Why Dembski's Design Inference Doesn't Work

BY JAMES BRADLEY, PROFESSOR OF MATHEMATICS EMERITUS, CALVIN COLLEGE

The theory of Intelligent Design has gained a great deal of credibility in the evangelical world since it first became widely known in the early 1990s; much of that credibility has been based on the belief that a solid theoretical foundation has been laid for Intelligent Design in William Dembski's 1998 book, *The Design Inference*. This article challenges that belief by questioning some of Dembski's assumptions, pointing out some limitations of his analysis, and arguing that a design inference is necessarily a faith-based rather than a scientific inference.

The Design Inference begins with two broadly accessible chapters that introduce the main ideas behind Dembski's method for inferring design. These are followed by four technical chapters that provide a rigorous mathematical foundation for the method. The book is not a contribution to either mathematics or science *per se*; rather it is an attempt to extend scientific methodology in a new direction.

The basic task of science is to account for natural phenomena. "Account for" typically means to provide causative explanations for phenomena and to enable prediction of other phenomena. Typically, causative explanations are mechanisms – for example, today we generally accept the sun's gravity as a causative explanation for the phenomenon of planets in our solar system staying in their orbits. Dembski's ambitious goal is to increase the repertoire of available causative explanations by providing a rigorous method acceptable to scientists that would allow intelligent design to be recognized as a legitimate cause.

The method is a variation on the standard method of statistical inference, which can be explained by way of an example. The Salk polio vaccine, developed in the 1950s, had to be tested on a large number of people to determine its efficacy. 400,000 children in grades one through three took part. Participating communities were divided into test and control populations, and the testing was "double blind." That is, some communities received the vaccine while others received a placebo, and which group a community belonged to was hidden from both the doctors as well as from the families of the children who participated. This ensured that doctors were not influenced in their diagnoses by knowledge about the vaccine.

The method proceeded by tentatively assuming that the vaccine was ineffective; that is, children in each community were assumed to be equally likely to contract polio after receiving their injection. Of course, this does not mean that exactly the same numbers of children would be infected in each community, but if the number of children who contracted polio in the vaccine group was significantly below those who contracted polio in the control group, the researchers would conclude that the vaccine was effective.

"Significantly" means that the difference was large enough to be very unlikely by chance. When the testing period was complete, the rate of polio incidence was 28 per 100,000 children in the vaccinated communities and 71 per 100,000 children in the control communities. Statisticians were able to calculate that the probability of this great a difference happening by chance was less than one in a million. Thus they concluded that the vaccine had been effective. Due to the Salk and later Sabin vaccines, polio has today been eliminated in most of the world.

Note how the procedure goes: the researchers first designed an experiment (in this case testing 400,000 children divided into vaccine and control communities). They then identified a pattern that would demonstrate that a factor other than chance was operative (in this case the pattern was that the number of children contracting polio in vaccine communities would be significantly less than in the control communities.) Then they did the experiment. Because the difference was extremely unlikely to have occurred by chance, they inferred that the vaccine was effective.

The polio researchers first designed the experiment, and then looked for the pattern after doing the experiment. The researchers thus could not have rigged the results because the pattern they sought was clearly described *before* doing the experiment. Dembski's design inference, however, looks backward in time – it takes already existing patterns and seeks an explanation other than chance, namely design.

The way Dembski addresses this problem is by requiring that patterns be *specified*, that is, describable in a way that is independent of the process of the observations. For example, suppose someone shows you a target attached to a tree with an arrow in the bull's eye. If the arrow was shot first and the target placed around it, the archer's claim of being a good shot would be invalid. But if the target were posted first and then he hit the bull's eye, he would be able to claim excellent marksmanship. In the second case, the specification (the target) was independent of the shot; in the first case it was not.

So to identify the presence of design, Dembski replaces the *prior* description of a pattern that statistical inference uses with a *specified* description. He still uses the presence of small probabilities in the same way. (He includes quite a lengthy discussion of "how small is small." While interesting, it doesn't bear on our discussion here.) He summarizes his design inference with the following "explanatory filter" (right).

So let's suppose we have an event and want to test it for design. We first see whether it is the result of a law of nature. If not, we test it to see if it involves an intermediate level probability; if so we attribute the event to chance. Lastly if it is of very small probability *and* is specified, the explanatory filter attributes it to design. If it reaches the sp/SP diamond but fails either the small probability or specification test, the filter follows the same convention as statistics and attributes it to chance due to lack of sufficient evidence to say otherwise.

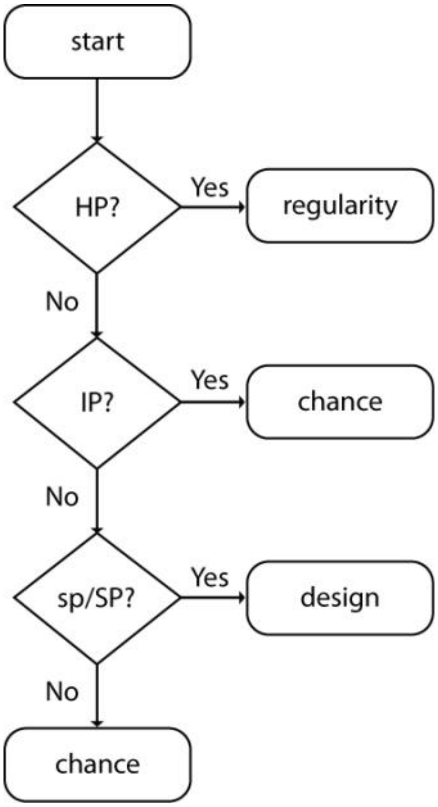

Figure 1. Dembski's explanatory filter. HP means "high probability." This diamond selects phenomena that can be accounted for by "laws of nature." IP means "intermediate probability." These are events like flipping five heads in a row with a coin: they do not involve laws of nature, they do involve chance, but the likelihood is not as small as Dembski wants to require in order to identify design. SP means "small probability" and sp means "specified" as discussed above.

The explanatory filter seems straightforward but it includes two fatal flaws, one involving the small probability requirement and the other involving the three way classification – regularity, chance, and design.

First, let's consider the small probability requirement. At one point, Dembski writes, "… a successful design inference sweeps the field clear of chance hypotheses. The design inference, in inferring design, eliminates chance entirely…"[1] To understand the term "chance hypotheses," we begin with an example. Suppose we are considering a situation in which the outcome is not predetermined but only two possible outcomes can occur – 0 or 1. The event we want to consider is that repeating the situation yields a sequence of ten 1's a row – 1111111111. Did they occur by chance or did someone arrange for only 1's to occur – that is, did the ten 1's occur by design? Suppose for the moment that our criterion for "small probability" is less than one chance in a thousand. (Dembski uses numbers much smaller than this, but for now this will illustrate our example well.)

Consider two cases. The first is the flip of a fair coin. 1 represents heads, 0 represents tails. Each is equally likely, so each has a probability equal to ½. The probability of ten heads in a row is $(½)^{10}$= ⅟1024, which is less than one in a thousand, so our chance hypothesis (that each outcome has probability ½) suggests we should attribute the sequence of ten 1's to design.

But now consider a second case, dropping a thumbtack on the floor. Let's use 0 to denote an instance in which the tack lands point up and 1 an instance where it lands point down. Suppose the particular thumbtacks we are dealing with land point down ⅔ of the time. Then the probability of ten 1's in a row is .0173 (or about 17 in 1000), considerably more likely than the coin example. In this case, the filter suggests we should attribute the ten successive 1's to chance.

The point is, different chance hypotheses give different results. Dembski writes, "…opposing chance to design requires that we be clear what chance processes could be operating to produce the event in question."[2] Dembski is very explicit about the necessity of the design inference eliminating *all* chance hypotheses. But this is a fatal flaw: except in very unusual cases, it is impossible to identify all possible chance hypotheses simply because finite human beings are unable to identify every chance scenario that might be operative.

Let's consider a more complex example that illustrates this limitation. The Sierpinski triangle (Figure 2)[3] provides a clear example of how specified, complex structures can arise by chance in unexpected ways. Construction of the figure starts with an equilateral triangle. The midpoints of each of the three sides are then connected, yielding a smaller equilateral triangle in the middle of the original triangle. This triangle is removed leaving three equilateral triangles, each having sides one half that of the original triangle. The process of identifying midpoints of sides, connecting them and removing the middle triangle is then repeated for each of the three new triangles. The process is repeated *ad infinitum* for all triangles produced.

The result is called a *fractal*, and it's a highly complex and specified figure. It has some surprising properties. Note that removal of the first triangle removed ¼ of the area. At the next step, ¼ of the remaining ¾ is removed. After an infinite series of steps, the total area removed $(\frac{1}{4} + \frac{1}{4}(\frac{3}{4}) + \frac{1}{4}(\frac{3}{4})^2 + \ldots)$ is 1. That is, the Sierpinski triangle has no area! Another amazing property is that it can be produced by a random process. The process is called the *chaos game* and goes like this: pick any point in the interior of the original equilateral triangle. Then randomly pick any of the three corners. Join the point to the corner selected, mark its midpoint, and use it as a new starting point. Again randomly pick any corner and repeat the same process. Keep on doing this. After continuing for a while, one can see that the marked points soon fall into the pattern of the Sierpinski triangle, albeit with a few stray marked points.[4] The successive corners *have to be picked by chance* – a systematic process like going from corner to corner around the original triangle won't work.

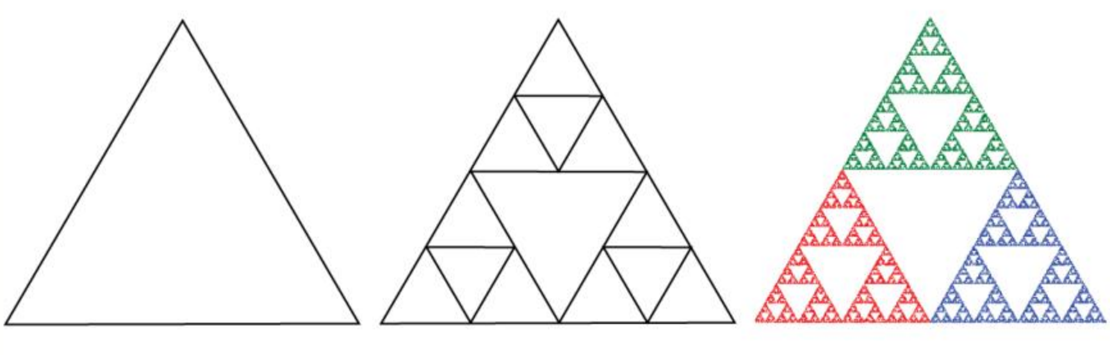

Figure 2. The Sierpinski Triangle is highly ordered but can be generated through a random process. Above we see the initial equilateral triangle, the construction of the Sierpinski triangle after two steps, and the completed triangle.

Suppose someone did not know about the chaos game. Since the area of the original triangle is zero, if a point in it were picked at random, it would have zero probability of being in the Sierpinski triangle. Similarly, any random sequence of points in the original triangle would seem to have zero chance of following the pattern of the Sierpinski triangle. Thus it would appear to that person that it satisfies the sp/SP criterion – specification and small probability. But in fact, the triangle can be generated by chance. Given just the specification of the Sierpinski triangle, investigators could easily eliminate the chance explanation and conclude that it exhibits design because the chance process that generates it did not occur to them. That is, because it is impossible in practice to identify *all* chance hypotheses, one can never eliminate the possibility that very sophisticated structures like the Sierpinski triangle could arise by an undiscovered chance hypothesis.

So the explanatory filter fails because it is normally impossible to eliminate all chance hypotheses. But its logic is also flawed. It depends on a strict trichotomy – it assumes that events are of one of three mutually exclusive types – regularity, chance, or design. However, Dembski is vague about his definitions of regularity and chance. He writes, "To attribute an event to regularity is to say that the event will (almost) always happen."[5] At one point, he identifies regularities with the outcomes of natural laws.[6] As for chance, he adds, "Events of intermediate probability, or what I am calling IP events, are the events we normally expect to occur by chance in the ordinary circumstances of life. Rolling snake-eyes with a pair of fair dice constitutes an IP event." But he never gives a clear definition. He then defines design as the logical complement of regularity and chance. Because regularity and chance are vague notions in *The Design Inference*, so is design.

For instance, consider some event that is the product of a previously unknown natural law. The explanatory filter will not identify it as a regularity and, if it can be shown to be specified and of low probability, it will be identified as the product of design. But at some future time, with more knowledge, it would be identified as regularity. So in such a case, the distinction between regularity and design depends not on the event but on the current state of the human understanding of nature.

Also, suppose an intelligent agent designed a natural process that incorporated chance. Human beings do this frequently – for example, football games begin with a coin flip, children's games often incorporate chance elements such as dice or spinners, and statisticians use random sampling in conducting research. In these cases, chance provides for fairness – each team in the football game has an equal chance of choosing whether or not to get the ball first, adults or older children cannot use their superior knowledge to advantage over youngsters, and every member of a target population has an equal chance of being included in the sample. So it is not unreasonable to think that an intelligent agent could design processes that include chance for various purposes.

Dembski, however, has recently denied this latter possibility. In a recent book[8], David Bartholomew argues that God uses chance. In a review of Bartholomew's book, Dembski rejects this assertion on the grounds that the clear, historical teaching of Christianity is that God knows the future so God can predict the outcomes of all events even if human beings cannot. Because God can predict them, he argues, they exhibit what appears to be chance, but it is not chance from God's perspective. He goes on to assert that, "strict uncertainty about the future means that God cannot guarantee his promises because the autonomy of the world can then always overrule God. " He also writes that "…God has given creation a determinate character…" Giving creation a determinate character is a theological position that many thinkers have taken, but it's controversial. Most importantly, however, even though Dembski's review of Bartholomew's book[9] was written a decade after publication of *The Design Inference*, it reveals an important feature of

Dembski's thinking – the strict separation of chance and design is not based on science but on theological presuppositions.

The logic of the design inference is to examine three mutually exclusive bins, let's call them A, B, and C. If an event does not fit in A, we test to see if it fits in B. If not, we test to see if it fits in C. If not, we put it in B by default. The process requires that A, B, and C be unambiguously distinguishable. But as we have seen, the explanatory filter cannot distinguish between A (regularity) and C (design) in the case of currently unknown natural laws. Furthermore, the assertion that B (chance) and C (design) are clearly distinguishable depends on theological assumptions, not on science. So the filter is not a reliable way for scientists to identify the presence of design.

In summary, then, Dembski has not achieved his ambitious goal of providing a scientific means of detecting intelligent design. The outputs of the explanatory filter can depend on human knowledge rather than on the phenomena being studied in two ways – they can mistakenly infer design when the phenomena are actually the product of currently unknown natural laws or when they are the product of unanticipated chance hypotheses. Also, the distinction between design and chance depends on theological assumptions. On both grounds, then, the design inference cannot be added to the methodology scientists can use to account for natural phenomena.

But there is another approach to understanding how design can be inferred. In a book of essays, Michael Heller argues that any discussion of science and religion necessarily involves an assertion of what science cannot do but religion can do. The key to progress in such discussions is to identify those issues that are truly outside the scope of science but on which religion can make a legitimate contribution. Heller argues that the essential issues are expressed in three questions: (1) Why is there anything? (2) Given that things exist, why do they have such an orderly, intelligible, structure? (3) How do we account for ethics and values? From this perspective, Intelligent Design is seeking to close an essential gap by trying to provide a scientific answer to the second question, something that cannot be done. That is, Intelligent Design claims that complex, specified structures provide evidence of direct action by an Intelligent Designer that cannot be accounted for by natural explanations. However, we saw earlier with the Sierpinski triangle how a highly complex, specified structure can arise from a simple random process. But that observation does not provide evidence for naturalism either – as Heller's second question points out, science cannot explain the origin of such a process. In short, one can believe in intelligent design and yet remain skeptical of the special divine action posited by the Intelligent Design movement. From Heller's point of view, the design inference infers *too little* design – all natural laws, all chance processes, and all instances of specified complexity are the results of design. But that inference is based on faith – it is not, nor can it be, a scientific inference.

Notes

1. William A. Dembski, *The Design Inference*, Cambridge University Press, 2006, p.7
2. Ibid, p.46
3. The diagram is from http://ecademy.agnesscott.edu/~lriddle/ifskit/gallery/gallery.htm.
4. A computer simulation of the chaos game can be found at http://www.cut-the-knot.org/Curriculum/Geometry/SierpinskiChaosGame.shtml.
5. *The Design Inference*, p.36
6. Ibid, p.53
7. Ibid, p.40
8. David J. Bartholomew, *God, Chance, and Purpose: Can God Have It Both Ways?,* Cambridge University Press, 2008
9. *Perspectives on Science and Christian Faith*, Volume 60, Number 4, December 2008, p.248
10. Michael Heller, *Creative Tension: Essays on Science and Religion*, Templeton Press, 2003