

Taxonomic incommensurability

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Abstract *In a shift of position that has gone largely unnoticed by the great majority of commentators, Thomas Kuhn's version of the incommensurability thesis underwent a major transformation over the last decade and a half of his life. In his later work, Kuhn argued that incommensurability is a relation of translation failure between local subsets of interdefined theoretical terms, which encapsulate the taxonomic structure of a theory. Incommensurability arises because it is impossible to transfer the natural categories employed within one taxonomic structure into the categorial system of another such structure. Apparently on the basis of such taxonomic incommensurability, Kuhn asserted a number of antirealist theses about truth, reference and reality. In this paper, it will be argued, however, that, far from leading to antirealist consequences about the relation between theory and reality, the taxonomic incommensurability thesis may be incorporated unproblematically within a reasonably robust scientific realist framework.*

1. Introduction

In his later work, Thomas Kuhn developed a refined version of the thesis of the incommensurability of alternative scientific theories. This version of the thesis involves differences between the taxonomic categories which scientific theories employ. I call it the thesis of *taxonomic incommensurability*. Kuhn associates a number of antirealist claims about truth and reality with this thesis. However, I will argue here that these claims do not follow from taxonomic incommensurability. Instead, it is consistent with a full-blooded scientific realism.

Kuhn is well-known for having argued that rival or successive scientific theories are incommensurable in the sense of being unable to be compared by means of common standards of evaluation. It is less well-known that Kuhn's views on this topic

underwent major changes subsequent to their original presentation. In *The Structure of Scientific Revolutions*, Kuhn presented incommensurability as conceptual, methodological and perceptual disparity between paradigms, which leads to communication breakdown and rational undecidability of paradigm debate. Somewhat later, he restricted incommensurability to the semantic relationship of untranslatability between theories, which he claimed to be similar to Quinean indeterminacy of translation. On his final view of the topic, Kuhn treated incommensurability as translation failure between interdefined clusters of terms within the special vocabulary of theories. (For discussion of these developments, see my (1993).)

In outline, this paper is organized as follows. In Section 2, I examine Kuhn's idea that scientific revolutions are characterized by change in the taxonomic structure which scientific theories impose upon the world. In Section 3, I consider Kuhn's claim that change of structure gives rise, at the semantic level, to localized translation failure between interdefined subsets of terms. Section 4 traces this untranslatability to a relation of no-overlap which Kuhn claims to hold between natural kinds. In Section 5, I critically examine Kuhn's claim that incommensurability entails the falsity of the realist idea of progress as increase of truth about a fixed set of entities. Section 6 criticizes Kuhn's rejection of the correspondence theory of truth. And in Section 7, I suggest that the scientific realist need find little to object to in the thesis of taxonomic incommensurability.

2. Taxonomic change

In *The Structure of Scientific Revolutions*, Kuhn emphasized the non-cumulative nature

of revolutionary scientific change. One aspect of such change which came to assume particular importance in later developments of his position is change of taxonomy. According to Kuhn, scientific revolutions are characterized by changes in the taxonomic schemes by means of which theories classify the entities in their domains of application.

Kuhn makes frequent use of historical examples, such as the astronomical categories of *planet* and *star*, and the chemical categories of *compound* and *mixture*. Such categories contain items which theories group together on the basis of characteristic properties or behaviour. Because theories typically classify their domains into a number of distinct categories, such theoretical classification requires a taxonomic system with multiple categories.

Kuhn suggests that change of taxonomic system is what typifies scientific revolutions. He notes that the criteria which define taxonomic categories change during a scientific revolution. However, since criteria also vary during normal science, the characteristics of revolutionary change lie elsewhere:

What characterizes revolutions is ... change in several of the taxonomic categories prerequisite to scientific descriptions and generalizations. That change ... is an adjustment not only of criteria relevant to categorization, but also of the way in which objects and situations are distributed among preexisting categories. (1987, pp. 19-20)

Revolutionary scientific change is not restricted, therefore, to changes in the claims theories make about members of a shared set of categories. Rather, such change alters the classificatory system by means of which category membership is determined, which leads to changes in both the criteria of classification and the membership of categories.

One of Kuhn's standard examples of taxonomic change is drawn from the transition between Ptolemaic and Copernican astronomy:

Before [the transition] occurred, the sun and moon were planets, the earth was not. After it, the earth was a planet, like Mars and Jupiter; the sun was a star; and the moon was a new sort of body, a satellite. (1987, p. 8)

Here Kuhn writes as if the entities themselves undergo change, rather than the taxonomic system; e.g., the sun was a planet, later it was a star. What he presumably means, though, is that while the sun was once *classified as* a planet, it was later *classified as* a star.

The transition to Copernican astronomy illustrates a number of features of the sort of taxonomic change Kuhn has in mind. First, there is a broadly fixed set of entities – in this case, the set of heavenly bodies – which constitutes a common domain of objects that is shared between different systems of classification. Second, change of taxonomy is not wholesale change of taxonomic scheme, since older categories, such as *planet*, are preserved in the later classification. Third, change of taxonomy involves the shift of objects or sets of objects between categories, as well as introduction of new categories (Cf. Kuhn, 1970b, p. 269). Fourth, as a result of such reclassification, entities which were formerly considered to be unlike each other are taken to be members of the same category.

Such taxonomic change has a number of consequences at the semantic level. Occasionally, major change of ontology or addition of new categories may result in the introduction of novel vocabulary, which varies semantically from previous vocabulary. However, in many cases the original vocabulary is preserved through change of taxonomy, and is therefore subject to change of meaning. Where a change affects the criteria by means of which a category term is applied, such change may alter the sense of the term. But in cases in which objects are transferred from one taxonomic category

to another, the retained terms may undergo change of extension as well.

3. Local holism and untranslatability

The semantic variance associated with taxonomic change lies at the heart of incommensurability. Instead of total communication breakdown, Kuhn argues for failure of exact translation between subsets of interdefined terms within the special language of theories. Such failure of translation is due to what Kuhn calls *local holism*.

According to Kuhn, revolutionary change of taxonomic structure, unlike piecemeal normal scientific change, proceeds in a holistic fashion. This is due to transfer of items between categories in taxonomic change:

Since such redistribution always involves more than one category and since those categories are interdefined, this sort of alteration is necessarily holistic. That holism ... is rooted in the nature of language, for the criteria relevant to categorization are *ipso facto* the criteria that attach the names of those categories to the world. (1987, p. 20)

The holistic nature of taxonomic change is reflected in the interdefinition of the terms which refer to taxonomic categories, since such terms are defined within a system of interconnected concepts.

Because of the holistic interdefinition of terms, it may be impossible to translate names for the taxonomic categories employed by one theory by means of the terms of another theory. One example discussed by Kuhn is the case of phlogistic versus oxygen chemistry. While much of the language used by proponents of the phlogiston theory is still in use, Kuhn says "a small group of terms remains for which the modern chemical vocabulary offers no equivalent" (1983, p. 675). Terms such as 'phlogiston', 'dephlogisticated air' and 'principle' form a cluster of conceptually related terms which

cannot be defined on the basis of the special vocabulary of the oxygen theory. "They constitute", Kuhn says, "an interrelated or interdefined set that must be acquired together, as a whole, before any of them can be used, applied to natural phenomena" (1983, p. 676). As a result of translation failure due to the holistic interdefinition of clusters of category terms, incommensurability emerges as a localized phenomenon, restricted to narrow subsets of terms within alternative theories.

4. Natural kinds and the no-overlap principle

Kuhn's later treatment of incommensurability is characterized by an emphasis on the semantics of natural kind terms. Kuhn argues that terms from one taxonomic structure fail to be translatable into another due to restrictions on relations between natural kinds, deriving from what he calls the *no-overlap principle*. Before I discuss this principle, however, I will introduce Kuhn's idea of a lexicon.

Where Kuhn once spoke of paradigms, he later tended to speak of lexicons or lexical structures. Kuhn sometimes describes the lexicon as a mental module which stores concepts and vocabulary (cf. 1993, pp. 315, 329). More typically, the lexicon is a structured vocabulary of kind terms, which represents a taxonomy of natural kinds (1983, pp. 682-3, 1991, pp. 4-5). Kuhn claims that successful communication does not require speakers to use the same criteria in applying terms to the world. It requires only that speakers operate with "homologous lexical structures" – i.e., with a structured vocabulary incorporating the same taxonomic system (1983, p. 683). Analogously, for translation to succeed from the lexicon of one theory into another, theories need only share lexical taxonomy. If they do not, they are incommensurable.

Kuhn insists that purely extensional constraints on translation are inadequate, since reference-preserving translation may fail to preserve crucial aspects of meaning (1983, pp. 679-80). Yet his claim that homology of lexical structure suffices for translation may suggest that sameness of reference suffices for translation. For one might suppose that lexicons which share taxonomic structure are simply those whose terms have the same extensions. This is where Kuhn's emphasis on natural kinds takes on relevance. The requirement of lexical homology insures that terms from intertranslatable lexicons refer to the same natural kind, rather than that they merely have the same extension. A single set of things may belong to a number of distinct natural kinds, as in the case of a species which is the sole member of a monotypic genus. Because of this, reference to a given natural kind requires that its members be individuated *qua* members of that kind, rather than in a merely extensional manner. The requirement of reference to the same natural kind is, therefore, a stronger constraint than co-extensiveness.

In Kuhn's later work, the requirement of reference to the same natural kind became the principal ingredient in his argument for incommensurability. More specifically, Kuhn's final argument for translation failure between lexical structures turns on a point about the hierarchical nature of natural kind taxonomies:

no two kind terms ... may overlap in their referents unless they are related as species to genus. There are no dogs that are also cats, no gold rings that are also silver rings, and so on: that's what makes dogs, cats, silver, and gold each a kind. (1991, p. 4)

In other words, a natural kind may include other kinds (or members of other kinds) as

members, only if it is a higher-order kind which contains subordinate kinds within the same taxonomy. Kuhn calls this the no-overlap principle because it precludes overlap between the membership of kinds.

The scope of the no-overlap principle is restricted to kinds from a given taxonomy, rather than from alternative taxonomies. Theories may classify things in different ways. A natural kind recognized by one theory may contain members which belong to a number of different kinds according to another theory. Within a taxonomy, however, no such cross-classification is permitted by the no-overlap principle. It is precisely because alternative taxonomies classify differently that the no-overlap principle results in failure to translate between lexical structures which embody such taxonomies.

How the no-overlap principle leads to untranslatability may be illustrated by means of Kuhn's example of celestial taxonomy. Suppose one sought to translate the Ptolemaic term 'planet' into the lexicon of Copernican astronomy. In addition to planets, other than the earth, which are classified as planets by Copernican astronomy, the Ptolemaic category *planet* includes the sun and the moon. Thus, to translate the Ptolemaic term 'planet' into the Copernican lexicon would require incorporation into the latter taxonomy of a single category containing members of three distinct Copernican categories. But no such category may be introduced as a natural kind of the Copernican taxonomy, since the Ptolemaic category combines entities together as members of a single kind which the Copernican scheme treats as members of distinct natural kinds.

Of course, this only raises the question why a kind from one taxonomy may not be integrated into a rival taxonomy. Kuhn's answer is not entirely clear, but he does suggest that it involves the *projectibility* of kind terms (1993, pp. 316, 318). Because

kind terms are projectible, their use presupposes that they refer to things which display lawful behaviour. Indeed, Kuhn takes the laws which govern the behaviour of kinds to be an essential part of the meaning of kind terms (1993, p. 317).

Given the relation between the meaning of kind terms and the laws governing members of a kind, untranslatability is due to difference in laws governing kinds from rival taxonomies. More specifically, a kind from one taxonomy cannot be introduced into a rival taxonomy if its members are classified by the latter taxonomy as members of distinct kinds subject to distinct sets of natural laws. For example, the Ptolemaic category *planet* cannot be introduced as a kind within the Copernican taxonomy, since members of such a category would be subject to incompatible laws normally governing the behaviour of distinct kinds of heavenly body. But, given the inability to introduce a kind from one taxonomy into the other, neither may the kind terms of one lexical structure be introduced into the rival lexicon. Thus, kind terms from one lexicon may not be translatable into another due to differences in the laws governing the kinds of different taxonomies.

5. Zeroing in on truth

Kuhn bases a number of antirealist claims on the thesis of incommensurability. Some have to do with truth, others with reference and reality. In the rest of this paper, I will focus on his remarks about truth, and then attempt to show why taxonomic incommensurability poses no threat to scientific realism.

Kuhn was often critical of the realist idea that the advance of science involves a build-up of truth about a common domain of entities. His criticism usually took the form

of an objection based on the radical ontological change evident in the history of science. For example, he says that in the transition between Aristotle, Newton and Einstein, there is "no coherent direction of ontological development" (1970a, p. 206). In such cases, Kuhn says that he can "see no historical evidence for a process of zeroing in [on nature's real joints]" (1979, p. 418).

Kuhn's remarks suggest the following argument against the realist account of progress. In the transition between theories, there is radical change in description of the entities postulated by theories, so that later theories refer to none of the entities to which earlier theories referred. Thus, the advance of science evidently does not yield an increase in truth about a common set of entities. The force of this argument may be blunted, however, by means of a causal theory of reference: to the extent that reference is determined by causal relation between speaker and reality, it need not vary with change in description of the entities postulated by theories. Kuhn's historical objection fails to carry weight against the realist account of progress, since change of descriptive content of theories need not inevitably be accompanied by radical change of reference.

However, in later work, Kuhn offered a different objection to the realist view of progress. He dismisses realist talk "of science's zeroing in on, getting closer and closer to, the truth" as meaningless. And he says that the fact such talk is "meaningless is a consequence of incommensurability" (1993, p. 330). The reason has to do with translation failure between lexicons and the no-overlap principle:

There is, for example, no way, even in an enriched Newtonian vocabulary, to convey the Aristotelian propositions regularly misconstrued as asserting the proportionality of force and motion or the impossibility of a void. Using our conceptual lexicon, these Aristotelian propositions cannot be expressed – they are simply ineffable – and we are barred by the no-overlap principle from access to the concepts required to express them. It follows that no shared metric is available to

compare our assertions about force and motion with Aristotle's and thus to provide a basis for a claim that our (or, for that matter, his) are closer to the truth. (1993, p. 330)

In this passage, Kuhn infers from untranslatability between a pair of theories that there is no sense in which one may be closer to the truth than the other. Thus, he takes the untenability of the realist account of progress to follow from incommensurability.

But in this Kuhn is seriously mistaken. The mistake turns on the intensional nature of translation versus the extensional nature of truth. Put simply, rival theories may make more or less true claims about the same entities, despite untranslatability. To bring this out, I will make three related points.

First, it is extremely implausible to suppose that conflicting theories *about the same domain* might be incapable *in principle* of being more or less true than one another. Unless such theories fail to refer to *any* actual entities, at least some of the terms employed by the theories must refer to at least some of the same things. For if the theories are competing theories of the same domain, and do not suffer from wholesale reference failure, then at least some of the entities referred to by terms of one theory must fall within the extensions of terms of the other theory. Given this, there is no reason in principle why one of the theories may not assert more truths about those entities than the other.

Second, inability to translate between theories does not entail that one theory may not be closer to the truth than another. Here the crucial point is that truth depends on reference rather than sense, so that sentences may be true or false of the same things even though their terms differ in sense. Given the possibility of non-synonymous co-referential expressions, terms from non-intertranslatable theories may nevertheless

have the same or overlapping extensions. Hence, it is possible for theories to make true or false claims about a common set of entities, to which the terms of both theories refer despite failure of translation. But such a possibility enables one theory to assert a greater number of truths about the shared set of things than the other does, so that it may approximate the truth more closely than the other.

The thrust of these two points is that the realist idea of advance on truth is not undermined by translation failure between theories. But Kuhn's objection was not just that no theory may be closer to truth than another. It was that there is no basis on which to *judge* that theories are closer to the truth. Kuhn claims that untranslatability between lexicons entails that theories are unable to be compared for closeness to truth.

Yet Kuhn's objection to such comparison is unconvincing. According to Kuhn, propositions from incommensurable theories cannot be compared as approximations to truth, since the propositions of one theory cannot be formulated within the lexicon of the other (1993, p. 330). But there is no need to formulate propositions within the lexicon of a single theory in order to compare them for truth. The lexicon of a theory is the special vocabulary of a theory, which constitutes a local fragment of an embracing natural language. As such, alternative lexicons are embedded within a background language, which contains a variety of vocabularies with special areas of application. Given the containment of alternative lexicons within a natural language, the background natural language may serve as metalanguage for the lexicons, which may be treated as object-languages. Employing the natural language as metalanguage, it may then be said of some object-linguistic sentence from a given lexicon that it is true while saying of another object-linguistic sentence from another lexicon that it is false. In this manner, it

is possible to compare the truth-content of incommensurable theories without translating between them. Of course, such comparisons are fallible and theory-laden. But that is surely a different issue.

6. Lexicons and truth

Kuhn often objected to the idea that theories may be true in the sense of corresponding to reality, arguing for example that 'the notion of a match between the ontology of a theory and its "real" counterpart in nature [is] illusive in principle' (1970a, p. 206). In his later work, Kuhn continued to oppose the correspondence theory (1991, p. 6, 1993, p. 330), though he grants a crucial role to a weaker conception of truth, similar to a redundancy conception (1991, p. 8). In what follows, I will focus on Kuhn's claim that lexicons are conventional structures which lack truth-value.

Kuhn's denial of correspondence between theory and reality takes the form of a denial that lexicons may be true or false. He concedes, though, that the notion of truth plays a legitimate role within the context of a lexicon:

Each lexicon makes possible a corresponding form of life within which the truth or falsity of propositions may be both claimed and rationally justified ... With the Aristotelian lexicon in place it does make sense to speak of the truth or falsity of Aristotelian assertions ... but the truth values arrived at need have no bearing on the truth or falsity of apparently similar assertions made with the Newtonian lexicon. (1993, pp. 330-31)

On the resulting conception of truth, truth is internal to lexicon in the sense that its use is restricted to assessing claims made within the context of a lexicon. Its scope is severely limited: neither is the truth of claims made in one lexicon relevant to that of claims made in another, nor may the concept of truth be applied to a lexicon itself. Kuhn is at pains to deny that his account of truth makes truth relative, remarking that

"it is effability, not truth, that my view relativizes to worlds and practices" (1993, p. 336).

As for the relation between lexicon and reality, Kuhn says that "lexicons are not ... the sorts of things that can be true or false" (1993, p. 330). Their "logical status", he says, "like that of word-meanings in general, is that of convention" (1993, p. 330). "The justification of lexicons or lexical change can only be pragmatic" (1993, p. 331).

Moreover, lexicons deal with experience in different ways:

Some ways are better suited to some purposes, some to others. But none is to be accepted as true or rejected as false; none gives privileged access to a real, as against an invented, world. The ways of being-in-the-world which a lexicon provides are not candidates for true/false. (1991, p. 12)

Thus, while the notion of truth has a role within a lexicon, there is no sense in which a lexicon may itself be true. Rather than being true or false, a lexicon has the status of a linguistic convention which may be judged on the basis of how well it serves a particular purpose rather than how well it reflects reality.

Kuhn's internalist conception of truth has profoundly antirealist consequences. It entails that scientific theories cannot be true reflections of reality and that scientific advance necessarily fails to yield an increase in truths about reality. Without wishing to claim that the correspondence theory of truth applies unproblematically to scientific theories, I wish to object to Kuhn's antirealist treatment of the truth-status of lexicons.

First, though, a point of agreement. Kuhn claims that lexicons are neither true nor false. They have the status of conventions. In this, he is clearly right. As Kuhn defines the term, a lexicon is a "structured vocabulary" – a set of words. But it is not words, or sets of words, that may be true or false. It is claims or assertions made using words which may bear truth-value. Moreover, that a given sound or sequence of letters should represent a particular semantic content is, at base, a matter of linguistic convention.

Thus, Kuhn is right to deny that lexicons have truth-value and to assert their conventional status.

The trouble starts when Kuhn concludes that theories are unable to truly reflect reality. Kuhn appears to suggest, for example, that theories are unable to correspond to reality *because* of the conventional status of lexicons (1993, p. 330). But the two issues are quite separate. Despite the fact that words gain meaning by convention, the truth of assertions made using words may still depend on the way things stand in the world. Thus, while theories may be expressed using the resources of a conventional lexicon, nothing follows from this about the nature of the truth of theories.

This is connected with another problem with the conventional status of lexicons. Kuhn writes as if their conventionality makes truth internal to lexicon, so that no question may arise of whether theory corresponds to reality. But such emphasis on conventionality distorts the fact that lexicons play an important theoretical role. The terms of a lexicon are natural kind terms introduced by a scientific theory to express its picture of the world. The lexicon of the phlogiston theory, for example, includes such terms as 'phlogiston', 'phlogistication' and 'dephlogisticated air'. An important scientific advance was made when it was found that the entities postulated by the phlogiston theory do not in fact exist. This means that there is a truth of the matter about the relation between lexicon and reality since a genuine question may be raised whether the entities postulated by a theory actually exist. But given the possibility of truth and falsity at this level, it follows that truth cannot be merely a matter internal to lexicon. The claims made using the terms of a lexicon may or may not correspond to the way the world is.

7. A realist remedy

The incommensurability thesis has been widely perceived as a serious threat to scientific realism. Kuhn himself associates a number of antirealist claims with the thesis. But I wish to suggest that the realist has little to fear from taxonomic incommensurability.

Scientific realism characteristically involves four main components. The first is anti-instrumentalism: the unobservable entities postulated by scientific theories are conceived as real things, not mere predictive devices. The second is an axiological thesis: the aim of science is to discover the truth about the world, and progress in science consists in advance toward this aim. Third, the realist adopts a correspondence theory of truth, according to which what makes a statement true is that the world really is as the statement says it is. Fourth, scientific realism is a form of metaphysical realism: scientists investigate an objective reality, whose existence, structure and properties are independent of human mental activity.

I claim that scientific realism is uncompromised by the thesis of taxonomic incommensurability. As we have just seen, Kuhn argues that translation failure between theories precludes convergence on truth, and he dismisses correspondence between theory and reality because of the conventionality of lexicons. Yet, as I have argued, neither Kuhn's rejection of progress toward truth nor his dismissal of correspondence truth may be sustained on the basis of taxonomic incommensurability. As a result, both the scientific realist view of the aim of science and of the nature of truth emerge unscathed by incommensurability.

As for the anti-instrumentalist aspect of realism, the issue of translation between

theories is entirely separate from that of the reality of theoretical entities. The concepts employed by theories may evolve in the history of science regardless of whether unobservable entities exist, or whether theoretical terms are to be treated as genuinely referring expressions. At a more general level, Kuhn's picture of science as involving continual revision of concepts and alteration of classificatory scheme is entirely consonant with a scientific realist account of science. For, according to realism, scientific theories are proposed to explain observable phenomena in terms of the behaviour of unobservable entities. Developing such explanatory theories involves the formulation of accurate concepts and classifications of such entities and phenomena. Since developing a theory is a fallible process, which involves continuous revision in light of empirical findings, modification of concepts and classifications employed by theories is a permanent feature of scientific inquiry. But, given the prevalence of conceptual and classificatory change, untranslatability between theories of the kind highlighted by Kuhn is bound to be a regular occurrence in theory change.

Turning finally to the most fundamental level of realist commitment, the thesis of taxonomic incommensurability in no way compromises the realist idea of an independent reality. Admittedly, Kuhn does occasionally say that world changes with paradigm and that the world is mind-dependent. But such claims play no part in the argument for translation failure between theories. Moreover, there is no need whatsoever to suppose that the world does change with change of taxonomy. Different theories may classify the world differently while the world remains the same. Hence, variation of taxonomic scheme is fully consistent with the mind-independence aspect of realism.

More generally, the existence of conceptual change in science has no bearing on the metaphysical issue of the existence of a reality independent of human thought. Taxonomic change has no metaphysical import. The resulting failure of translation is a semantic relation between theories of the same world.

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