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RIGID APPLICATION

ABSTRACT. Kripke defines a rigid designator as one that designates the same object in every possible world in which that object exists. He argues that proper names are rigid. So also, he claims, are various natural kind terms. But we wonder how they could be. These terms are general and it is not obvious that they designate at all. It has been proposed that these kind terms rigidly designate *abstract* objects. This proposal has been criticized because all terms then seem to come out rigid, thus trivializing rigidity. The paper starts with further criticisms of this proposal aimed particularly at a recent version given by LaPorte. The paper goes on to develop and defend an alternative proposal presented briefly in Devitt and Sterelny (1999): instead of taking those natural kind terms to rigidly designate an object we take them to rigidly *apply* to the members of their extensions. Schwartz has rightly insisted that a notion of rigidity must do some theoretical work if it is to be interesting. The paper argues that rigid application for kind terms does the same primary work as rigid designation for singular terms, the work of refuting description theories of some terms; and it does the same secondary work, of explaining certain modal phenomena (with one exception).

1. INTRODUCTION

Saul Kripke defines a rigid designator as one that designates the same object in every possible world in which that object exists. If a designator does not do this it is nonrigid (1980, p. 48). The proper name ‘Aristotle’ and the definite description ‘the last great philosopher of antiquity’ provide clear examples of the distinction: they both designate the same ancient Greek but only the name rigidly designates him.

Kripke argues that certain “natural kind” general terms are like proper names. He clearly thinks that one way in which they are alike is in being rigid (pp. 127–136). The terms he has in mind are

various species names, whether they are count nouns such as ‘cat’, ‘tiger’, ‘chunk of gold’, or mass terms such as ‘gold’, ‘water’, ‘iron pyrites’ . . . certain term for natural phenomena, such as ‘heat’, ‘light’, ‘sound’, ‘lightening’, and, presumably, suitably elaborated, . . . corresponding adjectives – ‘hot’, ‘loud’, ‘red’. (p. 134)

Kripke does not offer a new definition of rigid designation for these terms and so presumably the old one should apply to them. But we wonder how it could. ‘Aristotle’ and ‘the last great philosopher of antiquity’ are singular terms designating a certain concrete entity and so it is easy to see how they can be rigid or nonrigid. But the kind terms Kripke has in mind are predicates and it is not obvious that they designate at all. Perhaps we should see a mass term in subject position – for example, ‘water’ in ‘Water is refreshing’ – as a singular term designating the mereological sum of all parts of the appropriate stuff. But then it is certainly not rigid: ‘water’ will designate different sums of water in different worlds. In general, if we take these kind terms to designate their extensions none of them will be rigid. In the face of this difficulty, several philosophers proposed that these kind terms rigidly designate *abstract* objects of some sort, kinds, properties, or attributes.¹ But, as others pointed out, this proposal has the opposite problem. Too many terms, including ones like ‘pencil’, ‘hunter’, and ‘bachelor’, seem to come out rigid.² Yet, the criticism continues, rigidity was supposed to distinguish natural kind terms from these nonnatural ones. The proposal seemed to trivialize the notion of rigidity by making it indiscriminate.

In a recent paper, Joseph LaPorte (2000) nicely summarizes this history and then leaps to the defense of a version of the proposal. Stephen Schwartz (2002) has responded with a criticism of this defense and also with a criticism of an alternative proposal presented in Devitt and Sterelny (1999, pp. 85–86). I shall start by making further criticisms of LaPorte’s proposal. My aim is to show that proposals of that sort are indeed very unpromising. I shall then go on to develop and defend the alternative proposal according to which some kind terms rigidly *apply* to the members of their extensions.

Schwartz rightly insists that a notion of rigidity must do some theoretical work if it is to be interesting. On this score, I shall argue, rigid application is nearly as interesting as rigid designation.

2. LAPORTE’S PROPOSAL

LaPorte claims that his proposal does not trivialize rigidity. For, on his proposal, whereas ‘the honeybee’ designates the honeybee kind³ rigidly, other terms like ‘the insect species that is typically farmed

for honey’ designate that kind nonrigidly. The latter term picks out the kind

by means of the honeybee’s happening to satisfy a particular description, one that fails to apply to the honeybee in various other possible worlds. It might, for example, have been typical to farm *bumblebees* for honey . . . (2000, pp. 296–297)

Using similar reasoning, LaPorte concludes that ‘bachelor’ rigidly designates the bachelor kind but ‘the kind most commonly broached in discussions about analyticity’ does not; and that ‘soda’ rigidly designates the soda kind but ‘beverage my uncle requests at Super Bowl parties’ does not. So LaPorte rejects the idea that rigidity serves to distinguish natural from nonnatural kind terms (p. 299).

This proposal avoids trivializing rigidity by claiming that some kind terms like ‘beverage my uncle requests at Super Bowl parties’ are not rigid. But what is the basis for this claim? Suppose that among the kinds there is not only the soda kind but also the *different* beverage-my-uncle-requests-at-Super-Bowl-parties kind (which happens to be coextensive with the soda kind in the actual world).⁴ For short, call this kind “BMURASP.” Then, in the actual world, ‘beverage my uncle requests at Super Bowl parties’ would *not* designate the soda kind because the soda kind happens to satisfy a particular description. Rather it would designate the BMURASP kind. Indeed it would designate the BMURASP kind in all possible worlds: it would be rigid. So the semantic issue of whether this term is rigid comes down to the issue of whether the BMURASP kind exists and is distinct from the soda kind. A totally “unselective realist” about “universals” – roughly, a universal for every predicate – will think that there is indeed a distinct BMURASP kind with the result that the term is rigid after all. LaPorte’s claim that the term is not rigid requires a “selective realism” that rules out the existence of the distinct BMURASP kind. So the choice between these claims comes down to a controversial metaphysical issue in the theory of universals. LaPorte’s proposal seems to leave the rigidity issue with no substance beyond this metaphysical issue.

There is a certain identifiable object that both the name ‘Clinton’ and the definite description ‘the first two-term Democratic president to follow Franklin D. Roosevelt’ designate in the actual world. This uncontroversial fact opens the way to an interesting definition of ‘rigid’ for these “concrete designators.” The problem with extending

the definition to “abstract designators” is that there is no analogous uncontroversial fact about them.

LaPorte responds to an objection along these lines⁵ by arguing that “the metaphysical issue about kinds behind the objection pertains as well to concrete objects.” He considers ‘the president of the USA’ which “apparently designates Clinton non-rigidly” (p. 300). Drawing on Alan Sidelle (1992), Laporte claims that our ontology might include “office persons.” “An office person is an individual who is constituted at any given time by the man or woman in a given office” (p. 300). If our ontology did include office persons then ‘the president of the USA’ might rigidly designate such an entity – call it ‘Prez’ – rather than nonrigidly designate Clinton.

Of course, one need not recognize “unusual” objects like office persons in one’s ontology. But neither must one recognize “unusual” kinds, like the BMURASP kind. (p. 301)

So LaPorte thinks that the rigidity distinction for concrete designators is as entangled in controversial metaphysics as the distinction for abstract designators. He is wrong about this. Whether or not there are such objects as Prez – and I am inclined to think that there are – it is not controversial that ‘the president of the USA’ designates Clinton not Prez in the situations that concern us, situations where that description is contrasted with the name ‘Clinton’ in a rigidity debate. It is very hard to come up with actual examples where the view that a term designates concrete object *x* is rendered dubious by a controversy over whether another concrete entity *y* exists. In contrast, as the objection brings out, a lot of doubt is thrown on the designation of abstract designators by the two millennia of controversy over precisely what universals there are.

Let us explore the universals controversy a little. Selective realists think that there is not a distinct universal for every predicate. How then do they choose which predicates have distinct universals?⁶ In particular, how might they rule that ‘beverage my uncle requests at Super Bowl parties’ does not have the universal BMURASP to call its own? At first sight it might seem as if LaPorte’s selection principle is that only *simple* (one-word) predicates like ‘soda’ have distinct universals. But this clearly would not do because we can always introduce a single word to abbreviate a complex expression; for example, introduce (the somewhat unpronounceable)

'bmurasp' for 'beverage my uncle requests at Super Bowl parties'. In any case, LaPorte rejects this selection principle. He thinks that " 'bald-human kind' rigidly designates the bald-human kind [and] 'bald-happy-human kind' rigidly designates the bald-happy-human kind" (p. 313n). But then what could the principled basis be for the view that 'beverage my uncle requests at Super Bowl parties' does not rigidly designate the BMURASP kind?

LaPorte's proposal is an attempt to get an interesting rigidity distinction for kind terms by taking some of those terms to rigidly designate abstract objects. I think that the discussion so far shows how unpromising such attempts are. For, they seem doomed to yield a distinction with little substance beyond a stand on the controversial metaphysical issue about abstract objects. And there are three more considerations that count against such proposals.

Taking account of the nominalist suggests one. The nominalist denies that kind terms designate any universals either rigidly or nonrigidly because she denies that there are any universals. So a proposal like LaPorte's fails to yield a distinction between rigid and nonrigid kind terms that is of any use to the nominalist. Yet if there is a useful semantic distinction to be made here we might hope that it would be one that a nominalist could use.

We get the second consideration by generalizing Schwartz's criticism of LaPorte. LaPorte draws an analogy between the role of his distinction in explaining the modal properties of identity statements involving kind terms and the famous role of Kripke's distinction in explaining the modal properties of identity statements involving singular terms (pp. 297–298). Schwartz shows that the analogy is strained at best (2000, pp. 270–273). I shall add further criticisms at the end of section 4. Our conclusion is that LaPorte's distinction does no theoretical work. The generalization is that no proposal of this sort does theoretical work.

The third consideration is that there is an alternative proposal for kind terms that is better, one that distinguishes rigid from nonrigid *application*. And this is one that the nominalist could accept. Schwartz argues that this distinction also does no work (pp. 274–275). In sections 3 and 4 I shall show that it does do interesting work. In section 5, I shall respond to Schwartz's criticisms.

3. RIGID APPLICATION: PRIMARY WORK

I endorse Schwartz's demand that a distinction between rigid and nonrigid kind terms do some work in the theory of language. But what work should we *expect* a distinction to do? I want to consider this question before presenting the alternative proposal.

We have already noted (sec. 1) that the common expectation, shared by Schwartz, is that rigidity should distinguish *natural* kind terms from others. The failure of proposed distinctions to do this is what damns them in Schwartz's eyes. I think that this is not what we should primarily, or even secondarily, expect a distinction to do. *The primary work of a rigidity distinction for kind terms is identifying terms that are not synonymous with descriptions and hence refuting description theories of meaning for those terms.* I shall argue that the alternative proposal does this perfectly.

In considering work expectations for rigidity, it is helpful to go back to the beginning. Kripke (1980, pp. 5–15, 48–78) introduced rigidity in one of his two most novel arguments against the classical description theory of proper names proposed by Frege and Russell.⁷ This “lost rigidity” argument runs as follows: a name is rigid; a description of the sort that the theory alleges to be synonymous with the name is not rigid; so that theory is false. Thus, suppose that the description theory of ‘Aristotle’ is that it is synonymous with ‘the last great philosopher of antiquity’. Now consider the truth conditions of:

- (1) Aristotle was fond of dogs.
- (2) The last great philosopher of antiquity was fond of dogs.

In the actual world, the truth conditions of both (1) and (2) involve a certain ancient Greek that we refer to by ‘Aristotle’: if he liked dogs they are both true; if not, not. But in the nonactual situation where that person died before reaching maturity and studying philosophy, the truth conditions of (1) and (2) would involve different people. The truth of (1) would still depend on whether the person we refer to by ‘Aristotle’ was fond of dogs: ‘Aristotle’ is a rigid designator. But the truth of (2) would depend on whether whoever then fitted the description ‘the last great philosopher of antiquity’ was fond of dogs, presumably on whether Plato was: that description

is a nonrigid designator. So this description theory of 'Aristotle' is wrong.⁸

The lost rigidity argument will not refute all description theories of names because some descriptions are rigid. Thus, the "rigidified" description, 'the person who was *actually* the last great philosopher of antiquity', is of course rigid; and any description that picked out the unique essence of Aristotle would be rigid. Still, the lost rigidity argument refutes most description theories of names.⁹

Kripke follows his refutation of description theories with a sketch of a causal theory of the reference determination of names (pp. 91–97).¹⁰ And, we should note, this theory *explains* the rigidity of a proper name: given that the name's reference is fixed by its having an appropriate causal connection to an object in the actual world, it will designate that object in any world in which the object exists.¹¹

When Kripke later applies the term 'rigid' to natural kind terms he does so whilst likening these terms to proper names (pp. 127–128; see also p. 5). The key likenesses are that these terms are not covered by a description theory of meaning and their references are determined causally. Rigidity is not as prominent in Kripke's discussion of kind terms (pp. 116–139) as in his discussion of names but the primary work it does is of just the same sort: undermining description theories.

In light of this, it is clear that the primary work we should expect from a notion of rigidity for kind terms is featuring in lost rigidity arguments against description theories of meaning for some terms. We might also expect that the successor theory, a causal theory, will explain the rigidity of those terms.

Now, it is true that the terms that are said to be like names are all (arguably) natural kind terms but Kripke does not argue that no other terms are like names. And Hilary Putnam, discussing the likes of 'pencil' and 'pediatrician' (1975, pp. 242–245), has argued, in effect, that some other terms are like names. Whether or not any of these other terms are *rightly* likened to names, let alone whether they are rigid (Devitt and Sterelny, 1999, pp. 93–101), the point that I have been emphasizing stands: the primary job of a notion of rigidity is to show that some terms are not descriptive. If we come up with a notion that does that job then that is sufficient theoretical work to make the notion nontrivial and worthwhile. So its worth

does not depend on *only* natural kind terms being rigid nor indeed on *all* natural kind terms being rigid. The paradigm rigid terms were natural kind terms and so we certainly expect a notion of rigidity to apply to them. And it would be disappointing if it applied fairly indiscriminately. But, beyond that, a notion can apply where it may without reflecting on its worth.

I turn now to the proposed definition of “rigid application”:

a general term ‘*F*’ is a rigid applier iff it is such that if it applies to an object in any possible world, then it applies to that object in every possible world in which the object exists. Similarly for a mass term.¹²

Given that a general term applies to objects where a singular term designates just one, this proposal seems a natural way to extend rigidity from singular to general terms.

Clearly, if ‘*F*’ is a rigid applier then any individual *F* must be essentially *F*. So the view that there are any such ‘*F*’s entails a fairly robust metaphysical thesis. Still, that thesis has been popular from ancient times to the present and I think that it is plausible. Consider ‘gold’, for example. As we use ‘gold’ it applies to lots of stuff in the actual world with atomic number 79 and will apply to any of that actual stuff in another possible world should it exist there. Furthermore, should it apply to nonactual stuff in a possible world it will apply to that very stuff in every other world in which the stuff exists. Any piece of gold is essentially gold and ‘gold’ is a rigid applier.

The primary work that we should expect of rigid application is to feature in lost rigidity arguments against description theories. Rigid application does feature. Consider the theory that ‘gold’ is synonymous with the description ‘soft, yellow element that is the most malleable and ductile metal’. In the actual world that description applies to gold but in another possible world it might not apply to gold but to other stuff altogether. The description is a nonrigid applier. Yet ‘gold’ is a rigid applier. So this description theory of ‘gold’ is false. Rigid application does an equally good job of refuting description theories of other paradigm natural kind terms: ‘water’, ‘iron pyrites’, ‘heat’, ‘light’, ‘sound’, and ‘lightening’ all come out rigid.¹³ And it is not indiscriminate. ‘Bachelor’ is clearly not a rigid applier: someone who fails to tie the knot in this world might well do so in another. ‘Bachelor’ is representative of a whole class of

“nominal kind terms” including, in my view (Devitt and Sterelny, 1999, pp. 93–94), Putnam’s ‘pediatrician’. What about “artifactual kind” terms like ‘pencil’? I think these are also nonrigid appliers but I will leave discussion of them until section 5.

What about a favorite natural kind term, ‘tiger’, and other such “species” terms? The claim that these are rigid appliers may seem problematic. For, according to some popular biological theories, what is essential to being a member of a species is not something intrinsic to an organism but rather something relational. And the relational property in question is an accidental not essential property of an individual organism.¹⁴ If this were right, species terms would indeed not be rigid appliers. Rigid application could still do its work for many other natural kind terms like ‘gold’ and so our alternative proposal would not founder. Nonetheless, it would be disappointing that the proposal cannot handle species terms. So we wonder if the popular theories are right.

This is a big issue, but I would argue, boldly, that the theories are not right. First, I think that there are powerful reasons for thinking that there is an intrinsic component, as well as a relational one, to the essence of a species; in particular, for thinking that a species has a genetic essence, as Kripke and Putnam supposed. And any individual member of the species has that component essentially. Second, on the most plausible views of the relational component of a species’ essence, and even on some implausible ones, any individual member has that component essentially too. At least, any member has it essentially if Kripke is right in thinking that an organism’s essence is its relation to a certain sperm and ovum, hence to certain parents, hence to a certain family tree. Arguing these matters would take another paper.¹⁵ Meanwhile I shall mostly take ‘tiger’ as my example of a rigid applier because it is my favorite too.

We noted that the lost rigidity argument will not refute all description theories of names because some descriptions are rigid. For the same reason, the argument will not refute all description theories of natural kind terms. Thus, the rigidified description, ‘stuff that in the actual world is a soft, yellow element that is the most malleable and ductile metal’, is of course a rigid applier; and a description like ‘stuff with atomic number 79’ is a rigid applier on the metaphysical assumption that having atomic number 79 is essen-

tial to any stuff that has it. Still, the lost rigidity argument refutes most description theories of natural kind terms.

In sum, rigid application does the primary work with kind terms as well as rigid designation does it with proper names. The causal theory that succeeded the description theory of names explains their rigidity. Does the causal theory that succeeded the description theory of some kind terms do likewise?¹⁶ Partly it does. A kind term covered by the causal theory applies to all objects that are of the same kind as the actual sample in which the term was grounded (allowing perhaps for a few “errors” in the sample). So, wherever being a member of that kind is essential to any member, the term will be a rigid applier. So the rigid application of a natural kind term like ‘gold’ is explained partly by the semantic fact that it is covered by a causal theory and partly by the metaphysical fact that each piece of gold is essentially gold.¹⁷ Perhaps all kind terms covered by a causal theory are rigid but, we are a long way from establishing this.¹⁸

Rigid designation and rigid application are similarly explained and do similar primary work. We could take this as sufficient justification of rigid application and so leave it at that. Still, rigid designation was famously illustrated by a variety of modal phenomena and we might expect similar illustrations of rigid application. Furthermore, we can see rigid designation not only as illustrated by those modal phenomena but also as, to a somewhat superficial extent, *explaining* them. To that extent, rigid designation does some secondary work. We might expect rigid application to be similarly illustrated and similarly explanatory. We shall consider some examples which show that it is, with one exception.

4. RIGID APPLICATION: SECONDARY WORK

Explanation (I): We have already illustrated rigid designation in considering the truth conditions of:

- (1) Aristotle was fond of dogs.
- (2) The last great philosopher of antiquity was fond of dogs.

In the actual world, the truth of both (1) and (2) depend on whether the ancient Greek that we refer to by ‘Aristotle’ liked dogs. Yet in the nonactual situation where that person died before reaching maturity

the truth of (1) would still depend on whether that person was fond of dogs, but the truth of (2) would depend on whether Plato was.

We can see these phenomena as not only illustrating the rigidity of 'Aristotle' and the nonrigidity of 'the last great philosopher of antiquity' but also, to an extent, as *explained by* that rigidity and nonrigidity. The explanation is, of course, rather superficial because the phenomena are *so illustrative* of rigidity. Still, in the interests of finding work for the rigidity distinction, let us take it as explanatory here. Rigid application gives an analogous explanation.

Consider the truth conditions of:

- (3) Tigers make dangerous pets.
- (4) Large carnivorous quadrupedal felines that are tawny yellow in color with blackish transverse stripes and white belly make dangerous pets.

In the actual world, the truth conditions of both (3) and (4) involve the animals to which we apply 'tiger': if they make dangerous pets (3) and (4) are both true; if not, not. But in a nonactual situation the truth conditions of (3) and (4) might involve different animals: the diet of tigers might be so different that they lacked a white belly; and another species might have evolved somewhere in Africa that fitted the description 'large carnivorous . . . white belly'. In that situation, the truth of (3) would depend on whether the animals to which we would apply 'tiger', including any actual tigers, made dangerous pets, but the truth of (4) would depend on whether the animals fitting the description, including no actual tiger, made dangerous pets. These phenomena illustrate the idea that 'tiger' is a rigid applier whereas 'large carnivorous . . . white belly' is not and the phenomena are, somewhat superficially, explained by this difference in rigidity.¹⁹

Explanation (II). Consider the difference between:

- (5) The last great philosopher of antiquity might not have been the last great philosopher of antiquity.
- (6) Aristotle might not have been Aristotle.

Whereas (5) is true (with the scope of the first description wide), (6) is false. Kripke takes the falsity of the likes of (6) to be an "intuitive test" of rigidity (1980, pp. 48–49, 62). We can see the rigidity distinction as explaining the difference between (5) and

(6). (5) is true because ‘the last great philosopher of antiquity’ is nonrigid and would not have designated Aristotle if he had died before reaching maturity. (6) is false because ‘Aristotle’ is rigid and so always designates the same person and that person, like any other, must be self-identical.

Rigid application can give an analogous explanation. Consider the difference between

- (7) Large carnivorous quadrupedal felines . . . white belly might not have been large carnivorous quadrupedal felines . . . white belly.
- (8) Tigers might not have been tigers.

(7) is true (with the scope of the first kind term wide) because ‘large carnivorous quadrupedal felines . . . white belly’ is nonrigid and would not apply to tigers if they had three legs or non-white bellies. But (8) is false because ‘tiger’ is rigid; so it will apply to any animal in another possible world that it applies to in the actual world; so that animal will still be a tiger.

So, once again, rigid application does similar explanatory work to rigid designation. And, once again, we might see the explanation as somewhat superficial. This pattern is repeated in explanation (III).

Explanation (III): Consider:

- (9) It might have been the case that the last great philosopher of antiquity was not a philosopher.

(9) has two readings which are not equivalent. In reading (9a) the scope of the description is wide so it is equivalent to

- (10) The last great philosopher of antiquity is such that he might not have been a philosopher.

(9a) and (10) are true because being a philosopher is not an essential property of that last great philosopher, Aristotle (or of anyone). In reading (9b) the scope of the description is narrow and so (9b) is false: it is necessary that any philosopher (of any sort) is a philosopher.

In contrast, the two readings of

- (11) It might have been the case that Aristotle was not a philosopher

are equivalent. In (11a) the scope of the name is wide and so it is equivalent to

- (12) Aristotle is such that he might not have been a philosopher.

(11a) and (12) are true for the same reason that (9a) and (10) are: being a philosopher is not an essential property of Aristotle. But (11b), with the scope of the name narrow, differs strikingly from (9b). For, (11b) denies just the same essential property of Aristotle as does (11a) and so is true. We can explain this difference between the true (11b) and the false (9b) by pointing out that the name is a rigid designator but the description is not: the narrow-scope readings are equivalent to the wide-scope ones if and only if the singular term is rigid (Kripke, 1980, p. 12n).²⁰

Very similar phenomena are found with kind terms. Thus consider

- (13) It might have been the case that large carnivorous . . . with blackish transverse stripes and white belly were not striped.

(13), like (9), has two readings which are not equivalent, (13a) with the scope of 'large carnivorous . . . with blackish transverse stripes and white belly' wide and (13b) with it narrow. (13a) is probably true because tigers are not essentially striped whereas (13b) is false because it is necessary that anything with transverse stripes is striped. In contrast, the two readings of

- (14) It might have been the case that tigers were not striped,

like the two readings of (11), are equivalent. The narrow-scope (14b), like the wide-scope (14a), denies that being striped is essential to tigers and so is probably true.²¹ We can explain this difference between the probably true (14b) and the false (13b) by pointing out that 'tiger' is a rigid applier but 'large carnivorous . . . with blackish transverse stripes and white belly' is not. This explains why the truth of (14b) depends on whether being striped is inessential to the animals to which we would apply 'tiger'.

Explanation (IV). Finally, the rigid designation distinction is famously illustrated by the difference in the modal status of:

- (15) Hesperus is the bright planet seen in the evening
 (16) Hesperus is Phosphorus.

(15) is contingent: had things gone a bit differently in the formation of the solar system, some other planet might have been the bright one seen in the evening; the description is nonrigid. In contrast, (16) is necessary: there is no possible world in which Hesperus is not Phosphorus. This not only illustrates the rigidity of ‘Hesperus’ and ‘Phosphorus’ but is also, somewhat superficially, explained by that rigidity: both names designate the same planet in every possible world where that planet exists (Kripke, 1980, pp. 3–5, 98–102).

Kripke emphasizes similar phenomena with “theoretical identities” (pp. 98–99, 123–136). Consider:

- (17) Water is the most common liquid on Earth
 (18) Water is H₂O.

The claim is that (17) is contingent but (18) is necessary. How are we to understand this claim given that we are not taking ‘water’ to be a designator? It seems that we must take it as a claim about

- (17′) Anything is water iff it is a liquid that is more common than any other on Earth
 (18′) Anything is water iff it is H₂O.

(17′) is indeed contingent: in some possible world gin might have been more common than any other liquid on Earth. Yet (18′) is necessary: the water in any possible world will be H₂O and vice versa.

Sadly, these phenomena cannot be fully explained by appeal to rigidity. (18′) determines that ‘water’ and ‘H₂O’ apply to the same stuff in the actual world. The rigidity of these terms then determines that these terms will still apply to that actual stuff in any possible world in which it exists. But we are still short of establishing the necessity of (18′). The problem is the *nonactual* stuff that the terms refer to in other possible worlds. Rigidity determines that when one of the terms applies to some nonactual stuff in a world it will do so also in any world where that stuff exists. But that does not determine that the *other* term will apply to *that same stuff* in those worlds, which is what we need to establish the necessity. (18′) is no help here because it only concerns actual stuff. At best we can say that rigid application is *part of* the explanation of the necessity

because if the terms in (18') were not rigid it would not be necessary.²²

In sum, rigid designation is illustrated by, and somewhat superficially explanatory of, a variety of modal phenomena. With the exception just noted in explanation (IV), rigid application is similarly illustrated by, and somewhat superficially explanatory of, a similar variety of modal phenomena. In the last section we saw that rigid application does the primary work as successfully as rigid designation. In this section we have seen that, apart from the exception noted, the same is true for the secondary work. That is more than enough justification for rigid application.

I shall finish this section by returning to LaPorte's distinction. He claims that just as rigid designation explains the difference in the modal status of the likes of (15) and (16) it will also explain that difference of the likes of:

- (19) The honeybee kind is the insect species that is typically farmed for honey
- (20) The honeybee kind is *Apis mellifera*.

(19) is alleged to be contingent because 'the insect species that is typically farmed for honey' nonridly designates the honeybee kind whereas (20) is alleged to be necessary because both 'the honeybee kind' and '*Apis mellifera*' are rigid designators. So rigid designation does indeed do some theoretically interesting work.

We should note first that the work that LaPorte claims for his distinction is some *secondary* work. His distinction, unlike the one I have proposed, does not do the primary work of refuting description theories of some kind terms. And there are three problems with his claim that his distinction does explanatory work.

(i) The first problem is apparent in the metaphysical discussion in section 2. The claim depends on a selective realism about universals according to which there are no kinds the-species-that-is-typically-farmed-for-honey and *Apis mellifera* that are *distinct from* the honeybee kind. For if there are such kinds then 'the insect species that is typically farmed for honey' surely designates the former kind and '*Apis mellifera*' the latter kind with the result that both (19) and (20) are *false*. (ii) However, suppose that a selective realism could be justified that would allow us to see (19) as contingently true and (20) as necessarily true. The second problem for the

claim is that the modal properties of (19) and (20) would serve more as an illustration of the rigidity distinction than something explained by that distinction; the explanation would be, like the one of the modal properties of (15) and (16), somewhat superficial. (iii) This raises the third problem: we need a deeper explanation of both the modal properties of (19) and (20) and LaPorte's rigidity distinction. *In virtue of what* do 'the honeybee kind' and 'Apis mellifera' rigidly designate the honeybee kind? *In virtue of what* does 'the insect species that is typically farmed for honey' nonrigidly designate that kind? Given that 'bachelor' and 'bald-happy-human kind' are among LaPorte's rigid designators, it is hard to see where he could find an answer to this question. In sum, LaPorte's rigidity distinction rests on controversial metaphysics, does little if any theoretical work, and is left unexplained and mysterious. I think that this will be the fate of any attempt to base a distinction on the idea that some terms rigidly designate abstract objects.

5. SCHWARTZ'S CRITICISMS

Schwartz starts his discussion of rigid application on a positive note but ends it on a very negative one: he proposes "that we give up trying to think and talk about general terms as rigid or non-rigid" (2002, p. 275). My discussion has, in effect, already addressed some of his concerns about rigid application. I shall conclude this paper by considering his main criticism.

This criticism is that rigid application does not mark out the class of natural kind terms. Thus, giving the example of 'frog', he claims that "not all natural kind terms are rigid applicators" (p. 274). Further, giving the example of 'television set', he claims that "some apparently nominal kind terms are rigid applicators." But even if these claims are right, they are not grounds for dissatisfaction. As I have argued, it is a mistake to think that the primary task of the rigidity distinction is to distinguish natural kind terms from nominal kind terms. The primary task is to distinguish kind terms that are not covered by a description theory from ones that are.²³

This having been said, our examples of rigid applicators were natural kind terms and it is independently interesting to consider whether

all natural kind terms are and whether any other terms are. So let us consider Schwartz's examples.

I shall start with 'television set'. Schwartz has this to say: "I do not imagine that an object that is a television set in the actual world might be something else in another world" (p. 275). But surely it might. To see this we need to distinguish what is essential to being a television set from what is essential to being the object that happens to be a television set.

Television sets are all *artifacts*, things made by us. Not only that, they are very complicated. This makes it harder to see what is essential to being a television set. So, let us consider what is essential to being something much simpler that is often not an artifact: a paperweight. To be a paperweight an object must *have a certain function*, the function of securing loose papers with its weight. Paperweights often have that function because they are artifacts designed to have it. But they often get that function in a very different way: a perfectly natural object like a stone or a piece of driftwood becomes a paperweight *by being regularly used* to secure papers. So, whereas having a certain function is essential to being a paperweight, being an artifact is not. Similarly being an artifact is not essential to being a doorstop, a hammer, a pencil, a chair, or even a television set.²⁴ What is essential is having a certain function. Putnam once remarked that chairs might have grown on trees. So might television sets!

We need a word for these functional objects. I shall call them "implements." So what is essential to an object's being a particular sort of implement is having a certain function; the function is a *kind* essence. But having that function, hence being that sort of implement, is not essential to the object; the function is not an *individual* essence. A stone is not a paperweight unless it has the function of securing papers, but in another possible world it might not have that function: it might have been left lying on the beach. Similarly, a television set might have been left in its tree and never brought us CNN. Easier to imagine, an object that functions as a television set might have been designed and used as a very different implement: as an elaborate doorstop, as an ornament, or as a sacred object.²⁵ Whatever the essential nature of objects that are paper-

weights or television sets that nature does not include their functions *as* paperweights or television sets.

Kripke may disagree. He takes the example of a table and emphasizes the importance of the wood from which the table was made to the table's essential nature (1980, pp. 113–115). He rightly notes that this material origin is not all that is essential to the table: "if the very block of wood from which the table was made had instead been made into a vase, the table never would have existed." But then he goes on: "So, (roughly) *being a table* seems to be an essential property of the table" (p. 115n). This cautious suggestion is surely mistaken. Suppose that the person who made Kripke's table had gone through the same motions, using the same materials, making an object physically identical to the table (same size, shape, etc.), but intending it not to be a table but rather a light shade for a very modern building. Once built it was attached "by its legs" to the ceiling where it functioned as a lightshade for its entire existence. That object would never have been a table but it would still have been the very same object as Kripke's table.

So, in my view, the intentions of people who make or use implements are not essential to the natures of the objects that are implements. Had an implement been associated with different intentions it would have been a different implement but not a different object. Those engaged in the vexed metaphysical issue of statues who hold that a statue is essentially a statue (e.g. Baker, 2000) will presumably disagree. So be it. But it is odd indeed to suppose that two indistinguishable stones differ in their essential natures simply because one was left on the beach whilst the other was picked up and regularly used as a paperweight.

The semantic moral of all this is that, contrary to what Schwartz claims, the kind terms for implements are not rigid applicers.²⁶ 'Television set' may apply to an object in the actual world yet not apply to it in a world where the object was designed for other purposes and never used as a television set. 'Television set' applies to all the objects in a world that have the function of a television set whether because they were designed with that function or because they are regularly used with that function.²⁷ Whether those objects have that function in other worlds is beside the point.

I turn now to the example of 'frog'. Why does Schwartz think that 'frog' is not a rigid applier? Consider a particular frog. It starts life as a tadpole and then turns into a frog. So 'frog' then applies to it. But in another possible world it dies young as a tadpole. So 'frog' never applies to it in that world. So 'frog' is not a rigid applier. Many other terms are similar: consider 'moth' applying to what was once a caterpillar; 'cow' applying to what was once a calf.²⁸

Here are two ways one might attempt to preserve the idea that 'frog' is rigid. First, one might claim that 'frog' applies to tadpoles. Some analogous claims seem plausible: 'dog' seems to apply to puppies and 'cat' to kittens. Still, the claim about 'frog' seems rather strained. Second, one might claim that a frog is not the same object as the tadpole it comes from. But that seems even more strained.

So, for the sake of argument at least, let us accept Schwartz's view that the likes of 'frog' are not rigid appliers. Yet, as Schwartz insists, they are surely natural kind terms.²⁹ This does not show, I repeat, that rigid application does not do what it should, let alone that it does nothing interesting. Still, it is undoubtedly a bit disappointing that a natural kind term like 'frog' is not a rigid applier. Can we do anything to lessen this disappointment? I think we can.

An analogous situation arises with singular terms. David Kaplan (1989) has emphasized that not only are proper names rigid designators but so too are simple demonstratives like 'that'. But what are we to say about complex demonstratives like 'that murderer'? Suppose I say, gesturing toward Jones in the dock, "That murderer is insane." Would the proposition I expressed be true if Jones were insane *but had committed no murder*? To suppose that it would is to give the nominal 'murderer' no semantic role. That is implausible. So we must conclude that the proposition would not be true. It follows that 'that murderer' is not rigid: it does not designate Jones in worlds where he exists but 'murderer' does not apply to him. On similar grounds, it is arguable that the deictic pronoun 'he' is not rigid because it designates a certain object only in worlds where it is male. I have argued (2004) that referential descriptions are also not rigid: a referential 'the murderer' is just like 'that murderer'. The lack of rigidity of these terms is undoubtedly a bit disappointing. Yet, there are some ways in which that disappointment can be lessened. First, we note that 'that

murderer' and company are "weakly rigid designators" according to the following definition:

e is weakly rigid iff it designates the same object in every possible world in which that object exists *and any descriptive element of e applies to that object.* (Devitt, 2004, p. 250)

'That murderer' designates Jones in all possible worlds where he exists and 'murderer' applies to him. Second, we note that we can give an explanation of weak rigidity that is analogous to that of rigidity. Whereas rigidity (in the cases that concern us) is explained by a causal theory, weak rigidity is partly explained by a causal theory and partly by a description theory. Finally, just as the rigidity of a term refutes certain description theories of it, so also does the weak rigidity of a term. We can show this using arguments of the sort that Kaplan made famous concerning 'that': thus, 'that murderer' could not mean 'whichever murderer I am pointing at' because in other possible worlds this description might fail to designate Jones because I am pointing at someone else.

Schwartz is drawing our attention to some natural kind terms that are also partly causal and partly descriptive. 'Frog' is rather like the complex term 'adult human'. That term has a part, 'human', that is explained by a causal theory (let us suppose) and a part, 'adult', that is explained by a description theory. It is like 'that murderer' in this respect except that it is an applier not a designator. Is it also like 'that murderer' in being weakly rigid? Not in any theoretically interesting respect.

Note first the failure of this definition:

a general term '*F*' is a weakly rigid applier iff it is such that if it applies to an object in any possible world, then it applies to that object in every possible world in which the object exists and any descriptive element of '*F*' applies to that object.

The definition fails because all general terms would be weakly rigid appliers. Suppose that '*F*' were 'bachelor' and that its descriptive element was 'adult unmarried male'. Then if 'bachelor' applied to Ralph in some world it would apply to him in every possible world in which he existed and 'adult unmarried male' applied to him. The

problem with 'bachelor' is that its application is *entirely* determined by a descriptive element. To prevent such terms being weakly rigid we would have to modify the definition along the following lines:

a general term '*F*' is a weakly rigid applier iff *it applies to objects not simply in virtue of a descriptive element* and if it is such that if it applies to an object in any possible world, then it applies to that object in every possible world in which the object exists and any descriptive element of '*F*' applies to that object.

But then weak rigidity could not do the job of refuting (total) description theories of '*F*': the very definition of weak rigidity would have built into it that only terms that are partly nondescriptive are weakly rigid; see the clause emphasized.

So, we cannot look to weak rigidity to lessen the disappointment of discovering that 'frog' is not rigid. For that we must look to modes of reference. 'Frog' is indeed quite like the natural kind term 'tiger' in that its reference is largely determined causally. But it is a bit unlike 'tiger' in that its reference is partly determined by an associated description that picks out the frog-stage of a tadpole-frog.

In sum, Schwartz's criticism of rigid application fails: even if he were right that kind terms like 'television set' that apply to implements are rigid appliers and natural kind terms like 'frog' are not, this would not count against rigid application because it is not the job of rigidity to mark out the natural kind terms. In any case, he is wrong about the terms for implements: they are not rigid. However, he does seem to be right about natural kind terms like 'frog': they are not rigid because their mode of reference is partly descriptive. So the class of rigid appliers cannot be identified with the class of natural kind terms.

To conclude, attempts to base a rigidity distinction for kind terms on the rigid designation of abstract objects seem hopeless. For, such a distinction seems doomed to depend on controversial metaphysics, to do little if any theoretical work, and to be left unexplained. In contrast, rigid application can do much the same theoretical work for kind terms as rigid designation does for singular terms, the work of refuting description theories and of explaining modal phenomena.³⁰

NOTES

¹ Mondadori (1978), Donnellan (1983), Boer (1985). There is some support for the proposal in Kripke: he talks of “the physical property” yellowness being rigidly designated by ‘yellow’ which “in this respect resembles the natural kind terms” (p. 128n).

² Schwartz (1977 and 1980), Cook (1980), Macbeth (1995).

³ LaPorte uses the term ‘kind’ for these abstract objects but is neutral about whether these objects really are kinds rather than, say, properties, or attributes (2000, p. 311n). I think it would have been better to use property talk – ‘*F*-hood’, ‘*G*-ness’, ‘being *H*’ – because that would make the abstract nature of these objects more manifest. However, I shall (mostly) go along with LaPorte’s language.

⁴ Or, suppose that there is not only the property of sodahood but also the *different* property of being a beverage-my-uncle-requests-at-Super-Bowl-parties. (Let us ignore that my use of ‘my’ has a different reference from LaPorte’s.)

⁵ I made such an objection as an anonymous referee of his paper. Schwartz makes a similar objection (2002, pp. 267–270).

⁶ On this question, see Armstrong 1989. Armstrong is a selective realist.

⁷ The other is the “ignorance and error” argument. Other problems for the description theory of names (and potential problems for any description theory) are those of “the principled basis,” “unwanted ambiguity,” and “unwanted necessity” (Devitt and Sterelny, 1999, pp. 48–57; Kripke has pointed out to me that “unwanted ambiguity” would have been better called “unwanted idiolects”).

⁸ Lost rigidity arguments are easily confused with two related arguments:

1. An unwanted necessity argument compares two sentences like the following:

- (a) Aristotle was a philosopher.
- (b) The last great philosopher of antiquity was a philosopher.

Now if the description theory were right (a) should seem as necessary as (b). Yet it clearly does not: Aristotle might never have gone into philosophy. (For simplicity I am overlooking the fact that (b) is not strictly necessary because the last great philosopher of antiquity might not exist.) This argument differs from a lost rigidity argument in two respects. First, it rests on claims about the necessity of sentences whereas the lost rigidity argument rests on claims about the reference of terms in nonactual situations. Second, note that the predicate in (a) and (b), ‘philosopher’, is part of the description allegedly synonymous with ‘Aristotle’. For obvious reasons the unwanted necessity argument can only be run using sentences of this sort. The lost rigidity argument, in contrast, is not restricted to this sort of sentence: the predicate in (1) and (2), ‘fond of dogs’, is not part of the allegedly synonymous description.

But a lost rigidity argument *can* be run with this sort of sentence and then its difference from an unwanted necessity argument is not so apparent. Thus, a lost rigidity argument could be run on (a) and (b): in nonactual situations the truth conditions of (a) depend on whether the person we call ‘Aristotle’ was a

philosopher but the truth conditions of (b) might not. This argument differs from the unwanted necessity argument solely in appealing to claims about rigidity rather than necessity and so the arguments are easily run together (Kripke, 1980, pp. 74–78).

2. A species of the ignorance and error argument is also quite close to the lost rigidity argument. According to an *actual* error argument, the descriptions that many of us associate with a name are in fact not true of its bearer and so those descriptions could not fix its reference; ‘Einstein’ and ‘Columbus’ provide famous examples. This argument rests on claims about the reference of terms in *actual* situations and so is clearly different from the lost rigidity argument. But now consider a *possible* error argument: although the descriptions we associate with a name are not in fact wrong of its bearer they could be, and this would make no difference to its reference. The famous example concerns ‘Godel’ and the description ‘the man who proved the incompleteness of arithmetic’ (pp. 83–86). We can easily generate such an argument for any name. Thus, consider ‘Aristotle’. Suppose that the person we call ‘Aristotle’ was a fraud, stealing his philosophy from Plato, Alexander the Great, and others. In those circumstances the description that we all now correctly associate with ‘Aristotle’ (let us suppose), ‘the last great philosopher of antiquity’, would not be true of that person. Yet the name would still designate him not whoever fitted that description. This possible error would make no difference to the reference of the name. The target of this argument is the theory that the reference of a name is fixed by a description we associate with it whereas the target of the lost rigidity argument is that a name is synonymous with such a description. But both arguments rest on the one claim: that in a nonactual situation ‘Aristotle’ would designate the person that we refer to by the name and not whoever is picked out by a description.

⁹ We should note also that the argument does not refute any description theory that is not a theory of a name’s meaning but only of its reference fixing. In my view, ignorance and error arguments refute all description theories of names.

¹⁰ I am enthusiastic about such theories (1981) but they have a problem, “the *qua*-problem,” which I doubt that they alone can solve (Devitt and Sterelny, 1999, pp. 79–81).

What about the *meaning* of a name? Many inspired by Kripke have adopted the “direct reference” view that there is no more to the meaning (“semantic value” etc.) of a name than its role of designating its bearer. This is not Kripke’s view but he does not offer an alternative (pp. 20–21). I argue (1996, pp. 158–192; 2001; Devitt and Sterelny, 1999, pp. 67–71) that a name’s meaning is its property of designating its bearer *in a certain causal way*; its meaning is its (nondescriptive) *causal mode of reference*.

¹¹ Given the just-noted rigidity of some descriptions, the causal theory clearly does not explain all cases of rigidity.

¹² This slightly modifies the definition presented in Devitt and Sterelny (1999, p. 85) by generalizing it from the actual world to any possible world. I was largely stimulated to propose that definition by my anonymous reviewing of what was to become LaPorte (2000). The modification, suggested to me by Hartry Field, helps

rigid application do the secondary work discussed in section 4. A definition along these lines is also to be found in Cook 1980, as LaPorte pointed out to me.

¹³ Although, it must be noted, it does not do the job for the “suitably elaborated” ‘hot’, ‘loud’, and ‘red’.

¹⁴ See LaPorte (1997) and Okasha (2002) for nice presentations of this line of thought and references to supporting literature.

¹⁵ There are two fallback positions if the argument should fail. (1) We could deny that ordinary terms like ‘tiger’ are species terms in the technical biological sense, thus allowing them to be rigid even if the technical terms are not. I am reluctant to take this way. Still, it is a tricky semantic question just how far our ordinary terms are beholden to experts for their meaning and reference. (2) Second, if it turns out that all members of a species must have some relational property that is *not* part of the individual essences of its members, we could still claim that species terms are “weakly rigid appliers” in the following sense: if a term applies to an object in a possible world, then it applies to that object in every possible world in which the object exists *and has that relational property*. This weak rigidity would do the primary and secondary work that, I am arguing, rigidity does, although it would do it less elegantly.

¹⁶ Given the just-noted rigidity of some descriptions, the causal theory clearly does not explain all cases of rigid application any more than it explained all cases of rigid designation (note 11).

¹⁷ An analogous explanation can be given of the weak rigidity of species terms if we have to fall back to talk of that (note 15).

¹⁸ Exceptions may be provided by “artifactual kind” terms like ‘pencil’. It is possible, although I think rather unlikely, that ‘pencil’ is covered by a causal theory as Putnam (1975, pp. 242–245) and Kornblith (1980) suggest. Yet, I shall argue later (sec. 5), being a pencil is not essential to any pencil and so ‘pencil’ is not a rigid applier. It is hard to be confident about the range of causal theories of kind terms because they have a *qua*-problem that seems even harder to solve than the one for proper names (Devitt and Sterelny, 1999, pp. 90–101); see note 10 on names. Both LaPorte (2000, pp. 302–305) and Schwartz (2002, p. 273) think that the causal theory does the work of distinguishing natural kind terms from others. LaPorte thinks, as a result, that his notion of rigidity is not open to criticism for failing to do this work. Schwartz thinks that the notion is open to criticism because it not only fails to do this work but any useful work at all. I think that the causal theory *may* distinguish natural kind terms from others but, in any case, it partly explains the rigidity of those terms and that rigidity does some useful work.

¹⁹ So far as I can see, Kripke does not offer an explanation of phenomena like (3) and (4) that appeals to rigidity. However, any such explanation would clearly be in the spirit of his book.

²⁰ The conditional that if the singular term is rigid then the readings are equivalent has two potential problems: (i) Some think that there are *referential* descriptions and that these are rigid. If that were so, since these descriptions, like attributive ones, seem to yield nonequivalent readings – think of ‘It might have been the case that the philosopher was not a philosopher’ said with a particular

philosopher in mind – the conditional would be falsified. But, in my view, it is not so: referential descriptions are only “weakly rigid”; see section 5 below. (ii) It is common to think that *some* names, like ‘Jack the Ripper’, are “descriptive” or “attributive” but still rigid. Yet it is plausible to think that they yield nonequivalent readings; think of ‘It might have been the case that Jack the Ripper was not a murderer’. One might resist that thought in order to save the conditional. Or one might deny the rigidity of attributive names.

²¹ Kripke does not explicitly draw attention to these scope phenomena for kind terms but they are close to the surface of much of his discussion (1980, pp. 118–120).

²² So Schwartz is a bit too generous in saying that “rigid application . . . does a nice job of explaining the necessity of e.g. ‘All tigers are animals’” (2002, p. 274). Schwartz has drawn my attention to Scott Soames’ recent book (2002) in which he, in effect, also entertains the idea that rigidity for kind terms should be construed as rigid application. (He calls a rigid applier “an essentialist predicate”; p. 251.) He gives up on the idea because of rigid application’s failure to explain theoretical identities (pp. 257–259).

²³ We should note that a description theory seems no more appropriate for an artifactual kind term like ‘plastic’ than it does for natural kind terms like ‘gold’.

²⁴ As indeed Schwartz (1978) pointed out.

²⁵ Note that I am not making the mistaken claim that an object that, in some possible world, is designed as a television set but used as a doorstop is not a television set: it is both a television set and a doorstop. Rather I am claiming that an object that has not been either designed or used as a television set in a world is not a television set.

²⁶ This leaves a range of alternatives for the semantics of these kind terms (Devitt and Sterelny, 1999, pp. 93–101).

²⁷ This is a bit too simple. The nature of an implement quite often involves not only a function but also a physical characteristic: a pencil is not a pen, a chair is not a stool, a sloop is not a yawl.

²⁸ These and many other terms for *actual* biological stages were presented to me by Schwartz in correspondence. He went further, raising the specter of *possible* biological stages for the members of any natural kind: zebras might turn into giraffes; Socrates might turn into an alligator (cf. Plantinga, 1974, pp. 65–69). These strike me as fictional possibilities not real ones.

Schartz is claiming that ‘frog’ is not a rigid applier because a tadpole that turns into a frog in the actual world fails to do so in some possible world. One might also claim that ‘tadpole’ is not a rigid applier because tadpoles often turn into frogs and then ‘tadpole’ no longer applies to them. We can deal with that claim by allowing that, for the purposes of rigid application, a term applies to an object in a world if it applies to that object *at some time* in that world.

²⁹ Although we should note that there is a deal of uncertainty about which terms are natural kind ones because there is a deal of uncertainty about which kinds are natural.

³⁰ The main ideas in this paper were developed over the years in courses on reference at the University of Maryland and the Graduate Center. I am indebted to the participants in those courses. I am also indebted to Joseph LaPorte and Stephen Schwartz for correspondence on the general issues of this paper, to Karen Neander and Samir Okasha for correspondence on biological essentialism, and to Georges Rey for a helpful discussion.

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