Necessarily the Old Riddle – Necessary Connections and Induction

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September 12, 2018

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1 Introduction

As with any of the perennial problems of philosophy, the debate about the problem of induction has accumulated a plethora of proposed solutions as well as a large selection of arguments that the problem can never, ever be solved. One idea to solve the problem, which, as Stathis Psillos demonstrated,[1] predates the first modern formulation of the problem by David Hume by a number of centuries, is to justify induction by using ontology. The basic idea is this: if we know that there are necessary connections between properties F and and G such that F-ness necessarily brings about G-ness, then we are justified to infer that all, including future or unobserved, Fs will be Gs. The idea to solve the problem of induction with ontology, widely discussed in scholasticism, has been revived by David Armstrong, Brian Ellis, and, differently, by Stephen Mumford and Rani Anjum. In this paper, I will argue that these attempts to solve the problem of induction fail.

Before we delve into the discussion about whether the necessitarian attempts can be successful, we will begin by first characterising what the problem of induction actually amounts to. Following this, I will turn first to David Armstrong's proposal, which is firmly rooted in his account on universals and laws of nature, before we turn to the more recent dispositionalist approaches by Brian Ellis and Stephen Mumford and Anjum. After having discussed some of the existing criticism of these view, I will go on to argue that these arguments fail irreparably. The first problem is that necessary connections do not as required imply the corresponding universal regularities. The second issue is that these attempts do not justify induction, but amount to an elimination of a mere subset of all inductive inferences. And even if that elimination could be successful, it would still contain an inference to the best explanation, which is ampliative inference that is itself in need of justification.

[1] Psillos (2015)

2 The Old Riddle

The prominent formulations of the problem of induction differ significantly.[2] However, the formulation of the problem that still dominates the discussion today is David Hume's account from the Treatise of Human Nature.[3] Hume formulates the problem as follows: if inductive inferences were a product of reason, i.e. if they were justifiable, they would need to presuppose the premise that nature is uniform. If one wants to infer from any observed regularity to a universal regularity, one needs to presuppose that the regularities do not haphazardly change. This gives rise to a dilemma. According to Hume, there are only two possible ways to know that nature is uniform, either deductively (Hume's term is "demonstrably"), or inductively (which Hume calls "probabilistically"). According to Hume, we cannot reason for the uniformity of nature demonstrably, since that would entail that nature's regularity is a necessary fact. It is fair to assume that to Hume, the issue is that a deductive inference to the uniformity of nature would have to be made *a priori*, and would hence be a necessary fact. That does not seem to be possible: that nature is uniform is something we can only know from observation. But if we wanted to infer the uniformity of nature from observation, we would have to infer it *inductively*. Unfortunately, that is impossible as well, since if we then want to use the uniformity of nature to justify our inductive practice, we would enter a vicious circularity.[4]

As Peter Strawson has argued,[5] and as will become apparent below, this formulation of the problem is problematic, because it puts an impossibly high demand on what a justification, if one were even possible, is meant to achieve. The issue with this formulation is that it requires inductive

[2] I have argued elsewhere that there at least three different notions of justification in the literature. Whereas in sceptical accounts, a possible justification is often supposed to show how induction could be truth-preserving, there also exist notions of justification which demand to show that induction is truth-conducive, or that inductive practice is *rational*. See (redacted for review).

[3] Hume (2000 [1739/-40])

[4] Hume (2000 [1739/-40]), section 1.3.6

[5] Strawson (1952), 250, and (redacted for review).

inferences, if they were justifiable at all, to be enthymemes of deductive inferences, i.e. deductive inferences with suppressed premises. This is what a justified inductive inference would look like according to Hume:

P_1: All observed ferromagnets have so far attracted iron.

P_2: Nature is uniform.

P_3: If nature is uniform, then ferromagnets do not change their behaviour.

C: All future and unobserved ferromagnets attract iron.

The problem of induction is thus that it is impossible to justify the suppressed premise P_2, which together with P_3 would render the inferences in question truth-preserving.[6] That such a justification is impossible to obtain is entirely unsurprising, given that these are maybe the best known *sceptical* formulations of the Old Riddle.

In contrast to Hume's sceptical formulation of the problem, Laurence BonJour, for example, formulated the problem of induction as follows:

> If we understand epistemic justification [...] as justification that increases to some degree the likelihood that the justified belief is true and that is thus conducive to finding the truth, the issue is whether inductive reasoning confers any degree of epistemic justification, however small, on its conclusion.[7]

Thus, according to BonJour, the problem is not how we could show that induction could be made truth-preserving by introducing a suppressed premise which would render inductive inferences as enthymemes of deductive inferences, but merely to show how induction could be truth-conducive.

So why should we even include the classical formulations in contrast to less demanding ones such as BonJour's? Because, as will become apparent below, the necessitarian attempts orientate themselves along the lines of the

[6] See BonJour (1998), 190, and (redacted for review).

[7] BonJour (1998), 189.

sceptical attempts. They try to justify induction by filling in a supposedly suppressed premise and thereby reduce them to enthymemes of inferences that do not contain induction, although they fall short of demonstrating that these inferences are truth-preserving. Now that we have a clearer picture of what sort of inferences we are dealing with and what the problem of induction amounts to, let us finally turn to the proposed necessitarian solutions to the problem, starting with David Armstrong's account, and then move on to newer dispositionalist attempts.

3 Armstrong's Attempt

David Armstrong proposed to solve the problem of induction with a reference to a necessary connection. Say we want to justify what appears to be the following inference:

P_1 All ferromagnets observed so far have attracted iron.

C Future or unobserved ferromagnets will attract iron.

Armstrong's claim is that such an inference could be justified if we knew that there is for example a necessary connection between being a ferromagnet and attracting iron. The inference pattern Armstrong proposes covers two steps: Firstly, we observe that so far, all ferromagnets have attracted iron. From this,[8] we infer via an inference to the best explanation that there is a necessary connection between being a ferromagnet and attracting iron. For Armstrong, or any proponent of the Armstrong-Dretske-Tooley (ADT) view, necessary connections take the form of necessitation relations between universals. That there is a necessitation relation between being an F and being a G is expressed as $N(F, G)$, where N is a higher order polyadic universal, denoting the necessitation relation. $N(F, G)$ is also the form that

[8] Andreas Hüttemann also argues that the resilience of nature to produce a certain state of affairs is best explained by necessitarianism to be true. If one consistently fails to bring about an F that is no G, then we are justified to infer that there is a necessary connection of some kind between being an F and being a G. (Hüttemann (2014) 32-33).

laws of nature take in the ADT view. Armstrong now claims that the necessary connection $N(F, G)$ deductively implies the universal regularity $\forall x(Fx \rightarrow Gx)$, which in turn entails that all future or unobserved Fs will also be G. This inference pattern is a supposed solution to the problem of induction because Armstrong holds that in contrast to induction, the rationality of IBE is a brute fact. We could thus justify induction by reducing it to an inference pattern of IBE+deduction.[9] Accordingly, the inference regarding ferromagnets would look something like this:

P_1 All ferromagnets observed so far have attracted iron.

C_1 There exists a necessary connection between being a ferromagnet and attracting iron (from P_1, by IBE)

C_2 <u>All ferromagnets attract iron (from C_1)</u>

C_3 Future or unobserved ferromagnets will attract iron.

Armstrong goes on to claim that this is another advantage of the ADT-view over Humeanism. He claims while his account with the above inference pattern can solve the problem of induction by providing a way to infer the nature of future or unobserved cases from the nature of past or observed cases via the detour of inferring the necessary connection by IBE, the Humeans could do no such thing.[10] I will not discuss Armstrong's arguments against Humeanism any further in this article.[11] However, Armstrong is not the only person to have proposed using ontology to solve the Old Riddle. So we should take a look at another necessitarian attempt to solve the Old Riddle, before we turn to Helen Beebee's more general argument against the necessitarian accounts of induction, which serves as the segue to our argument to the effect that these attempts to solve the problem of induction are universally, irreparably, and necessarily, doomed.

[9] Armstrong (1983), 54–59.

[10] See Armstrong (1983), 54–59.

[11] See Smart (2013) for a discussion on whether Armstrong's arguments against the Humeans have any force. I do, however, believe Smart's arguments against Armstrong rely on an unfair representation of what sort of universals are admissible in the ADT-view.

4 Dispositional Accounts

Brian Ellis, like David Armstrong, holds that a Humean metaphysics makes the problem of induction insoluble. Ellis argues that in a world where everything is 'loose and separate', where there is just one little thing and then another, and where the laws of nature are contingent and are merely bestowed upon an essentially passive world, there is no way to make sure that nature could not completely change the next instant.[12] Against this, he argues that in a dispositional essentialist picture like his own, the problem would could be solved easily.[13] Ellis's own brand of dispositionalism, scientific essentialism, is a view in which the laws are the consequences of the irreducibly dispositional properties of the concrete things, which bear these dispositional properties essentially. A ferromagnet's disposition to attract iron is part of the essence of being a ferromagnet: if it didn't attract iron, it wouldn't be a ferromagnet. Since the laws are only consequences of the essential dispositional properties, they are neither contingent, nor ontologically prior to the causal processes a thing engages in. The kinds of objects there are, the dispositional properties they have, and the processes they are engaged in, all form natural kinds in his view. What natural kinds there are is for the sciences to discover.[14]

Ellis believes that such an ontology makes a solution to the problem of induction possible. The basic idea is this: if we know what sort of essential dispositional property P a kind of things E has, then we can from this predict how that thing is going to behave in certain circumstances C. The specific process that the exposure of E to C gives rise to, such as a ferromagnet's attraction of iron if there is some in the vicinity, is, like the kind of things E whose identity is fixed by having disposition P, also a natural kind. Hence, we are able to infer the following:

L1: For all χ, necessarily, if χ has P, and χ is in circumstances

[12] Ellis (1998), 104–105

[13] He also, and very cursory, argues that his scientific essentialism could solve Goodman's new riddle (Ellis (1998), 107.) I disagree, but this is a project for a future paper.

[14] Ellis (1998), 109.

> of the kind C, then χ will display an effect of the kind E.[15]

From this we are allowed to infer the regularity that

> Necessarily, if a is in circumstances C, then a will display an effect of the kind E.[16]

According to Ellis, this is what allows the scientific essentialist to solve the problem of induction. If we know what sort of dispositional properties a natural kind of things have, then we are justified to infer how these things will behave in future or unobserved cases.[17] Ellis's account of how to justify induction is very similar to Armstrong's, although their respective ontologies differ quite significantly. The general idea with both is that if we know that there holds a specific necessary connection, then we can infer the respective universal regularity, which includes all unobserved or future cases. Note that for his solution of the problem of induction, Ellis presumes that our world is deterministic, which is the main point of entry for Stephen Mumford's and Rani Anjum's criticism, which I will argue against below.

5 Why the Necessitarian Attempts Do not, and Won't Ever, Work

We have already discussed some arguments against the specific recent necessitarian attempts to solve the old riddle. However, since, as Stathis Psillos has shown, the idea to solve the problem of induction with some sort of necessary connections is by no means a new one,[18] and is not one that is tied to these specific accounts by Armstrong and Ellis, we should try to look at more general arguments against the the strategy to solve the old riddle with ontology. For this, I will first extend an existing argument by Helen Beebee concerning time-limited necessary connections, and then go on to discuss

[15] Ellis (1998), 114, italics adjusted for consistency.
[16] Ellis (1998), 115, italics adjusted for consistency.
[17] Ellis (1998), 116.
[18] Psillos (2015)

a number of general problems these attempts to justify induction all share and which make a solution of the problem by ontology seem impossible.

5.1 Time-limited Necessary Connections

Helen Beebee offers a much more convincing argument against necessitarian attempts than Ben Smart's argument we discussed above.[19] In this section, I will first recount Beebee's arguments, and then go on to argue for a stronger claim. Remember that according to the necessitarian accounts, the inference from any observed regularity to the existence of a necessary connection, from which we are then supposed to deductively infer the universal regularity, is an instance of an inference to the best explanation. Supposedly, the best explanation for the fact that so far, all Fs have been Gs, is that there is a necessary connection between being an F and being a G of some sort. However, her argument goes, there are multiple possible different sorts of necessary connections between F and G, which could act as an explanation, and which not all allow to deductively infer the universal regularity that all Fs are Gs. For example, it seems conceivable that necessary connections only hold for a specific period of time, and not only, as Armstrong proposes, eternally. After all, why wouldn't it be possible that what is necessarily connected until a certain time ceases to be so connected later? Beebee claims that without further argument, it is not clear why $N(F, G)$, as a temporally unlimited necessary connection, is the best explanation for the fact that so far, all Fs have been Gs. *Prima facie*, there are at least two possible necessitarian explanations why so far, all Fs have been Gs:

> (SF) [So far] F and G have been necessarily connected so far.

and:

> (T) [Timeless] F and G are timelessly (eternally) necessarily connected.[20]

[19] Beebee (2011)
[20] Beebee (2011), 510.

If we accept that a necessary connection could be time-limited, then why should the temporally unlimited necessary connection be a better explanation for the fact that so far, all Fs have been Gs, than the time-limited necessary connection that Fs and Gs have only been necessarily connected *so far*? But such a time-limited necessary connection would not entail the universal regularity that $\forall x(Fx \rightarrow Gx)$, only that the regularity has held so far. So unless there is an independent argument against time-limited necessary connections, she claims, there is no way to hold that the time-unlimited one is actually the best explanation for the observed regularity. But without that, Armstrong's inference pattern breaks down.[21]

Beebee notes her argument as portrayed above does not work in a dispositional essentialist picture. In dispositional essentialism, the essences of the natural kinds are made up of their dispositions. A ferromagnet, for example, if being a ferromagnet is a natural kind, wouldn't be one if it did not have the disposition to attract iron. So in this view, it is not possible that the necessary connection is time-limited: ferromagnets cannot at some point stop to attract iron: they would cease to be ferromagnets. It is simply not possible in that picture to be a ferromagnet and not to attract iron. However, Beebee argues, there is still a way to construct a sceptical alternative explanation. The trick is that when we observe things, we first have to establish that they are actually members of the relevant natural kind, which is supposed to have a particular dispositional essence. Say we observe a number of items which we, because of their behaviour, conclude are members of the natural kind "ferromagnet" and which have so far attracted iron. According to Beebee, Ellis proposes the following inference:

> (SE) All observed Fs have produced Gs. The best explanation of this is that the Fs are members of a natural kind K, whose essence is or includes the disposition to produce Gs. Hence all Fs (by virtue of membership of kind K) produce Gs.[22]

[21] Beebee (2011), esp. 509–511.
[22] Beebee (2011), 520

However, Beebee argues, although it is not possible that members of a particular natural kind ever have a different dispositional essence, it might be possible that future Fs cease to be members of that particular natural kind. That makes the following alternative explanation possible for the fact that so far, all Fs have been Gs:

> (SF*) *The observed* Fs are (or were, at the time at which they were observed) members of an Ellisian natural kind K, whose essence is or includes the disposition to produce Gs [...].

However, that does not entail the following, which would be needed for Ellis's solution to the problem of induction:

> (T*) *All* Fs are members of an Ellisian natural kind K, whose essence is or includes the disposition to produce G.[23]

Her argument amounts to the claim that while it might not be possible to exchange the natural kinds' dispsitional essences, it might be possible to exchange which natural kinds there are: things that look like ferromagnets might cease to be ferromagnets in the future, and hence, we would not be justified to infer that things that look like ferromagnets always attract iron in future or unobserved cases, because they just might stop being ferromagnets at some point.[24]

Jesse Mulder, while discussing Beebee's argument after a presentation, claimed that this exchange of what natural kinds there are instantiated is problematic. Say pigeons form a natural kind K, which is essentially disposed reproduce further pigeons. It is hence part of the very nature of pigeons to be able to produce further pigeons. And, to follow Mulder's argument, these new pigeons must have the very specific set of powers that make them the sort of pigeon that current pigeons have the power to produce, which entails that also the new pigeons cannot ever produce anything other than pigeons. An exchange in what Ellisian Kinds are instantiated is

[23] Beebee (2011), 521

[24] Beebee (2011), section 5.

hence impossible.[25] To this argument, Beebee has responded after a presentation of this paper that if what Mulder proposed were the case, it would make, for example, evolution impossible.[26] If pigeons could not do anything else than to again produce pigeons, which can only ever produce other pigeons, there could not be any evolution of pigeons. Evolution might be a genuine case in which we would expect that an exchange of what natural kinds are instantiated is not only possible, but actually happening.

While I agree with Beebee's argument that evolution would be impossible if it were impossible to change what natural kinds are instantiated over time, I do, however, hold that Beebee concedes too much when she agrees that in the Ellisian essentialist picture, it is supposedly impossible to change what is necessarily connected to what. Let us take a step back. There are, *prima facie*, three ways to argue that it is impossible that necessary connections, regardless of whether they are of the ADT- or the dispositional essentialist kind, are time-limited. One could either argue that it is logically, physically, or metaphysically impossible. Firstly, and without needing much argument, time-limited necessary connections are clearly not logically impossible. Logical modality (unless misconstrued as conceptual modality), is a consequence or a feature of the respective logical system. And no logical system implies that ferromagnets don't at some point repel samples of iron.

Secondly, arguing that it is physically impossible for necessary connections to change is either straightforwardly incomprehensible, or leads to a regress. In the case of the ADT-view, physical modality simply is the modality of necessary connections in nature: that it is physically necessary that any F is a G is nothing but to say that there is a $N(F, G)$ holds, that F-ness brings about G-ness. In order to say that it is physically impossible that at some instant in time t_1, $N(F, G)$ holds, while at a later instant, t_2, $N(F, H)$ holds, but not $N(F, G)$, would presuppose that there is a universal that, if instantiated, would bring about that at all times $N(F, G)$ holds but not $N(F, H)$. Now what would such a universal be? And moreover, even if we could find such a universal, *that* this universal is necessarily connected

[25] Jesse Mulder, in conversation

[26] Beebee, in conversation.

with the complex universal that $N(F, G)$ holds at any time, would require another necessary connection to ensure that the universal which forbids the time-limitedness of any particular necessary connection to be time-limited itself, and so *ad infinitum*. So even if we could make sense of the claim that it is physically necessary that the existing necessary connections hold timelessly in the ADT-view (and I don't believe we can), that still would result in a regress.

In the dispositional essentialist case, things are not quite as head-spinningly incomprehensible if one wanted to argue that it is physically impossible that what is necessarily connected is immutable. But it would still be impossible: in the essentialist picture, physical modality, if there is such a modality at all, is a consequence, is reducible to, metaphysical necessity: if it is physically necessary that Fs are Gs if the right stimuli are present, then this is so because it is the very nature of Fs to be Gs if the right stimuli are present. So for the dispositional essentialist, in order to argue that it is physically impossible, for a necessary connection to change one would have to argue that this is not physically, but *metaphysically* impossible.

That leaves us with option 3. For the ADT-view, it seems to go against the very programme behind that view to invoke metaphysical necessity to prohibit that which universals are necessarily connected is unchangeable over time: after all, it is supposed to be metaphysically *contingent* which universal is connected to which in this view. And both David Armstrong and Michael Tooley explored ways to make irreducibly time-limited laws possible without adding temporal indices to their universals.[27] For the ADT-view, at least in its historic form, we would have to leave the possibility of changes of which universals are necessarily connected open.

In dispositional essentialism, it seems like it should be more straightforward to prohibit time-limited necessary connections. After all, in this view, the necessity of ferromagnets to attract iron is metaphysical necessity, is a matter of the very nature of what it means to be a ferromagnet. However,

[27] Armstrong (1983), 79-80, and Tooley (1977), 686.

I cannot see we could find a non-circular argument why it is *metaphysically* impossible that metaphysical modality can't be time-indexed. Similarly, we cannot argue that it is metaphysically possible that metaphysical modality *can* be time-indexed, without having to concede that the possibility of it changing over time can then change over time, too. To make a long story short, metaphysical modality does not seem to be the right sort of modality to rule out that metaphysical modality is time-indexable.

In order to calm down after such a dazzling display of speculative metaphysics, let us take another step back. What would it mean for a proponent of dispositional essentialism to claim that metaphysical modality cannot be time-limited? They would have to say that metaphysical modality expresses the very nature of things. It is part of the very nature of ferromagnets that they attract iron. Should ferromagnets stop doing this, they would cease to be ferromagnets. It is this attracting of iron that makes ferromagnets ferromagnets. However, why wouldn't it be possible to change one's very nature? Why would some feature being "one's very nature" imply that it has to hold over all times and places? Attracting iron could be what makes ferromagnets ferromagnets from the big bang up until, but not exceeding, the year 3000, and after that. it's their repelling iron?[28] Be that as it may – to our great collective relief the remaining criticisms of the necessitarian attempts in this paper do not rely upon any baroque arguments about the possibility of time-limited necessary connections, although I do hold for the above-sketched reasons that time-limited necessary connections cannot be ruled out so easily, and that Beebee's argument succeeds. As we will see below, the necessitarian attempts to justify induction fail for more reasons, and do so necessarily.

5.2 Necessary Connections Do not Imply Strict Regularities

The worries don't stop with Beebee's arguments. For the necessitarian attempts to work, the existence of a necessary connection has to deductively

[28]The connection between this debate and Goodman's New Riddle will have to wait until another paper.

imply the corresponding regularity. However, in both the ADT-account as well as the dispositional account, this inference is problematic, if not entirely unwarranted. For the ADT-view, there exists the well-known inference and identification dilemma as proposed by Bas van Fraassen and David Lewis. Van Fraassen and Lewis take issue with the originally unspecified notion of necessitation in the ADT-view. Firstly, we have to identify what sort of necessity N is supposed to be, and then, how this necessity can actually *do* something in nature. The necessitation relation N is supposed to be a higher-order two-place universal holding between two other universals, such as being an F and being G. But what sort of necessitation is it? How does it actually make sure that every token of an instantiated F in indeed a G, which is what needs to be established if $N(F, G)$ is supposed to entail $\forall x(Fx \rightarrow Gx)$? Part of the problem is that N is not only a universal itself, but also a relation between universals. But that would be a relation between types. The question now is that how a necessitation relation between types does not necessarily imply that the same relation holds between their every token.[29] Armstrong later claimed to have solved the inference and identification problem by identifying N as causal necessity.[30] But even then, questions remain how the same causal necessity can relate types (universals) and tokens (their instances), as Armstrong proposes.

Whichever stance one takes on the metaphysical issues surrounding the inference and identification problem, there is another issue concerning the implication of the universal regularity by the existence of a necessary connection in the ADT-view, and that is the issue of *ceteris paribus* laws. The problem is that even if we grant the proponents of the ADT-view their entire ontology, including that they can solve the inference and identification problem, we still can't necessarily infer the regularity from the law. If there are cp-laws, then the universal regularity $\forall x(Fx \rightarrow Gx)$ is strictly speaking false, unless amended by the respective cp-conditions. I will not claim that Lange's and Cartwright's dilemma that cp-laws are either trivially true or

[29] van Fraassen (1989), 166, and Lewis (1983), 366.

[30] Armstrong (1993)

false (or vacuously true, respectively) is unsolvable.[31] However, if the necessitarian strategy to solve the problem of induction is to work, we need the universal regularity to be true. So it is up to the defenders of the ADT-view to offer a solution to the problem of cp-laws that still renders the regularity true. If I want to infer that all future or unobserved Fs will be also be Gs, then $\forall x(Fx \rightarrow Gx)$ needs to be true, and not *ceteris paribus*, $\forall x(Fx \rightarrow Gx)$. A regularity that $cp, \forall x(Fx \rightarrow Gx)$, is consistent with there not being a single F that is actually a G. Hence, if $N(F, G)$ only implies $cp, \forall x(Fx \rightarrow Gx)$, I am not justified to infer that *any* future F will actually be a G. But if I am not justified to make that inference, Armstrong's attempt fails. It was this very inference that lie at the heart of his proposed solutions to the Old Riddle.

As discussed above, Mumford and Anjum have pointed out that a very similar problem exists for Ellis's account. The issue is that there could be factors such as finks or antidotes that prevent a disposition from being manifested. Originally, the finks and antidotes problem has been formulated as an objection for conditional analyses of dispositions:[32] If one wanted to define that F is disposed to manifest G *iff*, were F exposed to stimulus S, it would manifest G, then obviously it would be a problem if that counterfactual would be false. And it is: in an antidote case, there could be a second background condition present that prevents the disposition to be manifested, such as an actual antidote. Take, for example, arsenic and its disposition to kill me if ingested. The objection is that without further qualification, the counterfactual that if I ingested a sufficient amount of arsenic, I would die, is false: I could have also ingested an antidote that prevents the manifestation of the disposition. The finks case is a bit more speculative and less straight forward: a disposition could be such that if the stimulus was present, the actual occurrence of the stimulus would rob the bearer of the disposition to lose that disposition. Picture a porcelain vase: the vase is fragile and has the disposition to break if the right kind of stimulus occurs. However, imagine the vase is such that if struck by a hammer, the vase,

[31] Lange (1993), 235 and Cartwright (1983), 47.

[32] Martin (1994), Bird (1998), and Bird (2007), 25–29.

instead of manifesting its disposition to shatter when struck, changes its molecular makeup in a way that it is no longer fragile. Thus, the occurrence of the stimulus prompts the vase to lose its disposition to shatter if struck.

Now at first sight, since Ellis does not propose a conditional analysis of dispositions, but rather claims that dispositions are irreducible to the conditionals they warrant, does not have to offer a solution to the finks and antidotes problem. However, without solving that problem, he cannot claim that Scientific Essentialism can solve the problem of induction. His claim was that

> L1: For all x, necessarily, if x has P, and x is in circumstances of the kind C, then x will display an effect of the kind E.[33]

implies:

> Necessarily, if a is in circumstances C, then a will display an effect of the kind E.[34]

However, neither L1, nor L2 are true, since if a disposition can be counteracted, then an individual will not necessarily manifest the disposition if the stimulus is present. Mumford and Anjum are correct that Ellis cannot solve the problem of induction that way. However, their claim that the problem of induction is a pseudo-problem is unwarranted itself, which I will argue for at the end of the next section where I discuss a possible way for the necessitarian to deal with the issues raised so far, since it fits better with the overall argument there. Let us now turn to this possible solution.

5.3 Inferences to the Uniformity of Nature

There may be another way out for a necessitarian solution to the problem of induction. Remember Hume's version of the problem: if we only knew that nature is uniform, we could justify inductive inferences by reducing

[33] Ellis (1998), 114, italics adjusted for consistency.
[34] Ellis (1998), 115, italics adjusted for consistency.

them to enthymematic deductive inferences. So if we were able to argue for the uniformity of nature, it seems at first glance that we could yield the following type of inference:

P_1: All observed ferromagnets have so far attracted iron.

P_2: Nature is uniform.

P_3: <u>If nature is uniform, then ferromagnets do not change their behaviour.</u>

C: All future and unobserved ferromagnets attract iron.

Again, we are faced with two options: either we argue for premise P_2 *a posteriori*, and in this context that would imply that we would have to argue ampliatively. Unfortunately, that would either result in a circle, or we would have to justify a different ampliative type of inference such as IBE. Alternatively, we could argue *a priori* for the uniformity of nature in general. The basic idea is that if there even are necessary connections at all, i.e. if necessitarianism of any kind is true, we could infer that nature will be uniform, because it simply cannot be differently than how it is, regardless of which *specific* necessary connections exist. In the case of specific necessary connections, such as whether F necessitates G or H, we cannot possible infer such information *a priori*, and hence we cannot know *a priori* that all Fs will always be Gs. But that is different in the case of the uniformity of nature. The arguments for the existence of necessary connections in general, i.e. whether there even are necessary connections in Armstrong's or Ellis's sense, can be made *a priori*. In fact a lot of the arguments for necessitarians views are, such as the argument that Humeans could not properly distinguish between accidental or lawful generalisations, while necessitarians can.[35]

The crucial question is whether P_3: "If nature is uniform, then ferromagnets do not change their behaviour" is true. Unfortunately, it is not.

[35]Molnar (1974) and Kneale (1950). There also exist *a posteriori* arguments for the existence of necessary connections in general, such as Andreas Hüttemanns argument that nature's apparent regularity and resilience under manipulation is best explained by the existence of necessary connections (Hüttemann (2014), section 4).

Even if we somehow knew that nature in general is uniform, that wouldn't necessarily help regarding any inference about the behaviour of future ferromagnets. The uniformity of nature, if nature is indeed uniform, merely implies that the strict fundamental regularities remain stable over time. But the uniformity of nature does not imply that all *observed* regularities remain stable, since even apparent irregularities could be consequences of more fundamental but as yet unobserved stable regularities. As long as we don't argue for a specific necessary connection between "being a ferromagnet" and "attracting iron", the fact that necessary connections in general exist does not entail that the fact that so far, all ferromagnets have attracted attract iron, is indeed a direct consequence of a necessary connection between these two properties. Instead, the fact that so far, all ferromagnets attracted iron, could be the consequence of a more fundamental and as yet undiscovered necessary connection, while "being a ferromagnet" and "attracting iron" are not necessarily connected at all. The observed regularity could in principle be a derivative one: there could be a more fundamental and as yet undiscovered necessary connection, which for example only implies that ferromagnets attract iron only under certain circumstances, which so far has luckily always been the case, but will never again occur from the year 2020 on. Hence, we do not know whether the observed regularities remain stable, even if nature is uniform: Ferromagnets could tomorrow stop attracting iron, and still, nature could remain uniform.

To make matters worse, all of the above arguments always presupposed that determinism is true, which it does not necessarily seem to be, given our best current physics. Let us grant the necessitarians that necessitarianism of the ADT-kind and Ellis's dispositionalism are compatible with indeterminism. Take, for example, the fact that smoking causes cancer. Let us suppose that the actual mutation that smoking can cause and which will lead to cancer is an indeterministic process: suppose that in every single case where the relevant substances come into contact with a cell, it is genuinely undetermined whether that cell mutates in a way that leads to cancer. It is possible that, if the process is indeterministic, no-one ever develops cancer through smoking, even if smoking has the disposition to cause cancer. Given

indeterminism, it is completely possible that an observed regularity does not match the respective disposition at all.

This finding motivates Mumford's and Anjum's supposed "dissolution" to the Old Riddle, which nonetheless still fails. Mumford and Anjum, who, like Ellis, propose a dispositionalist ontology, but reject the label "necessitarian", disagree about Ellis's particular account, but hold that with their ontology in tow, they can show that the Old Riddle is a pseudo-problem. They share with Ellis the view that there are irreducible dispositional properties, which render their bearers active in a way that the Humean must deny. But they disagree that this gives rise to any sort of necessary connection in a strong sense, since if an F has a disposition to be a G if presented with the right stimulus, then nevertheless, F does not *have* to become a G. Having the respective disposition, or power, makes Fs only *tend* to be Gs, since the manifestation of the disposition can always be counteracted, or because they might be genuinely indeterministic.[36] Hence, Anjum and Mumford claim, we should reject necessitarianism in the sense that having a disposition and being in the presence of the stimulus condition *necessitates* the manifestation of the disposition.[37] But without necessitation, it is possible that having a disposition and being exposed to the right stimulus conditions can still fail to bring about the manifestation, and hence the inference to the respective regularity fails, and with this Ellis's solution to the old riddle collapses.

So instead, Mumford and Anjum claim that the problem of induction is a pseudo-problem. They reconstruct the problem strictly along the lines of Hume's formulation of the problem, that is they hold the problem of induction to be that we need to justify the claim that nature is uniform so that we can make the respective inferences truth-preserving. And at least in the case of causal inferences, they claim, that is simply never possible, because in their ontology, that an F is disposed to be a G does not entail

[36] Mumford and Anjum don't always clearly differentiate between the existence of *ceteris paribus* conditions and indeterminism, but I will ignore this issue, like many others I have with their view, for the sake of the argument here.

[37] Mumford and Anjum (2011), chapter 3.

that all Fs are G. To phrase it in the terms outlined in our reconstruction of Hume's argument above, Mumford and Anjum claim that because of this failure to infer general regularities from dispositions, we will never be able to fill in the suppressed premise in an inductive inference to make the inference truth-preserving. What we *can* infer though are general, unspecific claims of the sort that "smoking causes cancer", if we know that smoking has the disposition to cause cancer *in some instances*.[38] There is a lot to be said about their line of reasoning, to which we will turn in shortly below, when we assess the necessitarian attempts in general.

And this is the exact reason why Mumford and Anjum's proposal to brand the problem of induction as a pseudo-problem is off the mark. They state two reasons for their claim: firstly they hold that necessary connections do not imply the regularities. I agree, but I fail to see how a reason to believe that the problem is insoluble is a reason to think it is a pseudo-problem. And secondly, they claim that if one accepted that dispositions do not necessitate their manifestations under the right circumstances, but only tend to their manifestations, then this might not imply universal regularities such as "all future and unobserved ferromagnets attract iron", but only less strict or general regularities such as "ferromagnets tend to attract iron" or "smoking causes cancer". After all, not every instance of smoking always causes cancer, but there is a connection between smoking and causing cancer, due to tobacco having the relevant disposition, while there always the possibility that the manifestation of that disposition is prevented.[39] In their view, dispositions do not give rise to perfectly strict regularities, but it is justified to infer general of stochastic regularities.

But if it is the case that it is always possible that the manifestation of a disposition can be prevented, or that an indeterministic disposition is never manifested, then it is possible that tobacco has the disposition to cause cancer if smoked, and yet not a single person ever develops cancer from smoking. Such a scenario *must* be possible if Mumford and Anjum are right. But then, there is no way to ensure that a disposition necessarily gives

[38] Mumford and Anjum (2011), 140–143

[39] Mumford and Anjum (2011), 141–143.

rise to even a stochastic regularity, and hence it could be completely useless if I want to make a prediction that at least some people develop cancer from smoking. But if the disposition does not even imply that vague prediction, how does that render the problem of induction a pseudo-problem? We still have no way to justify our inferences about unobserved or future cases.

With this, we will leave Mumford and Anjum aside for now and return to the stricter necessitarian attempts. We will now turn to the main argument against all attempts to solve the Old Riddle by reducing it to a different inference pattern such as the ones Armstrong and Bird proposed. I have argued elsewhere[40] that whether the problem of induction is at all solvable depends partly on how exactly one choses to formulate the problem. As we will see, the necessitarian attempts to solve the problem of induction presuppose a formulation of the problem that renders it insoluble.

5.4 Justification by Elimination

We have seen above that there exist various different accounts of what the problem of induction actually amounts to and what, accordingly, could even count as a justification of induction, if one were possible. The probabilists like Reichenbach, Salmon, and Donald Williams held that the problem of induction was to demonstrate how inductive inferences could confer at least some degree of truth upon the conclusion. They sought to solve the problem accordingly, for example by arguing that the law of large numbers entails that a large sample would resemble the population close enough to justify inductive inferences with a large enough sample.[41] On the other hand, the classical sceptical formulation of the problem by Hume can be read differently: there, the problem of induction is supposed to be that we cannot justify an additional premise that would turn induction into an enthymeme of a truth-preserving, a deductive, inference. The inductive character of these inferences would thus be eliminated. The strategies of Armstrong and Ellis try something similar: they try to turn inductive inferences into a series

[40] Removed for blind review.

[41] See, e.g., Reichenbach (1935), Salmon (1974), and Williams (1947).

of inferences, which are supposedly more secure. They first introduce an IBE from the observed regularity to the existence of a necessary connection, from which we are supposed to deduce the universal regularity. But they fall short of eliminating the ampliative step altogether. We also have to know *that* $N(F, G)$ holds, or *that* Fs are disposed to be Gs if in presence of the according stimulus. And there is no way to acquire such knowledge without an ampliative inference of some kind, in this case an IBE.

This is exactly Hume's Dilemma in slightly different terms: where he claimed that we can't presuppose that nature is uniform without either inferring that information inductively, which would result in a circularity if we then took that information to justify inductive inferences, or by inferring the regularity of nature deductively, by an a priori argument, which is impossible. In Armstrong's and Ellis's case, we would have to either infer that there is a necessary connection ampliatively, i.e. via IBE, which is itself in need of justification, or by an *a priori* argument, which is impossible. We cannot know that ferromagnets necessarily attract iron *a priori*. But then, we'd have to infer it *a posteriori*, and since we cannot directly observe that there is a necessary connection between being a ferromagnet and attracting iron, we'd have to infer this ampliatively. Armstrong and Ellis agree: they hold that the discovery of necessary connections of the respective kind is the task of modern science.

But not only is IBE an ampliative step which is itself in need of justification, it is one whose justifiability is hotly contested. Two main issues must be settled to justify IBE. Firstly, we have to be able to specify what exactly makes one explanation the uniquely best one, and secondly, we have to demonstrate how the best explanation can be truth-conducive. Both problems are far from trivial. Even granted that we can decide on a theory of explanation, and that we can decide on criteria for what makes a good, or even the best, explanation: then what guarantees that the best explanation is actually true? The most famous argument against the truth-conduciveness of IBE is the argument from a bad lot.[42] It is possible that

[42] van Fraassen (1989), 143

all explanations that are available for a certain phenomenon are all bad, and false. So even if we can decide on the single best explanation out of the set of available explanations, that explanation might still be just the best explanation out of a bad lot: the best explanation doesn't necessarily be a good one, or true.

I will not debate IBE any further here. However, what we can see here already from this very brief introduction into the worries of IBE is that not only is it itself an ampliative inference that is in need of justification, but that this justification is by no means less problematic than for induction. Armstrong called the rationality of induction a brute fact,[43] but if we take the above-sketched controversy surrounding IBE into account, that sounds like a gross overstatement.

But even if we grant Ellis and Armstrong that they can indeed justify IBE, then at best, they succeeded in replacing induction by IBE + deduction, but that hardly amounts to a *justification* of induction, but to an elimination. If their attempt to justify induction amounts to an elimination of induction and replacing it with IBE + deduction, their proposal entails that induction is only insofar justifiable as it can be eliminated. Any sort of justifiable inference would cease to be inductive.

But even if we grant them that, their proposal would be applicable to a very narrow kind of inductive inferences: those for which we can identify a necessary connection. For Armstrong, universals are supposed to be genuine physical properties which form natural kinds, and which to discover is the task of the sciences.[44] The same holds for Ellis's proposal, who proposed that dispositional properties are natural kinds, which to detect is the task of science. But we use induction everyday, featuring all sorts of properties that aren't natural kinds or fundamental physical properties. Say it is somewhere in the early 2000s, and I have just for the first time listened to Radiohead's *Amnesiac*. Listening to more and more albums from *OK Computer* onwards, I grow more and more confident that I will also like the next Radiohead

[43] Armstrong (1983), 54 and 59.
[44] Armstrong (1978), 11.

album I will listen to. This inference, which has proven to be very successful so far, is clearly an inductive inference in the sense that I infer from a sample – listening to parts of Radiohead's catalogue and observing my reaction to it – that my reaction to as yet unobserved samples of their body of work will be the same. However, according to Armstrong's own ontology, there is no such universal such as being a Radiohead album and being liked by the author, which could be necessarily connected. The same goes for Ellis's view. Unless we want to needlessly bloat our ontology, it would seem quite a stretch to claim that Radiohead albums have a disposition, which is supposed to be a natural kind, to evoke a positive response in me, or that I have the disposition to respond well to Radiohead albums from *OK Computer* onwards. And yet, it seems that my inference that I will like as yet unobserved Radiohead albums because I liked their past ones is a perfectly natural one. But it isn't one that could be reduced to the necessitarian inference pattern as described above. So these inferences, ones that we engage in every day, would still be unjustifiable.

To wrap up, we have seen that Armstrong and Ellis tried to solve the problem of induction by reducing it to an inference pattern in which induction does not appear anymore. But not only does this new inference pattern contain an IBE, which is no less problematic than straight up induction, it also is not applicable to a large number of everyday inductive inferences.

6 Conclusion

The necessitarian attempts to solve the problem of induction fail. To begin with, it is impossible to actually infer strict regularities from the necessary connections. And to even get so far, we would have to find a justifiable way to infer the existence of the relevant necessary connections, which must not be time-limited or exchangeable. And to top the whole problem off, the proposed solution would still only work for the narrow range of inferences that actually concern necessarily connected natural kinds. But even if we grant all of this, the issue lies rather in the basic idea in general.

Armstrong's and Ellis's attempts tried to succeed where Hume identified an insurmountable dilemma: to find some way to fill in the suppressed premise of the enthymematic inference that Hume thought induction to be. But this project does not justify induction, it, at best, eliminates induction and substitutes it with another ampliative inference such as IBE, which needs to be justified itself, and which is arguably hardly less problematic than induction is. If we want to hold on to the idea that induction is a *sui generis* kind of reasoning, we cannot justify it by trying to eliminate it, especially if that elimination only holds for a small number of cases and does not apply to the majority of our everyday inductive inferences.

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