

EVIDENCE AND INFERENCE

Abstract

I articulate a functional characterisation of the concept of evidence, according to which evidence is that which allows us to make inferences that extend our knowledge. I show that this entails Williamson's equation of knowledge with evidence.

1 Introduction

What is evidence? In this paper I shall consider the relationship between evidence and inference. That inference is important to the characterisation of evidence should be clear. We do seek evidence not for its own sake. Rather we want evidence because evidence will allow us to draw conclusions, that is to make inferences. It is evidence that allows us to infer that a theory is true or to know that a defendant is guilty. Can we use this intuition to tell us what evidence is? In what follows I will argue that it can. I have two objectives:

- (a) To articulate a functional characterisation of the concept of evidence. In short, I propose that evidence is what allows us to make inferences that extend our knowledge.
- (b) To provide an indirect argument for my characterisation by showing that it entails Timothy Williamson's claim that all and only knowledge is evidence, for which there is independent support.

2 The concept of evidence characterised

As is well known, Williamson argues that S's evidence is precisely what S knows. While we may regard this as a substantive and necessarily true identity claim, akin to 'water is H₂O', we should note that Williamson's argument is an *a priori* one. Williamson's *a priori* identity between knowledge and evidence invites the question, why do we have a concept of evidence at all? In what follows I suggest that we have a concept of evidence in order to characterise certain propositions *functionally*. Put in general terms, the concept of evidence serves to characterize propositions in terms of their role in inference. This is apparent from the fact the the term 'evidence' is most naturally used in the context of a proposition's being 'evidence *for*' some conclusion (or sometimes 'evidence against' and other cognates).

The characterisation of the concept of evidence I propose is this:

- (EC) p is in S's evidence if and only S can gain knowledge by inference from p .

(EC) captures the intuition that evidence is what we infer from in order to get knowledge; it acknowledges an asymmetry between evidence and what evidence is evidence for. Yet the asymmetry afforded by (EC) is local not global. Given some particular inference, it is the ‘what is inferred from’ that is the evidence. (EC) is consistent with its being the case that the knowledge inferred from evidence itself thereby becomes evidence, evidence that can be used as the premise of some further inference.

(EC) is the conjunction of the two implications:

(EC \rightarrow) if p is in S’s evidence then S can gain knowledge by inference from p ;

and:

(EC \leftarrow) if S can gain knowledge by inference from p then p is in S’s evidence.

I shall go on to give reasons why (EC \rightarrow) and (EC \leftarrow) provide accurate characterisations of the concept of evidence. But first some clarifications. The ‘can’ employed is intended to be a moderately loose kind of possibility, meaning ‘can in principle’. Reflecting on (EC \rightarrow), we want the ‘can [in principle]’ not to be refuted by the following cases and those like them. (a) S might have made all the inferences he is able to make from p , so there is no new knowledge to be had. (b) p might be so complex that it taxes S’s intellectual capacities to the limit just to entertain p . So although S knows p , S’s attempts to infer anything from p might be doomed to failure. (c) an evil demon zaps S’s brain whenever S attempts to make an inference from p . In all such cases S could in principle extend his knowledge by inference from p . Regarding (a) there may be some other fact q such that were S to know q , then S would be able to infer new knowledge from p and q together; regarding (b) and (c) were S’s intellectual capacity greater or not being disturbed by the evil demon, S would be able to make knowledge-producing inferences. In such cases S’s actual failure to make knowledge-producing inferences is due to no feature of the evidence but only to peculiarities of S’s particular situation. What (EC \rightarrow) seeks to bring out is that if something is evidence, then its epistemic status is enough to permit a subject to make knowledge-producing inferences, even if in fact a subject would not do so for unrelated reasons. (One can say that possession of evidence confers on the subject a disposition or ability, for which the cases cited are interferers.)

As regards (EC \leftarrow), it is important that p play a non-redundant role in the inference. Take any knowledge-extending deductive inference: we can include p as a premise in that argument, and indeed we can construct an argument in which p might appear to play a role (e.g. using and-introduction followed by and-elimination). I do not think that the notion of redundancy can be formalised. For example one might think that p is a redundant premise in the set $\{\Gamma \cup p\}$ in a derivation of q if q can be derived from Γ alone. But it might be that any derivation from Γ alone is very different from the former (all such proofs might be much longer) and it might be beyond the intellectual capacity of our subject to construct such a derivation. In such a case p would not be redundant in the sense relevant to (EC \leftarrow), and should be included amongst S’s evidence for q . The concept of redundancy also extends to the components of p if p is complex, e.g. a conjunction: the proposition $(r \wedge s)$ would not be part of one’s evidence just because one could gain knowledge by inference from r .

3 All evidence supports knowledge-producing inferences

In this section I shall provide the argument for:

(EC \rightarrow) if p is in S's evidence then S can gain knowledge by inference from p .

The idea behind (EC \rightarrow) is that evidence has a sufficiently high-grade epistemic status that a subject is capable of gaining knowledge by inference from it. (EC \rightarrow) contrasts with the claim that evidence might be epistemically low-grade and might be incapable of supporting knowledge-producing inferences. Hence the clarification of (EC \rightarrow) in Section 2 excluded purely accidental reasons why a subject might fail to produce knowledge from his evidence. Similarly, for a counterexample to (EC \rightarrow) a failure to produce knowledge must be attributable to the epistemic weakness of the evidence, not to the weakness of the inference procedures employed. Nor should a counterexample depend on its being the case that S is for some reason not entitled to use that inference procedure (e.g. because S happens to believe the procedure to be unreliable). 'S can gain knowledge' implies 'S will gain knowledge (in principle, and if perfectly reliable inference procedures are employed that are of a kind that S can use to gain knowledge)'.

Thus (EC \rightarrow) would be false if either of the following were true: (A) S infers q from evidence p by a perfectly reliable, appropriate procedure, but S's resulting belief, q , is not justified. (B) S infers q from evidence p by a perfectly reliable, appropriate procedure, but S's resulting belief, q , is not true.

That (A) is not true is clear. It is at the very least the function of evidence to justify our hypotheses. If a subject uses a faultless inference procedure to gain a new belief from her evidence, then the new belief is justified.

The falsity of (B), although less immediately apparent, follows immediately if all evidence is true, since all reliably inferred propositions will be true. Are all evidence propositions true? That all evidence is true is the best explanation of the requirement on any hypothesis that it must be consistent with the evidence. If evidence must be true, then this requirement excludes a set of propositions all of which must be false. The requirement that hypotheses be consistent with the evidence would lose its force if false propositions were among our evidence, for then perfectly true propositions would be excluded as being inconsistent with our evidence.

A response to this argument suggests that the injunction that a hypothesis must be consistent with the evidence is derived from the prohibition on believing contradictions. If one permitted hypotheses inconsistent with the evidence one would be permitting contradictions. But this response is inadequate, since the requirement of consistency with evidence is stronger than the prohibition on contradictions. If one is inclined to believe both of two propositions that contradict one another, the prohibition on contradictions means that one cannot fully believe both. In order to fully believe either of the propositions, one will have to reject the other. The prohibition on contradictions does not say which to reject. It may be that further evidence is required in order to decide between them. The requirement of consistency with the evidence is stronger since it does tell us which of the two contradictory propositions to reject. If a hypothesis and the evidence contradict one another, then the hypothesis is to be rejected. No further evidence is required. Of course, one may not always know what one's evidence is. In which case one might be in the position of

doubting that one's evidence is indeed evidence when it conflicts with a favourite, well-confirmed hypothesis. But it remains that case that if one did know in such a case that one's supposed evidence is indeed one's evidence, then one would be able to reject the hypothesis as false without further ado. This makes sense only if one's evidence is true. If one's evidence is true, then what is reliably inferred from it is also true. Hence (B) is false.

(That evidence is true makes it apparent that evidence must be conceived of in an externalist fashion. I shall return to this in more detail in Section 6. For the moment I shall reiterate that a strong conception of evidence is forced on us by the principle 'reject a hypothesis inconsistent with the evidence'. For example, we do not accept the principle 'reject a hypothesis inconsistent with what you believe'—for it may be appropriate to drop the belief instead. Hence evidence must be more than mere belief.)

Since (A) and (B) are false, we may conclude that evidence must be capable of supporting inferences that yield beliefs that are both true and justified. We know that not all true justified beliefs are knowledge. But it would be very odd if evidence could support inference to true justified beliefs but not to knowledge. Furthermore, Gettier cases typically arise because of reliance on justified but false lemmas. But the falsity of (B) means that we can rule out false lemmas. So there is no reason to suppose that evidence is capable of supporting inferences producing justified true beliefs without being able to support knowledge-producing inferences. We may conclude that evidence is indeed capable of supporting knowledge-producing inferences.

4 Propositions supporting knowledge-producing inferences are evidence

In this section I shall discuss:

(EC \leftarrow) if S can gain knowledge by inference from p then p is in S's evidence.

While (EC \leftarrow) is a natural counterpart of (EC \rightarrow) neither implies the other. (EC \leftarrow) can be true without requiring (EC \rightarrow). One could deny that evidence must be capable of supporting knowledge-producing inferences, yet agree that if some inference does produce knowledge, its premises must be among one's evidence. At the end of Section 3 I argued that (EC \rightarrow) entails all evidence must be knowledge. Although (EC \rightarrow) and (EC \leftarrow) are independent, it will be convenient to assume this consequence of (EC \rightarrow) in the discussion of (EC \leftarrow).

(EC \leftarrow) asserts the epistemological significance of evidence. If (EC \leftarrow) were false, then there are propositions that are not evidence but from which one can nonetheless make knowledge-producing inferences. Thus to deny (EC \leftarrow) would be to deny the place given to evidence in epistemology. If (EC \leftarrow) were false, it would be possible to gain knowledge by inferring from propositions not among our evidence, in which case there would be no reason for us to care about which propositions are among our evidence. A criticism may be made of S's claim to know q thus, "Proposition q is not supported by your evidence!". The falsity of (EC \leftarrow) would permit S to reply, "True, q is not supported by my evidence. But I did infer it from non-evidence propositions that support knowledge-generating inferences."

One might reject (EC \leftarrow) while still giving evidence key role. This role would be foundational. An inferred proposition may be thought of as standing at the near end of a chain (or tree) of inferences. For the inferred proposition to be known the chain of inference must start from evidence propositions. But the intermediate propositions need not count as evidence also. An adjustment to (EC \leftarrow) that encompasses this view would be:

(EC \leftarrow)' if S can gain knowledge by inference from p and p is not itself known by inference then p is in S's evidence.

According to the view of evidence just considered, inferred propositions cannot count as evidence, whereas non-inferred propositions, such as propositions known by direct perception, may so count. It should be noted that on this view, what counts as evidence may be very vague. The theory-ladenness of perception means that it will be unclear whether or not a known proposition should count as inferred or not. For example, it seems as if the fact that a tomato is ripe can be known by direct perception. But for some people, e.g. children, that the difference between ripe and unripe tomatoes is a difference in colour may be a fact that is learned, and so their knowledge that the tomato is ripe is inferred. As they become accustomed to making this inference, it passes from a conscious to an unconscious process, and until it would be inappropriate to call it an inference at all. So knowledge that the tomato is ripe will be something that is non-evidential at one stage but is evidential at a later stage. That some theory of a concept entails that it is vague is no objection to that theory on its own. But this vagueness does suggest that evidence could not play a central role in epistemology. Does it make a deep difference that in one case the proposition that the tomato is ripe is inferred from its perceived redness (and so is not evidence, according to (EC \leftarrow)' and in another case its ripeness is directly perceived (in which case the proposition is evidence)?

More of a problem for (EC \leftarrow)' is the fact that evidence propositions can be forgotten. Let q be inferred from a proposition p that is evidence by the lights of (EC \leftarrow)'. Then r is inferred from q . We may imagine that all the propositions are known. Let it be the case that between the first inference and the second inference the subject forgets the proposition p , so when inferring r she has no knowledge any longer of p . According to (EC \leftarrow)' she has no evidence for r : her evidence cannot be p , since she has forgotten p ; nor can it be q , since q is inferred and is thus not knowledge. That seems distinctly odd, since this subject certainly has a good reason for her belief in r (viz. her knowledge of q), and it again undermines the idea that evidence is epistemically significant.

5 Evidence and knowledge

The preceding sections articulated and defended the view, (EC), that p is in S's evidence if and only S can gain knowledge by inference from p , while also resisting an alternative view that S's evidence is just S's non-inferential knowledge.

If (EC \rightarrow) is true, then evidence itself cannot be less than knowledge, i.e. (E \rightarrow K). The principle 'no false lemmas' states that an inference that depends essentially on a false premise cannot generate knowledge. The principle can be extended. If an inference depends essentially on a premise that lacks sufficient justification to be knowledge, then the conclusion of the inference will also lack the requisite degree of justification for knowledge. This will be so whether justification is conceived of

externally (for example in terms of reliability) or internally (for example in terms of rules of rational belief-formation). ‘No false lemmas’ may be up-graded to ‘no unknown lemmas’ (i.e. no propositions may be used as essential premises that are not known to be true):

(NUL) S can gain knowledge by (non-redundant) inference from p only if S knows p .

‘No unknown lemmas’ plus (EC \rightarrow) gives us that all evidence is knowledge:

(E \rightarrow K) if p is in S’s evidence then S knows p .

The ‘no false lemmas’ (NFL) condition on inferential knowledge asserts that if an inference depends essentially on a premise that is false, the inferred proposition is not known. If an essential premise were true but unjustified the inferred proposition is not justified either, and so is not known. Consequently, for an inference to generate knowledge, its essential premises must be both true and justified. But as Gettier has shown, there is nothing special about true, justified beliefs. If p is a Gettier-style case of a justified true belief that is not knowledge, then we should not expect an inference that depends on p to be knowledge generating. Typically p is a proposition that is accidentally true, e.g. $p = q \vee r$, where q is false but justified but r is true but unjustified. But if p is accidentally true its truth cannot make any difference to the epistemic status of what is inferred from p . But since propositions inferred from false lemmas are not knowledge (NFL), neither then are propositions inferred from accidentally true propositions. In the kind of Gettier case just mentioned, an inference from p that yields a justified conclusion will depend essentially on the contribution of the disjunct q of p (since only the disjunct q is justified). But in that case the inference depends on a false lemma, and the conclusion is not knowledge. Hence an inference from a premise which is a Gettier case of a justified true belief that is not knowledge will not yield knowledge. Nothing short of a known premise will yield knowledge.

Hence, the left to right implication of (EC), (EC \rightarrow), entails that all evidence is knowledge. Correspondingly the right to left implication of (EC), (EC \leftarrow), entails that all knowledge is evidence, when conjoined with the highly plausible principle that inference from knowledge is knowledge generating:

(KI) if S knows p S can gain knowledge by inference from p ;
 (EC \leftarrow) if S can gain knowledge by inference from p then p is in S’s evidence;
therefore
 (K \leftarrow E) if S knows p then p is in S’s evidence.

(KI) is simply the idea that inference from what we already know has the power to extend our knowledge. Of course, there may be some strange cases where an individual is prevented from extending his knowledge by inference from a proposition p that is known to him (e.g. the evil demon who zaps his brain whenever he tries to infer something from p). As discussed, we should understand ‘can’ in the above principles as not being refuted by such cases.

To my mind it is difficult to see how anyone could deny (KI). However, the fact that (KI) looks similar the closure principle for knowledge might make one think that someone such as Nozick who rejects closure should reject (KI) as well. But that is not the case. (KI) does not imply closure although it is implied by closure. Even Nozick,

who is the best known denier of closure, thinks that some inferences from what is already known can extend knowledge. He simply rejects the claim that every (known) valid inference extends knowledge. Let p be the proposition that there is a book in front of me. From this proposition I may validly infer q , that there is a book somewhere near me, and r , that I am not a brain in a vat being deceived into thinking that there is a book in front of me. According to Nozick's tracking account of knowledge, the inference from the known proposition p to r does not yield knowledge. But the same account does show that the inference to q does succeed in yielding knowledge. So Nozick's ground for rejecting closure, his tracking account of knowledge, far from being a reason to reject (KI) in fact confirms it.

If we combine (KI) with (NUL) we get the following extended 'knowledge by inference' principle:

(KI+) S can gain knowledge by inference from p if and only if S knows p .

Recalling:

(EC) p is in S's evidence if and only S can gain knowledge by inference from p .

(KI+) and (EC) directly give us:

(E \leftrightarrow K) p is in S's evidence if and only S knows p .

The fact that (EC), along with the plausible (KI+), entails (E \leftrightarrow K) is indirect evidence in favour of (EC). For Timothy Williamson has argued persuasively for (E \leftrightarrow K) on independent grounds. The grounds are independent since Williamson's arguments proceed principally on the basis of whether we would regard certain propositions as part of a subject's evidence, whereas the arguments above concern principles concerning the function of knowledge. In so doing those arguments illuminate the concept of evidence in a way that Williamson's arguments do not (and are not intended to). There is no reason to suppose that 'evidence' and 'knowledge' are the really the same concept. If they were, one might ask, why do we have a concept of evidence? Why don't we make do just with the concept of knowledge? We have a concept of evidence distinct from that of knowledge to mark a special role for evidence. Evidence is characterised functionally as that which supports knowledge-yielding inferences. (KI+) tells us that it is knowledge that supports knowledge-yielding inferences, which explains why Williamson's equation is right.

6 Evidence and science

(E \leftarrow K) tells us that any piece of knowledge can in principle be evidence. In Section 4 we considered the proposal that evidence should be restricted to basic knowledge, knowledge that is not inferred from any other knowledge. The latter proposal would be attractive to empiricists, for whom perceptual or observational knowledge is the basis of all knowledge, or, at least, of all *a posteriori* knowledge. An empiricist might, furthermore, use such a view in a premise for an argument that all our (*a posteriori*) knowledge is limited to what we can observe:

(P1) All our evidence concerns the observable.

(P2) From evidence what concerns only the observable, only conclusions concerning the observable follow.

therefore

(C1) Only propositions concerning the observable can be known by inference from our evidence.

And if we add the further premise (P3) that all (*a posteriori*) knowledge is either observational or is inferred from such evidence, then we can conclude (C2), that all our (*a posteriori*) knowledge concerns the observable.

Note, however, that in the light of (E←K), (P1) tells us that all we know concerns the observable which is exactly the conclusion (C2) and trivially entails (C1). The point here is that, given (E←K), one could only be motivated to assert (P1) if one already accept the conclusion that all knowledge is observational.

(E←K) fits with the normal usage of ‘evidence’ in science. Part of the evidence for Einstein’s general theory of relativity is the precession of the perihelion of Mercury. But that precession is only observable in a very extended sense of ‘observable’. The precession is inferred from many individual observations of Mercury and involves considerable mathematical work as well as substantive auxiliary hypotheses. Modern radio telescope delivers nothing of significance that is perceptible, but rather the evidence is in the form of data collected in a computer, which, furthermore, has been processed by statistical software. The same goes for the evidence that is used in constructing weather models, which is collected and processed automatically.

The term ‘observation’ in science can be misleading to epistemologists, who following empiricist and positivist leads, tend to equate observation and perception. Historically, observation has typically been heavily perceptual, but even then it has rarely been exclusively perceptual. An astronomical observation may involve looking at a planet through a telescope, but the key information in the recorded observation will include the elevation of the telescope, its geographical location, and the time at which the planet was seen, which are not perceived through the telescope, and in the case of time, not perceptible at all (even if one has a watch). Likewise observations by nineteenth century chemists and physicists will record values of variables such as temperature and current, which cannot be perceived. Positivists may argue that the real observations are perceptions of the instruments. Even so, it remains true that the use of even perceptual reports need to be given context, which is not obviously perceptual: is what did the observer did to to avoid a parallax error something that is itself perceptible by her? But the central point here is that the empiricist proposal is a revision to our use of the term ‘observation’. Observation in modern science is even less perceptual and more heavily theory-laden. If the Higgs boson is observed, that will not be because anyone perceived it, nor will it be because someone spotted its trail on a cloud chamber photograph. Rather a vast array of different kinds of detectors, all designed in a theory-intensive way, are connected to a computer which delivers results in a statistical form.

Even is one wanted to question to the use of the term ‘observation’ here (and most scientists would not question its use), the key point is that the basic evidence for the existence of the Higgs boson will be non-perceptual and will be heavily theory-laden. Furthermore, if the evidence is strong enough for the physicists to conclude that the Higgs exists, then its existence become a fact that itself is evidence that can be used as required, for example in confirming the standard model of particle physics. The knowledge that itself is inferred can be evidence illustrates the import of (E←K) and of (EC←). What makes something evidence is not that it was produced in some specific way, but rather that it can be used for a certain purpose: drawing knowledge-producing inferences. Correspondingly what scientists

care about when then consider whether a proposition (such as an assertion that the precession of the perihelion of Mercury is 5557 seconds of arc per century, or that the Higgs boson exists) counts as evidence is not what general *kind* of source (perception, observation, inference from theory) produced the proposition, but whether the particular process that produced it warrants that proposition sufficiently that it can be relied upon in making further inferences. I have argued that such warrant is sufficient only if it is enough to make the proposition in question known.

7 Conclusion

At the outset I gave myself two objectives: (a) to articulate a functional characterisation of the concept of evidence that relates to inference; (b) to relate my characterisation to Timothy Williamson's claim that all and only knowledge is evidence.

The guiding idea behind (a) is that evidence is something we want for a purpose. We don't collect evidence for its own sake, but in order to make inferences from it (e.g. concerning the truth of a hypothesis). Of course we can make inferences from any old propositions and beliefs. But not just any old proposition or belief is evidence. We want evidence for epistemically worthwhile inferences, the ones that produce knowledge: evidence is that from which knowledge-producing inferences can be made.

This conception allows any proposition to be evidence, so long as one can infer knowledge from it. This stands in contrast to a foundationalist conception of evidence as that from which inference ultimately starts: evidence must be non-inferential. The inadequacies of this view of evidence were exposed by considering the possibilities of forgetting one's evidence or having it undermined by further evidence.

The conception of evidence as that which supports knowledge-producing inferences entails that all and only knowledge is evidence. This equation of knowledge and evidence is the conclusion reached by Timothy Williamson. My account and his are mutually supporting: mine provides an account of the concept of evidence, his provides a substantive identity concerning evidence. The idea that belief aims at knowledge is implicit in Williamson's epistemology (but not explicitly argued for). The initial intuition I employed concerning evidence is that we want evidence for a purpose: to make inferences from that evidence, inferences whose conclusions we can believe. Therefore, if belief aims at knowledge, then what we want from evidence is that it will permit knowledge-producing inferences.

References