November 26, 2025

Science Progresses with Gettier-Like Cases

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A modest small-e empiricism asserts that inductive inferences are the only way we can support results in science. Since inductive inferences are fallible, we can never be assured absolutely of the truth of any result in science. A definition of knowledge that requires truth precludes us from affirming that any particular result in a science is known. Once we drop the requirement of truth from the definition of knowledge, Gettier cases cease to be problematic. Gettier-like cases are pervasive in the history of science. Their results are routinely celebrated as successes and are carried over from earlier to later stages in the dynamics of scientific progress.

1. Introduction

Gettier cases have long vexed epistemologists. The are understood to pose a challenge to the long-standing conception of knowledge as justified, true belief. Debates over just how best to meet the challenge endure. Matters appear quite different when these ideas are considered in the context of our best science. Here I will argue that inductive fallibilism within even a modest small-e empiricism requires us to drop the insistence on truth for knowledge, if the term's use is to conform with its routine use in science. Then Gettier cases will no longer be of foundational concern. In so far as we can find Gettier-like cases in science, they are a routine and often celebrated component of scientific progress.

2. Scientific Knowledge

That inductive inference is fallible is a matter of definition. Deductive inferences are demonstrative. The truth of their premises assures the truth of their conclusions. The truth of the premises in an inductive inference enhances the likelihood of the truth of the conclusions, sometimes to a very great degree, but it can never assure their truth. The same is true if we consider inductive relations of support, such as provided by conditional probabilities. The best they can offer is very high probability. If ever an assurance of truth is provided, the inference has ceased to be inductive.

A quite modest empiricism asserts that we learn the contingent propositions of a science by inductive inferences from experience; and that this is our *only* means of doing so. We can find that some contingent proposition in science is very strongly supported inductively and thus very unlikely to be false. But we cannot affirm its truth absolutely.

The outcome is that we can never affirm that any particular, contingent proposition of a science is known if we define knowledge as justified, true belief. The routine talk of scientific knowledge is at best a speculation about a possible truth, according to this definition. Nothing we can do can close the gap between even the strongest of inductive support and the absolute affirmation of truth.

It is, of course, tempting to try to close this gap with extra conditions. All such efforts necessarily fail, for the fallibility of inductive inference is irremedial. As an example, we may be tempted to follow Lewis' (1996) lead and dismiss some possibilities as ignorable. The determination of what is ignorable is itself inductive and fallible. Lewis offered eight rules to assist in the determination. In so far as they can help us discern the truth, they are contributions to inductive logic and necessarily fallible. Descartes famously wondered if we could doubt that the hands we see before us are ours. Such doubt may at first seem ignorable until we learn that amputees routinely experience "phantom limb syndrome." In it, they sense the presence of amputated limbs.

This analysis leaves a single candidate for scientific knowledge: it consists of contingent propositions inductively well supported by experience. We could proceed using this as our definition of scientific knowledge. Since the term "knowledge" has a well-established meaning in epistemology and requires truth, it would preclude confusion if we replace the centrality of knowledge in our epistemic analysis with the idea of contingent propositions well supported inductively by experience.

The idea of such a replacement has appeared repeatedly in the literature, such as in Jeffrey (1968), Kaplan (1985) and Papineau (2021).

2. Gettier-Like Cases in Science

Gettier (1963) cases arise when we have good justification for a proposition, but the justification does not operate as intended. Nonetheless, the proposition still turns out to be true because of some unanticipated further factor. The truth, it is often said, is secured by unanticipated luck and thus cannot count as knowledge. In a version of a common example, in my visit to the town square, I notice that the clock in the tower reads noon. I am justified in believing that it is noon. What I do not know is that the clock has long been stopped at reading noon, so my justification fails. However, it just so happens that it is noon, so my belief is true. We are to doubt, the Gettier literature asserts, that my belief is knowledge.

The present project is to find cases like these in the history of science. We cannot replicate exactly the conditions of typical Gettier cases, but must find surrogates that function comparably.

To begin, a standard Gettier case requires an omniscient narrator who declares the truth. Thereby, we as readers escape the epistemic confines of the Gettier case. As Zagzebski (1994) has argued, those within the Gettier case narrative cannot escape and ascertain infallibly the truth. After I form the belief that it is noon from my glance at the clock on the tower, I might affirm the belief by noting that a clock elsewhere in the town square also reads noon. My justification remains inductive and is still fallible. It may be that all the clocks in the square are synchronized to a central clock and, on that day, the synchronization mechanism is undergoing maintenance under which all the clocks are set to noon.

Correspondingly in science, we have no way of escaping the limits of fallible inductive support. There is no omniscient narrator who tells us which of our contingent propositions are true. We can, however, work with a surrogate that functions well enough. That inductive support is fallible has led to a familiar dynamic in scientific progress. At any stage of a developing science, some of its inductively well supported results are true and some are not. We cannot tell at the time which are true and which not. However, when the science progresses to the next stage, that later stage can provide retrospective assessments. It can tell us when an earlier result is still considered a truth, even though the means through which it was supported inductively in the earlier stage was flawed. Loosely speaking, its truth was then secured by unanticipated luck. These are the Gettier-like cases in science.

3. A Surrogate for Luck

In familiar Gettier cases, luck is determinable because we have a range of possibilities readily identifiable and we are able to distribute chances over them. Then, when the requisite one is realized, we can call it luck. I might have entered the town square in a wide range of times. The chance that I entered at noon is small and thus lucky.

In the Gettier-like cases that we can identify in the history of science, it is no longer obvious how to identify a plausible and unique range of alternative possibilities over which we can distribute chances. Fortunately, we are spared the trials of having to try. A reliabilist version of how a Gettier case is lucky supplies the way needed. Here is one version of it: (de Grefte, 2023, p. 533)

> VERITIC LUCK: A belief is veritically lucky if and only if it is a matter of luck that the method one used to form one's belief produced a true belief.

The key notion here is *method*. Consider the methods used by a scientist at some stage of the development of the science. We can determine their reliability according to the superseding science of the next stage.

In some cases, the earlier methods are found to be reliable. In the cases of interest here, they are found not to be reliable. Their unreliability is not a matter of speculation over possibilities. Rather it is a matter of record of their actual performance in the history of science. The methods produced a wide range of results, many of which are false; or at least they are assessed as false by the later stage. In among these results, we may find those that are assessed as true by the later stage of the science, even though the method that produced them is unreliable.

In such cases, we might say, that they secured the truth by unanticipated luck. However notions of chance are no longer needed. The condition for a Gettier-like case is just that the earlier stage of the science secures a true result, while using methods of demonstrable unreliability.

Here I should emphasize that I am not advancing a skeptical thesis about scientific knowledge. In the many examples I have explored in the history of these Gettier-like cases, the earlier science used methods some part of which are deemed reliable by the retrospective analysis. These parts are responsible for the truths secured; and properly so. What preserves the Gettier-like character is that the scientists at the time could not know which parts of their methods would survive later scrutiny. They would not be able to discern then how their methods were succeeding and failing. Their account of how their results were justified would be mingled with the errors of their unreliable methods.

4. Examples

Here are two examples of these Gettier-like cases.

James Bradley (1729) discovered the phenomenon of stellar aberration. In it, the angular position of a star is altered slightly because of the motion of the earth with respect to the star. His method of deriving the formula[1] governing the angular shift was to subtract the speed of the motion of the earth from the speed of the propagating light using the Newtonian rule of composition of velocities. It was the standard method of treating velocity composition in the early 18th century. Nearly two centuries later, Einstein's special theory of relativity would contradict the Newtonian rule for motions at or near the speed of light. Where the Newtonian rule changes the speed of the light when the Earth's motion is subtracted, under Einstein's rule, the speed of the light remains fixed at c. Bradley could not have foreseen this development and the general failure of his method.

Further, he could not have foreseen a curious property of Einstein's rule. It does contradict Newton's rule for the speeds. However, under the conditions of stellar aberration to the accuracy required, Einstein's and Newton's rule give the same result for the angular change in direction of the light propagation. Bradley's formula is the correct formula and is still used today. It is a Gettier-like case in the history of science.

At the end of the nineteenth century, when Newton's corpuscular theory of light had been replaced by a wave theory, it was unclear that the effect of stellar aberration could be recovered from the wave theory. Arthur Berry (1898, p. 265), then writing his history of astronomy, captured the Gettier-like character of Bradley's discovery when he remarked "… and thus an erroneous theory led to a most important discovery."

[1] The angular shift in position α is governed by $\sin \alpha / \sin \theta = v/c$, where θ is the angular elevation of the star in the direction of motion of the Earth, v, and c is the speed of light.

Edwin Hubble (1929) reported his investigations of the speeds of recession and distances to galaxies. He found a linear relationship between them, Hubble's law, and that the constant of proportionality, Hubble's constant, is 500 km/sec/megaparsec. Hubble's analysis was not straightforward since he had what he thought were reliable, independent distance measures for only 24 of the 46 galaxies in his analysis. Hubble had used the known absolute luminosity of Cepheid variable stars to determine the distance to nearby galaxies and these distances then formed the basis of his further distance estimates. What he did not know was that even these 24 distance measures were incorrect. There are two types of Cepheid variable stars and he had misidentified the type in the nearby galaxies. His entire set of distance estimates was compromised by this flaw in his methods.

Later analysis corrected his distance estimates. The new estimate of Hubble's constant was roughly 70 km/sec/megaparsec. It turned out that all the corrections did was to alter Hubble's distance estimates uniformly by a constant factor of 6 or 7. It was a fortunate outcome that could not be expected if one finds that one's methods of distance estimation are flawed. The constancy of the correction factor meant that the linearity of Hubble's relations was preserved. Hubble's linear law, but not the value of his constant, remains standard today and is a Gettier-like case in the history of science.

These are just two examples of Gettier-like cases in the history of science. In a monograph now in preparation on "small-e empiricism," I will review further cases: Dalton's discovery of atomic theory, Carnot's discovery of the founding principles of thermodynamics, Thomson's discovery of the electron, Bohr's discovery of the quantum mechanics of atoms and Einstein's discovery of the general theory of relativity. What is distinctive about all the examples is that the Gettier-like results are not just carried over to the subsequent science, they are carried over as celebrated achievements. Bradley's result of stellar aberration is one of the very few observational results specifically identified by Einstein as important to his discovery of special relativity. Hubble's law remains today one of the most important foundations of modern cosmology. These examples show that Gettier-like cases in the history of science are far from troublesome. They are celebrated successes.

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