Putting Inference to the Best Explanation into Context

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ABSTRACT

It is often assumed that Inference to the Best Explanation, or 'IBE', belongs to the context of justification. But several recent developments might lead one to ask whether it is more appropriate to situate it in the context of pursuit. Peircean abduction, which has been designated as an immediate precursor to IBE, is, according to recent scholarship, best located in the context of discovery and pursuit, rather than justification. Furthermore, alleged difficulties in reconciling IBE with Bayesianism have led to a proposal for giving IBE a non-justificatory role, which is close to that of pursuit. I argue, however, that these considerations do not make a strong case for locating IBE in the context of pursuit. Although abduction plays an important role in the context of pursuit, IBE is not simply a renaming of abduction. It has been reconceptualised in a way which makes it unsuitable to operate in the context of pursuit. Considerations concerning the compatibility between IBE and Bayesianism also do not give strong grounds to locate IBE outside the context of justification. This is because we should not expect that the context of justification can be characterised in purely probabilistic terms. Thus IBE should continue to be regarded as a candidate for characterising epistemic appraisal in the context of justification.

1. Introduction

There is a well-known distinction in philosophy of science between the context of justification and the context of discovery. Roughly, the context of justification is concerned with the part of scientific inquiry which attempts to justify theories as either true or well-supported or confirmed by the evidence, whereas the context of discovery is concerned with the part of scientific inquiry in which new hypotheses are formulated. It has also been suggested that there is another context: that of pursuit. This context is concerned with questions about which theories should be further pursued in scientific investigations. It is often tacitly assumed that Inference to the Best Explanation, or IBE, belongs to the context of justification. But two recent developments might suggest that it is more appropriate to situate it in the context of pursuit.

First, in many accounts IBE is presented as if it were simply a renaming of a form of explanatory inference which has been recognised since at least the time of Charles Sanders Peirce: namely abduction (Peirce, 1931-1958). Yet recently scholars have persuasively argued that abduction for Peirce had no role in what we now call the context of justification (McKaughan, 2008; Nyrup, 2015). Rather, they argue, the best interpretation of his view is that he regarded abduction as an inference form central to the context of discovery and perhaps also the context of pursuit. The fact that a hypothesis could provide an explanation of certain surprising facts was a reason to think of it in the first place, and also to regard it as worthy of further pursuit. Now if IBE is indeed a direct heir to Peircean abduction, it might also be regarded as primarily a theory of pursuit, rather than justification.

Another line of thought which seems to lead in a similar direction comes from consideration of whether IBE can be made compatible with Bayesianism, which is usually taken to belong to the context of justification. This has been a debated issue, with some arguing for incompatibilist positions and others for compatibilism between the two forms of inference (Van Fraassen, 1989; Lipton, 1991; Weisberg, 2009; Henderson, 2014; Poston, 2014). Recently, Frank Cabrera has suggested that the most promising compatibilist accounts do not in fact account for everything that is going on in IBE (Cabrera, 2017). Instead he proposes that IBE and Bayesianism are complementary forms of inference, not because they can be shown to be compatible, but because they have different functional roles in scientific inquiry. This can be interpreted as a proposal that IBE should be regarded not as a theory of justification, but rather of something closer to pursuit.

In this paper, I argue that these considerations do not make a strong case for locating IBE in the context of pursuit. Whilst it is true that abduction plays a role, for Peirce, in determinations of pursuitworthiness, it does not amount

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to anything like a rule or a theory for pursuitworthiness. Furthermore, IBE is not just a renaming of abduction, but has been reconceptualised in a way which situates it more definitively in the context of justification. Secondly, I will argue that the objections to compatibilism between IBE and Bayesianism are not sufficient to motivate regarding these as belonging to different contexts. My conclusion is that neither argument succeeds in motivating the view that IBE is primarily a theory of pursuitworthiness, and it should continue to be seen as a candidate for a normative account situated in the context of justification. The plan for the paper is the following. After first introducing what the distinction between contexts amounts to (section 2), I discuss first the historical argument for situating IBE in the context of pursuit (section 3), and then the argument from the relationship with Bayesianism in section 4.

2. Contexts

Originally the distinction between context of justification and context of discovery was made to demarcate the proper domain of epistemology as a normative enterprise. The claim was, as Reichenbach put it, that 'epistemology is only occupied in constructing the context of justification' (Reichenbach (1938), p. 7). That is, epistemology deals with the question of how well justified theories are by the evidence without reference to the processes by which those theories came into existence. The process by which scientists actually come up with the hypotheses for the hypothesis space belongs to the 'context of discovery'. And for philosophers such as Reichenbach and Popper, the context of discovery is regarded as a free province where creative processes hold sway, and which cannot be regimented by the normative investigation of epistemology (Reichenbach, 1938; Popper, 1959). The context of justification was then characterised in terms of a hypothesis space and set of evidence which were both treated as exogenous, or given. The task in this context was conceived as one of developing a 'logic of confirmation', which might be developed either in terms of logical or of probabilistic relations between the hypotheses and the evidence. For example, Bayesianism presented itself as an important candidate for tackling problems such as: when is one hypothesis $H_1 \epsilon \mathcal{H}$ better supported by the evidence E than a hypothesis $H_2 \epsilon \mathcal{H}$? The Bayesian addresses this question as follows. First start with a prior distribution $p(H)$ over the hypotheses in $\mathcal{H}$. When evidence E is obtained, update the prior probability to the conditional probability of the hypothesis given the evidence $p(H|E)$:

$$p(H) \rightarrow p(H|E)$$

The conditional probability of the hypothesis given the evidence, or 'posterior probability', is given by Bayes' rule:

$$p(H|E) = \frac{p(E|H)p(H)}{p(E)}$$

where $p(E|H)$ is the 'likelihood', and $p(E)$ is a normalisation constant given by $p(E) = \sum p(E|H)p(H)$ (the sum is replaced by an integral if the hypotheses are continuous parameters). Hypotheses with higher posterior probabilities then can be regarded as better supported or justified. (Philosophers have also considered the question of how much hypotheses are supported by particular evidence, leading to a variety of 'confirmation measures' (Christensen, 1998)).

Later, the purpose of drawing a distinction between contexts came to be seen not so much as a demarcation of the proper domain for the normative evaluation of science, but rather as a way to characterise different types of normative evaluation. A number of writers began to think that actually some normative characterisation of the context of discovery is possible after all, and interestingly, they often appealed to Peircean abduction as providing an inference form that might characterise the discovery process (Hanson, 1960; Nickles, 1980; Schickore and Steinle, 2006). From this point of view, the point of making distinctions between contexts is to delineate the different kinds of normative questions which can be asked about scientific inquiry. The context of discovery concerns a set of normative questions about which hypotheses it is appropriate to formulate at the outset of scientific inquiry. The context of justification, on the other hand, concerns normative questions to do with what has been called 'epistemic appraisal', i.e. questions concerning truth or empirical support, such as which hypotheses are better supported or justified by evidence. The context of pursuit is in some sense intermediary between discovery and justification and concerns questions about which hypotheses should pursued in further scientific investigations (McMullin, 1976; Whitt, 1990; Seselja, Kosolosky and Straßer, 2012; Šešelja and Straßer, 2014). This task of assessing the research-potential of theories, their promise and unexplored possibilities has been called 'heuristical appraisal', in contrast with the 'epistemic appraisal' concerning confirmation or truth which goes on in the context of justification (McMullin (1976), pp. 423-424).

For each context, there can be different views about the type of normative appraisal that is involved. For the context of discovery, there is still debate about the type of psychological processes at play and the extent to which norms can govern a free creative process. However, even if one thinks that there cannot be a 'right way' to discover a hypothesis, one might still admit that there are some basic normative constraints on the product of the process. That is, there are some basic constraints what a theory must be able to do in order to be acceptable as a candidate for further pursuit and/or testing. This constitutes then a minimalist understanding of what is involved in the context of discovery.

The epistemic appraisal involved in the context of justification can also be understood in different ways. Traditionally, epistemic appraisal is taken to involve questions of truth, and the epistemic attitudes in question are then either beliefs or credences. However, there is a variety of views about both the aim of epistemic appraisal and what it can achieve and these are associated with different views on what epistemic attitudes are at stake. A more minimalistic understanding of epistemic appraisal would take it to involve appraisal of epistemic support. Such an evaluation will always concern a relation between hypotheses and a particular body of evidence – how well is a theory supported by that evidence (perhaps relative to some specified context). But we may well be interested in going beyond assessments of empirical support, and asking when theories are justified in some stronger or more absolute sense. After all, we want to know which theories we should act on for immediate purposes. Traditionally, these are the theories which we believe or to which we give high credence. But one might be less ambitious about what epistemic appraisal can achieve. We might simply want to know what theory we can 'treat as if it were true', even if we do not necessarily believe everything it says. Laudan designates this attitude of treating as true as 'acceptance' (Laudan (1977), p. 108), and he says

> Particularly in cases where certain experiments or practical actions are contemplated, this is the operative modality. When, for instance, a research immunologist must prescribe medication for a volunteer in an experiment, when a physicist decides what measuring instrument to use for studying a problem, when a chemist is seeking to synthesize a compound with certain properties; in all these cases, the scientist must commit himself, however tentatively, to the acceptance of one group of theories and research traditions and to the rejection of others. (Laudan (1977), pp. 108-9).

Here Laudan is concerned with the theories that are taken to be true for the purposes of ongoing scientific investigation. But presumably acceptance should also play a special role in immediate applications to practical problems. For instance, if a theory is accepted that a certain medicine is efficacious against a certain disease, this will be a central consideration in governing prescription choices by doctors.

Acceptance in Laudan's sense may be characterised by certain dispositions, in particular, to assert the theory, or to use it in a range of contexts. Gregory Dawes, for example, says that 'to accept a proposition is *to employ it as a premise in one's reasoning, whether theoretical or practical, in any domain to which it might apply*' (Dawes (2013), p. 68, emphasis in the original). Dawes conjoins this with having a realist aim ('with the goal of attaining knowledge'), but one could also conjoin it with taking the aim of scientific inquiry to be something more modest like empirical adequacy. Acceptance, as used in these more minimalist ways, need not involve any sense of inner conviction such as might be taken to be characteristic of belief. Rather, it is the attitude that one takes towards a theory one takes to be the best bet for current use.

In summary then, there are different kinds of epistemic attitudes which may be associated with epistemic appraisal. The appraisal may be aimed at determining what to believe, but it may also involve evaluation of which theories we can 'treat as true' or 'accept' in Laudan's sense. In fact, Laudan chooses to talk about a 'context of acceptance', instead of a 'context of justification'. I will continue to use the term 'context of justification', but with the understanding that it may involve a number of different epistemic attitudes, including belief as well as Laudan's notion of acceptance.

Finally, the heuristic appraisal in the context of pursuit can also be understood in different ways. The main concern is the question of which theories to pursue in future investigations. For this, one must assess the promise or potential of a theory for the future, based on its current status in relation to the evidence, and possibly also aspects of its historical development to date. There has been some work on characterising heuristic appraisal (McMullin, 1976; Nickles, 2006; Whitt, 1990; Seselja et al., 2012; Šešelja and Weber, 2012; Šešelja and Straßer, 2014), but it has in general received less attention than epistemic appraisal.

One view of heuristic appraisal takes it to be a much broader category than epistemic appraisal. Thomas Nickles presents a number of reasons for this view, including the idea that heuristic appraisal figures at all stages of research and it concerns not just theories, but also 'problems, techniques, equipment, personnel, etc.' (Nickles (2006), p. 165). Assessment of promise may also require attention to historical indicators, rather than just the current epistemic status

of the theory. For example, it could be that the overall rate of development of the theory is important,[1] or its track record in meeting new challenges (Whitt, 1992). Also, importantly, a broad sense of heuristic appraisal involves prudential or practical considerations as well as evidential considerations. What research should be pursued has to involve considerations of the significance or importance of the outcomes, not just considerations of whether the hypotheses are likely to be true or false. It also depends on questions like what resources are available.

One might try to set aside some of these practical considerations, costs, etc. and focus on a specifically epistemic notion of pursuitworthiness. Seselja et al. (2012), for example, suggest considering the type of pursuit which conduces to distinctively epistemic, as opposed to practical, goals (Seselja et al., 2012). One might then take this kind of epistemically focussed heuristic appraisal to be a kind of 'anticipatory epistemic appraisal', that is an evaluation of possible truth, or possible future degree of confirmation (Nickles (2006), p. 163). But it is important to stress that this is not equivalent to just determining which theories get the best epistemic appraisal now. Newer theories may not yet have had the opportunity to be developed to their full potential, and they may later turn out to be more effective than currently best confirmed theories. As Seselja et al. (2012) point out, robustness in the face of uncertainty is an important consideration in the context of pursuit. It is important not just to pursue the theory with the most epistemic promise, but also a number of 'backup' theories, since future investigation may derail the theory which currently enjoys the best epistemic appraisal. The norms for the context of pursuit then must take account of this 'hedging of bets', even when the focus is on potential epistemic performance. Although one will not usually want to regard two contradictory theories as both justified, it can be quite rational for scientists to work on and pursue mutually inconsistent theories.

As several authors have noted, the interesting question about pursuitworthiness concerns not the individual scientist, but the scientific community as a whole (Whitt, 1990; Seselja et al., 2012). What it is most rational for an individual scientist to pursue depends in large measure on idiosyncratic factors like training. What a theory of pursuitworthiness concerns is what set of theories the scientific community as a whole should pursue. Here the aim is that the space of possibilities is thoroughly investigated by the community, and that means that some groups of scientists may, and indeed should, work on theories which at a particular moment of time have less epistemic support. This is to ensure the robustness of the scientific inquiry as a whole, since it avoids prematurely shutting down potentially fruitful avenues of inquiry.

John Worrall provides a nice illustration of how the different normative questions can come apart even for an individual scientist (Worrall, 1990). He analyses the case of David Brewster, a 19th century scientist primarily remembered for his work on optics. On Worrall's account, Brewster's epistemic appraisal was that the wave theory of light was more empirically successful than the Newtonian corpuscular theory. Nonetheless, Brewster's heuristic appraisal was that the Newtonian theory was nonetheless worthy of pursuit, and possibly more so than the wave theory. Brewster thought this because he judged the heuristic potential of the Newtonian theory to be high, despite some set-backs. There need not be any contradiction in Brewster's combination of views if his views about the empirical success are located in a different context, thus addressing a different normative question than his views about pursuit.

In this paper, I will examine the question of the proper context for IBE. It is possible that a particular form of inference could play a normative role in more than one context – although the role may be different in each. On the other hand, it could also be that a particular kind of inference is really designed to answer the questions of one of the contexts, and is not appropriate for the others. Or it could be that an inference form has a primary role in one context, but can also do some work in others. In what follows, I will consider two different lines of argument for regarding IBE as playing a primary normative role in the context of pursuit rather than justification. I will argue that both arguments are unsuccessful.

3. A historical argument for placing IBE in the context of pursuit

In this section we consider an argument for locating IBE in the context of pursuit based on its ancestry in Peircean abduction. This is not an argument which anyone has explicitly made, to my knowledge, but it represents a natural line of thought. Recent scholarship interprets Peirce as regarding abduction as a theory of pursuitworthiness, which would give it a central role in the context of pursuit. And a number of authors have taken it for granted that IBE is closely related to, if not identical to, Peircean abduction. Putting these two points together makes a case for also regarding IBE as a theory of pursuitworthiness, at least if the Peircean view of scientific inquiry and the role of abduction therein is still worth taking seriously.

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[1]Measured perhaps by problem-solving ability, as on Laudan's view (Laudan, 1977).

3.1. Peirce and abduction

Let us first examine what Peirce meant by 'abduction' and the role that he ascribed it in scientific inquiry. In his early work, Peirce distinguished between three basic logical forms of inference used in scientific inquiry: deduction, induction and abduction (CP. 2.619-44). Deduction had the following form:

Rule: M is P
Case: S is M
————————-
Result: S is P

For example,

All the beans in this bag are white
These beans are from this bag
——————————-
These beans are white.

Abduction represented a kind of inversion of the deductive syllogism, where the Case was derived from the Rule and the Result:

Rule: M is P
Result: S is P
————————-
Case: S is M

For example,

All the beans in this bag are white
These beans are white
——————————-
These beans are from this bag.

Induction, on the other hand, corresponded to the syllogism:

Case: S is M
Result: S is P
————————-
Rule: M is P

For example,

These beans are from this bag
These beans are white
——————————-
All the beans in this bag are white .

Peirce associated each of the forms of inference with different stages in the process of inquiry. Roughly, it seems, he regarded inquiry as proceeding first through abduction, then deduction, followed by induction.

> Abduction [..] is merely preparatory. It is the first step of scientific reasoning, as induction is the concluding step. (CP, 7.218)

According to Peirce, abduction is involved in production of hypotheses, their deductive consequences are then drawn out, and finally hypotheses are subject to test and inductive generalisations are drawn.

> That which is to be done with the hypothesis is to trace out its consequences by deduction, to compare them with the results of experiment by induction, and to discard the hypothesis, and try another, as soon as the first has been refuted; as it presumably will be. (CP 7.220)

In later work, Peirce characterised abduction as an inference from a surprising fact to a possible cause, taking the following form:

> *Abduction Schema (AS):*
> The 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. (CP 5.189)

Abduction is then an inference to a hypothesis which could possibly explain the fact. But Peirce sees the conclusion as a provisional one. It gives only 'reason to suspect' that the hypothesis is true. It does not establish that it probably is true. Rather it tentatively establishes the hypothesis as one which could be investigated further:

> abduction commits us to nothing. It merely causes a hypothesis to be set down on our docket of cases to be tried. (CP 5.602)

Peirce does not see abduction as to be applied to facts collected by experimental investigation, but rather to facts that are striking at the outset of inquiry. He says

> [abduction] will include a preference for any one hypothesis over others which would equally explain the facts, so long as this preference is not based upon any evidence bearing on the truth of the hypotheses, nor on any testing of the hypotheses, after having admitted them on probation. (CP 6.524-5)

Peirce stresses that abduction is not a type of inference which has a role in justifying hypotheses, at least not if that involves an evaluation of how likely those hypotheses are to be true. He is quite explicit that probabilities only attach to hypotheses at a later stage of inquiry – namely after testing. For abductions, he says,

> Not only is there no definite probability to the conclusion, but no definite probability attaches even to the mode of inference. (Peirce (1976), 184)

The conclusion of an abduction is not that a hypothesis is likely to be true, but rather the abduction directs the provisional acceptance of the hypothesis on probation, pending further investigation.

This all supports the view that abduction for Peirce has a role in the earlier stages of inquiry before a hypothesis is subjected to testing. Scholars have differed here over the exact scope Peirce gave to abduction. Some have espoused the 'generative interpretation', according to which abduction is principally concerned with the discovery of new hypotheses (Hanson (1958); Fann (1970); Turrisi (1990); Campos (2011)). However, there are also a number of scholars who have defended a 'pursuitworthiness interpretation', which takes abduction to be concerned not so much with the origination of hypotheses, as with a slightly later stage in the process, namely the determination of which hypotheses should be pursued further and subjected to testing (Frankfurt (1958); Laudan (1980); Curd (1980); Kapitan (1992); McKaughan (2008); Nyrup (2015)). Generative interpretations are not always seen as rivals to pursuitworthiness interpretations: the view that abduction plays a role in both discovery and pursuit has also been defended (Mohammadian, 2019).

The main idea behind associating abduction with pursuit is that whether a hypothesis can explain the facts at the outset of inquiry is one criterion for determining whether it is worth pursuing further. Some scholars have gone further and suggested that Peirce thought abduction also provides comparative evaluation or ranking of hypotheses as more or less pursuitworthy (McKaughan, 2008; Mohammadian, 2021). For example, McKaughan argues that 'Peirce takes abductive reasoning to lead to judgments about the relative pursuitworthiness of theories' (McKaughan (2008), p. 446). This association is supported by several passages in Peirce where he connects abduction with economical considerations, for instance: 'the leading consideration in Abduction' is 'the question of Economy -- Economy of money, time, thought, and energy' (CP. 5.660)[2] Peirce developed a theory of the 'economy of research', which was elaborated in particular in his 'Note on the Economy of Research' from 1876 (CP, 7.139-7.161). This concerned the problem of 'how, with a given expenditure of money, time and energy, to obtain the most valuable addition to our knowledge' (CP, 7.140). It was thus concerned with the question of which hypotheses should be pursued in further investigations.

This kind of interpretation generally relies on a broader conception of abduction than the inference form given by the Abduction Schema above. These commentators point out that Peirce in his later writing used abduction in a broader

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[2]McKaughan also cites Peirce's alternative draft at CP. 7.220, where he says that 'the rules of scientific abduction ought to be based exclusively upon the economy of research'.

sense to refer not just to a particular inferential form, but to the whole stage of inquiry in which hypotheses are generated and/or assessed as worthy of pursuit. For example, part of McKaughan's assessment is based on looking 'beyond Peirce's schema to his other remarks about abduction' ((McKaughan, 2008), p. 451), and his broader reading is also suggested by his claim that 'Abduction is, for Peirce, a research strategy' ((McKaughan, 2008), p. 453). Mohammadian explicitly argues for understanding Peirce's mature theory of abduction more broadly as based on his theories of insight and economy, rather than on logical form (Mohammadian (2019), pp. 18-19). What these commentators do not do is to argue that conformity to the Abduction Schema is in itself a theory which includes relative judgements of pursuitworthiness. Indeed, in discussing the question of choosing hypotheses to subject to the process of further investigation, Peirce says that there are 'three considerations which should determine our choice of hypothesis' (CP, 7.220). First, the hypothesis 'must be capable of being subjected to experimental testing'.[3] Second, 'the hypothesis must be such that it will explain the surprising facts we have before us which it is the whole motive of our inquiry to rationalize'. And thirdly, economic considerations come into play: 'in view of the fact that the true hypothesis is only one out of innumerable possible false ones, in view, too, of the enormous expensiveness of experimentation in money, time, energy, and thought, is the consideration of economy.'

This suggests that Peirce did see conformity to the abduction schema – the second consideration above, as part of what makes a hypothesis worthy of pursuit. However, it is only part of what makes a hypothesis pursuitworthy, not a sufficient condition for pursuitworthiness. When there are several possible abductions, Peirce says that economical considerations should determine our preference between them:

> [T]here is only a relative preference between different abductions; and the ground of such preference must be economical. That is to say, the better abduction is the one which is likely to lead to the truth with the lesser expenditure of time, vitality, etc. (Peirce (1976), 37-8).

Thus the fact that a hypothesis satisfies the Abduction Schema for the relevant facts is one requirement for being pursuitworthy, but economical considerations provide the additional considerations required for a fuller picture of what makes a hypothesis pursuitworthy. Pursuitworthiness interpretations such as those offered by McKaughan and Mohammadian in which abduction provides criteria for comparative pursuitworthiness rely on taking a broader conception of 'abduction' which encompasses both the explanatory power of the hypothesis and economical considerations.

In fact, Peirce struggled for many years with finding a formal characterisation of abduction in this broader sense. To a modern reader, a natural thought is that this could be formalised in decision-theoretic terms, rather than sticking with quasi-syllogistic forms like *AS*. In a decision, a choice is made between actions, and here the actions can be taken to be the pursuit of different hypotheses. Furthermore, considerations like time, energy and money can be incorporated into the utilities assigned to different outcomes. The value of the knowledge to be acquired can also be explicitly incorporated into the utilities.[4]

3.2. Inference to the Best Explanation and Abduction

In 1965, Gilbert Harman described a form of inference that he said 'corresponds approximately to what others have called "abduction"' (Harman (1965), p. 88). He called it 'Inference to the Best Explanation'. The notion of Inference to the Best Explanation (or 'IBE') has been developed by Peter Lipton, who also refers to abduction as if it is the same thing as IBE (Lipton (1991), p. 56). Besides Harman and Lipton, many authors have assumed, even taken for granted, that IBE can be closely associated, if not identified, with IBE (Barnes, 1995; Psillos, 2002a; Josephson and G., 2003; Carruthers, 2006).

A number of people have objected to the association between IBE and abduction, often pointing out that IBE has been ascribed a very different role to Peircean abduction ((Hintikka, 1998; Minnameier, 2004; Paavola, 2006; Campos, 2011; Mackonis, 2013; Mcauliffe, 2015; Yu and Zenker, 2018; Davies and Coltheart, 2020; Mohammadian, 2021). Harman lifted Peirce's restriction of abductive inference to facts at the outset of inquiry, and applied the inference form to all evidence collected in an inquiry. He gave two canonical examples:

> When a detective puts the evidence together and decides that it *must* have been the butler, he is reasoning that no other explanation which accounts for all the facts is plausible enough or simple enough to be accepted. When a scientist inferences the existence of atoms and subatomic particles, he is inferring the truth of an explanation for various data which he wishes to account for. (Harman (1965), p. 89)

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[3]Similarly, in CP 5.197, he says that a hypothesis is admissible 'provided it be capable of experimental verification, and only insofar as it is capable of such verification'.

[4]This kind of approach is explicitly taken by Rescher (1976) and Nyrup (2015).

These examples make it clear that the evidence to which the inference is applied is all the 'evidence together' after the inquiry, or the 'various data', which have been collected experimentally. IBE thus provides a way to characterise the overall assessment of which hypothesis is best supported by all the evidence. Subsequent examples in the literature have also had this character. A case which is very often invoked is Darwin's inference to the best explanation of the many facts he had collected on his Beagle voyage (Darwin, 1859).

These changes signal a major shift in the role that the explanatory inference was conceived to play. Harman presents IBE explicitly as an inference form whose conclusions concern truth. Conclusions of abductions are no longer tentative or provisional as they were for Peirce. The new conception of IBE thus broke down the Peircean barrier between abduction and induction. Harman in fact even claimed that enumerative induction could be seen as a species of IBE (Harman, 1965). Whereas abduction had a different purpose in Peirce's account than induction, on the new view IBE and induction are both taken as inferences operating in the same domain: they are both part of the context of justification.

From this point of view, the historical argument for taking IBE as a theory of pursuit fails because part of Harman's innovation is that he sees explanatorily based inference as playing a very different role than Peirce did.

However, the reason why many authors have treated IBE and abduction as the same or closely related is presumably not because of the role they are given, but rather because of the close formal similarity between IBE and the Abductive Schema *AS*. A typical formulation of IBE is the following:

> *IBE Schema (IS):*
> 1. The surprising fact, C, is observed
> 2. If A were true, C would be a matter of course.
> 3. No available competing hypothesis can explain C as well as A does.
> Hence, A is true. (Mackonis, 2013)[5]

This bears some similarity to *AS,* but extends it by adding premise 3, which introduces an explicit comparison of the hypotheses in terms of their ability to explain. By contrast there is no comparative premise in *AS*, and the conclusion is less definitive.

However, even the similarity between these formal schemas does not allow us to construct a plausible version of the historical argument. When Peirce uses a broader conception of abduction in his later work, some of his remarks suggest the idea that abduction could be used comparatively, but as we have just seen, this is not because he moves towards a broader schema such as *IS*, but rather because there are additional considerations of 'economy' which he takes to be primarily responsible for comparative evaluations and which are not part of *AS*. Furthermore, in IBE, the comparison does not simply result in a ranking of one hypothesis as better than another in terms of explaining the fact. The comparison should result in the identification of which hypothesis is actually best (even if it is allowed that sometimes multiple hypotheses may tie for this position).

The comparative premise 3 is included presumably in order to make IBE a more suitable candidate for its putative role in the context of justification. It gives grounds for choosing one theory as the most likely to be true on explanatory grounds. However, the introduction of the comparative premise actually makes the inference form *less* suitable for determining pursuitworthiness. This is because it renders the inference too restrictive. Certainly, it seems that the ability to explain *some* of the phenomena can be an important index of pursuitworthiness. There are a number of examples of past theories which attracted attention because of their ability to explain some striking phenomena which other theories failed to give such good accounts of. An example here is Copernicus' theory which provided a very natural explanation of certain planetary phenomena, notably retrograde motion (Henderson, 2014). The theory of continental drift is another example (Šešelja and Weber, 2012). It was able to explain some of the striking congruence in shape between the east coast of South America and the west coast of Africa, as well as matching between paleontological and geological findings on two continents, by postulating that these continents were joined together in the past.

However, in neither of these cases, were the new theories able to give a better explanation of all the phenomena, taken as a whole. At the beginning Copernicus' theory was very much at odds with the Aristotelian understanding of terrestrial physics. Thus, much of the behaviour of terrestrial objects became unexplained, on the Copernican view (Kuhn, 1977). Similarly, although the continental drift theory did well in accounting for evidence of matching between

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[5]Lipton introduces even further elaboration of IBE. The basic process is a two-step one. We first have to 'produce a pool of potential explanations'. From these we 'infer the best one' (Lipton (1991), p. 58). However, on Lipton's account, not all the potential explanations enter into the evaluation of which is best. There is first an initial filter which selects a small number of plausible hypotheses out of the potential candidates which constitute a short-list for this evaluation (Lipton (1991), p. 149).

continents, it did not offer a mechanism for how the drift could occur which was at all plausible in the light of other evidence or background theory.

IBE is thus too restrictive to provide a characterisation of which theories are worthy of pursuit. It will not be rational to only pursue the theory which offers the best explanation of the evidence at a particular moment of time. It is not even that pursuit should be limited to some set of theories which provide better explanations of the overall available evidence. This is because theories which do not initially offer any explanation of a wide range of phenomena may still turn out to have epistemic advantages in the longer run. What indicated that theories like the Copernican theory and the continental drift theory had promise and were worth pursuing was not their ability to explain across the board, but rather their ability to account for some specific facts which were either unexplained or less well explained by other available theories. Such theories require pursuit in order to see whether with further development they may eventually be able to explain other phenomena that they initially have difficulty with. At any given time, it is often not clear in which direction such anomalies will be resolved. In the case of both the Copernican theory and the continental drift theory, ways to deal with the initial difficulties were later found. A theory might reasonably be kept in the running, because it provides a way of accounting for certain evidence, which no other extant theory is able to do, even when it cannot provide the best explanation of all the evidence. Abduction, then, is an important consideration for pursuitworthiness, though it is not a sufficient condition. A theory must also have some promise or potential in relation to other phenomena, and establishing this will be part of the heuristic appraisal overall.

In summary, then, if we take a broad conception of IBE and abduction, then they are very different, because part of the innovation of Harman and subsequent authors is indeed to suggest a new role for the inference form specified in the schema. From this point of view, there is no argument in favour of treating IBE as a theory of pursuit. If, on the other hand, we stick to a narrow interpretation of abduction and IBE in terms of schemas, then it becomes plausible that there is a close relation between between the two, because their schemas are very closely related. However, in that case, the introduction of a comparative premise actually makes IBE less suitable for determining pursuitworthiness, because the inference form has become more restrictive. It seems then that the addition of the comparative premise is better regarded as a modification which helps to fit explanatory inference for its new role in the context of justification, but which actually undermines the case for placing it in the context of pursuit. Thus, on neither interpretation of IBE and abduction is there a plausible historical argument for situating IBE in the context of pursuit.

4. The argument from incompatibility with Bayesianism

Another line of argument for relocating IBE back to the context of pursuit has come in response to alleged difficulties with its role in the context of justification. With the rechristening as IBE, explanatorily-based inference came to be seen as operating in the context of justification. In contemporary discussions, one of the most dominant paradigms for providing norms for justification is the Bayesian one. If IBE were to dovetail with Bayesian accounts of scientific inference, this would help to provide some justification for IBE also having a role in the context of justification. Although many philosophers have argued that IBE is compatible with Bayesianism, there are some who disagree, and take the alleged incompatibility as a reason to think that IBE is not really suited for the context of justification. An example of this line of thought is given by Frank Cabrera. Cabrera argues that there are some explanatory virtues which play a role in IBE but cannot be accommodated in the Bayesian framework (Cabrera, 2017). He suggests that this indicates that IBE is not exclusively concerned with epistemic appraisal, but should be thought of as a theory concerning what hypotheses are worthy of further investigation. I will argue that this line of argument does not succeed. But first, I will explain the argument in more detail and situate it in the discussion over compatibility between IBE and Bayesianism.

4.1. The relationship between IBE and Bayesianism

Attempts to show that IBE and Bayesianism are compatible forms of inference arose in response to van Fraassen's critique of IBE. As we have seen, IBE is often characterised by an inference schema such as IS. Van Fraassen objects to the idea that there can be such a rule which tells us which hypothesis we are justified in believing. He argues that IBE only selects the best 'from among the historically given hypotheses' (Van Fraassen (1989), pp. 142-3). But if we are to be justified in believing the hypothesis that provides the best explanation, he says, we need more than the conviction that it is better than the rivals we have in hand. We need to have some reason to think that the true hypothesis is likely to be among those rivals which we have in hand, and that we are not simply selecting the best of a bad lot.

After thus dismissing the full version of IBE, Van Fraassen considers what he calls a more modest or 'retrenched' version which says not that the best explanation should be believed, or is likely to be true, but rather only that hypotheses should be assigned higher probabilities when they provide better explanations. The idea is that

> Despite its name, [IBE] is not the rule to infer the truth of the best available explanation. That is only a code for the real rule, which is to allocate our personal probabilities with due respect to explanation. (Van Fraassen (1989), p. 146)[6]

Van Fraassen then argues that the retrenched version of IBE is incompatible with Bayesian conditionalisation, and thus falls prey to dynamic Dutch book arguments which justify conditionalisation (Van Fraassen, 1989).

Discussions of the relationship between IBE and Bayesianism have generally taken the lead from van Fraassen in considering not the full version of IBE, but rather the more modest version. A number of authors have resisted the idea that IBE is incompatible with Bayesian conditionalisation, and there have been two main ways of doing this. On the one hand, some have argued that the explanatory considerations involved in IBE constrain the choice of Bayesian priors and/or likelihoods. Lipton has presented a descriptive version of this view, where the explanatory considerations are heuristics that allow people to approximate Bayesian inference (Lipton, 1991). Weisberg, Huemer and Poston have argued for a normative version of this view, where explanatory considerations are argued to serve as normative constraints on the Bayesian probabilities (Weisberg, 2009; Huemer, 2009; Poston, 2014). On either version, it is possible, without any departure from Bayesian conditionalisation to accommodate IBE. One problem with these 'constraint-based' approaches is that they do not help at all with the problem of providing a justification for the role of IBE in the context of justification. They allow that IBE can be married with Bayesianism, but in the same sense in which any purported inference rule can be made compatible with Bayesianism by allowing it to constrain priors and likelihoods in a certain way. The question of whether IBE has any normative force still needs to be tackled independently.

Another approach is what has been called 'emergent compatibilism' (Henderson, 2014, 2017).[7] On this view, it is not necessary to see explanatory considerations as heuristics or extra constraints on priors or likelihoods. Explanatory considerations can be shown to be reflected in the Bayesian likelihoods, given constraints on the priors that a Bayesian might independently adopt. Simplicity, for example, is a factor playing an important role in Bayesian model comparison, where for natural choices of priors, there is a penalty for complexity in the likelihood (MacKay, 2003). Henderson (2014) argues that the kind of simplicity and unification considerations that Bayesians take account of in this way are exactly those which are involved in IBE. According to this approach, arguably some independent justification for IBE is given. This is of course conditional on a particular way of choosing priors, and the project of providing an *a priori* justification for these choices based on objectivist Bayesian principles is often regarded as flawed. Nonetheless, this account does provide some explanation, if not justification, for why, from a Bayesian perspective, explanatory considerations would tend to be favoured given standard practices. It thus seems to provide a relatively satisfactory solution to the problem of the relationship between the modest version of IBE and Bayesianism, and shows that they are compatible with one another.

4.2. Objections to compatibilism

However, there have been some objections to both forms of the compatibilist project. These have motivated the call for IBE to be moved out of the context of justification (Cabrera, 2017). Some of the objections are based on a long-standing idea that informational virtues cannot be accommodated in a probabilistic framework. This objection was raised by Popper who argued that a theory with more informational content cannot be more probable, because of the basic point that probabilities must respect entailment relations. Specifically, if T_1 entails T_2, then it must be the case that $p(T_1) \leq p(T_2)$. If a more informative theory is one which is logically stronger, then it can never get a higher probability than a less informative theory (Popper, 1959). The suggestion then is that informativeness needs to be taken into account as an additional consideration to truth. This idea has been an important part of Wesley Salmon's critique of Lipton's version of compatibilism (Salmon, 2001). Cabrera directs an objection in a similar spirit against emergent compatibilism (Cabrera, 2017). In the scientific context, IBE is typically characterised in terms of a constellation of different 'explanatory virtues', which include simplicity, unifying power, coherence, precision, scope, consistency with background belief, etc. (Thagard, 1978; Lipton, 1991; Psillos, 2002b). Cabrera argues that some of these virtues are

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[6]Van Fraassen suggests that this retrenched rule is 'more modest than inference to the truth of the favoured hypothesis' (Van Fraassen (1989), p. 146).

[7]See also Romeijn (2013).

'confirmational', namely simplicity, certain notions of unification, empirical adequacy and explanatory power. These he admits can be handled by the emergent compatibilist approach. However, Cabrera argues, some of the explanatory virtues, in particular precision, mechanism and scope are not confirmational, but 'informational'. These, he thinks, can be regarded as virtues which conduce to giving a theory more explanatory content, but are not connected to whether the theory is true or not. He claims then that these virtues are not taken into account by the emergent compatibilist treatment.

Cabrera argues that virtues like precision, mechanism and scope cannot be explicated in Bayesian terms, and claims that these should be understood as informational rather than confirmational virtues. His argument here relies on Popper's objection. Consider the virtue of precision, for example. Cabrera argues that a more precise hypothesis will entail a less precise one, and hence should get a lower probability. For example, he considers the hypothesis H_1: 'Fields F_1 and F_2 differ in the average height of corn stalks by 0.5 meters', which is more precise than the hypothesis H_2: 'There is some difference in the height of corn stalks in F_1 and F_2' (Cabrera (2017), p. 1255). Similarly, Cabrera claims, a more mechanistic hypothesis which fills in the details of how a particular mechanism works will entail a less mechanistic one. And a hypothesis with greater scope will entail one with lesser scope – as an example, here, he claims that Newton's theory entails the conjunction of Galileo's and Kepler's laws. Cabrera's claim is that because of these kinds of entailment relations, we cannot probabilistically favour theories with greater precision, mechanism, or scope.

4.3. Cabrera's proposal

According to Cabrera's view, the informational virtues determine the 'explanatory content' of a theory, and IBE involves taking into account this explanatory content alongside probabilities of the hypotheses. IBE should be thought of as a 'theory of acceptance', where acceptance is understood as an attitude which is not concerned exclusively with epistemic appraisal of hypotheses. Thus Cabrera says:

> IBE construed as a theory of acceptance says that the extent to which T_1 is an acceptable theory – in the sense of being worthy of commitment ... – depends on the extent to which T_1 is probable and explanatorily contentful. T_1 is acceptable just in case T_1 has a sufficiently high degree of probable truth and explanatory content, and T_1 is more acceptable than some rival T_2 just in case T_1 has a greater combination of probable truth and explanatory content than T_2. (Cabrera (2017), p. 1266)

For Cabrera, explanatory content constitutes a non-epistemic consideration, and because IBE combines epistemic and non-epistemic considerations, it involves an attitude which is not purely epistemic. Cabrera calls this attitude 'acceptance' and contrasts it with belief. He says:

> we ought not to view IBE as a theory of scientific inference at all, but rather as a theory of when a hypothesis H is "acceptable", where, roughly-speaking, this concerns whether H is worthy of commitment as a research programme. (Cabrera (2017), p. 1246)

Cabrera's use of 'acceptance' is different from that of Laudan, who regards it as an epistemic attitude, and contrasts it with pursuit. Acceptance for Cabrera involves commitment, which means confronting any future phenomena by means of the conceptual resources of the theory, using it 'in future inquiry into, deliberations about, and explanations of phenomena' (Cabrera (2017), p. 1264). A theory is accepted in this sense then if it is to be pursued in further inquiry. Cabrera also explicitly makes a connection between his sense of acceptance and pursuit in a footnote (fn. 36), where he says 'My use of "acceptance" most closely matches Laudan's use of "pursuit" and its cognates' (Cabrera (2017), p. 1264). In this, he follows the usage of authors like Cohen and van Fraassen who make no distinction between accepting a theory for immediate use, and longer-term commitment to the theory as a research programme, which is closer to pursuit.[8] Thus Cabrera's recommendation can be read as a recommendation that IBE should become a theory of pursuitworthiness. If IBE is relocated back to the context of pursuit, then it can happily co-exist with Bayesianism which occupies the context of justification. The two need not be seen as in any tension, since they belong to different contexts.

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[8]For example, Jonathan Cohen takes it that 'To accept that p' is

'to have or adopt a policy of deeming, positing, or postulating that p– that is, of going along with that proposition (either for the long term or for immediate purposes only) as a premiss in some or all contexts for one's own and others' proofs, argumentations, inferences, deliberations, etc., whether or not one assents and whether or not one feels it to be true that p' (Cohen (1989), p. 368).

Similarly, van Fraassen says

if a scientist accepts a theory, he thereby involves himself in a certain sort of research programme (Van Fraassen (1980), p. 12)

and also

4.4. Response to the incompatibility argument

Cabrera's proposal is based on the claim that there are certain explanatory virtues (mechanism, precision and scope) which should be regarded as 'informational', rather than 'confirmational' virtues. If true, this gives IBE a non-epistemic component. Cabrera bases this claim primarily on Popper's argument that theories with more informational content cannot be more probable than those with less. In fact, I do not think that the specific arguments Cabrera presents succeed in establishing this, since alternative ways to deal with Popper's objection have been suggested by Romeijn and van de Schoot (2008); Henderson, Goodman, Tenenbaum and Woodward (2010); Autzen (2019) and Henderson (2022). These alternative solutions allow for the possibility that the virtues in question can be given a Bayesian explication. I will not pursue this specific point here, because I want to make the broader point that even if there are some explanatory virtues which resist a Bayesian treatment, this does not mean that IBE should be understood in non-epistemic terms. Rather, these explanatory virtues could still be epistemic considerations, even if they cannot be captured in probabilistic terms.

Recall first that the debate over compatibilism between IBE and Bayesianism concerns not a full version of IBE, but a modest version that says only that one hypothesis should be taken as more probable than another on the basis of explanatory considerations. This places the discussion in the realm of a constrained problem set-up in which both the hypothesis space and the evidence are taken as given. This problem set-up is characteristic of the original narrow conception of the context of justification, which was defined as part of a project of delimiting the role of epistemic evaluation. This conception does not concern itself either with discovery or formulation of hypotheses to put in the hypothesis space, or with the process of evidence collection. As we saw in section 2, comparison of hypotheses using Bayesian probabilities is an important contender for characterising confirmation or empirical support in this constrained sense of the 'context of justification'.

However, as we have seen, the delimitative motivation for making distinctions between contexts later gave way to drawing the distinction more as a way of distinguishing between different types of normative evaluation in science. From that point of view, the task of epistemic appraisal is considerably broader than just looking at the relations between hypotheses and evidence given a particular hypothesis space. The task of determining what theories we may accept will involve also appraising the status of that hypothesis space itself, and also the status of the evidence collection process to date. Van Fraassen has made this point in his 'bad lot' criticisms of the original, full version of IBE. He argues that justifying the claim that the hypothesis providing the best explanation is true or likely true would require more than the claim that it is more likely than its competitors in the light of the given evidence (Van Fraassen, 1989). It also requires that one provide some justification that the hypothesis space under consideration is likely to contain the true hypothesis. Van Fraassen apparently thinks such justification cannot be given, but I think that this is not obvious, and the question of how to give such a justification deserves more scrutiny. A number of considerations seem important, such as how secure the framework in which the hypothesis is developed is, and how likely basic theoretical assumptions are to be replaced. This in turn requires evaluation of whether evidence still remains to be collected which could potentially overturn the theory, or whether the theory has already been extensively tested and all potentially relevant evidence has already been considered. Thus, the kind of conclusion drawn in the original IBE involves not just getting a high probability among those hypotheses in the hypothesis space, given the available evidence, but also an assessment of the status of that hypothesis space and that evidence themselves. The full version of IBE thus involves more considerations than the modest version, but these additional considerations can still be epistemic in nature, even if they are not spelled out in terms of probabilities.

If it does turn out then that some explanatory virtues are not susceptible to a Bayesian explication, the conclusion should not necessarily be that IBE involves non-epistemic considerations or considerations that are to do with pursuitworthiness. It is true that some of these further considerations may involve what might be called 'diachronic' aspects of theory development: namely what the status of the hypothesis space and evidence are and how we expect these to develop with future investigation. This kind of assessment of the state of development of theories and evidence and their promise for the future might sound similar to what is involved in assessing pursuitworthiness. However, there are still differences in the type of diachronic considerations which go into decisions about which hypotheses to pursue as opposed to which to accept (in the epistemic sense of 'accept'). Decisions regarding pursuit involves consideration

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acceptance involves a commitment to confront any future phenomena by means of the conceptual resources of this theory. It determines the terms in which we shall seek explanations. If the acceptance is at all strong, it is exhibited in the person's assumption of the role of explainer, in his willingness to answer questions *ex cathedra* (Van Fraassen (1980), p. 12).

In both these definitions, acceptance is associated with commitment to the theory both for immediate and longer-term use. Cabrera also draws no distinction between immediate and long-term purposes, saying that acceptance concerns 'which theories are worth committing to for the purposes of deliberation, explanation, and future inquiry into phenomena' (Cabrera (2017), p. 1266).

of where potential for development still lies, whereas decisions regarding epistemic acceptance involve more an assessment of whether a certain hypothesis which appears to be a top candidate in terms of support by the current evidence is likely to be secure if inquiry would proceed. For example, in a legal trial, lawyers may make decisions throughout the process about where it will be profitable to gather further evidence and which lines of investigation to still pursue. This involves assessment of the potential of different hypotheses in future investigation. However, this is different from the epistemic appraisal involved in coming to the final verdict. For that decision, jurors need to convince themselves that the case for a particular verdict is watertight – that future investigation (perhaps motivated by appeals) would not overturn the verdict. Although both decisions involve some diachronic assessment, they are still not the same type of evaluation.

Overall, then, even if some of the virtues involved in IBE were indeed irreconcileable with Bayesian evaluations of posterior probabilities, this does not necessarily mean that they are non-epistemic considerations. Rather they could be further considerations which are needed for the absolute evaluation of hypotheses. In fact, this seems most plausible not for virtues like precision, or mechanism, but rather for the virtue of 'fertility' or 'fruitfulness', which is sometimes, though not always, included in lists of explanatory virtues characterising IBE.[9] Assessing the fertility or fruitfulness of a theory will involve looking at its past history in order to assess its potential to develop over time, and looking at the status of the hypothesis space and the completeness of evidence collection will clearly constitute important parts of this assessment. Thus, this makes it at least promising that a version of IBE which gives a role to the virtue of fertility might be capable of providing a high-level account of epistemic appraisal in the broad sense.

It is worth noting that also from a Bayesian point of view, the evaluation of relative support or probability between hypotheses does not give the full story about epistemic appraisal. Bayesians have treated the general problem of which hypothesis to accept (or believe) by introducing some kind of detachment rule. A simple-minded version of this would be a probabilistic threshold where if the posterior probability of the hypothesis is the highest of those considered, and it falls above the threshold, then we should accept the hypothesis. More generally, this can be treated as a decision problem, where acceptance or non-acceptance of a hypothesis constitute different actions, with certain specified utilities. Then the Bayesian will typically employ the principle of maximising expected utility to determine which action should be taken. This may indeed provide the foundation for accepting the hypothesis when the probability falls above a certain threshold. In decision theory generally, utilities may incorporate various non-epistemic, practical considerations, but purely epistemic evaluation can still be accommodated, if one considers only epistemic utilities.[10] A decision about acceptance can be regarded as a special kind of decision which calls only for epistemic values to be considered (Rescher, 1976). As we have seen in section 3.1, a theory of pursuitworthiness might also be couched in decision-theoretic terms, but the types of values involved need not be the same as those involved in epistemic appraisals.

5. Conclusion

In this paper, we have found no reason to relocate IBE to the context of pursuit. Explanatory inference in the form of abduction plays a significant role in the context of pursuit. The ability of a theory to explain some phenomena is an important indicator that the theory has potential, and that it is worthwhile to pursue it further in the hope that a way may be found to account also for other phenomena using the theory. In typical formulations, IBE is an inference form similar to abduction, but it also incorporates comparison of theories for the quality of explanations that they provide. This modification makes it more fitted for a role in the context of justification. But I have suggested, it makes it less suitable for the context of pursuit, because it becomes overly restrictive and excludes many theories which would be worthy of pursuit.

The alleged incompatibility of some explanatory virtues in IBE with a Bayesian evaluation of probabilities also provides no reason to think that IBE cannot operate in the context of justification. We have seen that early uses of the context distinction delimited the context of justification to the constrained problem of comparing given hypotheses in relation to given evidence. But once the context distinction is seen as defining different kinds of normative questions, the context of justification should be regarded as concerning normative questions about epistemic appraisal in general. Epistemic appraisal in this broader sense involves assessing more than simply how well the theory does compared to other theories in a given hypothesis space. It also involves evaluation of the overall state of inquiry – whether the hypotheses so far formulated are promising enough that they are likely to be true, whether unconceived alternatives might still be lurking, whether the evidence so far collected is sufficient to underwrite thinking that the theory is

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[9]Some recent work has been done on this virtue by (Ivani, 2019).

[10]See Levi (1983) and Pettigrew (2009) for different ways of restricting utilities to concern purely epistemic considerations.

true. IBE appears to hold some promise as a way to characterise this broader notion of epistemic appraisal, since it incorporates considerations of fruitfulness as well as explanatory virtues which are more easily explicated in probabilistic terms. In my view, there is still work to be done to connect a detailed discussion of explanatory virtues to a broader conception of epistemic appraisal, but the view that IBE provides a normative theory in the context of justification is itself still worthy of pursuit.

6. Acknowledgments

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