Atoms and Sets:
A Characterization of Semantic Number

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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) { a. All the students / b. *Every/each student / c. The students } { met/gathered/lived together in this room / are (is) similar }.

The *all* noun phrase in (1a) allows an intelligible interpretation to the sentence, similarly to the simple plural definite *the students* in (1c). 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 (1986) points out that the pattern that is observed in (1) does not hold for all predicates that are traditionally classified as "collective". Consider for instance the following examples by Dowty, 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 }.

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

The distinction that Dowty draws between collective predicates is motivated by their different behavior with *all*. In this paper it is shown that Dowty's observation concerning *all* points to a general difference between predicates that can be observed with many other quantificational NPs. For instance, plural NPs with the determiner *no* give rise to acceptable statements when they combine with the collective predicates in (1), unlike singular NPs with *no*. However, both plural and singular *no* lead to unacceptable sentences when they appear together with the predicates in (2). This is shown by the following sentences.

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

(4) $\left\{ \begin{array}{ll} \text{a.} & \text{*No students} \\ \text{b.} & \text{*No student} \end{array} \right\}$ are (is) $\left\{ \begin{array}{l} \text{numerous} \\ \text{a good team} \end{array} \right\}$.

The examples above illustrate three mutually dependent phenomena that the theory of plurals has to explain: (i) Dowty's contrast between collective predicates; (ii) the effects of morphological number on interpretation (cf. *every* and singular *no* vs. *all* and plural *no*); and (iii) the contrast between "quantificational" NPs (e.g. *all the students*) and "non-quantificational" NPs (e.g. *the students*).

This paper 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.

Two additional simple assumptions account for generalizations (ii) and (iii):

- 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 non-quantificational 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 relationships with morphological number.

2 Atom predicates vs. set predicates

In the literature on plurality, it is customary to distinguish between *distributive, collective* and *mixed* predicates. It is assumed that distributive predicates refer to properties of "singular individuals" while collective predicate 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, and mean either that the people ate some pizzas separately or that they ate one pizza together.

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

(5) Mary and John/the children $\left\{ \begin{array}{ll} \text{a.} & \text{smiled} \\ \text{b.} & \text{met} \\ \text{c.} & \text{ate a pizza} \end{array} \right\}$.

Despite its intuitive appeal, it is hard to find a robust linguistic test that substantiates this distinction between predicates. One difficulty is exemplified by the following examples from Dowty (1986).

(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, whereas 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]

Another difficulty is 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*, also "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 to define a pre-theoretical test for "group referring" nouns (cf. 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 judgements of entailment between sentences. I therefore hypothesize that this traditional distinction has no direct implications for model-theoretical 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 by model-theoretic distinctions between predicates and arguments.

However, Dowty's 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.

[2] As claimed in Landman (1996,1997), similar effects may occur with conjunctive NPs too, when the conjoined description are known to be a team. For instance, Landman's (p.c.) 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 the Central Park.

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 NPs, whereas *be a good team* leads to unacceptable sentences with such NPs:[3]

(11) $\left\{\begin{array}{l}\text{no}\\ \text{at least two}\\ \text{many}\\ \text{few}\\ \text{exactly four}\\ \text{between four and ten}\\ \text{more/less than eleven}\\ \text{most of the/?most}\end{array}\right\}$ students $\left\{\begin{array}{l}\text{a. met}\\ \text{b. } * \text{ are a good team}\end{array}\right\}$

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 following sentences, which exhibit unacceptabilities that are similar to the unacceptabilities that are exhibited by their plural correlates in (11b).

(12) *No/*more than one/*many a student is a good team.

Note that the matter at stake is not only acceptability judgements, but more generally – the distinction between singular and plural sentences. As mentioned above, collective predicates can appear felicitously in singular sentences with "group referring" NPs. However, Dowty's distinction is preserved also in these cases. For instance, the sentence *all the committees are good teams* is equivalent to its singular correlate *every committee is a good team*. By contrast, the sentence *all the committees met in the hall* is not synonymous with *every committee met in the hall*. The singular sentence unambiguously means that there were separate meetings of the committees. 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 a "distributive" predicate: both kinds of predicates give rise to plural sentences with quantificational NPs which are indistinguishable (in acceptability or truth-conditions) from their singular correlates. For instance, the sentence *no students have blue eyes* is semantically equivalent with *no student has blue eyes*; similarly, the sentences **no committees have*

[3]Under a generic reading, some quantificational NPs 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 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 paper.

[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 another direction and held a separate meeting, but no committee dispersed.

blue eyes and **no committee has blue eyes* are equally unacceptable and can be assumed to be semantically equivalent.

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 *have blue eyes*.[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 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 seems to be some subtle variations between speakers. For instance, Dowty identifies a collective reading in the sentence *all the students played Hamlet*, which means that he reads it as distinguishable from its singular correlate *every student played Hamlet*. This classifies the predicate *play Hamlet* as a set predicate in Dowty's dialect. Some speakers that I consulted consider the sentence to be univocally "distributive" – equivalent to its singular correlate. This indicates that in these speakers' dialect, the predicate *play Hamlet* should be classified as an atom predicate.

Many nominals, including *student*(*s*), *committee*(*s*) etc. behave like atom predicates. However, relational nominals such as *brother*(*s*), *friend*(*s*), *colleague*(*s*) etc. behave like set predicates (cf. *all the students are brothers* vs. **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 list gives a summary of atom predicates and set predicates according to the criterion that was 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 1kg

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

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

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.

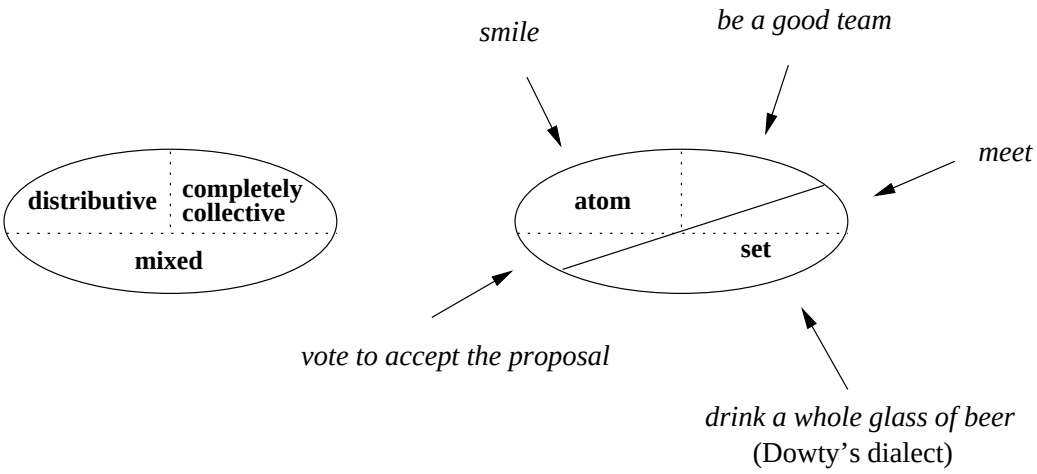

Figure 1: typologies of predicates

3 The characterization of semantic number

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

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

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 the following.

$$\begin{array}{lcllcl} \mathbf{student}' & = & \{\mathbf{m}', \mathbf{j}', \mathbf{s}'\} & \mathbf{smile}' & = & \{\mathbf{m}', \mathbf{j}'\} \\ \mathbf{committee}' & = & \{\mathbf{c}'_A, \mathbf{c}'_B, \mathbf{c}'_C\} & \mathbf{be\_good\_team}' & = & \{\mathbf{c}'_A, \mathbf{c}'_B\} \end{array}$$

According to principle 2, when such atom predicates are in the singular their denotations remain the same. However, in the plural, we standardly assume that they are mapped to sets of sets of atoms using a *distributivity operator* (cf. Link (1983)). The standard version of this operator maps any set to the set of its non-empty 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:

$$\begin{array}{lcl} \mathbf{student}'_{pl} & = & \{\{\mathbf{m}'\}, \{\mathbf{j}'\}, \{\mathbf{s}'\}, \{\mathbf{m}', \mathbf{j}'\}, \{\mathbf{j}', \mathbf{s}'\}, \{\mathbf{s}', \mathbf{m}'\}, \{\mathbf{m}', \mathbf{j}', \mathbf{s}'\}\} \\ \mathbf{committee}'_{pl} & = & \{\{\mathbf{c}'_A\}, \{\mathbf{c}'_B\}, \{\mathbf{c}'_C\}, \{\mathbf{c}'_A, \mathbf{c}'_B\}, \{\mathbf{c}'_B, \mathbf{c}'_C\}, \{\mathbf{c}'_C, \mathbf{c}'_A\}, \{\mathbf{c}'_A, \mathbf{c}'_B, \mathbf{c}'_C\}\} \\ \mathbf{be\_good\_team}'_{pl} & = & \{\{\mathbf{c}'_A\}, \{\mathbf{c}'_B\}, \{\mathbf{c}'_A, \mathbf{c}'_B\}\} \end{array}$$

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:

$$\mathbf{meet}' = \{\{\mathbf{m}', \mathbf{j}', \mathbf{s}'\}, \{\mathbf{c}'_A, \mathbf{c}'_B\}, \{\mathbf{c}'_B\}, \{\mathbf{c}'_C\}\}$$

Similarly, if Mary and Sue are the only two sisters in the model then the predicate $\mathbf{sister}'$ 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 $\mathbf{meet}'$ 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 sen-

[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).* Also set predicate adjectives seem to resist the singular number (cf. *this committee is similar*). I do not know any explanation of this systematic difference between nouns and verbs, which may have implications that go beyond the scope of the present article.

tences with quantificational NPs is the standard analysis of generalized quantifier theory. Recall that in this theory (Barwise and Cooper (1981), Keenan and Westerståhl (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.

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

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

The sentences in (18) similarly get the analyses in (19a-d).

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

(19) 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 (19a) and (19b) express acceptable statements, whereas the analyses in (19c) and (19d) express statements that are infelicitous due to selectional restrictions. As said above, this contrast is independent of the distinction between atom and set predicates.

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

(20) 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.

(21) 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 $\mathit{dfit}(D)$ between sets of sets of atoms in $\wp(E)$ (the power set of E), which is defined as follows: for any two sets $\mathcal{A}, \mathcal{B} \in \wp(E)$, the relation $(\mathit{dfit}(D))(\mathcal{A}, \mathcal{B})$ holds iff the relation $D(\cup\mathcal{A}, \cup(\mathcal{A} \cap \mathcal{B})$ holds.

In words, this definition means that the relation $\mathit{dfit}(D)$ holds between two sets of sets $\mathcal{A}, \mathcal{B} \in \wp(E)$ 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 $\mathcal{B}$.

[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 our present purposes.

For example, the sentences in (20) are analyzed as follows, where $dfit(\mathbf{every}')$ is synonymous with *all*.[8]

(22) a. $(dfit(\mathbf{every}'))(\mathbf{student}'_{pl}, \mathbf{meet}'_{pl})$

b. $(dfit(\mathbf{every}'))(\mathbf{student}'_{pl}, \mathbf{be\_good\_team}'_{pl})$

By definition of the *dfit* operator and of the denotations of the plural predicates *students*, *are meeting* and *are a good team*, we observe that these analyses of the sentences in (20) can be paraphrased as follows, respectively:

(23) 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 (23a) is completely coherent, the paraphrase in (23b) is equivalent to the unacceptable sentence **every student is a good team*, hence the unacceptability of (20a).[9]

More generally, the difference that is illustrated in (20) 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 vs. non-quantificational NPs

So far, we have concentrated on the contrast between atom predicates and set predicates in singular and plural. However, these contrasts appear only with NPs that are headed by determiners such as *all, no, many, exactly five* etc. For many other NPs, 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).

(24) $\left\{ \begin{array}{l} \text{the students} \\ \text{some students I know} \\ \text{five students I know} \\ \text{Mary and John} \\ \text{a/some student and a/some teacher I know} \\ \text{the student(s) and the teacher(s)} \end{array} \right\} \left\{ \begin{array}{l} \text{met} \\ \text{are a good team} \end{array} \right\}$

[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 such more complex cases see Winter (2001).

[9] It should be remarked that (23a) is perhaps not a completely adequate paraphrase of (20a). More reasonably, the exact statement that (23a) 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 paper.

[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 predicate $\mathbf{B}$. This is not necessarily the case when $\mathbf{B}$ is a set predicate.

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 by principles 1 and 2 above.

In general, Dowty and others 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* or *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 NPs in (24), including even conjunctive NPs such as *Mary and John* (see footnote 2).

It is often assumed that the noun phrases in (24) have a "referential" interpretation. Roughly speaking, this means that unlike the "quantificational" NPs in (11), they refer directly to an individual and not to a generalized quantifier over individuals.[11] Notably, this assumption about "referentiality" of the NPs in (24) is commonly adopted also for the indefinite NPs 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 non-quantificational ("referential") NPs can be used to account for the contrast we observe between (11) and (24). Let us adopt the following principle.

Principle 3 *When an NP 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 (cf. Link (1984), and more extensively Landman (1989,1996,1997)). To see how this principle works, consider for instance the "referential" noun phrase *the students* in (24). Assume that the students under discussion constitute the basketball team of their school. According to the Landman/Link proposal, the set that corresponds to the noun phrase *the students* can be mapped in 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*. This last sentence is of course perfectly acceptable, and hence also the acceptability of the former sentence is expected. By contrast, consider now the unacceptable sentence *all the students are a good team* from (11). In this case we have a quantificational NP, which cannot be mapped to an atom. Therefore, all we have said in the preceding section about the analysis of this sentence's unacceptability is still valid: due to the atomic status of the predicate, 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 ex-

[11] Technically, it is sometimes assumed that also "referential" NPs refer to generalized quantifiers, but of a special kind. This is irrelevant for our aims in this paper, but see Winter (2001) for arguments in favor of the uniform treatments of all NPs as generalized quantifiers.

amples (6), (7) and (14a). In (6), for instance, the sentence can be interpreted with a meaning similar to *the group of reporters asked questions*. Of course, this interpretation does not entail that every reporter asked questions.

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

(25) a. The members of the organizing committee met.

b. All the members of the organizing committee met.

(26) The organizing committee met.

Sentence (25a), but not sentence (25b), is entailed by sentence (26). This is so since it is quite 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 (26) to be true. Thanks to principle 3, this contrast between (25a) and (25b) is explained. The former sentence, but not the latter, has a reading that is equivalent to (26). 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 (25b) where the only way to achieve collectivity is using the *dfit* operator, which requires every committee member in (25b) to participate in the meeting.

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

5 Conclusions

The main claim of this paper 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/non-quantificational distinction between NPs. Of course, much further research is needed into the semantic facts that underly the atom/set distinction. I believe that such a line of research could not only contribute to the study of plurals, but 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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