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On Induction: Time-limited Necessity vs. Timeless Necessity

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RESUMEN

En este trabajo se defiende a solución de David Armstrong al problema de la inducción contra el ataque de Helen Beebee a dicha solución. Para resolver el problema de la inducción, Armstrong afirma que la explicación basada en la necesidad atemporal es la mejor explicación de nuestras regularidades observadas, mientras Beebee intenta demostrar que la explicación basada en la necesidad limitada en el tiempo es una explicación igualmente buena. Supuestamente, esta explicación bloquea la solución de Armstrong. Muestro que, aunque la explicación basada en la necesidad limitada en el tiempo fuese una explicación igualmente buena de nuestras regularidades observadas, esta explicación no bloquea la solución de Armstrong. Argumento que, en realidad, la explicación basada en la necesidad atemporal es una mejor explicación de nuestras regularidades observadas de lo que es la explicación basada en la necesidad limitada en el tiempo.

PALABRAS CLAVE: *Armstrong, Beebee, inducción, inferencia a la mejor explicación, leyes de la naturaleza, necesidad.*

ABSTRACT

This paper defends David Armstrong's solution to the problem of induction against Helen Beebee's attack on that solution. To solve the problem of induction, Armstrong contends that the timeless necessity explanation is the best explanation of our observed regularities, whereas Beebee attempts to demonstrate that the time-limited necessity explanation is an equally good explanation. Allegedly, this explanation blocks Armstrong's solution. I demonstrate that even if the time-limited necessity explanation were an equally good explanation of our observed regularities, this explanation does not block Armstrong's solution. I argue that, in fact, the timeless necessity explanation is a better explanation of our observed regularities than is the time-limited necessity explanation.

KEYWORDS: *Armstrong, Beebee, Induction, Inference to the Best Explanation, Laws of Nature, Necessity.*

I. INTRODUCTION

How do we justify generalisations such as 'all observed ravens are black, therefore, all ravens are black'? The conclusion – all ravens are black – does not seem to be supported by the premise – all observed ravens are black. A set

of events as a part of space-time does not justify all of the events regarding the totality of space-time. Synthetically, the issue is how to justify the inference from 'all observed *F*s are *G*s' to 'all *F*s are *G*s'. This is a classical problem in philosophy known as 'the problem of induction'.

Laws of nature are connected to the problem of induction. The actual world seems highly regular. We have observed that apples fall from trees; we have observed that planets follow elliptical trajectories; we have observed that water boils at 100 degrees Celsius; we have observed that electrons repel each other. If there is no reason for these observed regularities, then we have no reason to expect them to continue in the future. Postulating the existence of laws of nature, eternal and distinct from observational evidence, is one way, and I will argue it is the best way, to explain observed regularities. Briefly, the argument that will be discussed is as follows:

(1) All observed *F*s are *G*s.

(2) The best explanation for (1) is that it is a law of nature that all *F*s are *G*s.

∴ All *F*s are *G*s.

Before continuing, a distinction is required. Our discussion is metaphysical. I am not interested in the epistemic problem of how scientific theories are inferred from observational evidence. Scientific theories are *mathematical-physical* statements or propositional statements, such as the law of gravitation, Coulomb's law, Kepler's laws, Kirchoff's laws of electrical circuits and Darwin's theory of evolution. Scientific theories are true or approximately true. If a scientific theory is true, what makes it true is the existence of a law of nature. It is assumed that laws of nature objectively exist independent of the mental.

Armstrong (1983), chapter 4, sec. 5 and chapter 6, sec. 7; (1991), argues that the regularity theory, according to which laws of nature are identical to our observed regularities, does not allow us to solve the problem of induction. However, the theory of nomic necessity does make it possible to solve the problem of induction. According to this theory, laws of nature are second-order universals connecting first-order universals.[1] This second-order timeless necessary connection is what best explains our observed regularities.[2] Beebee (2011) advances a competing explanation for the regularity of the Universe, a time-limited necessary connection, and accordingly, she defends that Armstrong's timeless necessitarian explanation is not a better explanation than the time-limited necessitarian explanation. However, if this is right, Armstrong's solution to the problem of induction, based on timeless necessity, is no longer valid because Beebee's explanation implies adding an alleged *illicit* inductive premise to the above argument, i.e., an extra step.

The argument made in this paper is contrary to Beebee's proposal, and accordingly, two claims will be supported. (1) Even if Beebee's explanation is an equally good explanation of our observed regularities (i.e. Armstrong's explanation is not a better explanation than is Beebee's explanation), Beebee's explanation is compatible with Armstrong's solution to the problem of induction. (2) Actually, Armstrong's explanation is a better explanation of observed regularities than is Beebee's explanation. Therefore, Armstrong's solution to the problem of induction prevails.

The remainder of this paper is organised as follows. First, the no-solution of the regularity theory to the problem of induction is presented. Second, Armstrong's *explanans* solving the problem of induction is discussed. Third, Beebee's *explanans* is detailed. Fourth, Beebee's extra step is discussed, which is followed by two objections to Beebee's *explanans*, i.e., simplicity and prediction. Lastly, I follow the advice of Armstrong (1991), p. 511, according to which 'research in this field [inference to the best explanation] may (…) advance the study of the Problem of Induction'. Accordingly, connections between inference to the best explanation (hereafter, IBE) and the problem of induction are drawn and objections to time-limited necessity are presented.

II. The No-Solution of the Regularity Theory

The regularity theory assumes that the world is constituted by a sequence of events in space-time. That is, there is a pattern regarding the events of the world, but there is no necessary connection between these events. There are several metaphysical views concerning the regularity theory. Some of these views are simple (e.g., the 'pure regularity theory' discussed by Mumford (2004), p. 35), whereas others are sophisticated (e.g., the 'best systems theory' of Mill (1843), Ramsey (1978) and Lewis (2001)).[3] However, in this paper, it is not required to detail these versions. I will assume a naïve regularity theory whereby the observed regularities of the world are identical to the laws of nature, there is no difference between a law and its manifestation, and the content of a law is identical to the content of its manifestation.

According to Armstrong (1983); (1991), if the laws of nature are identical to the regularities of the world, then inductive scepticism is inevitable. That is, the regularity theory cannot explain the necessity of the rationality of induction. Premise (2) is an irrational inductive inference because it is not a *genuine* inference to the best explanation. The details of the argument are as follows. Let us consider 'all observed *F*s are *G*s' to be our *explanandum*, and 'it is a law that all *F*s are *G*s' is our *explanans*. For the regularity theorist, 'it is a law that all *F*s are *G*s' means that 'all *F*s are *G*s'.[4] Furthermore, 'all *F*s are *G*s' is logically equivalent to 'all observed *F*s are *G*s and all unobserved *F*s are *G*s'. Therefore, for the regularity theorist, the *explanans* 'it is a law

that all *F*s are *G*s' is the conjunction of 'all observed *F*s are *G*s and all unobserved *F*s are *G*s'. However, neither conjunct of the *explanans* explains the *explanandum*. On the one hand, the first conjunct – 'all observed *F*s are *G*s' – does not explain why 'all observed *F*s are *G*s', as it is circular. On the other hand, the second conjunct – 'all unobserved *F*s are *G*s' – does not explain why 'all observed *F*s are *G*s', as unobserved phenomena have no power to explain anything. Thus, as the regularity theorist does not explain why 'all observed *F*s are *G*s', premise (2) is an irrational inductive inference.

White (2005), p. 8, however, argues that Armstrong is wrong regarding the point outlined above. If we rewrite 'all observed *F*s are *G*s' as 'no non-*G* *F*s have been observed' and 'all *F*s are *G*s' as 'there are no non-*G* *F*s', then an explanation is available for the regularity theorist. Why have 'no non-*G* *F*s been observed'? The answer is that 'there are no non-*G* *F*s'. For example, we may say that flying pigs have not been observed because there are no flying pigs. According to White, this is a perfectly good explanation. As I see it, the problem of induction is primarily a problem concerning inferences from observed regularities. Putative flying pigs are not an observed regularity. Thus, there is nothing here to explain. The problem of induction is not a problem regarding the non-observed.[5]

III. Beebee's *Explanans*: Time-Limited Necessity

According to Armstrong's theory of nomic necessity, first-order universals (*F*, *G*) are necessarily connected in the actual world by a second-order universal, *N*, a state of affairs. That is, the expression 'it is a law that all *F*s are *G*s' refers to a second-order connection, *N*, between first-order universals, *F* and *G*, i.e., *N* (*F*, *G*). *F* and *G* are timelessly necessarily connected. However, this connection is nomically necessary and metaphysically contingent. That is, in the actual world, necessarily, if *a* is *F*, then *a* is *G*; but in other non-actual worlds, if *a* is *F*, then *a* could not be *G*.

In contrast to the regularity theory, if laws of nature are second-order universals that connect first-order universals, the problem of induction is solved. The inference from 'all observed *F*s are *G*s' to 'it is a law that all *F*s are *G*s' is an example of IBE, where *N* (*F*, *G*) is the *tertium quid* that mediates the observed and the unobserved. Armstrong (1983) supports premise (2) in three steps: inductive inference is rational; it is a necessary truth that induction is rational; and the explication of this necessary truth is required. In this paper, I will not discuss these steps, as Beebee does not object to them.[6]

Beebee addresses Armstrong's challenge to '[p]roduce a better, or equally good, explanation' [Armstrong (1983), p. 59] of why 'all observed *F*s are *G*s'. Beebee attacks premise (2) and proposes a new competitor as an explanation by slightly modifying the *explanandum* by adding the expression

'so far'. Truly, we must explain why 'all *so-far* observed *F*s have been *G*s'. Synthetically,

> *Explanandum*:
> (O) All observed *F*s have been *G*s so far.
>
> Armstrong's *explanans*:
> (T) *F* and *G* are timelessly (eternally) necessarily connected.
>
> Beebee's *explanans*:
> (SF) *F* and *G* have been necessarily connected so far.

We have two *explanantia* for the same *explanandum*. Beebee claims that (T) is not a better *explanans* than (SF). If this is correct, Armstrong's proposal is a failed solution to the problem of induction because an extra step – an alleged illicit inductive inference – is required to lead us from (SF) to (T). Armstrong's proposal begs the question, as he cannot justify induction assuming that the inductive step from (SF) to (T) is already justified. Beebee defends (SF) by making three points. First, the notion of time-limited necessity is not incoherent; second, (SF) has the same simplicity as (T); third, contrary to (SF), (T) has predictive powers, but this virtue does not matter in metaphysical discussions. As I agree that (SF) is not incoherent, I will only discuss the second and third points.

How do we justify (SF)? According to Beebee, if timeless necessities can justify (T), then time-limited necessities can justify (SF). The time-limited necessity N_t is an alternative to Armstrong's timeless necessity *N*. For example, N_t (*F*, *G*) is the relation that any *F* prior to *t* is necessarily *G* and future *F*s may or may not be *G*s. If after *t*, *F* is *G*, then the relation accidentally occurs. Thus, Beebee (2011), pp. 504 and 513, claims that (1) 'maybe the Universe will start behaving in other regular (…) ways' or that (2) '*F*s might stop being *G*s for no better reason than a particular time has passed' and chaos has descended upon the Universe. That is, according to the time-limited necessitarian, there are two slightly different ways to change the laws of nature. In both cases, the connection between *F*s and *G*s can cease to hold, but in the first case, the second-order universal, which connects *F*s and *G*s, may change and begin connecting other first universals with *F*s. For example, *F*s can start to be connected to *H*s.

IV. Beebee's Extra Step: Illicit Induction vs. Inference to the Best Explanation

Let us grant, for a moment, that Beebee is right; that is, (SF) is an equally good explanation as (T) (i.e. (T) is not better than (SF)). According to Beebee, there is an extra step of *illicit* inductive inference in Armstrong's solu-

tion to the problem of induction. However, to the best of my knowledge, the argument for the alleged illicitness in the extra step is unclear. Beebee states

> If that [(T) is not better than (SF)] is right, then the postulation of timeless necessary connections is not sanctioned by IBE, and Armstrong's proposed solution to the problem of induction fails. Indeed, it fails precisely because it presupposes an illicit inductive step. If IBE sanctions only inference to (SF), then an extra step (…) is needed to get us from (SF) to (T). And only inductive inference can be used to take this step [Beebee (2011), p. 511].

According to this passage, our initial argument may be rewritten in the following way:

(1) All observed *F*s have been *G*s so far.

(2) The best explanation for (1) is (SF).

(3) *Extra step*: If (SF), then (T).

∴ All *F*s are *G*s.

Let us attempt to clarify Beebee's argument regarding the illicitness of the extra step. If the timeless necessitarian claims that the inference from 'all observed *F*s are *G*s' to 'all *F*s are *G*s' is an irrational inductive inference, then the time-limited necessitarian may also claim that the inference from (SF) to (T) is an irrational inductive inference. The inference from 'all observed *F*s are *G*s' to 'all *F*s are *G*s' is an irrational inductive inference because, briefly, 'all *F*s are *G*s' does not explain why 'all observed *F*s are *G*s', as 'all *F*s are *G*s' is logically equivalent to 'all observed *F*s are *G*s and all unobserved *F*s are *G*s'. Analogously, the inference from (SF) to (T) is an irrational inductive inference because (T) does not explain why (SF), as (T) is logically equivalent to (SF) and (SF)' (where (SF)' means *F* and *G* are necessarily connected *after now*). The inference from (SF) to (T) is an illicit inductive inference. Therefore, it is not rational.

On the contrary, Beebee's extra step is not an illicit inductive inference as we are facing two different types of inferences. The inference from 'all observed *F*s are *G*s' to 'all *F*s are *G*s' is enumerative induction; however, the inference from (SF) to (T) is not enumerative induction, nor is it temporal induction. (SF) and (T) are justified by different varieties of metaphysical necessity. (SF) is justified by time-limited necessity (N_t), and (T) is justified by timeless necessity (N). That is, (SF) and (T) are different brands of 'glue', i.e., time-limited 'glue' versus eternal 'glue'.[7] Thus, (T) is not logically equivalent to (SF) and (SF)'. Logical notation may help to clarify this point.

Let (T) $\equiv N(F, G)$, (SF) $\equiv \forall_{t \leq t_{now}} N_t(F, G)$ and (SF)' $\equiv \forall_{t > t_{now}} N_t(F, G)$, then (T) $\not\equiv$ (SF) $\wedge$ (SF)'.

It seems that Beebee's extra step is an instance of IBE. Explanations are faced with why-regress questions. Why did you not come to the cinema? I did not come because I had a headache. Why did you have a headache? I had a headache because I had a discussion with my boss. Explanations must stop somewhere, unless we are disposed to an infinite chain of explanations. Some explanations are self-explanatory and do not demand further understanding. Other explanations require further explanations for understanding to be possible. Clearly, (SF) is not self-explanatory. It seems plausible to ask why *F* and *G* have been necessarily connected so far. The inference from (O) to (SF) provides an explanation, but (SF) itself requires explanation.

If Beebee's extra step is an instance of IBE, then (T) gains the status of the best explanation for (SF). Eternal 'glue' explains why time-limited 'glue' does not break. *Mutatis mutandis*, this second IBE, between (SF) and (T), is supported by the same reasons invoked by Armstrong to solve the problem of induction. That is, '[i]t is rational to postulate what best explains the phenomena' [Armstrong (1983), p. 55]; 'the essence of a good explanation' is to unify a phenomenon [Armstrong (1991), p. 506]. (T) unifies all possible (SF)s.

It may be objected that other competing explanations may explain (SF) as well as (T) and, at the end of the day, an illicit inductive step is required to infer (T). For instance, explanations of the type $N_{t+i}(F, G)$ (where $i = 1, 2, 3, \ldots$) may be the best explanations of $N_t(F, G)$, whereas the inference from $N_{t+i}(F, G)$ to $N(F, G)$ is inductively illicit. To this objection, I reply that if $N_{t+i}(F, G)$ were the case, then a third IBE must be inserted in the argument to infer $N(F, G)$ for the same reasons mentioned above.

V. Simplicity and Prediction: (T) vs. (SF)

Hereafter, I focus on the second point of the paper and argue that the timeless necessity explanation is a better explanation than the time-limited necessity explanation. Beebee discusses this objection in two parts. (T) is a better *explanans* than is (SF) because (a) (T) is simpler than (SF) and (b) contrary to (SF), (T) has predictive power.

Beebee (2011), p. 514, claims that '(SF) *itself* contains no adjustable parameters: there is no mention of any specific temporal constraint in the formulation of (SF), since (SF) merely asserts that *F* and *G* have been necessarily connected *so far*'. Thus, in light of simplicity, we could not decide between (SF) and (T), and therefore, the result is a tie. The 'only' difference

between (SF) and (T) is predictive power as (T) is an assertion about the past and the future, whereas (SF) is mute about the future. In science, a hypothesis that generates novel predictions is to be preferred to one that only provides explanations about past phenomena. If two (similar) scientific theories are under dispute, the best theory of both is the theory that has more predictive power. This is a line of reasoning that is current in science. However, 'Beebee's business' is metaphysics, and as such, she claims that predictive power is not an explanatory virtue in metaphysics, neither in practical nor in the theoretical sense as metaphysics does not address matters of testable consequences. Moreover, the timeless necessitarian begs the question against the sceptic, as the sceptic simply denies the assumption that predictive power is an explanatory virtue. Accordingly, an argument for predictive power must be advanced against the sceptic.

Let me start with the explanatory virtue of simplicity. Simplicity is a parochial term. What is simple for one might be complex for others. Nonetheless, some objectivity can be found regarding the term. If we consider simplicity in light of *syntactical* properties and with regard to the formal structure of a statement, an immediate result can be obtained. For example, a linear function is simpler than a quadratic function; a system of equations with two equations and two variables is simpler than a system of equations with three equations and three variables; an equation that does not depend on the parameter time is simpler than an equation that depends on the parameter time.

It is true that (SF) does not depend on any *specific* temporal constraint. However, contrary to Beebee, (SF) (i.e., $\forall_{t \leq t_{now}} N_t\ (F, G)$) depends on the parameter time. (T) (i.e., $N\ (F, G)$) does not depend on the parameter time. Thus, this subtle difference between (T) and (SF) is enough to assert that (T) is *syntactically* simpler than (SF).[8] Moreover, the formalisation of (SF) implies that the parameter time is interpreted as spanning infinitely backwards. Thus, there is an asymmetry concerning (SF) in that *F*s and *G*s may have always been connected in the past but may stop being connected in the future. This asymmetry concerning the relation between necessity and the parameter time does not exist in (T). Therefore, it can be concluded that (T) is simpler than (SF).

It may be objected that the crucial issue here is not whether observations take place in a particular time *t*. What is crucial is to note that (SF) and (T) convey two different kinds of necessity, and that any references to time, while useful for labelling, are otherwise irrelevant. In particular, the two kinds of necessity, seem to be fundamentally different in that 'time-limited necessity' concerns only observed events, objects, regularities, etc. – and it's completely silent about the unobserved –, while 'timeless necessity' concerns both the observed and the unobserved. Thus, the distinction between 'time-limited necessity' and 'timeless necessity' is just as regards the observed/ un-

observed. On the contrary, it does not seem to me that any references to time are irrelevant for (SF) and (T). References to time are required to distinguish the two kinds of necessity. The references of (SF) to time (i.e. the verb form and the expression 'so far') are crucial to understand the meaning of (SF). If the references of (SF) to time were elided from the definition of (SF), then there would be no difference between (SF) and (T) (i.e. (SF) ≡ (T)).

Now, I develop some ideas around the explanatory virtue of prediction. Induction is a form of ampliative reasoning in that the conclusion of the inference is not logically entailed by the premises. Rather, the conclusion amplifies the premises. Some enumerative data are observed, and a conclusion is inferred from those data. Based on what has been (repeatedly) observed, we infer something with respect to the observed and the unobserved. If induction is to be considered serious, then our conclusion *must* say something about the unobserved. Otherwise, it is not inductive reasoning. Thus, predictive power is a property of the conclusion of any inductive argument. Rejecting all propositions with predictive power because we have no grounds for believing in it is simply rejecting any explanation of induction.

Thus, I present an argument for considering scientific explanatory virtues as valid in metaphysical contexts. Inference to the best explanation is applied in everyday scientific and philosophical reasoning contexts. Some facts deserve explanation in light of competing hypotheses for explanation. Explanatory virtues, for example, serve as a guide to choose the best explanation for those competing hypotheses. It is controversial to say which explanatory virtues should guide our choice, and it is difficult to weigh the pros and cons of each virtue. Generally, simplicity, unification, coherence and predictive power are some of those virtues. However, other types of virtues, such as aesthetic virtues, can be invoked.[9] However, the fact that the same virtues are valid in different contexts of reasoning is less controversial.[10]

The role of the explanatory virtue of predictive success regarding IBE can be illustrated by the well-known philosophical application of IBE to the realist dispute regarding the philosophy of science.[11] It is worth describing this role as it helps to better explain my perspective. What best explains the predictive success of our scientific theories? Two competing philosophical explanations are available – the no-miracles explanation of Putnam and the neo-Darwinian explanation of van Fraassen. According to Putnam (1975), p. 73; (1978), pp. 18-22, the best explanation of the predictive success of our scientific theories is their truth or approximate truth. It would be a miracle if successful scientific theories were not true or approximately true. According to van Fraassen (1989), pp. 39-40, the best explanation of the predictive success of our scientific theories is the selection procedure, as scientists have selected scientific theories that are the result of true observed consequences.

Prima facie, in this case, both explanations are compatible. Both explanations may be inferred as scientists may select scientific theories with true

observed consequences, and those theories may be true. However, if we examine the virtue of the predictive power of the two explanations, it is clear that the no-miracles explanation is a better explanation than the neo-Darwinian explanation. The selective explanation does not explain why our scientific theories do not tend to be refuted by future experience. The past true observed consequences are independent of the predictive success of scientific theories, and these consequences are an external explanation concerning the properties of scientific theories. By contrast, the no-miracles explanation explains why only recalcitrant experiences can falsify our best theories. Our scientific theories are true theories or approximately true theories, and hence, they go on to make successful predictions. Thus, it seems that the no-miracles explanation is a better explanation than the neo-Darwinian explanation because it explains the future predictive success of our scientific theories.

We can now link epistemology and metaphysics. Scientific theories are true, or approximately true, because there are laws of nature. Laws of nature are the truthmakers for scientific theories. If laws of nature are timeless necessities, then the truthmaker for scientific theories is omnitemporal (past, present and future truthmakers exist). If laws of nature are time-limited necessities, then the truthmaker for the scientific theories is not omnitemporal. The time-limited necessitarian is fixed to a sort of *past-ism* (only past and present truthmakers exist) concerning truthmakers, which is problematic as this perspective excludes truths about the future.[12] Thus, it seems that the time-limited necessitarian is committed to a sort of *time-limited scientific realism* in the realist dispute of the philosophy of science.

Time-limited scientific realism is one more undesirable conception licensed by time-limited necessity. Thus, a new explanation for theory change is available, i.e., our best scientific theories may be falsified because the proper nature of things changes. Looking into the past, for example, the time-limited scientific realist may explain the transition from phlogiston's theory to oxygen's theory claiming that, in the eighteenth century, the necessary connection between *combustionness* and *phlogistonness* ceased to exist. In the eighteenth century, *combustionness* started to be connected to *oxygenness*, and thus, in the eighteenth century, a new theory of combustion was discovered, which is a theory putatively more faithful to our mutable nature.

VI. Inference to the Best Explanation

Grosso modo, inference to the best explanation can be traced back to Peirce's abduction. There is a surprising phenomenon that triggers our attention, and we try to explain it. The following is a description of Peirce's abduction reasoning:

> [A] surprising fact, *C*, is observed;
>
> But if *A* were true, *C* would be a matter of course.
>
> Hence, there is reason to suspect that *A* is true [Peirce (1998), p. 231].

If one wants to formulate IBE's reasoning, an additional premise is required for Peirce's abduction reasoning:

> [A] surprising fact, *C*, is observed;
>
> But if *A* were true, *C* would be a matter of course.
>
> No available competing hypothesis can explain *C* as well as *A* does.
>
> Hence, *A* is true [Mackonis (2013), p. 977].[13]

There is a surprising fact in light of background knowledge. If I am on holiday in Paris and encounter a friend of mine from New York, that would be a surprise for me. However, if I encounter that same friend at his office in New York, that would not be a surprise for me because it agrees with my previous knowledge regarding my friend's work place. Horwich (2011, pp. 100–104) uses probabilities and Bayes' theorem to define whether a certain fact is a surprising fact.[14] However, in this paper, I do not have to determine a criterion that recognises surprising facts. The present discussion assumes that all observed *F*s are *G*s deserves explanation, i.e., we want to explain why all observed *F*s are *G*s.[15]

If we integrate IBE's reasoning, the problem of induction and Beebee's (no-) solution to it, we obtain the following argument:

> For $t = t_a$
>
> (1) The surprising fact is that all *i*-observed *F*s are *G*s.
>
> (2) However, if N_{t_a} (*F*, *G*) were true, all *i*-observed *F*s are *G*s, would be a matter of course.
>
> (3) No available competing hypothesis can explain that all *i*-observed *F*s are *G*s as well as N_{t_a} (*F*, *G*) does.
>
> $\therefore$ N_{t_a} (*F*, *G*) is true.

Let us assume that at $t = t_b$, (where $t_b > t_a$), one i+1 *FG* is observed. Thus, a new entity is added to the set of *i*-observed *FG*s. To explain this new set of i+1-observed *FG*s, another inference to the best explanation is required. That is, N_{t_b} (*F*, *G*) must be inferred, as our background knowledge only explains

why *i*-observed *F*s are *G*s. For the time-limited necessitarian, every time that a new (black) raven is observed, that observation will be waiting for an explanation.

Something unusual is taking place. Clearly, inference to the best explanation does not proceed in this way. The contrast between the time-limited necessitarian and the timeless necessitarian is clear. Let us assume that the timeless necessitarian established, via IBE, that all ravens are black. Meanwhile, he observes a new black raven. This is not a fact that deserves explanation. For timeless necessitarian, it would be a surprise to observe, for example, an albino raven, but there is no surprise in observing another black raven. Instead of N_{t_a} (F, G), the timeless necessitarian inferred N (F, G). N (F, G) is independent of time. With N (F, G) in mind, and given that N $(F, G) \rightarrow \forall x$ $(Fx \rightarrow Gx)$, the timeless necessitarian explains *deductively* why all other observed ravens are black. Given that a is F and $\forall x$ $(Fx \rightarrow Gx)$, a is G. Thus, the timeless necessitarian is not struck by new *FG*s. On the contrary, the time-limited necessitarian cannot take the deductive step.

One may argue that there is no difference between the IBE's reasoning of the time-limited necessitarian and the IBE's reasoning of the timeless necessitarian, as both establish the same conclusion – all *F*s are *G*s. Thus, all new observed black ravens are not a surprise, and they are deductively explained.

I make the following two points in reply to the previous objection. First, the timeless and the time-limited necessitarian infer the same conclusion via different best explanations. The time-limited necessitarian, for example, infers that the best explanation is N_t (F, G), whereas the timeless necessitarian infers that the best explanation is N (F, G). When the time-limited necessitarian observes a new *FG*, the set of observed entities is enlarged by another entity. Given that laws of nature can change, i.e., N_t (F, G) may have been broken, one must infer another best explanation concerning this new enlarged set. Every new observed *FG* implies an inference to the best explanation, providing the time-limited necessitarian wishes to explain that new *FG*.

Second, the time-limited necessitarian and the timeless necessitarian require different steps in reasoning. The time-limited necessitarian first makes an IBE step towards N_t (F, G) and then makes an illicit induction step towards N (F, G). However, the timeless necessitarian only makes an IBE step towards N (F, G), and hence, the conclusion – all *F*s are *G*s – is rationally supported. The point of this discussion is only concerned with the first step, as it is unreasonable to make an inference to the best explanation every time that, for example, a new black raven is observed.

There is an additional issue concerning premise (3) of the argument described above. Beebee (2011), p. 514, considers that (T) (i.e., N (F, G)) can be one of the possible truthmakers for (SF) (i.e., N_{t_a} (F, G)). However, as Bird and Ladyman (2011) remark, if (T) is one of the possible truthmakers

for (SF), then (T) and (SF) are not competing hypotheses. Lipton (2004) argues that if two hypotheses are not competing hypotheses, then it is impossible to make an inference regarding the best explanation between the two. For example, my car does not work. What is the best explanation available? (a) The car is out of gas; (b) the car's battery discharged *or* the car is out of gas. The two explanations are compatible. One explanation does not pre-empt the other as both can be true. Thus, it does not make sense, without further evidence, to make an inference to the best explanation between these two explanations.

Lastly, Lipton (2004), p. 59, distinguishes between two senses in which an explanation can be the best explanation of competing plausible explanations: the *likeliest* and the *loveliest* explanations.[16] The likeliest explanation is the 'most probable explanation'; the loveliest explanation '[is] the one which would, if correct, be the most explanatory or provide the most understanding'. Primarily, likeliness aims for truth and loveliness aims for potential understanding. For example, before deriving the theory of relativity, Newtonian mechanics was one of the likeliest and loveliest explanations of physical phenomena. Today, Newtonian mechanics is no longer one of the likeliest explanations but it is still one of the loveliest explanations of the old data that support it.

With this distinction in mind, two versions of IBE are established: inference to the *likeliest* explanation and inference to the *loveliest* explanation. Lipton argues that we should follow the second type of inference because inference to the likeliest explanation is trivial in that '[w]e want a model of inductive inference to describe what principles we use to judge one inference more likely than another, so to say that we infer the likeliest explanation is not helpful' [Lipton (2004), p. 60]. That is, IBE pretends to describe strong inductive arguments. In these arguments, the premises make the conclusions likely. Thus, it begs the question to defend that our IBE are inferences to the likeliest explanation. To provide understanding, it is not enough to point out the likeliest explanation. In our case, (SF) seems to be the likeliest explanation but not the loveliest explanation. (SF) accommodates, as well as (T), all past regular observations, but (T) provides a deeper understanding or comprehension than (SF). Thus, it seems that (T) rather than (SF), is the loveliest explanation.

VII. Conclusion

In this paper, I have argued for two points. First, if the time-limited necessity explanation (SF) were an equally good explanation as the timeless necessity explanation (T), this explanation would not block Armstrong's solution to the problem of induction. Second, the timeless necessity explanation is actually a better explanation of our observed regularities than is the time-limited necessity explanation. Meanwhile, other competing plausible

explanations, allied with more rigorous applications of IBE, can be found in the literature. Let us wait and see.

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[1] The nomic theory is also known as 'DTA' (Dretskey-Tooley-Armstrong), but here I will only consider Armstrong's proposal.

[2] Foster (2007) presents a similar discussion and solution.

[3] Note, however, that Mumford denies the existence of laws but defends that there are necessities in nature.

[4] For some regularity theorists, this premise is controversial, but that controversial aspect is innocuous for our discussion.

[5] It may be objected that 'there is no sphere of uranium larger than 1 kg' is a non-observed regularity that requires explanation. To this objection, I reply that 'every *observed* lump of uranium has a critical mass less than 1kg' is the true observed regularity that requires explanation.

[6] These steps are fully discussed in White (1988).

[7] See Beebee (2011), p. 512, for the difference between time-limited necessity (N_t) and timeless necessity (N).

[8] See, also, Bird and Ladyman (2011).

[9] See Mackonis (2013).

[10] Yet, even in science, predictivism is controversial. If E is evidence for a hypothesis H, the truth of H seems to be independent whether E was known before or after H was formulated. It is intuitively appealing to consider that E supports more strongly H if E was predicted by H, but this intuition is controversial. For example, Horwich (2011), pp. 111-117, argues that this intuition is incorrect.

[11] For other philosophical applications, see Lipton (2004), pp. 67-69.

[12] See Armstrong (2004), pp. 145-150, for this point.

[13] See, also, Psillos (2002), p. 614.

[14] A surprising fact obeys the condition $P(C/E) << P(C)$, where 'the truth of E is surprising only if the supposed circumstances C, which made E seem improbable, are

themselves substantially diminished in probability by the truth of *E*'. For example, the outcome of 100 consecutive heads in the toss of a coin is surprising because $P(C/E) < 10^{-10} << P(C)$, where *C* means 'the coin is fair' and *E* means 'outcome of 100 consecutive heads'.

[15] Famously, Quine (1969), p. 126, dismissed the question as obscure.

[16] See Campos (2011) for a contrast between Peirce's abduction and Lipton's inference to the best explanation.

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