# Plurals

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The study of plurality has implications for our understanding of the semantics of natural language and broader issues in philosophy, largely by bearing on matters logical. Perforce, I'll emphasize some issues at the expense of others, and I'll indicate directions for further study along the way. Other overviews, with different points of emphasis, are Lønning [1997], Schein [2006], and Rayo [2007].

In the first instance, plurality is a morphological notion, and at least in English, it distinguishes between count and mass nouns. While the former can exhibit it (*dogs, trees, tables, chairs*), the latter cannot (**informations, *advices, *broccolis*). The semantics of plurality are far less straightforward.

## 1 MORE THAN ONE?

The simplest hypothesis is that plural morphology means *more than one*. That cannot be the whole story, however.

(1) a. The President met with bankers on Friday.
    b. The President met with more than one banker on Friday.

(2) a. The President didn't meet with bankers on Friday.
    b. The President didn't meet with more than one banker on Friday.

(3) a. Did you see whales on your trip?
        i. Yes, I saw (just) one.
        ii. # No, I saw (just) one.
    b. Did you see more than one whale on your trip?
        i. # Yes, I saw (just) one.
        ii. No, I saw (just) one.

While (1a) and (1b) convey exactly the same information, (2a) and (2b) do not. In the scope of negation, the plural seems to mean *one or more*. The same is true of questions, as (3a) and (3b) illustrate. Since (3(a)i) but not (3(a)ii) is a proper response to (3a), the plural seems to mean *one or more*. (3b) shows that if it meant *more than one*, we should expect the opposite pattern of felicitous answers. For this reason, various theorists have suggested that the plural always means *one or more*, and that the "more than one" interpretation is an implicature of some sort. Krifka [2004], Sauerland et al. [2005], and Spector [2007] implement this strategy in the context of truth-conditional semantics, Kamp and Reyle [1993] in Discourse Representation Theory.

A similar variability, with an explicit concern for compositionality, was pointed out by Chomsky [1975].

(4) That unicycle has wheels.

(5) Unicycles have wheels.

It seem as if the bare plural *wheels* means *more than one* in (4) but not in (5). The latter is what has become known as a *dependent plural* [de Mey, 1981]. Chomsky argued that this presents a problem for compositionality. The plural makes different contributions to the meaning of the two sentences, but we cannot predict whether the plural means *more than one* without knowing what kind of sentence we're interpreting.

Here, too, several theorists [e.g. Spector, 2007, Zweig, 2008] have suggested that the plural is semantically number-neutral and that the appearance of a plural meaning in (4) is the result of an implicature. Working out the details of this approach may have far-reaching implications for our theory of implicature. Unlike ordinary scalar implicatures which can be canceled, we cannot cancel the "more than one" implicature here. *Vide* (6).

(6) # That unicycle has wheels, though I don't mean to suggest that it has more than one wheel.

Dependent plurals thus seem to require some other account of implicature, perhaps one on which implicatures are computed alongside (or as part of) semantic composition [Chierchia, 2002, 2006].

## 2 COLLECTIVITY, DISTRIBUTIVITY, AND CUMULATIVITY

There is yet more variability to account for.

(7) All of the children slept.

(8) All of the children gathered in the yard.

(9) Three children ate four pizzas.

The predicate in (7) is what is usually called *distributive*: if it can be truly applied to a plurality, it can also be truly applied to each of its members. This connection fails in (8), making it *collective*: even if the children gathered in the yard and Jane is one of them, Jane didn't gather in the yard. (9) exhibits a cumulative reading: there were three children eating pizzas and between them, four pizzas were eaten.

Collectively interpreted sentences such as (8) cannot be analyzed in terms of distributively interpreted sentences. We thus need to take at least collectivity as basic. But perhaps collectivity is the only basic phenomenon, and what looks like further interpretations are simply the result of indeterminacy. On this view, (7) and (8) predicate a property of a plurality, and one way for the property to truly apply to it is for it to apply to each of its members. Compare: there are many ways for the sentence *there are potatoes in the pantry* to be true—the potatoes might be in bags or in a box, but these are just ways for a single reading to be true [see Harnish, 1991, Higginbotham, 1981, Katz, 1977].

The currently most wide spread view holds that the distributive interpretation is a genuine reading [see Gillon, 1987, for a range of arguments]. But what determines whether a sentence is interpreted collectively or distributively? It could be a matter of the lexical meaning of the verb so that the meaning of *sleep* includes the meaning-postulate that whenever it is true of a collection, it's also true of each member of the collection [Scha, 1981]. But we see readings that are inexplicable on this approach [see Winter, 2000].

(10) The girls wore a dress.

On the meaning-postulate approach, we can only predict the reading of (10) on which there is a single dress for all of the girls because there is no other operator that the existential quantifier *a dress* can enter into scope relations with.

Once we posit such an operator, (10) can be interpreted as *the girls are such that, for each of them, there is a dress that she wore.* This is a *distributive* operator: it distributes the predicated property to each thing in the plurality picked out by the subject.

One could think that the operator is part of the plural noun-phrase, so that collectivity or distributivity is a feature of the NP (see Lakoff 1972 and Gillon 1987, 1990, 1992). It is more likely, however, that this distributive operator is part of the verb phrase, based on examples combining distributivity and collectivity [see, e.g. Beck and Sauerland, 2000, Landmann, 2000, Lasersohn, 1995, McKay, 2006, Pietroski, 2005, Schein, 1993, Schwarzschild, 1996, Winter, 2000].

(11) The children woke up and gathered in the yard.

If the NP had to be read either collectively or distributively, one of the predicates wouldn't apply. But on the VP-analysis, (11) is essentially equivalent to (12).

(12) The children are such that each of them woke up and they gathered in the yard.

Gillon [1987, 1990, 1992] and Schwarzschild [1994, 1996] have argued that in order to capture all the semantic possibilities, the analysis needs to be more complex still. Some sentences aren't collective, but the predicate cannot be distributed all the way down to the individuals involved, either. Suppose we're buying apples. Each apple costs fifty cents, and we buy twelve. (13a) and (13b) are true in that case.

(13) a. The apples cost fifty cents.
b. The apples cost six dollars.

In (13a), the VP contains a distributive operator, while it is absent in (13b). In the right context, perhaps once we're told that the apples come pre-wrapped in six-packs, we can also describe the situation with (14).

(14) The apples cost three dollars.

We've already exhausted the possibilities with respect to the distributive operator. When it's present, (13a) is true while (13b) and (14) are false. When it's absent, (13b) is true and the other two false. Either way, we cannot predict the true reading of (14). We'd like a formal way of capturing roughly the paraphrase (15).

(15) The apples are such that each six-pack among them costs three dollars.

Here, the predicate is distributed to collections that in turn make up the plurality, rather than to the individuals in that plurality.

Formally, we accomplish this by allowing the distributive operator to distribute the predicate to contextually salient subclasses of the plurality. One particularly striking feature of this context-dependence is that certain subclasses are completely unavailable to ordinary speakers as targets for distribution [first pointed out by Scha, 1981]. In Figure 1, we can easily group the lines together in such a way as to make (16) true.

(16) The sides of $R_1$ run parallel to the sides of $R_2$.

But we cannot impose a contextual grouping on the lines in figure 2 that verifies (17).

(17) The single lines run parallel to the double lines.

Investigating why there are such constraints promises to shed light on how context can and cannot influence interpretation. The availability of contextual restrictions on distributivity may also be relevant to other issues, such as the interpretation of definite descriptions.

## 2.1 Descriptions

Definite descriptions in the singular, such as *the king*, convey uniqueness, i.e., that there is only one king. Definite descriptions in the plural, such as *the children*, convey maximality, i.e., that the predicate applies to all of the children—see (18) [Sharvy, 1980, presents a theory that captures the pattern].

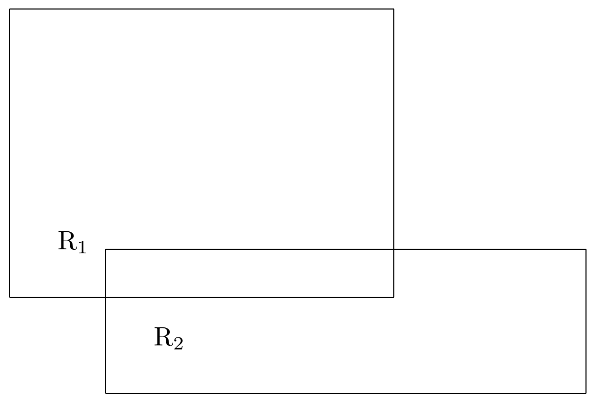


Figure 1: Rectangles

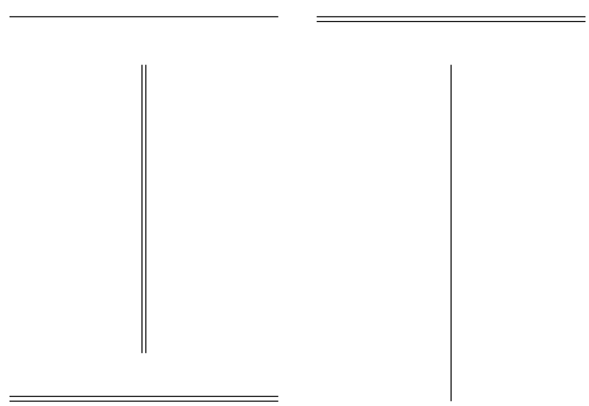

Figure 2: Lines

(18) The children slept until eight.

The uniqueness and maximality of descriptions seems to be at odds with actual usage, however. In the case of singular descriptions, this is the phenomenon of "improper descriptions" [e.g. Strawson, 1950]. *The child slept* can be perfectly appropriate, even knowing that there's more than one child in the world. How to account for this is a hotly debated topic [see Cappelen and Lepore, 2005, Stanley and Szabo, 2000, for some recent debate].

The corresponding phenomenon for plural definite descriptions is that, even though descriptions seem to have a maximal flavor, they aren't perfectly equivalent to universal claims about the members of the plurality [see, e.g., Brisson, 2003, Brogaard, 2007a,b, Dowty, 1987, Scha, 1981]. (18) can be true, even if some children woke up before eight. But the case of plural definite descriptions probably offers no support to theorists who deny that, in the case of singular descriptions, the uniqueness condition is part of the semantics. For in the case of plural definite descriptions, we have two sources of quantificational force—the description and the distributive operator—and the apparent non-maximality of the plural description may in fact be due to a restricted distributive operator [discussed in detail by Brisson, 2003]. Thus (18) might just mean (19).

(19) The children are such that each one in a (contextually determined) proper subset drawn from them slept until eight.

## 3 THE INTERPRETATION OF "AND"

Problems of interpretation also arise with a way of forming plural NPs: conjunction.

(20)
   a. Mary ran and Sue ran.
   b. Mary and Sue ran.
   c. Mary stretched and ran.

*And* is clearly univocal in these examples. They do not exhibit three words with distinct meanings that just happen to sound the same. But this raises a problem. When *and* connects sentences, it has a basically intersective meaning: in terms of possible worlds, the set of worlds determined by a conjunction is the intersection of the set of worlds determined by each of the conjuncts. Likewise, *and* has a basically intersective meaning when it connects predicates. The set of objects that satisfies the conjunctive predicate *tall, dark, and handsome* is the intersection of the sets that satisfy *tall* and *dark* and *handsome*, respectively. Extending this intersective idea to noun phrases works far less well. Indeed, this fact about conjunction and collectivity is one of the earliest observed and discussed facts in the philosophy of language. Thus Aristotle:

> There are two styles of [sophistical] refutation; for some depend on the language used, while some are independent of language. Those

> ways of producing the illusion which depend on language are six in number: they are homonymy, ambiguity, combination, division, accent, form of expression. [...] Upon division depend the proposition that 5 is 2 and 3, and even and odd, and that the greater is equal (for it is that amount and more besides).[Aristotle, 1984, 166a23-166a35]

That is, we don't want to conclude from *five is two and three* that five is both even and odd by illegitimately "dividing" the predicate into separate identity statements. The problem of explaining the logical force of this example also exercised Medieval logicians, for example Peter of Spain [1990, §75] and William of Ockham [1980, chp. 37].

In contemporary semantic theorizing, finding a unified meaning for conjunction that accounts for its basically intersective behavior in some contexts and its basically union-forming behavior in others is of interest because it ramifies into issues about how semantic composition is implemented in natural language. To say that a language (or some other system of representation) is compositional is to say that the meaning of its non-atomic parts is determined by the meaning of its atomic parts and their mode of combination. Hence, a theory that wants to describe the compositional structure of, say, English needs to say something about the semantic import of putting words together in the way that we do. One very popular idea is the following, essentially following Frege and articulated fully in Heim and Kratzer [1998]. (Almost) all composition is a matter of applying functions to arguments. This basic form of function application can be used to explain the behavior of all manner of expression, including predicates of arbitrary arity, quantifiers, and adverbs. But if function application is the only mode of producing meaningful complex expressions and the surface structure of these sentences corresponds closely to their logical form, it's just about impossible to see how we could give a single meaning for *and*.

One historically popular idea for solving this problem made use of a mechanism of "conjunction reduction." We know that the surface structure of sentences is the result of transformations of an initial structure (as is shown by constraints on wh-movement, for example). Given this fact, it's at least possible that the different surface configurations in which *and* can appear are the result of a single underlying structure. Specifically, (20a) might be the basic case, and (20b) and (20c) are derived from it by "reducing the conjunction." And while this operation has syntactic and phonological effects, it doesn't have any semantic implications because the level of interpretation relevant to interpretation—the logical form—is the shared deep structure. In that case, we can make do with a single meaning for *and*: phrasal conjunction [see, e.g., Lakoff and Peters, 1969, Massey, 1976, McCawley, 1972, 1988, Smith, 1969].

Unfortunately, the conjunction reduction approach fails because it cannot account for collectively interpreted noun-phrases formed using conjunctions, such as *Mary and Sue met*—it's not equivalent to *Mary met and Sue met*. For this reason, it may be required to make use of further principles of composition. The seminal paper in the area is Partee and Rooth [2002], who argue that we should allow the syntax to generate syntactic configurations that aren't interpretable by the application of function application. If we combine this with relatively tightly constrained rules about how the semantic system should deal with such failures of interpretability—for example, by applying an alternative rule in such cases—we can give a unified analysis of all occurrences of conjunction. Winter [2001] argues for a liberalized (and hence more powerful) version of this proposal [an alternative view of the mechanisms of composition that focuses on conjunction rather than function application is presented in Pietroski, 2005].

# 4 COLLECTIVITY AND COLLECTIONS

So far, I've assumed that, in some sense, plural NPs pick out a plurality of things (one or more of them). I end this overview by addressing directly how best to understand this pre-theoretic talk of pluralities, the issue that has been at the center of philosophers' attention. One way into the problem is to focus not on the interpretation of plurality, but on a related issue in logic and metaphysics—whether we as theorists can quantify over absolutely everything.

It is a commonplace that in ordinary speech, quantifiers are restricted. In the examples in (21), the quantifiers are not interpreted as ranging over every student that has ever existed anywhere in the world.

(21) a. Every student passed.
b. Some students didn't turn in their homework.

But for some purposes, it may be of interest to quantify over absolutely everything, for example, in making ontological claims about what sorts of things there are *not*. A metaphysician who says that there are no ghosts would not be happy if we took her to mean that there aren't any ghosts *around here*. She wants to assert something about the whole universe.

However, on a certain way of understanding our natural language, we cannot possibly quantify over everything. This issue turns on how to interpret NPs in collectively read sentences. There are basically three formal strategies. The first makes use only of standard, singular first order logic (it usually isn't emphasized that the logic is singular, but this will be important in a minute). This approach makes use of sets or some other kind of collectivizing object to capture the truth-conditions of the relevant sentences. The second retains first-order logic but adds another kind of variable, plural variables. The third makes use of the resources of second order logic. We can illustrate the three strategies by considering (22).

(22) The rocks rained down on the village.

For present purposes, we can take the whole verb phrase *rained down on the village* as an unanalyzed primitive, and I'll pretend that the only rocks in the domain of discourse are the ones that rained down on the village. The first strategy takes the expression *the rocks* to denote an object that collects the relevant rocks—perhaps the set that contains all and only those rocks, perhaps a mereological sum [Simons, 1987], or what have you. The set-based representation of (22) might then be as in (23).

(23) $\exists s(\forall x(\text{Rock}(x) \leftrightarrow x \in s)) \wedge (\text{Rained.Down}(s))$

This paraphrase has the benefit of retaining simple first order logic, a logical system that is formally and intuitively incredibly well understood. But it also has its drawbacks. A first point to make is that in a way, (23) gets the interpretation of the predicate wrong. A single object cannot rain down on anything, it can only fall, and the situation doesn't change even if that object has parts or elements. So in order to take (23) as an interpretation of (22), we need to interpret the predicate as expressing a derived notion of "raining down on the village," call it *rain**, so that *rain** is true of an object just in case it has elements or parts and these parts rained down on the village.

Two further concerns have inclined many researchers in the area to reject the simple first-order paraphrase. At least *prima facie*, it looks as if it has counterintuitive consequences about the ontological commitments we incur by speaking in a certain way. Specifically, it looks as if we as speakers of English are, when uttering (22), ontologically committed to the existence of sets in exactly the same way that we are committed to the existence of sets when we say things like (24).

(24) There is a set containing just the number one.

But intuitively, there is a real difference in the ontological commitment of a speaker who accepts only (22) and one who accepts (24). The first order logical paraphrase doesn't capture the difference since it analyzes both as quantifying over sets.

We can of course capture the difference by saying something about the theoretical machinery we use in semantics. In general, not everything we make use of in a semantic theory is something that the speaker of a natural language we interpret using that theory is committed to. For example, if we interpret quantifiers as second order relations (as in generalized quantifier theory), we don't want to say that this shows that speakers who use quantifiers in English are thereby committing themselves to the existence of sets. The use of sets is simply an artifact of efficient theorizing. We can take a similar line about the difference between (22) and (24): take the apparent ontological commitment to sets seriously when we interpret sentences explicitly about sets, treat it as an artifact of efficient theorizing when we don't. The concern is that we wanted to use the logical paraphrase in part to lay bare when we're talking about sets in a way that leads to ontological commitments, and that isn't possible on the present line.

Finally, and this has probably been the most influential line of argument, it looks as if the first order paraphrase in terms of sets or collections can be shown to be straight-forwardly mistaken in predicting that certain intuitively true sentences are incoherent. This line of argument was first presented in Boolos [1999b,c], focusing on sentences like (25).

(25) There are some things which aren't members of themselves.

Intuitively, (25) is true—every human being serves as a witness to the existential claim. But if we generally paraphrase plural noun phrases in terms of sets, (25) says that there is a set, and it contains all and only the things (including sets) that aren't members of themselves. Unfortunately, that leads directly to Russell's paradox.

A proponent of the singular first-order paraphrase could block Russell's paradox by restricting the domain of quantification in a suitable way. (25) leads to paradox because at least in principle, anything could be something we refer to with a plural locution (especially considering the data mentioned in §1 suggesting that the plural morphology doesn't mean *more than one*.) This principle is an instance of a comprehension scheme, which we might put in natural language as (26).

(26) Whenever there is one or more thing or things that have some property, then there are the things that have that property.

Now focus specifically on the consequent of (26). If plural expressions are always interpreted as denoting (possibly singleton) sets, then (26) is equivalent to (27). To make later comparisons easier, we also add the formal counterpart (28).

(27) Whenever there is one or more thing or things that have some property, then there is a set that contains all and only the things that have that property.

(28) $\exists w\big(\phi(w)\big) \rightarrow \Big((\exists s)(\forall y)\big(\mathrm{Set}(s) \wedge (\phi(y) \leftrightarrow y \in s)\big)\Big).$

Now, Russell's paradox arises only if the quantifier in the consequent *all and only the things that have that property* ranges over all of the sets. To see this, imagine that we're implicitly restricting the domain of that quantificational expression. The crudest way of doing so is to exclude all sets from the domain of quantification in the object language. In that case, the original troublesome existential claim (25) can be paraphrased in the metalanguage as (29).

(29) There are some things, and they are all and only the things that *aren't sets* and aren't members of themselves.

There's obviously no commitment to the existence of a set that contains all and only the things (including all of the sets) that aren't members of themselves. (29) is only committed to a set containing all and only the non-sets that are also non-self-elemental. No problem there.

That we should resolve Russell's paradox by appeal to such implicit restrictions has been argued in detail by Dummett [1981, chp. 15], Dummett [1991], and Parsons [1983a,b]. For concerns about the coherence of the idea that we cannot quantify over everything, see Lewis [1991], Boolos [1999a], and Williamson [2003], as well as many of the essays collected in Rayo and Uzquiano [2006].

I've just presented the problem in terms of sets and a very crude restriction on quantifiers. What is essential to the dialectic are just two parts. Plural

NPs are interpreted in terms of an object that somehow collects the objects intuitively denoted by the NP and there is some kind of membership relation that relates each of these objects to this collective object—this is what Rayo [2002] calls the *surrogate*-strategy. Paradox is avoided by some restriction of the quantifiers of the object language. In other words, the surrogate strategy is incompatible with quantification over absolutely everything. And the surrogate strategy is the only way to capture in a singular first order language the truth-conditions of sentences containing plural NPs. Thus, if natural language "needs" to be analyzed in terms of a singular first-order language, then it's impossible to quantify in natural language over everything. I'll say more about the notion of "needing to be analyzed" shortly, once we have the other options on the table.

Another way to block the derivation of Russell's paradox is to alter the formal system used to represent the semantics of the language we speak, and this comes in two flavors. The first retains a first-order logic, i.e., one that only quantifies over argument positions, but allows plural variables in addition to singular ones. Thus, we allow the logical representations in (30).

(30) a. $\exists x Fx$
There is an $F$.

b. $\exists xx Fxx$
There is one or more $F$s.

The logical representation (30b) does not invoke any collectivizing entity. It allows several objects to be simultaneous arguments of a predicate. The comprehension principle (26) is formalized as in (31), where $\prec$ should be read as *is among*.

(31) $(\exists w)\big(\phi(w)\big) \rightarrow \Big((\exists xx)(\forall y)\big(\phi(y) \leftrightarrow y \prec xx\big)\Big).$

When we plurally refer to one or more objects, the $xx$s in this case, we can only do so when there is at least one object among the $xx$s. Intuitively, the reason for this restriction is precisely the motivating thought for plural variables: we want to be able to refer to various objects without making use of a collectivizing entity. But because there is no such entity, it's impossible to refer to any plurality of objects without referring to some objects. In formal terms, (32) is analytically true, while (33) for example is analytically false.

(32) $(\forall xx)(\exists y)(y \prec xx)$.
For any things, there is some thing that's among them.

(33) $(\exists xx)(\forall y)\big(y \prec xx \leftrightarrow y \neq y\big)$
There are some things, namely, the non-self-identical ones.

Given such a plural first order language, Russell's paradox is no longer derivable from the simple sentence (25), rendered as (34).

(34) $(\exists xx)(\forall y)\big(y \prec xx \leftrightarrow y \notin y\big)$

The $xx$s whose extension is defined by (34) aren't themselves a set, so that (34) does not entail that there is a set that contains all and only the non-self-elemental things.

Essentially the same effect can be achieved by altering the standard singular first order logic in another way. Rather than extending it by introducing a special kind of first-order variable—plural variables—we can move to a second-order logic. Such a logic is characterized by allowing quantification over predicate positions. Formally, for example, sentences such as (35) are well-formed, where $j$ is an individual constant such as a name.

(35) $(\exists X)X(j)$.

It's hard to state the meaning of second-order logic informally without incurring unwanted commitments. One might say, for example, that (35) means that there is a property that John has. But that suggests that the second-order formalism is committed to the existence of properties we can quantify over. Perhaps the most famous worry in this direction is Quine's, who suggests that second-order logic is just set-theory in "sheep's clothing" [Quine, 1986]: (35) says neither more nor less than that there is a set that John is a member of. Using his criterion of ontological commitment [Quine, 1980], it follows that second order logic is ontologically committed to sets. Moreover, this substantive ontological commitment disqualifies second order logic from being logic at all, rather than a substantive theory about the world, which in turn raises concerns about the viability of logicism, the project of showing that arithmetic can be reduced to logic.

Why exactly Quine's criterion is supposed to have this consequence is less than completely clear. If it turns out that an existential quantifier that binds predicate positions quantifies over sets, and ordinary (unquantified) sentences with predicates can be the true instantiations of such existentially quantified sentences, then the ordinary sentences should be committed to sets—after all, the predicate must pick out one of the things quantified over. For further discussion, see Rayo and Yablo [2001], Wright [1983].

Indeed, this discussion just recapitulates Frege's concept horse problem [Frege, 1997]. Quantificational idioms in natural language tend to be object oriented, so that even when we try to explain quantification over non-object positions, we end up introducing objects that play the role of non-objects, such as sets, classes, or properties. The fact that we run into the concept horse problem in trying to elucidate the semantics of second order logic has made the following observation, due to Boolos, particularly important.

If we consider a specific family of second order logical theories, those that only allow quantification over one-place predicate positions, we are restricting ourselves to the so-called monadic second order logics. And Boolos showed that we can translate monadic second-order logic completely mechanically into first order plural logic. The key idea is to think of the one-place predicates quantified over in the second order logic as denoting all of the things that fall under them, not by denoting a set of these things, but simply denoting them plurally.

Thus, we simply rephrase what looks like predication in (36a) as a partitive construction in (36b) [see Higginbotham, 2000, Hossack, 2000, Linnebo, Winter 2004, for further discussion].

(36) a. John runs.

b. John is one of the runners.

Nonetheless, we want to keep second-order logic separate from plural first-order logic. As Rayo and Yablo [2001] and Williamson [2003] point out, the positions quantified over are formally distinct, one being predicative, the other objectual.

Now that the options are on the table, we can return to the issue what it means to say that natural language "needs to be analyzed" using one or another formal tool, in this case singular first order logic, plural first order logic, or second order logic. Formal languages are artificial objects. We can use them to represent logical properties of sentences of a natural language, such as entailment, equivalence, or incompatibility because these logical relations are precisely defined in the formal language. But we also need to make sure that we understand the formal language, not by learning to speak it, but by having an interpretation of the language. Such an interpretation must itself be couched in some meta-language which is primitively understood (i.e., not by being interpreted in some further meta-language). This is particularly important for the basic building blocks of the logic, its primitive vocabulary and its logical operators.

A good example concerns modality: we can have a substantive debate about whether talk about possibility or necessity is clear enough for certain philosophical purposes to simply be accepted, or whether it itself needs to be explained in terms of some other notion. Goodman [1983] and Quine [1966] are famous skeptics about the intelligibility of our modal talk and want to reconstruct (some aspects of) that talk in other terms. Quine [1973, 1982] are classic expressions of similar skepticism regarding second order logic. First order logic with quantification is the least controversial such logic, and the one whose basic building blocks of terms, functional expressions, relations, sentential connectives, and quantifiers have the easiest correspondence in natural language.

But as we've seen, first-order logic also has its limitations. If it captures the semantics of the language we primitively understand—aka natural language—we cannot quantify over absolutely everything. So there is some incentive to conduct one's metaphysical discussions in a logic that goes beyond the strictures of singular first-order logic. And the best way to show that we understand the formal tools employed in such a discussion is to show that we use basically these very same expressive resources in natural language. That is to say, if our best semantics for natural language is one that eschews the surrogate strategy in favor of plural first-order or monadic second-order logic, then the use of these formalisms is much less problematic. In a nice turn of phrase, Williamson suggests that the issue is

> what language we use as our home language, the language in which

we are happy to work, at least for the time being, without seeing it through the lens of a meta-language.[Williamson, 2003, 459].

### 4.1 Cumulativity and Events

Let's look at some data that bear on this issue.The simplest example of cumulativity is (9).

(9) Three children ate four pizzas.

The crucial observation about cumulativity is that the two quantifiers *three children* and *four pizzas* are scopeless with respect to each other. That is to say, neither of the following two scope relations captures the cumulative reading of (9).

(37) a. For each of three children $x$, there are four pizzas that $x$ ate.
b. For each of four pizzas $x$, there are three children that ate $x$.

Both (37a) and (37b) are too weak, since they're true in the situation in which the cumulative reading is true, but they're also compatible with situations in which the cumulative reading is false. (37a) is compatible with a total of twelve pizzas being eaten by the three children, (37b) with a total of twelve children doing the eating of four pizzas. One option, proposed by Scha [1981] in a paper that shaped the debate on these issues, is that there is a special dyadic quantifier. That is, at the level of logical form, the sentence has a single element *three-four* that applies to two NPs and a relational predicate to yield the cumulative reading. If that theory is correct, we would see that natural language furnishes us with very powerful quantificational resources [formal details of binary quantifiers can be found in Keenan, 1992, van Benthem, 1989].

An alternative to the dyadic quantifier approach involves embracing a Davidsonian event-analysis for the semantics of English. The core idea of this analysis is that predicates introduce event variables into the logical forms of sentences in which they appear, and that all the other parts of the sentence are analyzed as predicating something of the event thus introduced [see Davidson, 1980, Parsons, 1990]. On this strategy, (38a) is analyzed as (38b).

(38) a. John buttered the toast.
b. $\exists e\big(\text{Buttering}(e) \wedge \text{Agent}(e, j) \wedge \text{Theme}(e, t)\big)$

We can use such an event-based analysis to capture cumulative readings, as well. Informally, we analyze (9), *three children ate four pizzas* as (39).

(39) There were some eating events in which three children did the eating and four pizzas were consumed.

One very powerful reason to prefer such an event-based analysis of cumulativity to the polyadic quantificational analysis inspired by Scha comes from ditransitive verbs such as *give*. Consider (40).

(40) Three ATMs gave two customers two passwords (each).

The reading of interest is one in which we take two customers to not be distributive with respect to the three ATMs, i.e., we take there to be a total of only two customers, but where each of the customers got two passwords. This is probably the favored reading, since we can't take *two passwords* to be cumulative, as well—that would mean that somehow, two ATMs must have collaborated in the giving of at least one of the passwords.

Schein [1993] argues in great detail that this kind of mixed cumulative/distributive quantification cannot be captured with any analysis other than an event analysis along the lines of (39). On the polyadic approach, for example, we cannot scope *two passwords* "inside" the *three-two* complex that takes ATMs and customers as arguments, since there is no such spot to scope to. As such, these readings strongly speak in favor of a Davidsonian event-based analysis, though McKay [2006] has tried for an analysis that does without them.

## 4.2 The Unique Role Requirement

Landmann [2000], following Parsons [1990], argues that it is part of the semantics of such an event-analysis that events have a unique-role requirement. For each event, there can be only one thing that fills its agent role, one thing that fills its patient role, and so on. The kind of argument at issue concerns, for example, the analysis of (41a) as (41b).

(41) a. John and Mary met.

b. $\exists e\big(\text{Meeting}(e) \wedge \text{Agent}(e, j) \wedge \text{Agent}(e, m)\big)$

c. $\exists e\big(\text{Meeting}(e) \wedge \text{Agent}(e, j)\big)$

d. John met.

(41b) isn't viable as an analysis, since (41b) entails (41c), which we would think is the logical form of (41d). But clearly, (41d) isn't entailed by (41a), it isn't even grammatical.

The unique role requirement provides an argument for what I earlier called the surrogate strategy for representing collectivity. If the unique role requirement is correct, so is the surrogate strategy, since it is the only way to make it so that a single thing fills the agent role of collective predicates such as *meet*, *surround*, or *rain down*.

A natural response [see Pietroski, 2005, Schein, 1993] is to generalize the Davidsonian analysis to bind not a singular event variable, but a plural event variable. Using the example of cumulative readings to illustrate the idea, we can paraphrase (40) as (42).

(42) There were some events of giving something out, three ATMs did the giving, two customers were their recipients, and two passwords were given.

That is to say, all we want or can say about the ATM situation is that there were some events with the ATMs as agents, which crucially does not allow us to draw any inferences regarding each of the individual events. By parallel reasoning, we analyze *John and Mary met* as (43).

(43) There were some events, they were a meeting, and John and Mary were their agents.

And though the events all together constitute a meeting, we cannot infer anything about whether the individual events that make up the meeting are themselves meetings.

This is not the end of the dialectic. Landman cites examples such as (44a).

(44) a. The children in the choir sang a requiem.

b. There were some events, they were a singing, the children were their agents, and their theme was a requiem.

(44a) can be true if some kids were singing, some kids were just pretending, and some hid at the back of the choir and thought about comic books. And he suggests that at this point, it's not clear in what sense all of these children were agents of singing events, except insofar as they were part of a collection that, as a whole, engaged in some singing—Schein [2005, n. 62] contains a response.

# 5 CONCLUSION

Plurals provide challenges and resources for semantic theorizing. The challenge is to give a semantics that can account for distinctively plural phenomena, such as collectivity and cumulativity, while also interacting with other semantic features of a sentence, such as definite descriptions and conjunction to predict the full range of available readings compositionally. But they also allow us to motivate powerful semantic resources, such as plural quantification and additional sources of quantificational force, such as distributive quantifiers that are introduced by the verb phrase. Because plurality is such a systematic phenomenon, we can parlay empirically well-supported theorizing, such as debates about the event-based analysis of predicates, into fundamental issues about the correct logic for natural language and thence the proper logic with which to conduct our metaphysical and logical inquiry.

# RELATED ENTRIES

- Descriptions
- Quantifiers and Determiners
- Generics

- Mass Terms
- Quantification
- Implicature
- Logical Form
- Pragmatic Enrichment
- Possible-Worlds Semantics
- Dynamic Semantics

WORDCOUNT: 5955

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