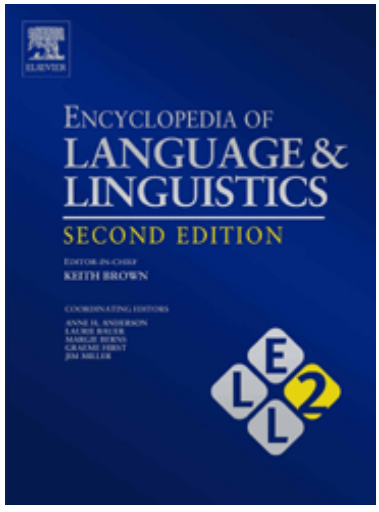

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Natural Kind Terms

S Gross, University of Pennsylvania, Philadelphia, PA, USA

Natural kind terms denote, or purport to denote, natural kinds – for example, physical, chemical, and biological kinds. They are of particular interest to philosophers concerned with what enables us to think and talk about natural kinds. According to *descriptivism*, the denotation of natural kind terms is determined by an associated description. According to *causal theories*, the denotation is determined by language users' causal interactions with exemplars. Hybrid views are also espoused. These positions parallel those taken on the denotation of proper names (cf. Stanley, 1997; *see* **Proper Names: Semantic Aspects** and **Proper Names: Philosophical Aspects**).

Debates about natural kind terms carry implications for a variety of philosophical issues. Causal theories, for example, are *prima facie* in tension with a methodological individualism that assumes that cognitive properties – including the semantic properties of an individual's terms – are determined by properties intrinsic to the individual (cf. Burge, 1979). Discussions of natural kind terms also intersect with debates in cognitive psychology concerning tacit essentialism (cf. Gelman, 2003) and with discussions in the philosophy of science concerning the bases for successful inductive generalization (cf. Kornblith, 1993).

What Are Natural Kind Terms?

Human first languages do not syntactically or morphologically mark natural kind terms as such. Natural kind terms are distinguished solely by the kind of kinds they purport to denote. What then are natural kinds? The core idea is that they are object groupings that reflect real distinctions in nature – in particular, distinctions that play an explanatory role in (accurate) scientific theories. Natural kinds are contrasted with arbitrary groupings of objects whose behavior cannot be explained by shared fundamental properties – for example, the kind comprising Plato's left ear, the natural numbers, and the shoes owned by current heads-of-state. Natural kinds are also contrasted with conventional groupings that reflect practical human concerns, such as the citizens of Pennsylvania. Relatedly, they are contrasted with artifactual kinds – objects grouped together in virtue of our intending them to fulfill certain functions, such as tables. Natural kind terms thus arguably include 'gold,' 'tiger,' and 'H_2O'; but not 'keys' or 'gorks' (where it is hereby stipulated that something is a gork if and only if it is Plato's left ear, a natural number, or a shoe owned by a current head-of-state).

This basic characterization leaves much room for disagreement about just which terms are natural kind terms. First, it admits adjectives – at least those that denote groupings that reflect real distinctions in nature (perhaps 'red' but not 'cultural' – cf. Kripke, 1972). But on some views, not all groupings are kinds, and so not all terms for them are kind terms. Many restrict kind terms to nouns or noun phrases that admit a generic reading, accept kind-level predicates like 'are widespread,' and are associated with criteria of individuation. These terms may be either mass or count nouns (cf. Carlson, 1991).

Second, there are disagreements about various further theses concerning natural kinds and, as a result, disagreements about which kind terms are natural kind terms. Some maintain, for example, that instances of a natural kind share an unchanging essence, that natural kinds fall into a non-cross-classifying hierarchy, or that natural kinds have no borderline instances.

On such bases, they argue against the inclusion of various candidate kinds – and thus against the inclusion of various candidate kind *terms*. Debates concerning biological species and terms for them are a prominent example (cf. Dupré, 1981; LaPorte, 2004). (Philosophers debate many other issues concerning natural kinds, not all of which affect the classification of natural kind *terms*. For example, they disagree about whether natural kinds have reality independent of our categorizations and about what sorts of entities they are: sets, properties, complex individuals, or something *sui generis*.)

Third, the use of many putative kind terms seems sensitive to human interests. It may seem that we have discovered that the denotation of 'water' is shared by 'H_2O.' But the uses of 'water' and of 'H_2O' are sensitive to amounts and kinds of impurities in differing ways. We would hesitate to call tea 'water' but not the stuff flowing in a river, even though the latter might have more impurities vis-à-vis H_2O than the former. However, neither tea nor a contaminated river is H_2O. Some conclude that 'water' is not a natural kind term, while others argue that such phenomena can be explained pragmatically (cf. Malt, 1994; Braisby *et al*., 1996; Abbott, 1997).

The Semantics of Natural Kind Terms: Descriptivism

We may distinguish three questions concerning the semantics of natural kind terms:

1. the *property* question: what are the semantic properties of natural kind terms?
2. the *foundational* question: in virtue of what do natural kind terms have these semantic properties?
3. the *competence* question: what is required for a speaker to grasp the semantic properties of natural kind terms?

The past 30 years of debate have been shaped to a large extent by Kripke's (1972) and Putnam's (1975) attacks on *descriptivism*. Classic descriptivism maintains three theses corresponding to these three questions. According to *property descriptivism*, the semantic properties of a natural kind term are those of some definite description. According to *foundational descriptivism*, a natural kind term has a particular semantic property – its denotation – in virtue of its relation to such a description. According to *competence descriptivism*, a speaker understands a term in virtue of associating it, explicitly or tacitly, with such a description.

Forms of descriptivism can be further articulated in various ways. For example, John Locke (1979: Book III, Chapter VI) – a *locus classicus* of descriptivism – in effect required that the relevant descriptions be constructed from observational terms. This is because his descriptivism is in service to his developmental and epistemological empiricism, according to which mental states arise from and are justified by experience. Locke distinguished the 'real essence' and the 'nominal essence' of substances, such as gold. The real essence is what makes gold what it is. Locke was pessimistic that we could ever discover a substance's real essence. The nominal essence is the list of observable properties that a speaker associates with the term for this substance. Locke held that the term 'gold' signifies an "abstract idea" composed of ideas of these observable properties (shiny, yellow, malleable, etc.). A natural gloss is that the content of a natural kind term like 'gold' is given by and identical to an observational description such as 'the stuff that's shiny, yellow, malleable, etc.,' and a speaker grasps that this is the term's content in virtue of taking that description to define it.

Against Descriptivism

Descriptivism is a natural view since such features clearly play a role in categorization. But Kripke and Putnam raised a host of objections aimed at separating how people categorize things from what determines the denotation in fact possessed by their terms.

First, there are *modal* objections. Consider 'gold' and a candidate Lockean description. Arguably, the sentence 'gold is gold' expresses a necessary truth – as does, on at least one reading, 'the shiny, yellow (etc.) stuff is the shiny, yellow (etc.) stuff.' But 'gold is the shiny, yellow (etc.) stuff' does not. For it is metaphysically possible both that there be stuff that possesses those observable properties but differs from gold in some fundamental way and that there be gold lacking some one of those properties. Relatedly, 'it's necessary that gold is gold' expresses a truth, but 'it's necessary that gold is shiny, yellow, etc.' does not. (It is thus often maintained that natural kind terms are rigid designators [*see* **Rigid Designation**], although how best to extend the concept beyond proper names is not obvious and depends on what one takes a kind to be; cf. Soames, 2002.)

A second, *epistemic* objection is that the descriptions associated with natural kind terms may be false without affecting the natural kind term's denotation. Suppose that I falsely believe that tigers are the fastest cat and that this is a fundamental, defining characteristic of tigers. It does not follow that, when I use the word 'tiger,' I in fact denote cheetahs. More generally, one might reject a view according to

which, as scientists revise their core beliefs in the light of new research, the denotation of their terms changes, so that scientists adopting different theories become communicatively isolated behind incommensurable vocabulary.

Finally, the *absence* objection points out that speakers competent in the use of a natural kind term often do not associate any particular description with it at all – or at least none that the speakers themselves would consider especially relevant semantically or that would uniquely pick out the natural kind at issue. Putnam (1975) notes that what he happens to know of beeches basically coincides with what he happens to know of elms, so he has available no descriptions that would account for the distinct denotations of 'beech' and 'elm.' Further, even if there are descriptions that uniquely pick out these kinds, it is far from obvious that they play any role in a speaker's cognitive economy.

Causal Theories

Rejecting descriptivism allows one to recognize the possibility of misalignment between what one's terms are about and how one conceives of them. But, if not one's conception, what determines the denotation of natural kinds terms? Causal theories deriving from Kripke (1972) and Putnam (1975) endorse a two-part account of the foundational semantics of natural kind terms: the denotation of natural kind terms is fixed by appropriate causal interaction with instances of the kind and can be socially transmitted to others by patterns of linguistic deference. A natural kind term is introduced with an intention – or comes to be used with an intention – that it denote stuff relevantly similar in underlying structure to *stuff like that*. What fixes the denotation is thus something like a Lockean real essence. 'Gold' denotes, not the stuff that shares various observable properties, but rather the stuff that has some fundamental properties responsible for the observable ones, whatever those fundamental properties might be. People not privy to samples of such stuff intend to use the term as do those who are. The denotation of 'beech' in Putnam's idiolect, for example, is fixed by the fundamental properties of the samples with which those to whom he defers have interacted. Scientific inquiry enables us to learn about these fundamental properties, but linguistic competence does not require – indeed, arguably helps make possible – such knowledge.

On such a view, what semantic properties a natural kind term has are in part determined by features external to speakers – by the (perhaps unknown) underlying nature of the ostended stuff and by features of one's linguistic community. Kripke's and Putnam's foundational semantics for natural kind terms thus supports *linguistic semantic externalism* – the thesis that the semantic properties of one's terms do not supervene on one's intrinsic states. A particularly vivid illustration is provided by Putnam's 'Twin Earth' thought experiment. Suppose that there is another planet just like ours except that, in place of water (H_2O), its lakes, oceans, swimming pools, etc., are filled with XYZ, a liquid superficially similar to water in appearance, taste, odor, etc., but with a different chemical microstructure. Since XYZ is not H_2O, it is not water but rather something that merely resembles water. Now, suppose Oscar is a denizen of Earth, and Twin Oscar is his counterpart on Twin Earth – an exact duplicate with respect to intrinsic properties. Out of Oscar's mouth, 'water' denotes water (H_2O), but not XYZ. Were it pointed out to Oscar that the liquid he just referred to as 'water' was in fact made up of completely different stuff, he would admit that he'd been misled by its superficial resemblance to water. Out of Twin Oscar's mouth, 'water' denotes XYZ (that is, what *they* call 'water' on Twin Earth), but not water – for parallel reasons. But Oscar and Twin Oscar are intrinsically identical. Therefore, their words' semantic properties are a function, not just of their intrinsic states, but also of external factors. Such externalism stands in sharp contrast to, for example, Chomsky's internalist conception of language (*see* **E-Language versus I-Language**).

Descriptivism Redux

Descriptivists have defended themselves both by replying to Kripke's and Putnam's objections and by raising problems for causal theories.

In reply to the *modal* argument, one finds four objections, presented here in increasing order of concessiveness. Some reject the very idea of metaphysical modalities. Others reject the intuitions behind the particular modal claims made, sometimes adding that such intuitions are sensitive to framing effects (and might not be cross-culturally robust – cf. Machery *et al*., 2004). Then there are those who deny that critics have considered the *right* descriptions: if 'gold' is associated with a *rigidified* description such as 'what's actually the most precious yellow metal,' the modal argument is blocked. Finally, some point out that the argument, if successful, applies only against *property* descriptivism and so does not yet pose a problem for strictly *foundational* descriptivists.

In reply to the *epistemic* objection, a descriptivist might likewise complain that causal theorists focus on the wrong descriptions. There must be *some*

accurate description that can be associated with the natural kind term. For instance, the relevant description could be constructed from the causal theorist's account of the determination of natural kind terms' denotation: 'the stuff that (actually) stands in such-and-such causal relations to users of the term K.' It may be objected that speakers can be competent in the use of natural kind terms despite not associating them with such theoretically sophisticated descriptions. We return to this sort of objection presently. But there are also less theoretically sophisticated candidate descriptions, such as 'the stuff that's (actually) relevantly like *this* stuff, or the stuff others have talked about' (so long as there is no bar on demonstratives), or on some views 'the stuff that's called water in this language' (cf. Haas-Spohn, 1997).

In reply to the *absence* objection, a descriptivist might posit tacit knowledge of the description's bearing on the natural kind term. That is, the descriptivist might hypothesize that the mind or brain associates natural kind terms with such descriptions, even though a speaker is not necessarily aware of this. Alternatively, a descriptivist might argue that such descriptions can play the role required by *property* and/or *foundational* descriptivism despite speakers' ignorance of them. Rather than positing tacit knowledge, the descriptivist might then abandon *competence* descriptivism altogether. This might appeal in particular to those who deny that a semantic theory must also play a role in an account of semantic competence. According to such theorists, the task of semantics is to characterize the semantic properties of expressions, not to explain how speakers grasp those properties (cf. Katz, 2004).

In addition to replying to causal theorists' objections, descriptivists emphasize that causal theories face *prima facie* problems of their own. First, it is not obvious how causal theories should accommodate apparently denotationless natural kind terms such as 'phlogiston' and 'unicorn' (*see* **Empty Names**). These terms are not synonymous. But it is unclear how a causal theorist can distinguish them semantically, since the theorist cannot appeal to a difference in denotation. Descriptivists face no problem here, since they can associate such terms with nonsynonymous descriptions ('the stuff flammable material gives off in combustion'; 'the horse-like mammal with a magical horn').

Moreover, causal theorists face the *prima facie* problem that, on their view, 'phlogiston' is not a denotationless term after all, since it was introduced via interaction with instances of combustion and thus arguably denotes *oxygen*, the stuff in fact responsible for the observed behavior. Unless they can resist this consequence, causal theorists would be committed to a history of science according to which phlogiston theorists were correct that phlogiston exists but simply wrong that it comes from the flammable material.

Finally, an object can be an instance of various natural kinds. If my use of 'gold' is associated with exemplars that are not only Au but also all instances of a particular isotope, what determines to which kind my term refers? Perhaps indeed the term should denote *metals*. This is an instance of the *qua*-problem (anticipated by Locke – cf. Stanford, 1998): it is unclear of what kinds the instances are exemplars, in particular whether we are to consider the instance *qua* gold, *qua* metal, *qua* a certain isotope, etc. Here too it can seem that the foundational semantics requires a constraining descriptive component.

Hybrid Views

In part for these reasons, some have developed hybrid views. There are two not mutually exclusive ways one can combine a moderate descriptivism with a causal theory – both of which have antecedents in Putnam (1975). First, some defend a limited *property* descriptivism while abandoning the claim that the denotation of natural kind terms is determined solely by such descriptions. The idea is that among the semantic properties of a natural kind term is an associated description (or a meaning with description-like content), even though the denotation is not determined by this description and might not align with its extension. Second, some maintain that a natural kind term's denotation is determined by causal relations to exemplars as constrained by some descriptively characterized requirement. It is not sufficient to say that a natural kind term denotes *stuff like that*: it must be stuff that is *relevantly similar* to the exemplar in ways that require at least some descriptive elaboration (cf. Stanford and Kitcher, 2000).

Neodescriptivists have attempted to absorb the insights of causal theories in other ways as well. We have already noted that one might include rigidifying and/or demonstrative expressions in the descriptions. In addition, some theorists distinguish two dimensions of semantic content: a description-like first intension and a second intension that, in the case of natural kind terms, is a function of the first intension and the actual environment of the speaker. The first intension determines a classically descriptivist extension. The second intension, however, does not determine an extension on its own at all; it constrains an extension that is in part determined by how the world in fact is (cf. Chalmers, 2002; *see* **Two-Dimensional Semantics**).

See also: Adjectives; Causal Theories of Reference and Meaning; Chomsky, Noam (b. 1928); Descriptions, Definite and Indefinite: Philosophical Aspects; Developmental Relationship between Language and Cognition; E-Language versus I-Language; Empty Names; Empty Names; Extensionality and Intensionality; Generics, Habituals and Iteratives; Inference: Abduction, Induction, Deduction; Kripke, Saul (b. 1940); Locke, John (1632–1704); Mass Expressions; Mass Nouns, Count Nouns, Non-count Nouns: Philosophical Aspects; Meaning: Development; Nominalism; Nouns; Proper Names: Philosophical Aspects; Proper Names: Philosophical Aspects; Proper Names: Semantic Aspects; Proper Names: Semantic Aspects; Putnam, Hilary (b. 1926); Reference: Philosophical Theories; Rigid Designation; Rigid Designation; Two-Dimensional Semantics; Two-Dimensional Semantics.

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Natural Language Interfaces

R W Smith, East Carolina University, Greenville, NC, USA

Communicating More Effectively with Computers

As technology has progressed to the point where computing hardware is at its most affordable, one can readily argue that the limiting factor in the usability of computers is the usability of the interface. At the onset of interactive computing, the ability to manipulate the data and programs resident on a computer was restricted to individuals able to master the very rigid syntax and vocabulary of command line interfaces. Consider the following scenario:

> Given a file of data containing test results, calculate the relevant statistics about each person and display and save a table of results in sorted order based on average.

A command line to complete this task might look like the following:

```
stats < data.txt | sort –k 3,3n > results.txt ; lpr
  results.txt
```

where *stats* is the program for calculating statistics, *data.txt* is the input file, and *results.txt* will be the output file.