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A Study on NP Classification

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0. Introduction

Roberts (1987) classifies NPs into individual denoting and quantificational NPs. Individual denoting NPs, in her system, include proper names, pronouns and those NPs with determiners listed under "individual denoting" in table (1). These NPs are translated merely as variables[1], without introducing any quantifiers in a Discourse Representation System (henceforth, DRS). Quantificational NPs,"whose determiner sets up a relationship between the denotation of the CN and that of the predicate of which the NP is subject (Roberts 1987, p191)", are NPs with quantificational determiners listed in table (1).

(1) Classification of Determiners (Roberts 1987, 197)

Individual denoting	quantificational
a	each
$some_{sg/pl}$	every
1, 2, 3, ...	$no_{sg/pl}$
$the_{sg/pl}$	most
this, that	few
these, those	many
	both
	neither

Kamp and Reyle (1993) classify NPs into definite and indefinite NPs. Indefinite NPs are further classified into quantificational and non-quantificational. In their system, definite NPs and indefinite non-quantificational NPs are treated

1. These variables are to be bound by the existential quantifier provided by Existential Closure, suggested in Heim(1982) and Kamp(1981). Cf. the Chapter 1 of Heim (1982) for the detail o Existential Closure.

just like individual-denoting NPs, and indefinite quantificational NPs are treated like quantificational NPs in Roberts system. Kamp and Reyle's classification of determiners is shown in table (2).

(2) Classification of Determiners (Kamp and Reyle 1993, p.311)

	Num=plur	Num=sing
Quant=+	most, many, few, no, all, at least two, at most two, exactly two, ...	every
Quant=-	some, several, two, 0 (zero det)	a
Definite	the, ...	the, ...

The purpose of this study is (1) to show that their classifications are not based on reliable criteria[2], and (2) to provide a new system of NP classification which can explain the empirical data which cannot be explained properly under their classification systems. To achieve the goals, I will examine whether or not it is reasonable to classify NPs into quantificational and non-quantificational by carefully examining the criteria applied by Roberts to classify NPs in section 1. In section 2, I will show that the classification system of Roberts' cannot explain the empirical data concerning the mode of predication to provide further evidence against Roberts' classification. She argues that a quantificational NP is translated into a quantifier and an individual type variable. Then, the acceptability of sentences in (3) is problematic since a collective predicate such as *agree-on-this-issue* requires a non-individual type argument.[3]

2. I will mainly examine the NP classification of Roberts(1987) rather than that of Kamp and Reyle (1993) simply since Roberts explicitly provides the criteria on NP classification while Kamp and Reyle do not.

3. A conjoined NP *John and Bill* is regarded as denoting a third individual which has the individulas (or atomic individuals) denoted by *John* and *Bill* as its parts. This kind of individual is called non-atomic (or i-sum) individual. A non-individual type variable is assigned an i-sum by a value assignment function. This idea that a conjoined NP denotes a new type of individual was first introduced in linguistic analysis by Masswy(1976). For more information on i-sum, confer to Link (1983) and Landman(1989).

(3) a. Many people agree on this issue.
b. Few people agree on this issue.

In section 3, I will introduce a new NP classification system adopting the idea of sub-entailment originally proposed by Dowty (1986). Section 4 will be the conclusion of this study.

1. Criteria on NP Classification in Roberts' System

The rule of thumb in Roberts(1987) to classify NPs into individual-denoting and quantificational is whether they have a group reading or not. She provides a set of tests for the group reading of an NP. I will evaluate them one by one in order to examine if they are rigid enough as classificatory criteria.

The first test of hers is that quantificational NPs cannot be an antecedent of discourse anaphora while individual denoting NPs can as in (4).

(4) a. [Every student]$_i$ came in. *He$_i$ sat down on a coach.
b. [Some students]$_i$ came in. They$_i$ sat down on a coach.

But this test is misleading because a quantificational NP can be an antecedent of a discourse pronoun *they* as in (5)[4]. Note that pronoun *they* but not *he* can be used in this situation.

(5) a. [Every student]$_i$ came in. They$_i$ sat down on a coach.
b. [Most students]$_i$ came in. They$_i$ sat down on a coach.
c. [Many students]$_i$ came in. They$_i$ sat down on a coach.
d. [Few students]$_i$ came in. They$_i$ sat down on a coach.

The second test is that only an individual-denoting NP contributes a sloppy reading as well as a nonsloppy one (strict reading) in "sloppy identity construction." Sentence (6) has at least two readings: (i) an i-sum individual

4. Kamp and Reyle(1993) who adopts Root(1986) maintain that a pragmatic accommodation called abstraction provide a discourse referent (or a variable) which can be an antecedent of the pronoun *they* in the subsequent sentence. I will not deal with their approach here.

consisting of three individuals who are Mary, Susan and Kathy (m+s+k) love a woman who is (m+s+k)'s mother and Bill loves his own mother(non-sloppy reading); (ii) m+s+k love (m+s+k)'s mother and Bill also loves (m+s+k)'s mothe (sloppy reading). However, sentence(7) is not ambiguous--it has only a sloppy reading.

(6) Mary, Susan and Kathy love their mother, and Bob does too.
(i) love-(m+s+k)'s-mother(m+s+k) and love-(m+s+k)'s-mother(b)
(ii) love-(m+s+k)'s-mother(m+s+k) and love-b's-mother(b)

(7) Every student loves his mother and Bill does, too.
(i) Every x [student(x) --> love-x's-mother(x)] and love-b's-mother(b)

This test is also dubious as a criterion to distinguish a quantificational NP from an individual-denoting one in the following reason. Roberts herself admits that even in a sentence where an indefinite-denoting NP is the subject of the first sentence of a sloppy construction, the non-sloppy reading is hard to get. According to her, when the determiner *some* is stressed, the non-sloppy reading is hard to get from (8a). She also confesses that it is harder to get the non-sloppy reading from (8b) than from (8a). Note that *some* and *four* are individual-denoting.

(8) a. Some girls like their teachers, and Bernie does too.
b. Four girls like their teachers, and Bernie does too.

The third test is whether or not an NP can occur felicitously as the subject of a predicate with a floated quantifier. According to her, only an individual denoting NP can be followed by such quantifiers. This test classifies *most*, *many*, and *few* into quantificational and *the* into individual denoting.

(9) a. The students all left.
b. #Few students all left.
c. #Many students all left.
d. #Most students all left.

However, this test is simply inappropriate as a criterion for classifying NPs into quantificational or individual denoting. This test is, rather, for whether or not an

NP is definite according to Dowty (1986, p110). If Roberts is correct, sentence (10) must be judged acceptable since some students is an individual denoting NP.

(10) *Some students all left.

The fourth criterion is that when one of the conjunct is a quantificational NP, the whole conjoined NP contributes only a distributive reading. Sentence (11a) has only a distributive reading while (11b) can have a distributive as well as a collective reading (Roberts 1987, p199).

(11) a. Both apartments and most of the mobile homes have a fire extinguisher in the kitchen.
b. Two movers and some neighbors carried the piano into the house.

Here, pragmatic information plays a role in determining the acceptability of a sentence[5]. In other words, it is not an absolute one. There are some cases in which a sentence whose subject NP contains a quantificational NP can have a collective reading. Moreover, sentences (12a) and (12b) read only collectively.

(12) a. John and many students lifted a piano, together.
b. John and most of his roommates played football, together.

The fifth test provided by Roberts is based on her assertion that the prepositions *among* and *between* take (only) a group denoting NP(group denoting NPs are a subset of individual denoting NPs). If an NP can be complent of these prepositions, it is individual denoting. If not, it is quantificational.

(13) a. Ellen found a thristle among some roses.
b. #Ellen found a thristle among few roses.
c. Jonathan found a poem stuck between (the) pages of logical formulae.
d. #Jonathan found a poem between both pages of logical formulae.

5. As for the interface of pragmatics with other modules of language, I follow the modular account which tries to keep the modules of language as autonomous as possible. The idea of this account is well expressed in Green(1981, p31): "... keep the pragmatics strictly out of the syntax.... Thus syntactic forms would be generated freely, according to the syntactic rules of language, without regard to their possible uses." The same thing can be said about the interface between pragmatics and semantics.

This test is not exclusive, either. Root(1986) reports that NPs with stressed *some* or numerals are not accepted as a complement of *among* as in (14). According to her fifth criterion, (14) must be judged acceptable.

(14) *among many (every, most, SOME, five) ducks

To recapitulate the above discussion, Roberts' criteria for classifying NPs into quantificational or individual denoting are not reliable. Without reliable criteria, it is impossible to classify NPs into one of the two categories.

2. Quantificational NPs Followed by Collective Predicates

Roberts(1987) as well as Kamp and Reyle(1993) maintains that a singular individual denoting NP is translated into an individual variable which is to be linked to an atomic individual in a model while a plural individual denoting NP is translated into a non-individual variable which is to be linked to a non-atomic (or i-sum) individual in a model. A quantificational NP is translated into a quantifier-individual variable schema. Then, since a collective predicate requires a non-atomic individual as its argument, the (un)acceptability of sentences (15), (16) and (17) can be properly explained. But the acceptability of sentence (18) is problematic (notice that the NP *most* (*many, few all*) *students* is quantificational in her system).

(15) *A student gathered in the hall.
(16) *Every student gathered in the hall.
(17) Some (several, five) students gathered in the hall.
(18) Most (many, few) students gathered in the hall.

Roberts tries to solve this problem by stipulating that such quantifiers as most, many, and few are ambiguous in that they quantify over atomic individuals which are members of the property denoted by the head common noun or over i-sum individuals generated by the property denoted by the head common noun ("plural quantification"). According to her, in sentence (18), these quantifiers quantify over i-sum individuals and the collective predicate gathered in the hall takes these i-sums as its argument. In other words, sentence (18) is translated into (19). Assume the connective @ is appropriately defined[6].

(19) Most X [students(X) @ gathered-in-the-hall (X)]

However, formula (19) does not capture the reading of sentence (18) since (19) represents the reading that for most groups of students X, X gathered in the hall. In following sub-sections, I will examine how Roberts modifies the notion "plural quantification" to properly deal with sentence (18). Then, I will point out some probems of her approach.

2.1. Plural Quantification

Link(1987) claims that there is a phenomenon where the quantification ranges over i-sums rather than atomic individuals in the denotation of a common noun. In sentence (20), the determiner all quantifies over groups (or i-sums) of companies which are competing with each other but not over individual companies. Sentence (20) is true iff every i-sum consisting of at least two companies which are competing with each other has common interests. (21) is the logical form of (20).

(20) All competing companies have common interests.
(21) ∀x[comanies(x) & |x|≥ 2 & competing (x) --> x has common interests]

Sometimes, the cardinality of i-sums, which a quantifier quantifies over, is explicitly expressed as in (22). *Any* in (22) quantifies over i-sums whose cardinality is 11.

(22) Any 11 students can make a soccer team.

Sometimes, the cardinality information is contextually provided. Sentence (23) means that "between many pairs of adjacent houses, there was a fence (Roberts 1987, p190)." That is, the determiner *many* quantifies over pairs of houses.

(23) Between many houses, there stood a picket fence.

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6. As in the generalized quantifier theory, a determiner quantifier can be regarded as a relation which takes two properties denoted by the head noun (CN) and the VP of a sentence. This position is taken by Roberts(1987) as well as by Kamp and Reyle(1993).

2.2. Restricted Plural Quantification

If quantifiers such as *most, many* and *few* range over i-sums, the accepatability of sentence (24) seems no longer problematic to Roberts' approach of quantification since the collective predicate *agree on this issue* predicates of an i-sum individual. Sentence (24) is translated into (25).

(24) Few people agree (with each other) on this issue.
(25) FEW x [people(x) & |x|≥ 2 @ agree-on-this-issue (x)]

As mentioned above, (25) does not represent the reading of sentence (24) since (25) is true iff the number of the i-sums of persons whose i-parts agree on this issue is few. But sentence (24) is about the cardinality of an i-sum of people who agree on the issue. Roberts' approach augmented with plural quantification is still inappropriate to solve the problem concerning sentence (24).

Roberts, aware of the problems of the plural quantificational approach to sentence (24), argues that "what seems to be at issue is the ardinality of the maximal collection of people who agree on the issue." To support this intuition, she introduces a new notion of "restricted plural quantification." Consider the following quotation from Roberts.

> ..., consider a situation in which there are twenty people and some burning political issue. Suppose that two of them agree on one potential solution to the problem, while three others agree on a different solution, and none of the others agrees with anyone on any solution. I think the relevant question is 'what's the largest number of people who agree?' .... One way to represent this intuition might be via a logical form such as (128):
>
> (128) FEW (σx[∃y(*person(y) & agree (y) & x=|y|)
> & ∀z(*person(z) & agree(z) --> x≥|z|)])
>
> where |y|means 'the number of atomic i-parts of y,' and *agree* (y) means that all i-parts of y agree in the same way. (128) means that the cardinality of the largest i-sum of people who agree in the same way is FEW. Though (128) does involve plural quantification, it is over a restricted type of i-sum, those which are a group of

people who agree in the same way, and not all i-sums which are in the lattice *person. (Roberts 1987, pp182-183)

Here, FEW is a characteristic function from a certain number, n, to a truth value, 1 or 0, such that if n is regarded as 'few,' FEW(n) is 1 and if not, FEW(n) is 0. In summary, she sloves the problem by defining *few* as in (26a). *Many* is defined similarly as in (26b).

(26) a. Few:λCNλVP FEW (σx[∃y(*CN(y) & VP(y) & x=|y|)
& ∀z(*CN(z) & VP(z) --> x≥|z|)])

b. Many:λCNλVP MANY (σx[∃y(*CN(y) & VP(y) & x=|y|)
& ∀z(*CN(z) & VP(z) --> x≥|z|)])

(Roberts 1987, pp183-184)

2.3. Problems of Roberts' Approach

Although the definition of 'few' in (26) can capture the reading of sentence (24) correctly, her approach has some problems. First, she does not specify how the universal and existential quantifiers in the denotation of *few* and *many* are introduced. In addition there is no quantifier corresponding to the determiner *few* in (128) of the quatation. The role of *few* here is to specify the cardinality of the largest i-sum which agrees on the issue, but it is not that of a quantifier. Second, if they are restricted quantifiers as argued by Roberts, *few* in sentence (24) must be translated into a quantifier which ranges over all the i-sums of persons which agree on the issue, but not over all the i-sums of persons. Then, the notion restricted quantification is better expressed in (27) rather than in (128).

(27) ∀x[*person(x) & agree-on-this-issue(x) --> FEW(x))

Logical form (27) captures the reading of (24) appropriately. However, *few* is still not a quantifier. It's role is to specify the cardinality of an i-sum. This contradicts Roberts' assumption that a quantificational determiner provides its own quantificational force. Even though the restricted quantification of this kind is adopted, the reading of sentence (28) cannot be properly captured by (29). According to her, Sentence (28) is true iff the cardinality of the largest i-sum

among the i-sums which agree on the issue is MANY. But for (29) to be true, the cardinalities of every i-sum which agrees on the issue must be MANY.

(28) Many people agree on this issue.
(29) ∀x(*person(x) & agree-on-this-issue (x) --> MANY(x)]

Third, if *few* is a plural quantifier with the denotations given in (26), it has to be treated as being ambiguous at least in three ways to give an appropriate interpretation to the following sentences. Sentence (30) means that for few individual students x, x wore blue jeans and sentence (31) means that for few non-atomic i-sum individuals X which are students, X has common interests.

(30) Few students wore blue jeans.
(31) Few competing companies have common interests.

Determiner *few* is a quantifier over atomic individuals in (30) and it is a plural quantifier of the usual sense (as in (21)). To treat a quantifier this way is not desirable unless it is inevitable.

Fourth, it is not always required to consider every i-sum to determine the truth value of a sentence which has a quantificational NP as its subject and a collective predicate as its VP. For example, sentence (32) is true only if there is at least one i-sum of persons who agrees on the issue in the same way and the cardinality of the i-sum is a member of one-place predicate MANY. The i-sum need not be the largest among the i-sums of persons which agree on the issue. That is, sentence (32) is translated into (33) where MANY(|X|) represents that the cardinality of X is in the denotation of *many*.

(32) Many people agree on this issue.
(33) ∃X[*person (X) & MANY(|X|) & agrees-on-this-issue (X)]

Then, the NP *many CN* is translated into a non-individual variable which is to be linked to a non-atomic i-sum individual in a model just like a group-denoting NP such as *some CN*. Notice that sentence (34) is translated into (35).

(34) Some people agree on this issue.
(35) ∃X[*person (X) & SOME(|X|) & agrees-on-this-issue (X)]

Why is it necessary to consider every i-sum of person which agrees on the issue to determine the truth value of sentence (24)?

(24) Few people agree on this issue.

I believe that the monotonicity of a quantifier plays a role here. When an NP with a non-monotone inctreasing quantifier is followed by a collective VP, the cardinality of the maximal i-sum must be considered. This generalization is further evidenced by the contrast between the truth conditions of sentence (36) and sentence (37). Sentence (36) has a monotone increasing quantifier, *at least 5*, and sentence (37) has a non-monotonic quantifier, *at most 5*. Sentence (36) is true iff there is at least one i-sum of persons whose cardinality is greater than or equal to 5 and the i-sum agrees on the issue in the same way while sentence (37) is true iff the cardinality of the maximal i-sum among the i-sums generated by the set denoted by *person* which agrees on the issue is at most 5.

(36) At least 5 people agree on this issue.
(37) At most 5 people agree on this issue.

Based on this observation, I will treat the maximality condition as being introduced by the non-monotonicity of a quantifier. Without the maximality condition, denotations of *many*, *few*, *some*, and *five* can be represented in a uniform manner as in (38).

(38) Many: λCNλVP MANY (σx[∃y(*CN(y) & VP(y) & x=|y|)
Few: λCNλVP FEW (σx[∃y(*CN(y) & VP(y) & x=|y|)
Some: λCNλVP SOME (σx[∃y(*CN(y) & VP(y) & x=|y|)
Five: λCNλVP FIVE (σx[∃y(*CN(y) & VP(y) & x=|y|)

Denotations in (38) are equivalent to those in (39).

(39) Many: λCNλVP [∃y(*CN(y) & VP(y) & MANY|y|)
Few: λCNλVP [∃y(*CN(y) & VP(y) & FEW|y|)
Some: λCNλVP [∃y(*CN(y) & VP(y) & SOME|y|)
Five: λCNλVP [∃y(*CN(y) & VP(y) & FIVE|y|)

In the end, Roberts treats quantifiers *many* and *few* as individual(or group)-denoting rather than quantificational when she defines them as in (26). In other words, she is treating quantificational NPs in her systwm in at least two ways: when they are followed by distributive predicates, their determiners are translated into quantifiers providing quantificational forces; when they are followed by collective predicates, their determiners are not translated into quantifiers but specify the cardinality of an i-sum. Insofar as determiners are classified into quantificational and individual-denoting as in Roberts (or into quantificational and non-quantificational as in Kamp and Reyle), this kind of pitfalls are always expected.

3. An Alternative NP Classification

I adopt the idea of van Eijk(1983) who classifies NPs with respect to their syntactic and semantic numbers. He defines the semantic number of an NP based on the denotation of the NP given in the genralized quantifier theoretical terms. Roughly speaking, an NP is semantically singular if and only if (hencefort iff) its denotation contains at least one singleton set in all models, and it is semantically plural iff the denotation has only sets that contain at least two members in all models. The semantic number of an NP is undefined, otherwise. He defines the semantic number of an NP as in (40).

(40) NP denotation [| a |][7] is proper iff [| a |] is defined and [| a |] =/= 0 (empty set) and [| a |] =/= P(U) (the powerset of the universe U of a model)

(i) the semantic number of an NP a is singular (s.n (a) = 1) iff in every M=<U, [| |]> where [| a |] is proper, 0 is not a member of [| a |] contains at least one singleton set.

(ii) the semantic number of an NP a is plural (s.n. (a) = 2+) iff in model M where [| a |] is proper, [| a |] has only sets as its elements that contain at least two members.

(iii) the semantic number of an NP a is undefined in all other cases.

7. [| |] represents the interpretation function of a model.

Now, NPs are classified as follows:

(41)

	syntactic number	semantic number
John	singular	singular
John and Bill	plural	plural
a man	singular	singular
five men	plural	plural
some men	plural	plural
few men	plural	plural
many men	plural	plural
many a man	singular	plural
most men	plural	undefined
every man	singular	undefined
all men	plural	undefined
no men	plural	undefined

Hereafter, I will group semantically plural NPs and semantically undefined NPs into semantically non-singular NPs. Actually, the denotaion of the common noun of an NP whose semantic number is undetermined contains at least two individuals, the NP is semantically plural, and it is the situation where these NPs are mostly used.

Secondly, I basically agree with Scha(1981) who classifies a determiner into distributive or collective based on whether or not an NP with that determiner can be followed by a collective VP. If the NP can be followed by a distributive VP, the determiner of the NP is classified as a distributive one. If an NP is followed by a collective VP, the determiner of that NP is treated as a collective one. With this criteria, Scha classifies determiners as in (42).

(42) Classification of Determiners (Scha 1981)

Distributive	Collective
each	
every	
a	
both	

0 det	0 det
all	all
$some_{sg/pl}$	$some_{pl}$
$no_{sg/pl}$	no_{pl}
2,3,4, ...	2,3,4,...
$the_{sg/pl}$	the_{pl}

However, his system is not fine-grained enough. For example, an NP of the form *most CN* can be followed by only some kind of collective predicate as in (43).

(43) a. Most farmers (of the town) gathered in Town Hall.
b. Most farmers (of the town) work, together.
c. *Most students is/are a big group.
d. *(?)Most musicians performed a symphony.

It is alluded in (43) that collective determiners must be grouped into subcategories with respect to the kind of predicates so as to explain the acceptability of the sentences in (43). Here, how to categorize predicates becomes essential.

Kamp and Frey cited in Root(1986) categorize predicates into three classes: distributive, collective and mixed which are ambiguous with respect to distributivity/collectivity. According to them, predicate 'gather' is mixed in that it can contribute a collective reading to a sentence and a distributive reading to another. The, the acceptabiulity of sentence (43a) is explained without assuming that the NP *most farmers* denotes a group individual (or i-sum individual). However, Dowty(1986, pp108-111) provides a convincing argument against thi approach. He maintains that mixed predicates of Kamp and Frey are collective predicates with "distributive sub-entailments." The notion "distributive sub-entailments' is informally defined as follows:

> Although collective predicates like *gather* obviously do not distribute down to the members of the groups of which they are predicated in a literal way (i.e. *The students gathered* doesn't entail **Every student individually gathered*), this doesn't really mean that such predicates completely lack entailments about the individual members of their group subjects. Consider what is required of

> individual students for the sentence *The students gathered in the hall* to be true. Clearly, every student in the group referred to by *the students* (or "most every student") must come into the hall and remain long enough that they are all there at a common time. Thus *gather* distributively entails some property of members of its group subject (each undergoing a charge of location), but gathering itself can only be true of the group *qua* group.

That is, the mixed predicates in Kamp and Frey are collective predicates with distributive sub-entailments in Dowty's approach.

Dowty also introduces the notion "collective sub-entailments" the definition of which is not given definitely but alluded in the following quotation:

> It has frequently been observed that ordinary singular effected-object sentences such as (28a) have causative entailments, that is, that (28a) entails that some action that John performed, presumably a complex one, brought about the existence of the cabin. I think (28b) should be no different, except that the entailment is that some "group action" by a subset of the group of students in question brings about the existence of the cabin.
>
> (28) a. John built that cabin.
> b. The students built that cabin.
>
> Now, I don't have a fully-developed theory of group actions, but fortunately I only need to make some very weak assumptions about what a group action is: namely an action by a group takes place whenever every member of the group does something. (Dowty 1986, pp104-105)

Then, when a collective predicate P which takes an i-sum X as its argument distributively sub-entails a property Q, every atomic i-part of X has the sub-entailed property Q. When a collective predicate P which takes an i-sum as its argument collectively sub-entails a property Q, a non-atomic i-part of the i-sum (possibly, the i-sum itself) has the property Q.

Based on these notions, he classifies predicates as in (44).

(44) Classification of Predicates
- (i) purely distributive predicates: fall asleep, ...
- (ii) collective predicates with distributive sub-entailments:
  - A. collectives whose only entailments may be distributive sub-entailments ("disguised distributives"): gather, ...
  - B. collectives with both collective and distributive entailments: be a happy couple, surround the fort, ...
- (iii) purely collective predicates: be numerous, be a large group,...
- (iv) predicates ambiguous between collective (iiB) and distributive: build a cabin, carry the piano upstairs, ...

I follow Dowty in classifying predicates.

Now, I will classify NPs with respect to what predicates they can take. To do this, I will examine what restrictions exist when an NP combines with a predicates. Clearly, a semantically singular NP of van Eijk's classification cannot combine with any collective VP as in (45).

(45) a. John fell asleep.
b. *John gathered.
c. *John sorrounded the fort.
d. *John is numerous.

Semantically non-singular NPs can combine with distributive VPs as in (46).

(46) a. John and Bill fell asleep.
b. Every student fell asleep.
c. Most students fell asleep.
d. Many students fell asleep.
e. Some students fell asleep.
f. 5 students fell asleep.
g. The students fell asleep.

However, *every-CN*, *each-CN*, and *both-CN* cannot combine with any collective VP as in (47).

(47) a. *Every (each, both) student(s) gathered in the hall.
b. *Every (each, both) student(s) surrounded the fort.
c. *Every (each, both) student(s) are a happy couple.

Most-CN, many-CN and *few-CN* can be followed by a collective VP with distributive sub-entailments, but not by a purely collective one as in (48).

(48) a. Most (many, few) students gathered in the hall.
b. *Most (many, few) students are a big group.

When *most-CN* is followed by a VP with collective as well as distributive sub-entailments, the resulting sentence is unacceptable or very odd.

(49) a. #Most musicians performed a symphony.
b. #Most soldiers surrounded the port.

Intuitions about determiner *few* are quite shaky. Sentences in (50) are judged unacceptable or at best questionable. However, sentences in (51) are acceptable.

(50) a. #(?)Few musisians performed a symphony.
b. #(?)Few soldiers surrounded the fort.

(51) a. A few musicians performed a symphony.
b. A few soldiers surrounded the fort.

This indeterminacy is also found when an NP with *few* is followed by an ambiguous predicates. Some informants judge that the sentences in (52) have only a distributive reading, but others judge that they are ambiguous a distributive reading and a collective reading. However, sentences in (53) can have both readings.

(52) a. Few students made a cabin.
b. Few students lifted a huge rock.

(53) a. A few students made a cabin.
b. A few students lifted a huge rock.

Taking a risk of the over-generalization, I will classify *most* and *few* into the same category with respect to the mode of predication.

Determiners *many, some, several* and *all* are similar to a few in that those NPs with these determiners can combine with a distributive predicate, a collective with distributive sub-entailments and a collective with collective sub-entailments as well as distributive sub-entailments as in (54). But they cannot come together with purely collective predicates.

(54) a. Many (some, several, all) students fell asleep.
b. Many (some, several, all) students gathered in the hall.
c. Many (some, several, all) students performed a symphony.
d. *Many (some, several, all) students are numerous.

NPs with numerals or definite articles can be followed by a distributive VP, a collective VP with distributive sub-entailments and a purely collective one.

(55) a. The (or 100) students fell asleep.
b. The (or 100) students gathered in the hall.
c. The (or 100) students performed a symphony.
d. The (or 100) students is a large group.

Table (56) summerizes the combinatorial characteristics of NPs.

(56) Combinatorial Characteristics of NPs

	Type I every each both	Type II most few	Type III many a few all, some	Type IV the the two two
distributive predicates	OK	OK	OK	OK
collectives with distributive sub-entailments	NO	OK	OK	OK
collectives with dis.and coll. sub-entailments	NO	NO	OK	OK
purely collective predicates	NO	NO	NO	OK

What table (56) illustrates is that purely collective predicates require as an argument a Type IV NP. Collective predicates with distributive sub-entailments require a Type IV, a Type III, or a Type II NP. Distributive predicates require as an argument an NP of any Type. Table (56) also represents that NPs are ordered with respect to their possibility to combine with a certain predicate. That is, if an NP can combine with a purely collective predicate, it can also combine with any other kinds of predicates. But the fact that an NP can combine with a distributive predicate does not guarantee that the NP can combine with a purely collective NP. From table (56), the ordering of (57) is inferred.

(57) Type I NPs < Type II NPs < Type III NPs < Type IV NPs [8]

I will define "minimal requirement" as in (58).

(58) A predicate P minimally requires as an argument an NP of Type a iff when the predicate takes an NP of Type b such that Type b < type a, the resulting sentence is ill-formed.

Then, a purely collective predicate minimally requires an NP of Type IV; a collective predicate with distributive as well as collective sub-entailments requires an NP of Type III; a collective predicate with distributive sub-entailments minimally requires an NP of Type II; and a distributive predicate minimally requires an NP of Type I. Ambiguous predicates are ambiguous in that they minimally require an NP of Type I or an NP of Type III. That is, if they follow NPs of Type I or II, they are interpreted distributively but not collectively. If they follow NPs of Type III or IV, they are interpreted distributively or collectively.

Based on the above discussion, I classify NPs as in (59). First, I classify them into semantically singular and semantically non-singular. Semantically non-singular NPs are further classified into Type I through Type IV NPs.

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8. The ordering in (57) is about the combinational potential of an NP with a predicate. The schema of A < B represents that B can combine with more predicates than A.

(59) Classification of NPs

Semantically singular: John, NPs with *a(n)*
Semantically non-singular
Type I: NPs with *every, each, both, no*
Type II: NPs with *most, few*
Type III: NPs with *many, a few, some, several, all*
Type IV: John and Mary, NPs with *the, the two, two, ...*

4. Conclusion

I have so far shown that the classification of NPs into individual denoting and quantificational is untenable and have provided a new NP classification system which classifies NPs into semantically singular and semantically non-singular as in (59). The new classification of NPs inevitably leads into the theory of NP semantics incorporating the assertions in (60).

(60) Assertions Concerning a New NP Semantics

I. A semantically singular NP is translated into an individual type variable.
II. A semantically non-singular NP is translated into a non-individual type variable which is to be linked to an i-sum of a model.
III. The existential quantifier is provided by default existential generalization (existential closure); the universal quantifier is provided by distributive expansion but not by determiner quantifiers such as *every* and *each*.
IV. The role of a determiner quantifier is to specify the cardinality (or the number of atomic individual) of an i-sum denoted by an NP with that determiner.
V. Distributivity is a property of a predicate but not of an NP. Accordingly, when a sentence is ambiguous with respect to distributivity / collectivity, the source of the ambiguity is the predicate of the sentence but not the subject NP of it.

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