Remarks and Replies

Atoms and Sets: A Characterization of Semantic Number

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This article analyzes the interactions of semantic number, morphological number, and quantification. It argues that the traditional typology of *distributive* and *collective* predicates is unsuitable for a truth-conditional theory of plurality. A new test is proposed for classifying the semantic number of predicates according to their behavior with singular/plural quantificational noun phrases such as *every/all student*(*s*) and *no teacher*(*s*). Predicates that are (in)sensitive to such number variations are called *atom/set predicates,* respectively, and it is shown that this distinction cuts across the traditional distributive/collective typology. The processes that govern the semantic number of sentences are reanalyzed in these terms.

Keywords: number, agreement, quantifier, plural, distributive, collective

1 Introduction

In a widely cited work, Vendler (1967:70–76) points out some important differences between the singular quantifier words *every* and *each* and the plural word *all.* The contrast that Vendler discusses can be illustrated using various predicates, as in the following sentences:

(1) $\left\{\begin{array}{ll} \text{a.} & \text{All the students} \\ \text{b.} & \text{*Every/Each student} \\ \text{c.} & \text{The students} \end{array}\right\} \left\{\begin{array}{l} \text{met/gathered/lived together in this room} \\ \text{are (is) similar} \end{array}\right\}.$

Like the simple plural definite *the students* in (1c), the *all* noun phrase in (1a) allows an intelligible interpretation for the sentence. By contrast, the singular words *every* and *each* in (1b) lead to unacceptable sentences.

Predicates such as *meet, gather, live together,* and *be similar* are often called *collective predicates.* Dowty (1987) points out that the pattern observed in (1) does not hold for all predicates

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that are traditionally classified as collective. For instance, consider Dowty's examples in (2), with the collective predicates *be numerous* and *be a good team.*

(2) {a. *All the students / b. *Every/Each student / c. The students} are (is) {numerous / a good team}.

Like the corresponding sentences with *every* and *each* in (2b), the *all* sentences in (2a) are unacceptable, and they are clearly interpreted differently from the acceptable sentences in (2c) with plural definites.

The distinction that Dowty draws between types of collective predicates is motivated by their differing behavior with *all.* In this article I show that Dowty's observation concerning *all* points to a general difference between predicates that can be observed with many other quantificational noun phrases. For instance, plural noun phrases with the determiner *no* give rise to acceptable statements when they combine with the collective predicates in (1), unlike singular noun phrases with *no.* However, both plural and singular noun phrases with *no* lead to unacceptable sentences when they combine with the predicates in (2).

(3) {a. No students / b. *No student} {met/gathered/lived together / are (is) similar}.

(4) {a. *No students / b. *No student} are (is) {numerous / a good team}.

These examples illustrate three mutually dependent phenomena that the theory of plurals must explain: (a) Dowty's contrast between types of collective predicates, (b) the effects of morphological number on interpretation (*every* and singular *no* vs. *all* and plural *no*), and (c) the contrast between quantificational noun phrases (e.g., *all the students*) and nonquantificational noun phrases (e.g., *the students*).

This article summarizes the main linguistic aspects of a formal semantic theory that explains these contrasts.[1] A simple model-theoretic distinction is made between meanings of natural language expressions that range over *atomic entities* and meanings that range over *sets* of such entities. This difference in *semantic number* is used as the key for a new classification of natural language predicates (nouns, verbs, and adjectives). One class includes all the predicates that are traditionally classified as distributive (e.g., *smile, tall, student*), as well as collective predicates such as *numerous* and *team.* These predicates all show equivalence (in truth-conditions or acceptability) between sentences with plural determiners (*all,* plural *no*) and the corresponding sentences with singular determiners (*every, each,* singular *no*). It is proposed that the predicates in this class, when *uninflected for number,* all range over atomic entities. By contrast, the denotations of uninflected collective predicates such as *meet* and *be similar* are treated as ranging over *sets* of atomic entities.

[1] A fully explicit exposition of the theory appears in chapter 5 of Winter 2001.

Two additional simple assumptions account for generalizations (b) and (c):

- The denotation of *number-inflected* predicates is computed using the denotation of their uninflected entry and their number feature so that singular predicates end up ranging over atoms and plural predicates range over sets.
- Noun phrases that have a nonquantificational interpretation can be interpreted using an operator that maps sets to atoms. This process is not available for quantifiers.

While these assumptions rely on some insights from previous works, they do not rely on the traditional distinction between distributive and collective predicates. Thereby, they lead to a new characterization of semantic number and its relationship with morphological number.

2 Atom Predicates versus Set Predicates

In the literature on plurality it is customary to distinguish among *distributive, collective,* and *mixed* predicates. It is assumed that distributive predicates refer to properties of ''singular individuals'' while collective predicates refer to properties of ''plural individuals.'' Mixed predicates are ambiguous or vague between the two usages. For instance, it is assumed that the sentences in (5a) report on individual smiling acts of *both* Mary and John/*each* of the children and that the sentences in (5b) report on a joint meeting between these people. The sentences in (5c) are ambiguous or vague between the two interpretations, meaning either that the people ate some pizzas separately or that they ate one pizza together.

(5) Mary and John/The children { a. smiled / b. met / c. ate a pizza }.

Despite its intuitive appeal, it is hard to find a robust linguistic test that substantiates this distinction among predicates. One difficulty is exemplified by the following examples from Dowty 1987:

(6) At the end of the press conference, the reporters asked the president questions.

(7) A: What was that noise?
B: Oh, I'm sure it was only the children getting up to watch cartoons. Go back to sleep.

In (6) it is clear that the sentence does not require that *each* reporter asked a question, and in (7) it is not stated that *every* child is getting up to watch cartoons. This makes it hard to justify the standard classification of predicates such as *ask a question* or *get up* as distributive.[2]

[2] As claimed in Landman 1996, 2000, similar effects may occur with conjunctive noun phrases, when the conjoined description is known to refer to a team. For instance, Fred Landman's (personal communication) example in (i) does not entail that *both* semanticists in the G&S duo give the talk. Similarly, (ii) does not necessarily mean than *both* singers in the S&G duo are singing.

(i) Groenendijk and Stokhof are talking at the conference.

(ii) Simon and Garfunkel are singing in Central Park.

Another difficulty lies in the definition of the difference between collective and mixed predicates. The problem is that with ''group-referring'' noun phrases such as *the committee* or *the group,* collective predicates such as *meet* start to behave like mixed predicates. For instance, the following sentence reports either on one joint meeting of the two committees or on two separate meetings:

(8) Committee A and committee B met.

Thus, the notorious difficulties with defining a pretheoretical test for ''group-referring'' nouns (e.g., Barker 1992, Schwarzschild 1996) extend to the distinction between collective and mixed predicates.

These points make it hard to base the typology of distributive, collective, and mixed predicates on solid semantic judgments of entailment between sentences. I therefore hypothesize that this traditional distinction has no direct implications for model-theoretic semantics. Contrasts between sentences such as *The man had blue eyes* and **The man met* or between *The committee met* and **The committee had blue eyes* should be explained in terms of selectional restrictions (e.g., individuals cannot meet, committees do not have blue eyes) and not in terms of model-theoretic distinctions between predicates and arguments.

However, Dowty's (1987) observations indicate that a model-theoretic distinction between predicates according to their semantic number may be needed after all. Dowty points out that while many collective predicates are acceptable with *all,* some collective predicates are not. For instance, reconsider the following contrast:

(9) All the students are meeting in the hall/*a good team.

This contrast is distinguished from the behavior of the same predicates with singular *every,* where both sentences are unacceptable.

(10) Every student is *meeting in the hall/*a good team.

The contrast is more general: predicates like *meet* have acceptable interpretations with many quantificational plural noun phrases, whereas *be a good team* leads to unacceptable sentences with such noun phrases.[3] While the sentences in (11a) are acceptable, those in (11b) are unacceptable like their singular correlates, when such correlates exist. Consider for instance the singular determiners in the sentences in (12), which are unacceptable, like their plural correlates in (11b).

[3] Under a generic reading, some quantificational noun phrases do get a coherent interpretation with the predicate *be a good team,* as in the following sentences:

(i) Exactly three/Many/Few students can be a good team.

That this is a matter of genericity can be observed when the predicate in (i) is replaced by a stage-level predicate.

(ii) *Exactly three/Many/Few students are the team that won the cup yesterday.

An analysis of such genericity-collectivity effects goes beyond the scope of this article.

(11) { No / At least two / Many / Few / Exactly four / Between four and ten / More/Less than eleven / Most of the/?Most } students { a. met / b. *are a good team }.

(12) *No/*More than one/*Many a student is a good team.

Note that the matter at stake is not only acceptability judgments, but more generally the distinction between singular and plural sentences. As mentioned above, collective predicates can appear felicitously in singular sentences with group-referring noun phrases. However, Dowty's distinction is preserved in these cases as well. For instance, the sentence *All the committees are good teams* is equivalent to its singular correlate *Every committee is a good team.* By contrast, *All the committees met in the hall* is not synonymous with *Every committee met in the hall.* The singular sentence unambiguously means that the committees held separate meetings. The plural sentence allows a situation where there was a joint meeting.[4]

In this sense, the collective predicate *be a good team* behaves like any distributive predicate. When they combine with a plural quantificational noun phrase, both kinds of predicates give rise to sentences that are indistinguishable, in acceptability or truth-conditions, from their singular correlates. For instance, *No committees are good teams* is equivalent to *No committee is a good team,* just as *No students are vegetarians* is equivalent to *No student is a vegetarian.* Similarly, **No committees are vegetarians* and **No committee is a vegetarian* are equally unacceptable—and can be assumed to be semantically equivalent—and the same relationship holds between **No students are good teams* and **No student is a good team.* The different selectional restrictions of the predicates *be* (*a*) *good team*(*s*) and *be* (*a*) *vegetarian*(*s*) are an independent factor and should not obscure their similarity in semantic number.

Thus, I propose a new typology of semantic number that classifies a predicate PRED according to its behavior in sentences like the following:

(13) a. All the/No/At least two/Many students/committees PRED
b. Every/No/More than one/Many a student/committee PRED

Assume that PRED is a predicate (verb, noun, or adjective) like *be a good team* or *be a vegetarian.*[5] If the sentences in (13a) and the corresponding sentences in (13b) are equally acceptable and, if acceptable, are furthermore semantically equivalent, then PRED is called an *atom predicate.* If

[4] The contrast between the two cases is more evident with verbs like *disperse: All the committees dispersed* can clearly be true in cases where *Every committee dispersed* is false. For instance, consider a situation where after a joint meeting of the committees, each committee went together in a different direction and held a separate meeting, but no committee dispersed.

[5] For nouns or adjectives substituted for PRED, we may need (in some languages, like English) to add a form of the *be* copula in front of the predicate in (13), and, in case it is a singular noun, an indefinite article as well.

the respective sentences in (13a) and (13b) differ in either acceptability or truth-conditions, then PRED is called a *set predicate.*

Some mixed predicates are clearly atom predicates. For instance, Dowty considers the following examples (attributing them to Bill Ladusaw):

(14) a. The students voted to accept the proposal.
b. Every student voted to accept the proposal.
c. All the students voted to accept the proposal.

The predicate *vote* leads to a collectivity effect with plural definite subjects as in sentence (14a), where the reported vote need not be unanimous. On the other hand, Dowty and Ladusaw point out that sentence (14c), with an *all* noun phrase, *is* equivalent to (14b). This characterizes *vote* as an atom predicate. With many other mixed predicates there seem to be subtle variations between speakers. For instance, Dowty identifies a collective reading in the sentence *All the students performed Hamlet;* in other words, he reads it as distinguishable from its singular correlate *Every student performed Hamlet.* This classifies the predicate *perform Hamlet* as a set predicate in Dowty's dialect. Some speakers I consulted consider the sentence to be univocally ''distributive''—equivalent to its singular correlate. This indicates that in these speakers' dialect, the predicate *perform Hamlet* should be classified as an atom predicate.

Many nominals, including *student*(*s*), *committee*(*s*), and so on, behave like atom predicates. However, relational nominals such as *brother*(*s*), *friend*(*s*), and *colleague*(*s*) behave like set predicates (compare *All the students are brothers* with **Every student is a brother*). Also, nominals that are modified by set predicate adjectives (e.g., *similar student*(*s*)) or relative clauses (e.g., *student*(*s*) *who met*) behave like set predicates.

The following lists summarize atom predicates and set predicates according to the criterion developed above:

(15) *Atom predicates*
a. sleep, smile, get up
b. be a good team, be numerous, form a pyramid, elect Clinton, constitute a majority, outnumber (both arguments), be alone
c. vote to accept the proposal, weigh 1 kg
d. (in some dialects) perform *Hamlet*, lift a piano, write a book
e. student(s), child(ren), shop(s), team(s), committee(s)

(16) *Set predicates*
a. meet, gather, disperse
b. be similar, be alike, be together
c. like each other, look at one another
d. perform *Hamlet together,* lift a piano *together,* write a book *together*
e. (in Dowty's dialect) perform *Hamlet,* lift a piano, write a book
f. colleague(s), brother(s), friend(s), similar student(s), student(s) who met

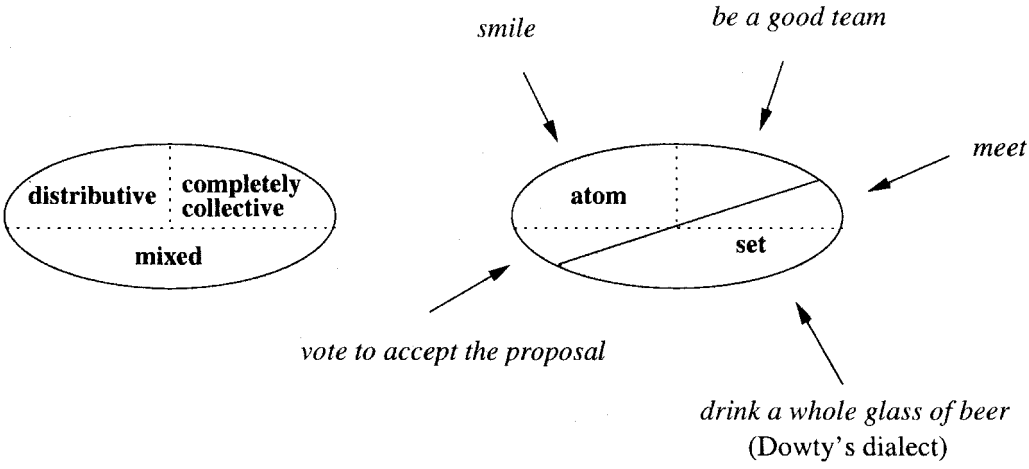

Figure 1
Typologies of predicates

This new typology of atom predicates and set predicates, and its distinction from the traditional distributive-collective-mixed typology, is graphically illustrated in figure 1.

3 The Characterization of Semantic Number

In the proposed theory, whether a sentence receives a distributive or collective interpretation depends on three factors: (a) the classification of the predicates in the sentence (nouns, verbs, and adjectives) as atom predicates or set predicates, (b) the morphological number of the predicates, and (c) the classification of the noun phrases in the sentence as quantificational or nonquantificational. Two principles determine the semantic number of predicates.

(17) *Principle 1*
When uninflected for number, atom predicates denote sets of *atomic* entities. Uninflected set predicates denote sets of *sets* of atomic entities.

(18) *Principle 2*
Number features change the semantic number of predicates so that all *singular* predicates denote sets of atoms whereas all *plural* predicates denote sets of sets.

According to Principle 1, atom predicates such as *smile, student, committee,* and *be a good team* correspond in their uninflected form to sets of atoms. These atoms represent either ''real individuals'' (students, teachers, ducks, etc.) or ''group individuals'' (committees, teams, senates, etc.), with no formal distinction between the two kinds. For instance, consider a model that includes six atomic entities: $\mathbf{m}'$, $\mathbf{j}'$, and $\mathbf{s}'$ for the students Mary, John, and Sue, and $\mathbf{c}'_A$, $\mathbf{c}'_B$, and

$\mathbf{c}'_C$ for committees A, B, and C. Typical denotations of the atom predicates that were mentioned above, when they are not inflected for number, are these:

(19) a. **student′** = $\{\mathbf{m}', \mathbf{j}', \mathbf{s}'\}$
b. **smile′** = $\{\mathbf{m}', \mathbf{j}'\}$
c. **committee′** = $\{\mathbf{c}'_A, \mathbf{c}'_B, \mathbf{c}'_C\}$
d. **be_good_team′** = $\{\mathbf{c}'_A, \mathbf{c}'_B\}$

According to Principle 2, when such atom predicates are in the singular, their denotations remain the same. For instance, we use $\mathbf{smile}'_{sg}$ to denote the meaning of singular forms of the verb *smile* (e.g., *is smiling* or *has smiled*), and we assume that this denotation is the same as the denotation **smile′** of the uninflected form of the verb. However, when they are in the plural, we standardly assume that atom predicates are mapped to sets of sets of atoms using a *distributivity operator* (see Link 1983). The standard version of this operator maps any set to the set of its nonempty subsets. For instance, the plural forms of the atom predicates *students, committees,* and *are a good team* (or *are good teams*) have the following denotations:

(20) a. $\mathbf{student}'_{pl}$ = $\{\{\mathbf{m}'\}, \{\mathbf{j}'\}, \{\mathbf{s}'\}, \{\mathbf{m}', \mathbf{j}'\}, \{\mathbf{j}', \mathbf{s}'\}, \{\mathbf{s}', \mathbf{m}'\}, \{\mathbf{m}', \mathbf{j}', \mathbf{s}'\}\}$
b. $\mathbf{committee}'_{pl}$ = $\{\{\mathbf{c}'_A\}, \{\mathbf{c}'_B\}, \{\mathbf{c}'_C\}, \{\mathbf{c}'_A, \mathbf{c}'_B\}, \{\mathbf{c}'_B, \mathbf{c}'_C\}, \{\mathbf{c}'_C, \mathbf{c}'_A\}, \{\mathbf{c}'_A, \mathbf{c}'_B, \mathbf{c}'_C\}\}$
c. $\mathbf{be\_good\_team}'_{pl}$ = $\{\{\mathbf{c}'_A\}, \{\mathbf{c}'_B\}, \{\mathbf{c}'_A, \mathbf{c}'_B\}\}$

Uninflected forms of *set predicates* such as *meet* or *sister* represent sets of *sets* of atomic entities. For instance, if the meetings in the model include one meeting of Mary, John, and Sue, one joint meeting of committees A and B, and two (separate) meetings of committees B and C, then the denotation of the predicate *meet* is the following:

(21) **meet′** = $\{\{\mathbf{m}', \mathbf{j}', \mathbf{s}'\}, \{\mathbf{c}'_A, \mathbf{c}'_B\}, \{\mathbf{c}'_B\}, \{\mathbf{c}'_C\}\}$

Similarly, if Mary and Sue are the only two sisters in the model, then the predicate **sister′** is a set that contains this one set: $\{\{\mathbf{m}', \mathbf{s}'\}\}$.[6] According to Principle 2, set predicates in the plural form (e.g., *sisters* or *are meeting*) adopt the denotation of their uninflected representation and therefore range over sets. However, in the singular their denotation ranges over atoms. This denotation is derived by taking only the singletons (sets with one element) from the denotation of the uninflected predicate. For instance, in the given model the singular verbal predicate *is meeting* denotes the set $\mathbf{meet}'_{sg} = \{\mathbf{c}'_B, \mathbf{c}'_C\}$, which includes only the atomic elements in the denotation **meet′** of the uninflected predicate.

Principles 1 and 2 allow us to explain the difference in sensitivity to morphological number between atom predicates and set predicates. In the singular the analysis of sentences with quantifi-

[6] Interestingly, nominal set predicates, unlike verbal set predicates, do not allow "group-referring" nouns in their extension. Thus, the sentence **This committee is a sister* is unacceptable even if the committee happens to consist of the sisters Mary and Sue. This contrasts with the acceptability of sentences like *This committee meets* (*on Tuesday*). Set predicate adjectives also seem to resist the singular number (e.g., **This committee is similar*). I know of no explanation for this systematic difference between nouns and verbs, which may have implications that go beyond the scope of the present article.

cational noun phrases is the standard analysis of generalized quantifier theory. In this theory (Barwise and Cooper 1981, Keenan and Westerstahl 1996) natural language determiners are treated as relations between sets of atoms. For instance, the determiner *every* denotes the subset relation between the noun and the verb phrase, so that a sentence such as *Every student smiled* is analyzed as follows:

(22) $\mathbf{every}'(\mathbf{student}'_{sg}, \mathbf{smile}'_{sg})$
$\Leftrightarrow \mathbf{student}'_{sg} \subseteq \mathbf{smile}'_{sg}$
$\Leftrightarrow \mathbf{student}' \subseteq \mathbf{smile}'$

In words: the set of students is a subset of the set of smilers.

Similarly, the sentences in (23) are analyzed as in (24a–d).

(23) Every committee/student met/is a good team.

(24) a. $\mathbf{committee}'_{sg} \subseteq \mathbf{meet}'_{sg}$
b. $\mathbf{committee}'_{sg} \subseteq \mathbf{be\_good\_team}'_{sg}$
c. $\mathbf{student}'_{sg} \subseteq \mathbf{meet}'_{sg}$
d. $\mathbf{student}'_{sg} \subseteq \mathbf{be\_good\_team}'_{sg}$

The analyses in (24a) and (24b) express acceptable statements, whereas the analyses in (24c) and (24d) express statements that are infelicitous because of selectional restrictions. As stated above, this contrast is independent of the distinction between atom and set predicates.

In the plural the difference between the denotations of the two classes of predicates manifests itself. Consider for instance the contrast in (9), repeated here.

(25) a. All the students are meeting in the hall.
b. *All the students are a good team.

According to Principle 2, since both the noun and the verb phrase in these examples are in the plural, they denote sets of sets of atoms. In the proposed theory plural *all* is treated as synonymous with *every*. This leads to a type mismatch between the denotation of the noun, which ranges over sets, and the denotation of the determiner, which ranges over atoms. As in previous works, notably Scha 1981 and Van der Does 1993, this mismatch is resolved by a special operator that maps determiners that range over atoms to determiners that range over sets.[7] The operator we employ is defined as follows:

(26) Let D be a relation between sets of elements in a domain E of *atoms*. The operator *dfit* (determiner fitting) maps D to a relation $dfit(D)$ between sets of sets of atoms in $\wp(E)$ (the power set of E), which is defined as follows: for any two sets $\mathcal{A}, \mathcal{B} \subseteq \wp(E)$, the relation $(dfit(D))(\mathcal{A}, \mathcal{B})$ holds iff the relation $D(\cup\mathcal{A}, \cup(\mathcal{A} \cap \mathcal{B}))$ holds.

[7] Whether this mapping from the denotation of *every* to the denotation of *all* is obtained by lexical means or by compositional means is irrelevant for present purposes.

In words, this definition means that the relation *dfit*(D) holds between two sets of sets $\mathcal{A}$, $\mathcal{B} \subseteq \wp(E)$ if and only if the relation D holds between the union of the sets in $\mathcal{A}$ and the union of the sets that are both in $\mathcal{A}$ and in $\mathcal{B}$.

For example, the sentences in (25) are analyzed as follows, where *dfit*(**every′**) is synonymous with *all*:[8]

(27) a. (*dfit*(**every′**))(**student′**$_{pl}$, **meet′**$_{pl}$)
b. (*dfit*(**every′**))(**student′**$_{pl}$, **be_good_team′**$_{pl}$)

By definition of the *dfit* operator and of the denotations of the plural predicates *students, are meeting,* and *are a good team,* these analyses of the sentences in (25) can be paraphrased as follows, respectively:

(28) a. Every student participated in a set of students that met.
b. *Every student participated in a set of students that each of its members is a good team.

While the paraphrase (28a) is completely coherent, the paraphrase (28b) is equivalent to the unacceptable sentence **Every student is a good team,* hence the unacceptability of (25a).[9]

More generally, the difference that is illustrated in (25) between plural atom predicates and plural set predicates is captured because the denotation of set predicates is *inherently* a set of sets, whereas the set of sets denotation of plural atom predicates is only *derived* from the denotation of their uninflected form (using a distributivity operator). The *dfit* operator is provably sensitive to this difference between set predicates such as *meet,* which are ''inherently plural,'' and atom predicates such as *be a good team* or *sleep,* whose plural forms' denotations are only derived.[10]

4 Quantificational versus Nonquantificational Noun Phrases

So far we have concentrated on the contrast between atom predicates and set predicates in singular and plural. However, these contrasts appear only with noun phrases that are headed by determiners such as *all, no, many, exactly five.* For many other noun phrases the contrast between atom predicates and set predicates vanishes. Consider our prototypical examples *meet* and *be a good team* in the following sentences, as opposed to the sentences in (11):

[8] In a similar way, the *dfit* operator makes a relation between the denotations of other plural determiners like *no* and *many* and the denotations of their singular correlates *no* and *many a.* For an analysis of more complex cases like this one, see Winter 2001.

[9] It should be remarked that (28a) is perhaps not a completely adequate paraphrase of (25a). More reasonably, the exact statement that (28a) makes is ''There was a meeting of students in which every student took part.'' An additional general *witness strategy* that is needed to get this interpretation is proposed in Winter 2001. The details of this proposal go beyond the scope of the present article.

[10] Formally: the plural meaning (*dfit*(D))($\mathbf{A}_{pl}$,$\mathbf{B}_{pl}$) is equivalent to its singular correlate $D(\mathbf{A}_{sg},\mathbf{B}_{sg})$ for any conservative determiner D and any atom predicates **A** and **B**. This is not necessarily the case when **A** or **B** is a set predicate.

(29) { The students / Some students I know / Five students I know / Mary and John / A/Some student and a/some teacher I know / The student(s) and the teacher(s) } { met / are a good team } .

A noun phrase like *the students* is standardly taken to refer to a set of individuals (e.g., students). Consequently, it is not surprising that a set predicate such as *meet* is consistent with such predicates: a sentence such as *The students met* is naturally interpreted as claiming that the set of students is among the sets that had a meeting. However, the fact that an atom predicate like *be a good team* is also consistent with a subject that refers to a set of atoms is not expected according to Principles 1 and 2.

In general, Dowty and others have pointed out that many atom predicates, and not only collective atom predicates such as *be a good team,* do not give rise to full distributivity effects with plural noun phrases such as *the students.* Consider for instance the distributive predicates *ask questions* and *get up* in Dowty's examples (6) and (7) or the mixed predicate *vote to accept the proposal* in (14a). In these cases a plural definite *the Ns* is not interpreted as synonymous with *all the Ns.* Similar points hold with respect to the other noun phrases in (29), including even conjunctive NPs such as *Mary and John* (see footnote 2).

It is often assumed that the noun phrases in (29) have a ''referential'' interpretation. Roughly speaking, this means that unlike the ''quantificational" noun phrases in (11), they refer directly to an individual and not to a generalized quantifier over individuals.[11] Notably, this assumption about ''referentiality'' of the noun phrases in (29) is commonly adopted also for the indefinite noun phrases in these examples. In many recent works (e.g., Reinhart 1997, Winter 1997, Kratzer 1998) such indefinites are treated using *choice functions,* which let an indefinite denote a particular individual. The distinction between quantificational and nonquantificational (''referential'') noun phrases can be used to account for the contrast observed between (11) and (29). Let us adopt the following principle:

(30) *Principle 3*
When a noun phrase refers to a set (plural entity), this denotation can be freely mapped to an atom that corresponds to this set.

A similar principle is assumed by many previous works on the semantics of plurals (see Link 1984, and for more extensive discussion Landman 1989, 1996, 2000). To see how this principle works, consider for instance the ''referential'' noun phrase *the students* in (29). Assume that the students under discussion constitute the basketball team of their school. According to Landman's and Link's proposal, the set that corresponds to the noun phrase *the students* can be mapped in

[11] Technically, it is sometimes assumed that ''referential'' noun phrases also refer to generalized quantifiers, but of a special kind. This is irrelevant for present purposes; but see Winter 2001 for arguments in favor of treating all noun phrases uniformly as generalized quantifiers.

the semantic analysis to the *atom* denoting the noun phrase *the school's basketball team.* Using this mapping, the sentence *The students are a good team* is interpreted as equivalent to the sentence *The school's basketball team is a good team.* The latter sentence is of course perfectly acceptable; hence, the acceptability of the former sentence is also expected. By contrast, consider the unacceptable sentence **All the students are a good team* from (9). In this case we have a quantificational noun phrase, which cannot be mapped to an atom. Therefore, everything said in the preceding section about the analysis of this sentence's unacceptability is still valid: because the predicate is atomic, the sentence is still analyzed as equivalent to the unacceptable sentence **Every student is a good team.*

Following Landman, the mapping from sets to atoms is assumed here as a general mechanism that is also responsible for lack of ''full distributivity'' as in Dowty's examples (6), (7), and (14a). For instance, sentence (6) can be interpreted with a meaning similar to that of *The group of reporters asked questions.* Of course, this interpretation does not entail that every reporter asked questions.

The mapping from sets to atoms makes another welcome prediction concerning the difference between noun phrases with *all* and simple plural definites. Consider the following examples:

(31) a. The members of the organizing committee met.
b. All the members of the organizing committee met.

(32) The organizing committee met.

Sentence (31a), but not sentence (31b), is entailed by sentence (32). This is so because it is impossible to imagine a situation where a committee meets but its members do not meet, though this does not mean that *all* of the committee members have to meet in order for (32) to be true. Thanks to Principle 3, this contrast between (31a) and (31b) is explained. The former sentence, but not the latter, has a reading equivalent to (32). Under this reading the denotation of the definite *the members of the organizing committee* is mapped to a ''group atom'' representing the committee itself. Such a process is impossible in (31b), where the only way to achieve collectivity is to use the *dfit* operator, which requires every committee member in (31b) to participate in the meeting.

There is of course much to be said about the distinction between quantificational noun phrases and nonquantificational noun phrases. In Winter 2000, 2001:chap. 4, it is proposed that this distinction corresponds (at least partly) to syntactic distinctions between determiner phrases.

5 Conclusions

The main claim of this article is that the proposed distinction between *atom predicates* and *set predicates* is helpful for the analysis of quantificational constructions with plurals. This new typology has intricate relations with the effects of morphological number on semantic interpretation and with the quantificational/nonquantificational distinction between noun phrases. Of course, much further research is needed into the semantic facts that underlie the atom/set distinction. I believe that such a line of research will not only contribute to the study of plurals, but can also lead to a better understanding of the interplay between different modules of grammar such as lexical semantics, morphology, and the syntax-semantics interface.

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