Can we solve the problem of induction?

1. Introduction

Imagine the following scenarios:

1. We are out on a boating cruise in the Pacific Ocean and discover a new island. Upon entering the island we are greeted by a flock of blue birds with very distinguishing features (they can't fly because their wings are upside-down, causing them to flap into the ground whenever they want to take off). For the first few days, we are scouting the island and constantly come across these blue birds with upside-down wings. There are many other birds around on the island, but all of them can fly. All the birds we have encountered so far with upside-down wings are blue. After a while we conclude that all the birds on the island with upside-down wings are blue. We have reached a *general* conclusion about a *complete* set of *states of affairs* from observation of an *incomplete* set of states of affairs. [1]

2. Every day we get up in the morning and our room is filled with sunlight. This does not in any way surprise us: the sun has risen every day of our lives and we assume that it will continue doing so for ever. Again, we have reached a *general* conclusion. This time, however, we have reached a conclusion about an infinite set of *events* from a finite number of observations of the event. [2]

3. We are in a physics laboratory and make the observation that all objects fall at a uniform acceleration in a vacuum. Maybe with the help of some theory we conclude that all objects - regardless of shape, size or mass - fall at a uniform acceleration in a vacuum. We also conclude that this will always be the case in the future. In this case we have again reached a general conclusion. But in this case we have reached a conclusion about a complete state of affairs *and* an infinite set of events in one go.

In all three of the above examples we have reached a general conclusion from a finite or incomplete number of observations. This is what's known as *induction* or *inductive inference.* In the first example our inductive inference was about things as they are *everywhere*. In the second example it was about things as they are *forever.* And in the third example - typically for science - the induction tells us what things are like *everywhere and forever.*

Induction is opposed to *de*duction, where a true general conclusion is reached from its premises in virtue of the fact that **the validity of the premises does not allow for the falsehood of the conclusion**. This, however, is not the fact with induction: **the validity of an inductively reached conclusion is *not guaranteed* by the validity of its premises.** And this is exactly where a big problem arises, namely the problem of induction.

The problem of induction can be phrased as follows: How can we ever reach a general conclusion about a state of affairs or a set of events if we have *no guarantee* as to their validity. In other words: is induction *rational.*

[1] example partly taken from Arnold Zuboff
[2] example due to David Hume

Who can really tell for sure that the sun will go up tomorrow morning? As Bertrand Russell states, a chicken, having been fed by the farmer every morning of its life, wakes up in full expectation of being fed but to its great surprise finds that it is led directly to the slaughterhouse to have its head chopped off.[3] We might just as much wake up one morning, finding that the sun has not risen or that all objects start floating around in defiance of Earth's gravity. These possibilities are just as much *logical* as the possibility that the world came into existence five minutes ago, complete with our beliefs that it has existed for x million years.[4]

In the remainder of this essay I want to expound on the problem of induction and clarify where the problems really lie, concentrating individually on the two fields of *scientific method* and *epistemology*. In part 2 I shall take a look at a general discussion of the problem of induction. In part 3 I shall look at how the problem relates to scientific method, taking a close look at how Karl Popper tried to solve the problem and arguing that Popper circumvented the problem without solving it. In part 4 I will discuss the problem of induction as it relates to epistemology and I will argue that the original problem is not so much a problem in itself, but that it leads to what I shall call 'the second problem of induction', which I will discuss in parts 5 and 6, considering scientific method and epistemology respectively.

2. The problem of induction: general discussion

A close analysis of the problem of induction is best started with the *metaphysical* problems it incurs as to the problem of *necessity.* This problem can best be described with the example of cause and effect as discussed by David Hume. Hume asked the following question: when an event A causes an event B, what is it that *necessitates* event B occurring as a result of event A occurring. Furthermore, if we accept this necessity, is there any way in which we can access this necessity consciously.[5] Hume asserts that "even after we have experience of the operations of cause and effect, our conclusions from that experience are *not* founded on reasoning, or any process of the understanding."[6]

The same problem of necessity can be applied to all other cases of induction[7]: do we have epistemic access to the necessity of X always occurring when Y occurs? Hume thinks not, and through partly introspective reasons he finds a strong argument for his case, and hence induction for him is very problematic. I will leave this issue at the side for the moment and try to find an answer for Hume in part 4.

[3] The Problems of Philosophy, 1912:35
[4] and this is just as logically possible as the fact that we may the figment of the mind of some evil demon: the notion of *scepticism* comes in here very strongly and I shall return to that issue later on.
[5] As Hume puts it: "When it is asked *What is the nature of all our reasonings and conclusions concerning [the] relation [of cause and effect]?* it may be replied in one word, Experience. But if we ... ask *What is the foundation of all conclusions from experience?* this implies a new question, which may be of more difficult solution and explication". (Hume 1955:32)
[6] David Hume An Essay Concerning Human Understanding, Chapter 4.2.
[7] I take it here that the assumed causal relation between two events is an example of induction.

Besides its metaphysical problem, induction also comes across some problems related to the field of *logic.* There seems to be a burning urge to be able to defend induction with principles of deduction, in order to guarantee the validity of inductive conclusions. It quickly gets clear that inductive arguments cannot be defended by some deductive argument and therefore induction is not *logical.*

One line of defence against this assertion is to say that inductive inferences are not 100% valid nor are they 100% invalid, but that they are *probable* to a degree between 0 and 100%. This argument does not take us very far however, since the probability expressed is still global, whereas the evidence to back up this probability is still taken from a finite number of observations. The probability argument therefore cannot escape the problem of induction.

Another line of defence is that induction can be defended by induction: we have seen that induction has been successful in the past and that therefore it will be successful in the future. Deductivists hold that this argument presents a very vicious circularity. However, as David Papineau[8] quite rightly points out, even deduction falls victim to this sort of circularity: the logical rules that are used to prove the overall validity of deduction are themselves derived through deduction.[9]

Even if, however, we accept induction as an argument against induction, we face a problem that was formulated by Nelson Goodman in 1953: Imagine we designate the predicate "grue" to all objects that are green when first observed before time *t* and blue when first observed after *t.* If we then state before time *t* that all emeralds are green, we can equally state that all emeralds are grue. However, this gives us the uncomfortable outcome of stating that all emeralds observed after time *t* will be blue.[10] I shall come back to this obvious problem posed to induction in parts 4 and 6.

3. Induction and Science

The philosophy of science is very much concerned with the problem of induction. The issues here are of two types: normative and descriptive. In other words, to what extent *does* induction actually play a part in scientific method and to what extent *should* it. The naïve inductivist can be said to claim that "If a large number of As have been observed under a wide variety of conditions, and if all those observed As without exception possessed the property B, then all As have property B." (Chalmers 1978:5). This position has its obvious drawbacks: how large is large? how wide is wide? And then there is the obvious problem of induction as stated above: where is the guarantee?

Karl Raimund Popper claimed that inductivism is and should not be a tool with which to deal with scientific enterprise. He offered an alternative that he thought would sweep the problem of induction out of the way: falsificationism. In short, Popper claimed that science was an ongoing process of conjectures and refutation of conjectures through falsification, and that any conjecture that was not capable of being falsified was not worthy of being scientific and was thus pseudo-scientific. Inductive methods play no part and hence the problem of induction can virtually be ignored and therefore has been "solved" as far as it concerns science.

But has it? Popper seems to ignore the fact that even a falsifying observation is very much subject to the problem of induction. Obviously a falsifying observation will not be relied upon when it is just made once, so the observation is emulated over and over again, in order to ensure that the falsification really is a falsification and not just merely some experimental error. But is not this repetition of falsifying observations just induction?

To conclude, it seems that induction cannot be escaped when setting up scientific models. There have, however, been attempts to give a descriptive and normative account of scientific method that don't merely use induction, but that place induction in a spot where it creates least harm. Imre Lakatos and Thomas Kuhn both proposed scientific methods that were consistent with the history of science hitherto (which cannot be claimed of Popper) and which attempted to give a normative framework which would make all future science respectable. Thus the problem of induction is not so much solved, but ways are found to deal with it, such that it causes minimal harm.

Induction and Epistemology: is there really a problem?

In epistemology it is undisputed (and indeed indisputable) that beliefs are formed through using inductive inferences and not merely deductive ones. The problem of induction, as seen from an epistemological point of view, can thus be formulated as: **How can we really know about something if our knowledge is based on beliefs which are inferred inductively.**

At this point I would like to raise the question: is there really a *problem* with induction?

Above I have presented the argument that induction is not logical and hence not rational. I very much think that we are committing a semantic fallacy if we equate rational with logical. [11] If we do equate the two, then we can agree with the critics of induction: nobody ever claimed that induction was *logical.*

---

[8] David Papineau, Philosophical Naturalism, 1993:158

[9] Papineau says that both the deductive defence of deduction and the inductive defence of induction are circular, but they are not *premise*-circular (i.e. the conclusion is not contained among the premises) which would make them vicious, but they are *rule*-circular, which does not necessarily make the argument vicious. Goodman even says that such circularity can be seen to be *virtuous.* (Papineau's 1993:157 ; Goodman 1953:64)

[10] Nelson Goodman: Fact, Fiction and Forecast, 1953

[11] Imagine the following scenario: we are in the post-office, the queue is enormous, mostly due to the fact that only one counter out of 20 is open. The man in front of us is getting really impatient, and once he is at the counter he starts screaming at the man behind the counter in a very abusive manner, because he had to wait so long in the queue. The rest of us in the queue might have observed that the man behind the counter was doing his utmost to work quickly and may murmur something to the extent that the screaming customer is behaving irrationally. When we say that, however, we are not in any way referring to his lack of deductive reasoning that we are all employing. We probably decided not to yell at the man behind the counter for a reason that was derived in an equally *inductive* manner. We still considered ourselves rational, however, and our designation of the angry customer as being irrational was based far more on the *way* he reasoned inductively, not the mere fact that he was reasoning inductively.

How about the claim that we lack the access to a notion of necessity needed to justify our inductive reasoning? At this point I would like to propose a genealogical-functional view of induction, that will do away with many of the problems. Let us imagine the following scenario: we are in a state of nature, where all around us there are animals that reason in all sorts of ways. Some reason inductively, others reason completely randomly, others (Descartes would be especially fond of these) reason purely deductively, and others reason in a counter-inductive way[12]**.** What happens in such a world? Animals begin to die because their method of reasoning is not functionally adapted to the environment. The counter-inductivists and the deductivists probably go first (the latter dying of starvation while trying to deduce if the fruit before them really exists), followed by those that reason randomly. Who's left: the inductivists. My point here is that as human beings we have, through evolution, functionally adapted to use induction via a mechanism designated as *conditioning*. It can be argued that this conditioning-mechanism is precisely the mechanism that is needed to recognise the *necessity* of the recurrence of events that Hume was looking for.

The above argument may seem a bit un-philosophical in its nature, but if we allow our sensory organs to be sources of knowledge - and our sensory organs developed in an evolutionary way that made them functional for our survival and for knowledge - then why shouldn't we be able to ascribe the same importance to induction.

Goodman's problem can be looked at in a similar way: would we seriously claim that all emeralds are grue? I somehow doubt that the use of predicates such as grue or bleen would tally with our developed sense of induction, since it does in a way *splice* the set of events into two, and an inductive statement usually refers to a complete set of statements. I think therefore, that if we used a term such as grue, we would be distributing our reasoning over two sets of possibilities, which would be tantamount to saying that everything will happen in an opposite way than so far. But above I have argued that this is not the way we function, since we developed in a way as to accommodate a *full* notion of induction.

To conclude this section I want to answer the question: is there really a problem with induction? I would argue that there isn't, if one takes a looser reading of the word. If the problem is that we can't argue logically for induction, then this is surely *a* problem, but is it necessarily so big as to be called *the* problem? Arguably not, and I think that if we relied entirely on deduction for knowledge and survival, we would be talking about a far bigger problem, namely the *problem of deduction.* Induction at least allows us to gain knowledge about the world, the same would not apply if we relied merely on deduction.

But I think there is a second problem related to induction, which is: *when* is induction a reliable source of knowledge (epistemological and scientific). It is to this question I want to turn now.

5. The proper use of induction: science

[12] i.e. they generalise that things will not happen the way they have always happened so far. Lemmings may be a species of animals who miserably fail to apply the principle of induction when year after year, they go and jump in the sea, not learning a lesson from their ancestors, who all failed to return when they were also 'just going for a quick swim'.

In section 4 I concluded that induction has to be accepted as at least one constituent of scientific method and pointed to the theories of Lakatos and Kuhn. The important thing about the methods proposed by both authors is that they do not allow simple falsification or simple induction to refute / confirm scientific theory. Rather, they see scientific method as a much larger structure[13] where observation and theory interact in a way that produces a continual shift in the two. In other words: the inductive rules are shifted by a theory in order to deal with observations whereas at the same time the inductively derived observations shift that very same theory.[14]

Nelson Goodman makes a similar statement about rules of reasoning in general when he says that "A rule is amended if it yields an inference we are unwilling to accept; an inference is rejected if it violates a rule we are unwilling to amend" (1953:64)

In other words, scientists seem to refuse to want to set up a certain standard or set of rules for the proper use of induction, in full line with Popper's theory of falsification[15]**.** The necessity to find such a precisely defined use of induction is much bigger in the field of epistemology, however, to which I now turn.

6. The use of induction: epistemology

For epistemology, the second problem of induction can be formulated as follows: **Under *what circumstances* do inductively inferred beliefs constitute knowledge?** In other words: how should induction be used and how should it not be used, if it should contribute to knowledge?

As in opposition to science, we cannot afford the luxury of leaving the question open, since the discipline of epistemology requires definite answers. One way of answering the above question is to say that induction should be *reliable.* But this does not bring us much further, since we still have to define reliable, and attempts to do this often end up with an inductive defence of induction[16]**.**

Even if I asserted above that Goodman's new problem of induction didn't seem so much of a problem because of its artificiality, it still creates the problem that enumerative inductions *can* be created so as to generate very unreliable conclusions. Goodman uses this problem himself to show that only *projectible* predicates should be used in inductive statements and not *non-projectible* predicates[17]**.**

[13] Lakatos calls these "research programmes", Kuhn talks about "paradigms"

[14] Again we can observe something like a functional evolution of the use of induction in science.

[15] If we set up a firm body of rules for induction, we are creating a framework whereby this framework acts as an unshakeable basis. However, in any scientific model, every component should be open to attack, even the rules for induction used.

[16] Papineau in Grayling 1995:136

[17] Quine (1969:115) transposes the notion of projectible features to the Raven paradox, where the observation of a green leaf confirms the existence of non-black non-ravens, and therefore the existence of black ravens. Quine says that a green leaf cannot project anything into the notion of black ravens, and therefore the conclusion must be done away with.

Another way to define the right circumstances for the use of induction has been by using the notion of *coherentism*. [18] Coherentists would argue that an inductive inference would be justified if it is coherent with the rest of our beliefs. Coherentism takes us a long way, but there are some problems with it, as there are with coherentism in general[19].

As we can see, the task of defining the right usage of induction is not an easy one in epistemology. I have tried to briefly present a few solutions that are mutually compatible, but need to point out, however, that the debate is still very much in action and that no solution has been generally agreed upon.

7. Conclusion

At the beginning of this essay, I asked the question if the problem of induction could be solved? In this essay I have tried to show that we have to be careful about what the problem of induction really is and have concluded that there are really two problems. I have argued that the original problem of induction indeed cannot be solved, but that - at the same time - it is not really that much of a *problem*. Instead, it leads us to a second problem of induction, which is to find the circumstances in which induction can be seen as justifiable. And this seemed to pose us with a much bigger problem. I have argued that a solution to this question is less important for scientists than it is for epistemologists, and that the quest for an answer is still very much in action.

To end with, I want to add that my discussion of the subject of induction has very much let scepticism back in as a serious problem: the sun may indeed not rise tomorrow. But, as is often the case in epistemology, there is something comforting about having scepticism as a potential opponent: a theory has then advanced to such an extent that only the most radical counterexamples could bring it down. And it is no doubt that the burden of proof in this case lies with the sceptics.

---

[18] Dancy 1985:208

[19] e.g. are our sets of beliefs really coherent?