

Licensing distributivity: the role of plural morphology¹

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This study investigates how the availability of quantificational distributivity depends on the morphosyntactic number of the VP, based on two different case studies: first, the behaviour of sentences with a group NP subject (such as the class or my family) in British English; and second, the interpretation of coordinated VPs in sentences like The guests are surrounding the newlyweds and singing or dancing. I argue that distributivity is only available when the VP is plural, not when it is singular or uninflected. This approach goes back to Link's (1983) original intuition that pluralisation and distributivity are two sides of the same coin. It also provides support for compositional analyses of semantic pluralisation, according to which predicates originate as singular and are pluralised at a higher derivational level, instead of being 'born plural' as in e.g. Krifka (1992), Landman (1996), and Kratzer (2008).

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The formal semantic analysis of plural predication, developed in the 1970s and 1980s (in particular Link 1983), is based on two intuitively appealing ideas: first, that singular VPs denote predicates that range over singular entities and plural VPs denote predicates that range over sets of entities; second, that the latter denotations are derived from the former in a way that guarantees equivalences like the one between (1a) and (1b):

¹ I thank Yoad Winter, Roger Schwarzschild, Lucas Champollion, Sophie Chesney, Hazel Pearson, Michelle Sheehan, several other British English informants, two anonymous reviewers, and various audiences for their many helpful comments, questions and native speaker intuitions.

- (1) a. Mary is a linguist and Sue is a linguist and Jane is a linguist.
 $\mathbf{m} \in \mathbf{linguist}$ and $\mathbf{s} \in \mathbf{linguist}$ and $\mathbf{j} \in \mathbf{linguist}$
- b. Mary, Sue and Jane are linguists.
 $\{\mathbf{m}, \mathbf{s}, \mathbf{j}\} \in \mathbf{linguists}$

To capture the entailment between (1a) and (1b), the extension of the set **linguists** needs to be derived in a systematic way from the extension of **linguist**: the latter denotes the set of all linguists, so the former should denote the set of all possible combinations of those linguists, which we can compute by taking the powerset of **linguist** and removing the empty set (cf. Bartsch 1973, Bennett 1974, Hoeksema 1983, Link 1983 and many others afterwards). We will call this operation *pluralisation* of the predicate, and use the notation * (from Link 1983, although we will define it in set-theoretical terms, while Link argues for a lattice-theoretical approach):

- (2) *Predicate pluralisation*²
 $*P := \wp(P) - \{\emptyset\}$

The way the *-operator is defined guarantees both the entailment from (1a) to (1b) and vice versa. The first entailment captures a property of plural predication known as *cumulativity*: if **m**, **s** and **j** are all in the extension of the singular predicate **linguist**, then any set containing one or more of these

2 The lambda calculus was removed from the undergraduate linguistics curriculum at Leiden University somewhere between my first and second attempt to pass Crit Cremers's semantics course. While I have mastered the proper use of lambdas since, I'll refrain from using them in this paper, one of whose purposes – after all – is to commemorate the excellent semantic education I've received thanks to Crit. However, it should be noted that the semantics of the *-operator formalised as a lambda term contains a universal quantifier; hence my remark, further on in this paper, that pluralisation is a quantificational operation.

individuals will be in the extension of the starred predicate ***linguist**. So, if (1a) is true, so is (1b), and so are the 'intermediate' statements *Mary and Sue are linguists*, *Mary and Jane are linguists*, and *Sue and Jane are linguists*. The second entailment - from (1b) to (1a) - captures the property of *distributivity*: if the set **{m,s,j}** is a member of plural ***linguist**, then so are all of its subsets; also, it follows that the entities **m**, **s** and **j** are all members of singular **linguist**. So if (1b) is true, so is (1a), and so are all intermediate statements. Since a single operation, *****, is responsible for both directions of the equivalence between (1a) and (1b), plurality and distributivity are inextricably tied up: we cannot turn a predicate over singular individuals into a predicate over plural individuals without, in the process, endowing it with the property of distributivity.

However, the core ideas behind this formalisation - plural predicates are derived from singular ones; pluralisation and distributivity are two sides of the same coin - have been challenged or (partly) abandoned in more recent work, mainly in order to deal with 'mixed' predicates like *win* or *eat a pizza*, for which cumulativity holds but distributivity does not (for example, we cannot conclude from *The boys ate a pizza* that each of the boys ate a pizza, since they might have shared a pizza among them). The notion that the basic denotation of a predicate is a set of entities, from which the plural set-of-sets denotation is compositionally derived when the predicate appears in its plural form, has been challenged too; for example, Krifka (1992) and Landman (1996) claim that predicates are 'born plural' (see also Kratzer 2008).

In this paper, I want to discuss two independent bits of linguistic evidence that (re-)emphasise the tight connection between plurality and distributivity. I claim that predicate pluralisation is a compositional operation associated with the presence of plural morphology on the VP (at least in languages that mark the VP for number, which will be the only languages I will look at in this paper), and that only this licenses

quantificational distributivity. The proposal is similar in spirit to the one made in Kratzer (2008), but while Kratzer assumes that the *-operator is licensed by plural features on the subject NP, I will show based on data involving British English group nouns that NP number does not matter, while VP number does. I will also discuss some evidence against the idea that predicates are born plural in the sense that they (may) come from the lexicon pre-starred.

1. Some preliminaries

I will work from the following basic assumptions, which I will not motivate here due to space limitations, but see De Vries (2014), De Vries (2015). First, I follow Winter (2002) in assuming that predicates can be classified as either *atom predicates*, which in their basic form range over atomic entities, and *set predicates*, which in their basic form range over sets. Atom predicates behave exactly like our analysis of *linguist* and *linguists* above: whenever they appear in the singular, they retain their basic denotation, but whenever they appear in the plural, they are turned into a set of sets with *. Set predicates (like *gather*, *meet*, *are similar*, *are friends*) are the opposite: whenever they appear in the plural, they retain their basic set-of-sets denotation, but whenever they appear in the singular (as in *The couple met in 1999*, or *The committee gathered*) they are turned into a set of atomic entities by a singularisation operation:

$$(3) \quad \textit{Predicate singularisation}^3 \\ \uparrow \mathcal{P}_{et,t} := \{ (\uparrow P)_e \mid P_{et} \in \mathcal{P} \}$$

3 This does not appear in Winter 2002, but is a generalised version of the \downarrow operation from Winter (2001a:243), that was first defined in De Vries (2015).

Here, \uparrow is a function that takes a set and maps it to the corresponding *impure atom*, which we can think of as a set 'grouped into' a single conceptually complex but semantically singular entity. Thus, the predicate singularisation operator \uparrow takes a set of sets and returns the set of all impure atoms corresponding to those sets; the result is a singularised predicate of type *et*.

Following e.g. Link (1984), Landman (1989) and Winter (2002), I am assuming that the \uparrow typeshift is available for referential set-denoting NPs, too:

(4) *Impure atom formation*

If X_{et} is the denotation of a referential NP, $(\uparrow X)_e$ is the *impure atom* corresponding to X .

The notion of impure atomicity captures the intuition that we sometimes conceptualise a collection of entities as an entity in itself - we can talk about a collection of things without really knowing or caring which individual entities make up the collection (this observation is often made about group nouns like *council* or *family*, but it holds for 'ordinary' plurals just the same). As I will argue in this paper, impure atom formation is triggered when a starred interpretation is unavailable for the VP, in order to avoid the type mismatch that results when both the subject and the predicate denote a set of entities; this invariably results in a sentence that lacks certain distributive interpretations.

Finally, I follow Scha (1981) and Winter & Scha (2015) in assuming that singular predication, too, can support distributive inferences based on the lexical semantics of the predicate - not because of a hidden operator like $*$, but because knowledge about the involvement of an argument's subparts in a given state or event can usually be inferred from the predicate meaning itself. So, just as I can conclude (5b) on the basis of (5a), the inference in (6b) follows from the sentence in (6a).

- (5) a. The table is white.
 b. \leftrightarrow Every part of the table is white.
- (6) a. The class laughed.
 b. \leftrightarrow Every student in the class laughed.

Winter and Scha call these inferences *pseudo-equivalences*: even though these statements 'feel' equivalent, their relation is non-logical and defeasible. For example, unlike the universally quantified statement in (6b), the sentence in (6a) is generally compatible with the existence of (some) exceptions in the form of non-laughing students (as noted by Dowty 1987 and many others).

More generally, the notion of pseudo-equivalence can be used to describe the relation between impure atoms and their corresponding sets, as follows: if X is a set of entities such that a sufficient proportion of X 's members share a given atom property P , the impure atom corresponding to X is also in the extension of P (cf. Winter 2001).

- (7) *Pseudo-equivalence of sets and impure atoms*
 $(\forall x \in X : x \in P) \Leftrightarrow \uparrow X \in P$, for any set of atomic entities X and atom predicate P .

The type of lexical distributivity captured by this pseudo-equivalence accounts for the availability of (some) distributive interpretations with group NP subjects, but as we will see in the next section, distributivity with group NPs is generally unavailable when the VP is singular.

2. The role of VP number in licensing distributivity: British English group NPs

Sentence (6a) is interpreted distributively: it follows from (6a) that the individual students laughed. Here are some other examples of distributive interpretations with group subjects:

- (8) a. The hotel staff is friendly.
- b. My family has blue eyes.

Like (6a), (8a) involves a non-complex VP consisting of a predicate whose meaning is conceptually restricted to individuals with (among other things) a mental state, which on its own is sufficient to support the inference from classes and staff to individual humans. The VP in sentence (8b) is more complex, but (given common assumptions about the non-quantificational semantics of bare plurals, e.g. Carlson 1977, Van Geenhoven 1998) still forms a semantic unit in the sense that nothing scopes out of it; again, the distributive interpretation can follow from reasoning about the conceptual restrictions of the predicate *has blue eyes*. But when we look at more complex VPs involving quantifiers and other scope-taking elements, a contrast between plural subjects and group subjects emerges. Compare the possible interpretations of (9a) and (9b):

- (9) a. The members of the Jones family are blond or red-haired.
- b. The Jones family is blond or red-haired.

Sentence (9a) is compatible with a situation in which some of the Jones are blond while the others are redheads; for sentence (9b) to be true, however, all the Joneses need to have the same hair colour. Similarly, sentence (10a) but not (10b) is true in a situation where half of the children are drawing and the other half are sleeping (sentence (10b) makes the weird claim that all children are simultaneously doing both). And sentence (11a), but not (11b),

is true in a situation in which each linguist in the research group gave a talk at a different location. (For a much more elaborate introduction of these and other 'distributivity tests', see De Vries (2015:3).)

- (10) a. The children are drawing and sleeping.
 b. # The class is drawing and sleeping.
- (11) a. The linguists have given a talk somewhere.
 b. The research group has given a talk somewhere.

De Vries (2015) shows that in all these cases, the interpretation that is missing from the (b) sentences can only be derived if the sentences involve plural predication, i.e. if their meaning is computed using * or a similar operator. Take the example involving disjunction:

- (12) $x \in (\mathbf{blond} \cup \mathbf{red-haired})$ (singular predication)
 $\Leftrightarrow x \in \mathbf{blond}$ or $x \in \mathbf{red-haired}$
- (13) $Y \in *(\mathbf{blond} \cup \mathbf{red-haired})$ (plural predication)
 $\Leftrightarrow \forall y \in Y : y \in (\mathbf{blond} \cup \mathbf{red-haired})$
 $\Leftrightarrow \forall y \in Y : y \in \mathbf{blond}$ or $y \in \mathbf{red-haired}$

An entity x is a member of $[[is\ blond\ or\ red-haired]]$ if x is either blond or red-haired. A set Y is a member of the extension of the set of sets $[[are\ blond\ or\ red-haired]]$ iff each of the members of Y is either blond or red-haired; this includes situations in which not all members of Y have the same hair colour. The observation that group-subject sentences lack this latter interpretation, and the other relevant interpretations in (9-11), indicates that group NP denotations are incompatible with starred predicates.

Why should this be so? De Vries (2014) argues that the distributivity contrast between group and plural subjects supports the common

assumption that group NPs denote atomic entities (following e.g. Landman 1989, Barker 1992, Schwarzschild 1996). *-based distributivity is essentially a quantificational mechanism, which only works when the predicate can be applied to a set; if plural definites are associated with sets but group NPs are not, the observed contrast follows straightforwardly. This conclusion may be a bit too simple, though, because the comparison here is not just between group NPs and definite plurals. The morphosyntactic number of the VP is also different: in the (a) sentences, that feature a plural subject, the VP is plural as well; in the (b) sentences the VP is singular. Of course, it is difficult to investigate the (possible) role of VP number separately from the group/plural contrast, since English has obligatory subject-verb agreement that links NP and VP number. In some varieties of English, however (most notably British English), singular group NPs are allowed to appear with a plural VP: both (14a) and (14b) are grammatical in British English.

- (14) a. The hotel staff is friendly.
b. The hotel staff are friendly.

In this section, I will make use of this fact to investigate the availability of Q-distributivity with group subjects with either a singular or a plural VP, by means of a small questionnaire study of six native speakers of British English.

The judgements used in investigating the availability of Q-distributive interpretations with British English group nouns were obtained from 6 native speakers of British English (5 from England, 1 from Wales, all with some background in linguistics), by means of a pen-and-paper truth value judgement task. Each of the 18 test items consisted of a sentence and a picture of a situation that was compatible with a distributive interpretation

of that sentence, but incompatible with a collective one; subjects were asked to judge whether or not the sentence could be true in the depicted situation. An example of such a picture and the various sentences used to describe it can be found in figure 1.



Figure 1

One of the pictures used in the British English questionnaire; it was accompanied by either "The cricket players are obese or underweight", "The cricket team is obese or underweight", or "The cricket team are obese or underweight". Informants saw all three picture/sentence combinations at various points in the questionnaire.

If the availability of Q-distributivity depends only on the number of the subject NP and not on the number of the VP, we expect all British English group noun sentences to behave like their Dutch and American English counterparts, disallowing *-based interpretations regardless of VP number. However, if the availability of distributivity depends on the number of the VP, we expect British English group sentences to disallow distributive interpretations when the VP is singular (like their American and Dutch counterparts), but to pattern with plural-subject sentences when the VP is plural. For all test items, it holds that the given sentence is true in the

depicted situation only if it is interpreted using *; thus, the number of 'true' responses directly indicates the availability of a distributive interpretation for every test sentence in the questionnaire.

The results of this small study confirm the hypothesis that VP number is the main factor influencing the availability of distributivity: in total, 23% of the singular-VP group-subject sentences were judged true, against 61% of their plural-VP counterparts and 83% of the sentences with a plural subject.⁴

These results can be accounted for by assuming that starred interpretations are not available for singular VPs. Whenever the VP is singular, it necessarily denotes a semantically singular (unstarred) predicate; this also forces the group subject to be interpreted as atomic, in order to avoid a type mismatch. However, when the VP is plural, it enables a plural interpretation for both the predicate and the subject NP, resulting in the presence of *-based readings that are otherwise absent with group subjects.⁵

These observations themselves are not sufficient to conclude that predicate pluralisation needs to be licensed by morphosyntactic plurality of the VP; it is also possible that predicates enter the derivation already starred, and then are singularised when they are inflected in the singular. In the next part of the paper, however, I will present some evidence that starred

4 As expected, most plural-subject sentences scored close to 100%, with the exception of two particular item clusters where they only scored 10% and 50%, respectively. This might indicate that some unexpected aspect of these sentences interfered with their ability to be interpreted distributively, which means that these sentences are less suitable as distributivity tests. If we remove the test items from those two clusters from our calculation of the total score, the total score becomes 92% 'true' for the plural-subject sentences, 74% for the plural group-subject sentences and 33% for the singular group-subject sentences.

5 See De Vries (2013, 2015:5) for a more elaborate analysis of the British English data; I assume that animate group NPs are semantically plural in origin, but are typeshifted into impure atoms when the VP is singular.

interpretations are not just unavailable for singular VPs, but also for uninflected ones; this means that only morphosyntactically plural VPs license pluralisation with * on the semantic level.

3. Pluralisation as the semantic correlate of number inflection: the (im)possibility of atom/set coordination

In his original 1983 paper, Link conceived of pluralisation as a lexical phenomenon, in which morphologically plural predicates enter the derivation directly from the lexicon with * already attached to them. But of course, according to standard syntactic assumptions, combining a predicate with plural morphology - or plural number features that are later spelled out in the form of plural inflection - is a syntactic process. If we want to associate * with plural number morphology, it makes sense to regard it as a separate lexical item that combines with the predicate compositionally. For example, in Sternefeld (1998), Beck (2001), and Beck & Von Stechow (2007), * has its own syntactic projection with the VP as its complement; Sternefeld (1998) and Joh (2008) argue explicitly that * is the semantic translation of plural verbal morphology. However, Krifka (1992), Landman (1996), and Kratzer (2008) argue in favour of a 'lexical' *, that enters the syntactic derivation already attached to its predicate and is not dependent on the presence of plural morphology. For Kratzer, this lexical * enables the distributive interpretation of a singular sentence like *The class laughed*, although she also argues that a compositional version of * is needed.⁶

6 The latter is evident on the basis of the data in the previous section, too: none of the examples of distributivity with more complex VPs would be derivable if * applied only to lexical predicates and not to entire VP denotations. For example, $Y \in *(\mathbf{blond} \cup \mathbf{red-haired})$ is false if both $(Y \cap \mathbf{blond})$ and $(Y \cap \mathbf{red-haired})$ are nonempty, i.e. if the members of Y don't all have the same hair colour.

At first glance, it seems hard to distinguish between Kratzer's lexical starring and our notion of (non-*-based) lexical distributivity as sketched at the end of section 1: both predict that a distributive interpretation will be available for group-subject sentences with a simple VP, like *The class laughed*, but not for sentences with a complex VP like the ones at the beginning of section 2. However, assuming our background assumptions are correct, the predictions of both approaches diverge when it comes to the analysis of VP coordinations. According to an approach that allows lexical starring, it should be possible to coordinate an atom predicate and a set predicate that are not inflected for number (as in (15a)), since a starred atom predicate is of the same semantic type as an uninflected set predicate. However, such a coordination would be impossible in an approach that only allows a compositional * licensed by plural verbal morphology, since the types of uninflected set and atom predicates do not match (see (15b)).

- (15) [[gather and dance]] =
- a. $\mathbf{gather}_{et,t} \cap *(\mathbf{dance}_{et})_{et,t}$
 - b. $\mathbf{gather}_{et,t} \cap \mathbf{dance}_{et}$ (either disallowed or necessarily empty)

According to my own judgements⁷, the second prediction seems to be correct: whenever we try to coordinate one of the distributive VPs from the previous section with a set predicate, the *-based interpretation becomes unavailable. In (16), all the guests have to be either singing or dancing; there is no 'mixed' interpretation. Sentence (17) is anomalous: it implies that all the children are simultaneously drawing and sleeping. In (18), *someone famous* takes scope over *John and Mary*, and the sentence is false in a

⁷ I have not done any systematic data-gathering here, although I have asked several other Dutch native speakers for their judgements and they mostly agreed with me. Still, the sentences are quite complex, so it would be worthwhile to test this more systematically and in more languages.

situation in which John and Mary each spot a different celebrity. And in (19), *hun kind* 'their child' refers to one child who is the child of both John and Mary, even though the Dutch sentence *Jan en Marie houden van hun kind* 'John and Mary love their child' can be used to talk about two different children.

- (16) The guests are surrounding the happy couple and singing or dancing.
- (17) # The children are sitting in a circle and sleeping and drawing.
- (18) John and Mary will meet in a bar and spot someone famous.
- (19) Jan en Marie moeten zonder ruzie uit elkaar gaan en goed voor *Jan and Marie must without fight from each.other go and well of hun kind zorgen.*
their child take.care
 'John and Mary should separate without fighting and take good care of their child.'

These data suggest that coordinations of uninflected atom and set predicates cannot be interpreted using *, which means that * is not available at the level of individual predicates. Clearly, though, the type mismatch inherent in these coordinations must be resolved in some way, or these sentences would be completely uninterpretable. I propose that the type mismatch is resolved using last-resort singularisation of the set predicate, as follows:

- (20) $[[\textit{surrounding and dancing}]] =$
 $\mathbf{surround}_{et,t} \cap \mathbf{dance}_{et}$ (type mismatch)
 $(\uparrow\mathbf{surround})_{et} \cap \mathbf{dance}_{et}$ (type mismatch resolved)
 $\Leftrightarrow \{ x = \uparrow X \mid X \in \mathbf{surround} \text{ and } x \in \mathbf{dance} \}$

Since the set predicate is singularised into a predicate over impure atoms,

the intersection of both predicates contains only impure atoms: groups of surrounds-and-dancers, conceptualised as atomic entities. If the second conjunct is itself a disjunction $P \cup Q$, its contribution to that intersection are precisely those impure atoms that are either members of P or of Q . Following the pseudo-equivalence in (7), an impure atom corresponding to a certain set X will be a member of a predicate P just in case the members of X are also members of P . So, for example, the disjunction *singing or dancing* only contributes groups of singers and groups of dancers, not mixed groups consisting of some singers and some dancers. This is the case regardless of whether or not we apply * to the set corresponding to *are surrounding the happy couple and [singing or dancing]*.⁸ Thus, sentence (16) is true just in case all (or more or less all) the guests are surrounding the happy couple and all of them are singing, or all of them are dancing.

The lack of distributive interpretations in the other examples above can be accounted for in a similar way. For example, in the absence of an *-operator, the quantifier *someone famous* in sentence (18) takes wide scope; the denotation of the uninflected VP *spot someone famous* is essentially the set $\{ x \mid \langle x, y \rangle \in \mathbf{spot} \}$ for some famous person y . Following the pseudo-equivalence in (7), all impure atoms in the set $[[\textit{spot someone famous}]]$ correspond to groups of y -spotters; there is no way we can derive 'mixed' groups consisting of members who each spotted someone else.

The above observations fit well with a compositional theory of the *-operator: if * is the semantic correlate of plural verbal inflection, we expect it to apply at the level of IP, not (uninflected) VP. They do not fit with a (fully or partially) lexical analysis of pluralisation, since the lack of a distributive interpretation for uninflected VPs suggests that atom predicates are unstarred at VP-level and only get pluralised higher up in the

8 I am assuming for simplicity's sake that * is optional here - see the remarks in section 4.

derivational tree.

4. Conclusions

The data presented in this paper show that semantic pluralisation, and hence the availability of distributivity, is closely related to the presence of plural verbal morphology. The British English group NP data indicate that singular VPs cannot be interpreted distributively, and as suggested by the English and Dutch set-atom coordination data, neither can non-inflected VPs. There are several remaining questions that will need to be addressed eventually. Most importantly, what does it mean for the *-operator to be 'licensed' by morphosyntactic plurality? We cannot just say that * is the denotation of plural verbal inflection, since we have been assuming that * does not apply to morphosyntactically plural set predicates. It seems to me that the answer to this question will need to involve a considerable syntactic component. Second, how is semantic pluralisation licensed in languages that do not mark number on the verb at all - might there still be a role for NP number, as in Kratzer's account of distributivity?

Finally, this paper demonstrates the need for both crosslinguistic and quantitative data in semantic research - the former, because it proposes a link between morphosyntax and interpretation that can only be tested by comparing languages with different morphosyntactic properties (such as Dutch and British English); the latter, because the truth value judgements involved can be quite subtle, and the personal intuitions of the author might be quite different from the judgements of the majority of language users. That the result of such quantitative data-gathering is often much more graded and vague than formal theories (including the theory of semantic plurality presented here) predict is, I think, one of the big challenges for

semantics and theoretical linguistics in general; one that necessitates an exploration of the 'crossroads' for many more years to come.

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