from some A's are B's to all A's are B's, in a way similar to Norton's theory. Of course, just like the fact version of the material theory, insofar as the inference is justified is wholly contingent on whether or not the justifying fact obtains (or to use Kelly's language, whether we are in an "induction friendly world"), and has nothing to do with what reasons the inferer has. This would mean that the inference was good in the All A's are B's worlds, and bad in the rest. I am by no means a proponent of this view, but it is interesting for at least two reasons. Firstly, according to Norton, many seem to misconstrue Norton's view with the view that inductive inference is actually deductive, (Norton, 2014, pp.673). I suspect that they may be mistaking Norton's view with the view sketched above. Secondly, the position above is hardly interesting or tenable. Unfortunately for the fact version of the material theory, it is untenable for precisely the same reasons (see the next section for details).

[15]Moreover, these can be can include tokens or types of these activities. I've avoided the term "action" since it is often taken to involve intention in some robust sense, and it is plausible that some things we do, like believe and infer, can be done unintentionally, or automatically. Nonetheless, it seems that these beliefs and inferences are capable of being justified or failing to be justified all the same.

Internalism about Justification: Where a is an agent and c is an action carried out by a: the factors that determine whether c is justified are internal to a.

Externalism about Justification: Where a is an agent and c is an action carried out by a: the factors that determine whether c is justified are external to a.

To oversimiplify a bit, proponents of externalism about justification believe that an act can be justified even when the acting agent does not have epistemic access to whatever is doing the justifying. In other words, you can be justified and not know it, (BonJour, 1985, pp.25). Internalists disagree, claiming that the agent must have epistemic access to whatever is doing the justifying; one can't be justified without knowing it, (BonJour, 1985, pp.24). We see then that the fact version of the material theory is thoroughly externalist. For the fact version, applications of inductive rules are justified when certain material facts obtain. These facts are external to the mind of the inferer, and epistemic access is not required in order for them to perform their justificatory role.

This, in and of itself, is no objection, as externalism is a perfectly respectable philosophical position. It does, however, have some non-trivial consequences for anyone defending the fact version of the material theory. Consider the relationship between justification and decision under the fact version. The motivating problem of induction involves justification, but the characteristic feature of externalism, the denial that epistemic access is a necessary condition for justification, separates justification from decision. The fact version of the material theory solves Hume's Problem rather handily by telling an externalist story involving facts, but since this story is external, it introduces a new question. Namely, how is the inferer to decide which inferences he or she ought to make? Call this Norton's Decision.

Norton's Decision

- In order to make an inductive inference I, an agent a must apply some inductive rule, r which licenses the inference.

- However, since r is inductive, it does not guarantee that the truth of the conclusion follows from the truth of the premises, and therefore, the application of r itself also requires justification. This justification comes from some *material fact*.[16]

- Belief in this fact will also require justification. Moreover, material facts are contingent matters, and belief therein cannot be justified deductively. Therefore, it must be justified by the application of some inductive rule r'.

  - If $r' = r$ then the justification is circular.
  - If $r' \neq r$, then r' is a new inductive rule, whose application must be justified by some uniformity principle. Return to the second step above.

In light of this, a has the two exhaustive options listed below.[17] What should a do?:

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[16]Hume's problem, as formulated here, appeals to uniformity principles as the sorts of things required to justify an inductive inference. Norton eschews uniformity principles for material facts to fill this justificatory role, so I've exchanged one for the other to show that the intersting part of Hume's Problem still manifests itself in the fact version of the material theory, even without appeal to uniformity principles.

[17]Indecision is covered by the latter option.

- Make the inference despite the fact that a does not recognize it as justified.

- Don't make the inference.

This should look strikingly similar to Hume's Problem from section 1.1. This is because Norton's Decision is merely an extension of Hume's Problem that demands a decision on the part of the inferer. This is relevant question to ask given that we lack direct, unmediated, epistemic access to the facts. Once we separate justification from decision in the way that the fact version of the material theory does, this question becomes especially pertinent as it cannot be solved in the same way as Hume's Problem.

Unlike externalists, internalists do not have to face Norton's Decision (or any similar externalist regresses). At least, they are not forced to see it as a wholly separate puzzle from Hume's Problem. Since an agent needs to have epistemic access to whatever is playing the justificatory role, the agent will be able to incorporate this information in their decision process. Accordingly, internalist solutions to Hume's Problem will often have a great deal to say regarding Norton's Decision, as the two can collapse together. My point here is not that the externalist is out of options, but rather, that the externalist story implemented in the fact version of the material theory is, at best, incomplete.

In adopting such a robustly externalist account of justification, the fact version solves Hume's Problem, only to introduce a more challenging problem in Norton's Decision. Not only are we trading one problem for another, but, as I shall argue, we seem to be trading down. A satisfying response to the problem of induction, material or otherwise, will need to solve the problem without bringing about a new, more difficult, one. If a solution that does introduce a new problem is to even be satisfactory, this new problem will either need to be less substantial than the initial problem, or some sort of solution to the new problem will need to be introduced. If we consider the fact version of the material theory, we see that neither of these is satisfied. Norton's Decision is no less compelling than Hume's Problem as presented in Section 1.1. Indeed, some internalists may argue that the two problems are one and the same. More damningly, however, if we insist that the two are distinct, as the fact version of the material theory does, then Norton's Decision appears to be a deeper problem than Hume's Problem. The fact version's externalist commitments separate justification from decision in such a way that makes the problem especially difficult to address. Since facts justify inference, and the inferer doesn't need to know or even be aware of the fact in order to be justified, then the story about how the inferer actually *decides* is wholly divorced from the story about why she is justified. Insofar as the material theory strives to characterize the actual practice of science, we should expect it to tell us about when and how inferring scientists make their inferences. However, as far as the fact version is concerned, whether and why the inferring scientist is justified in their inference is similarly divorced from what their scientific practice. In short, what the scientist thinks and does is not properly connected with when and why she is justified in doing it. This is unsatisfying for a position which explicitly aims to capture induction "as it is practiced by scientists," (Norton, 2003, pp.647). Moreover, Norton's defense of the fact version doesn't offer any suggestions regarding how we might address Norton's Decision. The problem isn't addressed at all. Because of this, it is unclear that the fact version of the material theory offers any advantages over the competition. Adopting the theory merely trades one regress for another, while incurring substantial theoretical commitments along the way. This, in

addition to the concern that the fact version undercuts the initial motivations of the material theory, seem to undermine the view completely.

2.2   Knowledge Version

The knowledge version of Norton's material theory of induction claims that inductive inference is licensed by the knowledge that certain material facts obtain. To defend against the prior knowledge regress, Norton then claims that different pieces of knowledge within the web are justified, in the case of mature science, by being part of a coherent whole, wherein each belief receives inductive support from several others in a non-hierarchical way. Thus, inductive inference is licensed by knowledge that a material fact obtains, and that knowledge (or rather, the belief that is a necessary condition for that knowledge) is justified by being a member of a coherent whole. The Prior Knowledge Problem is prevented since a circularly justified web of belief is not illicit. Each belief in the web is justified because the web as a whole is coherent, (Norton, 2014, pp.686).

I'll assume, for the sake of argument, that Norton's coherentist defense against The Prior Knowledge Problem is successful. I will further grant the coherentist thesis that justification of beliefs can be circular without being vicious, (BonJour, 1985, pp.87-88). Recall, however, that Hume's problem is not concerned with the justification of belief, but rather with the justification of the use of an inductive rule.[18] In order to address Hume's Problem, Norton will need to show that the justification of the use of an inductive rule can be non-viciously circular, since Hume's Problem is about the justification of inductive inference, not the justification of belief. Coherentism, qua coherentism, doesn't say anything about the justification of rules, applications thereof, or inferences. It only provides justification for beliefs.[19] It is left unargued why we should not consider circular justification of anything other than belief illicit. Hume's Problem claims that the justification for an inductive rule will either result in an infinite regress (Norton rejects this option, and its allegedly hierarchical presuppositions), or a vicious circle. Norton has chosen the circle, but has yet to tell us why it is not vicious. Unfortunately, there is substantial reason to think that it is. To see how, consider how the knowledge version of the material theory traces the line of justification.

The justificatory chain of command for the knowledge version of material induction goes as follows, where "$\Rightarrow$" indicates the relationship of justification:

Knowledge of a material fact $\Rightarrow$ Application of an inductive rule.

Coherence $\Rightarrow$ Knowledge of a material fact.[20]

Applications of inductive rules are justified by beliefs. Justification for beliefs can be circular, because these beliefs, when collectively coherent, are justified (and are therefore knowl-

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[18]Or, alternatively, an inference. In either case, something that is not a belief.

[19]Crucially, I'm not talking about belief in the validity or any sort of correctness of some form of inference, but the applciation of a rule (which doesn't necessarily, require a belief at all). This is the big difference, as the application of a rule is a totally different action type then the action type of having a belief. This is so because our inferences can be justified even if we dont know it, e.g. someone who has never taken logic is still perfectly justified in applying modus ponens even if they dont have a belief about it.

[20]"$\phi \Rightarrow \psi$" can be read "ϕ justifies ψ" or "ϕ supports ψ"

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edge). This may look ostensibly appealing, but things are not so simple. The problem is that Norton has smuggled something significant into his account of coherence.

Traditionally, coherence is complex property enjoyed by a set or collection of beliefs, (BonJour and Sosa, 2003, pp.88, 93). While the precise definition of coherence varies from account to account, coherentists typically take various relations between the beliefs that make up the set to be necessary conditions for the coherence of the set as a whole. These relations often include things like logical consistency, explanatory relations, and various inductive relations, (BonJour and Sosa, 2003, pp.93), Olsson (2017). The bad news is that Norton (2014) is nonspecific regarding the necessary conditions for what coherence is. He does, however, specifically endorse one necessary condition for coherence: relations of inductive support, (Norton, 2014, pp.685-687). This is problematic, however, since inductive support is established by the application of an inductive rule. With this crucial detail made explicit, we get the following:

Knowledge of a material fact $\Rightarrow$ Application of an inductive rule.

Application of an inductive rule and $x \Rightarrow$ Knowledge of a material fact.

Where x stands in for any other necessary conditions for coherence Norton has in mind. With this made explicit we can see the potential for circularity. This potential is actualized in the following puzzle.

Hume's Coherence

- In order to make an inductive inference I, one must apply some inductive rule, r which licenses the inference.

- However, since r is inductive, it does not guarantee that the truth of the conclusion follows from the truth of the premises, and therefore, the application of r itself also requires justification. This justification is derived from the *coherence* of the inferer's web of belief.

- A necessary condition for the coherence of the inferer's web of belief is a relation of inductive support. This relation of inductive support is established by some inductive rule r'.

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    - If $r' = r$ then the justification is circular.
    - If $r' \neq r$, then r' is a new inductive rule, whose application must be justified by some coherence property. Return to the second step.

Call the problem above Hume's Coherence. It looks an awful lot like Hume's Problem. Indeed, I do not believe it to be interestingly different from Hume's Problem in any way.[21]

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[21]Even if it were shown to be interestingly different, the problem would remain significant.

If this is correct, then the knowledge version of the material theory of induction fails to solve Hume's Problem.[22]

There is a potential line of defense that is worth addressing preemptively. The material theorist may be inclined to retort that the circularity in Hume's Coherence is not illicit. This is precisely the kind of circularity that the property of coherence aims to vindicate. I take this response to be unsatisfying. Perhaps justification among beliefs can be circular, but the necessary and sufficient conditions for coherence and justification for inductive rules, cannot be. Recall that for coherentists, coherence is a property of a collection of beliefs. This does not amount to the claim that circularity is, in general, admissible. If they did then coherentists wouldn't even recognize Hume's Problem as a problem. Rather, coherentists defend a very specific kind of circularity (coherence) that can only be had by a very specific kind of object (a collection of beliefs). The circularity above does not fit this form, however, as it includes both beliefs as well as applications of inductive rules. This is no longer the kind of thing that can have the property of coherence. Recall that all of the various necessary conditions for coherence that coherentists defend are relations between propositions, or, more generally, things with content. Things like beliefs can stand in these relations precisely because they have content, e.g. propositions can entail other propositions, but they cannot entail a rule or an action. The same goes for relations of inductive support. Coherence, however, is determined entirely by the presence or absence of these relations. Neither rules, their applications, nor inferences can stand in these relations, and subsequently, coherence simply is not applicable when they are present. Accordingly, the material theorist cannot simply gesture at epistemic coherentism to solve the problem.[23]

The material theorist may be inclined to concede this point to make another. It could be agreed that traditional coherentism cannot play this role, but perhaps some non-traditional coherentism, novel or otherwise, could accomodate the coherence of objects other than sets of beliefs. Then the circularity would be non-vicious. To say nothing of the plausibilty of

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[22]One may be inclined to wonder how an inferer's beliefs regarding the coherence of her set of beliefs plays into this picture. Indeed, coherentist accounts typically, although not always, appeal to some belief about the coherence of the set of beliefs in question. This is a legitimate question, and one I think the proponent of the knowledge version ought to consider. However, in order for this strategy to be legitimate the material theorist will have to tell a considerably more robust story about the necessary and sufficient conditions for coherence (or in Norton's terms, when a science is mature). See BonJour (1985) and Lehrer (1990) for examples of more fleshed out versions of coherentism. Without these conditions made explicit, it is not clear how such a belief could itself be justified. It is also worth mentioning that the knowledge version of the material theory concerns beliefs across a mature science at large, not just the beliefs of one particular individual. It may be plausible for the coherentist to claim, at the personal level, that it is possible for a particular infering agent to determine whether their beliefs are coherent. It is less clear whether one agent can determine the coherence of something much larger, like a mature science. However this question is to be answered, the burden of providing such an answer falls on the material theorist.

[23]It may be replied that a belief in an an inference rule, or rather, a belief that it is valid, or something like that, if justified, can be sufficient to justify that inference form. This way, rules can be treated as beliefs, which can have content, and play a role in coherence. Norton doesn't mention anything like this, so the material theorists exact position regarding this is unclear. Still, there are reasons to reject the idea that beliefs such as these should play this justificatory role. For instance The belief that, say, *modus ponens* is valid is what justifies the application of *modus ponens* and any beliefs resulting from applying the rule. Mere belief that *modus ponens* is valid does not do this. It is for this reason that fallacious reasoners are not justified when the deny the antecedant. This remains the case, even when they believe that denying the antecedent is valid. Accordingly, mere belief in a rule cannot be enough.

such a view, the response fails for reasons similar to the reasons why the fact version fails. If such a response is available, then it is equally available to the formal theorists. If coherence is what prevents the regress then the materiality of the facts believed plays no role in the dissolution of the dilemma.[24] If such a path is taken then, once again, the material theory will fail to be interestingly or effectively material. This, as before, undercuts the initial dialectical motivation for the theory in the first place.

If what I've said above is correct, then the knowledge version of the material theory fails to solve Hume's Problem, and is subsequently untenable. If this is correct in addition to my previous criticism of the fact version, then both versions fail, and the material theory, upon any construal, is untenable.

3   Conclusion

In the preceding sections I have argued that Norton supplies us with two importantly different material theories of induction, and that they both failed to accomplish their intended purpose of dissolving Hume's Problem. The fact version fails because it undercuts the initial dialectical motivations of the project, and fails to answer Norton's Decision. The knowledge version fails because circular justification of inductive rules remains vicious, even when circular justification of beliefs is not, resulting in Norton's Coherence. If my arguments are successful, then the material theory faces a significant difficulty.

It is unclear whether or not the material theory is beyond repair, and it may be the case that my objections are refuted. Nonetheless, I think there is some broader insight to be gleaned from my criticism. Suppose, for a moment, that each version of the material theory succeeds in dissolving Hume's Problem. Notice that in each case, it is not the material component of the material theory that prevents the regress. In the fact version, the regress is prevented by the mind-independent nature of facts. In the knowledge version, coherence plays the leading role in solving the problem. In each case, the material component sits quietly backstage, despite enjoying top billing. The question, then, is why should we think that the material component is in any way responsible for dissolving Hume's Problem. Crucially, we may wonder this even if we believe that there is something interestingly material going on with induction. Even if we believe that there is something compelling about the idea that inductive inference is local, or that induction operates on beliefs that are material in their content, it remains unclear how these contribute to a solution to Hume's Problem. Accordingly, the proponent of the material theory ought to consider precisely what role materiality actually plays both in solving Hume's Problem as well as explaining induction more generally. Ultimately, I don't know how these questions are best answered. However, it does seem clear that materiality, even if it plays some crucial role in our theorizing about induction, is not some panacea that remedies all of our inductive ills. Rather, it seems to be a humbler part of some larger machine. I admit that his might not be the most attractive way to view things, especially from a marketing perspective.

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[24]If it turns out that there is such a non-traditional coherentism, and that further, it allows for a non-vicious circularity that the formal theorist cannot avail themselves of, then the onus, once again, is on the material theorist to explain the details of this new coherentism, while also explaining why it is not available to formal theorists.

Nonetheless, I strongly suspect this is the attitude required if anything resembling the material theory is to be successful.

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