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# MUNDANE OR INCREDIBLE!? IDENTIFYING WHEN AN EXPLANATION IS REQUIRED

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This work explores the difference between something being merely extremely improbable but believable and something being literally incredible—unbelievably improbable without intervention of some sort. In the former case, a rational person would not expect a special explanation for the occurrence, but in the latter, she does. It is difficult to determine when an explanation is required for a highly improbable occurrence that, regardless of its unlikelihood, has happened. Simple probability calculus does not help, since the objective improbability of an event does not directly affect the reasonableness of attributing something to chance. Formal methods of assessing evidence such as Bayesian theory also seem to be unhelpful in supplying a general guide that is applicable in a variety of situations. One reason for this is that the extremely low probabilities involved ensure that the required assessments of prior probabilities are often inscrutable, resulting in unreliable calculations.

Roger White has suggested that the crucial feature of unbelievably improbable events is that they challenge our assumptions about their surrounding circumstances.[1] While this may be true, it is not very informative, for the primary assumption being challenged is that the situation is a result of mere chance. Elsewhere he notes that events that do not require explanations will be part of a homogeneous set.[2] But this also contributes very little to the task at hand, and White makes no attempt to provide a thorough account of when an explanation is needed for improbable events. In contrast, we want to know what features incredible events have that indicate they are not due to chance alone. John Leslie and Peter van Inwagen have proposed principles that can be used to distinguish when an especially improbable event may reasonably be attributed to mere chance and when the rational person should expect a more robust explanation. The weaknesses of their principles are shown and a revised principle is proposed that is more suited for the task.

To begin, consider three cases. Case 1: Suppose you enter a classroom of fifteen students, each having been assigned a university identification number. If you ask them to list the last four digits of their ID numbers on the board (in order of their seating arrangement, left to right, front to back), the (prior) probability of having that particular sequence of numbers is $1 \times 10^{-60}$. Though very improbable that this particular sequence occurs, it is reasonable to attribute the sequence to mere chance, with no further explanation required. We encounter such unlikely occurrences quite often in daily life.

In contrast, consider Case 2: Suppose you meet Cal for the first time at your poker group. Despite the current trends favoring "hold-em" styles of play, your group plays traditional five card draw with no wild cards. Cal gets a royal flush in spades on the first hand, with no replacement cards required. This is probably the first time you have ever seen that happen, but you could reasonably attribute it to chance, though it will make for good conversation later. But suppose that Cal also gets a royal flush in spades without replacement cards on the second hand. And the third. And suppose, contrary to what any rational poker player would do, you keep playing. For an additional six consecutive deals, Cal gets a royal flush in spades without replacement of cards. A total of nine times, the hand occurs in the first nine rounds of the night. The probability of this occurring is about $1.85 \times 10^{-58}$, which means that Cal's streak is slightly more likely than getting the series of numbers in the classroom as described in Case 1. Although Cal's run of royal flushes is slightly more probable than something mundane and attributable to randomness, it is unreasonable to consider Cal's fantastic streak the result of mere chance. No one who has a goal of winning would keep playing with Cal, even if there were no apparent method he was using to cheat.

Finally, consider Case 3: The university where Hal works issues new ten-digit computer security identification numbers to all of its employees. In casual conversation with some colleagues, Hal mentions that he is going to get a new identification number since the number he was issued is the same as his home phone number and he considers that a potential security risk. To his surprise, he finds that the next five employees with whom he speaks about this also have security identification numbers identical to their home phone numbers. (The individuals in question represent a fairly broad cross section of employees.) The probability of this randomly happening for all six of Hal and his friends is the same as in Case 1. It may have happened because someone in computer security made a very bad decision. Or maybe a technician hit a few buttons wrong when the numbers were designated. Or maybe a hacker reset the security numbers this way. In any case, it is obvious that this is not mere chance and some explanation is needed.

What is it about Case 1 that makes us recognize that it is reasonable to attribute its occurrence to mere chance, but irrational to think that Cases 2 and 3 are due to mere chance? Particular concerns are relevant, such as the knowledge that some people have cheated in card games in the past. But it would be helpful to have a general principle that can be used as a guide. Various aspects might be emphasized. One difference between Case 1 and Case 2 is that in the poker game, the extremely improbable occurrences were of value, at least to Cal, while the list of student numbers had no particular value. But in Case 3, Hal rightly considered it problematic that home phone numbers were used as security numbers. So value is an unreliable indicator. This is compounded by the fact that value often has a subjective nature, making it difficult to identify.[3]

In his investigation of contemporary design arguments, John Leslie has worked on this problem of distinguishing mere chance events from occurrences that require an explanation. Leslie suggests that having a "tidy explanation" of the event in one situation contrasted with having no similarly tidy explanation in another is the key factor.[4] Leslie provides several examples of situations where there are tidy explanations and those in which there is none. Indeed, we have a tidy explanation of the poker hands—Cal is cheating—that we lack in the case of the student identification numbers. But determining what constitutes a "tidy explanation" is not an easy task. For Case 3, we considered three explanations, but it is unclear how "tidy" they are. Two aspects of "tidiness" seem to be significant. First, the explanation should be plausible. Second, the explanation should not be applicable to other possible outcomes.

Peter van Inwagen, following Leslie, has expanded on these two aspects, providing a more formal principle for identifying when it is unreasonable to ascribe an improbable event to mere chance. Van Inwagen proposes the following:[5]

> Suppose there is an n-membered set of inconsistent and exhaustive possibilities (all about equally probable), $A_1, A_2, \ldots, A_k, \ldots, A_n \ldots$ Suppose further that $A_k$ is the member of this set that is actually realized. Suppose the number *n* is very, very large. (We can understand "*n* is very, very, large" this way: if a number between 1 and *n* has been chosen at random, it was very, very *improbable* before the random choice was made that that number would be chosen.) If we can think of a possible explanation of the fact that $A_k$ was realized that is a good explanation if it is true, and if we can see that, if one of the other possibilities in the set had been realized, no parallel explanation could be constructed for the realization of that other possibility, then the fact that it was $A_k$—and not one of the other *n*-1 possibilities in the set—that was realized cannot be ascribed simply to chance (at least not offhand, not without further argument).

Let us call van Inwagen's principle the Not Chance Principle or NCP. How would the examples above fare on NCP? The specific student identification numbers in Case 1 were not stated, but it is safe to assume that the numbers formed a sequence that had no particularly striking feature. There is no special explanation for the particular number series such that no parallel explanation could be provided for a different set. On van Inwagen's principle, we have no reason to doubt that the set is due to mere chance. Case 2 does not seem to fit as well. Here is an explanation of the outcome ($A_k$) that is good, if true: Cal is cheating. But consider an alternative possible outcome (something other than $A_k$), such as Cal having four aces in each of his first nine hands. A parallel explanation for this other possibility exists: Cal is cheating. Likewise with a series of nine consecutive straight flushes, and many other series of hands. So, besides $A_k$, there exist several other possible outcomes that have parallel explanations that are good if true. Although NCP may succeed for the task van Inwagen had in mind, which was to identify a sufficient condition for something not being attributable to chance, the principle is quite limited for it does not identify a fairly clear case of some type of manipulation as requiring an explanation. Can the principle be expanded so that it identifies more cases, including Case 2?

Here is a revised version that is adjusted for this weakness, NCP2 (italics indicate the substantive changes from NCP):

> Suppose there is an *n*-membered set of inconsistent and exhaustive possibilities (all about equally probable), $A_1, A_2, \ldots, A_k, \ldots, A_n$, where *n* is extremely large. Suppose further that $A_k$ is the member of this set that is actually realized. If we can think of a possible explanation of the fact that $A_k$ was realized that is a good explanation if it is true, *and if we can see that there are no or only a relatively extremely small number of other possibilities that are such that, had any one of them been realized, a parallel explanation could be constructed for the realization of those other possibilities (call this set the K set)* then the fact that it was Ak—a member of the K set—that was realized cannot be ascribed simply to chance (at least not without further argument).

NCP2, in contrast with NCP, gives reason to believe that Cal's hand was not due to chance. The other possible ways of cheating need not dissuade us from thinking that he was cheating in the actual sequence of hands. There are very few ways of assuring winning hands relative to all the possible ways Cal's hands could have gone. The phrase "a relatively extremely small number of other possibilities," is obviously vague. Though caution is in order in suggesting a proportion, something less than 0.01% seems a rough guide; some higher proportions may also be an acceptable mark, but certainly less than that is sufficient for raising red flags and can indicate that something was not due to mere chance. In any case rather than false precision, it seems best to leave NCP2 with that vagueness. NCP2 appropriately allows for other possible ways that things could have gone such that an explanation is still expected. It recognizes that even if other outcomes may have a parallel explanation, as long as those are a very small proportion of the set of possible outcomes, it is still unreasonable to attribute the actual occurrence to mere chance.

Unfortunately, a weakness remains in NCP2 that was imported from NCP. The questionable phrase remaining in NCP2 is the qualifying claim that the explanation should be a "good explanation if it is true." This phrase does little to provide a limitation on acceptable explanations, for it is quite unclear what it means for something to be a good explanation if it is true. Apparently something can make an explanation good, even if not true, or the qualifying conditional claim is unnecessary. Also, it seems that an explanation being true is not sufficient for it to be good. In the case of Cal, suppose it were true that there are poker gods who wanted to reward Cal for his unique dedication to the game (for this was his 2,632nd consecutive evening of playing poker, a record that may never be broken). If it were true that poker gods existed and wanted to reward Cal in this extravagant way, then what is wrong with the explanation that the poker gods manipulated the cards? If that is what actually happened and it adequately and truthfully accounts for the effect, would that make the explanation a good one? What is it in general that makes something a good explanation? These questions deserve more attention, but they present a too large of a tangent to be pursued in full here.[6] However, it is worth noting that one could make the case that the explanation involving poker gods who are rewarding Cal is not good even if it were true, primarily because it does not fit in with our general knowledge of the world. Explanations also need to have some plausibility or they will make no sense. For the purposes here, it seems we can improve NCP2 by replacing the phrase "a good explanation if it is true." Again, substantive changes are indicated by italics.

NCP3:

> Suppose there is an *n*-membered set of inconsistent and exhaustive possibilities (all about equally probable), $A_1, A_2, \ldots, A_k, \ldots, A_n$, where *n* is extremely large. Suppose further that $A_k$ is the member of this set that is actually realized. If we can think of a possible explanation of the fact that $A_k$ was realized that is *plausible and consistent with the knowledge of the world that rational and generally well informed people have*, and if we can see that there are no or only a relatively extremely small number of other possibilities that are such that, had any one of them been realized, a parallel explanation could be constructed for the realization of those other possibilities (call this set the K set) then the fact that it was $A_k$—a member of the K set—that was realized cannot be ascribed simply to chance (at least not without further argument).

The added clause makes the principle more practically useful, for NCP3 more clearly rules out poker gods and other fantasies, for these are not consistent with our knowledge of the world. When providing a principle about whether something requires a special explanation, we should consider broadly held and shared knowledge. Such limitation is needed so that fantastic possibilities need not be considered. If they were allowed, no distinctions of the kind we seek could be made. For more particular endeavors such as scientific research projects, specialized knowledge of the area also may be included, but the principle as stated remains more widely applicable.

One may object that NCP3 is still seriously flawed. Suppose that Cal had nine mundane hands instead. Suppose also, though no one suspected it, Cal cheated and precisely arranged the cards so that the nondescript hands he had included the exact cards he planned. He may have done this in order to practice cheating, for Cal knows that practice makes perfect. The objection is that now there is a parallel explanation for a *majority* of possible hands that Cal could have had. But if we have a parallel explanation of the remaining series of hands in the complement of the K set, then NCP3, similar to the original NCP, fails to identify Case 2 as one that requires an explanation. It seems that NCP3 is susceptible to giving "false negatives," and it may not flag the poker case after all.

There are two things to note in response to this objection. First, the objector's conclusion assumes that the explanation of Cal practicing cheating in routine hands is parallel with the explanation that he is cheating when being dealt the winning hands from among the K-set. The explanation that Cal is practicing cheating, however, is *significantly less* plausible for the series of hands in the complement of the K set, than it is for the series of hands in the K set. For skilled cheating of the type we are considering is extremely rare, while getting a series of hands from among the complement of the K-set is very common. It is quite implausible to suggest that someone is practicing cheating when they have any of the series of hands in the non-K set. Thus, the explanation that Cal is practicing cheating when he receives some series of hands from the non-K set is *not* parallel to the explanation that he is cheating in the situation of Case 2. So NCP3 is generally sufficient for distinguishing the two situations and the objection is unwarranted.

But the second thing to note is that the objector's case shows that the principle is subject to false negatives, even if not for the reasons suggested. NCP3 is not sufficient to identify each and every occurrence that is not due to mere chance. For even if extremely rare, it is possible that someone practices cheating by arranging hands that will not draw attention to his efforts, and if that did occur, NCP3 would fail to identify the situation as not being merely due to chance. There may be many other cases that appear to be due to mere chance, but in fact are not. But unlike in medical diagnostics, in this context a false negative is not very problematic. While we want to keep them at a minimum, our finite minds and limitations of knowledge imply that we will never be able to avoid false negatives entirely. We will never have a principle that guarantees we identify every extremely improbable occurrence that is not due to mere chance. After all, rational people can fail to believe many truths and these are simply more cases of those types.

Diagnostic tests also sometimes have false positives, and so could NCP3. A false positive would be a situation that NCP3 identifies as due to something other than mere chance, when it in fact was mere chance. Indeed, false positives are possible but they will be extremely rare. It is theoretically possible that someone be dealt nine straight royal flushes in spades due to mere chance. But if it were to occur, it remains unreasonable to believe that it was due to mere chance (without additional evidence). Even though the possibility of a false positive exists, its occurrence will be so extremely rare, that for any given situation that NCP3 identifies as not due to chance, one should still believe that that case is not a false positive. It is similar to having a worldwide lottery with one winner to win a billion dollars. It is possible that you will win, but it is entirely unreasonable for anyone to believe that she will win prior to the results. Yet, someone will win. Though a false positive could occur, in any case where the principle guides one to think an occurrence is not due to mere chance, it is quite reasonable to trust the principle.

So we have a moderate success. NCP3 is not foolproof. It allows for some false negatives and some false positives. Minimizing these is important but eliminating them entirely will be impossible. Even the most rational person believes some things that are false and fails to believe many truths, so a principle that allows for a comparable weakness is not a failure on that account.

Following Aristotle's wisdom that precision varies according to context, NCP3 strikes a balance and is a helpful guide for distinguishing those extremely improbable situations that ought to be investigated from those that should be attributed to mere chance.[7]

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## NOTES

1. Roger White, "Fine-Tuning and Multiple Universes," in *God and Design: The Teleological Argument and Modern Science*, ed. Neil A. Manson (New York: Routledge, 2003), p. 239.

2. Roger White, "Explanation as a Guide to Induction," *Philosophers' Imprint*, vol. 5, no. 2 (2005), p. 3.

3. For example, suppose John wins the lottery. It is of great value to him and of course highly improbable. But it is not of value to all (or at least the vast majority of) others who bought a ticket and it requires no special explanation. Also, one may value something for obscure reasons that are not shared by others.

4. John Leslie, *Universes* (New York: Routledge, 1989), p. 10.

5. Peter van Inwagen, *Metaphysics*, 2nd ed. (Boulder, Colo.: Westview Press, 2002), p. 152.

6. For more on explanation, see White, "Explanation as a Guide to Induction," and references provided therein.

7. My gratitude goes to David Haugen and Eric Kraemer, who provided helpful feedback on an earlier version of this paper.