

Testability, Likelihoods, and Design

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Abstract: It is often assumed by friends and foes alike of intelligent design that a likelihood approach to design inferences will require evidence regarding the specific motives and abilities of any hypothetical designer. Elliott Sober, like Venn before him, indicates that this information is unavailable when the designer is not human (or at least finite) and concludes that there is no good argument for design in biology. I argue that a knowledge of motives and abilities is not always necessary for obtaining a likelihood on design. In many cases, including the case of irreducibly complex objects, frequencies from known agents can supply the likelihood. I argue against the claim that data gathered from humans is inapplicable to non-human agents. Finally, I point out that a broadly Bayesian approach to design inferences, such as that advocated by Sober, is actually advantageous to design advocates in that it frees them from the Popperian requirement that they construct an overarching science which makes high-likelihood predictions.

The detection of the action of an intelligent agent is not in itself an esoteric matter, although its philosophical analysis is complex and interesting. In its most common manifestation, the detection of agency is simply the inference to the existence of other minds. We infer the existence of beings other than ourselves who share some of our own mental characteristics, including the ability to bring about results deliberately. Such an inference may take place at a (comparatively) direct level, when we infer that those immediately around us are not holograms, illusions, or androids but rather persons. However, we also infer the existence of unseen intelligent agents by observing the effects and artifacts they leave behind.

A Bayesian analysis seems prima facie well suited to such inferences, since they are inferences to causal hypotheses as explanations. But if design hypotheses should be evaluated according to a Bayesian version of inference to the best explanation, what strictures does this place upon design inferences? Does a Bayesian design inference require independent knowledge about the nature of any agents who might bring about the result in question? Specifically, is it necessary to know independently about the motives of hypothetical agents in order to infer design

in a Bayesian manner? Would a Bayesian approach (perhaps because of such requirements) automatically preclude inference to intelligent agency in highly unusual contexts? Suppose, for example, that an object which closely resembled known artifacts were discovered in a location where the probabilities were strongly stacked against the intervention of any ordinary intelligent agent. Would the exclusion of the sorts of agents we already know -- in particular, of human beings -- prohibit any Bayesian inference to agency in such cases?

Several probability theorists, dating back to Venn, have placed restrictions on design inferences that would seem to preclude them in unusual contexts. Usually, the requirement is that we know the motives of putative agents, which will probably mean that we must restrict ourselves to cases where we know independently that any agency involved would be finite or much like ourselves. Elliot Sober, the most recent proponent of this type of view, argues that in the absence of knowledge of purposes and abilities it would be impossible to obtain the likelihood of the given evidence on the hypothesis of design. This obstacle, Sober believes, makes design inferences in biology difficult or impossible. One of the best-known advocates of current intelligent design theory, William Dembski, seems to agree tacitly that Bayesian reasoning is unfriendly to design inferences in biology. But where Sober takes his argument as grounds for rejecting the inference to intelligent design in biology, Dembski instead rejects Bayesian reasoning, opting for an argument form that "eliminates chance" without inferring design directly.

I will argue that, while a broadly Bayesian likelihood analysis is correct for inferences to design, it does not in principle preclude them in biology or other fields where human agents appear to be excluded.¹ By using frequencies from known agents and applying these under

conditions of epistemic randomness, it is possible to fulfill the requirement for a likelihood on the hypothesis of design. Furthermore, a comparative analysis of the concept of prediction such as Sober advocates makes it possible in principle to argue for design when the likelihood of the object or event on design is not high enough for the hypothesis unqualifiedly to predict its occurrence. In this way, a comparative likelihood approach is actually helpful to the hypothesis of design, because it calls into question the requirement that any legitimate scientific hypothesis must be part of an overarching theory that makes novel predictions.

Design and Likelihoods

In "Testability," Elliott Sober argues that current intelligent design theory is unable to generate a testable prediction, because there is no way to argue independently regarding the probability of the observed features of biological systems given the hypothesis of intelligent design, leaving that probability undefined. Given this state of affairs, Sober argues that it is impossible to make an inference to the best explanation to design from biological data.

At the heart of Sober's criticism is the complaint that the case for intelligent design in nature is merely negative, and that a negative case is insufficient for drawing the conclusion that life was designed. At the end of his section on intelligent design, Sober says,

By adopting the understandable tactic that the best defense is a good offense, defenders of the hypothesis of intelligent design have attacked evolutionary theory's ability to explain this or that fact about living things.... Evolutionary biologists need to answer these challenges without giving the false impression that all biological problems have already been solved.... But at the same time, it is important not to forget that advocates of the design hypothesis have to do more

than press questions about evolutionary theory. They must develop a positive account of their own.²

The prominence of William Dembski in the intelligent design movement gives some credibility to the charge that contemporary design theorists are making an entirely negative case. Dembski's approach parallels and extends the work of R. A. Fisher, using rejection regions to eliminate the null hypothesis. Dembski treats chance as the null hypothesis, and his version of the design inference seeks to "eliminate chance" rather than comparing design and non-design. The Dembskian system explicitly excludes use of design as a positive hypothesis: "Because the design inference is eliminative, there is no 'design hypothesis' against which the relevant chance hypotheses compete...."³ Although elsewhere Dembski calls the inference to design an inference to the best explanation,⁴ he reiterates his argument from The Design Inference⁵ and appears simply to be christening it "an inference to the best explanation" rather than revising it so as to show that the evidence is more likely on design than on chance.

In contrast, Sober advocates a likelihood approach to the problem of origins. In a likelihood argument, evidence favors one of two mutually exclusive and jointly exhaustive hypotheses just in case the probability of the evidence given the truth of that hypothesis is higher than the probability of the evidence given its rival.⁶ If we let D (design) stand for the hypothesis that an intelligent agent has acted causally and deliberately, C (chance) stand for the negation of design,⁷ and e stand for the evidence in question, then by a simple extension of Bayes's theorem

$$\frac{P(D/e)}{P(C/e)} = \frac{P(D)}{P(C)} \times \frac{P(e/D)}{P(e/C)}$$

The point of contention becomes evident when we consider the ratio on the right. Dembski is

determined to infer design without making any reference to the likelihood of biological evidence on the hypothesis of design. He makes no use of inverse reasoning at all, seeking instead to reason directly that the complement of design (which in his system is divided into law and chance) is false. Sober takes at least the likelihood portion of Bayesian analysis to be indispensable and insists that we cannot infer design unless we can make a positive case (with some probabilistic force) that the hypothesis of design explains the evidence better than non-design.

On this theoretical issue, Sober has the better of the argument. Even when precise numbers are not available, it is not possible to make a justificatory inference to the best explanation in the absence of some notion of the comparative likelihoods of evidence on the hypotheses under consideration. Whether one accepts a full-blown Bayesian approach or the more modest likelihood analysis of Sober and Richard Royall,⁸ one cannot escape some use of likelihoods. After all, if the evidence were less likely on one's own hypothesis than on some alternative under consideration -- say, if $P(e/D) < P(e/C)$ -- this would have important epistemological consequences. A low likelihood for the evidence on C would certainly not show the falsity of C under those circumstances. Improbable, even bizarre coincidences do happen, and it is easy to conceive of situations in which all of the available hypotheses give a low likelihood to the evidence at hand. This may be an unsatisfactory situation, and under some epistemic circumstances it would be legitimate to look for a new hypothesis not yet thought of. On the other hand, under other epistemic circumstances (for example, if the available hypotheses were unquestionably exhaustive) one might be forced to conclude that the "least bad" explanation was the correct one. It is considerations of this sort which lead Sober to say, "[I]f a hypothesis

says that what you observe was very improbable...it does not follow that the hypothesis itself is improbable."⁹ He is therefore also right that advocates of design can only make an inference to the best explanation in favor of design if they can give an argument showing that the things we see are more likely, perhaps far more likely, on the hypothesis of design than on the alternatives.

Design and Agent Purposes and Abilities

Sober's contention, however, is not simply that the likelihood of life on the hypothesis of design is necessary. He also makes the potentially more damaging claim that it is unavailable, because of the need for a knowledge of any putative designer's purposes.

The fact that testing the design hypothesis requires that we have information about the goals and abilities the designer would have, if he existed, can be seen by considering Paley's example of the watch found on the heath....¹⁰

The problem of distinguishing the products of artificial selection from the products of natural selection is soluble only because we know something about the goals and abilities of plant and animal breeders. If we knew nothing about these human designers, the problem would be insoluble. What holds for artificial selection carried out by human beings holds in spades for the miraculous creating done by God.¹¹

Here, Sober is in illustrious company, echoing the argument of John Venn.

The simple fact is that any rational attempt to decide between chance and design as agencies must be confined to the case of finite intelligences. One of the important determining elements here, as we have seen, is the state of knowledge of the agent, and the conventional estimate entertained about this or that particular arrangement; and these

can be appreciated only when we are dealing with beings like ourselves.¹²

Venn uses "conventional estimate" to refer to agents' evaluation of particular arrangements as interesting or desirable. His clearest example concerns card games, since when a card game is invented, the arrangement that is advantageous according to the conventions of that game takes on significance for inferences to cheating. The probability that someone has cheated can in principle be raised by the appearance of a conventionally significant run of cards, since a cheater would aim for that arrangement. But if no game has been invented for which that arrangement is advantageous, it does not have any special significance for inferring design.¹³

Venn applies this concept to design inferences generally, arguing that for agents which are not known independently to be finite or "much like ourselves," we will have no knowledge of what sorts of arrangements they will deem desirable, and hence no way of arguing for their intervention. Discussing Michell's famous argument that the preponderance of stars found in pairs is not due to "mere chance," Venn uses the requirement that we know agent motives to argue strenuously against any attempt to infer design.

[W]hat do we possibly understand about the nature of creation, or the designs of the Creator, which should enable us to decide about the likelihood of his putting the stars in one shape rather than in another, or which should allow any significance to "mere chance" as contrasted with his supposed all-pervading agency?¹⁴

John Maynard Keynes is less explicit about the requirements for design inferences, but he seems to follow Venn in requiring knowledge of motives and abilities.

The discussion of final causes and of the argument from design has suffered confusion from its supposed connection with theology. But the logical problem is plain and can be

determined upon formal and abstract considerations. The argument is in all cases simply this--an event has occurred and has been observed which would be very improbable a priori if we did not know that it had actually happened; on the other hand, the event is of such a character that it might have been not unreasonably predicted if we had assumed the existence of a conscious agent whose motives are of a certain kind and whose powers are sufficient.¹⁵

Expounding this analysis further, Keynes discusses the fact that it can be difficult to obtain information independently regarding the prior probability of the existence of an agent having these motives and abilities.¹⁶ On this application of inverse inference to design, the "motives and abilities" are to be built directly into the agent hypothesis, and the likelihood of the event on agency is to be obtained only in relation to the hypothesis of a highly specific type of agent. Keynes does say (in this agreeing with contemporary intelligent design theorists) that the argument from design should not be confused with theology. But it might reasonably be pointed out that, if God is one of the agents under consideration, any attempt to determine His motives and abilities a priori is certainly an exercise in theology. This, in fact, is one of the reasons that a Bayesian inference form appears disadvantageous to design arguments when the agents are not human. For it seems possible that we will be required to say ahead of time what God (or even aliens) would appreciate, value, and desire, and to describe the extent and limitations of their abilities.

Sober says something very much like this in his discussion of the possibility that life was seeded onto our planet by aliens.

What would an intelligent civilization in another galaxy have wanted to

accomplish if they had long ago seeded the earth with life? We have no idea. Were they creating copies of the life forms that inhabited their home planet, or were they conducting an exotic experiment? Would they have constructed only a few simple organisms and then allowed the rest to evolve from them, or would they have made millions of different organisms in their factories? Was their purpose commercial, or was the seeding just for fun?¹⁷

Sober implies that we cannot get a likelihood on design by aliens if we cannot answer these kinds of questions. Yet in an important endnote, he seems to be admitting that this sort of information is actually not necessary.

To infer watchmaker from watch, you needn't know exactly what the watchmaker had in mind; indeed, you don't even have to know that the watch is a device for measuring time. Archeologists sometimes unearth tools of unknown function, but still reasonably draw the inference that these things are, in fact, tools.¹⁸

As Sober indicates here, it is simply false to say that we need to know a designer's goals in order to infer that an object or an event is the result of design. While a knowledge of motives is often a useful way to determine a likelihood on design, it is by no means necessary. In criminal investigation, it is often possible to determine that a death was not the result of natural causes but rather of agent intervention without knowing the motives or "goals" of any putative agent in killing this person. Sober's own example shows that similar reasonable inferences are possible in the case of tools. If the argument in these cases is (or ought to be) an exercise in inverse reasoning, there must be some other way of obtaining the necessary likelihood on design.

What of the abilities of putative agents? Is it correct to say that we need independent

evidence regarding the abilities a designer would have if he existed in order to determine a likelihood for an object on the hypothesis of design? Once again, the archeological example seems to contradict this assertion. It would be misguided to insist that we cannot conclude that a given object was the result of agency unless we know on independent grounds that any agent who would have existed at that time and place would have had the ability to make the object. It is not the existence of totally incompetent agents we are inferring from the object! In fact, it is often reasonable to conclude that agents having tool-making abilities existed in a certain place and time from the discovery of tool-like objects in that location.

The argument that we need to know agent abilities may gain plausibility from a confusion between two meanings of "the abilities of agents." On the one hand, the statement that we need to know the abilities of agents may simply be taken to mean that we need to know the likelihood of the evidence on the hypothesis of agent intervention generally, or even that this likelihood must be greater than zero. If this is all that one means by a need to know the abilities of agents, the requirement is unobjectionable and would not preclude any of the reasonable inferences just discussed. The difficulty arises because Sober, Venn, and perhaps Keynes appear to have a stronger requirement in mind. Their analyses require knowledge of the qualities (motives, abilities, etc.) of specific hypothetical agents, considered not just as random members of the class of agents but as unique entities. What purposes would aliens have if they existed and were going to seed the earth? What purposes would God have in making life or arranging the stars? What abilities would a designer have if he existed? To put it mildly, such information is difficult to obtain.

And it is unnecessary. Suppose that our only evidence that intelligent agents lived

somewhere is the discovery of putative artifacts. We therefore do not have independent, specific knowledge about what abilities agents (human or otherwise) would have had if they had lived in that place. Instead, we have general knowledge about what the agents we are already acquainted with have actually produced. It is on this basis that we are able to say that objects which are (say) shaped like arrowheads with serrated edges have a higher likelihood on the hypothesis of agent intervention than on chance hypotheses.

Frequencies provide an important empirical source of likelihoods, a source which can connect the work of Michael Behe to the likelihood demanded by inverse inference. Behe defines a property of objects, irreducible complexity, which frequently is a result of agent intervention. As Behe defines it, an irreducibly complex system is

[a] single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning.¹⁹

Irreducible complexity is important in providing a higher likelihood on design than on chance for biological systems, because it defines a property that is important for our grouping objects as machines. It is possible to overlook the positive implications of Behe's case, because he himself emphasizes strongly the difficulties of producing irreducibly complex objects by gradualistic processes. Nevertheless, the comparison to machines points the way to a positive argument. Behe repeatedly refers to "molecular machines,"²⁰ and the definition of irreducible complexity applies to acknowledged machines regardless of whether they resemble one another in such non-essentials as size, color, and type of construction materials. Behe most frequently uses the example of a common mousetrap as exhibiting irreducible complexity among man-made

machines, but he also mentions a vine trap, a Rube Goldberg machine, and a rotary motor.²¹ Examples could be multiplied almost ad infinitum, from butter churns to BMW's (or sub-systems thereof). While it would be very difficult to give exact numbers, it is obvious that agents we already know about design and produce irreducibly complex objects with some frequency, and this despite the fact that agents also produce objects that are not irreducibly complex. This observation can help us to get a grip on the comparative likelihood of such objects on design and non-design hypotheses, provided that we have evidence regarding the latter likelihood.²²

An argument for design from irreducible complexity therefore does not merely involve saying that the object we find is very unlikely given our physical theories. One can easily imagine a situation in which we knew that the likelihood on chance was low, but in which we did not have evidence for a higher likelihood on design. Suppose, for example, that we located a cloud of hydrogen molecules, not very large, floating in interstellar space and not dispersing.²³ In the apparent absence of a sufficient amount of mass to hold the cloud together gravitationally, the discovery would certainly be anomalous on the assumptions of our current physics. But there would be no particular reason to consider design a better explanation than some as-yet-undiscovered physical law or unknown factor in the vicinity of the cloud. There is no evidence, either a priori or from past observation, that agents have any inclination to make small clouds of gas serving no particular function. Sober apparently believes that the case in biology is analogous to the case of the gas cloud.

Venn's example of the star pairs fits the same analysis. There is, it seems, no good likelihood argument for design from the large numbers of star pairs. Venn decides that star distribution is "not random" but that stars "have a tendency to go in pairs,"²⁴ a conclusion

consistent with the "unknown physical law" type of response imagined in the case of the gas cloud.²⁵ Venn's refusal to conclude design from the star pairs seems to be quite reasonable. However, contrary to his own analysis, this is not because we do not know God's "purposes" or how much He values star pairs. The inference might still be possible given evidence regarding agents generally. But there is apparently no other evidence, or at best, only the weakest of evidence, showing that agents would be likely to arrange stars in pairs.

It would be a very different matter if, far in the future, we managed to take pictures of the region around Alpha Centauri (where no humans had ever gone) and found incontrovertible evidence that a Volkswagen Beetle was orbiting a planet there. We might indeed wonder why anyone, particularly any non-human, would want to make that object just there. Nonetheless, the fact that the object would be virtually type identical to objects known to be made by agents, and the vanishingly small probability of its arising in any non-intentional fashion, would make it only reasonable to conclude that the car was designed by someone or other. The design claim in biology is best construed as saying something much like this: We have found complex biological machines. These machines, being in some cases part of the human body, or predating human life on earth, could not have been made by humans. But even if we do not know who designed such machines or why, it does not follow that we are incapable of telling that they were designed.

Design and Non-Human Agents

Sober (or even Venn) might attempt to deny the relevance of the frequency data I have mentioned to the origin of objects which existed before mankind. This would constitute a more sophisticated version of the rather common argument that it is not possible to reason about the activities of transcendent designers from the behavior of mundane designers. Design advocates

frequently respond, accurately enough, that nothing in their argument requires that the designer be transcendent (i.e. divine or supernatural).²⁶ But the skeptic can press his point by arguing that all of our evidence concerns human beings and that any original designer of life, whether technically transcendent or not, would not be human. The skeptic could then argue that any agent which existed at that time and had the ability to design living systems would be so different from human beings that we could know nothing about what he would be likely to do. Perhaps such beings would have no desire to make irreducibly complex objects.

While the design advocate must admit the logical possibility of a world in which humans make irreducibly complex objects but other agents do not, this bare possibility does not render data from humans irrelevant to the design argument when the designer would not be human. Any attempt to use frequencies, either to make a straight inductive inference or to construct a likelihood for a Bayesian inference, must confront the problem of induction. It is always possible that a group which differs in one respect from the sample we have already examined also differs in the very area about which we want to make an inference. The sampled and unsampled group may differ in time, in place, or (in the limiting case) in the simple fact that one is sampled and the other not. To return to the archeological example, it is possible that human beings living in a different time were not able to make arrowheads or did not want to make them. Nonetheless, if we find an object that shares important properties with objects (arrowheads) known to have been made by human beings, it is not reasonable to resist the inference that this one was made by an intelligent being simply because the makers of the newly discovered arrowhead would have lived at a different time from the other makers we know about. It is arbitrary to require special hesitation in applying data from a known group to an unknown group in biological arguments for

design. Any attempt to draw a line at just this point would begin with the assumption that the gap between humans and unknown, non-human agents is epistemically more significant than the gap between human beings at different times. But whatever the significance of this difference in other contexts, we need not grant that it blocks the application of human data to other agents when considering the hypothesis of design. It may be true that a non-human agent would be "very different" from humans. Perhaps we have reason to believe that such an agent would be more powerful or more intelligent than humans, would possess a different kind of body from humans, or might even be disembodied. But even granting the probability of such differences, it does not follow that such an agent would differ from humans in inclination or ability to make machines. One can ask, "What if aliens would not want to make irreducibly complex objects?" or "What if God would not want to make irreducibly complex objects?" But these questions serve no epistemic purpose. We could just as well ask, "What if non-human agents would be more inclined than humans to make such objects?" Just as highly intelligent humans sometimes are more inclined to become inventors than their less gifted peers, it might be that a super-human intelligence would have greater inclination towards machine-making than humans. But both the negative and the positive "what if's" are purely speculative. With respect to an inclination to make irreducibly complex machines, non-human agents are epistemically random members of the class of agents simpliciter. There is no argument from the respects in which they might be expected to differ from humans to any difference in the properties in question -- ability and desire to make irreducibly complex objects. When there is no reason to believe that an unsampled group belongs to a different reference class from the sampled group with respect to the property in question, there is no rational ground for treating the unsampled group differently when making

inferences about that property. In that case, the unsampled elements of the population should rationally be treated as random members for purposes of direct inference regarding that property.²⁷

A different difficulty arises with respect to the reference class for the object to be explained. I am using "irreducibly complex objects" as the class of objects to be explained and noting how often agents within our knowledge make them. But could we not use instead "living objects" and note that agents of our acquaintance have never made living objects? Would this not mean that we should estimate that agents generally never make living objects, even those containing IC systems?²⁸

Once again, reference class difficulties are by no means unique to design inferences; they arise whenever induction is used. It is always possible to describe an object or event in such a way that it is unique. It is therefore necessary to decide where it is reasonable to draw our reference class lines and how much weight to put upon various differences, since some differences are clearly unimportant.

It might be argued, however, that in the case of living entities it seems actually to be difficult for humans to make them, despite repeated attempts. Therefore the property of being living should carry more weight for a frequency estimate based on human data than some trivial property. It is true that many irreducibly complex objects are not alive and that humans have never yet made a living object. However, it does not follow that the likelihood of a living object on agency (given a sample group of humans) is vanishingly small. Our experience of agents known to us indicates that an extrapolation of the machine-making abilities possessed by these agents might indeed permit the making of living objects at some time. Such improvements would

include a sheer increase in programming capability together with improved technology for manipulating matter at the micro-level. Given current experiments in genetic engineering, it is no longer pure science fiction to imagine that human beings might become capable of making living objects. Hence, despite their failure to do so thus far, it would be false to say that the likelihood of a living object given even human involvement is close to zero. Other considerations besides the frequency with which those objects have been made thus far by agents are relevant, although these considerations may be based on other frequencies, such as the frequency with which agents make things requiring large amounts of complex programming, the frequency with which agents overcome obstacles in scientific technology, and so forth.

Furthermore, it is not necessary that we take the object whose origin we are investigating as a whole and make a frequency argument from that point onward. For example, Sober describes John Maynard Smith's visit to a warehouse full of German war machines whose uses he did not know. Sober points out that a likelihood analysis favoring design was possible for Maynard Smith because the objects could be legitimately thought of in terms of their sub-components (such as dials and gauges) and properties such as symmetry, smoothness, and being made of metal.²⁹ Not only does this case provide yet more evidence that likelihoods do not require a knowledge of purposes, it also shows that a strong likelihood argument is possible even when one has not observed an agent making an entire object of a certain type.

It is even possible to imagine cases in which a strong likelihood argument from some features of the object outweighs the fact that known agents have not yet been able to make anything having all the properties of the object to be explained. To modify the Volkswagen example, we might find an automobile built on such a (very large or very small) scale that

humans lack the ability to make it. But the fact that humans are not able to manipulate matter on that scale would not preclude an argument to design based on the fact that only agents are known to produce objects of that type. Similarly, Behe has pointed out the extraordinary resemblance of the bacterial flagellum to a rotary motor,³⁰ including its possession of a U-joint, bushing, and drive shaft. It may well be rational to make a likelihood argument on this basis despite the fact that no agent known to us has made an entire bacterium.

Once again, the argument to design from machine-like biological entities cannot be ruled out in principle. Whether the attempt to block it comes from the human/non-human distinction or from the living/non-living distinction, intuitive examples suggest that these problems are in principle answerable and that a likelihood favorable to design plays an important role in the biological argument.

Design and Prediction

The discussion thus far might seem to indicate that adoption of a likelihood analysis will primarily mean more work for advocates of design, more requirements they will have to satisfy, more data they will have to bring into consideration. But in one very important respect an analysis of confirmation based on comparative likelihoods lightens the burden for design advocates. Such an approach allows them to point to confirmation for an empirical hypothesis in the absence of high-likelihood predictions.

One of Sober's main emphases in "Testability" is his thesis "that testing is an inherently contrastive activity -- testing a hypothesis means testing it against some set of alternatives."³¹ From this he concludes that prediction, at least in cases where theories do not literally entail observations, should also be thought of contrastively. We can say that two hypotheses make

different predictions regarding observed evidence even if neither of them gives a high likelihood to the evidence, just in case the evidence has different likelihoods on the two hypotheses.³²

When we refer to an hypothesis as "making predictions" without any qualifier, we often mean that we would actually expect certain things, or that certain things would have a very high probability, given the truth of the hypothesis. This stronger sense of "prediction" accords well with the idea that any new scientific theory must show its "fruitfulness" by giving rise to a "research program" based upon predictions. Does intelligent design make predictions in this stronger sense? Does it need to do so?

Sober's modest, contrastive concept of prediction indicates that a theory may be rationally warranted as the best explanation of empirical evidence even if it does not predict that evidence (much less further observations) in this strong sense. This is not the well-known distinction between prediction and accommodation, between old and new evidence. Instead, it is a distinction between two senses of "prediction." On the one hand, evidence may meet some high threshold of likelihood on a theory, in which case the theory will "predict" the evidence in the sense that it will tell us to expect that evidence (e.g., $P(e/H) \approx .9$). But whether or not this is the case, one theory may give a higher likelihood to the evidence than does any alternative -- the first theory may "predict the evidence more strongly" than its rivals. There can be an overwhelming difference in likelihoods in favor of a particular theory even if the likelihood of the evidence on the theory is not high in an absolute sense, perhaps no more likely than not. (In that case, if A and B are the only two theories under consideration, $P(e/A) < .5$, but $P(e/A) \gg P(e/B)$.) While the likelihood ratio does not answer all questions (in particular, of course, the question of prior probabilities for the hypotheses), the concept of comparative prediction does raise the possibility

that a theory can be the best explanation of a natural phenomenon even if it cannot be generalized into a "Science" that tells us independently where to expect further effects of the same cause or even whether the same cause will act in other cases. And if scientific theories are intended not simply to generate further research but actually to supply true causal explanations of natural phenomena, then such explanatory considerations will be of legitimate scientific interest.

These considerations are particularly relevant to the hypothesis of intelligent design -- in any context -- because of an important fact about agents: An agent is not a physical law and will generally not behave like a physical law. Even objects made frequently by agents may not be so overwhelmingly likely on the hypothesis of agency that we can say that we will definitely find such objects wherever intelligent agents have acted. (There are plenty of agents who don't make Volkswagens.) Furthermore, an agent will often intervene in one case and not in another, despite his ability to intervene more often. Nevertheless, the inference to agency may be strongly warranted by comparative considerations when a particular type of object needs to be explained.³³

Examples make the legitimacy of such inferences clear. A detective confronted with a man who has been shot in the back of the head will be justifiably confident that the event was not the result entirely of non-agent causes. Moreover, if the weapon is nowhere to be found, and if the angle of the shot is such as would be (essentially) impossible if the man were holding the weapon in his hand, the detective will strongly suspect murder rather than suicide. The hypothesis of murder can be well justified even if the murderer remains nothing more than a definite description -- "The person, whoever it was, who killed Jones" -- in which case motive will be unknown. The hypothesis can also be justified even if the likelihood of the evidence is

not terribly high on the hypothesis that some agent has acted upon Jones. It may be that Jones is a very well-liked fellow and that other people are more likely to shake his hand or to clap him on the back than to shoot him in the head. In such a case, of course, it will be very difficult to know where else, if anywhere, the murderer might strike. Some murderers kill only once. If the evidence as to motive and specific perpetrator is sufficiently thin, no general "science of intelligent murder" will allow further predictions to be made. The hypothesis in question will be only about this case, and will simply say that this death was the result of murder. Whether or not we wish to bestow the honorific of "scientific" upon the detective's conclusion, it could surely be a rational inference about the cause of an event in the physical world.

The Volkswagen example illustrates a similar point. The hypothesis that some agent has been intervening deliberately in the physical system around Alpha Centauri does not give us any strong reason to expect to find a Volkswagen per se. There are so many other, better, things we can imagine a powerful agent's wanting to do, and it is certainly true that we have no independent evidence as to either goals or abilities of any putative agent in the case, except that it was apparently not a human being. Moreover, even if it is the case that the Volkswagen was designed (which would seem beyond reasonable doubt), we will remain largely ignorant of the motives of the designer and of other facts (such as whether the designer still exists) that might enable us to make positive predictions regarding further evidence of his activities. Does this mean that a design hypothesis in the case of the Volkswagen should be ruled out of court as "unscientific"? Does the difficulty of formulating an overarching "Interstellar Automobile Design Science" on the basis of this one case make the discovery of the Volkswagen, and its correct causal explanation, uninteresting or unimportant?

Both cases illustrate the best construal of the intelligent design argument regarding some biological systems. Regardless of whether it is possible to say independently where interventions will occur, and regardless of whether one can state confidently that certain structures definitely will appear if an intelligent agent has acted, the ratio of likelihoods can strongly favor intelligent design as an explanation for particular kinds of evidence.³⁴

Sober clearly expects Darwinism to be the main beneficiary of his concept of contrastive prediction. He emphasizes that, on his theory, design advocates cannot argue simpliciter that Darwinism "cannot explain" what we observe. Even if the likelihood of what we observe is very low on Darwinism, Sober insists, we should never use phrases like "cannot explain."³⁵ Since explanation is always contrastive, low likelihoods in themselves do not tell us which is the best explanation. But one probabilistic benefit of Sober's approach for design advocates lies in the fact that they do not have to argue that design is an overarching Theory, like a theory in physics, that gives an unequivocally high likelihood to many observational facts. Design advocates are thus freed by a Bayesian approach from the strictures of leftover Popperianism. If an hypothesis is indeed the best competitive explanation of a particular physical fact, then the hypothesis can have scientific importance regardless of whether or not it yields predictions in the strong sense.

Conclusion

Philosophical theses should not be adopted for pragmatic reasons. Regardless of which side in the biological design debate receives the most benefit from a likelihood approach, we should first ask whether it is analytically correct and debate that question on its merits.

Nonetheless, it is interesting to see what would happen if all sides were to agree to discuss the matter from a broadly Bayesian perspective. Very likely it will at some point become

necessary for the different parties to the debate to discuss the priors, which is exactly what Dembski, for instance, wants to avoid.³⁶ But since prior probability reflects our other evidence, and since there is no reason to give special privilege to one set of evidence over another, the need to discuss priors cannot be evaded forever.

Moreover, the likelihood ratio itself has intrinsic interest, particularly if a likelihood ratio which heavily favors design can be obtained using a fairly generic design hypothesis. Advocates of design have been wrong -- strategically as well as philosophically -- to accept their opponents' evident assumption that a likelihood analysis will end the discussion immediately, leaving design proponents groping in a fruitless attempt to probe the interior workings of the (hypothetical) Divine mind. Once it is granted that proponents of design in particular cases need to make a positive argument, there remains the evaluation of the positive argument itself. The concept of irreducible complexity, and the tendency of agents to make irreducibly complex objects, is one important line of thought to consider. Moreover, the distinction between "prediction" in its comparative and strong senses permits advocates of design to examine evidence on a case by case basis, without being obligated from the outset to prove that their hypothesis generates multiple high-likelihood predictions. If, as Sober has argued, "friends of Design should shun" an eliminative form of inference,³⁷ they should also be aware that likelihoods provide a viable alternative, one which will encourage, not end, lively debate.³⁸

Endnotes

1. I am using the phrase "broadly Bayesian" to include both the pure likelihood approach of Richard Royall and full-fledged Bayesianism which uses prior probabilities for the hypotheses. Nothing in this paper is intended to indicate advocacy of strict likelihoodism without priors. I am saying little about priors here because I am examining the question whether a broadly Bayesian approach is deleterious to a design inference in unusual contexts.

2. Elliott Sober, "Testability," Proceedings and Addresses of the APA, 73:2 (1999):67.

3. William Dembski, The Design Inference (Cambridge: Cambridge University Press, 1998), 68.

4. William Dembski, Intelligent Design (Downers Grove, IL: InterVarsity Press, 1999), 273-75.

5. *Ibid.*, 127.

6. The use of Bayesian reasoning when the hypotheses are not exhaustive presents special problems, most especially the problem of when to look for an explanation in the "catchall hypothesis." See Wesley Salmon, "Rationality and Objectivity in Science or Tom Kuhn Meets Tom Bayes," in Martin Curd and J.A. Cover, eds., Philosophy of Science: The Central Issues (New York: W.W. Norton, 1998), 568-569, 572-573. (See note 35, below.) For purposes of this paper, I will focus on the ratio between likelihoods on two exclusive hypotheses, which can be calculated whether or not the hypotheses are exhaustive.

7. Throughout this paper, when I use the term "chance" myself (rather than attributing its use to Michell, for example), I am referring to any non-deliberate process, including the operation of physical laws. I am aware that other uses of the term are possible.

8. Richard Royall, Statistical Evidence--a Likelihood Paradigm (London: Chapman and Hall, 1997).

9. "Testability," 58.

10. *Ibid.*, 63.

11.Ibid., 64.

12.John Venn, The Logic of Chance (New York, NY: Chelsea Publishing Company, 1866), 260.

13.Ibid., 254-55.

14.Ibid., 260. Venn appears to be incorrect in his evident assumption that Michell wishes to argue primarily for Divine intervention. Michell actually states that he is inferring "either design, or some general law..." and repeats this more than once. See J. Michell, "An Inquiry into the probable Parallax, and Magnitude of the fixed Stars, from the Quantity of Light which they afford us, and the particular Circumstances of their Situation," Philosophical Transactions 57 (1767):243, 249-250.

15.John Maynard Keynes, A Treatise on Probability (London: Macmillan, 1921), 297.

16.Ibid., 298.

17. "Testability," 65.

18.Ibid., 73, n 20.

19.Michael Behe, Darwin's Black Box (New York, NY: The Free Press, 1996), 39.

20.Ibid., 4-5, 51, 157.

21.Ibid., 195, 74, 70. Not surprisingly, Behe's work has received plenty of criticism. I do not propose here to give a general defense of Behe's empirical argument against his critics, because I am making a methodological use of his concept in relation to the possibility of obtaining a likelihood for features of biological systems on the hypothesis of design. In keeping with the anti-Darwinian emphasis of Behe's work, many of his critics have attempted to argue that irreducible complexity is not highly unlikely on chance, but that question is not directly relevant to the point here. See Niall Shanks and Karl H. Joplin, "Redundant Complexity: A Critical Analysis of Intelligent Design in Biochemistry," Philosophy of Science 66 (1999): 268-282. Similarly, criticisms that allege that some of the systems Behe discusses are not in fact

irreducibly complex do not invalidate the use of the concept to obtain a likelihood for whatever systems do have the property. Finally, if it is true that some biological systems have a property that is useful in grouping machines as a class, some criticisms which seem to arise from (for example) the failure of Behe's definition to include a ceteris paribus clause would be better met by a refinement of the definition than by an abandonment of a useful category.

22. The approach I am advocating here deliberately departs from Keynes's recommendation that we make the motives and other qualities of the hypothetical agent part of the design hypothesis itself. When production frequencies are our major source of likelihood data, the hypothesis need not be so specific. If agents deliberately make an object or cause an event for a variety of motives, these motives will all contribute to the set of observations which gives the likelihood. If agents of various levels of ability make the object, this will also affect the likelihood without the need to separate out different ability levels. This way of drawing the line between the hypothesis and the likelihoods concentrates maximal attention on the impact of the putatively artifactual evidence -- that is, on the ratio of the likelihoods for that evidence independent of the prior probabilities of the hypotheses. If we obtain a likelihood by using a more specific hypothesis, the debate will shift very rapidly to the prior probability that exactly that sort of agent has existed. That debate will require us to combine evidence regarding the proclivities of known agents with all of our other relevant data, including, for example, reasons we might have for believing in the existence of an agent before the existence of human beings. The independent confirmational impact of the putative artifact will thus be obscured. If, on the other hand, we use a relatively generic agent hypothesis and still obtain a large difference in likelihoods favoring design for the object in question, this result will have more intrinsic interest, since it will depend upon fewer assumptions about the designer.

23. I owe this example to Timothy McGrew.

24. The Logic of Chance, 261.

25. Venn, however, carefully prescinds from making any causal hypothesis and states that probability cannot give us causal conclusions.

26. Dembski, Intelligent Design, 276-77.

27. Timothy McGrew, "Direct Inference and the Problem of Induction," The Monist 84 (2001): 153-74.

28. I owe this criticism to Elliott Sober from personal communication.

29. Elliott Sober, "The Design Argument," in Neil A. Manson, ed., God and Design (London: Routledge, 2003), 39.

30. Darwin's Black Box, 69-72.

31. "Testability," 52.

32. *Ibid.*, 57.

33. Both Sober (personal communication) and Dembski have implied that agents will need to be treated as law-like entities in order to obtain a probabilistic likelihood on design -- an assumption unacceptable to libertarians. See William Dembski, "Detecting Design by Eliminating Chance: A Response to Robin Collins," Christian Scholar's Review 30 (2001):350-51. It is possible that their opinion on this point arises from taking probability to be entirely objective, i.e. external to the mind. A theory of epistemic probability would preclude the need for "treating agents as lawlike," however, as on this view a statement that an agent will "probably" do something does not imply a metaphysical assumption about the agent's intrinsic nature but only states an epistemic probability relative to evidence.

34. It is worth noting that the discovery of one such object and a justified conclusion that it is best explained by intelligent intervention will at a minimum provide a reason for keeping one's eyes

open for other similar objects. If design inferences seem warranted repeatedly in biology, this can justifiably increase confidence not only that there was a designer for some aspects of life, but also that he was both able and willing to make many things. Under those circumstances, a prediction of finding still more irreducibly complex objects might well become legitimate. This situation would correspond to a case where friends and family of Jones began dying under suspicious circumstances at an alarming rate, or where we found more and more machines in regions of space previously inaccessible to human beings. However, the first design inference in all these cases did not have to enjoy such an auspicious prior epistemic basis in order to be reasonable.

35. "Testability," 67. This passing reference to the possibility of low likelihoods on Darwinism is of interest. Perhaps Sober would not actually want to concede that what we observe has an extremely low likelihood on natural explanations thus far offered, but for purposes of "Testability," he waives the question. While he points out that there might be some as-yet-undiscovered non-design hypothesis that would explain the evidence better than Darwinism ("Testability," 66), Sober does not seem to take very seriously the option of looking for non-Darwinian explanations, either for particular systems or for the origin of life itself (where only a chemical analogue to Darwinism would be relevant, in any event). If what we see does in fact have a very low probability on current naturalistic explanations, and if these explanations are not exhaustive, it is at least worth contemplating the possibility that some hypothesis not now under serious scientific consideration would fare comparatively better vis a vis the evidence. Hence, the consideration that current hypotheses are not exhaustive presents a challenge for proponents of natural theories as well as for proponents of design.

36. Dembski, The Design Inference, 67-68.

37. Elliott Sober, Branden Fitelson, and Christopher Stephens, "How Not to Detect Design,"

Philosophy of Science 66 (1999):487.

38.Thanks to Evan Fales, Robin Collins, Elliott Sober, Branden Fitelson, and especially Timothy McGrew, who all provided helpful comments on various drafts of this paper.