

Inference to the Best Explanation

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Abstract

Inference to the best explanation (IBE)—sometimes called ‘abduction’—is a way of reasoning that we rely on all the time, both in everyday life and in scientific practice. Even though it is remarkably common, IBE is often discussed in loose or imprecise terms. That lack of clarity leaves room for several well-known objections that, in many cases, can be avoided once we spell out more carefully what IBE actually involves. At its core, IBE tells us to accept the explanation that does the best job of making sense of the evidence, but only if that explanation is genuinely good enough to deserve our confidence. Once this condition is made explicit, some influential criticisms lose much of their force. Other objections, however, may remain serious challenges for anyone who thinks IBE is a legitimate way to reason. Supporters of IBE have developed a variety of responses to these concerns, and the debate continues. This chapter clarifies what IBE is, surveys the major objections raised against it, and highlights the most promising strategies for answering those objections.

Keywords: Abduction; Bayesianism; Explanation; Induction; Inference to the Best Explanation; Prediction; Theoretical Virtues

Key Points

- Inference to the Best Explanation (IBE) is a widespread method of inference.
- IBE needs to be carefully formulated to avoid errors.
- There are many objections to IBE as an inference method, but there are plausible responses to them all.
- IBE relates to several important aspects of Bayesian updating.

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1 Introduction

In some ways inference to the best explanation (IBE) may seem obviously correct. After all, if one is to infer the truth of an explanation, it is hard to see how one could do better than inferring the truth of the best explanation. Nevertheless, as one examines this ubiquitous form of reasoning more closely it becomes clear that care must be taken to formulate it correctly. Furthermore, even when IBE is formulated appropriately it faces several seemingly powerful objections. Given its widespread use in both science and ordinary life, it is beneficial to study IBE closely and explore the prospects for defending it from criticism.

2 What is Inference to the Best Explanation?

The process of seeking explanations and employing explanatory reasoning is widespread. It is so widespread in fact that many argue that engaging in inference to the best explanation (IBE) is ubiquitous in our reasoning from a young age.¹ It is also widely employed in the practice of science.² Perhaps the most famous example of IBE in science is Charles Darwin's argument for natural selection. Darwin here argues for the theory of natural selection and defends the explanatory method. He offers this concise summary in *The Origin of Species*:

It can hardly be supposed that a false theory would explain, in so satisfactory a manner as does the theory of natural selection, the several large classes of facts above specified. It has recently been objected that this is an unsafe method of arguing; but it is a method used in judging of the common events of life, and has often been used by the greatest natural philosophers. (Darwin, 1962, p. 476)

However, another great scientific achievement may even better illustrate the general nature of IBE.

The discovery of the planet Neptune was a triumph of IBE.³ By the mid-1800s it was known that Uranus's orbit around the sun differed from what Newton's theory of gravity predicted. Given the tremendous amount of evidential support for Newton's theory, two astronomers, John Couch Adams and Urbain Le Verrier, independently hit upon the best explanation of the data. They postulated a hitherto unobserved planet as the cause of

¹See the following for a sampling of the empirical evidence on offer that people use IBE in their ordinary lives: [Brewer et al. \(2000\)](#), [Douven and Mirabile \(2018\)](#), [Keil and Wilson \(2000\)](#), [Lombrozo \(2006, 2016\)](#), and [Wilson and Keil \(2000\)](#). See [Liquin and Lombrozo \(2020\)](#) and [Walker et al. \(2017\)](#) for empirical evidence that even young children are quite adept at employing such reasoning. The ubiquity of IBE leads some, e.g. [Enoch and Schechter \(2008\)](#), [Lycan \(1988, 2019\)](#), and [McCain and Poston \(forthcoming\)](#), to argue that it is a basic belief-forming method for humans.

²[Trout \(2016\)](#) goes so far as to insist that all of modern science is built upon IBE.

³Our discussion of this historical episode and the mistaken postulation of the planet Vulcan greatly benefited from the presentations in [Douven \(2022\)](#) and [Douven \(2025\)](#). Both of these works are great resources for information about additional episodes from the history of science where IBE was prominently on display. Also, valuable in this respect is [Aizawa \(2025\)](#), which has helpful discussions of IBE's use in important discoveries in neuroscience.

Uranus’s otherwise irregular orbit. The existence of such a planet not only accounted for the observations of Uranus but did so in a way that fit with the truth of Newton’s theory. There was no other explanation that explained all the data nearly as well. Hence, they inferred the existence of Neptune, which was subsequently observed not long after.

The discovery of Neptune is an almost ideal representation of IBE. There is a lot of data. A particular hypothesis best explains this data. Scientists infer the truth of the hypothesis in question because it is the best explanation and then later observations further confirm the hypothesis. Consequently, we see that IBE when done well leads us to new discoveries. Importantly, IBE does not seem to be reducible to another form of inference—it is not simply some combination of deduction and enumerative induction. IBE is a distinct method of inference, and it works well. Thus, many conclude that reasoning via IBE is legitimate in the sense that when done right it can produce rational beliefs and even knowledge.

No one could deny the legitimacy of IBE if every instance of IBE properly employed worked out as things did with the discovery of Neptune. But, IBE, like all of science and all scientific reasoning, is fallible. A case that is very similar to that of the discovery of Neptune reveals that IBE is not unerring. Not long after the discovery of Neptune Le Verrier tried his hand at planet discovery again. He posited the existence of a small hitherto unknown planet, Vulcan, in order to explain why Mercury’s orbit deviated from what Newton’s theory predicts. This time, however, the stars did not align in favor of Le Verrier’s IBE. After repeated attempts to find Vulcan, it could not be located. Although positing Vulcan was the best explanation of the data (namely, the large amount of evidence in support of Newton’s theory and the oddity of Mercury’s orbit), it turned out to be a false hypothesis. IBE led to the wrong conclusion.

Now, lest one be inclined to dismiss IBE too quickly, two things are worth noting. First, the Vulcan incident shows at most that IBE is fallible, i.e. IBE will not always lead one to a true conclusion even if IBE is carefully performed. It does not show that IBE is illegitimate or unreliable in general. Second, we now know why Mercury has the orbit that it does. Einstein’s theory of general relativity explains the precession of Mercury’s orbit without the need to posit Vulcan. General relativity is a better explanation than Newtonian mechanics + Vulcan. As a result, it may be that the entire Vulcan affair supports IBE in the end. After all, part of why general relativity was accepted was because of its ability to better explain Mercury’s orbit.

The reader should not assume that IBE is an inference method only used by professional scientists. Rather it is a method used by everyone. Pressing questions arise daily. Where are the car keys? Why does the garage door fail to shut? Why is it raining when the forecast called for clear skies? In each case it is common to consider candidate explanations and believe the one that provides the best explanation.

3 Understanding Inference to the Best Explanation

Before diving into the debates surrounding IBE, it will be helpful to get clearer on how it should be understood. Here is a common formalization:

1. $F_1, F_2, \dots, F_n$ are facts in need of explanation.

2. Hypothesis H explains the F_i .
3. No available competing hypotheses would explain the F_i as well as H does.
4. Therefore, H is true. (Lycan, 2002, p. 413)

Of course, there are a number of details in this formalization that are in want of further explication. Let us briefly look at each of the lines of this formalization.

3.1 $F_1, F_2, \dots, F_n$ are facts in need of explanation

In this context, the data that has been collected are the facts that need explaining. In the example concerning the discovery of Neptune some of the facts in need of explanation were the observations made about Uranus’s orbit.

Although in some contexts much ado has been made about whether or not facts are in need of explanation or are striking, this is a red herring for discussions of IBE.⁴ Whether or not particular facts strike individuals or groups of people as being surprising or striking and so standing in special need of explaining, is irrelevant. All that is required for IBE is that we are in possession of some set of facts and evaluate hypotheses that may explain those facts. This is an objective relation, independent of how it is represented in an individual’s psychological makeup.

3.2 Hypothesis H explains the F_i

There are two importantly different ways one might read the word “explains” in (2). The term might be understood in a factive sense so that only a true hypothesis can explain. On this reading hypothesis H ’s explaining the F_i is a matter of H providing the actual (correct) account of why or how the F_i obtain. This is not how “explains” should be understood in this context though. If this were what is meant, then the conclusion of any IBE would have to be true. Once it is acknowledged that H explains the F_i in this factive sense, it logically follows that H is true. So, instead of this factive reading of “explains”, the relevant sense here is that of a ‘potential’ explanation. H explains the F_i in this sense by it being the case that H , if true, would account for why or how the F_i obtain. IBE, in broad strokes, licenses inferring that the best potential explanation of the facts is the actual explanation of those facts.

Another key point of this line is the idea of explaining itself. There is a vast literature on the nature of explanation.⁵ Some argue that the vast differences in accounts of explanation pose a problem for the viability of IBE.⁶ The worry is that it seems that some accounts of the nature of explanation fit better with IBE than others. As a result, it may appear that IBE faces a significant problem: IBE is legitimate only if one first settles the debate about the correct account of explanation.

⁴See Baras (2022) for discussion and criticism of facts being striking in an important sense.

⁵See Salmon (1989) for an overview of the most prominent accounts from the 20th Century. See Woodward and Ross (2021) for a more up to date discussion, and see Ross and Woodward (2023) for further elaboration and discussion.

⁶See Cabrera (2020) and Prasetya (2023, 2024) for discussion of this purported problem.

There are several reasons to doubt that this is a genuine problem for IBE. First, it is not an objection to the legitimacy of a form of inference that it works for some more specific instances and not for others. Consider deductive inference. It is not an objection to deduction that affirming the consequent is invalid while modus ponens is valid. At most this simply calls for attention to which forms of deductive inference are valid. With respect to IBE, suppose it turns out that only IBE to the best causal explanation is legitimate. That does not undermine IBE as a form of inference. It just means that one must attend to whether or not a particular IBE is comparing causal explanations.

Second, some scholars (e.g., [Cabrera, 2020](#); [Douven, 2022](#)) contend that this problem can be dismissed by recognizing that IBE is not in fact committed to any particular account or model of explanation at all. Instead, according to this response, IBE should not be understood in terms of the best explanation of some facts being true, but rather in terms of the hypothesis that exemplifies the best mixture of theoretical/explanatory virtues being true. For instance, it may be that one can tell whether a given hypothesis is simpler than another without adopting a particular theory of the nature of explanation. Of course, this way of addressing the concern also requires that theoretical/explanatory virtues are themselves not tied to any particular account of explanation.^{7,8}

Third, one might avoid this problem without having to commit to a particular account of explanation by opting for a broad notion of explanation that encompasses the other major accounts of explanation. One suggestion for this is to insist that when it comes to IBE an explanation is a specific sort of answer to a “why” or “how” question. Namely, an explanation is an answer to these sorts of questions that provides information concerning how relevant facts depend upon other facts. As [Kim \(1994, p. 68\)](#) puts the general point, “explanations track dependence relations.”⁹

In sum, the fact that there are many rival accounts of explanation does not undermine IBE. Furthermore, one can grasp and evaluate the nature of IBE without committing to a specific account of the nature of explanation. This can be done by either opting for a very general notion of explanation as information about dependence relations, or by insisting that IBE should be simply focused on the theoretical/explanatory virtues of hypotheses and drop discussion of explanation altogether. For simplicity, and to stick with the majority of the literature, we can assume something along the lines of the first response and continue to discuss explanations throughout our examination of IBE.

⁷In addition to [Cabrera \(2020\)](#) and [Douven \(2022\)](#), see [Schupbach and Sprenger \(2011\)](#) for reasons to think that at least the virtue of explanatory power (the range and amount of data that a hypothesis can explain) can be given an analysis without the need for adopting any particular account of explanation.

⁸This dissolution of the problem at hand fits nicely with [Poston \(2014, pp. 74–75\)](#) insistence that explanation is primitive: “there is no analysis of explanation having this form: a group of statements ϕ explain another statement ψ if and only if X , where X is some set of non-trivial conditions.” After all, if explanation is primitive, then there is no informative account of what makes for an explanation. In which case it makes sense that IBE would not be committed to any particular account of explanation.

⁹See also [Ruben \(1990\)](#), [Strevens \(2008\)](#), and [Ylikoski \(2013\)](#) for this sort of approach to explanation. See [McCain \(2015, 2022\)](#) for discussion of how this sort of account of explanation encompasses the other major accounts of explanation and fits well within the framework of IBE.

3.3 No available competing hypotheses would explain the F_i as well as H does

Again, keeping in mind that IBE should be understood in terms of potential explanations, (3) tells us that one potential explanation is such that no available competing hypothesis would (if true) explain the F_i as well as it does. Hence, it is the best potential explanation. In essence the idea is that when making an IBE we consider the available hypotheses and the quality of the explanations each would provide of the F_i if they were true. If H_1 and H_2 are otherwise equal, but H_1 , if true, would explain more F_i than H_2 does, H_1 is the better explanation. Or, if H_1 and H_2 explain the same F_i and are otherwise equal, but one hypothesis is simpler than the other, then the simpler hypothesis is better.

A host of features have been identified as explanatory virtues, including: explanatory power (the range of phenomena explained and/or how well the hypothesis accounts for the relevant data), various kinds of simplicity (e.g., requiring fewer mechanisms or fewer kinds of entities), coherence with background information, and non-ad hocness, among many others.¹⁰ When determining how well various hypotheses explain the F_i we look to the explanatory virtues the hypotheses possess and determine which has the best complement of them.

In some (mostly contrived) cases, this may be easy to discern. The rival hypotheses may be equal along all dimensions except for one, simplicity say, in which case the simplest hypothesis is best. In realistic cases things are more complex. It may be that H_1 is simpler than H_2 , but H_2 has greater explanatory power than H_1 . In such cases it may be difficult to determine which hypothesis provides the best explanation of the F_i . Of course, this is not a problem with IBE itself, but rather a difficulty that we face in applying IBE. Science, like life itself, can be hard. It can be hard to figure out which is the best explanation. Nevertheless, the key point here is straightforward. (3) is a matter of H being a more virtuous explanation of the F_i than its available rivals.

3.4 H is true

The most common formulation of IBE concludes that H is true. However, it should be noted that it is also quite common to take the conclusion of IBE to be merely that H is likely true. In other words, one might reason via IBE to the conclusion that H is simply more probable than not. Or one might construe IBE as something even weaker because H 's being the best explanation may be understood as simply a factor that increases the probability (understood as rational credence) of H . Depending on the strength of the conclusion of an IBE there will be important differences in the formulation of the inference method. Nonetheless, the heart of the matter remains the same. Acceptance of IBE as a legitimate inference method carries with it at a minimum a commitment to thinking that the explanatory quality of a hypothesis is relevant to the probability of its truth.

¹⁰See [Beebe \(2009\)](#) for a helpful list of many explanatory virtues. Also, see [Schindler \(2022\)](#) for the results of an empirical study aimed at discovering the value that natural scientists, social scientists, and philosophers place on various explanatory virtues.

4 Two Objections that Suggest IBE Needs to be Refined

Although several important challenges have been put toward IBE, two of the more prominent ones need to be discussed here. It is not because these objections are the most forceful, or that they are the most widely discussed (though at least one of them is very well known). Rather, these two objections are discussed here because many supporters of IBE take the lesson of these objections to be that IBE as it is commonly formulated needs refining.

The more famous of these objections is Bas van Fraassen's (1989, p. 143) 'Best of a Bad Lot':

To believe is at least to consider more likely to be true, than not. So to believe the best explanation requires more than an evaluation of the given hypothesis. It requires a step beyond the comparative judgment that this hypothesis is better than its actual rivals... For me to take it that the best of set X will be more likely to be true than not, requires a prior belief that the truth is already more likely to be found in X , than not.

The challenge that van Fraassen raises here is that it could be that H satisfies the conditions laid out in the common formulation of IBE while being unlikely to be true. More specifically, van Fraassen points out that it could be that H explains the relevant F_i and that no rival hypothesis explains the F_i as well as H , but this is only because all the hypotheses evaluated (including H) are bad ones. Hence, it may be that H is the best available explanation of the F_i even though H is more likely than not to be false.

In order to better appreciate this problem, consider the following sort of example: a detective is trying to solve a crime but with few substantive leads. So far there are three suspects, and although the guilt of one of them, the butler say, better explains the relevant evidence than that either of the others are guilty, it is very unlikely that the Butler committed the crime. Put in terms of probability, it could be that the probability that the Butler is guilty is .4 whereas each of the other hypotheses have a probability of .1. So, while the hypothesis that the Butler is guilty better accounts for the evidence than any of the available rivals, it would be a mistake to infer that the Butler committed the crime. After all, more likely than not the Butler is innocent. This is what van Fraassen is worried about when it comes to IBE in general. Merely knowing the comparative truth that H is a better explanation than its rivals does not warrant us in making a non-comparative judgment as to the probability that H is true. Van Fraassen plausibly maintains that we need reason to think that the true hypothesis is, or is likely to be, part of the set of hypotheses that we are considering in order for IBE to legitimately license inferring the truth of the best explanation. It seems that IBE, at least as commonly formulated, faces a significant challenge here.¹¹

The second challenge is similar to the Best of a Bad Lot, though the two are different in important ways. This objection, which McCain and Poston (2019) dub the "Disjunction Objection", also relies upon the fact that it seems that merely being the best explanation

¹¹This assessment is not universally endorsed, of course. For instance, Schupbach (2014) argues that the Best of a Bad Lot objection is not a challenge for IBE at all.

is insufficient for warranting an inference to H 's truth.¹² Nevertheless, the Disjunction Objection poses a distinct challenge for IBE as, unlike the Best of a Bad Lot, it can arise even in situations where it is granted that it is known that the true hypothesis is among those considered. The easiest way to get a handle on this objection is to think about a contrived example where there are only a few possible hypotheses. For instance, assume that there are exactly four possible hypotheses that can account for the relevant F_i : H_1 , H_2 , H_3 , H_4 . It is possible that H_4 , say, explains the F_i better than any of the other three hypotheses. And yet, it may be that even in this case H_4 is more likely to be false than true. For example, it could be that the probability of H_4 is .4 and the probability of H_1 , H_2 , and H_3 is .2 each. In such a case H_4 is twice as likely as any of its rivals.¹³ Nevertheless, H_4 is still itself more likely than not to be false—it is only .4 probable. That is to say, the disjunction of H_4 's rivals, $\langle H_1 \vee H_2 \vee H_3 \rangle$ is more probable than H_4 . As commonly formulated, IBE commits us to inferring that H_4 is true. However, it seems clear that in this case it would be irrational to think that H_4 is true (or even likely to be true). Consequently, it again seems that IBE, as commonly formulated, faces a significant challenge.

According to many supporters of IBE, the lesson to be drawn from these objections is not that IBE is problematic. Instead, the lesson is that the common formulation of IBE requires refining. The needed refinement is to restrict IBE to instances where H is not only the best available explanation of the F_i , but also a sufficiently good explanation of the F_i in its own right.¹⁴ There are various ways that one might attempt to spell out exactly what it takes for an explanation to be sufficiently good. One promising approach is offered by [McCain and Poston \(2019\)](#): H is a sufficiently good explanation of the F_i when H 's overall probability is above a certain threshold. As McCain and Poston put the point, H is sufficiently good to warrant inference only when 'Swamping' (the disjunction of H 's rivals being more probable on the relevant evidence than H is) is not in effect. Another promising approach is [Dellsén's \(2021\)](#) appeal to 'explanatory consolidation'. Essentially, explanatory consolidation is the idea that H is sufficiently good when the evidence possessed suggests that H is a better explanation than any other hypothesis that could be formulated.

Regardless of how exactly one precisifies 'sufficiently good' it appears to be a needed refinement to IBE. Thus, IBE is better understood in this way:

1. (The decoherence premise) $F_1, \dots, F_n$ are facts in need of explanation.
2. (The plausibility premise) Hypothesis H is a sufficiently good explanation of the F_i .
3. (The superiority premise) No available competing hypotheses would explain the F_i as well as H does.
4. Therefore, H is true.

This labeling of the three premises of IBE helps to make the general structure of such inferences clear. When we pair the decoherence premise with the plausibility premise and

¹²See [Fumerton \(1995\)](#) and [van Fraassen \(1989\)](#) for early presentations of this objection.

¹³It is assumed here that higher probability directly correlates with being a better explanation.

¹⁴See [Musgrave \(1988\)](#), [Lipton \(2004\)](#), and [McCain and Poston \(2019\)](#) for more on the importance of this restriction.

the superiority premise, the result is a restoration of coherence. Hence, one way to think of IBE is as a means of reaching, or returning to, an overall coherent epistemic state—it is a way of making sense of the world around us.

Another thing that should be noted before turning to other objections to IBE is how the revised formulation of IBE resolves both the Best of a Bad Lot and the Disjunction Objection. First, the Best of a Bad Lot. If it is required that H be a sufficiently good explanation, then it is clear that IBE does not apply in cases of bad lots. After all, it is guaranteed that at least one of the lot, namely H , is not a bad hypothesis. Second, the Disjunction Objection. If H must be sufficiently good in order for inferring its truth to be warranted, then it is plausible that H must be more probable than the disjunction of its rivals. This is obviously so on McCain and Poston’s understanding of sufficiently good as that is just what it means for a hypothesis to be sufficiently good. It is also plausible that other takes on this restriction, such as Dellsén’s, will have this result as well. If a particular way of understanding does not lead to a formulation of IBE that avoids the Disjunction Objection, that is a reason for supporters of IBE to reject that formulation and instead opt for another take on sufficiently good.

5 Other Prominent Objections

As we have seen, IBE withstands two seemingly powerful objections via refinement of how it is formulated. There are, however, several other objections that remain even after IBE is suitably refined. It is to these that we now turn.

5.1 Unconceived Alternatives

As with many of the objections to IBE, the problem of unconceived alternatives finds its most prominent expression in the work of van Fraassen. Here is how he puts it:

I believe, and so do you, that there are many theories, perhaps never yet formulated but in accordance with all evidence so far, which explain at least as well as the best we have now. Since these theories can disagree in so many ways about statements that go beyond our evidence to date, it is clear that most of them by far must be false. I know nothing about our best explanation, relevant to its truth-value, except that it belongs to this class. So I must treat it as a random member of this class, most of which is false. Hence it must seem very improbable to me that it is true. (van Fraassen, 1989, p. 146)

At the heart of this challenge is the idea that H ’s being the best explanation of the F_i does not warrant inferring H ’s truth because there are so many false hypotheses that can account for the F_i . Of central importance to this objection is van Fraassen’s contention that not only are there many false hypotheses that offer potential explanations of the F_i , but also that many of these false hypotheses offer explanations of the F_i that are just as good as the explanation provided by H . If this is correct, then IBE is in dire straits because any time we identify the best explanation we have reason to think that it is simply one among many equally good hypotheses the vast majority of which are false.

Hence, even when H is determined to be the best available explanation there is no good reason to believe it is true, or even likely to be true.

The thrust of this objection can be understood by considering an analogy. A first-year math student works on a problem and comes to a solution. However, the student has discussed several similar problems in the past with a graduate student and learned that there were complexities he did not consider. Given this track record, the first-year student should be skeptical that his apparent solution is the actual solution.

van Fraassen seems to be thinking of IBE along lines similar to the case of the math student. When an explanation is the best of those conceived, there is good reason to believe that there are many other unconceived explanations that are just as good (maybe even better) than the best that has been found so far. In such a case, there is reason to be skeptical that the current best explanation is the actual explanation.

Given that this objection hinges on van Fraassen’s claim that there are a large number of, as of yet, unthought of rivals to H that explain the F_i as well as H does, it is unsurprising that supporters of IBE have responded by denying this claim. When it comes to the empirical sciences, some insist that our methods of forming hypotheses make it so that H is not merely one among many false hypotheses.¹⁵ The key to this line of response on behalf of IBE’s use in the empirical sciences is the fact that when constructing hypotheses and broader theories in science a tremendous amount of background evidence is brought to bear. The rigor of the process of hypothesis formation and testing along with the background evidence built up over successive experimentation makes it so that when H is the best (sufficiently good) explanation of the F_i , H is likely to be true. When it comes to instances of IBE outside of the sciences, a case can be made that in many instances we have no good reason to think that van Fraassen’s claim is true.¹⁶ Consider the explanatory hypothesis that one’s roommate ate the pizza last night when it is missing in the morning. Is it really the case that there are a large number of unconceived virtuous explanations of the missing pizza? It does not seem so. Hence, this objection does not seem fatal to IBE.

5.2 The Informativeness Objection

Yet another objection to IBE from the work of van Fraassen is what might be called the “Informativeness Objection”. This objection arises from van Fraassen’s distinction between two kinds of theoretical virtues. ‘Confirmational virtues’ are “features that give us more reason to believe this theory to be true” (van Fraassen, 1983, p. 166). These are distinct from ‘informational virtues’, which are features of a theory that tells us about the world.

Here is how McCain and Poston (2024, p. 436) formulate van Fraassen’s argument:¹⁷

(V1) If theory T' provides information that T does not provide, and not conversely, then T' is no more likely to be true than T .

¹⁵See Lipton (2004) and Psillos (1996, 1999). For further discussion of this issue as it pertains to the debate concerning scientific realism see Devitt (2011) and Stanford (2006).

¹⁶See McCain (2025) for discussion.

¹⁷They draw the argument from van Fraassen (1983, pp. 166–167).

(V2) A feature of T cannot provide more epistemic reason to believe that T unless it makes T more likely to be true.

So,

(V3) Informational virtues are not confirmational.

When (V3) is coupled with the idea that often providing more information about relevant phenomena will make one hypothesis a better explanation than another, a further consequence of van Fraassen's thought emerges:

(V4) The fact that T' is a better explanation than T is no epistemic reason to believe T' over T . (McCain and Poston, 2024, p. 437)

(V4) directly conflicts with IBE. Hence, if van Fraassen's attack on the epistemic value of informational virtues is correct, IBE is seriously flawed.

McCain and Poston insist that the argument at the heart of the informativeness objection fails to pose a genuine threat to IBE. First, they argue that while (V1) is true, strictly speaking, it is limited in scope. In particular, they point out that a new theory T' may provide more information by explaining how other well-supported theories are consistent with the earlier T , and in doing so provide further support for T . While this would not amount to T' being more probable than T , it does undermine (V1)'s ability to be paired with (V2) to entail (V3).

Second, they argue that (V2) is either false, or true but irrelevant to IBE. In support of thinking that (V2) is false they appeal to a distinction between 'weight of evidence' and 'balance of evidence'. Weight of evidence refers to how much evidence there is for H , and the balance of evidence refers to how probable the evidence makes H . For example, if one has observed twenty tosses of a coin and the results have been a roughly equal number of heads and tails it is plausible that one should think it is 50% probable that the next toss will land heads. Similarly, if one has observed two hundred tosses of a coin and the results have been a roughly equal number of heads and tails it is plausible that one should think it is 50% probable that the next toss will land heads. In both cases the balance of evidence is the same (it is 50% probable that heads will be the result of the next toss). However, there is a much greater weight of evidence for this hypothesis in the second scenario. McCain and Poston claim that there can be cases wherein the weight of evidence concerning H increases without the balance of evidence changing. In such cases they insist that there is more epistemic reason to believe H despite the probability of H remaining unchanged, which would mean that (V2) is false.

When it comes to thinking that (V2) is irrelevant to IBE even if true, McCain and Poston point out that it is important to keep in mind the difference between full belief and degrees of belief when evaluating (V2). When thinking in terms of full belief, accepting the truth of H is an all-or-nothing matter, and so it can seem puzzling as to how it can be reasonable to come to accept H since its truth remains uncertain. And adding uncertain beliefs guarantees a decrease in the probability of one's overall set of beliefs. However, when looking at degrees of belief, it becomes clear that the theoretical virtues of H can increase its probability. On this way of looking at things, the set of propositions one

has a credence over (assigns a probability to) does not change, instead one's credences (probability assignment) are adjusted in accord with Bayesian updating in the light of new evidence. If the degree of belief approach is correct, then while (V2) may be true, it fails to impugn IBE.

5.3 Voltaire's Objection

Once again, [van Fraassen \(1980, p. 90\)](#) provides an early expression of another prominent objection to IBE. He says, "some writings on the subject of induction suggest that simpler theories are more likely to be true. But it is surely absurd to think that the world is more likely to be simple than complicated." [Lipton \(2004, p. 144\)](#) provides a more detailed explanation of the objection:

Why should the explanation that would provide the most understanding if it were true be the explanation that is most likely to be true? Why should we live in the loveliest of all possible worlds? Voltaire's objection is that, while loveliness may be as objective as you like, the coincidence of loveliness and likeliness is too good to be true. It would be a miracle if using explanatory considerations as a guide to inference were reliably to take us to the truth.

Voltaire's Objection can be made more precise by putting it in terms of an argument:

- (VO1) IBE can yield justified conclusions only if there is adequate justification for believing that explanatory virtues are truth-conducive.
- (VO2) If there is adequate justification for believing that explanatory virtues are truth-conducive, then that justification is either a priori or a posteriori.
- (VO3) The justification for believing that explanatory virtues are truth-conducive cannot be a priori.
- (VO4) The justification for believing that explanatory virtues are truth-conducive cannot be a posteriori.
- (VO5) Therefore, there cannot be adequate justification for believing that explanatory virtues are truth-conducive.
- (VO6) Therefore, IBE cannot yield justified conclusions.¹⁸

Although Voltaire's Objection provides a formidable challenge to IBE, there are several plausible ways of responding to this challenge. One way of responding is to deny (VO2). When responding to a similar argument to inductive reasoning more generally, some contend that there can be pragmatic justification that is neither a priori nor a posteriori.¹⁹ One might make a similar move in defense of IBE by insisting that there

¹⁸This formulation is drawn from [McCain \(2025\)](#).

¹⁹For example, see [Reichenbach \(1938, 1949\)](#), [Salmon \(1957, 1974\)](#), and [Skyrms \(1975\)](#). It may be that the sort of entitlement response to skepticism that [Wright \(2004, 2014\)](#) defends can be understood as a kind of pragmatic defense as well.

is pragmatic justification for taking explanatory virtues to be truth-conducive, and that this shows that (VO2) sets up a false dilemma. Another route is to deny premise (VO3) by arguing that in fact we have a priori grounds for thinking that explanatory virtues are truth-conducive.²⁰ Finally, one might deny (VO4) by contending that we have empirical grounds for thinking that explanatory virtues are truth-conducive. Here one simply points out that we have a tremendous amount of evidence that IBE gets us to the truth quite often in science and in our ordinary lives. In fact, it works so well that Lycan (2019, p. 118) contends that our allegiance to relying upon explanatory virtues to guide us to the truth is “ground-level and operates every second of the day.” Thus, there are a variety of ways that one might go about defending IBE from Voltaire’s Objection.²¹

5.4 Multiple Plausible Rivals

An objection to IBE that did not originate with van Fraassen, is what Dellsén (2017) calls the “problem of multiple plausible rivals.” Here is his description of the general problem:

Suppose $\{H_1, \dots, H_n\}$ is a set of available competing explanatory hypotheses (assumed to be *ideal* in order to set aside the bad lot problem).²² According to IBE, whether a hypothesis H_i in this set is inferable will depend exclusively on whether H_i is lovelier than other hypotheses in the set (and perhaps also on whether H_i is ‘sufficiently’ lovely).²³ Intuitively, however, the extent to which it is reasonable to infer H_i also depends on whether there are many plausible alternatives to H_i that are lovely enough to be taken seriously as alternative explanations for E (even if they are not nearly as lovely as H_i itself). The general problem here for IBE is that it has no resources for taking into account the possibility that an inference to H_i may be undermined by the availability of multiple plausible rivals to the loveliest hypothesis. (Dellsén, 2017, pp. 23–24)

One might think that McCain and Poston’s response to the Disjunction Objection works equally well here. If it is problematic to infer H_i in Dellsén’s case, it seems to be because Swamping is in play. The explanatory quality (loveliness) of H_i ’s rivals makes it so that they are at least somewhat probable, and the problem arises here because the disjunction of the rivals is more probable than H_i . So, it may seem that IBE, when formulated so that the best is only to be inferred when it is sufficiently likely, is immune to this purported problem.

²⁰Responses of this sort have been offered in defense of induction in general by Carnap (1968), Kyburg (1956, 1965), and Strawson (1952). Lycan (1988) and Psillos (1999) have applied this move to defenses of IBE.

²¹There are many sub-debates related to this particular objection. For instance, Swinburne (1997) and White (2005) argue for the truth-conduciveness of simplicity in particular. However, Sober (2015) and Roche (2018) put forward important challenges to this idea. While Bird (2017), McCain (2018), and McCain and Poston (2014, 2017) argue that explanatory virtues in general are evidence of truth, Rinard (2017) and Roche and Sober (2013, 2014, 2017) argue that such virtues are not reliable guides to truth.

²²“Ideal” here means that the true hypothesis is among the set of those considered.

²³“Lovely” refers to the theoretical virtues possessed by H . The more virtuous H ; the lovelier H is. Hence, the best explanation of some data is the loveliest explanation.

[Dellsén \(2024\)](#), however, insists that this does not solve the problem of multiple plausible rivals. In fact, Dellsén insists that in his initial presentation of this problem he anticipated this sort of response and showed that it fails:

One might think that this problem can be solved with minor modifications to IBE by either requiring that the inferred hypothesis H provide a far better explanation than competing available hypotheses, or by requiring that we set some fairly high *absolute threshold* for H 's explanatory loveliness. However, it is easy to see that no solution of this kind will get to the heart of the problem. Consider a variation of the previous case in which there are only two plausible competing explanations. . . In that case, it would surely be more reasonable to infer [the original loveliest hypothesis] is true than it was in the original case. And yet altering the case in this way keeps fixed both the absolute explanatory loveliness of the loveliest explanation and the relative explanatory loveliness of the loveliest and second-loveliest explanation. Accordingly, the modified versions of IBE we are now considering wrongly predicts that this altered case is on a par with the original case with regard to whether it is reasonable to infer [the loveliest] hypothesis. It should be clear, then, that we need to look elsewhere for a solution to the problem. ([Dellsén, 2017](#), p. 24)

And so, Dellsén contends that solving the Disjunction Objection will not likewise solve the problem of multiple plausible rivals.

[McCain and Poston \(forthcoming\)](#) demur. They insist that Swamping gives rise to both objections, and so blocking it defends IBE from both objections. To see their line of thought, recall Dellsén's setup: H_i is lovelier than the other hypotheses in the set, let's say H_1 , H_2 , and H_3 . Nevertheless, H_i 's rivals "are lovely enough to be taken seriously as alternative explanations for E ..." This makes it so that inferring H_i is unjustified. If it really is the case that H_i should not be inferred in this situation, it seems that it must be because the explanatory quality of its rivals makes it so that H_i is more likely to be false than true, i.e. because $\Pr(H_1 \vee H_2 \vee H_3 \mid E) > \Pr(H_i \mid E)$. But this would mean that Swamping occurs in Dellsén's example.

When it comes to a variation of Dellsén's example wherein there are only two hypotheses, McCain and Poston maintain that there is still no problem for IBE. One way of cashing out this variation of the case is to assume that H_i is the best explanation, H_3 is the second loveliest explanation, and the other two hypotheses have been definitively ruled out. Dellsén concludes that in this case it still is not reasonable to infer H_i . McCain and Poston disagree. They contend that if H_i is the best explanation of the two, and explanatory quality is a guide to truth (which Dellsén grants (see [2017](#), p. 21)), then it follows that $\Pr(H_i \mid E) > \Pr(H_3 \mid E)$. Since these are the only two possible explanations in this variation of Dellsén's example, their probabilities must sum to 1. But, these two facts mean that $\Pr(H_i \mid E) > .5$. This, though, means that Swamping is absent, and it is fine to infer H_i . Consequently, McCain and Poston conclude that multiple plausible rivals are a problem when and only when they result in Swamping. As a result, it seems that when IBE is carefully formulated it is not affected by the problem of multiple plausible rivals.

5.5 Incoherence

Climenhaga (2017) provides another objection to IBE that does not directly come from the work of van Fraassen. Climenhaga's objection centers on the contention that IBE licenses inferences to inconsistent conclusions from the same body of evidence. Climenhaga illustrates this objection with two examples. Here it will be sufficient to grasp the objection to consider just his first example.

Climenhaga's example involves coin flips and drawing balls from urns. In the example at hand, which following McCain and Poston (forthcoming) we can refer to as "Black Ball", it is known that there are four indistinguishable urns holding exactly four balls each. It is known that the following is true of the urns:

Urn 1: 4 white balls

Urn 2: 2 black balls, 2 white balls

Urn 3: 3 black balls, 1 white ball

Urn 4: 4 black balls

Furthermore, it is known that two flips of a fair coin will determine which urn will be selected. If the coin lands heads the first time, then the second coin flip will decide between Urn 1 or Urn 4. If the coin lands tails the first time, then the second coin flip will decide between drawing from Urn 2 or Urn 3. Finally, Climenhaga is clear that in his case he is assuming that, all other things being equal, when E is more probable given H_1 than it is given H_2 , H_1 better explains E than H_2 does.²⁴

After the set-up is given, Climenhaga stipulates that a black ball was drawn. He then questions what best explains the drawing of a black ball. It is here that Climenhaga contends IBE runs into a problem. There are two ways we might approach this question, which lead to conflicting answers.

If we are thinking just in terms of the urns, then it is most probable that the ball was drawn from Urn 4. The prior probability of each urn being selected is the same and Urn 4 has the highest probability of yielding a black ball, so that the ball was drawn from Urn 4 is the most probable hypothesis concerning which urn was drawn from. Since Urn 4 is most probable and all else is equal, the best explanation of why a black ball was drawn is that Urn 4 was selected. Hence, it seems that IBE yields the result that we should infer that the ball was drawn from Urn 4.

If we are thinking about the coin flips, we get a different result though. The prior probability of heads and tails are the same, but $\Pr(\text{black ball} \mid \text{tails on the first flip}) = 5/8$ whereas $\Pr(\text{black ball} \mid \text{heads on the first flip}) = 1/2$. Consequently, that tails came up on the first flip of the coin is a better explanation than that heads came up on the first flip. Hence, according to IBE, we should infer that the coin landed tails on the first flip.

²⁴While the principle that Climenhaga (2017, p. 254) gives to highlight this assumption seems plausible, it is worth noting that on its own it does not license coming to believe a hypothesis. After all, IBE does not just say that H can be inferred when it better explains the evidence than a particular rival; it says that H can be inferred when it is the best, i.e. better explains the relevant evidence than all of its available rivals. This point will not affect the discussion that follows though.

While these might seem to be unproblematic, when we put the two best explanations together we end up with an incoherent result. We know that Urn 4 was selected only if the coin landed heads on the first flip. However, if the coin landed tails on the first flip, then we know that the ball was drawn from either Urn 2 or Urn 3. Thus, Climenhaga contends that reasoning in accordance with IBE leads one to form inconsistent beliefs. The same body of evidence in this case licenses an IBE to the conclusion that the ball was drawn from Urn 4, and it licenses another IBE to the conclusion that the ball was drawn from either Urn 2 or Urn 3.

Three responses to this objection have been put forward. First, [McCain and Poston \(forthcoming\)](#) contend that the examples Climenhaga uses to make this objection are instances of the Disjunction Objection. As a result, they contend that the solution to the Disjunction Objection also resolves Climenhaga’s worry. They insist that the purported problem for IBE arises in Black Ball only if both inferences that lead to the incoherence are genuinely licensed by IBE. However, they maintain that in Black Ball there is Swamping. In particular, McCain and Poston argue that the hypothesis that the ball was drawn from Urn 4 fails to be a sufficiently good explanation of a black ball being drawn. The reason for is that the disjunction of two rival hypotheses is more probable than it is, i.e. $\Pr(\text{Urn 2} \vee \text{Urn 3} \mid \text{Black}) > \Pr(\text{Urn 4} \mid \text{Black})$. Hence, when IBE is formulated so that it requires no Swamping, it follows that one should not infer that Urn 4 was selected in this case. Without IBE licensing this inference, Climenhaga’s problem does not arise.

[Dellsén \(2024\)](#) offers a second way of responding to this objection. According to Dellsén “one might then suggest that there is a privileged ‘level’ of explanation on which IBE should be taken to operate—at least in the type of cases that lead to incompatible claims being inferred via IBE. In short, the privileged ‘level’ is that at which the set of hypotheses provide more informative explanations” ([Dellsén, 2024](#), p. 62). If IBE is restricted in the way that Dellsén suggests, the more informative explanation will be that either Urn 2 or Urn 3 was selected because this explanation takes into account not only the information about the urns but also the information about the coin flips. Hence, again IBE will not license the inference to the conclusion that the ball was drawn from Urn 4.

A third response to the objection is put forward by [McCain and Poston \(forthcoming\)](#). This response to Climenhaga’s objection emphasizes the importance of paying attention to causal/explanatory priority. The thought is that the apparent inconsistency vanishes when the causal structure of Climenhaga’s example is carefully considered. In the example, the coin flips are causally prior to the selection of which urn to draw a ball from. This causal/explanatory structure is itself an important part of the relevant evidence. The quality of an explanation concerning urn selection is causally dependent on the result of the coin flip. The fact that Urn 4 has only black balls is not as important as one might have thought initially because Urn 4 is selected only if the result of the coin flip places things on the Urn 1 or Urn 4 path. The evidence thus determines that it is equally likely that things are on the Urn 1 or Urn 4 path or the Urn 2 or Urn 3 path. But, given that the coin flip makes it equally likely that things are on either path, drawing a black ball is most probable if the path is in fact the one with Urn 2 or Urn 3. Hence, the best explanation of the black ball being drawn is that either Urn 2 or Urn 3, not Urn 4, was selected. Thus, when causal/explanatory priority is attended to the apparent inconsistency generated by IBE disappears.

It is important to keep in mind that while these responses are independent, they are all mutually consistent. As a result, a supporter of IBE may appeal to all three of them in responding to Climenhaga’s objection.

5.6 Purported Conflict with Bayesianism

Bayesian inference is a powerful and subtle model of confirmation that is widely endorsed and put to good use in a variety of areas. A final objection to IBE stems from this fact. Essentially, the objection contends that IBE is incompatible with Bayesianism, and so IBE is problematic. Before exploring this objection, it is worth considering what is required for Bayesianism updating. First, a subject needs to have a prior probability assignment for H (the proposition to be confirmed/disconfirmed by the evidence) and E (the evidence the subject will come to have) as well as the likelihood (i.e. $\Pr(E \mid H)$ —the probability of the evidence existing given that H is true). Once these three features are in place, Bayes’s Theorem spells out exactly what probability the subject should assign to H once in possession of E (i.e. $\Pr(H \mid E)$). The challenge for IBE arises when we consider how IBE fits within this framework.

There is a variety of ways that one might construe the connection between Bayesianism and IBE. Essentially, these can all be put into two categories, with some interesting distinctions within those categories. The first category is that Bayesianism and IBE are incompatible. Some insist that IBE gives an extra boost to explanatory hypotheses over what is specified by Bayesian updating (conditionalization). This would make IBE susceptible to a Dutch Book argument (i.e. reasoners who follow IBE would be rationally committed to taking bets that are guaranteed to lose in the long run).²⁵ Others allow that IBE and Bayesianism conflict in this way, but insist that this is not a problem for IBE because Dutch Book arguments fail to show that IBE is problematic²⁶ and because there is reason to think that IBE outperforms Bayesianism when it comes to some updating tasks.²⁷

The other category of answers to the fit between Bayesianism and IBE is that the two are compatible. Some insist that this is so because IBE is merely a heuristic for Bayesianism.²⁸ In other words, they contend that IBE is fine to use because our cognitive limitations make it so that we cannot reason in a Bayesian fashion a lot of the time. So, the best we can do is approximate Bayesian reasoning via IBE. Others contend that IBE and Bayesianism are consistent without relegating IBE to a mere heuristic. Some argue that IBE is central in assigning appropriate prior probabilities.²⁹ Others hold that IBE is at work establishing likelihoods.³⁰ Still others insist that IBE is at work in setting both the priors and the likelihoods.³¹ Thus, there are many ways that IBE seems to be compatible with Bayesianism, and even if the two are incompatible it is not clear that

²⁵See [van Fraassen \(1989\)](#) for a seminal presentation of this objection to IBE.

²⁶See [Douven \(2013, 2022\)](#) in support of this response, but see [Pettigrew \(2021\)](#) for a critical appraisal of Douven’s arguments. [Pettigrew \(2020\)](#) provides a sustained discussion of Dutch Book arguments in general.

²⁷See [Douven \(2016, 2017, 2022\)](#), [Douven and Schupbach \(2015a,b\)](#), and [Douven and Wenmackers \(2017\)](#).

²⁸See [Dellsén \(2018\)](#), [Lipton \(2004\)](#), and [McGrew \(2003\)](#).

²⁹See [Huemer \(2009\)](#), [Weisberg \(2008\)](#), and [Poston \(2014\)](#).

³⁰See [Henderson \(2013, 2017, 2022\)](#).

³¹See [Okasha \(2000\)](#) and [McCain and Poston \(forthcoming\)](#).

this spells doom for IBE.

6 Conclusion

In order to plausibly be considered a rational form of inference IBE must be formulated carefully. Particularly, it must be formulated so that it does not fall prey to bad lots or the Disjunction Objection. Once IBE is understood to be restricted to only licensing inferences when the best explanation is sufficiently good, it avoids both the Best of a Bad Lot and the Disjunction Objection. Nevertheless, even properly formulated IBE is the target of several objections. Although these objections have intuitive pull, there are many responses available to defenders of IBE. While many of these debates rage on, there is sufficient evidence to conclude that at the very least IBE is rationally defensible as none of the objections against it is an obvious success.

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Further Reading

- Bird (2023). Wide ranging discussion of the nature of science and how we come to have knowledge in science. Chapter 7 “Abductive Knowledge” is particularly helpful in laying out Bird’s influential ideas on inference to the best explanation.
- Dellsén (2024). Short overview of inference to the best explanation and challenges to it.
- Douven (2022). Defense of formal model of abduction/inference to the best explanation with far-ranging discussion from philosophy to psychology to historical examples.

- [Douven \(2025\)](#). Excellent encyclopedia entry on the topic of abduction/inference to the best explanation.
- [Harman \(1965\)](#). Early discussion of inference to the best explanation, which coined the term “inference to the best explanation.”
- [Lipton \(2004\)](#). The first book-length treatment of inference to the best explanation in the contemporary philosophical literature.
- [McCain and Poston \(2023\)](#). Short and accessible overview of key elements of IBE with particular focus on the connection between explanation and evidential support.
- [McCain and Poston \(forthcoming\)](#). Explanation and wide-ranging defense of inference to the best explanation.
- [Schindler \(2018\)](#). Discussion and defense of the role of theoretical virtues in establishing the acceptability of scientific theories.
- [Thagard \(1978\)](#). Early attempt to spell out precise criteria for when one explanation is better than another.