

GENERICS AND THE STRUCTURE OF THE MIND

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1. Introduction: The Semantics of Generics

Generics are sentences such as ‘ravens are black’, ‘tigers are striped’, and ‘mosquitoes carry the West Nile Virus’. Such sentences occur frequently in everyday speech; we continually rely on these constructions to convey information to one another. It is far from clear, however, how we are to assign truth conditions to these sentences.

If we focus our attention on generics such as ‘tigers are striped’, the situation does not seem too vexing. ‘Tigers are striped’ cannot be understood as expressing a universal claim to the effect that *all* tigers have stripes; it is compatible with the existence of stripeless albino tigers in the way that the universal claim is not. Perhaps ‘tigers are striped’ should be understood as equivalent to ‘most tigers are striped’, or ‘generally tigers are striped’. Alternatively, perhaps it means that *all normal* tigers are striped. Accounts to this effect can be found in a variety of guises throughout the literature (for example, Krifka, M., F. Pelletier, G. Carlson, A. ter Meulen, G. Chierchia, and G. Link. (1995); Greenberg (2003); Asher and Morreau (1995); Pelletier and Asher (1997)).

Let us consider Asher and Morreau (1995), and Pelletier and Asher (1997) in more detail. These authors do not make the simple claim that a generic of the form “Ks are F” is true iff all normal Ks are F, but rather claim that such a generic is true iff for each individual K, the most normal worlds for that K according to a certain ordering of worlds, are such that that K is F. (The ordering of worlds is given by a contextually determined similarity metric on worlds.) Or less formally, we have that the generic is true iff each K would be F under the circumstances that are ‘most normal’ for that particular K. Thus, while an albino tiger might in actuality lack stripes, this, we might suppose, is only because the actual circumstances are abnormal for that tiger, in as much as she is albino. A world in which that particular tiger was not albino would be a more normal world for that tiger than the actual world.

One might find such an account convincing in the case of such generics as ‘tigers are striped’. Consider, however, generics such as ‘ducks lay eggs’, ‘lions have manes’ or ‘peacocks have blue-green tails’. No male ducks lay eggs, and no female lions have manes, nor do female peacocks sport blue-green tails. And unlike the case of an albino tiger, these creatures do not lack the relevant properties because actual circumstances are in some way abnormal for them. The most normal of circumstances will be ones in which any given male duck never lays an egg—it would only be in the most *abnormal* or worlds that such a duck would lay eggs. These generics are intuitively true, yet it is not the case that for each given member of the kind, the most normal circumstances for that individual will be one in which they possess the relevant property.

Pelletier and Asher (1997) attempt to rescue their account from the difficulties posed by such generics through quantifier domain restriction. Perhaps, when we say ‘ducks lay eggs’, we are not talking about *ducks* simpliciter, but rather are talking only about the female ducks. They suggest that this sort of domain restriction is acceptable as long as the restricted domain is a sub-kind of the kind in question; female ducks constitute a natural sub-kind of ducks, hence the truth of the above generic. Numerous puzzles arise if we adopt this proposal. For example, it is odd that ‘ducks lay eggs and are female’ is not a true generic. If the predicate ‘lays eggs’ requires the domain to consist only of female members, why can we not truly predicate ‘is female’ here? Alternatively, why can we not restrict the domain to the male ducks, and thereby render true ‘ducks don’t lay eggs’? The males surely constitute just as natural a sub-kind of ducks as do the females. Similarly, if domain restriction is permitted so long as the restriction is to a natural sub-kind why are generics such as ‘Dogs are poodles’ and ‘mammals are cows’ not true? It is hard to see why poodles and cows are not natural sub-kinds of dogs and mammals respectively. One might think that these are paradigmatic examples of natural sub-kinds.

Difficulties continue as we consider generics such as ‘mosquitoes carry the West Nile virus’. This is a true generic, even though less than 1% of mosquitoes carry the virus. It is certainly not true that all normal mosquitoes carry the West Nile virus or that circumstances are somehow more normal for a given mosquito if it is infected. It is more plausible that all normal mosquitoes are, in fact, virus-free—that any circumstances in which a given mosquito is infected are quite abnormal for that mosquito. (If anything, the account under discussion here would seem to predict the truth of ‘mosquitoes don’t carry the West Nile virus’.) The truth of ‘mosquitoes carry the West Nile virus’ does not appear to have anything to do with what is *normal* for a mosquito. Since, if anything, it is quite abnormal for a mosquito to carry the virus, no further restrictions on the domain of *normal mosquitoes* will predict that the generic is true. No means emerge by which we may invoke domain restriction here. It seems that generics cannot be assimilated to *all normal*, or any such variant.

We might wonder if some generics are made true by the predicated property being *uniquely* possessed by the kind in question. The truth of ‘mosquitoes carry

the West Nile virus', for example, might depend on mosquitoes being the virus's sole bearers. There is, I believe, a reading of the sentence to that effect, but it is not the only reading. The unique-possession reading is obtained by emphasizing 'mosquitoes', or paraphrasing as 'it is *mosquitoes* that carry the West Nile virus'. Notice that one could disagree with such an assertion by claiming that deer ticks also carry the virus: if it is *mosquitoes* that carry the West Nile virus, then it cannot be that deer ticks carry it also. There is, however, another very natural reading of 'mosquitoes carry the West Nile virus' on which there is no incompatibility between its truth and the truth of 'deer ticks also carry the virus'. There is nothing contradictory in an assertion of 'mosquitoes carry the West Nile virus, and deer ticks do too'. There is thus a reading of 'mosquitoes carry the West Nile virus' whose truth does not require that mosquitoes be the only insects that carry the virus. This is the more natural reading of the statement, and is obtained so long as 'mosquitoes' is not pronounced with stress. We readily judge the sentence to be true on this reading, and an account of generics must explain why this is so.

It is also not generally *sufficient* for the truth of a generic that the kind in question be the unique possessor of the predicated property. Consider, for example, 'humans are autistic'. Humans are the only species whose members are afflicted with this condition, but we do not judge the generic to be true. Similarly, humans are, roughly speaking, the only species to sport one-legged members, yet 'humans are one-legged' is quite obviously false.

Ariel Cohen (1996) offers an intriguing and sophisticated account of generics, which is perhaps the most subtle and promising account to be found in the literature. I consider his account at considerable length in Leslie (2007, 2008), however, and find it to be vulnerable to counterexample. Cohen begins by asking us to consider the notion of the contextually supplied alternatives to a predicate 'is F', which he denotes as $\text{Alt}(F)$. A contextually supplied alternative is a natural, intuitive notion: the alternatives to 'drives to the department' include 'walks to the department', 'bikes to the department', 'takes the bus to the department', and so on. The alternative to 'is female' is 'is male', and the alternatives to 'lays eggs' include 'bears live young', and so on. The predicate 'is F' is always included in the set $\text{Alt}(F)$, and the alternatives need not be incompatible with each other. Cohen also introduces the notion of the contextually supplied alternatives to a kind K, which he denotes by $\text{Alt}(K)$. Again, the notion is highly intuitive: the alternatives to the kind Cat include other mid-sized mammals, and the alternatives to the kind Ant include other insects, and so on. With these notions in place, Cohen distinguishes between two different classes of generics: absolute and relative generics. The truth conditions for the two classes are given as follows:

Absolute generics:

'Ks are F' is true iff the probability that an arbitrary K that satisfies some predicate in $\text{Alt}(F)$ satisfies 'is F' is greater than .5

Relative Generics:

'Ks are F' is true iff the probability that an arbitrary K that satisfies some predicate in $\text{Alt}(F)$ satisfies 'is F' is greater than the probability that an arbitrary member of $\text{Alt}(K)$ that satisfies some predicate in $\text{Alt}(F)$ satisfies 'is F'.

An absolute generic, then, is true so long as the probability that the arbitrary relevant K (i.e. K that satisfies some predicate in $\text{Alt}(F)$) satisfies 'is F' is greater than .5. For example, 'tigers have stripes' is a true absolute generic, since the probability that the arbitrary tiger has stripes is greater than .5. Similarly, 'ducks lay eggs' is a true absolute generic, because, of the ducks that perform some or other alternative to laying eggs (i.e. some or other means of gestating), the probability that the arbitrary such duck lays eggs exceeds .5. A relative generic is true so long as the probability that the arbitrary relevant K satisfies 'is F' is greater than the probability that the arbitrary relevant member of the relevant alternative kinds satisfies 'is F'. 'Mosquitoes carry the West Nile virus' is a true absolute generic, since the arbitrary mosquito is far more likely to carry the virus than the arbitrary insect.

Cohen adds a further condition to his account, which all generics must meet if they are to be true: the homogeneity condition:

Homogeneity:

These conditions must hold for all salient partitions of the kind K.

That is, the probabilistic conditions specified above must hold in all the salient partitions of the kind. The notion of a salient partition is left somewhat vague in Cohen's work, but it is fairly intuitive. For example, gender is a salient partition in animal kinds, and so if a generic is to be true of an animal kind, it must meet the conditions specified above for both the male and the female members of the kind. Thus, despite the fact that over 80% of chickens are female, 'chickens are female' is a false generic. Even though the arbitrary chicken has a .8 chance of being female, this is not so amongst the male chickens. The probability of an arbitrary male chicken being female is, of course, zero, and so the generic is false.

The homogeneity condition is quite strict, however. Cohen is able to classify generics such as 'chickens are female' as false, only at the price of also classifying generics such as 'lions have manes', 'peacocks have fabulous blue-green tails', and 'cardinals are red' as likewise false. The predicated properties in the latter three generics are possessed only by the males of the species, and so the homogeneity condition is violated. These generics are wrongly predicted to be false.

It is also difficult to derive the result that 'dogs are four-legged' is true, while 'dogs are three-legged' is false, on Cohen's account. If *number of legs* constitutes

a salient partition of the kind Dog, then ‘dogs are four-legged’ will be false, since homogeneity will be violated. If, however, *number of legs* does not constitute a salient partition, then ‘dogs are three-legged’ will be predicted to be true also! The arbitrary dog has a much greater chance of having three legs than your arbitrary mid-sized mammal—three-legged dogs live on easily with human help, while three-legged wolves, foxes and tigers are rarely so fortunate. ‘Dogs are three-legged’ would thus be a true relative generic on Cohen’s view.

There are quite a few other generics that are intuitively false, and yet are predicted to be true relative generics. Humans, for example, are far more likely than the arbitrary mammal to be blind, one-legged, or paralyzed, which should suffice to render true ‘humans are blind’, ‘humans are one-legged’, and ‘humans are paralyzed’.

The truth conditions associated with relative generics, then, appear to be overly weak. They are also too strong, though, under some circumstances. As things stand, ‘mosquitoes carry the West Nile virus’ is correctly predicted to be a true relative generic, since the arbitrary mosquito is far more likely than the arbitrary insect to carry the virus. Let us suppose, though, that fleas also carry the virus, and do so at a greater rate than mosquitoes—‘mosquitoes carry the West Nile virus’ is still correctly predicted to be true, since the arbitrary mosquito is still more likely to carry the virus than the arbitrary insect. If, however, the flea population grew so rapidly as to vastly outnumber all other insects, at some point it would cease to be the case that the arbitrary mosquito would be more likely than the arbitrary insect to carry the virus. At this point, ‘mosquitoes carry the West Nile virus’ would fail to be a true relative generic on Cohen’s account. Intuitively, however, it would remain true. The size of the flea population has no bearing on the truth of ‘mosquitoes carry the West Nile virus’.

Cohen’s account, then, is subject to counterexample, despite its ingenuity and promise. The foregoing discussion should indicate that the truth conditions of generics is no simple matter. The extant accounts of generics are fittingly complex; they invoke everything from iterated modalities to non-standard logics to comparative probabilities. I argue in detail in Leslie (2007, 2008) that each account is subject to systematic counterexample. There is no successful account of the truth conditions of generics to be found in the current literature.

In the interest of brevity, I will not rehearse these criticisms here, but will rather describe my own positive account of generics. In light of this account, I will consider the question of whether generics are quantificational. Certainly, their logical forms closely resemble those of quantified statements. I will argue that, despite appearances, generics are in no sense quantificational. The generic operator Gen is a variable-binding operator that is used to express generalizations, and yet is not a quantifier. In the final portion of the paper, I argue that, while this is a surprising result from the point of view of philosophy of language, it is to be expected given the role of generics in our psychology.

2. Generics and Cognition

As I argue here and in Leslie (2007, 2008), no existing account of generics is successful. Counterexamples aside, however, it is instructive to consider just how complicated the accounts turn out to be. Consider Cohen's account once again:

Absolute generics:

'Ks are F' is true iff the probability that an arbitrary K that satisfies some predicate in $\text{Alt}(F)$ also satisfies 'is F' is greater than .5

Relative Generics:

'Ks are F' is true iff the probability that an arbitrary K that satisfies some predicate in $\text{Alt}(F)$ satisfies 'is F' is greater than the probability that an arbitrary member of $\text{Alt}(K)$ that satisfies some predicate in $\text{Alt}(F)$ satisfies 'is F'

Homogeneity:

These conditions hold for all salient partitions of the kind K.

We may compare the complexity of Cohen's account to the simple and concise definition we can provide for the quantifier 'all':

"All Ks are F" is true iff $\{x: x \text{ is a K}\} \subseteq \{x: x \text{ is F}\}$

Other accounts of generics are no less complex; they may feature iterated modalities, or even invoke non-monotonic logics.

This asymmetry in complexity between accounts of generics and accounts of explicit quantifiers such as 'all' becomes even more remarkable when we consider data from language acquisition. Strangely enough, young children find generics *easier* to acquire and master than explicit quantifiers. Generics appear in children's speech very early in development, significantly before explicit quantifiers do (Gelman 2003; Roeper, Strauss, and Pearson 2006). And under some circumstances, it has been found that three-year-old children will even interpret explicitly quantified statements as though they were generics (Hollander, Gelman, and Star 2002). It seems that they find generics so much easier to comprehend than quantified statements, they rely on this easier interpretation at times, rather than attempting to process the more taxing quantificational claim. Explicit quantifiers, whose semantics have proved quite tractable for the theorist, are *more challenging* for the young child than generics, which have remained baffling to linguists and philosophers throughout forty years of research.

That generics would be easier for children to acquire than explicit quantifiers is all the more puzzling in light of the fact that there is no articulated operator associated with generics. We do not say ‘Gen tigers are striped’ in the way we say ‘most tigers are striped’. This is no quirk of English either; there is no known language that has a dedicated, articulated generic operator. Children, then, would not only have to master an immensely complex set of truth conditions, they would have to associate that set with the *absence* of an operator. Associations with absence are notoriously difficult for children to master,¹ so it seems almost paradoxical that they *ever* master generics, let alone before they master quantifiers.

Even if we set aside the acquisition patterns, the fact that no known language has a dedicated articulated generic operator is a fact that cries out for explanation. In every language that has been studied to date, generics have the least marked surface forms; it is natural to conjecture that this is a linguistic universal. Why should these strange, elusive generalizations *always* correspond to unmarked surface forms? Or to frame the question once more in terms of acquisition: how do all language learners come to know that it is *these* peculiar, quirky generalizations that are to be associated with the *absence* of operators?

It is not, I think, an accident that natural language’s least marked generalizations are also its most complex and unlearnable. Children do not ever *learn* truth conditions for generic claims. Rather, the generalizations that generic sentences express correspond to the cognitive system’s most primitive, default generalizations. The ability to generalize pre-dates the acquisition of language; infants as young as 12 months readily form category-wide generalizations on the basis of experience with a few instances of the category (Graham, Kilbreath, and Welder 2001). There must, then, be an early-developing cognitive mechanism responsible for these most basic generalizations.

This mechanism must be in place before the child begins to learn language, since pre-verbal infants have the capacity to generalize. Generics, I claim, give voice to the generalizations this primitive mechanism produces. The child, already possessed of the mechanism at the time of language acquisition, does not need to learn something new and complex; she need only continue to form the generalizations she has been making since her earliest days. I will argue in the next section that the strange truth conditional features of generics can be traced to what are, quite plausibly, some quirks and biases in this mechanism. (For more details concerning this section and the next, see Leslie (2007, 2008).)

If the comprehension of generics invokes a mechanism that the child has already been using for some time, it is not surprising that the acquisition of generics occurs so early—we would predict that this would be so. And if this mechanism is the cognitive system’s most basic, default means of generalizing, we can begin to understand why generics have the least marked surface forms across languages. Chomsky (2000) suggests unmarked surface forms invoke cognitive defaults. For example, he notes that a sentence such as “John climbed the mountain” can only be understood to mean that John climbed *up* the mountain.

The unmarked form “climbed the mountain” is never interpreted to mean *climbed down the mountain*. Chomsky (2000) suggests that this may reflect a fact about our concept of climbing—by default, we think of the act of climbing as involving climbing *up* an item, not *down* it. To obtain the non-default reading, we must explicitly include the preposition “down”, thereby employing a more marked form. We might think of such marked information as supplying an instruction to the conceptual system to the effect that it must deviate from its default means of proceeding.

I suggest that explicit quantifiers serve to direct the cognitive system to generalize in specific, non-default manners—to form, say, *universal* or *existential* generalizations. Generics, in virtue of being unmarked, do not supply any such instructions. The cognitive system proceeds with its default, automatic means of generalizing. Thus it is no coincidental fact that generics always correspond to the least marked surface forms.

If all this is correct, we would expect some further predictions to be borne out. If generics give voice to our most primitive, default generalizations, while explicit quantifiers, in contrast, require our conceptual system to actively diverge from this default, then we would expect that explicit quantifiers would be more difficult to process. We would expect that, if sufficiently heavy cognitive demands are placed on people, they might mistakenly treat quantified statements as though they were generics. I am currently collaborating with Sam Glucksberg and Sangeet Khemlani to investigate whether adults are susceptible to such errors. It has already been found, however, that young children are indeed susceptible.

Hollander, Gelman and Star (2002) asked three-year-olds, four-year-olds, and adults a series of yes/no questions involving either generics, or the explicit quantifiers “all” and “some”. (For example, they asked their subjects “are all fires hot?”, “are some fires hot?” or “are fires hot?”) They found that the three-year-olds gave the same pattern of responses, regardless of whether the questions involved quantified statements or generics. This pattern of responses, remarkably, was identical to the pattern of responses that four-year-olds and adults gave to the *generic* versions of the questions. (Naturally, the older subjects altered their responses when they were confronted with questions containing quantifiers.) The three-year-olds, however, responded as though they were faced with generics in all cases.

The experimenters further found that the three-year-olds were able to successfully handle questions containing quantifiers, so long as they were only asked about a limited set of items that were immediately before them, rather than about categories in general. Thus, if the three-year-olds were presented with four crayons and asked “are all the crayons in the box?” or “are some of the crayons in the box?”, they responded appropriately. In Leslie (2007, 2008), I suggest that this is because the cognitive demands are lower when the children are asked to consider a limited number of items, and higher when they are asked to consider abstract categories. Scenarios of the latter type impose sufficiently high cognitive demands that the youngest children were unable to process explicit quantifiers.

Instead, they fell back on the less taxing default operations associated with generics. Thus the rather surprising data of Hollander, Gelman and Star (2002) is to be expected if the account of generics I am proposing is correct.

There is a significant amount of empirical work that remains to be done, but the data that is currently available points to the theory I am advocating. Goldin-Meadow, Gelman and Mylander (2005) studied congenitally deaf children who have never been exposed to either spoken language or sign language, and so go on to develop their own communicative gesture system called “home signs”, and found that these children routinely employ gestures that are most naturally understood as generics. The experimenters were extremely conservative in their classification of gestures as generic—as opposed to episodic or otherwise specific—but they nonetheless found that congenitally deaf children produce generic gestures at (or at least extremely close to) the rate at which hearing children produce generic utterances.² These findings are remarkable since the deaf children have never been exposed to any form of language, and so a fortiori have never encountered generics. Generic gestures are produced even in the absence of any adult model of their production.

A further piece of tantalizing data is to be found in Everett’s (2005) work on the Amazonian language Piraha. Everett claims that Piraha is devoid of explicit quantifiers, yet nonetheless features generics. Piraha’s generics have truth conditions that correspond to the truth conditions of English generics. For example, “panthers eat people” is a true generic in Piraha, even though very few panthers actually eat people, as is “birds lay eggs” (Everett, pers. comm.). Everett’s work on Piraha is in its early stages, and his claims stand in need of independent confirmation. It is fascinating to think, though, that there may be a language that is so minimal as to lack explicit quantifiers, but which nonetheless contains generics.

There is, then, a strong case to be made for the idea that generics give voice to our most primitive generalizations. This claim alone, of course, does not shed much light on the strange truth-conditional nature of these statements. I will argue in the next section, however, that the otherwise puzzling truth conditions of generics become far more tractable against the backdrop of this theory. In particular, I will argue that the strange truth conditional features of generics can be traced to what might reasonably be quirks and biases in our most primitive mechanism of generalization.

3. The Fundamental Mechanism of Generalization

We can, I believe, identify four main features of our most primitive mechanism of generalization, which go a long way towards explaining our puzzling truth-conditional judgments concerning generics.

It is clear that this mechanism ought to be an efficient information gathering mechanism, since it is our most basic and immediate means of

obtaining information about categories. One way such a mechanism might be efficient is for it to take advantage of regularities out there in the world. For example, animal kinds are quite similar to one another at a level of abstraction: Animal kinds, by and large, have characteristic noises, characteristic modes of locomotion, characteristic diets, characteristic methods of reproduction, and so on. I claim that this mechanism operates in part by identifying these dimensions of regularity—‘characteristic dimensions’, as I call them—within a domain of kinds, such as the domain of animal kinds, the domain of artifact kinds, and so on. Once the mechanism has identified a characteristic dimension for a domain of kinds, it will then seek to fill in a value along the dimension for a given kind within the domain.³

If the mechanism is seeking only to find a value along a characteristic dimension, it can do so on the basis of very limited experience with members of the kind. If *noise* is determined to be a characteristic dimension for animal kinds, for example, then if one is faced with even a single instance of a novel animal kind, one is poised to take whatever noise that particular instance makes and project it, at least tentatively, across the kind. *No statistical surveying is needed for this generalization to be made.* The generalization can be made on as little evidence as an encounter with a single instance of the kind. (See Macario, Shipley and Billman (1990), and Nisbett, Krantz, Jepson and Kunda (1983) for experimental evidence that we do, in fact, employ some such means of arriving at generalizations.) The generalization is, of course, potentially subject to revision, though only under limited circumstances, as I discuss below in connection with the fourth and final feature of the mechanism.

In the case of animal kinds, it is natural to suppose that *reproduction* is a characteristic dimension. Having identified reproduction as a characteristic dimension of animal kinds, we can fill in the value for ducks upon learning of the egg-laying ducks. The existence of even just a few egg-laying ducks will suffice to provide a value for this dimension. Since all we are looking to do is locate a value along a dimension, no statistical information about the percentage of ducks that lay eggs, etc, is needed. The fact that less than half of ducks lay eggs has no effect on this generalization.

The second main feature of this mechanism is how it deals with information that is particularly striking, often horrific or appalling. Consider the generics:

Mosquitoes carry the West Nile Virus.

Sharks attack bathers.

Pittbulls maul children.

Tigers eat people.

These generics are intuitively true, yet very few members of the kind in question actually possess the predicated property. When dealing with the sort of information that one would be well-served to be forewarned about, the mechanism

generalizes in the face of even just a few members of the kind possessing the property.

Of course, it would be inefficient to generalize such information to *every* kind that has a member with the property. We do not judge ‘animals carry the West Nile Virus’ or even ‘insects carry the West Nile Virus’ to be true, even though both kinds have *some* members that carry the virus, since those virus-carrying mosquitoes belong to both kinds. The mechanism, I suggest, looks for a *good predictor* of the property in question, and thereby avoids generalizing too broadly. For a kind to be a good predictor of a striking property, I propose, the members of the kind that lack the property must at least be disposed to have it. It is important, for example, that the virus-free mosquitoes be capable of carrying the virus. If there is no such shared disposition, the generalization is not made. If, for example, an accountant or two are convicted of murder, we do not judge that accountants are murderers, because we do not think that accountants are in any way generally disposed to be murderers. The odd murdering accountant is a ‘bad apple’, in no way indicative of the nature of accountants in general. Interestingly enough, defenders of such claims as *Muslims are terrorists* routinely argue that there is something about Islam—its very doctrine—that instills in its followers the disposition to perform terrorist acts. (See, e.g., B. Lewis 1990.) I discuss these issues further in Leslie (2007).

The third feature of the fundamental mechanism of generalization deals with rather more neutral information. When faced with information that is neither striking nor found along a characteristic dimension for the given kind, it appears that the mechanism in question requires the majority of the kind to possess the property for it to be generalized. Consider, for example, ‘barns are red’, or ‘cars have radios’. These are true generics, but only because a large majority of the kind in question satisfies the predicate. Were only a small percentage of barns to be red, we would not consider ‘barns are red’ to be true.

The final main feature of this mechanism involves how it deals with the members of the kind that are exceptions to the generalizations. It matters very much whether they simply fail to have the property in question, or whether they have an equally vivid, concrete positive property instead. I claim that we are far more prepared to maintain our generalizations when faced with the former kind of ‘negative’ counterinstances than when faced with the latter kind of ‘positive’ ones. For example, let us say that we determine that reproduction is a characteristic dimension of animal kinds, and understand that birds, being animals, must therefore have reproduction as a characteristic dimension. We observe some egg-laying birds, and fill in *lays eggs* as the appropriate value. The male birds simply fail to lay eggs. They constitute merely negative counterinstances, since they do not possess some equally positive alternative property. Our generalization is easily retained in face of these male birds. Were we to learn of some birds that bear live young, however, the generalization would need to be weakened to ‘birds lay eggs or bear live young’. It cannot be maintained as is in the face of such positive counterinstances.

Alternatively, consider the true generic ‘peacocks have fabulous blue-green tails’. Female peacocks are unfortunate creatures that drably lack tails. Yet were they to have fabulous *pink* tails instead of the stumps they actually have, then ‘peacocks have fabulous blue-green tails’ would not be true. The female peacocks would constitute positive counterinstances, and the generalizations could not be maintained. In these circumstances, the generalization would have to be weakened to ‘peacocks have fabulous blue-green or pink tails’.

4. Semantic Truth Conditions and Worldly Truth-Makers

We can now describe how the world must be for a generic of the form ‘Ks are F’ to be true:

The counterinstances, if any, are negative, and:

If F lies along a characteristic dimension for the Ks, then some Ks are F

If F is striking, then some Ks are F and the others are disposed to be F

Otherwise, the majority of Ks are F

These worldly truth specifications should not be mistaken for semantically derived truth conditions, however. The distinction is quite intuitive, though it is rarely drawn. Let us suppose, for example, that a dispositionalist theory of color is correct: what it is to be red is to be experienced as red by standard observers in standard conditions. The dispositionalist theory of color—which is clearly a metaphysical theory, *not* a semantic one—provides us with the worldly truth makers for ‘Bob is red’; this claim is true iff Bob is experienced as red by standard observers in standard conditions. These are the only circumstances in which ‘Bob is red’ will be a true statement. An analysis of these circumstances, such as the dispositionalist theory provides, is not a semantic analysis of “Bob is red”. It tells us nothing about semantically derived truth conditions for ‘Bob is red’. It tells us nothing about the semantic entailments of ‘Bob is red’, and it tells us nothing about the compositional structure of the sentence. The dispositionalist theory is a metaphysical theory—no more, and no less.

For example, it may well be that for Bob to be experienced as red by standard observers in standard conditions, there must exist standard observers to experience him as such. If this is so, as is quite plausible, the truth of ‘Bob is red’ metaphysically entails the existence of standard observers. The entailment is surely not *semantic*, however. It would be bizarre to think that it is part of being semantically competent with ‘Bob is red’ that one recognize that the truth of the claim entails the existence of standard observers. If this was so, no one save the dispositionalists themselves would count as semantically competent with ‘Bob is red’!

Considerations of compositionality, and a desire to keep semantics at least in touch with syntax suggest that the semantic truth conditions for ‘Bob is red’

may be no more complex than $\text{Red}(\text{Bob})$ —that is, the application of a monadic predicate to a singular term. These semantic truth conditions line up well with the sentence’s syntax, and respect its compositional structure. To substitute the regimented version of the worldly truth specifications results in the following monstrosity:

“Bob is red” is true iff $\text{Gen } x, y [\text{StandardObserver}(x) \ \& \ \text{StandardCondition}(y)]$
 $[\text{ExperiencesAs_In}(x, \text{Bob}, \text{red}, y)]$

where Gen is the generic operator. But ‘Bob is red’ is not a generic; it is a singular statement, and to claim otherwise leads one far from the project of arriving at a semantics that mirrors sentences’ compositional structures. Such considerations, among others, often lead semanticists to simply disquote individual expressions when giving semantic truth conditions. (Cf. King (2002).)

In giving semantic truth conditions for generics, we can make use of a *tripartite structure* to lay bare their logical forms (Heim 1982; D. Lewis 1975; Kamp 1981). A tripartite structure consists of an operator—usually a quantifier—a Restrictor, and a Scope:

Quantifier x, \dots, z [Restrictor x, \dots, z] [Scope x, \dots, z]

The Restrictor specifies the domain over which the variables range, and the Scope specifies the property that is attributed to the relevant members of the domain. For example, we can represent ‘most tigers are striped’ as:

Most x [Tiger(x)] [Striped(x)]

In the case of generics, we posit a generic operator Gen that occurs to bind variables and to relate the Restrictor to the Scope. The logical form of ‘tigers are striped’ is represented as:

$\text{Gen } x$ [Tiger(x)] [Striped(x)]

In general, generics are regimented as:

$\text{Gen } x \dots z$ [Restrictor($x \dots z$)] [Scope($x \dots z$)]

I propose that the semantic truth conditions of generics will *use* the generic operator Gen , as above. The tripartite structure serves to lay bare the compositional structure of generics by dividing the material into Restrictor and Scope, and so is an essential part of the semantic truth conditions. If we pursue our analysis further, though, I suggest that we leave semantics behind us. The worldly truth specifications at the beginning of this section are specifications of *how the world must be* for a generic to be true. They are

not semantic truth conditions. Those disjunctive, non-compositional conditions are ill-suited to serve as semantic truth conditions of generics, just as *Bob is experienced as red by standard observers in standard conditions* is ill-suited as the semantic truth conditions of 'Bob is red'. We ought to handle the generic operator disquotationally, just as we ought to handle the predicate 'is red' disquotationally.

4.1. Inferences Involving Generics

One might object that it is all well and good to simply disquote the generic operator, but no satisfying account of generics can do without a metalanguage analysis of the operator. If we do not provide a metalanguage analysis, we do not predict any semantically valid inferences will be specifically licensed by the operator. Nicholas Asher made this point at length in his commentary on my work at a recent semantics workshop (Asher 2006). Asher views this as a shortcoming of my proposal, but I must admit I see it as an advantage. With one exception, which I consider below, I claim there simply are no inferences concerning Gen that hold in virtue of form.⁴ That is, while we endorse many inferences concerning a given generic, we invariably find other generics for which the corresponding inference patterns don't hold. Whatever inferences we may be disposed to make with a given generic, these inferences are *not* due to the semantics of generics alone. Other than one which I explain below, there is no schematic inference that holds regardless of the *particular* generic that figures in it

Theorists who study inferences concerning generics do not tend to insist that there are *deductively* valid inferences licensed by them, but rather consider *defeasibly* valid, or *default*, inferences. The notion of defeasible validity is the central notion of non-monotonic logics. Defeasibly valid inferences are warranted inferences that may be retracted in light of additional information. They are inferences that hold given what is currently known, but may be given up in light of new information.

A prominent example from this literature is as follows:

Birds fly.

Tweety is a bird

So, Tweety flies.

This inference is defeasibly valid, because the conclusion is warranted relative to the premises, but the conclusion should be rejected were we to discover additional information such as that Tweety is a penguin.

Theorists in the default reasoning tradition such as Asher and Morreau (1995) and Pelletier and Asher (1997) have claimed that generics as such support

these inferences. They claim that the following schema is a defeasibly valid one:

Ks are F
a is a K
So, a is F

It is undeniable that we are inclined to endorse various instances of this schema, such as the above example concerning Tweety's flight. Asher and his collaborators take it that any semantic account of generics must explain why we endorse these instances.⁵ Recall from earlier discussion that these theorists propose accounts of generics that we may roughly gloss as the claim that Gen means *all normal*. This analysis, they claim, explains why people find the above inferences attractive: if we know that all normal Ks are F, then on assumption that a is a normal K (a reasonable assumption absent information to the contrary), we know that a is F.

The above inference schema is only attractive, however, for a limited range of generics. Given that less than one percent of mosquitoes carry the virus, the following inference is *not* an attractive one:

Mosquitoes carry the West Nile Virus.
Buzzy is a mosquito.
So, Buzzy carries the West Nile Virus.

Nor is the following inference one that we should be inclined to endorse:

Ducks lay eggs.
Beaky is a duck.
So, Beaky lays eggs.

These examples are telling: the default inference schema does not hold for all generics. It is not warranted in virtue of the form of these sentences. It works well for some generics, but fails for others.

In particular, the default reasoning inferences hold well for those generics for which the corresponding claim 'all normal Ks are F' is also true, and it fails for those that don't. I would suggest that it is the often concomitant belief that *all normal Ks are F* that is underwriting the inferences here. We feel the inferences to be correct or incorrect depending on whether the corresponding *all normal* claim is true. Many true generics have true corresponding *all normal* claims; for such generics, the above inferences are attractive. However, as I discuss in the first section of this paper, a true *all normal* claim is neither necessary nor sufficient

for the truth of a generic in general, and those generics whose corresponding *all normal* claims are false do not participate in the default inferences.

To conclude on the basis of considering this restricted range of generics—ones in which the corresponding *all normal* claim is true—that the above inference schema is valid is an objectionable move. It is akin to studying the inferential profile of an inclusive disjunction by considering only the cases in which both disjuncts are true, and then claiming that inclusive disjunctions entail their two disjuncts.

As noted above, I do believe that there is one inference involving generics that does appear to be universally acceptable:

Ks are F.

Ks are G.

So, Ks are F and G.

I do not know of any particular instances where we are reluctant to endorse this inference. It should be noted that this fact alone does not entail that the inference must be semantic, and entailed by a metalanguage analysis of Gen—the data to be explained here is that whenever we accept the two premises, we also accept the conclusion. To capture this data, I suggest the following thesis concerning our fundamental mechanism of generalization: it generalizes a conjunction of properties to a kind iff it generalizes each conjunct to the kind. This is a thesis about the workings of this mechanism. If it is a true thesis, however, it must be noted that it explains the relevant data—our inclination to endorse all instances of the above schema—as well as any account that located the basis of the inference in a metalanguage analysis.

Further, the account I am offering of the generic conjunction-introduction judgments here fares better than any extant account of generics when confronted with certain instances of the schema. Asher and his colleagues treat generics as restricted universals, and so explain the conjunction introduction schema as an instance of conjunction introduction in the scope of a universal quantifier. Consider, however, the following, intuitively valid argument:

Peacocks lay eggs.

Peacocks have fabulous blue-green tails.

So, Peacocks lay eggs and have fabulous blue-green tails.

An informal poll suggests that people are happy with the above inference. Yet no restricted universal account can explain why this is so, because there are *no* peacocks that satisfy the conjunctive predicate. No individual peacock lays eggs and has a fabulous blue-green tail, since only the females do the former, and only the males possess the latter. I know of no account of generics that explains

how a generic could be true even though no member of the kind satisfies the predicate, or is even disposed to satisfy it. If, however, generics with conjunctive predicates are judged true just in case each conjunct is generalized to the kind by the mechanism of generalization I have characterized, then we would expect that this statement would be judged true, even though no peacock satisfies the predicate.

5. Quantificational Behavior

Thus I do not take it as a failing of my account that I do not provide a metalanguage analysis of Gen. This does not mean that there are not semantic questions to be asked here. A further semantic question that we might ask is: Is Gen a quantifier? It is certainly a variable binding operator, and it is used to express generalizations, in the sense that generics involve commitments as to the properties of unencountered instances of the kind in question. The other examples of such items are all quantifiers: ‘all’, ‘every’, ‘most’, and so on. Should Gen be considered a member of this class?

In his 1977 dissertation, Greg Carlson informally classifies generics as non-quantificational statements. They are not, he notes, about *how many*, or *how much*, in the way that quantified statements are. A quantified statement such as “most Ks are F” can be given in response to the question “how many Ks are F?” Upon being asked “how many tigers have stripes?” for example, one could respond by saying “most tigers have stripes”, or “all tigers have stripes”, and so on. One cannot, however, respond by saying “tigers have stripes”. This is simply not an appropriate response to the question. Of course, this is no more than a loose and informal characterization of what it is to be quantificational, however.

Carlson’s original account did *not* treat Gen as a variable binding operator relating a Restrictor and a Scope. Rather, he took the logical forms of generics to include a one-place predicate operator G that takes a predicate of individuals to a predicate of kinds, and treated the bare plural in sentence as a singular term referring to a kind. The logical form of ‘tigers have stripes’, for example, was ‘G(Striped)(tigers)’. The predicate ‘G(Striped)’ is a monadic predicate of kinds, and ‘tigers’ is a singular term referring to the kind Tiger. Thus at the time of Carlson’s observation, generics were assigned very different logical forms than those of quantified sentences.

In light of the more recent views of the logical forms of generics, which posit an operator Gen that relates the material in the Restrictor to the material in the Scope, let us revisit the question of whether Gen could be considered a quantifier. The informal observation that quantifiers tell us *how much* or *how many* can be given a formal analog in terms of *isomorphism invariance*. If we restrict our attention to operators that bind a single variable, this requirement can be simplified. For such an operator this requirement reduces to the idea that, for it to be quantificational, it must be definable as a function from the

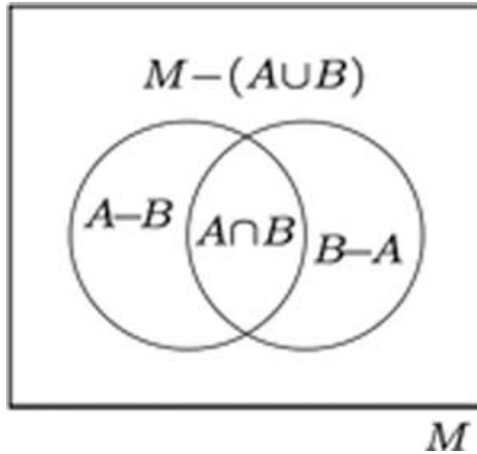


Figure 1.

cardinalities of sets to truth values (Westerstahl 2005; Larson and Segal 1995; Higginbotham and May 1981; Sher 1991; Glanzberg forthcoming). I will argue that there is no such definition of Gen.⁶

How exactly are we to understand the claim that quantifiers are definable as functions from set cardinalities to truth values? We begin by observing that any two monadic predicates “is A” and “is B” partition the universe of discourse into four disjoint subsets. If we let M be the universe of discourse, and let A and B be the sets $\{x: x \text{ is } A\}$ and $\{x: x \text{ is } B\}$ respectively, then we have the four-way partition represented in Figure 1.

We can further define k , l , m , and n as follows:

$$j = |M - (A \cup B)|$$

$$k = |A - B|$$

$$m = |A \cap B|$$

$$n = |B - A|$$

(Where $|A|$ is the cardinality of A .) Consider now a regimented sentence of the form $Qx[Ax][Bx]$. For such an operator Q , we can formulate the following condition: If Q is a quantifier, then Q is definable as a function from k , l , m , and n to true or false. For example, we can give the truth conditions of the following sentence schemas as follows:

All $x [Ax] [Bx]$ is true iff $k = 0$

Most $x [Ax][Bx]$ is true iff $m > k$

Some $x [Ax][Bx]$ is true iff $m > 0$

A little reflection should suffice to show that no such truth conditions will be forthcoming for sentences of the form Gen x [Ax][Bx]. An example considered earlier provides a nice illustration of this. As things stand, “peacocks have fabulous blue-green tails” is true. Were female peacocks to have fabulous pink tails in place of the brown stumps they in fact have, “peacocks have fabulous blue-green tails” would not be true; only the weaker “peacocks have fabulous blue-green or pink tails” would be true in those circumstances. This thought experiment does not involve altering any of the relevant cardinalities, however. The numbers of peacocks, blue-green-tailed individuals, blue-green-tailed peacocks, and non-blue-green-tailed non-peacocks all remained unaltered. That our intuitions about the truth of a generic can be altered by such facts that do not pertain to cardinalities reflects the fact that generics depend on far more than cardinalities for their truth and falsity.

Other examples are forthcoming. Consider the true generic “Mosquitoes carry the West Nile virus”. We can regiment this as Gen x [x is a mosquito] [x carries the West Nile virus]. Let us assume that mosquitoes are the only things that carry the virus, and further imagine that all and only those mosquitoes that carry the virus are blind mosquitoes; every mosquito that carries the virus is blind, and every mosquito that does not carry it has excellent vision. Then the set {x: x carries the West Nile virus} is the same as the set {x: x is a blind mosquito}. Thus an operator that is sensitive only to the cardinalities of sets will not distinguish between them. If the truth of generics was definable in terms of set cardinalities, then “mosquitoes are blind mosquitoes” would be true in the circumstances described if “mosquitoes carry the West Nile virus” was true. Of course, we think the latter is true but the former false, which shows that Gen is not a function from cardinalities to truth values.

The latter example suggests a stronger conclusion than that Gen cannot be defined as a function from cardinalities to truth values. It suggests that we cannot give adequate truth conditions for generics if we identify the semantic values of predicates with their extensions. In the example described, the set of things that carry the West Nile virus is the same as the set of things that are blind mosquitoes, and yet the two sentences have different truth values. Clearly, generics operate on semantic values more fine-grained than extensions.

My reader may have noticed that there is a more liberal use of the term ‘quantifier’ than I am countenancing here—one according to which even proper names are quantifiers (Barwise and Cooper 1981). (There is, however, some resistance to such a liberal usage, and many theorists reserve the term for operators that behave in the way I am characterizing here (Larson and Segal 1995; Higginbotham and May 1981; Sher 1991; Glanzberg forthcoming; May 1991).) This more liberal use of the term understands quantifiers to be functions from sets (i.e. predicate extensions) to truth values (rather than the more strict criterion that they be functions from set *cardinalities* to truth values). It is important to notice here that *even on the liberal view*, generics are not quantifiers. They are

not functions from extensions to truth values. Thus even a theory that counts proper names as quantifiers cannot count generics as such.

It appears that even intensions—extensions across possible worlds—are also too coarse-grained to provide an adequate treatment for generics. Consider, for example, the predicates in the last example rigidified with ‘actually’ or ‘in actuality’. Such predicates are commonly understood to have the same extension in every possible world that they have the actual world. Nonetheless, “mosquitoes in actuality carry the West Nile Virus” is true, but “mosquitoes in actuality are blind mosquitoes” is false. These predicates have the same intensions, but the sentences have different truth values.

In case one does not care for appeals to predicates rigidified by using ‘actually’, other examples are forthcoming. Consider a virus, say, the M-virus, that is necessarily only mosquito borne—nothing else can carry it. (The metaphysical details behind the case are unimportant; it is certainly not semantically incoherent to suppose there could be such a virus.) So, necessarily, everything that carries the M-virus is a mosquito. The sets $\{x: x \text{ carries the M-virus}\}$ and $\{x: x \text{ is a mosquito that carries the M-virus}\}$ are the same sets, even across possible worlds. Correspondingly, the predicates “carries the M-virus” and “is a mosquito that carries the M-virus” have the same intensions. Nonetheless, intuitions are quite strong that “mosquitoes carry the M-virus” is true, while “mosquitoes are mosquitoes that carry the M-virus” is false.⁷ (Similarly, we might elaborate on the tale and say that the M-virus necessarily co-occurs with blindness in its carriers; intuitions about “mosquitoes are blind mosquitoes” remain unchanged.)

This leaves us with the tantalizing suggestion that generics join propositional attitudes in requiring their semantics to operate on entities that are even more fine-grained than intensions.

That aside, it is of course evident that Gen is in no sense a quantifier. Evidently, even a modalized version of Barwise and Cooper’s ‘liberal’ sense of quantification, as described above, will still not count generics as quantifiers. Gen is not even a function from *intensions* to truth values. Generics may express generalizations in the sense that they involve commitments as to the nature of previously unencountered instances, but they are not quantificational. They are generalizations that are not fundamentally about *how much* or *how many*.⁸

6. Primitive Generalizations

Let us combine the observation that generics are not quantificational with the claim that they express the conceptual system’s default generalizations. This entails that our most basic means of forming general judgments is not primarily concerned with *how many*. These cognitively primitive generalizations do not operate on set extensions, or any such abstraction. They are not grounded in such extensional or statistical information, but rather depend on factors such as how striking and important the information in question happens to be.

As surprising as this may initially seem, the claim fits well with the “Two Systems” view of cognition set forth by Daniel Kahneman and his colleagues. They argue that we can identify two systems of cognition. On the one hand, we have System 1, a fast, automatic, effortless lower-level system; on the other, System 2, a slower, more effortful higher-level system, whose workings are rule-governed. These two systems can arrive at conflicting judgments, which is how we are able to identify the presence of two systems, rather than one. As in intuitive illustration, consider the following problem (Kahneman 2002):

A bat and a ball cost \$1.10 in total. The bat costs \$1 more than the ball. How much does the ball cost?

Most people report an initial inclination to answer “10 cents”. This answer springs to mind quickly and automatically. It is quite opaque *why* this response comes to mind; it just *seems* like the right answer, at least at first. To arrive at the correct response of “5 cents”, we need to invoke algebraic reasoning. We know that $Bat + Ball = 1.10$, and $Bat = Ball + 1$. Solving for $Ball$, we obtain 5 cents. The reasoning that leads to *this* response is perfectly transparent to us; we could explain our thought process to others, for example. It invokes conscious, deliberate reasoning that follows the rules of algebra. The initial response of “10 cents” is supplied here by System 1; the response is fast and automatic, and it is quite opaque how we ever arrived at it. The response of “5 cents” is supplied by System 2; it is arrived at by effortful, conscious, rule-governed reasoning.

Kahneman and his colleagues argue that it is System 1 that underlies the results of their famous ‘feminist bankteller’ experiment. In this experiment, subjects are given the following description:

Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations

They are then asked, under a variety of circumstances, to assess the probabilities of the proposition that

Linda is a bankteller

And the proposition that

Linda is a bankteller who is active in the feminist movement

Time and again, people assign a higher probability to the latter proposition than to the former. Of course, this amounts to assigning a higher probability to a conjunction than to one of its conjuncts, in violation of the rules of probabilities. There is a certain intuitive pull associated with such a response; it just *seems* that

Linda is more likely to be a feminist bankteller than a bankteller. It takes the stern application of probabilistic norms to appreciate that this is an error. Again, System 1 is responsible for the intuitive response—the response that experimental subjects overwhelmingly provide. It takes System 2 to intervene and impose the laws of probabilities for us to resist the response given by System 1.

System 1 is here neglecting the most basic set-theoretic aspect of probability. If the extension of an event-type A is included in the extension of an event-type B, then the probability that an event in A will obtain cannot exceed the probability that an event in B will obtain—this is why no conjunction can be more probable than its conjuncts. System 1 is not sensitive to these set-theoretic considerations.

System 1 neglects information about quantity too. Our intuitive evaluations of painful procedures are often insensitive to the duration of the procedure, and depend instead on the peak amount of pain, and the end amount of pain, both of which are non-extensional attributes (Kahneman and Frederick 2002). Thus people will claim to prefer a painful procedure extended by a period of less intense pain to one that is not thus extended. People are also willing to pay the same amount to save endangered birds, whether they would be saving 2,000, 20,000, or 200,000 birds, and Toronto residents are willing to pay the same to clean up one or two polluted lakes in the region as they are to clean up all polluted lakes in Ontario. Various studies have also documented the neglect of base-rate information in making statistical estimates (Kahneman and Frederick 2002).

In this vein, people are very often moved far more by concrete, vivid examples than by dry, though well-founded, statistical facts. Nisbett, Borgida, Crandall, and Reed (1976) offer a nice illustration of this. They ask us to imagine that we are deciding whether to buy a Volvo or a Saab. We read *Consumer Reports* and find the consensus there reported to be significantly in favor of Volvos. These reports are based on the experiences of several hundred consumers. We then encounter someone at cocktail party who exclaims: “A Volvo! You’ve got to be kidding. My brother-in-law had a Volvo. First, that fancy fuel injection computer thing went out. 250 bucks. Next he started having trouble with the rear end. Had to replace it. Then the transmission and the clutch. Finally, he sold it in three years for junk.” The logically proper response is to add this one negative case to the overwhelmingly positive statistics based on several hundred cases—i.e. to essentially discount it. It must be admitted, though, that most of us would think twice about getting a Volvo after hearing this testimony. The power of such a personal and vivid anecdote is remarkable. At the intuitive level, is it far more convincing than abstract statistical facts.

There are various experimental analogs of the scenario described above; that people place more weight on a single anecdote than on statistically robust information has been well-documented. (See, e.g., Hamill, Wilson, and Nisbett 1979, Tversky and Kahneman 1972, Nisbett, Borgida, Crandall, and Reed (1976) Nisbett and Borgida 1975). Of course, if this is correct, my reader will be far more convinced by the Volvo anecdote than by a description of the experimental data, so I will say no more on this point.

The evidence surveyed so far suggests that System 1—the more primitive system—is not particularly sensitive to information about *how much* or *how many*. I suggest that generics are judgments issued by System 1. They are thus non-quantificational; they do not depend on considerations of quantity, or any such information easily captured by set-theory. They are, however, automatic, effortless, and cognitively basic. Quantifiers, in contrast, express judgments issued by System 2, the rule-governed, extension-sensitive, higher-level system. Quantifiers *do* depend on considerations such as *how much* and *how many*. They are thus easily describable in the terms of set-theory.

Generics share other characteristics with System 1 also. The judgments issued by System 1 are sensitive to the affective nature of information, such as how striking it happens to be. Rothbart, Fulero, Jenson, Howard, and Birrell (1978) conducted an experiment to test the effects of striking information on our estimates of statistical frequencies. Their subjects heard brief descriptions of the behavior of fifty people, forty of whom were well-behaved, and ten of whom engaged in criminal activities. For half the subjects, the described criminal acts were quite horrific, consisting of crimes such as rape and murder, while for the other half, the crimes were much less disturbing—shoplifting, forgery, and the like. The subjects were then asked to estimate the frequency of criminals in the groups they had just heard about; they consistently provided higher *statistical* estimates of criminality for the more extreme group, even though the actual percentage of criminals was the same for both groups. These estimates, provided by System 1, were thus influenced by the striking nature of the information at hand.

System 1 is also ‘frame dependent’; its judgments depend on how information is presented or described. For example, we are more likely to favor a medical procedure if it is described as having a 90% survival rate, than if it is described as having a 10% mortality rate. I wonder if generics might perhaps be rightly thought of as frame dependent. For example, people have the firm intuition that “mosquitoes carry the West Nile Virus” is true, but “mosquitoes are mosquitoes that carry the West Nile Virus” is false. In evaluating the second sentence, there is a feeling that we are inappropriately overlooking the mosquitoes that don’t carry the virus, but this feeling is not present when evaluating the first, even though, of course, the two claims have the same exceptions.

7. System 1 and Errors of Judgment

Much of the work that has been done on understanding the nature of System 1 has focused on errors of judgment. It must be emphasized that this is an artifact of research methods, however; there is nothing inherently erroneous about System 1. The situations in which one can most confidently conclude that two distinct systems are operating are ones in which conflicts arise between the responses that people arrive at intuitively, and ones that, upon reflection, they recognize as

correct. Such a situation offers the most direct evidence for the existence of two systems. These circumstances obtain when people are given a task that calls for a rule-governed, quantity-sensitive response of the sort that System 2 provides, but nonetheless they rely on the easier, quicker, automatic judgment delivered by System 1, rather than invoking System 2's more arduous operations.

This simply means that System 1 may be erroneously *overused*, not that it is in some way inherently erroneous. Some questions and tasks appropriately involve the working of System 1. For example, instead of asking subjects to rate the probabilities of Linda's being a bankteller rather than a feminist bankteller, we might have asked them to judge how much Linda *resembles* a bankteller rather than a feminist bankteller. No error would have been involved in judging that Linda more closely resembles a feminist bankteller than a bankteller. The task at hand called for a System 1 judgment, so no error is associated with providing one.⁹

Generics, I suggest, express System 1 judgments. There is no erroneous overuse of System 1 involved in uttering and understanding generics; the use of System 1 is appropriate to the production and comprehension of generics. Errors only arise when we interpret quantified statements as though they were generics. As mentioned earlier, there are situations in which three-year-olds do exactly this; they interpret quantified statements as though they were generics. These three-year-olds ought to employ System 2 to understand the quantified statements, but they incorrectly rely on the easier, more available judgments of System 1—namely those associated with generics. One only makes such an error when one treats a quantified statement as a generic; treating generics as generics constitutes no error whatsoever.

8. Conclusion

Generics express our most primitive and fundamental generalizations. These generalizations are not about *how much* or *how many* in the way that quantificational statements are. Rather, they stem from System 1, a lower-level cognitive system that is not particularly sensitive to such considerations. Quantifiers, in contrast, belong to System 2; they invoke the more sophisticated workings of this higher-level system. Thus quantifiers are harder to process and understand than generics, and so are acquired later, and prove more difficult for children to master. The non-extension-based, non-quantificational generalizations expressed by generics may be more puzzling for the theorist than these more transparent quantifiers, but they are more basic and fundamental to human cognition.

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Notes

1. See, for example, Sainsbury (1973). The difficulty of forming associations with absences is known in the literature as the ‘Feature Positive Effect’, and has been well documented over the last thirty years.
2. A gesture was classified as generic if it represented a prototypical property of the kind in question that was not present in context, and did not contain any further indications (such as being accompanied by a negation gesture) that it was intended to refer to a particular instance of the kind in that context. The children studied here have two means of invoking their subjects of predication—they can either employ deictic gestures, or mimetic gestures that function as common nouns (Goldin-Meadow, Butcher, Mylander and Dodge 1994). If a particular instance of a kind was present in the context (e.g. a toy elephant was at hand), a gesture was classified as generic *only if* it reflected a stable, prototypical property of elephants *that was not possessed by that particular elephant*. For example, a pointing gesture followed by a trunk gesture would not be classified as generic if that particular elephant had a trunk. If the elephant in question lacked a trunk, then for the gesture to count as generic, it would have to lack any indication that it was intended to point out a particular feature of that elephant—for example, if it was accompanied by a negating gesture, then it would be understood to mean that that particular elephant does not have a trunk. The classification procedure was thus very conservative. Of course there is nonetheless a certain interpretative gap, and it is impossible to be certain that all the relevant gestures were in fact generics, as opposed to, say, normative claims to the effect that that particular elephant ought to have a trunk. However, even such a normative claim draws on ‘generic knowledge’—the child would only be disposed to make such a normative claim if she already believed the corresponding generic. See Prasada and Dillingham (2006a, b) for an intriguing discussion of the role of generic knowledge in licensing such normative beliefs.
3. Elizabeth Shipley (1993) suggests that much early learning proceeds in this manner. (She calls characteristic dimensions ‘overhypotheses’, but the idea is much the same.) Macario, Shipley and Billman (1990) provide experimental evidence that supports this idea.

4. Obviously there are semantically valid inferences involving generics in a loose sense, for example “birds fly and tigers have stripes, therefore tigers have stripes”. The validity of this inference is obviously not licensed by the fact that the conclusion is a generic, but is rather an instance of conjunction elimination. The fact that generics, on my account, are truth evaluable is enough to preserve the validity of these inferences. The putative inferences Asher and I are discussing here are ones that would hold in virtue of the fact that the premises or conclusion are generics.
5. The fact that we are inclined to endorse some particular inferences does *not*, of course, establish that the inference is semantic. I imagine that we are all inclined to defeasibly endorse—absent information to the contrary—inferences such as *Mary’s boyfriend has cheated on her three times, so he’ll cheat on her again*, and *Jane’s boyfriend has stolen money from her three times, so he’ll steal from her again*, and so on. We should not conclude that there is some semantic property of the schema *A’s boyfriend has done X three time, so he’ll do X again* that underwrites these inferences. It is not for the semanticist to explain our defeasible endorsement of these inferences.
6. In order to make use of the simplified version of isomorphism invariance, I will focus on cases where Gen binds a single variable. Although Gen is unselective, and therefore capable of binding more than one variable, it will suffice to demonstrate that Gen is not isomorphically invariant in this simplest case. An operator fails to satisfy isomorphic invariance if there are *some* instances in which it is not isomorphically invariant. I will thus focus on generics of the form Gen x [Kx] [Fx], and show that the truth of such generics are not functions of the cardinalities of sets.
7. The explanation of these differential intuitions lies, I believe, in the nature of the counterinstances to the claims. Whether a counterinstance is positive or negative depends specifically on the generalization at hand—male birds are intolerable, positive counterinstances to “birds are female”, since they have the positive alternative property of *being male*, but are permissible, negative counterinstances to “birds lay eggs”, as they simply fail to lay eggs, and do not have a positive alternative property in its place. We are, of course, considering the same birds in both cases—whether they are positive or negative counterinstances is relative to the specific property (understood (hyper-)intensionally) being predicated. Now, the mosquitoes that do not carry the M-virus do not possess a positive property that is an alternative to *carrying the M-virus*, but they *do* possess a positive alternative property to *being a mosquito that carries the M-virus* – namely, *being a mosquito that does not carry the M-virus*. This subtle shifts turns merely negative counterinstances into positive ones, because they possess the positive, concrete property of *being a mosquito that is virus-free*. Intuitively speaking, it feels somehow that we would be overlooking the virus-free mosquitoes in judging true “mosquitoes are mosquitoes that carry the M-virus”, while this is not so in judging true “mosquitoes carry the M-virus”. The phenomenology is quite similar when we consider “ducks are female” and “ducks lay eggs”. I would suggest that this feeling of ‘overlooking’ is a hallmark of the phenomenon of positive counterinstances.
8. (Technical note) Some NPs that are plausibly quantificational are built up out of an n-place quantifier (in the strict sense), and some predicate-denotations

that are ‘frozen’ in some of its argument positions (Westerstahl 2005). A simple example of this is the NP “all red balls”. This quantificational NP is built up out of the 2-place quantifier “all”, with its first argument place filled in by “red balls”, to create the 1-place quantifier “all red balls”. “All red balls” does not pass the cardinality test for quantifierhood, but since it is thus derivable from a strict quantifier, we may decide to count it as a quantifier. More complicated examples include NPs such as “everyone except John” and “more women than men”. If generic NPs could be understood as being built up out of an n-place cardinality operator with frozen argument places, then this would undermine the argument that they are not quantificational.

It is vital to note, however, that the NPs above are all quantifiers in the ‘liberal’ sense of Barwise and Cooper (1981). That is, they are all functions from predicate denotations to truth values. The ones mentioned above all partition the powerset of the domain of discourse into those sets of individuals that are mapped to True, and those that are mapped to False. If we begin with a cardinality operator and freeze some of its argument places with predicate denotations, we will not construct an operator that does otherwise. Certainly, we will never construct one that operates on more fine-grained entities than extensions or intensions. Thus hopes of arguing that generics are quantificational on these grounds will surely be dashed.

9. There may even be many situations in which System 1 is *less* prone to error than System 2. For example, in our interactions with other people, and our judgments concerning those interactions, we are often better off ‘trusting our instincts’ than approaching the situation dryly and analytically. A recurrent theme in the television series *Star Trek* is the plight of the unfortunate Data, who lacks human intuitions, particularly those concerning social situations. His attempts to compensate for this lack of intuition with careful and considered analytic reasoning are all too often met with failure. When it comes to reading and responding to social cues, the careful, conscious reasoning of the sort we associate with System 2 is a poor substitute for the automatic, intuitive deliverances of System 1.

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