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Title:
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Date:
2021-01-01

Citation:
Sankey, H. (2021). How not to know the principle of induction. International Journal for the Study of Skepticism, 11 (3), pp.243-254. <https://doi.org/10.1163/22105700-bja10020>.

Persistent Link:
<https://hdl.handle.net/11343/281415>

How Not to Know the Principle of Induction

1. Introduction

The problem of induction is the problem of how to justify induction in a non-circular manner. If we infer from the past reliability of induction to its continued reliability in the future, we use induction to support itself. We reason in a circle and thereby fail to justify induction. If induction is unable to be provided with a non-circular justification, the result is scepticism with respect to beliefs that are based on induction.¹ Such scepticism would apply *inter alia* to everyday predictions regarding the future as well as to scientific knowledge of universal laws. It may even give rise to scepticism about the external world if knowledge of objects outside the mind is taken to require an inductive inference from sense experience to the existence of external objects.

Philosophers have long sought a solution to the problem of induction that avoids the sceptical outcome. Some of the most prominent attempts to solve the problem may be briefly enumerated as follows. The pragmatic response claims induction will work if any method will work. The analytic solution takes reasoning inductively to simply be part of what it means to be reasonable. The falsificationist “solves” the problem by doing away with induction altogether. Some downplay the circularity by distinguishing virtuous from vicious circularity (or rule from premise circularity). Others suggest the circle may be avoided by a regress of

¹ Sometimes known as “Hume’s problem,” the problem of induction is customarily associated with David Hume, e.g. (1777), IV.

higher order inductive principles. In this paper, I consider a well-known attempt to provide an *a priori* justification of induction.²

In his classic introductory text, *The Problems of Philosophy*, Bertrand Russell presents a justification of induction which is based on a principle that he refers to as “the principle of induction”. This principle underlies our use of induction. It thereby provides a rationale for the inductive inferences that we routinely make. The principle is one of a number of principles that Russell refers to as “logical principles”, and which he takes to be known on an *a priori* basis. In this paper, I seek to show that Russell’s proposed justification of induction in *The Problems of Philosophy* is unsuccessful.

2. The principle of induction

According to Russell, our use of induction depends on the principle of induction, a principle that we know to be true.³ The question I wish to pursue is on what basis we know the principle to be true. Before turning to that question, let us first consider the principle of induction itself.

² For detailed discussion of the best-known attempts to solve the problem of induction, see Salmon (1966) and Skyrms (2000). For up-to-date coverage, see Henderson (2018).

³ In this and subsequent sections, I quote extensively from *The Problems of Philosophy*. The reason is that Russell’s main presentation of the principle of induction in chapter VI of the book is not explicit about the *a priori* status of the principle. That the principle is an *a priori* one only emerges from remarks scattered throughout the remainder of the text. Hence, my discussion contains a significant exegetical element. It is a reconstruction of Russell’s view based on remarks that are of relevance to the principle rather than reporting what Russell explicitly says when he presents the principle.

Russell formulates the principle of induction as follows:

- (a) When a thing of a certain sort A has been found to be associated with a thing of a certain other sort B, and has never been found dissociated from a thing of the sort B, the greater the number of cases in which A and B have been associated, the greater is the probability that they will be associated in a fresh case in which one of them is known to be present;
- (b) Under the same circumstances, a sufficient number of cases of association will make the probability of a fresh association nearly a certainty, and will make it approach certainty without limit. (Russell (1912), 66)

This statement of the principle of induction relates to use of induction to make a singular prediction. As Russell says, it “applies only to the verification of our expectation in a single fresh instance” (1912), 66-7. However, Russell also offers a modified version of the principle which relates to the use of induction to arrive at a general law. The modified version of the principle may be briefly characterized as follows: the greater the number of A’s that have been B’s, the more likely it is that all A’s are B’s. The distinction between inductive inference about particular cases and inductive generalization is an important one for understanding the nature and practice of inductive inference. But, for the purposes of this paper, the difference between the two formulations of the principle is not essential. The question of interest here is the epistemological one of how it is possible to know that the principle of induction is true. That question is independent of the form of any particular inductive inference, whether it be singular, universal or otherwise.

3. The justificatory role of the principle

What role is played by the principle of induction? The principle enables us to justify belief that is based on an inductive inference. Suppose we have observed a great many white swans, and no swans that are not white. Given the principle, we are justified in inferring that the next swan we see is likely to be white. We are thereby justified in believing that the next swan we observe will be white.

The principle of induction plays a justificatory role with respect to beliefs based on induction. When we employ induction to justify a belief the justification of the belief derives from the principle of induction. An inductive inference is justified to the extent that it conforms to the principle of induction. A strong inductive inference, for example, one in which A has strong correlation with B, and no correlation with non-B, derives considerable support from the principle. By contrast, a weak inductive inference, for example, one in which A has little or no correlation with B, and is frequently not associated with B, derives little or no support from the principle. In this way, the principle of induction plays a justificatory role with respect to our use of inductive inference.

Russell's point is not simply that appropriate use of induction on a particular occasion is justified on the basis of the principle of induction. He takes the principle of induction itself to be justified. Indeed, he takes it to be known to be true. In effect, we know that our use of induction is justified because we know that the principle of induction is true. But on what basis is it justified or known to be true?

4. Neither disprove nor prove

Russell makes two key points regarding the epistemic status of the principle of induction.

The first point is that it is not possible to disprove the principle of induction:

... a man who had seen a great many white swans might argue, by our principle, that on the data it was *probable* that all swans were white, and this might be a perfectly sound argument. The argument is not disproved by the fact that some swans are black, because a thing may very well happen in spite of the fact that some data render it improbable ... The fact, therefore, that things often fail to fulfil our expectations is no evidence that our expectations will not *probably* be fulfilled in a given case or a given class of cases. Thus our inductive principle is at any rate not capable of being disproved by an appeal to experience.

(Russell (1912), 67-8)

Thus, according to Russell, the principle of induction may not be shown to be false by means of experience. This may be explained in terms of the example of white swans. If a great many swans have been observed to be white, and none have been observed to be non-white, then it is probable that all swans are white. Given this, it may be predicted that the next observed swan will be white. But suppose that instead a black swan is observed. Given the evidence available prior to observation of the black swan, it still was probable at that time that all swans are white. The fact that a black swan is observed does not undermine the claim that, given the evidence, it is probable that all swans are white. Thus, a false inductive prediction does not show the principle of induction to be false.

It is not just that the principle cannot be shown to be false. It is impossible to show that it is true. Russell puts the point as follows:

The inductive principle ... is equally incapable of being *proved* by an appeal to experience. Experience might conceivably confirm the inductive principle as regards the cases that have been already examined; but as regards unexamined

cases, it is the inductive principle alone that can justify any inference from what has been examined to what has not been examined. All arguments which, on the basis of experience, argue as to the future or the unexperienced parts of the past or present, assume the inductive principle; hence we can never use experience to prove the inductive principle without begging the question.

(Russell (1912), 68)

Russell allows that past experience may support the principle. For example, observation of a fresh case of A being B where A has previously been correlated with B fits with and confirms the principle. But this only works for observed cases. There can be no direct evidence for the principle in relation to unobserved items prior to observation of those items. To show that the principle applies to unobserved items (e.g. future cases), the principle must itself be assumed. The principle must itself be employed to argue that it applies to unobserved cases.⁴ Any attempt to establish the principle by appeal to experience begs the question on behalf of the principle.

In sum, Russell holds that the principle of induction is unable either to be shown false or to be shown true by appeal to experience. But if the principle may neither be proven nor disproven by appeal to experience, this suggests that it is not an empirical principle. That is, it is not a principle that may be known to be true or false on the basis of empirical evidence. How, then, can it be known to be true?

⁴ Here Russell appears to closely follow Hume, who remarks that no argument from experience can show the future to resemble the past, “since all these arguments are founded on the supposition of that resemblance” (Hume (1777), IV, II, 32).

5. *A priori* self-evidence

Russell understands the principle of induction to be one of a number of general principles governing knowledge and reasoning that are “self-evident logical principles” (Russell (1912), 72). Apart from the principle of induction, such principles include the laws of identity, contradiction and excluded middle, which are known as the “laws of thought” (Russell (1912), 72). Principles such as these are presupposed in all of our reasoning but cannot themselves be established by argument or empirical evidence. Because the principles are unable to be shown true by argument or empirical evidence, Russell takes them to be self-evident.

Russell explains this as follows:

In most questions of daily life, such as whether our food is likely to be nourishing and not poisonous, we shall be driven back to the inductive principle But beyond that, there seems to be no further regress. The principle itself is constantly used in our reasoning, sometimes consciously, sometimes unconsciously; but there is no reasoning which, starting from some simpler self-evident principle, leads us to the principle of induction as its conclusion. And the same holds for other logical principles. Their truth is evident to us, and we employ them in constructing demonstrations; but they themselves, or at least some of them, are incapable of demonstration. (Russell (1912), 112)

Russell takes the principle of induction and the other logical principles to be true. Moreover, he takes them to be known to be true. Their truth is evident to us even though we may not establish their truth by reasoned argument.

For Russell, then, the truth of the general logical principles is unable to be known on the basis of sense experience or by reasoned argument. And yet they are known to be true due to their self-evidence. What kind of knowledge is this? Here Russell sides with the continental

rationalists in rejecting the empiricist idea that all knowledge comes from sense experience (Russell (1912), 73). Some knowledge does not arise from experience. Rather than being known on the basis of experience, the principles are known *a priori*. They are known in a manner that is independent of experience. As Russell writes, “some knowledge is *a priori*, in the sense that the experience which makes us think of it does not suffice to prove it, but merely so directs our attention that we see its truth without requiring any proof from experience” (Russell (1912), 74).⁵

For Russell, *a priori* knowledge of the principle of induction is a form of “intuitive knowledge” (Russell (1912), 133). Intuitive knowledge stands in contrast with “derivative knowledge”. Derivative knowledge is knowledge that ultimately arises from intuitive knowledge by means of inference. Inference plays no role when an item of knowledge is known intuitively.⁶ Intuitive knowledge is immediately evident to us rather than being based on demonstration or proof. It is, as Russell says, “luminously evident” (Russell (1912), 111). As we have seen, Russell takes knowledge of *a priori* logical principles such as the principle of induction to be intuitive knowledge. But intuitive knowledge is not restricted to logical

⁵ It seems clear in context that Russell does not intend for the word ‘see’ in the phrase “see its truth” to be understood in the literal sense of seeing with one’s eyes, i.e. as in visual perception. Instead, the word ‘see’ is being used to describe a cognitive rather than a perceptual act of seeing. Perhaps ‘apprehend’ or ‘recognize’ would be better words to express the idea.

⁶ *Terminological comment:* I have chosen to use the phrase “known intuitively” rather than “known by means of intuition”. Russell does not employ the word ‘intuition’ in this context. Instead, he speaks of intuitive knowledge and knowing intuitively. The significance of this point is not immediately apparent, though it may avoid any implication that there is a faculty of intuition.

principles that are known *a priori* to be true. Russell takes immediate perceptual knowledge as well as knowledge based on memory to constitute intuitive knowledge as well.

Russell regards items of intuitive knowledge as self-evident. Self-evidence admits of degrees (Russell (1912), 117). The strongest form of self-evidence provides “an absolute guarantee of truth” (Russell (1912), 137). This form of self-evidence obtains when one is directly acquainted with the fact to which a true belief or statement corresponds. Weaker forms of self-evidence provide only a “partial guarantee of truth” (Russell (1912), 136). Weaker forms of self-evidence apply where a judgement is made on the basis of evidence rather than direct acquaintance with a fact. Russell takes perceptual knowledge and knowledge of some of the principles of logic to possess the highest degree of self-evidence. But “the inductive principle”, he says, “has less self-evidence than some other principles of logic” (Russell (1912), 117). Despite having less than maximal self-evidence, the epistemic status of the principle of induction remains that of *a priori* knowledge.

6. Interpreting probability

Russell’s proposed justification of induction consists in saying that it is justified by the principle of induction which is known to be true on an *a priori* basis. This is an intelligible and maybe even coherent position. But is it correct? I wish to suggest that there is reason to think that it is not.

As we saw in section 2, Russell states the principle in probabilistic terms. It is important to ask what is meant by the notion of probability in the context of the principle of induction. Russell does not explicitly say how he understands the notion. However, as is well-known, the notion of probability may be interpreted in a number of different ways. This suggests that Russell’s principle of induction may in turn be understood in different ways. How the principle

is understood will depend on how the notion of probability is understood. For present purposes, I shall focus on the two main ways of understanding probability, the subjective interpretation and the objective interpretation.⁷

Belief admits of degrees with variation in strength. According to the subjective interpretation of probability, probability is degree of belief. A high probability reflects a high degree of belief. If one is certain about a belief, then that belief has a maximal probability of one. If one has strong but inconclusive evidence for a belief, then one's degree of belief will be less than one but significantly greater than a half. If one has insufficient evidence to either believe or disbelieve a proposition, one may withhold judgement about the proposition. The probability of such a belief would be one half, or perhaps marginally greater or less than half. If one has good evidence that the belief is false, then the degree of belief will be less than half. On this conception of probability, the probability of a belief just is the degree of belief in the proposition believed.

By contrast with the subjective interpretation, on an objective interpretation, probability resides in the world rather than in the mind. One way of thinking about probability in objective terms is to think of it in terms of frequency. That which occurs frequently has high probability.

⁷ For detailed analysis of the alternative interpretations of probability, see Salmon (1966), 65-96 and Skyrms (2000), 137-50. Russell leaves the concept of probability unanalyzed in *The Problems of Philosophy*. However, he explores different interpretations of probability in considerable detail in later work (e.g. Russell (2005), Part V). For present purposes, I ignore distinctions between different kinds of subjective and objective interpretations of probability. What is important here is the distinction between subjective interpretations which locate probability inside the mind, and objective interpretations which locate probability in the world outside the mind.

What rarely or infrequently occurs has low probability. If, for example, rabbits are extremely common in a given region, then the probability that we will see a rabbit as we drive through the region is quite high. By contrast, if koalas are very rare in that region, then the probability that we will see a koala as we drive through the region is extremely low. Probability in this sense is frequency of occurrence rather than degree of belief. It is entirely possible that one might have an elevated degree of belief in a proposition even though the probability of an event which would make the proposition true is extremely low in the frequency sense of probability.

7. Subjective construal

Let us turn first to the subjective interpretation of probability. It is possible to construe the principle of induction in light of the subjective interpretation of probability. On such a construal, probability is interpreted as degree of belief. Understood in this way, the principle says that the greater the number of A's associated with B, the higher the degree of belief that we have that the next A will be B. In other words, a strong correlation of A with B gives rise to strong belief that the next A will be B.

Can this be known *a priori*? The question is how it is known that one's degree of belief increases as the correlation of A with B increases. It seems entirely possible that an increase in degree of belief is something that may be known on the basis of an introspective survey of one's beliefs. For, in order to determine one's own degree of belief, one need only reflect upon the nature of one's beliefs rather than appeal to sense experience or the world outside the mind. Accordingly, one may introspectively monitor one's degree of belief to determine whether the strength of one's belief that the next A will be B increases in line with an increasingly high correlation of A with B. Assuming that this is the case, it seems to be possible to know *a priori* that our degree of belief that the next A will be B increases as A is found to be increasingly

associated with B. This is something that may be determined by thought alone rather than by empirical observation.⁸

The trouble is that this is of little assistance with the justification of inductive inference. We may well know *a priori* that our degree of belief increases as we observe an increased correlation of A with B. But such an increase in subjective degree of belief is of no relevance to the reliability of inductive inference in application to the world outside the mind. There is not the slightest reason for mere increase in degree of belief to yield confidence that induction is a reliable guide to the way things stand in the world itself. The mere fact that my degree of belief increases has no implication whatsoever with respect to the question of whether the next A that I observe will in fact be B. As we are often made painfully aware, our beliefs about the world can well fail to correspond to the way the world actually is.

Against what I have argued in this section, it might be objected that subjective probability should not be understood as degree of belief *simpliciter*. It should instead be understood as degree of *rational* belief. When a belief has a high probability in the subjective sense, it is not just that an individual has a strong belief but that the level of epistemic

⁸ Here I assume that an introspective survey of, or reflection upon, one's beliefs gives rise to *a priori* justified belief or knowledge about one's beliefs. It is possible that one might take the view that introspective access to and reflection upon one's beliefs constitutes a form of experience. But this would have the effect in the current context of making knowledge based on introspection or reflection *a posteriori* rather than *a priori*. It would also involve an unusual understanding of what is meant by experience, which is usually taken to be perceptual experience arising from the use of our senses (*viz.*, vision, hearing, smell, taste and touch).

justification that the individual has for the belief is high. The question now is whether one's degree of epistemic justification may be known *a priori*.

This question gives rise to issues which relate to the dispute between epistemic internalism and externalism which are outside the scope of the present paper.⁹ But the following point may be made. If epistemic justification is construed in an internalist manner, so that it is possible for an individual to determine their level of justification by introspective access to the grounds of their belief, then it is possible to have *a priori* knowledge of degree of rational belief. For one may determine the level of justification of one's belief by reflection alone without need to know how the world in fact is. But, as before, the relevance of such an internal evaluation of grounds of belief to whether the next A will in fact be B has simply not been established. The question of the reliability of inductive inference when applied to the world outside the mind brings in external factors which cannot be known in an *a priori* manner to obtain.

8. Objective construal

Let us now turn to the objective interpretation of probability. As understood here, the objective interpretation of probability construes probability as frequency of occurrence. That which occurs frequently is probable and that which occurs infrequently is improbable. On this interpretation, the principle of induction tells us that if a great number of A's have been observed to be B, and none have been observed not to be B, it may be concluded that in general A's are frequently B. In other words, high correlation of A with B indicates that A's are

⁹ For detailed analysis, including distinctions between different forms of internalism (e.g. accessibilism, mentalism), see Pritchard (2016), 77-90.

frequently B. Thus, the principle of induction licenses an inference from high correlation of A and B to a generalization about the frequency with which A's in general are B. It also licenses an inference to the effect that the next observed A is likely to be B.

The question is whether it may be known *a priori* that observed correlation is an indication of actual frequency. In effect, this is a question of how it may be known that the world is the sort of place in which a large number of past observed A's being B indicates that in general A's are more frequently B or that the next A will be B. What we are considering is a substantive factual question about the nature of reality. In effect, the question is whether nature is uniform. The question is whether a correlation of properties that has been observed to obtain in the past reflects the fact that this correlation holds in general, and not just in the observed cases. But such a factual question is not one that may be answered by thought alone. It is an empirical matter which would need to be determined by empirical investigation of the way that the world in fact is. It cannot be determined by pure thought without empirical information that the world is the sort of place in which past observed correlation indicates frequency with respect to all cases, both observed and unobserved.¹⁰

In sum, it is quite unreasonable to suppose that we may have *a priori* knowledge that past correlation indicates overall frequency of occurrence. This is simply not the sort of thing that may be known independently of experience. I conclude that, on the objective construal of

¹⁰ Of course, as noted in section 4, we would be unable to show that the world is the sort of place in which past correlation is indicative of overall frequency without presupposing the principle of induction. But the point here is not that nature cannot be shown to be uniform by *a posteriori* means. The point here is that this cannot be done by *a priori* means either.

probability, the principle of induction is unable to be known on an *a priori* basis. Hence, the principle cannot play the role assigned to it by Russell in the justification of inductive inference.

9. Conclusion

The notion of probability is ambiguous. Russell's principle of induction may therefore be interpreted in two different ways. If interpreted in terms of the subjective interpretation of probability, the principle of induction may be known *a priori* to be true. But it is unclear how this should give us any confidence in our use of induction, since induction is applied to the external world outside our minds. If the principle is interpreted in light of the objective interpretation, it cannot be known to be true *a priori*, since it applies to frequencies that occur in the world outside the mind, and these cannot be known without recourse to experience. Given these two points, I conclude that Russell's principle of induction fails to provide a satisfactory justification of induction.

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