The Semantics of Natural Kind Terms: How to Make Kripke’s Theory Work

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Abstract

This paper clarifies and defends the Kripkean view of natural kind terms, with some help from Kaplan. Natural kind terms fall into two categories. Vernacular terms such as ‘water’, ‘gold’ or ‘tiger’ are directly referential, designate rigidly and are non-descriptive. They contrast in semantic properties with non-rigid descriptive terms such as ‘mammal’, ‘species’, or ‘acid’ which are clearly defined. Scientific terms are descriptive. A few descriptive terms (‘the smallest prime’, ‘H₂O’ and perhaps others) may be regarded as rigid de facto. A descriptive term locks the properties of the referent into an analytic, a priori definition, thus entailing change of meaning and referent with each new discovery or theory change. A directly referential term such as ‘water’ has no descriptive content, thus ensuring continuity of referent when new properties of that referent are discovered or theory change occurs.

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[M]y argument implicitly concludes that certain general terms, those for natural kinds, have a greater kinship with proper names than is generally realised. This conclusion holds for certain for various species names, whether they are count nouns, such as ‘cat’, ‘tiger’, ‘chunk of gold’, or mass terms such as ‘gold’, ‘water’, ‘iron pyrites’. It also applies to certain terms for natural phenomena, such as ‘heat’, ‘light’, ‘sound’, ‘lightning’, and, presumably, suitably elaborated, to corresponding adjectives – ‘hot’, ‘loud’, ‘red’.

(Saul Kripke, Naming and Necessity p.134)

§1 Descriptive and directly referential terms

Kripke's claim that natural kind terms such as ‘water’, ‘gold’ or ‘tiger’ have more in common with proper names than they do with most other general terms has been much criticised. It is alleged that the semantic notion of rigid designation is trivialised by its extension to natural kind terms. Debates about the classification of kinds arise which seem to challenge the notion of rigidity, particularly in biology. Then there is the accusation that Kripke tries to derive an essentialist theory from a theory of semantics. I believe that by spelling out the semantics of direct reference and rigid designation as they apply to natural kind terms – which Kripke himself did not do - many of the misunderstandings regarding these and other issues can be resolved.
The key distinction in semantics between directly referential and descriptive terms separates natural kind terms themselves into two distinct categories, a fact either misinterpreted or ignored by many commentators, including Kripke himself. The vernacular natural kind terms (such as ‘water’, ‘gold’ or ‘tiger’) cited by Kripke and Putnam share with proper names three characteristics not shared with most general terms. They are directly referential, they designate rigidly and they are non-descriptive. Directly referential natural kind terms contrast in semantic properties with descriptive natural kind terms such as ‘mammal’, ‘species’ or ‘acid’. All theoretical scientific terms are descriptive because they must be clearly defined. In the case of Kripkean theoretical identities such as ‘water = H₂O’, the left-hand term is directly referential whereas the right-hand one is descriptive. Both terms are rigid. Though all directly referential terms are rigid designators, the converse does not apply. We can call this the Kripke-Putnam-Kaplan view.

David Kaplan explains the distinction between descriptive and directly referential terms by pointing out that there are two routes from a designator to a referent. The first is via a description or set of descriptive conditions (‘propositional content’); the other is the direct route which bypasses descriptive conditions or content. The descriptive route is well-known. Descriptive general terms designate their referents indirectly, in virtue of the properties the said referents possess. These properties are encapsulated in the descriptive definition which the term abbreviates or with which it is synonymous. A descriptive definition spells out the necessary and sufficient conditions for inclusion in the extension of

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1 Most commentators analyse the semantic data correctly, but differ widely in their interpretations regarding the significance of those data.
2 See Martí 2003 for a challenge to this accepted view, contested by Sullivan 2005.
3 I include Kaplan although he only suggests in passing that natural kind terms might be regarded as directly referential (1989, 580-581, fn. 30). His insights regarding direct reference can help us understand what is going on when we use natural kind terms. I include Putnam out of deference to tradition, though his and Kripke’s views diverge considerably. See Hacking, 2007b.
4 1989, 576. Kaplan has in mind singular terms, notably indexicals and demonstratives, but the principle can be applied to other directly referential terms.
5 This parallels Donnellan’s distinction (1966) between attributive and referential uses of definite descriptions.
6 This is an over-simplified account. If a definition is analytic it must be a priori, though there are a priori truths which are not analytic and may have nothing to do with the purely semantic notion of analyticity. See Salmon, 1993, and Boghossian, 1996, for anti-Quinean arguments linking analyticity and a priority.
the term. So the term ‘grandmother’ designates in all possible worlds those individuals who satisfy the description ‘female parent of a parent’. Anyone who grasps the meaning (intension or Sinn) of the term ‘grandmother’ understands a priori its applicability conditions. The properties of the referents of the natural kind term ‘mammal’ or the artefactual term ‘pencil’ are similarly encapsulated in analytic descriptive definitions. If a definition is analytically true it is necessarily true, but only in the sense that it is knowable a priori to be true in all those worlds where the defined term has the same meaning as in the world where its meaning is fixed.

In contrast, a directly referential term does not designate in virtue of a descriptive condition which an object must satisfy if it is to qualify for inclusion in the extension of the term, as is the case with ‘grandmother’, ‘mammal’ or ‘pencil’. Instead, we start with the thing itself (the individual or kind), give it a label, and use that label to track it across possible worlds (to talk of it in counterfactual situations). In so doing, we designate it rigidly. The referent of a directly referential term is determined prior to any proposition being expressed in which it is a component. A directly referential term enables us to hook onto people, things or stuff about which we may know very little. It allows us to engage in discourse about the same individual or kind despite changes in our knowledge of its properties, or changes in the properties themselves. The semantic distinction between directly referential and descriptive terms reflects an epistemic distinction in our knowledge of the properties of the kinds they designate.

If ‘water’ were to be regarded as a descriptive rather than as a directly referential term, in grasping its meaning we should have a priori access to an analytic definition which encapsulates the unique set of properties possessed by water. The definition of ‘water’ in

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7 LaPorte’s genealogical definition of ‘mammal’: ‘Mammalia = the clade which stems from ancestral group G’. Collins English Dictionary, 1979 gives vernacular definitions: ‘mammal: any animal of the Mammalia, a large class of warm-blooded vertebrates having mammary glands in the female, a thoracic diaphragm, and a four-chambered heart’; ‘pencil: thin, cylindrical instrument used for writing, drawing, etc, consisting of a central rod of graphite encased in wood and sharpened, or held in a mechanical metal device.’

8 This is why, as Kripke says, we need no qualitative criterion to identify the referent of a rigid designator such as ‘Nixon’ in other possible worlds; see N&N 42-47, 50-53 for further arguments.

9 Here I have in mind the changes an individual will undergo in the course of a lifetime. Changes in the properties of kinds on the other hand (as distinct from changes in our knowledge of those properties) may lead to change of reference, hence change of meaning (as for example when biological species either evolve or get reclassified).
the *Collins English dictionary*, 1979, runs as follows:

‘Clear, colourless, tasteless, odourless liquid, essential for animal and plant life, falls as rain, found in impure form in rivers, lakes and oceans. ..... Formula \( H_2O \).’

If we omit the formula ‘\( H_2O \)’ from the dictionary definition above, we are left with a descriptive definition which summarises the properties of water most familiar to us, a description which Aristotle would have recognised. However, there are possible worlds containing liquids which answer the descriptive definition of ‘water’ but which we would not count as water, like Putnam’s fictional Twin Earth where people drink XYZ. The descriptive definition associated with the term ‘water’ underdetermines its referent – it is insufficient to guarantee the uniqueness of water. This is one reason why Putnam claims that in the case of ‘water’ and other natural kind terms, intension does not determine extension. Intension does determine extension in the case of descriptive general terms like ‘grandmother’, ‘mammal’ or ‘pencil’.

The chemical formula ‘\( H_2O \)’ does establish the uniqueness of the stuff water. However, it is not derivable from a priori reflection on the meaning (intension) of the term ‘water’. Since the statement ‘water is \( H_2O \)’ is not a priori, but expresses a scientific fact which had to be discovered a posteriori, it cannot be analytic. Furthermore, if ‘water is \( H_2O \)’ is not analytic, it cannot be necessarily true according to the only notion of necessity acknowledged on the descriptivist view – necessity in virtue of meaning. Kripke’s controversial but correct claim that ‘water is \( H_2O \)’ expresses a necessary a posteriori truth concerns necessity in virtue of the properties of objects or kinds, ‘de re’ or metaphysical necessity. Since no analytic definition of ‘water’ can identify water uniquely, and the

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10 Aristotle would probably have included in his definition of ‘water’: ‘one of the four key elements’.
11 Putnam, 1975. There are several flaws in Putnam’s presentation of his Twin Earth argument which need addressing, but they do not affect the discussion here.
12 Putnam would reject this last sentence on the ground that there is an epistemic possibility that pencils might turn out to be organisms (1975, section 9). I would argue that there is no such epistemic possibility in the case of a familiar artefact all of whose properties are knowable a priori. See Schwartz 1977, introduction.
13 The necessity of true identity statements such as ‘Hesperus = P hosphorus’ (and by extension ‘water = \( H_2O \)’) derives from the necessity of self-identity (i.e. of an object with itself), not from any notion of analyticity. See discussion in ‘I&N’. This is a complex issue which requires separate treatment.
uniquely identifying component of the definition of water is only knowable a posteriori, ‘water’ cannot be a descriptive general term. The same holds for ‘gold’, ‘tiger’ and other vernacular natural kind terms.  

We must now distinguish between a description which gives a meaning (as with ‘female parent of a parent’ or ‘female fox’) and a description which is used to fix a reference (like the dictionary definition of ‘water’, above) . A description which gives the analytic definition or synonym of a term is part of semantics proper. The facts in virtue of which a label is assigned to a referent and comes to be accepted by a linguistic community are not part of semantics proper. In the case of a directly referential term, the reference-fixing description is no part of ‘what is said’ by statements containing the term. A semantic rule tells us a priori that it is incorrect to apply the term ‘grandmother’ to a childless woman – it gives the necessary and sufficient satisfaction conditions for the correct application of the term. No semantic rule can spell out a priori the correct applicability conditions of the terms ‘water’, ‘tiger’ or ‘gold’. Furthermore, no semantic rule can tell us a priori whether the applicability conditions of a term have been met in any specific instance. To know this, we need to be in possession of certain a posteriori facts concerning the properties of the referent.

In the case of directly referential natural kind terms, reference is fixed by paradigmatic exemplars of the kind itself. A sample of liquid is to count as water if it bears the relation same liquid to the samples of liquid first used to introduce the term ‘water’. Clearly, if we are to know whether one sample of water bears the relation same liquid to another, we need some ‘criterion of sameness’. Underpinning the idea of a criterion of

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14 For an extensive discussion of these arguments see N&N, 114 -139.
15 N&N: ‘to fix a reference is not to give a synonym’ p. 15; ‘A description may be used as synonymous with a designator, or it may be used to fix its reference’, p.59. See Kripke's discussion of the fixing of the reference of the standard metre, 54-56, for the key argument.
16 Reference-fixing descriptions and definitions are part of what Kaplan calls ‘metasemantics’, not semantics. The so-called ‘causal theory of reference’ is an account of how meaning is fixed, so is a metasemantic theory. Kripke says: ‘The original concept of cat is: that kind of thing, where the kind can be identified by paradigmatic instances. It is not something picked out by any dictionary definition’, N&N, 122.
17 This account of reference fixing – the ‘causal-historical theory’ - is discussed in Putnam 1975, section 6, N&N 134 -139, and in countless other papers. There are difficulties with this ‘metasemantic’ theory which cannot be addressed here, but they do not affect the current discussion. For a good overview, see Stanford and Kitcher, 2000.
sameness for a natural kind is the metaphysical assumption that there is uniformity in nature, and that all members or samples of a kind share certain key properties without which that kind would not be the kind it is. We are initially ignorant as to what those properties might be. Finding out what they are is a matter for scientific investigation. Putnam’s ‘stereotypes’ or ‘operational definitions’ provide us with a (defeasible) yardstick for identifying normal members of the kinds lemon and tiger.\(^{19}\) The pre-scientific stereotype for water might be its dictionary definition minus the formula ‘H\(_2\)O’. Nowadays the criterion of sameness for a chemical compound such as water is taken to be its molecular structure, H\(_2\)O; for a chemical element such as gold, it would be the number of protons (79) in the nucleus of its atom; for a kind such as tiger, it might be its ancestry or its DNA\(^{20}\). But the idea that there must be a uniformity linking all samples of a kind, if it is to constitute a kind, precedes any knowledge of what that uniformity might consist in.

With all this in mind, a key difference emerges between the applicability conditions of a descriptive term like ‘grandmother’ or ‘mammal’ and those of a directly referential term like ‘water’. The applicability conditions of a descriptive term are part of the meaning of the term and are thus knowable a priori, as we saw. The applicability conditions of a directly referential term are not knowable a priori so are not part of the meaning of the term. They concern those properties of the referent which require a posteriori investigation. We can therefore say that the criterion of sameness for the referent of a descriptive general term is knowable a priori\(^{21}\), whereas that of a directly referential natural kind term is a matter for scientific enquiry.

\section*{§2 Two kinds of rigid designation}

The function of a rigid designator is to mark out for every possible world the same object (‘Aristotle’) or natural kind (‘water’, ‘gold’) that it designates in the actual world. Once a

\(^{19}\) Putnam 1970 and 1975.

\(^{20}\) LaPorte argues that the ancestral origin of a species gives its essence, though its DNA is used to trace back that ancestry. Whatever the criterion of sameness of a biological kind might be, it is not knowable a priori unless its definition is stipulated, in which case it is a descriptive term (like ‘mammal’).

\(^{21}\) The properties encapsulated in a scientific descriptive definition are discovered empirically or their existence is inferred from empirical evidence. The definition itself is stipulated, by agreement with other members of the scientific community.
rigid designator is assigned to a referent, it can thereafter designate no other object or kind. The natural kind term ‘water’ designates only the liquid we now know to be H\textsubscript{2}O, even when we travel to Twin Earth. In contrast, the description ‘clear, tasteless, colourless, odourless liquid’, being non-rigid, designates both H\textsubscript{2}O and XYZ.

However, if the notion of rigidity is extended to include natural kind terms, it suggests that other general terms might designate rigidly as well.\textsuperscript{22} As mentioned earlier, there is an asymmetry between rigid designators and directly referential terms. All directly referential terms must be rigid, but the converse does not apply. If, as Kripke argues, certain natural kind adjectives (‘hot’, ‘red’) can, given ‘suitable elaboration’ rigidly designate too, it suggests that a clearly-defined complex description can rigidly designate a determinate set of properties. It would follow that some rigid designators are directly referential whereas others are descriptive, recalling Kripke’s distinction between ‘de jure’ and ‘de facto’ rigid designators. ‘The smallest prime’ is a descriptive term and ‘2’ is directly referential.\textsuperscript{23} They are both rigid, however, since they co-designate the same referent and no other in this and all possible worlds. The ‘possible worlds’ mechanism used to define rigid designation is a blunt instrument. It cannot differentiate between those designators which are stipulated to attach rigidly to a referent and cling to that referent in all possible worlds (the ‘rigid de jure’ or directly referential terms), and those designators which in fact designate the same referent rigidly in virtue of a set of descriptive conditions which that referent happens to satisfy in all possible worlds (the ‘rigid de facto’ descriptive terms).\textsuperscript{24} The usual examples given of descriptive or ‘de facto’ rigid designators are mathematical terms, as above. But the phenomenon of rigidity is far more widespread than presupposed, once the notion is extended to include predicates. This does not mean that rigidity is thereby trivialised.\textsuperscript{25} It can still do the work required of it, as we see now.


\textsuperscript{23} N&N 21, fn. 21. Kripke briefly explains the distinction, but does not engage in discussion regarding its implications. ‘The smallest prime = 2’ is of course a necessarily true identity statement.

\textsuperscript{24} Many writers, including Kaplan, Salmon and Soames, have commented on this. See Kaplan 1989, 492 -8.

\textsuperscript{25} There is much current discussion on this topic. Many commentators assume that ubiquity leads to trivialisation, so either try to circumvent the arguments which lead to ubiquity or reject the rigidity of natural kind terms. See Soames 2002, Salmon 2003, Marti 2003, 2004, Sullivan 2005, Lopez de Sa 2007, LaPorte 2000, Schwartz 2002.
§3  Rigidity and change of meaning

A descriptive term can only be rigid (i.e. rigid \emph{de facto}) if it designates a clearly-defined and determinate set of properties. If the term ‘mammal’ were to designate rigidly a set of properties F, G, H, the term could only retain sameness of meaning and referent across possible worlds \emph{provided that the properties designated remained the same}. If biologists decided, by a combination of discovery (of properties) and stipulative definition, that the term ‘mammal’ designated a different set of properties G, J, K, this would entail meaning change and perhaps change of referent. The word ‘mammal’ would no longer mean what it used to since it would no longer refer to the same kind of thing. In such an eventuality, the term ‘mammal’ could not be regarded as rigid.\footnote{LaPorte argues that ‘Mammalia’ is a rigid term, although its meaning has changed. He says (p. 48-9): ‘the mere evolution of meaning does not destroy the rigidity thesis. A term need not keep its meaning over time in order to be rigid at a time’. A term which does not keep its meaning over time cannot be rigid, whether it is a directly referential or a descriptive \emph{de facto} term.
} Rigidity \emph{precludes} change of referent, therefore change in meaning.\footnote{In the case of a directly referential term, its only meaning is its referent. A rigid \emph{de facto} term must have continuity of both referent and descriptive sense.
} Terms such as ‘mammal’, ‘acid’,\footnote{See discussion on the definition of acids in Stanford and Kitcher 2000.
} or ‘species’, whose extensions vary whenever natural kinds are re-classified to conform to theory change regarding the properties in virtue of which they should be taxonomised, must be descriptive and \emph{non-rigid}.

Since a descriptive term can only be rigid \emph{de facto} if the properties it designates remain \emph{fixed in the same combination} across all possible worlds where those properties co-exist, the criteria for being a rigid designator \emph{de facto} are clear and stringent. ‘Grandmother’ and ‘pencil’, though not natural kind terms, may well satisfy these criteria whereas ‘mammal’ may not. Chemical kind formulae such as ‘H\textsubscript{2}O’ or ‘CO\textsubscript{2}’ do satisfy these criteria, since they rigidly designate a specific kind of stuff in virtue of the molecular properties of the stuff in question. The theoretical terms of physics are clearly descriptive. Whether or not any are rigid is an interesting question which I leave for debate.

§4  Concluding remarks

The distinction between the terms ‘water’ and ‘H\textsubscript{2}O’ lies not in their rigidity, since both are
rigid, but in the type of rigidity they exemplify. ‘H₂O’ is a descriptive term, rigid de facto. The structural properties of the chemical kind designated by the term are encapsulated in the meaning of the term. Of course these properties must remain the same if the term is to retain its meaning (intension) and continue to determine the same referent. The rigidity of ‘water’ on the other hand stems from the fact that it is a directly referential term. Any information or operational definition ²⁹ we associate in our minds with the term is not part of its meaning. If the stereotypical properties of a kind are locked into an a priori definition of that kind, those properties are stipulated to be the necessary and sufficient properties of the kind in question. If we discover a new property of that kind, the meaning of the designating term changes along with its referent. This has happened in the cases of the natural kind terms ‘mammal’, ‘species’ and ‘acid’, but it has not happened in the case of ‘gold’ or of ‘water’. Our knowledge and understanding of the properties of water have profoundly changed between Aristotle’s time and ours, yet the stuff which is the object of our interest remains the same. The only ‘meaning’ of ‘water’ is its referent, the stuff it stands for. I hope that the distinctions pointed out above help us understand why.

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²⁹ I have avoided using the term ‘concept’ in this paper since it would require some elucidation. I am quite sympathetic to David Wiggins’ view, which he takes from Frege, that the term ‘concept’ is linked to the notion of reference. Wiggins used the term ‘conception’ to characterise our understanding of the stuff water. Our conception of water has changed though the concept has not.

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