

Kornblith's Natural Kinds and the Problem of Euthyphro

by

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Abstract

In *Knowledge and its Place in Nature*, Hilary Kornblith argues that since successful science is the best judge of which natural kinds exist and certain special sciences take knowledge to be a natural kind, epistemology should be continuous with the sciences. Kornblith's argument depends crucially upon anti-reductionist scientific realism about natural kinds. In section one, I describe the homeostatic property-cluster (HPC) conception of natural kinds, which Kornblith espouses, and Kornblith's non-reductive scientific realism about such kinds. I show section two that the HPC conception of kinds and the success conditions for a science both entail that two objects are members of the same kind only if they are similar with regard to the HPC's property components. In section three, recalling Euthyphro's belief that what is good is what the gods love and Socrates' response that some gods love what other gods hate, I show that for multiply realizable kinds, the similarity condition just described reveals a deep inconsistency between higher- and lower-level sciences regarding which kinds exist. I then show that such inconsistency places Kornblith's argument for naturalized epistemology on the horns of a dilemma.

Kornblith's Natural Kinds and the Problem of Euthyphro¹

In *Knowledge and its Place in Nature* (2002), Hilary Kornblith, following W. V. O. Quine (1969), argues that epistemology is best construed as a scientific enterprise. According to Kornblith, successful science is the “best judge” of which natural kinds there are, and since knowledge prominently figures in the predictions and explanations of various successful sciences—cognitive ethology and psychology, in particular—knowledge itself is shown to be a natural kind and thus a proper object of scientific inquiry. Kornblith's argument depends crucially upon the conjunction of scientific realism and anti-reductionism about natural kinds: Scientific realism about natural kinds (hereafter ‘scientific kind realism’) makes possible the claim that cognitive ethologists and psychologists are investigating the same thing as epistemologists (at least of a certain stripe), and scientific kind realism about knowledge implies anti-reductionism about natural kinds. In this paper, I argue that anti-reductionist scientific kind realism—or Euthyphro Realism—is beset by difficulties similar to those faced by Euthyphro himself regarding the good. When Euthyphro claimed that what is good is what the gods love, Socrates asked of Euthyphro, what is good when one god loves what another hates? In this paper, I ask the Euthyphro Realist, which kinds are there when the sciences disagree about which kinds there are? This question, I show, forces the proponent of Kornblith's argument for naturalistic epistemology onto the horns of a dilemma.

An overview of this paper will prove useful. In section one, I describe Kornblith's conception of natural kinds, *viz.*, kinds as homeostatic property-clusters (hereafter, HPCs), and Kornblith's non-reductive scientific realism about such kinds. I show in section two that the HPC conception of kinds entails a claim regarding similarity between members of the same kind. In

section three, I first argue that since the similarity implied by higher-level kind-membership is embraced by some sciences but rejected by others, there is inconsistency between the sciences about which kinds exist. I then show how this inconsistency results in the above mentioned dilemma.

I make four assumptions. First, natural kinds are homeostatic property clusters (which I describe below). Second, scientific kind realism is true. Third, those kinds posited by the so-called Standard Model of fundamental particles exist (I do not assume the existence of other kinds).² Fourth, for any two objects x and y , such that $x \neq y$, x and y are similar relative to some property F iff x has F and y has F .

1. Homeostatic Property Clusters and Non-reductive Realism³

Following Richard Boyd (1988, 1991), Kornblith argues that a natural kind, “is a cluster of properties which, when realized together in the same substance, work to maintain each other, even in the face of changes in the environment” (Kornblith 1993). Natural kinds consist in physically realizable homeostatic clusters of properties. Now, certain combinations of properties are excluded from being realized. The example Kornblith (1993) offers is of a water molecule. Only certain chemical bonds are physically possible; thus, H_2O is a realizable molecule, while HO_2 is not.⁴ Because some property clusters are excluded, there exist “gaps” between the kinds that exist (Kornblith 1993). For example, as we move across the Periodic Table of Elements, instead of a continuous piling up of one electron after another within a single shell about the nucleus, we find gaps where the successor function halts in one shell and picks up in a new one. Gaps, such as the those between Ne and Na, partially define the boundaries of natural kinds. What is more,

according to Kornblith, such boundary defining gaps occur throughout nature, whether at the level of the fundamental particles or within, say, the domain of psychology.

Additionally, not every property component of an HPC is definitionally relevant. (Let us call a property relevant to defining a natural kind, a 'kind-defining' property.) Drawing from the history of substance classification, Kornblith points out that a substance's color was for a limited time considered a kind-defining property (Kornblith 1993). That shiny yellow we all know and love was taken for a time to be a defining property of gold. But what ultimately determined that color is not kind-defining for substances is that it often fails to coincide with other established kind-defining properties such as how the substance interacts with other substances or the substance's chemical composition which explains its interactions. So, although for substances, color and kind often coincide, the former was ultimately rejected, thus showing that not every property component in an HPC is kind-defining. In short, then, on the HPC conception, natural kinds are discovered by finding the gaps that lie between them and by discovering which property components within the homeostatic cluster are essential to the kind.⁵

Now, according to Kornblith, since natural-kind posits ought to be left to the sciences, successful prediction and explanation within cognitive ethology and psychology provide strong reasons to accept knowledge as a natural kind and thus to reject reductionism regarding kinds.⁶ According to Kornblith, many organisms rely upon information processing systems for their survival. As a result, successful cognitive ethology requires non-reducible intentional terms to explain these organisms' behavior. It is therefore, says Kornblith, appropriate to attribute belief to these organisms. Now, since these organisms have been selected for on the basis of their belief-producing systems, we see that natural selection has provided these organisms with belief-

producing mechanisms that are reliable. Therefore, when one of these organisms possesses a true belief, that organism *ipso facto* has knowledge.⁷ In short, both psychologists and cognitive ethologists use the term ‘knowledge’ to refer to true belief that is produced by reliable processes. Thus, both are referring to the very HPC–reliably produced true belief—as studied by externalist epistemologists. So, to summarize, (a) determining which kinds there are is a discovery rather than a stipulation; (b) such discoveries are made by and are the basis for successful science; and, (c) such discoveries are made at all levels of successful science. Kornblith concludes that one should thus embrace non-reductive scientific realism about the HPC conception of natural kinds.

2. *Kind Membership Similarity and the Success Requirement*

In this section, I show two things. First, I show that the HPC conception of natural kinds entails that if two material objects are members of the same kind, then they must be similar with regard to the property components of the HPC. (Call this the “Membership Similarity Condition.”) Second, I describe how a science’s success, judged by how well that science’s predictions are borne out and how reliable its explanations are, requires the Membership Similarity Condition. (Call this the “P/P/E Similarity Condition.”)

As scientific realists, we can learn something about the nature of properties by asking how scientists determine which properties exist. David Hume (1748) points out that from a given effect, one cannot deduce its cause; 230 years later, D. M. Armstrong noted that a property must have causal efficacy if it is to be known (1978). In short, scientists infer which properties exist from causal interactions revealed by multiple values substituted for the relevant independent variables (IVs) and the resulting dependent variable (DV) values. Why multiple IV and DV

values? Essentially this: the inference to a particular property based on observing a single effect has little justification for claims about which properties exist. But observing a correlation between changes in an effect (the DV) and changes in the initial conditions (the IV) often provides considerable inferential justification. Thus, the changes requisite for inferential justification must occur across multiple IV settings resulting in multiple DV measurements.

Now, consider one crucial assumption underlying this methodology. If, as just described, one can manipulate the initial conditions, measure her IV manipulation, measure the DV changes, *and* see that there is a statistically significant correlation between the IV and DV changes, she becomes quite justified in making her inference to the property involved. On the other hand, confounding variables undermine inferential justification for two reasons: (a) such variables (by definition) alter observed DV changes beyond changes resulting from IV manipulation alone, and (b) DV changes *vis-à-vis* IV changes are largely what our causal inferences are based on. That IV-DV manipulation and measurement can increase inferential justification, while insidious variables can confound it, shows that such inferential justification to a particular property *assumes similarity across multiple instances of the same property and dissimilarity across instances of distinct properties.*⁸

If, as Hume and Armstrong point out, properties are known only through causally interacting with them, then a property is discovered only through inference based on observing individual instances of the property. But inferring that *F* is a property requires multiple instances of *F* and our recognizing similarity with regard to *F* across those instances. Assuming scientific realism, science's recognizing such similarity implies the similarity's existence. Thus, discovering that *F* is a property requires the observed objects to be similar with regard to *F*. Assuming

natural kinds are HPCs, this point generalizes to the Membership Similarity Condition: for any two objects, x and y such that $x \neq y$ and an HPC, x and y are members of the same HPC only if x and y are similar to each other with regard to the properties comprising the HPC in question.

I shall now argue for the P/P/E Similarity Condition, that is, that the measure of scientific success, *viz.*, successful scientific prediction and explanation, requires the Membership Similarity Condition. Notice that the connection between natural kinds and laws of nature cannot be overstated. Jerry Fodor (1974) claims that natural kinds are the sorts of things whose names appear in universally quantified law-statements. Jaegwon Kim (1992), following Nelson Goodman (1979), takes natural kinds to be projectible properties, and it is for this reason that kind-names appear in law-statements. Now, the HPC conception of natural kinds is distinct from what Fodor and Kim have in mind, but if—as I am assuming—the HPC conception is right, then it is just the names of HPCs' components that appear in law statements perhaps in virtue of their being projectible. Either way, laws and kinds are inextricably intertwined.

Predictions and explanations rely crucially upon law-statements. To see this, notice first that predictions are used in two ways. Some predictions are used to test a theory or establish a law. (Call these predictions 'experimental predictions'.) Other predictions, however, are used in the application of previously established laws. (Call these 'application predictions'.) For example, in the early days of the twentieth century, experiments were run to test the predictions entailed by Einstein's Special Theory of Relativity; in the middle twentieth century, the established laws of Special Relativity were used to predict the violent reaction caused by the atomic bomb. Consider also that explanations, like application predictions, cite previously established laws.

What explains the violent reaction of the atomic bomb includes references to the laws cited by Special Relativity Theory.

Establishing the existence of laws through verifying entailed predictions, using previously established laws to predict the behavior of a particular object, and explaining the behavior of some object all require recognizing that two members of the same kind are similar with regard to the relevant properties. For, to establish laws by testing entailed predictions, one runs multiple experiments on the same natural kind or property; but the natural kind or property must be held constant across the experiments, otherwise there is little justification to say that the different tests are testing the same theoretical law-statement. Holding the kind or property constant across tests requires recognizing that two members of the same kind or with the same property are similar. Likewise, using previously established laws to make predictions or explain behavior also requires a recognition of similarity. Here, though, one must determine which law-statements apply to the observed object. Such determination requires recognizing that the observed object is a member of the natural kind or possesses the property whose name appears in the law-statements. That is, the object must be *similar* in the relevant way to the sorts of objects described in the statement of the established law.

Now, if the HPC conception of natural kinds is correct, then it is not necessarily the names of natural kinds that appear in law-statements, but rather the names of the HPC's property components. But this is no cause for concern. For, moving from properties to kinds just is moving from a single property to a cluster of properties that meets the homeostasis condition. Consequently, if one HPC is seen to be instantiated in some object and we know from previously established laws how other instantiations of the property components behave in similar conditions,

then—confounding variables aside—we can predict and explain the behavior of the observed object. Thus, the standards of success for sciences entail the P/P/E Similarity Condition, which in turn requires the Membership Similarity Condition. Scientific success and scientific kind realism both require that two objects x and y are members of the same HPC only if x and y are similar relative to the property components of the HPC in question.

3. *The Dilemma of Euthyphro Realism*

Kornblith's (2002) argument that knowledge is a natural kind occurs within a larger argument, which, in a nutshell, can be put like this:

- (1) Since scientists make successful predictions and explanations using the concept of knowledge as a natural kind, knowledge is a natural kind.
- (2) Since knowledge is a natural kind, it is a proper object of scientific study.
- (3) Therefore, epistemology is best construed as a scientific enterprise.⁹

My concern is with (1).

Recall that Euthyphro believed that what is good is what the gods love. Scientific realists about natural kinds (or 'scientific kind realists') hold that which natural kinds exist are those which successful science judges exist (Kornblith 1993, 2002). In response to Euthyphro, Socrates posed this question: If an act is loved by one god, but hated by another, is the act good or not? What I call 'Euthyphro Realism'—anti-reductionist scientific kind realism—faces a similar problem: If various successful sciences are inconsistent with each other about which natural kinds exist, then which natural kinds in fact do exist? I shall show that premise (1) and the just stated

Problem of Euthyphro Realism together force the proponent of Kornblith's argument for naturalized epistemology onto the horns of a dilemma.

According to Kornblith, knowledge consists in a homeostatic property cluster, an HPC. In the last section, I argued that the HPC conception of natural kinds—like other conceptions—and scientific kind realism entail that two objects x and y are members of the same kind only if x and y are similar with regard to the properties in which the kind consists. But this is a crucial point. For, suppose we have two objects, x and y , and that A and B are each full descriptions of both. That is, A is a full description of x and y including statements of all similarities between them, and B is also such a description of x and y .¹⁰ Suppose, further, that the set of statements comprising A is a proper subset of the set of the statements comprising B . That is, there is at least one statement found in B but not found in A , although all of A 's statements are found in B .¹¹ As it turns out, one of the statements found in B , but not in A , is a similarity claim about some property. If that property is a component of a natural kind, and, according to A and B , x and y are similar in possessing all the remaining component properties of that natural kind, then there is inconsistency between A and B about the number of natural kinds x and y belong to. For, there is a kind-membership similarity between x and y that is claimed by a statement in B , but, by the Membership Similarity Condition and *modus tollens* is strictly denied by A .

Suppose, now, we generalize this scenario to include any two objects x and y such that $x \neq y$. Given such a generalization, there will be at least one property similarity stated in B that A fails to recognize. Therefore, the number of kind-membership similarities between x and y stated in A will always be equal to or less than those stated in B .¹² My claim is that the relationship between A and B in the generalized scenario is the sort of relationship that exists between the lower-level

and higher-level sciences. For, if some higher-level property is multiply realizable, then the very sort of inconsistency described in the non-generalized case arises between the lower- and higher-level sciences. To show this, I turn to that arch-anti-reductionist Jerry Fodor.

Fodor (1989) has pointed out there are two types of scientific explanation. In one, the *explanandum* (that which needs to be explained) and the *explanans* (the explanation) are at the same level; in another type, the *explanans* is at a lower level than the *explanandum*. (Fodor calls the latter a mechanistic explanation.) But for any *explanandum* described by the Standard Model of particle physics, its *explanans* must also be described by the Standard Model; no divorce between the *explanans* and the *explanandum* can occur, for there is no lower level to which to appeal. We can thus divide the sciences themselves into two types: those whose *explanantia* can be at a level lower than the *explanandum*, and those whose *explanantia* cannot be so.¹³

This division between sciences becomes particularly instructive when we notice that higher-level sciences appeal to lower-level *explanantia* when explaining the *failure* of a higher-level explanation or application prediction. (Call this ‘P/E’-failure.) But notice that for any science for whom an *explanans* can be at a level lower than the *explanandum*, that science must recognize natural kinds at the levels of both the *explanandum* and the *explanans* at least some of the time. But if higher-level sciences appeal to lower-level kinds to explain instances of P/E-failure, then higher-level sciences can appeal to lower-level kinds in order to explain higher-level P/E-successes. This is just what Fodor (1989) points out when describing the so-called mechanistic explanation of some higher-level phenomenon. We therefore see that, whether in cases of P/E-failure or success, *higher-level sciences recognize lower-level kinds*.

Now, consider specifically cases of so-called multiply realizable kinds, if such kinds exist. Let us say that a kind is multiply realizable iff that kind can be realized by distinct lower-level kinds. Let us say also that for any two objects x and y such that $x \neq y$, x and y are distinct members of the multiply realizable kind iff they are both members of a higher-level kind, but are qualitatively distinct at the lower level. In short, if x and y are distinct members of a multiply realizable kind, then the kind just is being multiply realized. My claim is therefore this: for any objects x and y , if x and y are distinct members of a multiply realizable kind, and the lower-level description of x and y is a full description of x and y including statements of all similarities between them, then the lower-level science denies at least one similarity that the higher-level science posits. Moreover, at least one of those disputed similarities must be required by membership in the higher-level multiply realized natural kind. (Otherwise, x and y would not be distinct realizers of a single higher-level kind.) Therefore, there is at least one natural kind of which the higher-level science claims x and y are both members and of which the lower-level science, by the Membership Similarity Condition and *modus tollens*, denies x and y are both members.

Notice that higher-level kinds are multiply realized by lower-level kinds, but lower-level kinds are not multiply realized by higher-level kinds. As a consequence, although a higher-level science will describe the lower-level kinds, because of the Membership Similarity Condition and by *modus tollens*, some higher-level kinds will never be described by lower-level sciences. Therefore, these higher-level sciences will always posit more kinds than the lower-level science. And from this it follows that there will be at least one kind—*viz.*, any multiply realizable kind—the existence of which a higher level science accepts but a lower-level science strictly rejects.¹⁴

Now, as Socrates pointed out, when faced with one god's loving what another hates, Euthyphro could appeal to agreement between the gods regarding at least some acts. But while Euthyphro could defer to some agreement between the gods, such deference to the sciences leads the Euthyphro Realist to reductionism. For, the only kinds that all sciences agree upon are the lower-level kinds. Assuming the Standard Model is correct, then the Realist following Euthyphro is left only with leptons, quarks, bosons, and so forth—no kind we call 'knowledge'.

Thus, Kornblith is faced with a dilemma: In order to avoid the inconsistency between higher- and lower-levels sciences about which kinds exist, Kornblith must either deny scientific kind realism or embrace kind reductionism. If Kornblith denies scientific realism about higher-level kinds, then it is not obvious in what sense cognitive ethology, psychology, and epistemology are all studying the same thing, as he claims they are, in which case it is not clear how epistemology is continuous with the sciences. If, as per the other disjunct, Kornblith embraces kind reductionism, he denies that knowledge is a natural kind. Since science is in the business of discovering and studying natural kinds, knowledge fails to be a legitimate focus of scientific inquiry. Each disjunct thus entails a denial that epistemology is continuous with the sciences.

To summarize, then, the HPC conception of natural kinds entails the Membership Similarity Condition. For multiply realizable kinds, this condition plus *modus tollens* reveals a deep inconsistency between higher- and lower-level sciences regarding which kinds exist. Such inconsistency places Kornblith's Euthyphro Realism in the dilemma of either denying scientific kind realism or embracing kind reductionism, either of which undermines Kornblith's argument for naturalized epistemology.

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Endnotes

1. I am indebted to comments by Al Mele, Katherine Guin, Doug Kutach, David Bixler, Todd Adams, and Howard Baer.

2. Here just a couple of words about the Standard Model, a fuller treatment of which can be found in Gordon Kane's *The Particle Garden* (1995) and *Supersymmetry* (2000), whence comes much of the following. According to the Standard Model, all matter is comprised of six leptons and six quarks, and all these particles interact by means of four and only four forces, each of which is mediated by exchanged bosons. Now, we've all heard that all material objects consist in atoms and that an atom consists in a nucleus made up of neutrons and protons which are circumscribed by electrons. An electron is just one of the six leptons. Among the six quarks, one kind of quark is called an 'up-quark', another a 'down-quark'. Neutrons consist in two down-quarks and one up-quark; protons consist in two up-quarks and one down-quark. The quarks within neutrons and protons hold together by exchanging bosons. And for the purposes of this paper, that is a sufficient description of the Standard Model.

There are, however, two important consequences of the Model. First, the Standard Model is taken to describe the fundamental constituents in nature. One reason is this: Experimental evidence has shown us that, unlike a larger object which decays into its components, a fundamental particle, when it decays, decays into just other fundamental particles. Physicists take this and other experimental evidence to show that fundamental particles have no constituents. If string theory turns out to be true, for example, it will not be that strings comprise leptons and quarks; rather, we will simply have been mistaken about the *form* of quarks and leptons. Leptons and quarks, if string theory is true, will not be so much like points but rather like lines or loops; quarks and leptons themselves, though, will still exist as the fundamental constituents of matter. (Thus, the term 'decay' is ambiguous, describing different types of processes depending on the level of description)

The second important aspect of the Standard Model for this paper is that all members of the same fundamental particle kind—for example, all electrons or all up-quarks—are exactly similar. If one electron has a charge of -1.602×10^{-19} C, then all electrons have -1.602×10^{-19} C of charge. Indeed, for all kinds of fundamental particles, such exact similarity holds across all members of that fundamental-particle kind. This is a theoretical consequence of the Standard Model and has been confirmed experimentally. (Before reading it in Kane [2000, see p. 35], I had testimonially confirmed this fact through correspondence and conversation with three physicists—David Bixler at Angelo State University and Todd Adams and Howard Baer at Florida State University—and the philosopher of physics, Doug Kutach, at Brown University.)

In summary, (a) the kinds posited by the Standard Model are assumed to be real; (b) each member within a fundamental particle kind posited by the Model is exactly similar to every other member within that kind, and (c) the Standard Model is assumed to describe the lowest level of the material world. With that picture of the Standard Model in hand.

3. Much of what is discussed in this section is drawn from Kornblith's (1993), to which Kornblith (2002) directs the reader for a fuller description of the HPC conception of natural kinds.

4. These exclusions occur at the fundamental level as well. Consider, for example, that the Pauli Exclusion Principle along with quantum numbers prevents (perhaps it is more precise to say, whatever structural aspect of the universe the Principle picks out does the preventing) various metaphysically possible arrangements of the fundamental particles from obtaining in our world. The result is that the realization of various kinds of atoms is precluded, and thus the Periodic Table of Elements describes at present only 112 elements (see Los Alamos National Laboratory's website: <http://periodic.lanl.gov/default.htm>).

5. So, why ought we accept the HPC conception? For this reason: The HPC conception coheres with the natural kinds scientists are particularly interested in discovering and appeal to when predicting and explaining phenomena. At the level of the Standard Model, for example, scientists are interested in discovering which forces exist and which properties are "instantiated" in the world. But what figures into the particle-physics theories about the ontology of the world are entities described in terms of which properties regularly appear together and which property clusters, therefore, seem precluded. In short, each distinct particle kind is a distinct homeostatic cluster of properties. Thus, kinds on the HPC conception just are the kinds described by the Standard Model, whose kind-posita continue to be very useful for prediction and explanation. Assuming scientific realism, we do well, I believe, to accept the HPC conception of kinds.

6. In fact, Kornblith (1993) rejects reductionism about objects, causation, and kinds; however, I shall concern myself reductionism about kinds only.

7. Kornblith's argument that cognitive ethologists are studying the same natural kind as epistemologists seems at odds with the following claim. According to Kornblith,

Knowledge, on this view, first enters our theoretical picture at the level of understanding of the species, rather than the individual. Explanations of individual behavior require reference to desires and beliefs, but a distinction between belief and knowledge is simply irrelevant here. (Kornblith 2002, 57).

Traditionally, epistemologists have been studying human knowledge whose reliable processes were also selected for. But with human knowledge the distinction between mere belief and knowledge is crucial. Thus, the connection between cognitive ethologists' use of 'knowledge' and epistemologists' use of that term seems tenuous at best.

8. Of course, this assumption is reasonable. If two properties F and G give rise to similar sets of DV measurements across similar sets of tests, we have no justification for inferring that F and G are distinct. If, for example, after running a series of tests on a particle p_1 , the DV measurements indicate that p_1 has a negative charge, and then particle p_2 is run through the same tests which yield the same DV measurements as for p_1 , it would be odd indeed to conclude that p_2 has a positive charge. We (rightly) *distinguish* between two properties based on *differences* in observed sets of causal interactions. Similarly, if F and G give rise to different sets of DV measurements across similar sets of tests, there is no reason to believe F and G are in fact the same property. If p_1 repels p_2 and attracts p_3 , but p_4 attracts p_2 and repels p_3 , we infer (again,

rightly) that p_1 and p_4 possess different properties. We expect, to paraphrase Hume, like sets of IV manipulations and properties to produce like DV measurements.

Of course, physical properties come in sets. But at the lowest level, a set of properties is nothing over and above a conjunction of its constituents. So, for example, it might be determined that a particle p has a rest mass of 9.109×10^{-31} kg, a charge of -1.602×10^{-19} C, and spin 1/2. A conjunctive predicate might be used to pick out this property set,

(1) x has a rest mass of 9.109×10^{-31} kg, a charge of -1.602×10^{-19} C, and spin 1/2

If the set of physical properties picked out by (1) is discovered to be a regular, homeostatic feature of the universe, then it qualifies as a natural kind, in which case the predicate in question might be replaced with something a bit more manageable:

(2) x is an electron

9. Kornblith (2002) also offers arguments for why the project of standard analytic epistemology has reached a dead end, but these arguments go beyond the scope of this paper.

10. More precisely, by ‘full description’ I mean a list of statements attributing to x all the (non-mere-Cambridge) properties x has, to y all the (non-mere-Cambridge) properties y has, and for any (non-mere-Cambridge) property that is possessed by both x and y , there is a statement claiming that x and y are similar with regard to that property.

11. One might wonder here whether A could in fact be a full description. In this somewhat formal discussion, I am merely stating that it can, but that it can will be shown via example when the discussion turns in a moment to multiply realizable kinds.

12. The phrase ‘equal to’ figures in here because I assume universal quantifiers have no existential important. It is possible that only one electron, say, is realized in a particular world, in which case the number of kinds recognized by higher-level sciences will be equivalent to the number of kinds recognized by the lower-level sciences.

13. Only sciences at the level of the Standard Model can fall within the latter category.

14. I am distinguishing between denying a kind’s existence and merely failing to recognize it. If CERN and FermiLab together created a distinct group whose research focuses exclusively on quarks, the creation of this project would not entail a denial that leptons exist; leptons merely fall outside the project’s scope. Forming such a group does not create a distinct ontological domain; such divisions of laboratory labor are largely arbitrary. But if multiple realization is a genuine feature of the natural world, distinct ontological levels are also such a feature. My claim is that, for any x and y , if multiple realization is a genuine feature of the world, and x and y are distinct members of a disjunctive kind, then the higher- and lower-level sciences will be inconsistent with each other about the number of property, and thus kind-membership, similarities between x and y .