Objectivity as Independence

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1. Introduction

In this paper, I will argue for a counterfactual independence account, according to which scientific objectivity can be defined in terms of counterfactual independence.

The counterfactual independence account is inspired by Nozick's invariantism about objectivity: "an objective fact is one that is invariant under all admissible transformations" (Nozick 2001: 82). To pick one of Nozick's own examples, the shape of a bottle is objective iff the shape remains the same (that is, invariant) if the bottle is rotated or moved in different (actual and possible) ways (Nozick 2001: 78).

However, Nozick's invariantism suffers from at least three shortcomings:

1. Nozick does not provide an explication of the central modal notion of invariance. He merely illustrates the notion of invariance by way of example (such as the bottle example above).
2. Nozick distinguishes between invariant and varying facts. But his account does not restrict which kinds of facts may play these 'roles'. This lack of restriction gives rise to a worry: objectivity is quite cheap. For instance, my political convictions would turn out to be objective

because they would remain the same if the location of a grain of sand on Mars were to change. This sounds implausible.

3. Nozick's choice of examples suffers from a one-sided diet, because all of his elaborate examples are from physics (Nozick 2001: 77-8, 82-7). Examples from other sciences are sparse (for instance, Nozick 2001: 90-1, 95, 108). Such a one-sided diet is dissatisfying if one is after a general explication of scientific objectivity, as opposed to objectivity in physics only.

These shortcomings motivate three tasks:

- to provide an explication of invariance (*explication task*),
- to propose a restriction on which kinds of facts can play the role of invariant and varying facts (*restriction task*), and
- to discuss examples of objectivity that generalize from physics to other sciences (*generalizability task*).

My main goal is to defend the counterfactual independence account as a theory of scientific objectivity that meets these tasks. Due to the space constraints of a discussion paper, I will not assess the merit of the counterfactual independence account relative to alternative accounts of scientific objectivity.

The plan of the paper is as follows: in Section 2, I will take up the explication task and the restriction task. I will articulate a preliminary version of

the counterfactual independence account specifying a necessary condition for objectivity. In Section 3, I will address the generalizability task by applying the preliminary version of the counterfactual independence account to examples of objectivity that can be found in various science, not only in physics. I will argue that the preliminary version applies to these examples. In Section 4, I will provide reasons for adding another necessary condition (the *Absence Condition*) to complete the counterfactual independence account as a definition of scientific objectivity. Section 5 provides a conclusion and an outlook on three advantages of the counterfactual independence account.

2. The Counterfactual Independence Account

Regarding the explication task, I propose to explicate Nozick's undefined modal notion of invariance as counterfactual independence. It is useful to introduce the notion of counterfactual *dependence* first in order to define *independence* in a second step.

> Fact A counterfactually depends on fact B iff if B were the case, then A would be the case, and if B were not the case, then A would not be the case.

This notion of dependence is familiar from counterfactual theories of causation and explanation (for instance, Lewis 1973; Woodward 2003).[1] We are now in a position to define counterfactual independence:

> A is counterfactually independent of B iff if B were the case, then A would be the case, and if B were not the case, then A would (still) be the case.

Although this notion of independence (and its synonyms such as stability and resilience) has not been explicitly used to define scientific objectivity, it is at the heart of various attempts to capture other central concepts in the philosophy of science, such as laws of nature (see, for instance, Skyrms 1980; Lange 2009; see also Nozick 2001: 85-6).

Furthermore, I take it to be useful to attribute the following features to counterfactual independence:

- Independence is *relational*. The sentence "A is independent" does not make sense or is at least incomplete. Only "A is independent of B (or, in relation to B)" is complete and meaningful. Moreover, A might be independent of B but not of some other fact C.

[1] I will remain neutral between different semantics for counterfactual conditionals.

- Independence is *contrastive*. Suppose A is independent of B. Asserting such independencies (explicitly or implicitly) relies on a relevant contrast class whose elements specify possible alternatives to, or variations of, B (van Fraassen 1980; similarly, Lipton 2004). Thereby, the contrast class indicates which antecedents matter for the counterfactual conditionals if we want to assert that A is independent of B. In the simplest case, the contrast class of B is {not-B}. But, as I will illustrate in Section 3, in realistic examples of scientific objectivity the relevant contrast class tends to have more members.
- Independence is *gradual*. Contrast classes may differ in how many elements they have. This allows for degrees of independence (Nozick 2001: 87, 99). Suppose that fact A is independent of fact B_1 given the small contrast class $\{B_2\}$. Some other fact A* displays a greater degree of independence of B_1 than A, if A* turns out to be independent of a contrast class with more elements, such as the class $\{B_2; B_3\}$, that has $\{B_2\}$ as a proper subset.

If objectivity is defined in terms of independence, as I propose, then objectivity inherits these three features.

Let me now turn to the restriction task. Following the mainstream in the literature on scientific objectivity (for instance, Daston and Galison 2007), I will assume that scientific objectivity is an *epistemic* notion. It is a notion characterizing evidence or evidential support relations between a body of

evidence and some hypothesis. Hence, I will distinguish scientific objectivity from ontological objectivity (that is, mind-independent existence, as referred to in various debates on realism, such as scientific, moral, and mathematical realism). Ontological objectivity is not my topic but one advantage of the counterfactual independence account consists in that it points towards a way of understanding this kind of objectivity (see Section 5).

Assuming that scientific objectivity is an epistemic notion, I propose the following restriction on the kinds of facts that are counterfactually independent of one another: the invariant facts are facts concerning empirical evidence (for some hypothesis), whereas the (counterfactually) varying facts concern (a) the different (possible) scientists (or groups of scientists) who do the research to obtain the evidence, and/or (b) the different methods scientists use (illustrations will follow in Section 3).

Merging my answers to the explication task and the restriction task, we arrive at a preliminary version of the counterfactual independence account:

> Evidence E is scientifically objective in relation to a given contrast class of investigating scientists and methods, only if
>
> - *Independence Condition:* E is counterfactually independent of the scientists, or of the methods they use.

I will argue (in Section 4) that the *Independence Condition* has to be complemented by another necessary condition (the *Absence Condition*) to turn this preliminary version into a proper definition of scientific objectivity.

3. Application to Three Kinds of Objectivity

Now, I will take up the generalization task by applying the counterfactual independence account to three kinds of objectivity that occur frequently in the (experimental) sciences, not just in physics. I will argue that the counterfactual independence account captures at least three kinds of objectivity: objectivity as replication, objectivity as robustness, and objectivity as Mertonian universalism.

I take all three kinds to be representative, as they are perceived as being widespread and paradigmatic in the literature on objectivity in philosophy and history of science. I will present these kinds of objectivity in a 'stylized' way: that is, I will work with an abstract description of each kind. I will not provide detailed case studies for each kind.

Of course, there might be further kinds of objectivity in science, as indicated in the recent literature: for instance, "structural objectivity" (Daston and Galison 2007; Padovani et al. 2015) and the objectivity of assessment reports (such as the IPCC report, see Oppenheimer et al. 2019). For this reason, I take it to be a fruitful task for future research to explore whether the counterfactual independence account can also be applied to further kinds of objectivity.

The first kind of objectivity – objectivity as replication – consists in the successful replication of experimental results that serve as evidence. That is, a scientist S_2 (or, more realistically, a group of scientists) is able to replicate the experimental result E of another scientist S_1 (or another group of scientists) by using the same method M that S_1 applied.[2] That is, in replication cases, the varying facts concern different (group of) scientist(s), not the method used.

The counterfactual independence account captures objectivity as replication in the following manner: evidence E, obtained by using experimental method M, is objective relative to the contrast class {scientist S_1; scientist S_2} iff obtaining E is independent of whether S_1 or S_2 is applies method M – that is, the following two counterfactual conditionals have to be true: (1) if S_1 used experimental method M, then E would be the experimental result, and (2) if S_2 used M, then E would also be the experimental result.

Objectivity as robustness, the second kind of objectivity, consists in establishing that an experimental result, evidence E, is robust. That is, different (groups of) scientists are able to achieve the same result in their labs by using different methods.[3] That is, in case of robustness, the varying facts mainly concern the methods being used; the varying facts might also concern the (group of) scientist(s), but it is possible that a single group of scientist arrives at robust research results by applying different methods. I apply the counterfactual

[2] See Carnap (1932: 446), Popper (1934: 18-9), and Rorty (1980: 333-42); and more recently Douglas (2004: 462) and Lloyd and Schweizer (2014: 2069-70).
[3] See Carnap (1932: 446-7); in the current literature, see Douglas (2004: 458) and Wimsatt (2007: Chapter 4).

independence account to a type robustness where the varying facts include methods *and* scientists.

According to the counterfactual independence account, we can capture objectivity as robustness in the following way: experimental result E is objective in relation to the contrast class {scientists S_1; scientist S_2; method M_1; method M_2} iff (1) if S_1 were to use M_1, then would E would be the result, and (2) if S_2 were to use M_2, then would E would also be the result (or some equivalent piece of evidence E' that can be mapped onto the result E of applying M_1).

Objectivity as universalism – the third kind – is the requirement that certain *features of scientists* should not matter when they assess the evidence. For instance, a scientist's nationality or social class should not matter for this activity. Merton famously expresses this point as the rule of "universalism" that is part of the "ethos of science":

> "The acceptance or rejection of claims entering the lists of science is not to depend on the personal or social attributes of their protagonist; his race, nationality, religion, class, and personal qualities are as such irrelevant." (Merton 1942: 270)

I use Merton's terminology of "universalism" to label this kind of objectivity. Different expressions of universalism can also be found in other prominent places in the literature.[4]

Is the counterfactual independence account able to capture universalism? In the context of this paper, universalism might be best understood as an additional constraint on other kinds of objectivity, such as objectivity as replication and objectivity as robustness. According to the counterfactual independence account, objectivity as universalism consists in adding further elements to the contrast class. This strategy for describing universalism applies to both objectivity as replication and objectivity as robustness.

Suppose that two scientists S_1 and S_2 differ in certain features F_1 and F_2, in "personal or social attributes" (ibid.). For instance, two scientists might differ w.r.t. their nationality, social class, gender, or the sponsors funding their research (for instance, public funding versus industry funding).

In the case of objectivity as replication, "universalism" simply enlarges the relevant contrast class; it becomes {scientist S_1; scientist S_2; *feature F_1; feature F_2*}, and the resulting conditionals are (1) if S_1 *with feature F_1* used experimental method M, then E would be the experimental result, and (2) if S_2 *with feature F_2* used experimental method M, then E would also be the experimental result.

[4] For instance, Weber (1949: 58), Daston (1992: 599), Daston and Galison (1992: 98), Longino (1990: 76-81), Daston and Galison (2007: 121); see also Nozick (2001: 96).

In the case of objectivity as robustness, the enlarged "universalist" contrast class is {scientist S_1; scientist S_2; *feature F_1; feature F_2*; method M_1; method M_2}, while the relevant conditionals are: (1) if S_1 *with feature F_1* were to use M_1, then would E would be the result, and (2) if S_2 *with feature F_2* were to use M_2, then would E would also be the result.

In sum, I have argued for the claim that the counterfactual independence account applies to three pervasive kinds of scientific objectivity. This result helps to address to generalization task, because all three kinds of objectivity can be found in various (experimental) sciences, not merely in physics. Moreover, applying the counterfactual independence account to the three kinds of objectivity illustrates that independence is *relational* (because each kind of objectivity fixes certain facts relative to which the evidence is objective), *contrastive* (because a relevant contrast class has to be chosen) and *gradual* (because the kinds of objectivity suggest contrast classes with a different number of members).

4. Adding the Absence Condition

The preliminary version of the counterfactual independence account presented in Section 2 only specifies a necessary condition (the *Independence Condition*). To arrive at a definition of objectivity, we need to add one further condition taking into consideration that claims about independencies are defeasible (the *Absence*

Condition). Consider two examples of defeaters for illustration (for simplicity's sake, I will focus on objectivity as replication in these examples).

First, suppose that scientist S_1 first learns that a fellow scientist S_2 has successfully replicated her experimental study. She rightly takes this information to be an indication of scientific objectivity. Then, however, S_1 also learns that S_2 has been working with a method that is known to be unreliable. Hence, the 'replication' was merely a matter of luck. This second piece of information plays the role of a defeater, as it makes S_1 confident that the (seeming) replication does not establish the objectivity of the empirical results of her own study (for a historical case study, see Daston and Galison 2007: 11-16, 154-161; Reutlinger forthcoming: section 3.1).

Second, imagine that S_1 learns that S_2 failed to replicate the experimental result E of her original empirical study. S_1 counts this information as indicating a failure of objectivity. But imagine that S_1 also obtains evidence that S_2 is funded by a company (whose non-epistemic interests are in conflict with the result E of her original study) and that S_2 has omitted a relevant part of the data (for real cases of biased research, see Oreskes and Conway 2010; Reutlinger forthcoming: section 3.2). For S_1, the second piece of information is defeating evidence: now, S_1 has a good reason not to treat the result of S_2's study as undermining the objectivity of her original study. Whether her original study did indeed produce objective evidence depends on whether it will be successfully replicated in the future.

Both examples suggest that claims about counterfactual independence are defeasible. For this reason, a proponent of the counterfactual independence account should demand that there be no evidence of defeaters. This is indeed the second necessary condition – the *Absence Condition* – I impose on scientific objectivity:

> Evidence E is scientifically objective in relation to a given contrast class of scientists and methods if and only if:
>
> 1. *Independence Condition:* E is counterfactually independent of the scientists, or of the methods they use.
> 2. *Absence Condition:* There is no evidence of defeaters.

This completes the counterfactual independence account as a definition of scientific objectivity.[5]

5. Conclusion

I have proposed the counterfactual independence account and I have argued that this account is able to overcome the shortcomings of Nozick's invariantism. For

[5] Whether the *Absence Condition* is indeed satisfied has to be determined on the level of analyzing concrete case studies exemplifying the 'stylized' kinds of objectivity discussed in Section 3. It is, however, not my goal to provide such an analysis in this paper (this has been done elsewhere; for instance, Reutlinger forthcoming provides a recent detailed analysis).

this reason alone, I believe it is an account of scientific objectivity that deserves further discussion. One promising avenue for pursuing such a discussion consists in applying the counterfactual independence account to additional kinds of objectivity analyzed in the literature in history and philosophy of science (see Section 3).

Finally, let me stress three advantageous and fruitful consequences of the counterfactual independence account for future research.

First, the account explains why scientist strive for objectivity: valuing objectivity is simply a plea for more evidence, for more evidence from different sources (from different scientists and/or methods). Hence, if scientists care about empirical evidence, it is not surprising that they value objectivity. It might be fruitful to elaborate this idea on the basis of extant accounts of empirical confirmation (such as Bayesianism and frequentist hypothesis testing).

Second, the counterfactual independence account can be adopted by both scientific realists and scientific anti-realists, because objectivity is characterized by observable facts (facts about evidence, scientists, and methods). Hence, the account I propose is neutral w.r.t. the persistent disagreement about scientific realism. I take this to be an advantage of defining objectivity in terms of independence.

Third, although I have focused on scientific objectivity, the counterfactual independence account also opens up a novel way of understanding ontological objectivity. Suppose that some fact A is ontologically objective – that is, A exists mind-independently. A proponent of the counterfactual independence account

might adopt the following approach to ontological objectivity: A is ontologically objective relative to the contrast class {there are mental states concerned with A; there are no mental states concerned with A} iff (1) if there were mental states concerned with A, then A would obtain, and (2) if there were no mental states concerned with A, then A would still obtain. Surely, this is not the final word on ontological objectivity but it is a direction worth exploring – a direction that might spark a debate among philosophers of science and metaphysicians.

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