Was Hume Mathematically Challenged?

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Abstract

Many commentators contend that Hume made some obvious mathematical errors in I.iv.1 of his *Treatise*. This paper argues that a proper understanding of Hume's historical context exonerates Hume of any serious mathematical errors and helps to provide a plausible understanding of the nature of his argument in I.iv.1.

Was Hume Mathematically Challenged?

Commentators have recently been paying closer attention to Hume's 'Of scepticism with regard to reason'.[1] In this section Hume argues (i) that "all knowledge resolves itself into probability" (T 1.4.1.3, 181) and (ii) all probability reduces or diminishes "till at last there remain nothing of the original probability" (T 1.4.1.6, 182) so that we reach "a total extinction of belief and evidence" (T 1.4.1.6, 183). Nevertheless, many commentators continue to take a dim view of Hume's argument for the second conclusion. For instance, Louis Loeb candidly claims that the argument is "wrongheaded ...[and] ill-conceived" (2004, 356). Even more unflatteringly, in discussing Hume's "notorious" diminishing probability argument Michael Ridge makes the following remark: "Any attempt to present the argument as even remotely plausible would go beyond the present scope and moreover in my view the argument cannot be rescued" (2003, 196, note 6). Very often commentators arrive at such a conclusion because they believe that Hume has committed obvious mathematical errors. In this paper I shall argue that we need not interpret Hume as being mathematically challenged in section I.iv.1. Indeed, I shall argue that a proper understanding of Hume's historical context exonerates Hume of any serious mathematical errors and helps to provide a plausible understanding of the nature of his argument in I.iv.1. More specifically, in the first section of this paper I shall argue that accusations of being mathematically challenged seem to presuppose an anachronistic Bayesian reading of Hume's probability arguments. Freed from such an anachronistic reading, Hume can plead not guilty to the charge of violating a basic axiom of the probability calculus. In the second section I shall contend that a non-Bayesian approach helps to alleviate the puzzlement about some other seemingly odd mathematical moves in Hume's argument and allows us to reconstruct Hume's reasoning in a plausible way. Obviously the goal of this paper is modest because I do not attempt to provide an overall interpretation of Hume's 'Of scepticism with regard to reason'. Convincing commentators that there is even a possible interpretation that is remotely plausible is difficult enough it appears.

I. Bayesianism is a Bust for Understanding Hume's Probability Argument

Let us begin with Hume's own way of stating the extinction of evidence argument. Having argued that all of our beliefs attitudes are fallible and thus controlled by "probabilities", Hume emphasizes the importance of investigating such probabilistic reasoning to "...see on what foundation it stands" (T1.4.1.4, 181). Hume then returns to the key point of his previous argument: if a belief is fallible[2], then we cannot (or should not) accept any fallible belief at face value. Indeed, Hume claims that we have a *duty* to consider the possibility that we have erred in all contexts:

> In every judgment, which we can form concerning probability, as well as concerning knowledge, we ought always to correct the first judgment, deriv'd from the nature of object, by another judgment, deriv'd from the nature of the understanding.... Here then arises a new species of probability to correct and regulate the first, and fix its just standard and proportion. As demonstration is subject to the controul of probability, so is probability liable to a new correction by a reflex act of the mind, wherein the nature of our understanding, and our reasoning from the first probability become our objects (1.4.1.5, 181-182).

But once we enter these reflexive waters, we seem headed for an epistemic shipwreck. In other words, this path eventually leads to the extinction of all evidence according to Hume:

> Having thus found in every probability, beside the original uncertainty inherent in the subject, a new uncertainty deriv'd from the weakness of that faculty, which judges, and having adjusted these two together, we are oblig'd by our reason to add a new doubt deriv'd from the possibility of error in the estimation we make of the truth and fidelity of our faculties. This is a doubt, which immediately occurs to us, and of which, if we wou'd closely pursue our reason, we cannot avoid giving a decision. But this decision, tho' it shou'd be favourable to our preceding judgment, being founded only on probability, must weaken still further our first evidence, and must itself be weaken'd by a fourth doubt of the same kind, and so on *in infinitum*; till at last there remain nothing of the original probability, however great we may suppose it to have been, and however small one diminution by every new uncertainty. No finite object can subsist under a decrease repeated *in infinitum*; and even the vastest quantity, which can enter into the human imagination, must in this manner be reduc'd to nothing. Let our first belief be never so strong, it must infallibly perish by passing thro' so many new examinations, of which each diminishes somewhat of its force and vigour. When I reflect on the natural fallibility of my judgment, I have less confidence in my opinions, than when I only consider the objects concerning which I reason; and when I proceed still farther, to turn my scrutiny against every successive estimation I make of my faculties, all the rules of logic require a continual diminution, and at last a total extinction of belief and evidence (T1.4.1.6, 182-183).

In short, Hume seems to argue in this passage that a careful consideration of our fallibility leads to the conclusion that all of our beliefs lack any evidence[3] to support them. I shall call this view epistemic egalitarianism because it entails that all of our beliefs are equal, epistemically speaking.

Now we are in a position to confront our first mathematical problem. If Hume's diminishing probability argument about the *extinction* of evidence entails that the probability of a belief is zero, then it seems that the denial of that belief would have a probability of one. This inference is based on a widely accepted axiom of the probability calculus: Prob (p) = 1-Prob (not-p). And if some beliefs can be assigned a probability of one, then Hume is not entitled to claim that there is an extinction of *all* belief and evidence, which would seem to translate into the claim that (∀p) (Prob (p) = 0). So what is going on here? Bennett provides an interesting perspective on this issue:

> For many years I thought that by its 'total extinction' Hume meant a lowering of subjective probability to zero; but that credited him with an argument that is too blatantly unsound...
>
> The badness of my interpretation is something I learned from graduate students at Syracuse University, and Charles Howell showed me what to put it in its place. What Hume has in mind, I now see, is not a sinking probability but a widening margin of error. I begin by setting Prob(P) at n± 0.1[4]; then at stage 2 I alter this to n± 0.1 + k; then at stage 3 to n± 0.1 + k* for some k*>k; and so on. He thinks that if this is carried on for long enough, it will lead to a result whose margin for error is so wide as to make the

> probability assignment boring, or even vacuous, the extreme case being Prob(P) = 0.5 ± 0.5, which uninformatively puts Prob(P) in the range from 0 to 1. That is the 'extinction of belief' with which the argument is supposed to threaten us. One might wonder why each stage should further enlarge the margin of error, rather than sometimes shrinking it; but assuming the former is not as gross as assuming that each stage should lower the probability (2001, 315).

One advantage of the interpretation that Bennett endorses is that it avoids attributing to Hume a violation of an axiom of the probability calculus. Although this interpretation does have some plausibility, the text itself does not strongly suggest that Hume is thinking in terms of "margin of error".

Is there another way to rescue Hume here? Ironically the best way to interpret Hume here does entail that he violates the probability calculus *as we understand it.* Such an interpretation, however, is not uncharitable if we understand the historical context. Hume's *Treatise* was published prior to the appearance of Bayes' Theorem in 1764. So Bayesian readings of I.iv.1 run the risk of being anachronistic.[5] While many philosophers have applied a Bayesian framework to Hume's reasoning, especially about miracles, some have argued that "...much if not all of the treatment of probability in the *Treatise* itself is... non-Bayesian if not anti-Bayesian" (Gower 1991, 2). If Hume is not a Bayesian or proto-Bayesian, then how should we approach Hume's wide-ranging discussions of probability?

Historically speaking, the main alternative to a Bayesian account of probability is Baconian.[6] While both Bayesian and Baconian approaches allow for measuring the probabilities, they differ with respect to the scale of measuring. One way of summarizing the difference is as follows:

> ...what all conceptions of probability have in common is that they provide different criteria for grading degrees of *provability*, and the degrees of provability allow for two kinds of scales. Pascalian [and thus Bayesian[7]] scales take the lower extreme of probability to be disprovability or logical impossibility; the Baconian scale takes the lower extreme to be only non-provability or lack of proof. [note omitted] Because Baconian probability uses a different lower extreme than Pascalian probability, mathematical axioms that apply to the latter, such as complementational rules of negation, addition, and multiplication, do not apply to the former, with the consequence that degrees of Baconian probability are ordinal but not mathematical. Contextual considerations determine which scale is more useful or appropriate to employ. Baconian gradations of provability, its advocates argue, are particularly appropriate for assessing differential weight or relevance of evidence (Coleman 2001, 198).[8]

If Hume is indeed a Baconian with respect to probability then any violation of what is presently a widely accepted axiom of Bayesian probability calculus in I.iv.1 would be quite understandable.

So what reason do we have to think that Hume was a Baconian when it comes to probability? At a general level, Hume's conception of philosophy is certainly influenced not by Bayes but by Francis Bacon. Bacon of course is prominently mentioned in the Introduction to Hume's *Treatise* (T Intro.7, xvii) and Baconian ideas about reasoning are explicitly endorsed in *EHU* 10.39 and *EPM* 5.17.[9] Moreover several commentators have developed detailed textual arguments supporting a Baconian reading of Humean probabilities. While an extensive examination of all of the relevant texts and argumentative strategies would take us too far afield here, consider Hume's comment from his discussion of the probability of causes: "...the mind is determin'd to the superior only with that force, which remains after subtracting the inferior" (T 1.3.12.19, 138). Barry Gower provides the following commentary on this passage:

> As in the case of chances, *it is the differences between, and not the ratio of, the number of observations favourable to a predicted effect and the number of observations unfavourable to it, which measures the probability of the argument for that conclusion*. [note omitted] Thus suppose we wish to measure the probability of the belief that the next occurrence of cause *C* will produce effect *E*. Our evidence is that *m* out of *m+n* previous occurrences of C have produced E, and that *n* out of *m+n* have not produced E. Only if *m>n* will the belief in question have a probability at all, and for all Hume says we can take the absolute value of, *m-n* as a measure of this probability. Clearly, probabilities measured like this can have any positive value greater than zero. Without too much violence to the spirit of Hume's proposal we can easily modify it so as to yield probabilities between zero and one; we can simply divide the difference between the superior and the inferior numbers of observation by their sum. That is, provided *m>n*, the probability that the belief that C will again produce *E* is (m-n)/(m+n)... If it should happen that C has failed to produce E as often as it has succeeded, then m=n and the probability of the belief that E will follow C is zero. *Clearly in Hume's system zero does not signify impossibility* (1991, 15; emphasis added).[10]

From this perspective it is easy to see how Hume could claim in I.iv.1 that the probability of *any* particular belief (including p and not-p) would reduce to nothing. For Hume is simply arguing that all beliefs have the same evidential backing. All beliefs are on a par epistemically speaking, as the term epistemic egalitarianism suggests.[11] But it is difficult to accuse Hume of violating a Bayesian axiom when he operates not just in a pre-Bayesian but a non-Bayesian framework.

If this Baconian reading of Hume is viable, then we also have good grounds to claim that Hume has a normative notion of probability. According to Gower, a consequence of Hume's Baconian approach to probability is the following: "Hume's system for measuring probability is ... quite unlike modern methods. For him, to have the belief that proposition *p* is probably true is to have some good reason to expect the truth of *p* rather than the truth of *q*, where *q* is some contrasting belief..." (1991, 15). Applied to I.iv.1, this understanding would yield the reading that when Hume maintains that probability reduces to nothing, he means that there is no *good reason* to believe *p* rather than any contrasting belief.

In short, the Baconian interpretation of Hume's approach to probability is preferable for several reasons. First, it makes sense of the clear influence of Francis Bacon on Hume's thoughts. Second, it does not run the risk of anachronistically applying Bayesianism to Hume. Third, to the best of my knowledge no one has disputed the textual evidence that commentators such as Gower have presented for a Baconian reading of Hume. Fourth, it makes sense of a major part of Hume's probabilistic reasoning in I.iv.1 that would be extraordinarily problematic from a Bayesian perspective. This is not to deny that a Bayesian approach to Hume's texts might have some value.[12] But whatever insights we might gain should be reconciled or related to Hume's Baconian leanings.[13]

II. Improving the Mathematical Plausibility of the Probability Argument

Now that we have seen the advantages of a Baconian reading of Hume's understanding of probability we can tackle three other mathematical questions/worries about his argument: why should the probabilities always decrease instead of increase?[14] And even if the probabilities do decrease, why could the value not asymptotically approach a number such as 0.09 as a limit instead of zero?[15] Lastly, if we are always multiplying two positive real numbers, then how can we reach zero probability? Let us address the third worry first. Actually, this is a fairly minor point because, as many commentators have noted, maintaining that all beliefs have virtually no evidence (if the calculations approach a number close to but greater than zero) to support them is functionally equivalent to the sceptical claim that all beliefs have no evidence to support them.[16] But if the Baconian reading of Hume is correct, then the decreasing probabilities of which Hume writes could *literally* reach zero because for a Baconian zero signifies a total lack of evidential support, not impossibility. In other words, if we had to translate Hume's thesis into a Bayesian framework, we would say that all beliefs have a probability of 0.5, which is easily attainable when multiplying two positive real numbers less than one (such as multiplying .8 and .625).

Responding to the other two questions/worries about the reason why the probability will eventually decrease and why it will not reach a limit requires a more detailed look at how Hume sets up the argument. Of course, Hume's argument does not in any way deny that, mathematically speaking, probabilities can increase or approach limits. In some particular cases Hume would agree that we initially raise our estimations of the probability that we are correct (see T 1.4.1.2, 180-181). But Hume clearly thinks that certain epistemological contexts should force one to continually reevaluate the standing of one's beliefs "downward" (without approaching a limit) until one concludes that the probability that any particular belief is true is zero (understood in the Baconian sense). Why does Hume think that? If we think of probability in the Baconian sense such that "...the mind is determin'd to the superior only with that force, which remains after subtracting the inferior" (T 1.3.12.19, 138) then consider the following reconstruction of Hume's reasoning.[17] At the beginning of the section he writes about the "testimony" of reason: "We must, therefore, in every reasoning form a new judgment, as a check or controul on our first judgment or belief; and must enlarge our view to comprehend a kind of history of all the instances, wherein our understanding has deceiv'd us, compar'd with those, wherein its testimony was just and true" (T 1.4.1.1, 180). If we compare each doubt to a testifier, then each doubt must be subtracted from whatever testimony supports reason. That is to say, in such a case we are not multiplying fractional numbers between zero and one but instead tallying up the doubts that we have about our faculties and subtracting them from whatever reasons we have to trust them. In the global case of considering reason itself, he insists that these doubts proceed to infinity; in this case, we will always have as many doubts as we have reasons so that each reason will be opposed by an *equally strong* doubt. That is, whatever reasons we have for a particular proposition is always counterbalanced by the infinite number of doubts *of equal strength* that can be generated about our belief forming capacities.[18] From this perspective, the probability that a belief is true will easily drop to zero as we continually subtract the infinite number of doubts that may be raised against the testimony of reason: it need not increase and it need not reach a limit greater than zero. While one may dispute the *epistemological* assumptions driving this reasoning, it is difficult to find a *mathematical* flaw in the argument if we grant

Hume his views.

Before closing, we should note that even if one is not impressed with the Baconian casting of this argument, others have employed Bayesian arguments that have a similar outcome. Fred Wilson, for example, compares Hume's iterative probability argument to reasoning about the evidentiary force of hear-say evidence (1983, 122), noting that legal theorists like Bentham similarly contended that chains of such testimony approach zero (1983, 123). With the testimonial analogy in hand, Wilson argues that "..it is not hard...to generate Hume's sceptic's regress of probabilities, through some elementary applications of the probability calculus" (1983, 105).[19]

For the other example we leave the field of Hume studies for a more general argument. In 1952 C. I. Lewis and Hans Reichenbach clashed over a philosophical point that bears an eery resemblance to Hume's iterative probability argument. George Schlesinger summarizes Lewis's main thesis in the following manner:

> Lewis argued that if a statement can be established only as probable then it must have a ground. But if the ground itself is only probable then *it* must have a ground, which in turn must have a ground. It follows, therefore, that in order to assign a value to the probability of *e* its probability relative to its ground must be multiplied by the probability of that ground's probability relative to its own ground, which in turn must be multiplied, etc. We would thus end up assigning virtually zero to the value of *e*'s probability. Lewis thus made his famous pronouncement, "nothing is probable unless something is certain" (1991, 39).[20]

Hume's argument uncannily anticipates this particular principle and, because Hume argues that nothing is certain, bites the bullet and maintains that nothing is probable. Of course just as Hume was pronounced mathematically challenged for his argument, so too Reichenbach contends that this argument "..is invalid for mathematical reasons" (1952, 152). According to Reichenbach:

> ...the probability of [an] event is not given by the product p*q, but by a more complicated formula, the rule of elimination. Its application requires a knowledge about the probability of the event in case the sentence s is false. Let this probability be =p′; then the probability of the event is equal to q*p + (I - q)*p′. [note omitted] This expression need not be smaller than p, and can even be larger (1952, 152).

Schlesinger, though, argues that the rule of elimination does allow probabilities to dwindle away rapidly in some contexts, such as the likelihood that a message is preserved in a children's game that begins with the message whispered into the ear of one child, who whispers it into the ear of another child, and so on (1991, 42-44). Schlesinger presses the point that we can reconstruct Lewis' argument with certain epistemological assumptions so that it is based on the rule of elimination and does not violate it (1991, 44-46). The technical details of Schlesinger's defense are not important here. My main point is simply that even if we interpret Hume as a proto-Bayesian, his diminishing probability argument is defensible or, at least, not wildly implausible or obviously mistaken. And it is even more plausible if we read Hume as a Baconian with respect to probability.

Those who simply dismiss Hume's arguments of I.iv.1 or who believe that Hume's reasoning here is so mathematically fallacious that we should overlook them in the name of charity cannot maintain their stance without providing us some account of how Hume has gone astray. Given the various ways that one can plausibly reconstruct his argument for the extinction of evidence, we have good reason to claim that Hume's Baconian conception of probability allows him to argue for a robust epistemic egalitarianism. Of course I have not argued that Hume's argument *succeeds*. Unless one insists that we must interpret a philosopher as asserting true theses, I need not shoulder the tremendous burden of showing that epistemic egalitarianism is true to show that Hume affirmed it. And here I am not even concerned with the question of Hume's considered stance on epistemic egalitarianism. I have only made a strong case that Hume's argument is not only mathematically consistent and valid, but plausible as well. The burden of proof shifts to those who want to dismiss it to show why the argument is so bad.

In sum, I have contended that Hume's argument for epistemic egalitarianism is not obviously mistaken, especially if we understand Hume as a Baconian with respect to probability; those who believe that it is obviously mathematically fallacious owe us a detailed explanation of this conspicuous confusion. Given how well this Baconian perspective illuminates Hume's diminishing probability argument, perhaps we have additional evidence that Hume's probability arguments about induction, miracles, and natural religion should be read with a Baconian eye. But that is a topic for another day.

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NOTES

1. All references to the *Treatise* come in two parts. The first is a reference to a paragraph in the Norton and Norton (2000) edition; the second is a page reference to the Selby-Bigge edition, revised by P.H. Nidditich (1990). So for example a reference to Hume's famous is/ought paragraph would be (T 3.1.1.27, 469-470). The section under discussion here appears in T 1.4.1.1-7, 180-187.

2. By labeling a belief as "fallible", I do not mean to imply that the propositional content of the belief is possibly false. According to Hume, while mathematical truths are necessarily true, our epistemic grasp of such truths is fallible. As he puts it at the beginning of this section: "In all demonstrative sciences the rules are certain and infallible; but when we apply them, our fallible and uncertain faculties are very apt to depart from them, and fall into error" (T 1.4.1.1, 180).

3. Recently several commentators such as Don Garrett (see his 1997) and David Owen (see his 1999) have argued that "evidence" should not be read as a normative term of epistemic evaluation. This view strikes me as implausible and here I shall simply assume that we should understand "evidence" in the traditional "evidential grounds" way. For arguments against "non-evaluative" views espoused by commentators such as Garrett and Owen, see Loeb 2002, 43-47 (including notes 13, 15 and 19) and 102 (including notes 2 and 3).

4. The text actually reads as follows: "Prob(P) at n y± 0.1". The occurrence of the "y" seems to be a typographical error, though. So I have omitted it.

5. For an extended and technical Bayesian discussion of I.iv.1 and various related issues, see Vickers 2000. The Bayesian framework of this discussion is evident when Vickers examines I.iv.1 to provide

> ...a plausible reading of it, including an account of the application of the sceptical principle to itself. That application gets short shrift, however, in favor of attention to the apparent embodiment of the tension between empiricism and scepticism in two principles: First is the Bayesian empirical principle of Conditionalization: the posterior belief in a hypothesis after an observation should be what prior belief – before the observation – in the hypothesis conditioned upon the observation was (2000, 156).

6. For more on this approach to probability, see Cohen 1977. Although some have disputed the claim that this view of probability originated with Bacon, I shall use this term simply because it seems to be present in Bacon's work.

7. Coleman writes broadly of Pascalian probability and classifies Bayesian probability as a type of Pascalian probability (2001, 196). This classification is standard.

8. Hume's embrace of this Baconian approach would make sense considering his legal background and his ambitions as an historian, as Gower emphasizes:

> Hume was trained, and occasionally practiced, as a lawyer. Moreover, as a historian he would quite naturally have thought in legalistic terms when determining the reliability of

> witnesses and documents. He would, therefore, have been accustomed to think of a measure of probability as expressing a degree of provability. So, for example, if there were good reasons favouring a position and equally good reasons against it, then a fair minded jury should come to the conclusion that the proposition in question is not proven and there is no probable argument in its favour. That is to say, if certainty represents one end of the probability scale, then uncertainty represents the other end. So, when the numbers of chances for and against my winning in a game of chance are equal, there will be no proof either of my winning or of my losing; the chances will cancel or 'destroy' each other so as to leave the outcome quite uncertain. There are, as it were, zero degrees of probability that I will win, and that I will not win (1991, 8).

9. For some discussion of these passages, see Coleman 2001, 197 and 223, note 10.

10. Interestingly enough, Dauer's reconstruction of Hume's iterative probability argument (that aims to show that "...decent sense can be made of it and that it is not *clearly* mistaken" (1996, 227)) crucially employs the notion of justified degrees of confidence:

> Since justified degrees of confidence...aren't probabilities, let's introduce the notation 'Cr(q)' for it. Let Cr(q) range between O (for having no reasons for q) and 1 (for being justified in having full confidence in q). Let Cr(∼ q) also range in this way between 0 and 1. In [some cases], we can expect $0<Cr(q)<1$ while $Cr(\sim q)=0$. While credibilities of this sort clearly aren't probabilities, in some cases Cr(q) can be more like probabilities in that $Cr(q)+Cr(\sim q) = 1$ (1996, 222).

Dauer's notion of credibilities sounds uncannily similar to the Baconian conception of probability (so when he claims that they aren't probabilities, I presume that he means that they are not Bayesian probabilities). Dauer's arriving at such a reading of Hume's argument provides independent support for the Baconian reading of Humean probabilities.

11. It is probably worth noting in this context that from a Bayesian perspective epistemic egalitarianism entails that all beliefs have a probability of 0.5 while from a Baconian perspective epistemic egalitarianism entails that all beliefs have a probability of 0.

12. As Gower puts it:

> ...the problems in applying Bayesian analyses to those of Hume's arguments which appeal to probabilistic considerations are greater than have been acknowledged. Hume's *conclusions*, about induction, miracles, and natural religion can, indeed, be generated by Bayesian methods. Perhaps, even, some of Hume's *premisses* can be fairly represented in Bayesian terms. But it does not follow that his *reasoning* is Bayesian. Indeed, this consequence cannot follow if the rift separating our probabilities from Hume's is as deep as I have claimed (1991, 17).

13. For interesting discussion of some related issues, see Ferguson 2002.

14. See, e.g., Imlay 1981, 126.

15. Bennett provides a version of this worry in the following passage:

> ...an infinite series can have a finite sum. Suppose for instance that the stage 2 reflection increases the margin of error by 0.1, stage 3 by a further 0.01, stage 4 by a further 0.001, and so on *ad infinitum*, the final margin of error does not spread to 1 but merely to 0.11111... A margin of error, in short, may expand for ever without spreading over much of the territory (2001 vol. 2, 316).

16. Wilson puts the point this way:

> "Vanishingly small" will do as well as "zero" in undermining in belief and evidence. Moreover, given that no mathematician of that age was ever clear on the distinction between zero and the vanishingly small, that is, on the nature of infinitesimals, it is a harsh judge indeed that will condemn Hume for a similar failure of understanding (1983, 102).

See also Imlay 1981, 126, DeWitt 1985, 131, Morris 1989, 51 and Dauer 1996, 214.

17. This particular reconstruction is admittedly a bit speculative. But given the evidence supporting a Baconian reading of Hume, this reconstruction is a *plausible* way to understand Hume's reasoning that avoids any *obvious* mathematical errors. That is, it undermines that suggestion that Hume's argument is so mathematically flawed that we cannot provide a plausible reading of his reasoning.

18. Gower's discussion of an earlier part of the *Treatise* is similar to my interpretation of I.iv.1:

> It is clear... that a legal model is influencing Hume's thinking. Some evidence produces 'testimony', as it were, for one side of a case to be judged; other evidence produces 'testimony' for the other side. To reach a judgment we must find a way of balancing the one against the other. If the testimonies are qualitatively equal, *i.e.* count as equally reliable, then in coming to a conclusion we can consider only the quantitative difference between those which prove the case and those which disprove it. For example, in a legal context, if there are three equally reliable witnesses, two of whom testify that a certain event occurred at a certain time and place whilst the other testifies that it did not, then the force of the probable argument for the conclusion that the event did occur could be said to arise from our subtracting the disproving testimony from the proving testimony. So, if a further witness, just as reliable, were to come forward and were to testify for the event's having taken place then the force of the probable argument for that same conclusion would be doubled, whereas if he were to testify for its non-occurrence then that force would disappear altogether (1991, 8).

19. For a criticism of Wilson's analogy, see DeWitt 1985, 133-136. In the end DeWitt admits that "...it is not terribly critical whether Hume intended his probability argument of I,iv,1 to be of the same form as the hearsay argument..." because he agrees that "...there is a reconstruction of Hume's argument, consistent with Hume's text, which is valid and contains no obviously false premisses" (1985, 136).

20. Reichenbach (1952, 151) also attributes this argument to Bertrand Russell.