Lexical distributivity with groups and properties[*]

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1.   Introduction

How do we make inferences about individuals based on sentences that involve predication over a plurality? For instance, why do we conclude from (1a) that it is the individual children who laughed, and from (1b) that each of the girls probably had a beer of her own?

(1)   a. The children laughed.

       b. The girls had a beer.

In the early 1980s, two different answers to this question were proposed. According to Scha (1981), there is no formal difference between the derivation of the *distributive* interpretation of the sentences in (1) - which supports the inference that the property expressed by the predicate holds of the single individuals that make up the plural denotation - and the derivation of the *collective* interpretation of sentences like the following, which does not support such an inference:

(2)   The children $\left\{ \begin{array}{l} \text{gathered in the garden.} \\ \text{met last week.} \\ \text{are a good team.} \end{array} \right\}$

Unlike the examples in (1), the sentences in (2) do not involve the 'trickling down' of the predicate to individual members of the plurality but rather express that a certain property holds of the plurality as a whole. In both cases, according to Scha, the predicate applies directly to the denotation of the plural definite, and any information about the way its individual members participate in the expressed event is part of the lexical semantics of the predicate. Thus, according to Scha's analysis, collectivity and distributivity inferences with referential expressions are not triggered by the compositional semantics of the sentences in question, but by lexical information.

However, the account most widely adopted is the one originating in Link (1983), which analyses distributivity in terms of a semantic operator comparable to the overt universal quantifier *each*.[1] This distributivity operator (henceforth D-operator) quantifies over the members of a plurality, allowing the predicate to apply to each of these individuals.

In the most radical version of the operator-based analysis, exemplified by Link (1983), there is a direct correlation between semantic mechanism and interpretation: a distributive interpretation can only be derived by means of a D-operator. However, in this paper I will argue (following Dowty 1987, Roberts 1987, Winter 1997 and Champollion 2010) that there are two ways to derive distributivity: one involves the kind of conceptual reasoning argued for by Scha, the other is operator-based. I show that we need a theory of lexical distributivity to account for distributive interpretations with group nouns like *team* and *committee*, as operator-based distributivity is systematically unavailable with these nouns. An apparent counterexample to this claim are sentences like *The team is wearing an orange vest*, whose distributive interpretation seems to require a covert quantifier over team members to take scope over the indefinite. However, I argue that this is not a case of quantificational distributivity, but of lexical distributivity over two arguments: a group and (an individual correlate of) a property.

2. Distributivity with plurals and groups

2.1 Two kinds of distributivity

Adopting the terminology of Winter (1997), I will call the two kinds of distributivity that I want to distinguish *Q-distributivity*, which corresponds to Link's D-operator-based distributivity, and *P-distributivity*, which corresponds to Scha's lexical semantics-based distributivity. Schematically:

(3)   *Advocated approach (based on Winter 1997, 2000, Champollion 2010):*

D-operator: No D-operator
Q-distributivity (=direct predication):

collectivity P-distributivity
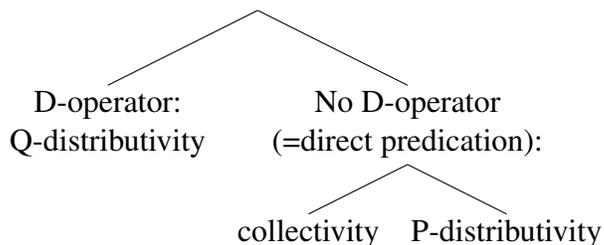
Because the analysis in (3) lacks a one-to-one correspondence between interpretation and mechanics, it is important to keep the two apart in our terminology. I will use the terms *collectivity* and *distributivity* to refer to interpretations, as follows:

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[1]Link (1983) proposes an operator $\star$ that pluralises distributive predicates like *laugh*; from the algebraic properties of $\star$ and the fact that its application is restricted to predicates that contain nothing but atomic individuals in their extension, it follows that whenever a plurality is in the extension of $\star P$, P is true of all the atoms that make up the plurality. The D-operator as covert *each* was proposed in Link (1987) and further fleshed out by Roberts (1978). Unlike $\star$, the application of the D-operator is not a priori restricted to a particular class of predicates, which enables a purely structural analysis of distributivity.

(4) Suppose we have a sentence S of the form *X Pred*, where X is a plural, conjunction or group noun, and *Pred* is a predicate. An *interpretation* of S is *distributive* if we infer that $[\![Pred]\!](x)$ for every member x of $[\![X]\!]$; otherwise[2] it is *collective*.

The two semantic mechanisms that I use to derive these interpretations are covert quantification (for example by means of a D-operator), and direct predication over a plural individual. Formally:

(5) Suppose we have a sentence S of the form *X Pred*, where X is a plural, conjunction or group noun, and *Pred* is a predicate:

   a. Applying a *D-operator* derives the logical form $\forall x \in [\![X]\!] \; [[\![Pred]\!](x)]$
   b. *Direct predication over a plural individual* derives the logical form $[\![Pred]\!]([\![X]\!])$.

Finally, and somewhat obviously: a P-distributive interpretation is a distributive interpretation that is derived by direct predication over a collection. A Q-distributive interpretation is a distributive interpretation that is derived by the D-operator.

There is no formal semantic difference between collectivity and P-distributivity in this approach, as they are modelled using precisely the same compositional mechanism. Rather, the distinction between the two is entirely lexical: both collectivity and P-distributivity are rooted in the lexical semantics of the predicate and our reasoning about parts and wholes with respect to the predicate meaning. Hence, *The children laughed* receives a distributive interpretation, and *The children are a good team* a collective one. A sentence like *The children gathered* is collective with respect to the predicate as a whole (only groups can gather) but distributive with respect to certain conceptual parts of the predicate meaning: we can infer from it that each individual child was in the garden (Dowty 1987). This shows that the distinction between collectivity and P-distributivity is not very clear-cut; rather, they represent the two extremes on a continuous scale of interpretations.

Q-distributivity

Despite the many cases where distributivity effects can be accounted for in terms of direct predication over a collection, several authors have shown that some distributive interpretations cannot be reduced to the lexical meaning of a predicate (cf. Winter 1997, Brisson 1998). Here is an example of a sentence for which a purely lexical approach (like Scha's) does not completely cover the truth conditions for the different interpretations available:

(6) The children are hiding somewhere.

If we analyse the adverb *somewhere* as an existential quantifier over locations, an analysis in terms of direct predication would result in the indefinite's taking scope over the entire plurality of girls:

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[2]For now, I am ignoring cases of 'intermediate distributivity', as in *Rodgers, Hammerstein & Hart wrote musicals* (Gillon 1987), which is true not because each wrote musicals of their own or because the three of them wrote musicals together, but because Rodgers and Hammerstein collaborated to write musicals and so did Rodgers and Hart. The definition in (5) can be straightforwardly extended to accommodate such cases.

(7) $\exists x$ [**place**$(x) \wedge$ **hide_in**(**the_children**,x)]

But this only allows an interpretation in which there is one place where the children are hiding collectively, whereas (6) also has a distributive interpretation according to which each individual child found a hiding place of its own. To derive the latter, the members of the plurality *the children* need to take scope over the existential quantifier introduced by the indefinite. And the only way to allow *the children* to have wider scope than *somewhere* is to introduce another quantifier, as in (8):

(8) $\forall x \in$ **the_children** [$\exists y$ [**place**$(y) \wedge$ **hide_in**(x,y)]]

Such a quantificational analysis is generally formalised, following Link, with the help of a D-operator, a covert quantifier comparable to overt *each*. Without this D-operator, the plural denotation cannot take wide scope, and the meaning of the sentence is derived through direct predication as in (7).

We find Q-distributivity with a diverse range of phenomena; let us have a look at two other examples. *DI* and/or *CI* are shorthand for 'distributive interpretation' and 'collective interpretation', as defined in (4).

(9)   The semanticists are walking or cycling.
        $\Leftarrow$ For every semanticist x, x is walking or x is cycling.   *(DI)*
        $\Leftarrow$ The semanticists are walking or the semanticists are cycling.   *(CI)*

Sentence (9) is entailed by both of the statements below it, which correspond to two of its possible interpretations. According to the first, the disjunction *walking or cycling* applies to each individual semanticist, which means that (9) is compatible with a situation in which part of the semanticists is cycling and the other part is walking. According to the second interpretation, the disjunction *walking or cycling* applies to the collection of semanticists as a whole: either they are all walking, or they are all cycling. While the second interpretation can be analysed in terms of direct predication over a collection, the first cannot: in order for the individual semanticists to take scope over the disjunction, we need a quantifier over semanticists.

Our third example involves pronoun binding. Sentence (10) below has a collective interpretation that requires that the boys are brothers; it also has an interpretation according to which all boys have a different mother, which can only be accounted for assuming quantification over boys with the pronoun *their* in its scope:

(10)   The boys would be upset if John kissed their mother.
        $\Leftarrow$ For every boy x, x would be upset if John kissed x's mother.   *(DI)*
        $\Leftarrow$ The boys have the same mother and would be upset if John kissed her.   *(CI)*

Sentence (11) is a similar example involving reflexive anaphora in Dutch (I use Dutch because it lacks number marking on the third person reflexive pronoun, which will make it particularly useful when we will compare the behaviour of plurals with that of group nouns in section 2.2):

(11) De kinderen vinden zichzelf nogal slim.
The children consider-3PL REFL.3SG/PL *rather clever*
'The children consider themselves rather clever'
⇐ For every child *x*, *x* considers itself rather clever   *(DI)*
⇐ The children consider the children rather clever (as a group).   *(CI)*

To summarise, while simple distributive sentences may often be analysed in terms of P-distributivity, the truth conditions of more complex cases involving scope interactions and binding cannot be adequately captured without assuming covert quantification by something like a D-operator.

2.2 Groups and group distributivity

Group nouns are singular nouns that refer to a seemingly plural entity, such as *committee*, *team*, *collection*, *set*, *council* or *group* itself. In many contexts, they can be used interchangeably with a plural noun phrase that refers to the same collection of entities:

(12)   a.   The children/class $\left\{ \begin{array}{l} \text{gathered in the garden.} \\ \text{are a good team.} \end{array} \right\}$

     b.   The children/class $\left\{ \begin{array}{l} \text{laughed.} \\ \text{told riddles.} \end{array} \right\}$

The sentences in (12) show that group nouns, like plurals, allow both collectivity and P-distributivity. This is in line with our idea that both collectivity and P-distributivity are based on world knowledge-based reasoning about parts and wholes in the context of predicate meanings: groups, even if their denotation is atomic, have a clear part-whole structure which should be able to support these inferences.

However, of the examples of Q-distributivity listed in section 2.1, all are unavailable with group nouns. Below, I repeat the examples, this time with group noun rather than plural subjects:

(13) The group (of semanticists) is walking or cycling.
⇍ For every semanticist *x*, *x* is walking or *x* cycling.   *(DI)*
⇔ The semanticists are walking or the semanticists are cycling.   *(CI)*

We have seen in (9) that both a distributive and a collective interpretation are available if the subject is a plural definite. However, if the subject is a group noun as in (13), only the latter is available: (13) can only be false in a situation where some of the semanticists are walking while the others are cycling.

Our next examples also run parallel to our earlier data in section 2.1, and show a similar contrast between plurals and group nouns. (From now on, I will not write out the CI and DI interpretations, but only indicate which of them are available.)

(14) The class is hiding somewhere.   *(only CI)*

(15) ?The class would be upset if John kissed their mother.   *(only CI)*

(16)   De klas vindt zichzelf nogal slim.   *(Dutch; only CI)*
       *The class consider-*3SG REFL.3SG/PL *rather clever*
       'The class considers itself/themselves rather clever'[3]

In each of these cases, the only available interpretation is the CI (hence, the original sentence and the CI entail each other); distribution over individual group members is ruled out. As a consequence, sentence (14) must mean that everyone hid in the same place; sentence (15) presupposes that the pupils in the class are siblings; and finally, sentence (16) can be true even in a situation where the individual children do not consider themselves particularly clever, as long as they feel that their class as a whole is.

It turns out that sentences with group noun subjects systematically lack an interpretation that their plural-subject counterparts do have: the Q-distributive interpretation, which is derived by quantification over individual members of a collection. This is in line with the common assumption (Landman 1989, Barker 1992, Schwarzschild 1996) that group noun denotations are atomic (i.e. they lack an internal structure that is accessible to the compositional semantics) while definite plurals denote sums (entities with internal structure). If a group noun denotation lacks internal structure, it has no individual members that can be quantified over. As a consequence, any distributive effects that we get with group nouns must be the result of P-distributivity. In contrast, the members of a semantic plurality are standardly assumed to be accessible to the compositional semantics by means of the D-operator, which means that distributive effects with plurals may be analysed as either P- or Q-distributivity. The contrast between (6-11) on the one hand and (13-16) on the other thus supports an analysis of groups as atoms.

2.3   Group distributivity with *a*-indefinites

There is one apparent exception to the above generalisation. The sentences in (17) have both a collective and a distributive interpretation, despite the fact that they seem to involve a quantificational expression (the indefinites *a portrait of the Queen* and *a blue shirt*):[4]

(17)   a.   The class painted a portrait of the Queen.
            ⇐ There is a portrait of the Queen that the class painted   *(CI)*
            ⇐ For every pupil in the class x, x painted a portrait of the Queen   *(DI)*

       b.   The team is wearing a blue shirt.
            ⇐ There is a blue shirt that the team members are wearing together   *(CI)*
            ⇐ For every team member x, x is wearing a blue shirt   *(DI)*

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[3]While (15) seems a bit awkward because of the combination of a singular antecedent and a plural pronoun, the Dutch anaphora data have no such problem, as the third person reflexive pronoun *zichzelf* is not marked for number. As a consequence, it can be bound by singular as well as plural NPs. This rules out an explanation of the contrast between groups and plurals in terms of number morphology.

[4]Note that not all varieties of English allow these sentences - many English speakers that I consulted prefer a dependent plural (*portraits of the Queen* or *blue shirts*), both with plural and group subjects. In Dutch, where dependent plurality is optional but the singular is preferred, the equivalents of (17a-b) are unproblematic.

If we analyse the indefinites in (17) as existential quantifiers, we may expect these sentences to lack a DI. According to the generalisation proposed above, group nouns do not allow Q-distributivity because their denotation has no members that can be quantified over. Hence, the existential quantifier denoted by the indefinite therefore takes scope over the entire plurality, deriving the CI as the only possible interpretation of (17a-b). However, contrary to this expectation, both sentences have a distributive interpretation as well; in the case of (17b), it is even the preferred interpretation.

This apparent Q-distributivity over group nouns also happens with numerical indefinites; examples like (18) seem to be fine in all varieties of English I have encountered:

(18)   This batallion received four insignia.   *(CI/DI)*

Finally, group distributivity is available with both direct and indirect indefinite objects:

(19)   (The children in Group A and Group B each made an origami animal.) Group A
        gave the animal to a teacher, Group B gave it to a parent.   *(CI/DI)*

How to account for this apparent exception to the generalisation established in section 2.2? In principle, there are two possible ways out. The first is to reconsider the analysis of groups as atoms and claim that in cases like the above, the individual group members *are* accessible to the semantics, perhaps because group denotations can shift to pluralities under certain circumstances. (Such a shift is proposed by Landman (1989) for independent reasons.) This solution would account for the exception; however, it would also render the general pattern inexplicable.

The second way out is to claim that there is something special about indefinites. It is this approach that I will develop here.

3.   P-distributivity beyond unary predicates

In this section, I argue that the group distributivity cases with indefinite objects are all cases of P-distributivity. While the examples of P-distributivity we have seen so far all involved intransitive predicates, with distribution over a single argument, there is no a priori reason that would limit P-distributivity to only one argument. Just as we can analyse sentence (20a) in terms of direct predication over a plurality (as in (20b)), we can analyse a sentence like (20c) as a relation between two pluralities (as in (20d); cf. Scha 1981). And just as (20b) is vague with respect to the involvement of particular individuals, (20d) is vague with respect to the particular relations: we cannot tell if all the boys and all the girls were involved in the kissing, how many boys were kissed by each of the girls or how many girls kissed each of the boys, but we do know that individual boys were kissed by individual girls.

(20)   a.   The girls laughed.

        b.   **laugh**(**the_girls**)

        c.   The girls kissed the boys.

        d.   **kiss**(**the_girls**,**the_boys**)

In order to be able to extend this analysis to cases of group distributivity with indefinite objects, we cannot analyse the indefinite as a generalised quantifier with existential force. I propose that the indefinite in (17a-b) and similar sentences denotes a property, which I view here as something very similar to a group - a higher-order entity that allows P-distributivity over its individual instantiations. Thus, just as the verb in (20c) denotes a relation between two pluralities, it denotes a relation between a property and a group in (17a-b); and just as with (20c), any inferences about individual members of the group or individual instances of the property are due to P-distributivity, not based on quantification.

Neither the idea of property-denoting indefinites nor the idea of polyadic P-distributivity is new. The latter was already assumed in Scha (1981) and empirically motivated (although not very explicitly) in Winter (2000); the former are the subject of a growing body of semantic literature starting with Milsark (1974). In the remainder of this paper, I will discuss the polyadic P-distributivity analysis of cases like (17a-b) in more detail and examine some possible alternative approaches.

3.1 Property-type indefinites and individual correlates of properties

While classical Montagovian semantics treats indefinite noun phrases as generalised quantifiers with existential force, non-quantificational analyses of indefinites have been proposed in the literature at least since Carlson (1977) and Milsark (1974), in which they can denote kinds or properties, and the work of Kamp (1981) and Heim (1982), in which they denote free variables. McNally (1992) and Zimmermann (1993) propose that indefinites may also be interpreted as properties (of type $\langle e,t \rangle$) even outside of the predicate position, and this idea has subsequently been used to account for a wide range of semantic phenomena.

McNally (1992) discusses property-type indefinites in relation to *there*-sentences, arguing that the traditional distinction between weak and strong NPs of Milsark (1974) can be reduced to the distinction between property-type and quantificational NPs. Zimmermann (1993) proposes that opaque verbs like *seek* take property-type arguments. Assuming that indefinite PP complements denote properties, Mador-Haim and Winter (2007) argue that a puzzling contrast between the interpretations of certain PPs follows naturally.

A recurring question in the literature on property indefinites in argument position is how they compose with the predicate. After all, unless the relevant predicates are systematically ambiguous, there is a type mismatch between the argument (which is of type $\langle e,t \rangle$) and the predicate function (which wants an entity). In principle, there are two ways to go about this: there might be some special operation that composes verbs and property-type arguments (cf. van Geenhoven 1998, Chung and Ladusaw 2004), or the property might shift into its entity correlate (cf. Chierchia 1984, McNally 1992). I think the second approach is the most appropriate in this case: we have been talking about P-distributivity as involving reasoning about entities with a salient part-whole structure, and an individual correlate of a property seems just this kind of thing. However, ultimately it does not really matter what implementation we choose. We can chose to formalise the property-based account of polyadic P-distributivity in terms of entity correlates just to make the semantics more explicit, but if future work should show that there is actually some kind of Semantic

Incorporation at work here, the idea behind this analysis would not be invalidated. The important point is that the indefinites in question denote properties, and it is this point that I will stress in the remainder of this paper.

3.2 Alternatives to the P-distributivity analysis

In this section, I will discuss two alternative analyses of the group distributivity data that do not involve property-type indefinites: group credit and quantification over kinds. I argue that neither of these alternative approaches is able to fully account for the data.

Group credit
One might argue that we could analyse group distributivity as a special case of a 'group credit' interpretation, which in turn is a special case of collectivity. Consider the following sentence:

(21)   The team is holding up a trophy.

Sentence (21) can be true if only one of the team members (say, the captain) is actually holding a trophy: because the captain represents his team in doing so, the entire team 'takes credit' for the trophy-holding and (21) can be considered true on its collective interpretation. Similarly, we might say that if some representative proportion of the team is wearing a blue shirt, the team as a whole is wearing a blue shirt, and therefore the collective sentence *The team is wearing a blue shirt* can be true in a 'distributive' situation where each individual team member is wearing their own shirt.

   If group distributivity is a special case of group credit, it should behave in a similar way. In particular, we expect the group-distributive reading to persist under an existential paraphrase, just as happens with the group credit-reading of our trophy sentence. However, this is not the case:

(22)   a.   There is a trophy that the team is holding up.
               ⇔ The team is holding up a trophy.

        b.   There is a blue shirt that the team is wearing.
               ⇏ The team is wearing a blue shirt.

Sentence (22a) shares its truth conditions with (21): it is still true if the trophy is held up by no team members but the captain. Sentence (22b), however, cannot be interpreted distributively unless we read *a blue shirt* as 'a *kind* of blue shirt'. In other words, it does not have the same truth conditions as its non-paraphrased counterpart. This contrast between group credit and group distributivity cannot be explained under an analysis that treats them as essentially the same phenomenon. I therefore conclude that this kind of analysis cannot fully account for the group distributivity data.

Quantification over kinds
The second alternative analysis is based on the aforementioned observation that sentence

(22b) is compatible with every individual team member wearing their own shirt if we interpret *a shirt* as 'a kind of shirt'. From this, we might conclude that the group distributivity effect in *The team is wearing a blue shirt* is a matter of quantification over kinds as well: the noun *shirt* does not denote a set of ordinary objects but a set of kinds (each of them a subkind of *shirt*), and *The team is wearing a blue shirt* is interpreted as the assertion that there is a subkind of shirt (say, the polo shirt) of which the team members are wearing instantiations. Again, this assertion is compatible with a situation in which every team member is wearing their own shirt.

Quantification over kinds may be able to explain part of our group distributivity data - it is hard, if not impossible, to prove that it is not involved - but it does not explain all of it. In particular, there is a contrast between *a-* and *some*-indefinites that would remain quite mysterious under this analysis. Consider the following data:

(23) a. A rare owl was sighted in this forest recently.

  b. Some rare owl was sighted in this forest recently.

(24) a. The team is wearing a blue shirt.

  b. The team is wearing some blue shirt.

The pair of sentences in (23) shows that *some*-indefinites can quantify over kinds as easily as *a*-indefinites can: (23a) and (23b) are both grammatically correct, and truth-conditionally equivalent. However, this is not the case for the sentences in (24), which are both grammatical but do not have equivalent meanings. Sentence (24b) requires that every team member is wearing the same kind of blue shirt; if half of the team is wearing a polo shirt and the other half a button-down shirt, the sentence is false. This follows when we analyse the sentence in terms of existential quantification over kinds. However, (24a) can be true in such a situation, which cannot be explained under a quantification-over-kinds analysis.

How, then, does the P-distributivity analysis account for the difference between *a* and *some*? Note that the other phenomena that have been argued in the literature to involve property-type indefinites all show the same contrast when the available interpretations are concerned:

(25) a. John is a linguist.

  b. John is #some linguist. (on the intended reading)

In (25a), it is predicated of John that he is a linguist - *a linguist* is of type $\langle e,t \rangle$ and the sentence is entirely on a par with, for example, a sentence like *John is tall*. In contrast, (25b) cannot express such a simple predication. Its most readily available interpretation is a taxonomic one that may be paraphrased as 'John is a (specific or nonspecific) kind of linguist'; in addition, it has an (albeit slightly strange) identity reading with *is* as a full verb, paraphraseable as 'There is some linguist and this person is John'. Neither reading involves a predicate **linguist** of type $\langle e,t \rangle$, suggesting that this is not a possible denotation for the indefinite *some linguist*. A similar contrast can be seen with opaque verbs (Zimmermann 1993) and PP interpretations (Mador-Haim and Winter 2007):

(26) a. John is looking for a secretary.

  b. John is looking for some secretary.

(27) a. We're far from a gas station.

  b. We're far from some gas station.

On its opaque reading, (26a) is interpreted to mean that John is looking for *any* secretary, not a particular one; it also has a transparent reading according to which there is a particular secretary that John is looking for. In contrast, (26b) only has the transparent reading (in addition to a 'some kind of'-reading comparable to the one in (25b)). If we claim, with Zimmermann, that opaque readings result when the verb takes a property-type complement, this again suggests that property denotations are unavailable for *some*-indefinites.

The same pattern again appears in (27a-b). The universal interpretation of the indefinite *a gas station* in (27a) can be accounted for under the assumption that it denotes a property: the location function denoted by the preposition, then, returns the location or 'eigenspace' of the set of gas stations, rather than that of a particular individual gas station. Being far from a collection of elements entails being far from each element in the collection, hence the universal interpretation. Again, the *some*-indefinite in (27b) lacks this interpretation.

All in all, the above data suggest that *some*-indefinites cannot receive a property denotation, which is why sentences involving such indefinites systematically lack interpretations that their *a*-indefinite counterparts do have. Since the P-distributivity approach attributes certain group distributivity effects to the involvement of property-type indefinites, it predicts, correctly, that these effects will not occur with *some*.

4.   Conclusions

In this paper I have argued that we need two different semantic mechanisms to fully account for distributivity phenomena. We need Link-style operator-based distributivity to deal with sentences that involve scope-taking elements or pronoun binding; this kind of distributivity is unavailable with group nouns, which supports an atomic analysis of these nouns. The fact that we still get distributive inferences with group nouns shows that we *also* need a Scha-style lexical distributivity mechanism. The puzzling behaviour of sentences with a group noun subject and an indefinite object can also be explained in terms of lexical distributivity, under the common assumption that indefinites may denote properties.

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