Form vs. Content-driven Arguments for Realism

Juha Saatsi[1]

Abstract

I offer a meta-level analysis of realist arguments for the reliability of ampliative reasoning about the unobservable. We can distinguish *form-driven* and *content-driven* arguments for realism: form-driven arguments appeal to the form of inductive inferences, whilst content-driven arguments appeal to their specific content. After regimenting the realism debate in these terms, I will argue that the content-driven arguments are preferable. Along the way I will discuss how my analysis relates to John Norton's recent, more general thesis that the grounds for licit induction are always material.

1 Introduction

Scientific realists maintain that science progresses by making good inductive inferences about the unobservable world. Anti-realists, on the other hand, are sceptical about our inductive powers. Most of the literature either advocates or criticises some particular realist argument. Here I take a much broader, meta-level perspective on a wide selection of realist arguments. The aim of this is two-fold: to impose a degree of order on the debate to begin with, and to evaluate the profitability or otherwise of certain *kinds* of arguments *en masse*.

More specifically, I will be concerned with the following two issues. Firstly, I wish to compare and evaluate a broad array of realist arguments by discerning their basic intuitions. I will focus, in

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particular, on the way in which the different arguments are underwritten by contrasting general views on induction. Secondly, I will consider the following question. Given our analysis of different realist arguments, how should realism be defended against the selective inductive sceptic (whose scepticism concerns the unobservable, not induction in general)? I will argue that the content-driven realist arguments are preferable, and that this can fruitfully focus and reform the realist project.

The paper proceeds as follows. I will begin by looking at an array of realist arguments, first in the abstract (§2), and then in terms of some existent arguments (§3). Then in §4 I will attend to some interesting parallels between my analysis of realist arguments and Norton's recent 'material' theory of induction. In the end (§5) I will argue that the content-driven arguments for realism are preferable.

2 The realism debate: initial observations

The arguments considered below aim to defend realism against *selective* inductive scepticism, not against Hume's all-embracing scepticism.[2] We modestly begin with the premise that we have got some substantive inductive knowledge of unencountered observable affairs (the sun rising tomorrow, Jupiter having moons etc.). Assuming this much, the challenge is to argue that we should also take seriously some ampliative inferences to the unobservable.

The first task is to understand and sort out the various intuitions and motivations behind the different realist responses to this challenge. There's a broad array of realist arguments littered around the vast literature. Let us begin with some initial observations about these arguments.

1. The following schema captures the basic form of most realist arguments at some level of abstraction:

> We are happy with *such-and-such* inductions $\{I_O\}$ about the observable.
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> *Such-and-such* inductions about the unobservable $\{I_U\}$ are *relevantly similar* to $\{I_O\}$.

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[2] This kind of selective scepticism is typically attributed to van Fraassen.

We should be happy with $\{I_U\}$.

Given the nature of *selective* scepticism, realists naturally attempt to built a bridge between certain observable matters and certain unobservable matters by attending to the kinds of inferences that scientists make about these respective domains. In one way or another they argue that observability per se is epistemologically irrelevant in the face of the fact that certain inductive inferences are similar, so that countenancing one (class of) inference(s) whilst being sceptical about the other is unnatural or ad hoc. The above schema is, of course, only an abstract blueprint that underlies various concrete realist arguments. The actual arguments implementing this schema differ with respect to how inductive inferences are construed and classified, to spell out what the two classes of inductions $\{I_O\}$ and $\{I_U\}$ are, and in what sense they are 'relevantly similar'.

2. Different realist arguments are motivated by different understandings of the inductive method of science. Inference to the best explanation (IBE) is often the central point of contention. Some say it is a unifying feature of all scientific reasoning, and realism turns on arguing that explanatory virtues are truth-tracking virtues. The most optimistic line of thought appeals to IBE in a rule-circular fashion at the meta-level. Others avoid appealing to a meta-level IBE by arguing for realism directly on the grounds that scientific inferences can be construed as IBEs. Yet others argue for realism without appealing to explanation at all, preferring to leave it open whether any (extant) descriptive scheme captures the inductive method.

3. The aim and scope of realist arguments differ. Some wish to produce a single overarching argument that covers all 'mature' and 'successful' science, once and for all. Others are happy to produce one argument for realism about this and another for realism about that, in a more piecemeal fashion. We can talk about *wholesale* and *retail* arguments for realism-about-X, depending on the scope of the arguments. (Magnus & Callender, 2004) A wholesale argument aims at justifying a realist attitude towards some large class of inferences $\{I_U\}$ for the purpose of bridging the alleged epistemological gap between the observable and the unobservable. A retail argument zooms in on some relatively small class of inferences $\{I_U\}$.

4. Realist arguments differ in their basic assumptions about exactly what aspect of scientific inductive inferences is germane to the realist project. Some arguments focus more on the *form* of these inductions, whilst others focus more on the *content*. We can talk about *form-driven* and *content-driven* realist arguments for realism-about-X, depending on whether the emphasis is on the form or the content, respectively. The form-content distinction is logically independent from the retail-wholesale distinction, but all paradigmatic wholesale arguments in the literature are form-driven, whilst retail arguments are content-driven.

The distinctions above are comparative and relative. These attributes are simply meant to serve to order the various realist arguments by discerning one argument as more form-driven (wholesale) or more content-driven (retail) than another. These abstract distinctions will become clearer with concrete examples, below.

Given these initial observations, we should now try to analyse the whole gamut of different arguments that have made their way into established realist literature. How do these arguments realise the basic argument schema in 1 above? Do their respective advocates differ in their attitudes towards induction in general? Why are some realists inclined to give wholesale/form-driven arguments, whilst others prefer retail/content-driven arguments? Can we analyse the pros and cons of these different leanings by abstracting away from the details of the particular arguments?

I will next take a closer look at the form-content distinction in reference to some specific realist arguments, and then compare the distinction to a recent view on induction advanced by John Norton, before in the end coming back to the last question above.

3 The realism debate: an array of arguments

A realist argument is form-driven if it attempts to justify some inductive inferences by reference to some general formal attribute unifying all these inferences. Content-driven arguments, by contrast, take there to be more justificatory analysis to be done on case-by-case basis by taking into account what these inferences are about. The contrast between form and content-driven arguments admits of degrees. A set of inferences can share some single characteristic which in a realist argument becomes concurrently the vehicle of justification for

each instance of inductive inference featuring that characteristic. Corresponding to the level of generality at which such characteristic is described—how encompassing the class of such inferences is—we have more and less form-driven realist strategies. This abstract preliminary distinction between form-driven and content-driven arguments is best clarified via concrete exemplars of actual realist arguments. I will consider the arguments in the table below.

Advocate	Argument	Form vs. Content
Boyd / Psillos	No-Miracles argument	Extremely form-driven
Lipton	1st-order explanationism	Rather form-driven
Hacking / Achinstein	Experimental realism	Rather content-driven
?	Scientific arguments	Fully content-driven

Extremely form-driven.

The standard explanationist argument for realism, originating from Putnam, and finessed by Boyd and Psillos amongst others, is form-driven to the extreme. Psillos (1999) is a notable recent author in this lineage. He argues (roughly speaking) that the scientific method is based on inference to the best explanation, and that by meta-level use of IBE we can (in the framework of externalist epistemology) justify the scientific use of IBE as truth-tracking. Hence, we've got an attempt to justify realism by reference to an extremely general characteristic unifying all scientific inferences to unobservables. Namely, they are all of the same form: IBE.[3]

There are a couple of noteworthy ideas underlying Psillos's form-driven explanationism. First of all, Psillos (following Harman (1965), and Josephson (1996, 2000)) takes IBE to be a fundamental, primitive

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[3] Admittedly there are many subtleties to Psillos's argument, regarding the rule-as-opposed-to-premise-circularity of the meta-level justification, for example, and the fact that Psillos of course allows for different degrees of confirmation: not all explanatory inferences are epistemologically on a par as far as their confirmatory strength goes. But the basic form of the justificatory argument is this, and it is form-driven.

foundational form of inductive inference (see Psillos (2002), for example). Secondly, Psillos explicitly appeals to the similarity in the form of our reasoning about the observable and the unobservable matters, displaying clearly the underlying intuition:

> Theoretical beliefs in science are formed by means of abductive reasoning. But so are most of our every-day commonsense beliefs. Realists have exploited this fact in order to argue that if one has no reason to doubt commonsense abductive reasoning, then one should have no reason to doubt abduction in science. The *pattern of reasoning*, as well as justification, are the same in both cases. (Psillos, 1999, p. 211, my emphasis)

And on these grounds Psillos accuses the selective sceptic (van Fraassen) of adopting a selective attitude against inferences about the unobservable:

> Clearly, van Fraassen sustains a selective attitude towards IBE. The latter is a means of going beyond the realms of what has been actually observed and forming warranted beliefs about unobserved things and processes. Yet IBE is not a means of forming warranted beliefs about the realm of unobservable things or processes. (Psillos, 1996, p. 34)

Rather form-driven.

Many realists are wary of meta-level application of IBE, and also of the idea that there is pertinent justificatory unity to *all* scientific inferences that can be viewed as being abductive in form. Yet some of these realists wish to tap into the pivotal explanatory dimension of science, and appeal to explanatory virtues in a less form-driven way. These realists argue that the gap between ampliative inferences to observables, on the one hand, and to unobservables, on the other hand, is bridged by virtue of the fact that the respective inferences are *not only* of the same general form (IBEs), *but also* of the same more specific 'inferential kind'.

Lipton (2004) presents such an argument. He develops an overarching *descriptive* account of confirmation and induction in terms

of inference to the best explanation.[4] Regarding the justificatory challenge of realism, he puts forward a very general argument to unify and justify a significant class of abductive inferences of science. After repudiating the No-Miracles Argument, Lipton considers a less form-driven, first-order explanationist strategy:

> Can explanationism defend realism instead by appeal to the *structure* of those first-order inferences? ... The *structure of causal inferences* is the same, whether the cause is observable or not. ... So there is a prima facie case for saying that all these inferences should be construed in the same way: granting the truth-tropism of inferences to observable causes, we ought also all to be realists about inferences to unobservable causes, since the *inferences have the same form* in both cases. (2004, pp. 199–200, my emphasis)

Although Lipton avoids a form-driven abductive inference about science at the meta-level, he still provides a very general template for justifying scientific inferences. For him any scientific first-order instance of causal abduction is (probably) approximately true by virtue of being '*formally similar*' to everyday ampliative reasoning about the observable. Unlike Psillos, Lipton takes it to be incumbent on the realist to provide a more specific description of the kind of abductive reasoning that allows us to bridge the gap between everyday theorising and scientific theorising. Hence Lipton stresses the *causal-contrastive* mode of IBE. But is that enough said? I will return to this below (§5).

How form-driven is this particular realist argument? It depends on how tightly the relevant 'inferential kind' is delineated. Just appealing to causal explanations (spelled out as contrastive explanations – cf. Lipton (2004, ch. 3)) yields a rather form-driven argument with very meager constraints one the content of the inference. The notion of contrastive causal explanation is a broad one, even at the level of observable matters.

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[4] Unlike Psillos, Lipton is not a totalitarian 'IBE fundamentalist', claiming that all inductive inferences are best construed as abductive. Rather, for him the scheme of inference to the best explanation simply plays a significant role in understanding inductive reasoning.

Rather content-driven.

At the more content-driven end of the spectrum there is a set of arguments whose advocates are collectively known as *experimental* realists.[5] Experimental realists do not have to advocate any level of explanationism, not even as a significant descriptive thesis about the scientific method. Traditional questions about general characterisation of induction are simply irrelevant to their realist arguments, for these arguments do not primarily rely on the idea that a scientific inference to some unobservable posit has a particular form. Rather, these content-driven arguments rely on case-specific considerations, typically closely following the reasons that scientists themselves supply for their beliefs about something unobservable. For example, regarding the paradigm unobservable entity, the atom, it has been popular to examine Perrin's original reasoning to the existence of atoms on the basis of Brownian motion. (Achinstein, 2002; Miller, 1987; Salmon, 1984)

Although there are many content-driven realist arguments that differ considerably in detail and rhetoric, there is a common underlying pattern to be found. Each "experimental" argument—I will question the aptness of the title below—is naturally construed as relying on some material assumption about the uniformity of the world that crosses the observable-unobservable boundary. The unwritten premise is that the uniformity assumption required for realism-about-X is as innocent as some assumption required by some induction about an unobserved observable. These uniformity assumptions pertain to particular matters of fact, and the epistemic warrant conferred by an experimental realist argument is correspondingly localised.

Achinstein (2002) is the latest (and the clearest) representative of this line of thought.[6] He analyses Jean Perrin's reasoning to the existence of atoms as *causal-eliminative*, also giving a more general account of the conditions on which this kind of reasoning is justified. Achinstein presents Perrin's reasoning as follows (2002, p. 474)

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[5] Some of the *entity* realist arguments (e.g. Hacking, 1982) are also naturally interpreted as belonging to this category.

[6] There's much to this paper besides the argumentative step that I will solely focus on. But this argumentative step, I take it, is the crux of Achinstein argument against the selective sceptic.

1. Given what is known, the possible causes of effect E (for example, Brownian motion) are $C, C_1,\ldots, C_n$ (for example, the motion of molecules, external vibrations, heat convection currents).
2. $C_1,\ldots, C_n$ do not cause E (since E continues when these factors are absent or altered).

So probably

3. C causes E.

Observing the microscopic particles dancing around, continually accelerating and decelerating, indicates the existence of internal forces responsible for such behaviour, assuming that no plausible external cause can be found. And the meticulous experiments performed by Guoy did indeed allow Perrin to eliminate the plausible external candidate causes $C_1,\ldots, C_n$. The various experiments performed by himself and others then allowed Perrin to claim quantitative evidence for his initial conclusion and for the numerical value of Avogadro's constant.

Such scientific reasoning immediately raises obvious anti-realist worries. First of all, there is the possibility that the hypothesis of internal molecular forces singled out by eliminative reasoning is merely the best of a bad lot. How do we know that all the possible alternative causes of the phenomenon have been cited and eliminated by experiments? Achinstein's response is to insist that the realm of possibility here is restricted by our background knowledge.

> The claim that the possible causes cited probably include the actual one can be defended by appeal to the fact that the *phenomenon in question is of a certain type* that, experience has shown, in other cases is caused by one or the other of the causes cited. (2002, p. 478, my emphasis)

But this immediately raises a second anti-realist worry: how can we justify inferences to the unobservable on the basis of the observable, on the basis of what 'our experience has shown'? For example, in Perrin's argument we need to justify the inductive generalisation from '*All observed* accelerating bodies in contact with other bodies exert forces on them' to '*All* accelerating bodies, including molecules (if any exist),

in contact with other bodies exert forces on them' (ibid., 481). And empiricists like van Fraassen, of course, take such inductive inferences to the unobservable to be unjustified and unjustifiable.

The way Achinstein responds to this second worry brings the content-driven character of his argument to the fore. According to Achinstein, the realist can provide a positive empirical reason for taking observability *not* to be a biasing condition for an inductive generalisation from a sample.

> One can vary conditions or properties in virtue of which something is observable (or unobservable). For example, items can be observable (or unobservable) in virtue of their size, their distance from us in space or time, their duration, their interactions (or lack of them) with other items, and so on. ... If we vary the conditions in virtue of which bodies are observable and find no differences in whether bodies have mass, and if we have no contrary empirical information, then we have offered an empirical argument to support the claim that the fact that all observed bodies are observable does not bias the observed sample with respect to the property of having mass. (ibid, 484–485)

Arguably selective scepticism should feel serious tension here. The realist appeals to independence of mass with respect to variation in conditions and other properties that are relevant for observability, and arguably that sort of independence also counts for the legitimacy of certain ampliative inferences about unobserved observables. For example, having observed conservation of momentum for bodies of various sizes and masses we infer that conservation of momentum holds for bodies bigger and more massive than the ones we have so far observed. The selective sceptic is happy with this inference, but not with an inference that takes us from observed collisions to unobservable collisions. So whence the difference? After all, the logical possibility of *observability* being a biasing condition is on a par with the logical possibility of *having been observed* being a biasing condition. We can view the inductive inference to unobserved observables being underwritten by the specific assumption that

> (*) momentum conservation is independent of the size and
> mass of the colliding bodies, at least for all observable

bodies.

The induction to unobservables is correspondingly underwritten by the assumption that

(**) momentum conservation holds for all bodies regardless of their size and mass.

If we are justified in making some assumptions that unify the world beyond our observations, as the selective realist concurs, why would those assumptions *never* extend their reach to the unobservable? Isn't it simply ad hoc to happily go from our observations to (*), but deny that (**) is an illegitimate extrapolation? There doesn't seem to be anything in our experience to suggest an epistemological difference *in the content of these particular assumptions*.

Achinstein's argument is content-driven because it concerns only a very particular uniformity of the world: the relevant mass-related properties (e.g. conservation of momentum) are independent of the properties in virtue of which bodies are observable, or otherwise. Achinstein's realist analysis takes explicitly into account those particular matters of fact which underwrite Perrin's inductive argument for the existence of atoms. And his response against the selective sceptic turns on a kind of *Tu Quoque*: arguably our inductive inferences about the unobserved (but not unobservable) massive bodies are underwritten by assumptions that are epistemologically no different from the ones that the content-driven argument appeals to in this instance.

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It seems that different realist arguments are motivated by different general views on induction. The advocates of form-driven arguments are inclined to look for an underlying unity in the form of scientific inferences to bridge from observables to unobservables, whilst the proponents of more content-driven arguments turn on our intuitions about some particular assumptions about the world. Many arguments of the latter kind are notoriously imprecise and rhetorical (but also intuitively pulling, e.g. Hacking, 1982), and a certain amount of interpretation is required. The interpretative gloss presented here, emphasising the content-driven character of these arguments, gains impetus from the following observation. Many have reacted to these arguments by objecting that they are *just as abductive in form* as the

form-driven realist argument based on the success of science. (e.g. Resnik, 1994; Psillos, 1999) These reactions are misguided but unsurprising: if one is looking for a form-driven and formal justification of induction, and is furthermore tempted to massage any inductive argument into an inference to the best explanation, then the experimental realist arguments seem to rely on an abductive form. However, the intuition driving the content-driven arguments is that the justificatory work is done at the level of particular material assumptions. The fact that a realist argument turning on a particular uniformity assumption can be naturally construed as an inference to the best explanation is wholly irrelevant, given the very different view on what makes an induction licit. John Norton has contrasted these different perspectives on induction with his 'material theory of induction' to which I will now turn.

4 Parallels with Norton's analysis of induction

Norton (2003, 2005) provides a broad meta-level analysis of ampliative reasoning that supports a content-driven view of induction. In their attempt to describe good inductive reasoning, philosophers have identified many an inductive schema operative in the sciences and everyday life, from simple enumerative induction to fancy Bayesian logics. Norton calls such abstractions *formal* theories of induction: they attempt to provide a formal schema to distinguish licit inductive inferences independently of case-dependent detail. The basic motivation for Norton's content-driven view of induction comes from the realization that any extant formal schema furnishes both licit and illicit inductions, and therefore cannot by itself mark what makes an induction licit. Rather, a licit induction is licensed by local 'material postulates', not the form of induction per se. Hence, Norton advocates a *material theory of induction* according to which all licit inductions are ultimately "underwritten by local material facts."[7]

Consider the classic case of enumerative inductive generalisation, for example. There are several good inductive arguments of this form, of course.

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[7] Similar views have been championed by others before Norton. See e.g. Rescher (1980), Sober (1991).

> Sample A of lead melts at 327.5 degrees Celsius.
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> Sample B of lead melts at 327.5 degrees Celsius.
>
> Sample C of lead melts at 327.5 degrees Celsius.
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>
> Any lead sample melts at 327.5 degrees Celsius.

This is (presumably) a licit induction. But this simple form of enumerative induction is, of course, illicit when the target of generalisation is a kind which is less homogeneous with respect to the property in question. Hence, one cannot thus infer the melting point of any sample of plastic, say. What makes the inductive argument above licit is not its form, argues Norton, but the fact that it is an enumerative induction *about lead* (or about an element). This is typically left implicit, but it can be included explicitly as a premise—'lead (as an element) is uniform in this respect'—rendering the argument (in this case) deductive, an instance of *demonstrative* induction. Norton calls such (typically unwritten) local premises 'material postulates'. A material postulate is a proposition stating a particular uniformity-fact.

Similarly, consider the following abductive argument, regarding the cause of solar eclipse.

> (OBS) The sun appears to be engulfed, little by little, by a massive object, leaving a halo.
>
> (BE) The best explanation of (OBS) is that the sunlight is obstructed by an intervening celestial body.
>
> (IBE) The best explanation is probably true.
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>
> Therefore, the cause of the eclipse is an intervening celestial body.

Given suitable background knowledge this is a licit inference. What makes it licit? We should notice that there are two local parameters that need to be fixed (to get the premise (BE)) in order to apply the schema IBE. First of all, we need to say what *counts as an explanation* in this context. Why exactly is it that a bona fide explanation of (OBS) can be provided by a hypothesis about an intervening body, but not the hypothesis that the Sun and the Moon make love and discreetly hide

themselves in darkness? We don't have, nor do we need to have, an overarching general theory of explanation to answer this. Rather, it suffices to look at the relevant background knowledge about the nature of light and the Sun. Secondly, if we have different competing explanations, *how are these to be compared* so as to make (BE) true? What exactly is it that makes an explanation in terms of an intervening body *better* than, say, an explanation in terms of changing intrinsic nature of the Sun? Again, such comparison turns on particular assumptions about the prevailing facts about the Sun, instead of general facts about explanation. Hence, what makes the above argument licit is not the fact that it is *an instance of* abstract universal schema of inference to the best explanation. Rather, it is the fact that in this local context our explanatory judgements regarding the two parameters are such that they ensure this schema really functions. That is, our background-knowledge-dependent explanatory judgements reflect the relevant ways the world is, the *facts*. If we want to make explicit the material postulates that underwrite this inference, we need to write down the particular background assumptions that underlie (BE).

Enumerative induction and inference to the best explanation do not exhaust induction schemes, of course, but arguably the lesson generalises. (Norton, 2003) It is important to be clear here that Norton's thesis is first and foremost a *descriptive* one. It is one thing to describe good-as-opposed-to-bad inductive reasoning, say, and a whole other thing to *justify* some way of reasoning as profitable (truth-tracking, or empirical-adequacy-increasing, say) (Lipton, 2004). Norton's theory aims to locate a distinction between good inductions and bad inductions in the abstract, without making any further claim as to whether we are actually in a position to *know* which are which. It locates the distinction between licit and illicit not in the form (or any universally describable feature) of an inductive argument, but in its *content*. This philosophical theory about the distinction between good and bad inductive arguments does not in itself amount to knowledge that any particular inductive argument is good, since we may not know that the relevant local material postulates really represent *facts*. So justification is a further question.

Nevertheless, Norton does also suggest that his theory does have interesting justificatory repercussions regarding Hume's problem of

induction.[8] Hume's description of induction focused on enumerative generalisation, and thus his argument against the possibility of justification of induction naturally turned on the idea that enumerative generalisation hangs on the assumption of uniformity of nature. Although it is nowadays clear that enumerative induction is woefully inadequate as a description of our variegated ways of inductive reasoning, many think that Hume stated his argument in a general enough form for it to apply to any mode of non-deductive reasoning. Norton disagrees. For the way in which Hume's problem is typically presented relies explicitly on formal understanding of induction. Consider attempting an inductive justification of induction. We've got our first-order inductions about the world, and we've got a meta-induction about the past success of these first-order inductions. Such constructions, Hume's argument goes, are blatantly circular because both arguments are of the same *form*: 'more of the same'. If we are trying to thus establish the reliability of this formal schema of enumerative induction (irrespective of what the schema is applied to), we irrefutably end up running in circles. But according to the material theory of induction, no induction is licit purely by virtue of its form anyway. So the classic circularity predicament is based on a misconstruction of the whole justificatory challenge.

In the material theory of induction, by contrast, a good induction is grounded on the facts correctly described by the material postulate. So justifying a particular induction is a matter of justifying the relevant material postulate. This material postulate cannot be just taken as given, and justifying a particular material postulate requires another induction. But this is a *different induction*, grounded on *different facts* described by *different material postulates*. No circularity ensues, and arguably our best actual inductions are background-dependent and local in exactly this way:

> It merely describes the routine inductive explorations in science. Facts are inductively grounded in other facts; and

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[8] I briefly mention this line of thought here because it usefully illustrates how engrained the more formal way of thinking about induction is. But I do not wish to get too embroiled in this debate. (See Okasha (2006), and references therein) For whatever its outcome is, my appropriation of Norton's descriptive thesis to the realism debate is equally valid.

those in yet other facts; and so on. As we trace back the justifications of justifications of inductions, we are simply engaged in the repeated exercise of displaying the reasons for why we believe this or that fact within our sciences. (Norton, 2004, p. 668)

This avoids the circularity problem, but isn't there an obvious regress here? Norton is optimistic in this regard.

What remains an open question is exactly how the resulting chains (or, more likely, branching trees) will terminate and whether the terminations are troublesome. As long as that remains unclear, these considerations have failed to establish a serious problem in the material theory analogous to Hume's problem. (Norton, 2004, p. 668)

The problem at hand is different from Hume's, but it is potentially equally damaging. It seems that several everyday inductions yield beliefs which are justified on a par with our best scientific theories. Consider the paradigm induction of the sun rising tomorrow. Pre-scientifically such induction concerns some basic regularity of the world. We can now justify this regularity by appealing to a different, scientific material postulates that represent more general facts about gravitation and dynamics. These facts are more general but they are still local by virtue of not being a priori universal postulates about worldly uniformity that equally applies to green emeralds, say. But can we take our best science-discovered regularities to be any better confirmed than these everyday inductions? And even if have such reverence for scientific over everyday beliefs, it is not clear how the science-informed starting point—a more general basic regularity—is any less problematic *qua* basic regularity? Both regularities are inferred from a finite set of experiences.[9] Although there is a sense in which we have scientifically justified what was taken to be a primitive regularity beforehand—and hence accords with the scheme of material induction which '*describes* the routine inductive explorations in science'—the philosophical challenge of justifying induction concerns

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[9] Norton rejects the 'simple argument that that such brute facts are always singular and that no collection of singular facts can license a universal', but doesn't explain on what grounds he does so.

the respective starting points. What reason do we have to believe that our best science will still work tomorrow?

Despite these reservations, I fully subscribe to Norton's *descriptive* thesis about the locality of inductions and of their inherent background dependency. Regarding justification, it does show that one needs to be more careful about how the all-out justificatory challenge is posed. A typical two-line statement of *The* Problem of Induction is not in line with the fact that we do not have a universal formal schema (or a set of schemas) to capture the difference between licit and illicit inductions. However, an equally difficult problem of responding to a wholesale inductive sceptic may remain. But now we should return to the challenge posed by the selective sceptic, and I will argue that the content-driven view on induction does have ramifications regarding this more specific challenge.

5 Why content-driven realist arguments are preferable

Let's now return to questions posed at the end of section §2. Only one question remains: does the above analysis of realist arguments shed light on their pros and cons? The answer is 'yes'. Let's begin with the arguments that are driven by (more) emphasis on (more) formal similarities, whilst downplaying case-specific details. The seeming advantage of these arguments is that one gets more with less: a justification of a significant class of scientific inferences by their shared form, without having to pay much attention on what these inferences are about. This mirrors the appeal of form-driven descriptive theories of induction: being able to tell licit from illicit inductions by a mere formal schema. Norton has argued that the descriptive project is forced take into account ever-present material assumptions. Similarly, I will presently argue, the justificatory project must pay heed to material assumptions. We will see that the downside of form-driven realist arguments is an increased epistemic risk that is unacceptable. By contrast, the (more) content-driven arguments have (more) emphasis on case-specific content. The advocates of content-driven arguments are happy to admit that justification of knowledge of the unobservable world is a business that always hangs on assumptions of particular matters of fact driving ampliative inferences. These arguments are epistemologically more secure, but the price to pay for this is the

limited scope of each particular argument.

We can criticise form-driven realist arguments as follows. These arguments suffer from what could be termed the *Description–Justification Gap*. Too much emphasis is paid on formal descriptive unity, without realising that descriptive unity can be cheap and does not amount to justificatory unity. Unified description can be achieved at the level of formal induction schemas simply by abstracting away from the specific material postulates that make particular inferences licit. But fully capturing what makes a particular induction licit requires more. Since a licit induction is always underwritten by a material postulate correctly representing a relevant fact, some justification must be given at that level as well. This is exactly what is missing in the realist arguments that attempt to cross the gap between the observable and the unobservable by comparing the respective inductive inferences vis-à-vis their form. In the extreme form-driven case, for example, the ambitious meta-level use of inference to the best explanation appeals to descriptive unity that spans from scientific to *philosophical* explanations.[10] Given how flexible the required unifying characterisation of IBE is, the two parameters (cf. section §4) determining what counts as an explanation, and what counts as a good explanation, are left wide open. But the mere form of an inference cannot carry the justificatory burden.

A realist espousing a form-driven argument may argue that in the *absence* of any reason to think that scientists' IBE-infested methodology becomes suddenly unreliable in some unobservable domain, our epistemic attitude to scientists' conclusions should be uniform regardless of whether the targets of investigation are observable or not. But this is insufficient, and more is required: a *positive* reason to think that the respective inferences are in same epistemological boat. Having a reason to suspect an inductive inference in a particular context requires a reason to suspect that the material postulate underwriting that inference does not correspond to worldly facts. For example, we have such grounds to suspect the inductive generalisation from 'All Turkish adult males I've encountered are bearded' to 'All adult male Turks are bearded'. We know enough of

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[10] Explaining the success of the scientific method by its truth-tracking ability is a philosophical explanation, albeit a naturalistic one.

human beings to know that nationality simply isn't a strong enough unifying factor in this respect. But *not* having such negative grounds for suspecting an induction does not amount to having positive grounds for it, either. For example, we may not be able to give any such *particular* reason to assume that inferring to the best explanation of the success of science is less likely to yield a true conclusion than inferring to the best explanation of a solar eclipse. But without any *positive* reason to think that the respective explanatory virtues are on a par as inductive virtues we are left wondering whether the material postulates underwriting the respective inductions really represent wordly facts. Why assume that the world is a place in which enquirers like us evolve so as to develop the ability to assess what is *really* the explanatory truth behind the success of science? Some answer needs to be given, and it is cold comfort if the advocate of the form-driven argument can respond only by pointing to the fact that the realist inference can be viewed as having the *form* of inference to the best explanation.

Similarly, we may not have any particular reason to suspect that scientists' appeal to explanatory virtues in quantum physics is any less reliable as an inductive guide than farmers' evaluation of the explanatory virtues required to catch a flock-harassing beast. But what we need is a positive reason to think that the respective explanatory virtues are on a par as inductive virtues. And just appealing to the abductive form of the respective inferences isn't enough on its own, given the huge difference in the two domains and the kinds of inferences made, even if the inferences do belong to a unified kind at some level of abstraction, when we leave it open enough what counts as an explanation and how explanatory goodness is measured.

The advocates of form-driven justificatory arguments are under pressure to shift emphasis on the contents of inductive inferences in order to rule out illegitimate use of cheap descriptive generalisations. For this reason Lipton (2004), for example, focuses more narrowly on *causal-contrastive* explanations: allegedly the epistemic status of an inference to the best causal-contrastive explanation is unrelated to the explanans being observable or otherwise. But the notion of causal explanation at stake is still rather open, and Lipton attempts to justify a very broad class of explanation-driven inferences by a single realist argument. Although the unifying characteristic here is not *purely* formal—a causal explanation obviously needs to reflect a *causal fact* about the world—it does not seem that Lipton's schema captures what

makes each instance of causal-contrastive abductive inference licit. There is still much contextual variability in how the best explanation is chosen.

Lipton explains that 'for the causal explanations of events, explanatory contrasts select causes by means of the Difference condition: *To explain why P rather than Q, we must cite a causal difference between P and not-Q, consisting of a cause of P and the absence of a corresponding event in the case of not-Q*' (2004, p. 42).[11] This is a rather abstract characterisation of what is required of good causal-contrastive explanations, and ultimately much hangs on case-dependent detail. For example, the notion of 'corresponding event' is highly contextual, and gets fixed by factual assumptions regarding the situation at hand. These material assumptions are needed to tell the licit uses of this schema from the illicit ones. We can leave these assumptions implicit when we deal with mundane explanations of observable matters by observable causes. But moving further away from everyday experience increases the risk of misjudging the explanatory status of causal hypothesis, and the mere form of a causal-contrastive IBE is not enough to warrant it. One can respond by further narrowing down the class of causal-abductive inferences by explicitly fixing more specific assumptions. This clearly yields a more content-driven realist argument. But how content-driven do we need to go?

6 Conclusion: the realism debate reformed

The justificatory challenge for the realist is to argue for a *Unity of Inductions* that makes selective scepticism unnatural and unappealing. The literature contains a great variety of ways to argue for such unity, and I have argued that the intuitions behind the different arguments correspond to more content-driven and more form-driven understanding of induction. This offers a useful way to order the sprawling debate for comparison and evaluation of the alternatives.

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[11] For example, the fact that John handed his essay in on time is explanatory of John rather than Jane receiving the highest mark, given that Jane was penalized for not handing her otherwise good essay in on time. Handing her essay in on time is 'the corresponding event' absent in the causal past of Jane receiving her marks.

The conceptual distinction between form vs. content-driven not only serves to systematise the realism debate; it also has deeper repercussions. For one thing, the more form-driven arguments are found to be seriously problematic. This is due to the gap between achieving a descriptive unity and achieving a justificatory unity: we haven't been given any positive reason to think that the kind of descriptive unity that the form-driven arguments capitalise on amounts to a relevant justificatory unity. This pushes the realist towards the more content-driven argumentative strategies. I have argued that the "experimental" realist arguments can be viewed as (rather) content-driven arguments. But this raises further questions. What is the best way to construe these content-driven arguments in *general* terms? Exactly how content-driven are they? I'll finish the paper with some tentative remarks on these issues.

The material theory of induction acknowledges that any licit inductive argument has both a form, and an underlying material postulate. The form-driven realist arguments argue for the Unity of Inductions at the level of shared form, whilst the content-driven arguments depend on an analysis of the relevant material postulates. Hence, the justificatory work in the latter is done by comparing the material postulates pertinent to some induction-to-observables, on the one hand, and some induction-to-unobservables, on the other. But this way of putting it makes it clear that these arguments have nothing to do with "experiments", or "entities" *per se*. Rather, they have to do with a content-driven comparison of the respective inductions.

The material postulates underwriting inductions to the observable and to the unobservable, respectively, are still going to be different, of course, so there is no question of *identifying* the postulates required by the realist with those required by the selective sceptic. The best one can do is still a judgement of *naturality*, or otherwise, of drawing the line of epistemic incredulity at a particular point. But this is how realists have always argued, admitting that there is always ample *logical* room for inductive scepticism, selective or not. This is just the nature of induction *qua* non-deduction. But of the various ways of arguing against the unnatural scepticism of the anti-realist, the content-driven approach, I maintain, is the best. For if the particular material facts are what make an induction licit, then a realist appealing to descriptive unity takes an unnecessary epistemic risk. Appealing to the form of an inference, instead of its material postulates, raises the possibility that an

inductive inference is taken to be licit when there is no relevant material fact to underwrite it. Of course, the more abstract the unifying description, the higher the epistemic risk. But the absolute minimum—corresponding to the strongest realist arguments—is achieved by focusing on material postulates themselves.

How content-driven are these arguments then? Do they go at all beyond scientific reasoning itself? Sure they do. The content-driven realist arguments are bona fide philosophical arguments. Scientists latch onto the correct material postulates by the methods of science, which may or may not make the material postulates transparent. If a scientist appeals to a theory *T* because it is the simplest and the most unifying, and hence the most explanatory perhaps, it is a task for the philosopher to make explicit how these contextual judgements reflect the particular material facts, given the scientific background knowledge of the domain in question. Only once material postulates have been made transparent can we compare them with the particular assumptions underwriting some commensurate inductions to the observable. Hence, although the specific content-driven arguments hang on case-dependent detail, its master plan can be described in general terms. This presents a new challenge for the philosophers of science, reforming the realism debate. The recurring question is: can we argue for realism about this, or that, in terms of local material postulates?

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